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С

# A Comparative Study of Image Segmentation Techniques

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#### Abstract:

Image segmentation is the most important phase in Image analysis. In image segmentation image is partitioned into different parts on the basis of either similarity or on the basis of discontinuity. The features used for the classifications are intensity, color, texture or some other properties. Segmentation plays very important role in medical imaging, object detection, traffic control system, video surveillance etc. This paper focuses on pixel based segmentation techniques and also edge based & region based techniques and comparative study of all these techniques. Keywords: Segmentation, Image analysis, pixel based, edge based, region based

#### 1. Introduction:

Image segmentation in a crucial step in Image Analysis. Segmentation is the separation of image into various objects or regions depending on similarity or discontinuity criteria. Many factors are used for segmentation process such as texture, color & grey value [1]. The main aim of segmentation is just to partition the image into segments not to recognize them. So Image segmentation is nothing but a method of dividing a digital image into number of partitions. The purpose of segmentation is to simplify the image so it becomes more easy & meaningful for Image analysis. The following are the steps in Image analysis :



**2.Types of Image Segmentation Techniques :** There are so many types of Segmentation techniques[2].They are broadly classify into 3 types :

- Pixel based Techniques
   Edge based Techniques
   Edge based Techniques
- 2. Edge based Techniques
- 3. Region based Techniques

We can further classify these techniques as follows:

**3. Pixel Based Techniques:** Among all the three types of approach pixel based approach is the simplest one. This approach is useful for segmentation of images which contains light object on dark background [3,4]. Here two types of pixel based segmentation are discussed: One is the thresholding and the other one clustering.



**3.1 Thresholding technique:** It uses local pixel intensity value. It is one of the simplest & popular technique used for Image segmentation [5]. Threshold value can be either selected manually or automatically [6].

**3.1.1 Local Thresholding technique:** Here image is subdivided into different partitions & unique threshold values are selected for these segments. This method is useful for images having unequal illumination. When threshold value is computed for each pixel then it is called Adaptive thresholding technique [7, 8].

**3.1.2 Global thresholding Techniques:** Here single threshold value is selected for the whole image. These techniques are applicable for scanned images & these are very fast.

Local Thresholding	Global Thresholding			
• These are	• These are very fast & applicable for typical			
applicable for images having unequal	scanned document			
illumination				
Region size dependent	• Not applicable for noisy images			
Time consuming method	• Not useful for complex & degraded type			
Computationally expensive	images			
• Not useful for real time application	• Some of the global thresholding techniques			
• It removes background by using local mean	are traditional, iterative & multistage [7,8].			
& standard deviation[9]	SCIDIO			

**3.2 Clustering Technique:** It is nothing but grouping of pixels that belong together. There are two approaches for clustering :

1. Divisive clustering: Here we are considering whole image as a cluster & then spit it into smaller clusters.

**2.** Agglomerative clustering: Each pixel is considered as a cluster & then they are recursively merged into bigger and bigger one.

**3.2.1 K-means clustering Technique:** In this technique image is partitioned into K clusters. Each pixel belongs to a particular cluster only.

**3.2.2 Fuzzy C means clustering Technique:** Fuzzy c-means (FCM) is a clustering technique which allows one pixel of data to belong to all clusters with different membership degree. It is frequently used for pattern recognition.

Fuzzy c-means clustring
This is soft clustering method
Pixel belongs to all the clusters with
some membership degree
Computationally slow & not memory
efficient
This method is applicable in medical
imaging & security system

**4. Edge based Techniques:** Edge based detection techniques based on discontinuity approach. Points, edges & lines are considered as the main types of discontinuities in the grey level value [10]. Edge detection technique removes unnecessary information by reducing image size & keeping essential structural properties [11]. Two commonly used techniques for edge detection are Gradient based 1'st order derivative & Laplacian based 2'nd order derivative [12].

**5. Region based Techniques:** Region is nothing but the collection of pixels. These pixels are selected based on similarity approach [13].

**5.1 Region growing methods:** It is simplest region growing segmentation technique. Here some points are selected called seed points. User can use some criteria to select these seed points. Region starts from these seed points & adding neighboring points satisfying the membership criteria. Then the process continues.

8 8 81	, , , , , , , , , , , , , , , , , , ,	I I I I I I I I I I I I I I I I I I I				
Region growing	Works for noisy images where	Result varies according to				
	edge identify-cation is difficult	seed point selection				
Region splitting &	It is sequential segmentation	difficult to decide best				
Merging	algorithm	splitting & merging criteria				

**5.2 Region Splitting Methods:** This method starts with the whole image. Use some similarity criteria to check whether all pixels in the image satisfy it or not. Subdivide the image into subimage. One of the method to split the image into smaller and smaller quadrant regions.

The main issues in this method are:

1. Deciding when to split the region. 2. Deciding how to split the region.

**5.3 Region Merging Methods:** Region merging is opposite to region splitting. Start with small regions & merge the region based on similarity criteria. Repeat the process until o more splitting occurs.

**5.4 Region splitting & Merging Method:** It is opposite to region growing technique. It follows top down approach i:e splitting starts with the whole image & splits it into smaller parts. After splitting into sufficient subparts it's desirable to merge them to get appropriate regions.

#### 6. Comparative Study of Edge Based and Region Based Methods:

Region based	Edge based				
Region based methods gives more information as	Edges contains pixel where intensity value				
they contain more no of pixels	changes abruptly				
They based on similarity criteria.	They based on discontinuity criteria				
These are robust techniques.	These are less complex methods				
These works better for noisy images	It is difficult to identify edges in case of noise				
	images or occlusion				

#### 7 Conclusion:

Some of the important segmentation methods like pixel based, edge based & region based are discussed in this paper. There are various techniques which are applicable in different situations that depend on nature of image. The pixel based techniques are simple & applicable for images containing light objects on dark

background. Edge based segmentation methods works on the discontinuity principle. These techniques are simple & applicable for medical imaging, biometrics as it is useful for object detection. Region based segmentation methods works on similarity principle. These are robust techniques & gives better results in case of noisy images.

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# Survey On Cloud Computing And IOT For Agricultureal Real Time Development In India

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#### Abstract

The integration of cloud computing and IoT has become the forthcoming technology and utilized in different sectors such as security, agriculture and smart cities. Cloud computing is used for data storing and sharing on cloud via internet. Most of the developing nations utilized in cloud computing for keeping their data safe and secured. Where as in IoT various physical devices are connected to internet for sharing and accessing of data or information. Sensor is the most vital component of IoT. In India agriculture is the main source for the largest population in India to earn money and carry out their livelihood.

This paper mainly focuses on the utilization of cloud and IoT in agriculture field within the developing nations. Keywords: Internet of things (IoT), Cloud computing, Agriculture. SaaS, PaaS, IaaS.

#### Introduction

One of the vital areas of the human activity is. Agriculture in India most population depends on the farming and agriculture [1]. The essential need for the agriculture is irrigation. For correct utilization of water resources is an most important thing. In developing countries farmers are used universal approaches for crop planting. The most used types of irrigation are sprinkler where water is sprayed to plants in the same way as natural rain fall. The sprinkler method is most adequate and it savesS more water. The integration of cloud computing and IoT plays a vital role to resolve best possible ways for water saving and convenient utilization of water.

To measure all these constraints we needed special types of sensors such as moister sensor for moister[2,3,4] regulate the content cited in the soil, the humidity sensors determines the content present in air and for latitude and longitude of field, location sensors is usage.

#### Literature Review

Kiran R. Bidua et. al. (2015) in Internet of Things and Cloud Computing for Agriculture in India [5] focuses on proposed model for IoT and cloud computing for agriculture, challenges and benefits.

M. Sowmiya et. al.(2019) in Smart Agriculture Using lot and cloud Computing [6] discuss applications of IoT in agriculture field for the essential improvement of the farmers to better crop cultivation and also IoT technologies such as wireless sensor networks, cloud computing, big data analytics, embedded system and communication protocol and benefits.

Sashi Bhaushan Maharana et. al (2015), in applcation of Cloud Computing in Agricultural development [7] focuss on services of cloud computing such as SaaS, PaaS and IaaS and challenges in agriculture in India like soil erosion, lack of mechanization, agricultural marketing, scarcity of capital and inadequate transport and benefits.

V. Keerthi et. al.(2016) in E-Agriculture services framework design for cloud [8] focuss on the cloud services in agriculture, E-Agriculture services for farmers, E- agriculture services like Data acquisition service layer(DASL), Teiler-RSA library security service(TRLSS), agriculture services provider module(ASPM), agriculture data storage service layer (ADSSL), agriculture agriculture solution reporting service module(ASRSM) etc.

#### **Concept Of IoT In Agriculture**

The internet of things (IoT) is a global network of intercommunicating devices and it is a perception where "things", specifically everyday objects such as all home appliances, furniture, cloths, vehicles, roads and smart materials etc. arereadable, recognizable, locatable, addressable through the internet. IOT will connect objects of the world in both sensory and intelligent manner through combining technology [9] developments in item identification, sensors and wireless sensor networks and nanotechnology.

# **Concept Of Cloud Computing In Agriculture**

Cloud Computing is a broad term for anything that concern delivering hosted services through internet. The cloud computing name was encouraged by cloud symbol that's often used to serve the internet in flowcharts and diagrams. Cloud computing grant three types of services such as infrastructure as a service(IaaS), platform as a service(PaaS), and software as a service(SaaS). IaaS delivers utility services typically in a virtualized surrounding, PaaS delivers platform on cloud infrastructure and SaaS delivers the application over the internet via a cloud infrastructure which was built on underlying IaaS and PaaS layer[10].

# **Objectives**

The objective of the study of paper is how much we can recommend IoT and Cloud computing in day to day agricultural activities of the farmer of India. To increased the production of a crop with minimum interaction of a human being using IoT and cloud computing technology, IoT uses various types of sensors and for to sensors collect the data that shows the exact condition of a plant and atmosphere and correct information is send to farmer using cloud computing.

#### **Benefits Of Cloud Computing And IoT**

The following are the benefits of cloud computing and IoT in agriculture.

#### **Cloud Computing Benefits**

- 1) Today, storage and maintenance of large volumes of data is reality. Suden workload are also managed effectively and efficiently by using cloud computing.
- 2) Data to be managed by a professional team of service providers and a good deal more authority and organized the data.
- 3) It will motivate the farmers and researchers to get involved and more into agriculture.

#### **Benefits of IoT**

- 1) The cost of production is decreased.
- 2) Sustainability
- 3) Protection of the surrounding
- 4) With IoT adequate monitoring of the farming surrounding is protected.
- 5) Better quality.
- 6) Improved yield, nutrients and farming.
- 7) IoT helps the farmer to monitor the fields at several locations by enabling remote monitoring.

#### Challenges

- 1) Lack of knowledge about the weather forecast, pets and diseases.
- 2) Lack of alertness among the farmers about the profit of ICT in agriculture.
- 3) Agriculture marketing is still a big concern in rural areas. In the absence of appropriate marketing efficiency, the farmers depend on local traders and intermediaries for the disposal of their agricultural products sold at throw away prices.
- 4) Transportation is one of the main challenges faced by the agriculture sector of India.
- 5) Soil erosion is one of the many issues concerning the Indian agriculture. This is the greatest crime to Indian agriculture.
- 6) Because the poor ICT infrastructure and ICT illiteracy.
- 7) IoT offers tremendous potential for innovate in agriculture.

#### Conclusion

The proposed paper focused on cloud computing and IoT in the agriculture. With the help of IoT, farmer may be able to plant directly to the customers not only in small areas or the shops but in a wider region. Cloud computing would permit the corporate sector to supply all basic services at cheap cost for farmers in rural region. Agriculture can be implemented in the same way as our irrigation automation system can also implement agricultural security with cloud computing and IoT integration. Agricultural condition checked with the help of sensors used and the owner can monitor information such as temperature, soil humidity details, surface water etc.

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#### A Survey On Web Mining Concept

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#### Abstract-

The development of the web is causing the constant growth of information, leading to numerousdifficulties such as an increased difficulty of extracting potentially valuable information. The vast amount of information offered online, the World Wide Web is a fertile part for data mining research. The investigation in web mining goals to progress new techniques to successfully extract and mine useful information or information from these web pages. Due to the heterogeneity and absence of structure of Web data, automated detection of targeted or unpredicted knowledge/information is a challenging job. In this paper, we survey the research in the area of Web mining, point out the categories of Web mining and variety of techniques used in those categories. In this paper we mentioned research scope in the areas of web usage mining, web content mining and concluded this study with a brief discussion on data managing and querying.

Keywords- Web, data mining, sequential pattern, page rank, hits, hyper link analysis, database view

#### I Introduction

The World Wide Web (WWW) is continuously growing with rapid increase of the information transaction volume and number of requests from Web users around the world. For web administrator's wand managers, discovering the hidden information about the users' access or usage patterns has become a necessity to improve the quality of the Web information service performances. From the business point of view, knowledge obtained from the usage or access patterns of Web users could be applied directly for marketing and management of E-business, E-services, E-searching, and E-education and so on. The following problems will be encountered during interacting with the web

- Finding relevant information
- Creating new knowledge out of the information available on the Web
- Personalization of the information
- Learning about consumers or individual users

#### II Web Mining

Web mining is the application of data mining techniques to discover patterns from the Web. According to analysis targets, web mining can be divided into three different types, which are Web usage mining, Web content mining and Web structure mining.

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# **III Web Usage Mining**

Web usage mining is the process of extracting useful information from server logs e.g. use Web usage mining is the process of finding out what users are looking for on the Internet. Some users might be looking at only textual data, whereas some others might be interested in multimedia data. Web Usage Mining is the application of data mining techniques to discover interesting usage patterns from Web data in order to understand and better serve the needs of Web based applications. Web usage mining can also refer as automatic discovery and analysis of patterns in click stream and associated data collected or generated as a result of user interactions with Web resources on one or more Web sites. The goal is to capture, model, and analyse the behavioural patterns and profiles of users interacting with a Web site. The discovered patterns are usually represented as collections of pages, objects, or re-sources that are frequently accessed by groups of users with common needs or interests.

Usage data captures the identity or origin of Web users along with their browsing behaviour at a Web site. Web usage mining itself can be classified further depending on the kind of usage data considered: Interdisciplinary

- Web Server Data
- Application Server Data
- Application Level Data

Here are the four techniques

- 1. Sequential-pattern-mining-based : Allows the discovery of temporally ordered Web access patterns
- 2. Association-rule-mining-based: Finds correlations among Web pages.
- 3. Clustering-based: Groups users with similar characteristics.
- 4. **Classification-based :** Groups users into predefined classes based on their characteristics



**Figure-2 Web Usage Mining** 

# **IV Web Structure Mining**

Web structure mining is the process of using graph theory to analyse the node and connection structure of a web site. According to the type of web structural data, web structure mining can be divided into two kinds:

- Extracting patterns from hyperlinks in the web: a hyperlink is a structural component that  $\geq$ connects the web page to a different location.
- > Mining the document structure: analysis of the tree-like structure of page structures to describe HTML or XML tag usage.

# V Web Content Mining

Web content mining is the mining, extraction and integration of useful data, information and knowledgefrom Web page content. The heterogeneity and the lack of structure that permits much of the ever-expanding information sources on the World Wide Web, such as hypertext documents, makes automated discovery, organization, and search and indexing tools of the Internet and the World Wide Web such as Lycos, Alta Vista, WebCrawler, ALIWEB [6], MetaCrawler, and others provide some comfort to users, but they do not generally provide structural information nor categorize, filter, or interpret documents. In recent years these factors have prompted researchers to develop more intelligent tools for information retrieval, such as intelligent web agents, as well as to extend database and data mining techniques to provide a higher level of organization for semi-structured data available on the web. The agent-based approach to web mining involves the development of sophisticated AI systems that can act autonomously or semi-autonomously on behalf of a particular user, to discover and organize web-based information.



#### **VI** Conclusion

In this paper, a study on Web mining has given with research point of view. Misperceptions regarding the usage of the term Web mining is elucidated and discussed briefly about web mining categories and various approaches. In this survey, we focus on representation issues, various techniques of web usage mining and web structure mining and information retrieval and extraction issues in web content mining, and connection between the web content mining and web structure mining

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#### Review Paper For Avoiding LPG Fire Accident For Using Ardiuno Board

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#### Abstract:

The LPG gas is highly inflammable and can burn even at some distance from the source of leakage .The LPG gas are widely used in the cooking in almost all countries, because it is the preferred fuel source. From buten and fluren dangerous liquid made up of LPG gas they can cause the harmful incident. This paper focus only alert the people for avoiding the dangerous fired accident, that cause from LPG leakage. In industrial sector, the gas leakage is the major problem in residential location, such as the gas cylinder Industry, car, service station etc. When gas is leak then they are cause the fire accident. So, according to all these problem, One of this preventive method is use to avoid this leakage incident. The goal of this paper is to automatically sense & detect gas leakage . when LPG gas is leak from at the particular stage then LED light is "ON ", Alarm "beep" and quickly alert to the people through SMS and E-Mail. In the gas leak detection kit, a gas sensor has been used, which is sense the high sensitive to gas LPG .There is an buzzer to beep when has meet the LPG gas to the sensor .The Input pin A0 of the sensor is connected to with the output Ardiuno pin D7.At this use the (MQ5) sensor.

#### Introduction:

In our day to day life so many technology are available and the environmental condition take the very important for our health. Consequently, the issues from air quality and environment in the gas Industrial area need to alertness and regarding the environment toward public workers health. LPG are gets the harmful effect, it cause the fire accident. The fire accident security is the major problem due to cause LPG gas leakage. The LPG gas are used in many places such as, gas Industry, car, at home gas cylinder, service station storage tank, etc. Sometimes, the very small fire accident but can't take any proper action to control the fire and can cause make major . So, according or overcome this problem the LPG gas sensor is sense the and detect the gas leakage through the buzzer as well as alert the person through the SMS or the E-mail using the GSM system.

#### **Literature Survey:**

Selvapriya [1]: This paper describes that sensor for sensing the leakage and produce the result alarm and also alerts human via Short Message Service (SMS).T. Soundarya [2]: This paper discusses the design of gas controlled detection, monitoring and control system of LPG leakage using relay DC motor over knob is automatically leakage safety device. LPG is highly inflammable and can burn even at some distance from the source of leakage This paper deals with the regulator is switched off. By accident, if the knob is turned on results in the gas leaks. This paper deals with the detection, monitoring and control system of LPG leakage Using relay DC motor the stove knob is automatically controlled using DC motor .Aashish Shrivastava [3]: The proposed system in this journal is a GSM based Gas detection systems. GSM module is used GSM based Gas detection systems. GSM module is used send messages to the user in case of leakage. Abhishek Gupta [4]: This paper proposed a system that is designed and implemented to meet the health and safety standards for the gas bank of Hotel Management Department. The proposed system is tested and the results are verified by producing an early warning signal under the less severe condition and activate a high pitched alarm during the leakage.Anitha [5]:This paper describes the system will inform the owner about any unauthorized entry or whenever the door is opened by sending a notification to the user. After the user gets the notification, he can take the necessary actions using ardiuno and microcontrollerE. Jebamalar Leavline, D. Asir Antony, Gnana Singh ,B. Abinaya [6] : This paper describes the inform the people through the alarm system, 2015

#### **Methodology:**

The sensor work to sense the gas. When sensor sense the LPG gas occurs, it gives a HIGH pulse of throw Ao pin . The Ao pin Input are attached to the Ardiuno board , the Ardiuno board are continuously read the Ao pin Output . When Ardiuno gets Ao Pin is HIGH pulse then quickly meet the buzzer and then buzzer is alert to the person using throw the beeping Alarm.

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#### Sensor :

Sensor is a device, to detect the events changes in environment and send the information to the other electronics device such as microcontroller platform. The sensor are senses dangerous gases that can occurs in the fire accident.. In This paper use the MQ6 sensor, this is detect the LPG gas leak. Which output connected to the Ardiuno board. These sensor are help to the Ardiuno to interact with the surrounding and made the Implementation of many electronics project possible.

#### Ardiuno:

Ardiuno board is a microcontroller board . It is based on the ATmega328. This board includes digital I/O pins-14, analog I/P-6 pins, ceramic resonator –A16, Power jack, ICSP header, RST button and USB connection. The power supply of this board is done with the help of AC to DC adapter. In this board we use the voltage is 5v.14-pins are digital I/O and 6-pins are the analog I/P. The DC current use for 3.3v pin. 32kb are flash memory ,2-kb is SRAM, 1kb is EEPROM and CLK speed is 16 MHz.

**Buzzer:** The buzzer are just like speaker called the piezo speaker, it is use in Ardiuno board for beeping. In this paper the buzzer are directly connected to the Ardiuno board. Connection of the buzzer and Ardiuno board through the pins that is one pin connected to the Ardiuno ground (GND

-pin) and the other end to digital pin- 8the frequency are present between about 20 Hz and 20,000.

# 3. System Design:

The basic idea behind developing this application is to help detect the gas leakage in the Industry or any other places preventing this problem as shown in fig2. Gas leakage is the major concern with residential as well as commercial premises and gas powered transportation vehicles. One of the preventive measure to avoid the danger associated with gas leakage is to



install a gas leakage detector at vulnerable locations. The objective of this work is to present the design of a cost effective automatic alarming SMS alert system which can detect LPG leakage in various premises. In particular, the alarming system designed has higher sensitivity for cooking and camping.

#### **Conclusion:**

In this paper ,gas leakage syste using ardiunno board. LPG gas sensed by the MQ6 sensor ,As well as it detects LPG gas and sound is produce using buzzer ,using this system to avoid fire incident and provide the Industry safety etc. Therefor ,the researchers concluded that the "LPG gas leakage detector with Ardiuno board which is helpful or for prevent to us any danger gas leakage and useful for the safety to avoid the gas leak that can causes the harmful result.

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# A Brief survey of Internet of Things And Machine Learning Methods

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#### Abstract-

This paper provides a brief survey of basic concepts of Internet Of Things and algorithm used in machine learning. We begin with the boarder definition of Internet Of Things (IoT) and in rest of the paper we introduced some learning methods including supervised and unsupervised methods and deep learning paradigms. In final sections, we present some of the applications of IoT and an extensive bibliography. Keywords- IoT, applications, Machine learning.

#### 1.Introduction

In current year, the Internet of Things (IoT) has drawn major research awareness. Connecting everyday things embedded with electronic devices, software, Hardware and sensors to internet enabling to gather and replace data without human interaction called as the Internet of Things (IoT). The term "Things" within the Internet of Things refers to anything and everything in lifestyle which is accessed or connected through the internet[1]. IoT is considered as important part of the web of the longer term. The future of the Internet will contains of heterogeneously connected devices which will further expand the borders of the world with physical entities and virtual components. The Internet of Things (IoT) will give power to the connected things with new capabilities. During this survey, the definitions, concept, fundamental technologies, and applications of IoT are systematically reviewed. Firstly, various definitions of IoT are introduced; secondly, some open issues associated with the IoT applications are explored and eventually some machine learning methods.

#### 2.The Concept Of IoT

In 1999, the real term "Internet of Things" was coined by Kevin Ashton during his work at Procter&Gamble. Ashton who was working in supply chain optimization, wanted to be a focus for senior management's attention to a latest exciting technology called RFID (Radio frequency identification)[2]. Because the internet was the foremost modern new trend in 1999 and because it somehow made sense, he called his presentation "Internet of Things". There are also other domains and environments during which the IoT can play a remarkable role and improve the quality of our human lives. These applications include transportation, industrial automation, healthcare and emergency response to natural and man-made disasters where human decision making is difficult. The IoT enables physical objects to observe, hear, think and perform jobs by having them "talk" together, to share information and to coordinate decisions[3]. The IoT transforms these objects from being traditional to smart by exploiting its underlying technologies such as ubiquitous and pervasive computing, embedded devices, communication technologies, Internet protocols, sensor networks and applications. Smart objects along by means of their supposed tasks constitute domain specific applications (vertical markets) while ubiquitous computing and analytical services form application domain independent services (horizontal markets). Fig. 1 illustrates the general concept of the IoT in which every domain specific application is interacting with domain independent services, whereas in each domain sensors communicate directly with one another.



Fig 1: Overall concept of IoT

#### 3. IoT APPLICATIONS

IoT is effectively a platform where embedded devices are connected to the internet, so they can accumulate or collect and exchange data with each other. It enables devices to interact, work together and, learn from each other's experiences. There are some important applications relater to Iot. They are as explain below:

# 3.1 WEARABLES

Wearable devices are installed with sensors and softwares which collect data and knowledge about the users. This data is later on pre-processed to extract necessary insights about user. These devices mostly cover fitness, health and entertainment requirements. The pre-requisite from internet of things technology for wearable applications is to be highly energy efficient or ultra-low power and little sized [4].

# 3.2 SMART CITIES

Smart city is one of another powerful application of Internet of Things generating curiosity between world's population. Smart surveillance, automated transportation, smarter energy management systems, water circulation, metropolitan security and environmental monitoring all are examples of internet of things applications for smart cities.

# 3.3 IoT IN AGRICULTURE

Farmers are using meaningful insights from the data to yield better return on investment. Sensing for soil moisture and nutrients, controlling water usage for plant growth and determining custom fertilizer are some simple uses of IoT. Used of IoT in agriculture is very easy for farmers to growing a crops.

# 3.4 IOT IN HEALTHCARE

Healthcare is one of the basic needs of anybody. The concept of connected healthcare system and smart medical devices bears enormous potential not only for companies, but also for the well-being of individuals generally. Research shows IoT in healthcare will be considerable in coming years. IoT in healthcare is designed at empowering people to live healthier life by wearing connected devices. ZigBee protocol is usually used in this healthcare application.

#### **4.Machine Learning**

On the other hand, Machine learning, is one of the main application of artificial intelligence (AI) that provides systems the ability to exhibit human intelligence without being explicitly programmed. Machine learning focuses on the development of computer programs which will access data and use it to find out for themselves. The process of machine learning involves data such as examples, direct experience, or instruction, in order to look for patterns in data and make superior decisions in the future based on the examples that are provided. The most important aim is to allow the computers learn automatically without human intervention

and change actions accordingly. Some of the most popularly used algorithms of ML fall in the categories of supervised algorithms, unsupervised algorithms, semi supervised algorithms, and reinforcement algorithms. Some of the fields of application of Machine Learning are driverless vehicles, anomaly detection in dangerous systems, assistance in medical technology, sensor data analysis, spotting spam mails etc. The application of ML in sensor data analysis has given the wearable devices their much needed intelligence. ML have made these devices more personal to the users due to the analysis performed on the sensor data which helps in getting better insights about the person wearing these devices.

#### **5.**Conclusion

World has been changed completely due to Internet. From few years ago, IoT has been developed quickly and a large number of enabling technologies has been proposed. The Iot has been the trend of the next Internet. In this paper, we presented brief survey about concept of IoT and some learning methods.

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# **Efficient Query Processing in Mobile Databases**

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#### Abstract—

While on move, each mobile user may want to retrieve some informationrelated to certain object, place or service. In order to carry out such activities like information retrieval it has to fire a query which may be satisfied with a Mobile Base Station (MBS)or a database which also may be mobile[1]. MBS establishes communication with mobile client and it serves a large number of mobile users. In the mobile computing architecture, each MBS is connected to a fixed network. Mobile clients that requests query and the database server which provides the answer, move between cells while being active and this intercell communication is known as a handoff process. Each clientnode in a cell connects to the fixed network by means of wireless radio, wireless Local Area Network, cellular network or satellite [2]. The bandwidth capacity provided by wireless networks is very small as compared with the fixed network It is very important to use power very efficiently and effectively. So the query processing in mobile environment is definitely of great interest. Caching mechanism is used to cache frequently accessed database items. Cachemechanism along with prioritization is targeted to enhance the query operation. In critical situation like server failure, channel distortion, and disconnection cache assists mobile nodes. A caching management strategy includes caching granularity, caching replacement policy and caching coherence in order to maintain its effectiveness.

Keywords—query processing, replication, prioritization, caching

# I. INTRODUCTION

In mobile computing, query can be served with databases using two different mechanisms namely: a)the pull/push mechanism, and b) the caching mechanism. Push mechanism is classified into two schemes: On-demand broadcast and Periodic broadcast. On-demand broadcast refers to the optimization method used at the server side. It serves an on-demand request or a request that is sent to the server for processing. Periodic broadcast determines how to disseminate the database item to mobile client in order to minimize the response time and tuning time of retrieving database items. In mobile computing a complete broadcast file is referred as a broadcast cycle.Communication cost is very important parameter in distributed environments. Mobile hosts may reside at different location so it becomes difficult to estimate communication cost. Location dependent queries may be formulated to acquire data easily.

A query is the way to instruct a DBMS to update or retrieve specific data from the server. The actual update and retrieval of data undergoes various "low-level" operations. The query can be "Give me the list of all doctors who are heart specialist." It can be transformed into SQL statement as

"select doctor\_id from doctors where speciality = 'Heart specialist';"

This SQL statement will be translated further by the DBMS so that the program process the query in a timely manner.

# **II. Phases Of Query Processing**

There are three phases [3] that a query undergoes during the processing of that query:

A. *Parsing and translation:* Most queries submitted to a DBMS are in a high-level language such as SQL. In this parsing and translation stage, the query in human readable form is translated into such forms that are usable by the DBMS. These may be some relational algebraic expression forms like query tree and query graph. **B. Query Optimization** 

# In general Query optimization methods try to obtain such execution plans that minimize CPU, input/output and communication costs. In centralized environments input/output cost affects most but in distributed environments, communication cost plays important role. It is not worth calculating plans and their associated costs statically, instead dynamic optimization strategies are required in mobile distributed environment.

# **C.** Evaluation

In a mobile environment, since users are continuously moving, mobile database systems must be able to choose an execution site for the different phases of query processing depending on their current environment. The decision execution site revision should be as flexible as possible.

In a mobile computing environment there are three types of entities: a) mobile client that submits a query, b) mobile server that processes a query or a part of it, and c) moving object which represents the data targeted by the query. According to these entities queries can be classified into five categories.

# 1) Non Location Related Ouery (NLRO)

In a query if all the predicates and attributes are non location related then it is called a Non Location Related Query (NLRQ). For example:

"list all hospitals with cardiac facility".

# 2) Location Dependent Queries (LDQ)

If a query results depend on the location of the query issuer then the query is called Location Dependent Query [8].

# 3) Location Aware Query (LAQ)

If a query has at least one Location Related simple predicate or one Location Related attribute then it is called Location Aware Query[3]. For example: "what is the temperature in Nagpur?"

#### 4) Continuous Ouery (CO)

This type of queries includes all queries issued by mobile terminals and querying objects which are themselves moving. For example a query of this type could be : "Find all the ambulances with cardiac facility within 50 feet of my vehicle". The result of the query is a set of ambulances position that varies continuously with the movement of the driver.

#### 5) Ad Hoc Ouerv

Ad Hoc queries are generally used in traditional DBMS. This type of query clearly mentions the information required in the query. There is no context awareness information involved. The query result is based on the actual query itself. For example a query of this type could be: "University student wants to retrieve his/her academic record or personal details".

#### III. The Query Management Issues And Solutions In Mobile Database

Since a mobile computing system is a distributed system, here some of the processes are running on mobile hosts (MHs), whose location in the network changes with time. There are some new issuessuch as mobility, low bandwidth of wireless channels, disconnections, limited battery power and lack of reliable stable storage on mobile nodes arose in Mobile distributed systems. There is a variety of limitations occurring in www aiirjournal.con mobile databases.

- Security .
- Data distribution and replication
- Location based service
- Recovery and fault tolerance
- Transaction models
- Replication issues

We have studied strategies for Query Processing in Mobile databases to overcome these issues as

#### follows.

# A. Replication Strategies in Mobile Environments

To increase the performance of query processing, throughput replicating data at several sites is a powerful mechanism to provide fault tolerance. The replication strategies used are Synchronous and Asynchronous replication. It is seen that unlike synchronous replication asynchronous replication may not keep the database consistent at every moment. If the time lag is compromised, it may result in fewer requirements of resources. Different data ownership models [4], Workload partitioning data ownership model, Master/Slave data ownership model and Update anywhere data ownership model keep the replicas consistent. These methods may be adopted based on different applications implemented in mobile environments. On the basis of volume of replication and the number of transactions respective ownership models may be chosen. The update anywhere ownership model can make the replication strategies in increasing the throughput but has to be implemented as synchronous replication as any site can update data at any time.

#### B. A Mechanism For Prioritizing Query Results For Delay Tolerance

To overcome the problem of disconnection, a continuous query processing system for intermittently connected mobile networks in which a node must be able to hear the transmission of at least one another node on the network it must have sufficient power to function. A mechanism for prioritizing query results[5], guarantees enhanced accuracy and reduced delay in query processing. The conventional continuous query processors send the results of continuous queries instantaneously over the network, whereas the delay tolerant distributed query processor stores them in an output buffer.

# C. Fault Tolerance Using Cooperative Caching

To cope with communication bandwidth and storage constraints, cooperative caching[6] method prioritizes the data-items in terms of their value, as reflected by supply and demand.

The model using cooperative caching uses MARKET algorithm [6] for querying mobile P2P databases. a novel strategy is used in MARKET for a mobile peer to prioritize the reports based on their relevance. The relevance of a report depends on its size, demand (how many peers are querying it), and supply (how many peers already have it). Queries are disseminated to enable the estimation of demand. MALENA, A machine learning algorithm is used to enable the estimation of the supply.

# D. Log Based Recovery with Low Overhead for Large Mobile Computing Systems

Sender based message logging along with movement based checkpointing is used to reduce the number of checkpoints taken by a mobile host[7]. The mobility of a node is used for deciding when it needs to take a checkpoint. The storage at a Base Transceiver Station is utilized to store the checkpoints and message logs of the mobile hosts. Also sender based logging scheme avoids the extra copying of the message to the BTS. If the message logging is combined with the underlying communication protocol, then no extra overhead is placed for logging the messages at the sender BTS.

# E. Distributed Lock Management for Mobile Transactions

A lock management scheme[8], where a read unlock for an item is to be executed at any copy site, regardless of whether that site is different from the copy site in which the lock is set for fault tolerance. The lock management scheme utilizes the presence of replicated copies of data items to reduce the read unlock message cost incurred by the mobility of transaction hosts over fixed networks.

# F.Fault-Tolerance in Distributed QueryProcessing

A publicly available distributed query processing system for the grid [9] describes the implementation of a rollback-recovery protocol and presents measurements of the cost of both protocol overheads and recovery. It can exhibit low overhead and can yield significant performance improvements through recovering and continuing after failure.

# G.Efficient Recovery Scheme for Mobile Computing Environment

An efficient recovery scheme [10] is based on message logging and independent checkpointing. It is seen that with the message logging and periodic checkpointing, asynchronous recovery can be achieved even in case of multiple and concurrent failure occurrences. For the management of recovery information, such as checkpoints and message logs, the movement-based scheme is given. The Mobile Host (MH) carrying its recovery information to its current Mobile Service Station (MSS) can recover instantly in case of a failure.

This scheme controls therecovery costas well as the transfer cost. To maintain the exact answer of continuous spatial queries seems very costly.

# H.Top-K Query Processing Method With Replication

The top-k query processing method with replication strategy in MANET guaranties the exact query results in a limited searcharea. For replicating data items *FReT* (topology-Free Replicationfor Top-k query)[11], replication strategy is used. In FReT, the ratio of the number of allocated replicas *replication ratio*) and combination of replicasretained by each node (*replica combination*) are determined to efficiently acquire the exact answer. Due to the movement of the nodes FReT has no maintenance costs. the query messages are sent repeatedly by query-issuer untilit acquires a top-k result by increasing the TTL (timetolive) which defines the

search area by a hop count. Theincrease in TTL is based on two approaches: the expanding ring and bundling methods. The expanding ringmethod aims at reducing the overhead whereas the bundling method aims at reducing the delay.

# I.Continuous K Nearest Neighbor Query Scheme with Privacy and Security Guarantees in Road Networks[12]

a three-party system architecture i.e. "preprocessing server - users - LBS server", is proposed in Continuous K Nearest Neighbor Query Scheme where the preprocessing server(PS) encrypts and rearranges each POI record in the LBS database using pseudorandom permutation. PS stores each corresponding symmetric key and the permutation table to POI records. The LBS server is not aware of the symmetric keys and the permutation table. Since it cannot determine which POI record in its database is provided to the user so itguarantees user privacy. LBS server regularly publishes POI distribution based on which an index table is created, then user constructs a query based on oblivious transfer. It enables the user to secretly acquire the symmetric key and the permutation record from the PS. The PS is not aware of which symmetric key and permutation record have been provided to the user so user privacy preservation is maintained and the user can only obtain one key material to his target POI record each time. it guarantees the data security of server, the user sends a query to LBS for the details of his target POI record in and decrypts the query result without revealing query privacy to the LBS

#### **IV.** ANALYSIS

In a mobile distributed environment, the communication costs are much more difficult to estimate because the mobile host may be situated in different locations. The best site to access data depends on where the mobile computer is located.

	Query processing strategy	r arameters/problem	Ennancement in	Methodology used		
	2		parameters			
1 I	Replication Strategies in	volume of replication ,	Increase in	Workload partitioning data		
1	Mobile Environments	no. of transactions	throughput	ownership model, Master/Slave		
				data ownership model and		
			e e	Update anywhere data ownership		
	6			model		
<b>2</b> a	a continuous query	disconnection	enhanced accuracy	Prioritizing Query Results.		
1	processing system For Delay	190	and reduced delay	results of continuous queries over		
, r	Tolerance 📐 📐	N 2340	1-6381	the network are stored in an		
		4072		output buffer by the delay		
				tolerant distributed query		
		Why.	icom	processor		
3 1	Fault Tolerance Using	Communication	Proper utilization of	MARKET algorithm prioritizes		
0	Cooperative Caching	bandwidth and storage	bandwidth	the reports based on their		
		constraint		relevance. MALENA algorithm		
				is used to enable the estimation		
				of the supply.		
4 l	Log Based Recovery with	mobility of a node	reduced number of	Sender based message logging		
1	Low Overhead		checkpoints for	along with movement based		
			mobile host	checkpointing		
5 1	Distributed Lock	replicated copies of	reduce the read	A lock management scheme		
1	Management for Mobile	data items	unlock message cost			
	Transactions					
6 l	Fault-Tolerance in	protocol overheads and	It exhibit low	distributed query processing		
	Distributed Query Processing	recovery.	overhead and can	system for grid implements a		
			yield significant	rollback recovery protocol which		
			performance	recovers and continues after		
			improvements	failure.		
			through			

#### Table 1. Analysis of enhancement in parameters 1

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7	Efficient Recovery Scheme	message logging and	Controls transfer	with message logging and
		periodic checkpointing	cost as well as the	periodic checkpointing,
			recovery cost.	asynchronous recovery can be
				achieved
8	Top-K Query Processing	No of replica	exact query results	FReT (topology-Free Replication
	Method With Replication		in a limited search	for Top-k query)
			area	
9	Continuous K Nearest	POI record	Privacy and Security	LBS server regularly publishes
	Neighbor Query Scheme		guaranty	POI distribution based on which
				an index table is created. then
				user constructs a query based on
				oblivious transfer

Analyzing the above strategies it is essential to make the best possible utilization of connectivity of mobile nodes. In order to decide the nodes to choose which data to be transmitted first, some sort of data prioritization is necessary. Every mobile node generates additional result compared to the number of answer it can transmit to the server. The mobile host can choose the order in which it should transmit the data when the connectivity is available from the currently available. The fetching of the most relevant results from the buffer to the server reduces the priorities of the old results. Each time a continuous query queues in the results for delivery, a collective score is assigned to each query in its output buffer. In case of disconnection cached data with higher-priority are delivered before delivering all the lower priority results [13]. The queries with minimum weight values are served initially. It is necessary to avoid the buffer over flow by removing the least prioritized buffers. The distance from the client and the downstream bandwidth required to transmit the results to the client plays important role in prioritizing results.

#### **V.CONCLUSION**

It is seen that query processing for mobile databases is very much centered on the issues of caching, broadcasting, and scheduling. Mobile clients system is responsible to maintain the data in its cache efficiently and effectively. Wireless network system communicates data using broadcasting systems [14]. With this system, the number of mobile users does not affect the query performance. Server system is responsible for designing techniques for the server to accommodate multiple requests so that the request can be processed as efficiently as possible. The work may be extended by capturing the query arrival pattern in the various Base stations of the environment, to minimize the number of message exchanges and delay ingetting answer for query. A secure online mobiledatabase and optimized query processing system needs to be developed to make it as a reality.

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#### Handwritten Character Recognition Techniques on Pali Language: ASurvey

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#### Abstract:

Handwritten text recognition involves the ability to concede the comprehensible handwritten text and translate into machine encoded text with the help of OCR. Pali is a language that is referred as the language of the Thervadic Canon. Pali language is translated in many different scripts like Sinhala, Burmese, Lao, Devnagri and many more to translate the sermons of Lord Buddha. The retrieval and translation of such rich ancient Indian literature helps to open the doors to the past and history that the modern languages cannot offer. The objective of this survey paper is to summarize and compare the methods and work done on recognition of Pali scripts, texts and handwritten documents. Keywords: Pali,Optical character recognition, Handwritten text recognition Segmentation.

#### I) Introduction

A major research domain in the area of image processing is Handwritten Character Recognition. In handwritten texts or scripts there are no restrictions on the techniques of writing scripts. The earliest writing was usually based on pictograms. Understanding, maintaining and retrieval of such ancient scripts it is very difficult due to many reasons. Science these pictograms and scripts are difficult to read and understand; this became a barrier in accessing and discovering the knowledge.

The physical evidence of Pali is as recent as 500 years old with vast majority of 300 years. Pali was being written on manuscripts made by the palm leaves and these were threaded together with strings to make books. But being an organic material it doesn't last well in the humidclimate.

Optical Character Recognition techniques gives a solution to this barrier of retrieval of such important document as this technology enables to convert to convert different handwritten scanned texts, documents or scripts into data which can be easily searched, edited and will be available worldwide for study and research as well.

**Pali:** Pali language is originally a spoken language with said to have no alphabet of its own. The Tipitaka was first fixed in writing in about 100 BCE, by Sri Lankan scribe-monks who wrote the Pali phonetically using their own Sinhala alphabet. Since then the Tipitaka has been transliterated into many different scripts (Devanagari, Thai, Burmese, Roman, and Cyrillic etc.). Translations in English of the most popular Tipitaka texts abound as it is, and many students of Theravada find that in learning the Pali language even justa little here and there can greatly deepen the understanding and appreciation of the Buddha's teachings. Today Pali is studied mainly to gain knowledge from Buddhist scriptures, and is frequently chanted in a ritual context. The literature of Pali; historical chronicles, medical texts, and inscriptions is also of great historical importance.

#### **II Properties Of Pali Script**

The Pali alphabets consists 41 letters, in which 08 vowels and 32 consonants are there. Pali being a phonetic language, each letter has its own characteristic sound. Figure 1 shows the vowels and Figure 2 shows the consonents of Sinhala language used by sinhalesein Sri Lanka.

đ	ආ	ବ୍ର	õ	S	උඉ	θ	ଷ
39	အာ	ŝ	ත්	5	ê	C	23
Α	Á	I.	Í	U	Ú	Е	0

Vowels Fig 1.

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#### Consonants Fig 2.

ච 0 c	ත් ක ch	ອ ອ j	ඣ ¶ <i>jh</i>	ෂී 2] <sub>ද</sub>	(2)1	2			ක ද k	බ ම kh	හ c ස	ස හ gh	ඩ c ng
ත ර ද	д 8 th	e o d	ධ e dh	න ඳ n					ວ ທີ (	්ය ගා≾්	ୟ ଏ. ମ	ති ගැක්	ණ පි 2
ය හ y	ර ද r	@ % /	ව 0 v	ස හ s	හ ග h	₩ U9	i i	disc	0 9	д 9 ph	ହ ୧୦୦୦	භ න 6h	ම ං m

#### **III** ) Related Work

Several works were done by OCR on many other scripts like MODI, Devnagari, Bengali giving top rated accuracies setting standard for others. In 2004 U. Pal and B.B. Chaudhari describes work done on 12 major Indian scripts through OCR. In 2007 V.N. ManjunathAradhya, G. Hemantha Kumar,

S. Noushathshow a multilingual OCR leading to a good accuracy. Also, Apurva A. Desai used OCR technique for recognizing gujarati handwritten digits in 2010 resulting 82% success rate and likewise AmitChoudhary, Rahul Mishra, SavitaAhlawat routine this with binarization method for judging the capability of OCR for English characters in 2013 giving accuracy of 85.62%.

In 2015 NehaGautam, R.S. Sharma, GarimaHazrati used Optical character recognition with some other techniques for Classification of Akkhara-Muni; a Pali character with overall success rate 85.4%.

Recognition of Pali Characters forDevnagari was shown by Kiran S Mantri, S P Ramteke, and S R Suralkar in 2012, here comprision features like image pre-processing, feature extraction and classification algorithms have traversed to design software (OCR) with good performance. The recognition rate is 100% which has been done using simple feed forward multilayer perceptron also a back propagation learning algorithm to guide each network with the characters in that particular group has been used.

In 2018 Siddharth S More, Prashantkumar

L. Borde, Sunil S Nimbhore worked on Isolated Pali Word (IPW) Feature Extraction using MFCC & KNN Based on ASR with classification of 80.36% and 81.83% respectively.

Another work using simple feed forward multilayer perceptrons and back propagation learning algorithm is used to train each network character in that group as an input-example to that network for Pali character recognition system is done by Kiran S. Mantri, S. P. Ramteke and S. R. Suralkar.

In 2014 Chamari M. Silva, N. D. Jayasundere, C. Kariyawasam work on the state of handwriting recognition of modern Sinhala script with good accuracy this paper worked on the problem areas that requires attention and also examined the current state of handwriting recognition in Sinhala language.

Character Recognition is known as Optical Character Recognition (OCR) which has become very interesting and challenging research area in image processing domain. OCR is a process of conversion of text whether it is printed, handwritten or typed form into machine encoded text. OCR work has been done on various scripts in India like MODI, Brahmi, Devnagari but still Pali script has been neglected due to its complexicity and lack of database.

#### **IV) Structure Of HCR**

Recognition of the Handwritten Characters involves many steps, the make steps are shown in Fig 3. Starting from the data acquisition process which means collection of sample database to work on till the post processing.

This process includes scanning of data, preprocessing that includes resizing image, binarization etc. then features extraction, classification techniques and post-processing.

# A. Image acquisition

In Image acquisition, the recognition system takes a scanned image of a specific format such as JPEG etc. The acquisition of image can be done through a scanner, a digital camera or any other suitable digital input device.

# **B.** Pre-processing

In pre-processing a series of operations like normalization of the input image is performed on the scanned input image. It enhances the image for rendering and makes it suitable for the segmentation process.



The tasks which are performed on the image in pre-processing stage are shown in Fig.2.

In the process of Binarisationa gray scale image is converted into a binary image using global thresholding technique. The binary image is then inverted to obtain image such that object pixel are represented by 1 and background pixel by 0 this stages to produce the preprocessed image suitable for segmentation.

# **C.Segmentation**

In the segmentation stage, the decomposition of sequence of characters into sub-images of individual character is performed.

# **D.Classification and Recognition**

The classification stage is called a decision making part of the recognition system. It can be defined as the process of classifying a particular character into an appropriate category. The structural approach for classification is usually based on relationships present in image components. The statistical approaches are based on use of a discriminated function to classify that image. Some of the statistical classification approaches are Bayesian classifier, decision tree classifier, neural network classifier, nearest neighborhood classifiers and many more. Finally, there are classifiers based on syntactic approach that assumes a grammatical approach.

# **E.Post-Processing**

There are various approaches that can be used to improve the accuracy of OCR results, and once classification of the image has been done recognition of the same will be preceded. Finally Post-processing stage is the concluding stage of the recognition system. SSN 2349-6381

# VI. Conclusion Andfuture Scope

In this paper, an overview of various techniques of handwritten character recognition have been studied and presented. In HCR the optical character recognition system does not operate automatically, it involves number of phases such as image acquisition, pre-processing, segmentation, feature extraction, classification and post-processing. Brief explanations of all the mentioned phases are given. For further studies an efficient OCR system can be developed using any combination of the above mentioned techniques.

The OCR system can also be helpfully used in different practical applications such as number-plate recognition, smart libraries and various other real-time applications. Considering the research work done on recognition of Pali language the efforts taken are not that adequate. This survey paper can serve as a helpful guide and update for readers working in the Handwritten Character Recognitionarea.

# Acknowledgment

The author is thankful to Dr. D. N. Besekar, Associate Professor, Department of Computer Science, ShriShivaji College Akola, for the guidance and co-operation.

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#### Zonal Base Classification On Ladakhi Numerals

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#### Abstract:

The feature extraction techniques play an important role in recognition system. It is very important field of image processing and pattern recognition. There are many techniques for feature extraction like statistical feature, structure feature, shape feature etc. This paper introduced the Ladakhi numbers and feature extraction approach for handwritten ladakhi numerals recognition. Here I will use zoning method for feature extraction and find the statistical features for numerals.

Keywords:Ladakhi numerals, feature extraction, zoning method, statistical features

#### **I** Introduction

Character Recognition is known as Optical Character Recognition(OCR) which has become very interesting and challenging research area in image processing domain. OCR is a process of conversion of text whether it is printed, handwritten or typed form into machine encoded text.

In India OCR work has done on various scripts like MODI, Gurumukhi, Bengali but still Ladakhi script has neglectedmay due to its complexicity.

The Ladakhi script has written using Tibetan script. From literature survey it is found that some work has done in Tibetan script but yet to developed OCR for Ladakhi script.

The process of character recognition start with data acquisition process which means collection of sample data from various people. This process are divided into two classes online recognition and offline recognition [1].

The character recognition process has several steps such as scanning of data, preprocessing that includes resizing image, binarization etc. than features extraction, classification techniques and post-processing[2]. There are many techniques that are used to extract the features such as contour profile, projection histogram, zoning, Zernike histrogram[3]. The Ladakhi script is almost same as Tibetan script. From literature survey it is found that some work has done in Tibetan script. The work has alreadydone on almost all the Indian script. The author R.R.Herekar and S.R.Dhotre [1] have worked on English alphabets. They have performed the feature extraction using zoning method together with the concept of euler number. They found the end points of each character and found in which zones the end points lies. The authors Long-Long Ma and Jain Wu[4] have worked on online handwritten Tibetan syllable recognition method based on component segmentation method. They compared the character segmentation method, segmentation free method and proposed method and found that proposed method achieved the highest recognition accuracy rate i.e. 81.23%. Huiwen Gong and Wei Xiang[5] have analyze and extract the Tibetan text features and find the structure features by K-mean algorithm. P.Vithlani and C. K. Kumbharana[6] proposed structural and statistical feature extraction method for character and digit recognition using zoning method and also extract the features like numbers of end points, end point existence in zones, zones with zero foreground pixels value, number of horizontal and vertical lines etc.

#### II Ladakhi Numerals Set

Ladakhi is Tibetic language. It is very much similar to Tibetan script and it is spoken in Leh district of Ladakh which is situated in Northen India. The character set of Ladakhi script has 30 consonant 5 vowels and 0-9 numerals[7].

0 1 2 3 4 5 6 7 8 9

#### III Proposed Feature Extraction Method

Feature extraction is a process of finding the feature of images using various methods by which we can achieve the high recognition accuracy. Very first the handwritten samples of ladakhi numbers are collected from various peoples than samples are scanned and stored in digital format. Resized the image into standard dimension I took 40\*40 and stored. Then stored images are loaded and convert into binary image. Morphological operation such as Dilation, Erosion, Skeleton, Thin operation can be performed on images. That image can be used for zoning base feature extraction. IV **Zoning** 

Zoning based feature extraction is one of the most popular method used to find statistical feature of image[6]. The number is divided into 4\*4 sizes that is divide into 16 equal zones.





Z1	Z2	Z3	Z4
Z5	Z6	Z7	Z8
Z9	Z10	Z11	Z12
Z13	Z14	Z15	Z16

#### Fig.1: zoning of number 2

#### Figure2: zoning of number 1

Fig 3: zones name from z1 to z16

As shown in figure 1 the number 2 is divided into 16 equal zones and it is found that the number2 lies in zones z6,z7,z10 and z11. Similar process will apply on other numbers and find the respective zones in which they lie. After that calculate the statistical feature for each zones and stored that values in database which will used for further processing.

#### **V** Proposed Algoritham

Step1: Collect samples/images of handwritten Ladakhi script.

Step2:Scan the collected images.

Step3: Load the image and Crop the image

Step4: Resize the image into standard size(40\*40)

Step5: Convert the image into binary image.

Step6: Apply the morphological operations as required. (dialation, erosion, thin, skeleton etc.)

Step7: Performed Zoning method on number image.

Step8: Divide digit image into 4\*4 equal zones i.e.16 zones.

Step9: Find the statistical features of each zone (mean, median, standard deviation, max)

Step10: Stored that values in array.

Step11: Apply same process for all numbers.

#### VI. Conclusions

Zonal method is very applicable for feature extraction of Ladakhi script. hence by applying this method we can identify statistical feature of ladakhi numerals

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# Study On Current Security Issues in Internet Of Things

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#### Abstract

Internet of Things (IoT) is an innovative and new age technology, which supports global infrastructure for exchange and sharing of data by interconnecting the uniquely identifiable physical and virtual devices without any interference of humans. Security is one of the important aspect related to the IoT technologies, applications, and platforms. The main objective of IoT security is to preservation of privacy, confidentiality and to make sure the security of the users, infrastructures, data, and devices of the IoTandgive the assurance for availability of the services offered by an IoT ecosystem. This paper represent the study about the related security issues during data transmission and the some cryptographic algorithms used atoms man a set Keywords: Internet of Things, Security algorithm, Encryption. Scipling

#### **I. Introduction**

Internet of Things is the new age technology concerned with devices and networks through Internet. The Internet of Things (IoT) is composed of physical objects embedded with electronics, software, and sensors, which allows objects to be sensed and controlled remotely across the existing network infrastructure, facilitates direct integration between the physical world and computer communication networks, and significantly contributes to enhanced efficiency, accuracy, and economic benefits [1]. Therefore, IoT has been mostly used in various applications such as environment monitoring, energy management, medical healthcare systems, building automation, and transportation. Unfortunately, due to the resources of IoT devices, they always highly complex to give assurance.

#### **II. Introduction To Iot Security**

Due to the variation of the devices and number of communication protocols in an IoT security relief based on the traditional IT network solutions. In fact, the current security measures which are applied in a conventional network may not be sufficient. Attack vectors as listed by Open Web Application Security Project (OWASP) concern the three layers of an IoT system, which are hardware, communication link and interfaces/services. Hence, the implementation of IoT security mitigation should encompass the security architecture at all IoT layers, as presented in Figure 1. Radio Frequency Identification (RFID) and Wireless Sensor Network (WSN) are considered as part of an IoT network.

In the present internet scenario, enormous number of protocols and technologies are available to address most of the security issues for wireless networks, but still the existing tools have a constraint in applying them in the domain of internet of things (IoT) because of limitations in IoT hardware nodes and WSNs. Another reason is conventional security protocols devour large amounts of memory and computing resources. Also IoT devices usually have to work in harsh, erratic and even intimidating surrounding environments, where they are prone to various security breaches. By 2020, more than 25 billion IoT devices uses the various categories of industries that will be using IoT. Unauthorized access, theft or damage of confidential information, replication of SIM information, imitation of air interface information are the major security issues related to the terminals of sensors in internet of things (IoT). Any security mechanism should be designed to provide confidentiality, Integrity, authentication and non-repudiation. Both IEEE (Institute of Electrical and Electronics Engineers) and IETF(Internet Engineering Task Force) is mainly working towards the design of communication and security issues for communication between IoT and the internet.

#### **III. Secured Iot Architecture**

IoT has to ensure the security of all layers. In addition, IoT security should also include the security of entire system crossing the perception layer, network layer, middleware layer and application layer.

Three IOT Layers, Its Operations and Security problems.

There are three layers in the IOT Architecture. That are Perception Layer, Network Layer and Application Layer



Figure 1. Three-layer IoT architecture.

**1. Perception Layer**: The perception layer is kwon to be object layer. It contains the sensors and actuators for identifying any particular operations. The main responsibility of perception layer is to digitizing and transferring data to the object abstraction layer through secure channels. The main responsibility of Object layer is to collects the required information from the physical objects and converts that to digital signal and pass it to network layer. The collection of sensors and actuators is the object layer that forms WSN (Wireless Sensor Network).

At physical level the security problem includes the physical security and it supports the sensing devices and security for the collection of information. Due to plain and uncertain protective capability of sensing nodes the security of WSN, RFID and M2M terminal [4] are affected.

#### WSN:

Security is a challenging thing for WSN as it is not simple task for always watching the sensor nodes but in order to prevent the transmission of data from attackers it must be secured. The WSN security necessities are availability, confidentiality, integrity and authentication and other requirements such as localization, selforganization and data freshness.

In sensor node, the data move from several medium stages so the loss of the data will be more. In such stage the data confidentiality supports encrypted data so that only the receiver can decrypts it to get back the original data. The data received by the receiver should not be get changed by the intruder that is data integrity. The data authentication checked that the data is received from the authenticated node [5]. The data availability to make sure that the data is available even after the attack. At the time of transmitting data using location details of the sinking nodes, the location must be secured otherwise the malicious nodes may control the non-secured data by sending incorrect signal strengths or replaying signals. This is source localization one of the fantastic thing with the security in WSN is self-particular infrastructure for the nodes to be organized and have self-healing property. Data freshness make sure that only the new and fresh data is transmitted and no old data is being transmitted or replayed. The glow can be verifies by including some time related counter.

# **RFID** (radio frequency identification):

It is an automatic technology for identification of objects and human beings. This technology mainly uses RFID tags for exchanging data without manual support. The different attacks and security issues of the tags are:unauthorized tag disabling,unauthorized tag cloning,unauthorized tag tracking and Replay.

**2. Network Layer**: IoTobserve a number of risks and crises in network layer such as virus attack, destruction, confidentiality, integrity, man-in-the-middle attack. The mostlyregular attack is Dos attack which is affected by enormous requirement of nodes for data transfer. And also sending huge amount of data affected congestion. Some of the security concern at the network layer is detect the authentication, Anti-ddos, Encryption mechanism, communication security. Earlier by-hop encryption mechanism was taken; using this in the transmission strategy the information is encrypted [6]. In occurrence of communication security TLS/SSL or IPsec are used to encrypt the bridge in the transport layer and protect security of network later. Protecting sensors are used to assure the privacy of the humans and objects from the physical world.

**3. Application Layer** The security needed for several of application environment are different, and one of the characteristics are data sharing [7]. The authority of traffic management is carried by this layer. At this level only the path-based DOS attack was sponsored. Only at this level the service desire by the customer will be supported. For a large scale development of IOT application this layer was very important. It is the top most

layers that found formulas, business logic and UI to user end. The security necessities [2][3] in this layer is authentication and key agreement, privacy protection, security education and management. few of the application layer protocols are CoAP which has a transport UDP and security DTLS, MQTT which has a transport TCP and security TLS/SSL, XMPP which has a transport TCP and security TLS/SSL, RESTFUL which has a transport HTTP and security[9] HTTPS, AMQP which has a transport TCP and security TLS/SSL, Web socket which has a transport TCP and security TLS/SSL, DDS which has a transport TCP/UDP and security TLS/SSL, SMQTT which has a transport TCP and has own security[8]. As technology gets updated every day, android/mobile applications [7] can be linked with IoTs with incorporated and inbuilt security handling techniques in the future.

#### **IV. Encryption Algorithms**

The requirement for the lightweight cryptography have been discussed [2], [3], also the lack of the IoT in terms of constrained devices are highlighted. There in reality exist few lightweight cryptography algorithms that does not always effort security-efficiency trade-offs. over the block cipher, stream cipher and hash functions, the block ciphers have shown approximately better performances.

**1. ECC (Elliptical Curve cryptography)** ECC is a public key cryptography, in this type one key is given for encryption while the other is given for decryption. This algorithm is placed on elliptic curve theory [3]. ECC has a 164-bit key which can fulfil a level of security while the others need 1024 bit key [4] Even with low computing power and battery usage we accept the same level of security and this is frequently used for mobile applications. The main advantage of the ECC algorithm is the key size is very small and storage.

**2. mCrypton**mCrypton algorithm is developed for small type of devices like RFID tags and sensors. mCrption has 3 key types 64 bits, 96 bits and 128 bits. This serve us in enabling much compress implementation of hardware and software. This is frequentlypredefined as a security block for applications like smart cards, security tokens. In devices with minimum cost RFID tags and sensors it is not possible to execute primitive due to cost constraints. This is developed with extreme efficiency in management of the resource and consumption of power. This algorithm is placed on the architecture of crypton[5]. This has very good flexibility due to variant key sizes [6].

**3. AES** ( **Advanced encryption standard**) The AES algorithm is predefined for electronic encryption of data. It gives either public or private key. It has variable key length like 128/192/256 bits [6]. Each and every key could encrypt or decrypt a 128 bit data. AES is confirm to be a reliable algorithm. AES given a high security.

# V.Conclusion

The invention of the IoT paradigm in the last decade has led to number of threats and attacks against security or privacy of Internet of Things (IoT). In this paper gives a brief idea that as more and more IoT applications are developed, it results in the development of the possibility of surface area for external attacks. There will be security attacks based on the 3 layers of the IoT architecture and discussed them with possible solutions. Also here summarized some encryption methods providing security and their limitations in various layers. In order to hold the IoT technologies and applications, these privacy and security issues and limitations need to be solved and implemented, so that power of IoT technology can be used for constructive applications.

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# Internet of Things (IOT): System Architecture To Analyze Data In Order To Turn Them Into Information Required In Real Time

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# Abstract

(IOT)Internet of things brings millions of devices together to work together & to process data to perform certain task. IOT system presents several features such as distribution, openness, interoperability and dynamicity. The architecture allows us to collect & share the data in an environment using wireless sensor network (WSN). The layered architecture of IOT makes it possible & helpful to understand & develop its technical framework of Logical layered architecture. This paper focuses mainly on the basic architecture & its flow of working. The paper also explains the layered architecture in detail.

Keyword: Internet of Things (IoT), Sensor, Wireless sensor network (WSN), System architecture, Lower-Power Wide Area Network (LPWAN), Radio Frequency Identification (RFID).

#### Introduction:

(IOT) Internet of things is a big network of transferring sensed data from sensor or actuator to perform various applications.

Devices exchange data without human intervention automatically. IOT has ability to make ordinary electronic devices to communicate with each other for taking smart decisions using artificial intelligence (AI). This technology includes unique

identification, heterogeneous device data to communicate to build a smart network for making smart decisions.

Internet of things is an era of technological revolutions which depends on dynamic technical innovations for making smarter network using various techniques. IOT is a multidisciplinary domain which covers a large number of innovations. The physical device embedded with sensors, actuators such as RFID (Radio frequency identification), WSN (Wireless Sensor Network), LPWAN (Lower Power Wide Area Network) etc. which collects the required data from the device & send or transmits it to perform the required task such as smart water management, smart air pollution detection, smart street light system, etc.

Essential components which are used to build IOT are

- Hardware such as sensors, actuators, etc
- Middle ware components such as Storage
- & data analytical tools.
- Visualization using different applications. These all tires in all make computing & communication possible. Its development depends on dynamic technical innovation this is very important from wireless to nanotechnology.

# **Related Work:**

In the field of IOT, there are number of researches addressing aspects of architecture design, system setup & technologies of IOT.

Soumyalatha, Shruti G Hegde [1] explained various application of IOT, Tools for users, relationship between Wireless Sensor Network (WSN) & IOT. They also focus on use of IOT in the field of agriculture for better yielding of crops & lessen up the manpower. Dr Aditya Tiwari [2] has explained study on IOT & its application in different field of Science & Technology. It also discusses the element of IOT along with its different applications. Ahmed Khalid [3] architecture of IOT & research criteria & also identifies several open issues related to the research criteria that needs to be known. Ahmed El Hakim [4] have discussed about device that exchange data atomically in real time without any human intervention, also explains how IOT converts ordinary products into smart communicating machines .Miao Wu,Ting-Jie Lu, Fei-Yang Ling, Jiny Sun, Hui-Ying Du [6] explained existing three layer structure is at initial stage of development, cannot give the proper working of IOT the five layer architecture could help researchers & developers to better understand the IOT internet of things.

#### **Proposed Architecture:**

Architecture of IOT can be classified into four layers.



# Fig 1. Layered Architecture Of Iot

- 1) Data Collection Layer: The data from the sensor such as RFID (Radio frequency identification), WSN (Wireless Sensor Network), LPWAN (Lower Power Wide Area Network), GPS, etc. is collected to move it in the upper or next layer.
- 2) Network Layer: This layer is responsible to move the collected data into the next layer. This layer should have scalable, flexible, standard universal protocol for transferring data from different devices. Also should support multiple organizations to communicate independently.
- 3) Management Layer: This layer act as a middlemen between network layer & Application layer. The layer has the responsibility for the security & privacy of the data & to manage bulk amount of data to be processed in all cases.
- 4) Application Layer: This is the upper most layers which provide user interface with various applications for health, food management, waste management, etc.



Fig 2. Detail View of IOT Architecture

The figure 2. gives the detail view of the previous architecture module which explains the gateway which is responsible to collect the data from the previous or primary layer & forward it to the repositories or management layer to analyze the data though it might be in the real time to send it to the next layer.

# Implementation & Analysis:

IOT is implemented in lots of field such as agriculture, Smart Cars, Health Care system, etc. To implement IOT the three components such as 1) hardware components, 2) middleware components, 3) Visualization are required which are described. So to build IOT some key elements are necessary such as:

# Unique Identification for each device:

IOT consists of number of devices where each device contains Unique Identification Code (UIC) for communication and control, access devices through internet. Ipv4 addressing supports limited number of smart devices as compared to Ipv6. Also devices are given unique object id for identification and communication within devices.

#### **Sensing Devices:**

Each device is embedded with sensor and actuator which continuously sense the data based on the context. Though it is used for which application such as, Smart Home devices, Smart Cars, Smart Watch etc.

- 1. Communication: The collected data is transferred in the network to the database through Radio Frequency Identification (RFID), Wireless Sensor Network (WSN), Wi-Fi, 3G, and 4G etc. for performing particular task.
- 2. Data Storage & analysis: Data sensed from the devices as to be stored in the device & from the large amount as to be stored in the device & from the large amount of raw data the meaningful information is to be extracted. The information is analyzed by different analytical tools which should support interoperability with different platform.
- **3.** Visualization: Visualization is possible by using different applications. The end users have to download the required application though which user can interact with the data base & get useful information.

#### **Conclusion:**

Internet of things is a huge network of making machines speak or communicate to each other to make the world a smarter place to live in. Also IOT make our lives easier by supporting various working things possible without human intervention. In this paper we have tried to explain the IOT architecture which will analyze data in order to turn them into information so that it would make the smarter network of real time.

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# Security Issues and Challenges inCloud Computing: A Review.

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# Abstract:

Cloud computing is the domain where the security of data must be protected over the network. When using the various services over cloud, security issues must be consider. The cloud computing architecture provides a way to services based on demand and to resource utilization like network, storage, servers, services and applications. Cloud computing is offering on demand services to its user over the Internet and stores data with its resources in environment causes the security threats .This paper consists of review of various security issues related to the cloud computing, research challenges with security measures dealing with the security problems. This paper also provides review of some of the issues related to cloud storage.

Keywords: Cloud Computing, Security issues, confidentiality, authenticity, encryption, cloud data storage, cloud data security.

# 1. Introduction

Utilization of shared resources as well as various services over the network increases, thus results in increase in the cost of hardware and software. Cloud computing provides a way to serve when user demands over the network with reduction in the cost of hardware and software. Cloud computing provides variousservices and features like flexibility, reliability, unlimited storage, portability, quick processing power but security of cloud is still an issue to be consider [1][2]. The cloud computing provides three types of services namely Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). Cloud computing becomes the business necessity as well as it is mostly used in academic area. There are some examples of cloud services like webmail, online file and various business applications. The cloud storage as inexpensive storage often used in small enterprises. Based on the importance of data actual storage location may be on single storage environment or replicated to multiple storage. The cloud computing mechanism consists of storage layer for storing data, basic management layer for security and stability of cloud storage, application interface layer provides application service platform and access layer provides the access platform.[3][4]

This research paper include various issues and challenges to cloud security and provides a review of different security threats to cloud computing like trust, privacy, confidentiality, authenticity and discuss the solution to overcome these issues.

#### **1.1Security Model**:

# There are three types of Cloud services:

Software As Service (SaS) is called as a delivery model which describes as a process by which Application service provider (ASP) various software application over the network. Due to this it is does not needed to install and operating the application over the own computer reducing the software maintenance load. In this software and data associated with is hosted over cloud environment, one can use that application on someone else's system.[1][3][4]. In SaS, the ability to use appliances which is implemented on cloud organization can be obtained from different devices like mobile, workstation from anywhere at any time.[4] **Platform as a Service (PaaS):** 

PaaS provides the computing platform and solution stack without downloading software or installing it for developer. To test the cloud applications and implement it, PaaS provides an infrastructure with high level of integration.

There are different types of PaaS such as Add on development possibility, open platform & open service, standalone developments environments and application delivers on environments.[3][4]

#### Infrastructure as a Service (IaaS):

In Infrastructure as a service (IaaS) virtualization technology is use to share the hardware resources for executing services. So

as to provide resources such as servers, network and storage accessible by applications and operating system. It provides API for interactions with hosts, switches and routers and capability of adding new equipments.[3]

In IaaS composition different computing resources which include loading, processing unit should be supplied by the supplier.[3][4]

# 2. Cloud Deployment Model:

There are three Cloud Deployment Models which are 1) Public Model 2) Private Model 3) Hybrid Model

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**Public Model**: The public infrastructure is available to the general public. Public cloud is a model in which resources are available to everyone or anywhere. In public cloud, the cloud computing accessible in effective ways and are accessible over the network to user with detached assets and charges client on the basis of utility. The cloud organization possessing and accomplishing by provider who suggest its retune to public domain E.g. Google, Amazon, Microsoft offers cloud services via Internet. The public clouds are less secure since it places an additional inspection to ensure all application and data accessed on it are not subjected to malicious attacks.[1][4][7]

**Private Model**: This model is developed for private organizations and the service is not publicly accessible by everyone. This type of cloud computing model generally used by Big organization for allowing administrators to effectively become in-house service providers catering to customers within the corporation. Also private cloud architecture provisioned services on corporate networks. The advantages of internal cloud model is Higher Security and Privacy, Coast Energy Efficiencies, More control, improved Reliability[1][4]

# Hybrid Model:

Hybrid cloud is combination of Public and Private cloud. A hybrid cloud is the choice for enterprises. The private cloud model need some services. Hybrid cloud model has number of advantages: Scalability, Cost Efficiencies,

Security, Flexibility etc. The transfer the data takes place between two or more cloud without affecting each other. The hybrid cloud

useful for providing secure services regarding payroll processing. The drawback of hybrid cloud is the complexity in effectively creating and prevailing the solution. [3][4][8]

# **3.Cloud Computing Application:**

- 1. The cloud computing is used to run all sorts of applications that a personal computer can run.
- 2. Accessibility of applications and data is at anytime and anywhere over the network.
- 3. Cloud computing system reduce the hardware and software costs .
- 4. Client use the enormous processing capability of Cloud system's. Also cloud is used to compute complex calculations. The cloud system processing power required back end to speed up the calculation.
- 5. Cloud computing is having significant advantages over other computing system but it has its own security issues.[9]

# 4. Cloud Security Issues And Challenges :

There are important concerns related to security and privacy using cloud computing . There are four types of while discussing the security issues of a cloud.

- 1. Data Issues
- 2. Privacy issues
- 3. Infected Application
- 4. Security issues



#### **Data Issues:**

In cloud based system, the issues of security regarding to a sensitive data are:

- 1. As we know that whenever a data on cloud ,it is accessible by anyone from anywhere anytime the common, private and sensitive data on a cloud.So it required data integrity method in a cloud computing.
- 2. Also data stealing is prominent issues in cloud computing enviroment since cloud service

- 3. provider doesn't own server due to cost affective and flexible for operation. So, there is chances of data to be stolen from these external server.
- 4. In the cloud computing, data loss occurs due to service provider shut down services Also, the data can be lost, damage or corrupted [11].

**Privacy issues:** It must make sure that secrecy can be achieved regarding to the personal information of customer and user. It is also make sure about whois accessing and maintaining server. So as to enable the service provider to protect users information.

# **Infected Application:**

The service provider have all rights of monitoring and maintenance of server, so as to prevent malicious user uploading infected application onto the cloud, affecting cloud computing services.

# Seurity issues:

There is two level security, one at service provider and other at user leve. It s make sure to secure server from external threats. Though ther service provider provides security, customer or user must make sure that there is no loss of data, stealing, tampering of data or information. [11]

# 5. Security Issues And Solutions:

Following are some of the key security issues:

1)Trust 2)Confidentiality 3)Authenticity

4) Encryption 5)Key management

# 5.1 Trust:

The customer facing the problem of trust between him and the service provider because customer never sure about the service provided is trustworthy or not including data is secure from intruder or not. The SLA(Service Level Agreement) document is an agreement between customer and service provider which provides details of duties of service provider with future plans.Still there are trust issues and secrecy to resolve security issues in cloud.SLA framework generally used as trust management model for security in cloud environment.[2]

# 5.2 Confidentiality

The confidentiality prevent disclousure of Private and important information. The information which is stored on geographically dispersed locationface the

problem of confidentiality means to prevent the disclosure of private and important information. Since all the information is stored on geographically dispersed locations, becomes a big issue. Encryption is the method by which confidentiality is achieved. Also the secure cloud storage service which is designed based on public cloud structure. The technique of cryptography is used to achieve the privacy.[2]

# 5.3 Authenticity

The data is residing at different places in cloud is accessible by the authenticate user. So the user must be authenticated by access control mechanism. The digital signature is the solution for authentication problem. Still user can't get access. The owner of data provides the credential information. The username and password generates the identity information for the user provided to service provider by the data owner. Thus this method is proves to be scalable.

# **5.4** Encryption:

This is widely used method of securing data in cloud environment. As it needed to have computational power thus reducing the overall performance. The several cryptographic methods are used to achieve security in cloud. To increase the overall performance, whenever user wants to make query, the query parameter is evaluated against data stored and results also decrypted by the user not the cloud itself.

Various method like end to end policy based encryption and homomorphic encryption provides the results of calculation performed on encrypted data rather than raw data.thus increasing data confidentiality and better encryption.

# 5.5 Key Management

In cloud environment the encryption/decryption keys and its management is big security issue. The Keys stored on cloud is bad option. The separate database is used to store keys locally. The solution to key management is to use two level encryption techniques which helps to store encryption keys in cloud.

# 5.6 Data Splitting

This is an very fast method as an alternative to encryption since it split data over mulitple hosts which are non-communicatable. As user gain access to recollect his original data from the service provider, it has its own security issues. The solution is to use the Multi cloud database model which ensures integrity and availability of data after spliting. Thus security is achieved by enhancing the data stored and replicate in multiple clouds. So there is less chance of intruders to attacks since clouds share data using secret sharing algorithm.

#### 5.7 Multi Tenancy

The resource scarcity issue is solved in cloud environmet by different resources and services are shared among different applications at different places. But it leads to confidentiality issues. These systems and applications must be isolated to achieve confidentiality. As data and application stored on both on virtual server and actual hardware leading to security issues. Since one virtual machine hosting a malicious application can affecting other machineperformance. [2][6][8]

#### 6. Conclusion

In this study various security issues are faced by cloud computing, Also some of the possible solution to these problems were provided. Thus it can be concluded encryption along with the proper authentication techniques and data integrity is to be consider.

#### 7. Future Work

Cloud computing is relatively a new and widely emergingdomain and it must have to overcome the security issues inorder to be more and more prominent technology of the future. A lot of research is being done in this regard to solve these major issues but still many problems are unseen and unknown and the doors for future research arealways open.

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# **Review on Social Media Sentimental/ Opinion Analysis**

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#### Abstract:

After introducing of social media sites, information is quite faster transferring from one place to other easily, but with this there are some pros and cons. Sometimes wrong information of rumors spread very fast as well as people sending their views or opinion about person, any product etc, so here opinion or sentimental analysis plays very important role. In this paper research review of sentimental/opinion data analysis is used to identify and analysis of comments or opinions of different people from different sites for person, issues, events, topics and their attributes or some business review which will then useful in decision making.

Keywords: Information retrieval, sentiment analysis, opinion mining, data mining

#### Introduction:

Sentiment analysis or opinion mining is the computational study of people's opinions, attitudes, appraisals, and emotions toward entities, individual person, issues, events, topics and their attributes.

"What other people are thinking" is always an essential piece of information during the decision-making process in business intelligence.

For example, In businesses there is importance of public or consumer opinion about product or services.

Now use of social media in everywhere(i.e., reviews, forum discussions, blogs and social networks) on the internet, individuals and organizations are increasingly use of public opinions in these media for their decision making.

It is a very important method in today's world where our maximum work is carried on internet be it communication, reading news, blogs placing reviews about a company, product/software or person. So it becomes very important to detect the exact meaning of the sentence written or else it may lead to disastrous (in many cases completely opposite) understanding of the issue. The essential issues in sentiment analysis are to identify how sentiments are expressed in texts and whether the expressions indicate affirmative (favorable) or negative (unfavorable) perspective toward the subject.[3][4]

Opinion Mining or Sentiment analysis involves creating a system to explore user's opinions made in blog posts, comments, reviews or tweets, about the product, policy or a topic [6].

#### **Components of Opinion Mining**

There are mainly three components of Opinion Mining [7]:

• **Opinion Holder**/ **source**: Opinion holder is the holder of a particular opinion; it may be a person or an organization that holds the opinion. In the case of blogs and reviews, opinion holders are those persons who write these reviews or blogs.

• Opinion Object: Opinion object is an object on which the opinion holder is expressing the opinion.

• **Opinion Orientation:** Opinion orientation of an opinion on an object determines whether the opinion of an opinion holder about an object is positive, negative or neutral.

There are two main types of opinions: regular opinions and comparative opinions.

#### Different Levels/ Classification of Sentiment Analysis

In general, sentiment analysis has been investigated mainly at three levels [5].

• **Document level:** At this level is to classify whether a complete opinion document expresses a positive or negative sentiment.

• Sentence level: At this level the sentences and determines whether each sentence expressed a positive, negative, or neutral opinion.

Objective sentences - that express factual information from sentences

Subjective sentences - that express subjective views and opinions.

• Entity and Aspect level: Aspect level performs fine-grained analysis. Aspect level was earlier called feature level or feature-based opinion mining and summarization.

# **Challenges In Opinion Mining**

There are many challenges in Opinion Mining as follows:

- Domain-independence: Good in one domain and poor in other.
- Asymmetry in availability of opinion mining software.
- Detection of spam and fake reviews.
- Incorporation of opinion with implicit word/data and behavior data.
- Mixed Sentences and confusion in affirmative words.
- Way of Expressing the Opinion in different ways for difficult to identify.
- Use of Abbreviations and shortforms, Orthographics Words
- Typographical errors Sometimescause problems while extracting opinions.
- Natural language processing overheads: The natural language overhead like co-reference, ambiguity, Implicitness, inference etc. created difficulties in sentiment analysis tool [5][7][8].

As well as above challenges to analysis social media, there are also some other challenges to manage the information:

**a.Scraping**—social media data are accessible through APIs, but as major dataholders like facebook, Google, twitter, etc are making their 'raw' data accessibility are difficult for commercial value of the data..

**b.Data cleaning**—Data cleaning is to cleaning of unstrutured textual data.

c.Data protection—It is related to security of data.

d.Data analytics—foreignlanguages, foreign words, slangs, spelling errors and natural languages. [21]

# Methodology

- 1. A)Dataset –Any dataset on where to apply different technique to retrieving information likeSentiment Strength Twitter Dataset or any social / business site datasets.
- 2. B)Pre-processing Techniques
- 3. **Tokenization**This step breaks the large paragraphs called chunks of text is broken into tokens which are actually sentences. These sentences can further be broken into words.
- 4. **Normalization**There are many tasks performed simultaneously to achieve normalization. It includes the conversion of all text to either upper or lower case, eliminating punctuations and conversion of numbers to their equivalent words. This increases the uniformity of preprocessing on each text.
- 5. **Stemming**The stemming process is used to change different tenses of words to its base form this process is thus helpful to remove unwanted computation of words.
- 6. LemmatizationLemmatization is the process of merging two or more words into single word
- 7. **Removing Stop Words**Stop words refer to most common words in the English language which doesn't have any contribution towards sentiment analysis.
- 8. Noise removalThe datasets taken comes in raw form. We have applied manual cleaning of raw data along with the use of regular expression in NLP used to eliminate noises

# **C)Feature Extraction**

1. **TF-IDF**The term frequency-inverse document frequency (also called TF-IDF), is a well-recognized method to evaluate the importance of a word in a document.

# 2. Word N-grams features

- 3. The word N-grams feature model is one of most simple and effective representation model for natural language analysis and Twitter sentiment analysis. N-Gram will form the features of text for supervised machine learning algorithms. Some studies have shown state-of-the-art performance for sentiment classification on Twitter data using a unigram model [12], [13].
- 4. Twitter specific features
- 5. The number of hashtags, emoticons, negation, POS and the presence of capitalized words are used as features.

# 6. Word sentiment polarity score features

- 7. The word sentiment polarity score is a lexicon-based sentiment feature, and some approaches [14], [15] commonly use it as a sentiment feature for tweet sentiment analysis.
  - a. Polarity results for sentiment analysis are usually in the form of positive or negative, providing only single-dimensional information in sentiments. Compared to face-to-face communication, this analysis provides the least rich approach to capturing human affective information. To improve the quality of sentiment analysis output, based on the information richness [10]

# 8. Word representation features

9. Learning word vector representations from a large number of unannotated text corpora has recently been used in various natural language processing tasks. [16],[17]

# **D**) Classification Algorithms

For classification of word following algorithm will be useful: Support Vector Machine(SVM), Logistic Regression, Naive Bayes, Decision Tree, K-Nearest Neighbour (KNN), Random Forest

# **E) Performance Parameters**

For performance point of view two important parameter are Accuracy, Precision [18]

# Machine Learning In Sentiment Analysis (Ontology Based)

Almost all Machine learning algorithms for sentiment analysis follow standard steps to classify the sentiments as explained below [19]:

- 1. **Noise Removal**: Cleaning the data to extract relevant data from irrelevant data which increases the ability of an algorithm to predict based on the training data set.
- 2. Classification: Categorizing the data into positive and negative class.
- 3. Named Entity Recognition: In order to predict actual meaning of the comments, it is obvious to extract entities like sender, receiver, and the aspects of their conversation and then classify them as positive or negative.
- 4. **Subjectivity Classification**: Sentences can be classified into subjective or objective. Subjective are expressions on any attributes, events with the properties. Objectives are opinions that describe feelings toward entities.
- 5. Feature Selection: The features can be unigrams, bigrams, or n-grams with or without punctuations.
- 6. Sentiment Extraction: It can be done using unsupervised and supervised machine learning algorithms such as extra trees classifier, random forest classifier, naïve Bayes, and support vector machine.



# **Ontology for Sentiment Analysis(SA)**

Ontology-based Sentiment Analysismodel consists of classes, subclasses, objects, and their properties. The objects are stored in the database, and ontology model can be queried using query language like SPARQL to retrieve the data. Using ontology, a dynamic model can be developed that can predict objects regardless of the domain being used. Features of the domain are extracted by building ontology which helps in getting the refinedSentiment Analysis. [19]

#### **Future Scope**

A drawback of such information overload is sometimes evident inusers' inability to find important information whenever to need.

User-generated content allows collective understanding, which is a massive machine-human knowledge processing function capable of managing chaotic volumes of information. [11]

There are several approaches by which the data can be obtained for research and development. One of these approaches is from Open Data Portals. The open dataportals provide authentic data sets. The datasets can be downloaded from different portals in multiple formats including XML, CSV, JSON and many others. [9] **Future Work:** 

The following section discusses the work that will be implemented with future releases of the Web Application.

1. First, users' awareness of identity management online may increase overtime. The "manipulation" of personal image online may need to be taken into considerations in future work.

- 2. Second, There are a different other issues hidden in the "long tail". Future work can be done to design more sophisticated algorithms in order to reveal the hidden information in the "long tail". Several of these issues may be of great interest to education researchers and practitioners.
- 3. Often times, manual analysis is time consuming not only because of the time spent on analyzing the actual data, but also the time spent on cleaning, organizing the data, and adapting the format to fit the algorithms. We plan to build a tool based on the workflow proposed here combining social media data and possibly student academic performance data.
- 4. Possible future work could analyze student's generated content other than texts (e.g. images and videos), on social media sites other than Twitter (e.g. Facebook, Tumbler, and YouTube). Future work can also extend to students in other majors and other institutions. [20]

Automated opinion mining and summarization systems are thus needed, as subjective biases and mental limitations can be overcome with an objective sentiment analysis system. The issue of detecting opinion spam or fake reviews. Finally, we also introduce the research topic of assessing the utility or quality of online reviews.

# Conclusion

Sentimental or opinion analysis is a major research area which focus on the understanding and behavior of the society, it is also very important for business to understand the feedback and expectation from the users to improve the quality of product. In this paper explained the procedure to analyzing the opinion using different techniques, also gives insight on recent updates and innovation in sentimental analysis using recent ontology based machine learning approach explored better decision making.

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# Survey Paper On On-Line Handwritten Character Recognition Of Devnagri Script

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# Abstract

Today's the age of computer revolution and the mouse and keyboard have limitations as compared to input through natural handwriting. There are several devices available through which we can input data in our own handwriting for example pen sensitive writing pad.

Through natural handwriting we can communicate very easily. There are several system which have been developed for handwriting recognition for various character sets but very less efforts has been made to build an on-line handwriting recognition system for Indian languages by the automatic identification of handwritten scripts provides many important applications. This paper presents ananalysis of feature extraction methods and classifiers.

Keywords:HCR, feature extraction, character recognition, classification, Devnagri script,PDA.

# (I) Introduction

Character recognition is the process of identification of printed character from a handwritten notes or images or cheque or letters or medical reports. Both technology and process of OCR is electronic conversion of images of handwritten or printed text into a format which machine can understand, if we give a scanned documents.

Handwritten recognition(HWR) or Handwritten Character Recognition(HCR) is a technique in which a computer system can recognize character and other symbols written by hand in natural handwriting and input sources are paper documents, photographs, touch screen and other devices

The field of character recognition is divided into two parts

- 1) Offline character recognition
- 2) On-line character recognition

The process of reading handwritten text from the static surface is known as offline handwriting recognition. Offline handwritten recognition works on scanned images.

On-line character recognition involves the automatic conversion of text written a special digitizer or PDA, where a sensor picks up the movement of pen tip also pen up and down movement. These systems collect data during the process of input.

On-line character recognition is mostly used in communication devices such as smartphones, tablets or PDAs.

Handwriting is a skill that has been popular mean of communication and documentation over thousands of year. As it has a long history, it can be considered more natural easy and convenient way of entering data rather than other text entry methods or virtual keyboards. In such system user are allowed to use e-pen, stylus or figure tips which make it natural and convenient form to input data using various supported handheld devices.

#### (II) Hindi

Hindi is an Indo-Aryan language spoken mainly in India, and also in Nepal, Singapore and South Africa. There are about 615 million Hindi speakers over the globe, about half of whom are native speakers. According to report in 2011 there were 612 Hindi speakers in India, 1.3 million Hindi speakers in Nepal, 361,000 Hindi speakers in South Africa (in 2003), and 50,000 Hindi speakers in Singapore (in 2017).

Hindi is a major language of the world and is the official language of India. English is the second official language in India at the central level. It is a standardized form of Hindustani language in which Sanskrit and similar words in Sanskrit are more used and Arabic-Persian words are less. Hindi is constitutionally the official language of India and the most spoken and understood language of India. However, Hindi is not the national language of India, as no language was given such status in the Constitution of India. It is also the most spoken language in the world after Chinese. According to the calculations of the World Economic Forum, it is one of the ten powerful languages of the world.

Hindi, written in the Devanagari script, is one of official languages of the government of India - the other official language is English. Both languages are used in parliament, in the judiciary, in communications between the central government and state government, and for other official purposes.

Hindi first started to be used in writing during the 4th century AD. It was originally written with the Brahmi script but since the 11th century AD it has been written with the Devanāgarī alphabet.

# Devanāgarī alphabets for Hindi Vowels (स्वर) and vowel diacritics

अ	आ	হ	र्इ	ਤ	জ	ऋ	ए
а	ā	1	ī	u	ū	r,	е
[^]	[a]	[i]	[i:]	[u]	[u:]	[7]	[e]
क	का	कि	की	ক্তু	कू	कृ	के
ka	kā	ki	kī	ku	kü	kŗ	ke
<b>ਦੱ</b>	ऐ	ओ	ऑ	औ	अं	अः	ॲ
ê	ai	0	ô	au	ań	aḥ	āņ
[e]	[æ:]	[0]	[0]	[9:]	[aŋ]	[əh]	[ã:]
कॅ	कै	को	कॉ	कौ	कं	कः	काँ
kê	kai	ko	kô	kau	kań	kaḥ	kām

# Numerals

O sunya	S 1 ek	2 do	3 teen	8 4 char
S panch	6 che	Z saat	8 aaht	S 9 nau

	क	ख	ग	घ	ভ	च	छ	ড	झ	স
	ka	kha	ga	gha	ńa	ca	cha	ja	jha	ña
	[kə]	[kʰə]	[gə]	[g <sup>n</sup> ə]	[ŋ ə]	[tʃə]	[ʧʰə]	[႖ၖခ]	[අ <sub>u</sub> ១]	[ɲə]
	ਟ	ਠ	ਤ	ਫ	ण	ਰ	थ	ਵ	ध	न
	ţa	ţha	<b>da</b>	dha	ņa	ta	tha	da	dha	na
	[tə]	[tʰə]	[də]	[duə]	[ຖອ]	[tə]	[t <sup>h</sup> ə]	[də]	[dñə]	[nə]
	ਧ	फ	ब	મ	ਸ	ਧ	र	ल	ਕ	
	ра	pha	ba	bha	ma	ya	ra	la	va	
	[pə]	[pʰə]	[bə]	[bʰə]	[mə]	[jə]	[rə]	[lə]	[və]	
	হা	ষ	स	ह						
	śa	şa	sa	ha						
	[ʃə]	[şə]	[sə]	[ĥə]						
	Additic	onal cons	onants							
	क	ख़	रा	ज़	फ़	ड़	ਫ਼			
	qa	ђа	ġa	za	fa	ŗa	<u>rh</u> a			
	[qə]	[xə]	[Yə]	[zə]	[fə]	[tə]	[[ <sup>n</sup> ə]			
	Comm	on conju	nct con	sonants						
	ଝା	হা	त्क	ਫ਼	द्य	द्द	त्त	ভ	ন্দ	
	ksa	jña	ttka	dva	dya	dda	tta	ḍhḍha	dbha	
	द्म	ह्म	ह्य	প্র	র	र्प	ਸ	ਟ੍ਰ		
	dma	hma	hya	śra	tra	rpa	pra	tra		
C	ci,	-11								_
	UL	JIIn								
		11/								
			4/1							
				Y						

Consonants (व्यंजन)

# III Related Work

In recognition system reported by Keerthi Prasad, Imran Khan,NaveenRChanukothimath, Firoz Khan and Deepak D J, they used two different approaches namely DTW and PCAbased approach, compared DTW and PCA approach with both functional and non-functional requirements. The recognition rate of PCA based approach is 87.5% and Time taken for the same is0.8 sec. whereas recognition DTW approach is 68.7% and 51 sec respectively.

A paper presented by Anoop M. Namboodin and Anil K. Jain, they presented a script identification algorithm to recognize 6 major scripts in an on-line documents. In their work they did classification at word level, which allow to detect individual words of a particular script presented within the text. In this paper they reported classification accuracies are much higher than those reported in the case of script identification of offline handwritten documents.

A paper presented by Andreas Holzinger and Lamija Basic, BerhardPeisch, MatjazDebevc, their aim was to develop a system works with character recognition and uses calligraphic SDK, version 6.0 as recognition engine. They used Asus MyPad A626 PDA for prototype as Experimental device. They achieved the goal that is better recognition rate, especially the letters from user who mostly right cursive can recognize much better.

#### IV) Methodology



Fig 1: Process of Character recognition

On-line HCR system coverts users' handwritten data which is written on special devices such as digitizer or PDA into machine understandable text.

It includes following Phases, obtained output from one phase becomes input for the next phase.

1) Data Acquisition: In on-line Handwritten Character Recognition data is collected at the time of input. In this phase pen tip parameters like position, acceleration, velocity and sometimes pressure on writing surface are used for data acquisition.

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2) Preprocessing: The Process of reducing noise and other undesirable effects to improve the data is known as preprocessing.

During the input process if user touches the screen accidentally such as 'wild points' known as noise and in the pre-processing noise is reduced

Devnagri word is firstly smoothed using a median filter and then binarized by thresholding method. Preprocessing contains sequence of steps

- 1) Binarization 2) Normalisation 3) Sampling 4) Denoising 5) Thinning
- 3) Feature Extraction: This is the technique in which relevant information from input is extracted. The major challenge in this phase is extract minimal set of data with maximum data recognition.

Feature Extraction methods are based on 3 types of features

- i) Statistical
- ii) Structural
- iii) Global transformation

#### **Statistical Methods:**

Some of the important statistical feature used for character representation is

i) Zoning: A character is divided into several zones. We define these zones by dividing the size normalized image into nxm Zones.

Here we divide the character into 2x2 Zones.



Fig 2: 2x2 Zone of Hindi character 'A'.

- ii) Pixel Value Feature: In pixel value method the image of character is converted into black and white then the noise is removed, the hole filling operation is performed to obtain the uniform character.
- iii) Histogram based feature: Character can be represented by projecting the pixel gray value. This representation creates one dimensional signal from 2-d image, which can be used to represent the character image. Histogram values can be obtained by drawing the histogram of gray char image. We store the histogram count value into column matrix.
- 4) Classification and recognition: In this phase the goal is to find the optimal letter to a given sequence of input. The letter corresponding to the maximum probability is noted as recognized letter.
  - There are several types of classifiers

regression.

 i) Support Vector Machine: SVM is supervised learning tool which is used for classification and regression. The basic SVM takes the set of input data and predicts for each given input. A SVM Construct a hyper plane in a high dimension space which can be used for classification



Fig 3: Support Vector Machine

ii) Artificial Intelligence: ANN is widely accepted classifier for diverse pattern. It is inspired by the biological neural network structure and function. Data which passes through the network affect ANN structure, because Neural Network learns from its experiences and surroundings.

A neural network basically made up of nodes and neurons, these neurons are interconnected.

The basic unit of neural network is neuron, it consist of n number of inputs and each input is multiply by a connection weight w(n). The product of input and weight are summed and feed through an activation function to generate output. Architecture of NN is dependent on nature and complexity of applications. Multilayer NN with proper selection of parameter is capable to classify almost any pattern.



Fig 4: Artificial Neural Network

**Discussion:** 

Phase	Description	Approaches
Pre-Processing	To enhance quality of character	Binarization , Normalisation, Sampling, Denoising, Thinning
Feature Extraction	To extract feature or characteristics from an character	Statistical, Structural, Global transformation
Classification	To classify a character into its particular class.	Support Vector Machine, Artificial Neural Network

# V) Conclusion:

This paper gives brief introduction about phases of character recognition. It discuss feature extraction phase and gives overview of some statistical features. It discusses two types of classifiers SVM and ANN. All feature extraction techniques and classifiers have their capability and limitations, so they are used according to application.

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# A Study of Comparative Analysis of Machine Learning Classification and Clustering Techniques

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# Abstract

Web Text mining discusses to the practice of stemming high quality information from the text. Research and application of web text mining is an important branch of data mining. Mostly researchers using search engine, information retrieval and many outlier's detection techniques to search the knowledge based information. Web contains mostly structured data and unstructured datastructured data which is only 5% to 10% of whole data. Around 80% of data is Unstructured [1].At the time of functioning with unstructured data like text and multimedia contentsfirstlydata is to be converted to structured form which is actually required for further processing. This paper definesbestmachine learning techniques which are helpful in the analysis of text data from the web and performanceswith text pre-processing, classification and clustering. This paper shows the experimental results obtained from techniques and discuss the advantage and challenges. Also infers which machine learning technique is more relevant for processing the text data. Keywords— Classification, Text Mining, Extraction, Stemming, SVM, Naïve Bayes, Stopword Removal

# I) INTRODUCTION

It is viewed that text mining on Web is a crucial step in research and application of data mining. We are mainly using information retrieval, search engine for detection techniques to look up the resourceful and preferred Web information. There are mainly two forms of data on web Structured data and unstructured data. There are numerous procedures to handle structured data. The main problem on text mining on Web is handling unstructured data. Text classification model is contains three major modules i.e. pre-processing of unstructured data, learning of probabilistic model and the classification of unseen data by using learned model.

This study projected on first conversion of unstructured data into structured words which is required for text classification. This framework is trained and tested by using "Reviews" dataset containing different errors related questions about programming languages like java, css, ios, angularjs and many more. In this paper theexisting term weighting schemes namely TF-IDF used as feature selection process in filtering text and examine the performance of technique using datasets the orrectness of these term TF-IDF as the selection of features is measured according to the accuracy of the results obtained using the classification program known as Support Vector Machine (SVM).

#### **II) RELATED WORK**

DixaSaxena, et. al. in their study applied and discussed all the possible methods on supervised and unsupervised learning for feature extraction from the text datasetand then categorization with the help of traditional bag-of-words model approach to the unconventional neural networks also compared with the pros and cons of the methods applied.[1]

In this paper feature selection process in filtering website author used two existing term weighting schemes namely TF-IDF and Entropy. Their study observes the performance of both methodsapplying on datasets and compared with term weighting schemes. The correctness of these term weighting schemes as the selection features is measured according to the accuracy of the outcomesacquired using the classification technique known as Support Vector Machine (SVM). Author concluded that the performance of TF-IDF and Entropy on the basis of Accuracy. Results showed that TF-IDF performed better than Entropy. [2]

In this paper author used unlabeled samples of short text as dataset for their classification, in their study they combined the SVM and semi-supervised learning to learn and labelthe unlabeled collected samples in the short text and study the effect of both the trained classifier and general model. In this paper, proposed semi-supervised learning and SVM algorithm is compared with the KNN algorithm and concluded with the result that the proposed classifier classify a large number of short texts and mining the useful information from the short text. [3]

Author proposed the fake news detection with the help of hybrid classification model to improve accuracy of the fake news. The fake news detection procedure carried out in threeparts which are proprocessing, feature extraction and classification. The hybrid classification designed is the combination of the KNN and random forest. The performance of the proposed model is analyzed in terms of accuracy, precision and recall. According to the result obtained up to 8% overall results are better with the use of proposed hybrid model as compared with SVM. [4]

In this paper they analyze the sentiments for movie Review, Twitter and Gold dataset using optimized SVM. They made Comparison between Optimized Support Vector Machine towards Support Vector Machine and naïve bayes classifier also Modify hyper parameter value of RBF kernel SVM which gives better result as compared to Support Vector Machine and Naïve Bayes algorithm. Projected methodology has establishbest value for hyper parameter which classifies dataset with more accuracy than existing system. Also suggested that there are many function of SVM kernel exists with many hyper parameters which can be used to get the better performance. [5]

# III) PROPOSED METHODOLOGY

In the proposed experiment and for mining purpose "Reviews" dataset is used. The first process to carry out is the preprocessing of data which include stopword and stemming in the next step feature extraction is done using TF-IDF for getting the machine learning algorithms supported format from datasets containing arrangements of text and image. After feature extraction the dataset obtained is given as a input to the Classification Algorithms like SVM, Naïve Bayes. Here 60% of data is taken as training set and rest 40% for testing dataset. With the classifier the accuracy rate, precision and recall is calculated. Whole process of the proposed model is shown in Figure 1.



#### Naive Bayes:

**Based on Bayes' Theorem,** Naive Bayes classifiers are a collection of classification algorithms which is not an individual algorithm but a category of algorithms where all algorithms share a common principle, i.e. all pairs of features being classified is independent of each other. It is used only when the dimensionality of the inputs is high. The Bayesian Classifier is capable of computing the possible output based on the given input. In this method it is possible to add new raw data at runtime and have a better probabilistic classifier. Naive Bayes classifiers are among the most successful known algorithms for learning to classify text documents. [6]. *Support Vector Machine:* 

# Support Vector Machines are among one of the most robust and successful classification algorithms which is used for classification and regression analysis.SVM are **supervised learning models** helps to analyze the large amount of data to identify patterns from them. It is a latest classification method for both linear and nonlinear data and uses a nonlinear mapping to transform the original training data into a higher dimension. Among the new dimension, it searches for the linear optimal separating hyper plane (i.e., "decision boundary"). With an appropriate nonlinear mapping to an adequately high dimension, data from two classes can be partitioned by a hyper plane [7]. **SGD(Stochastic Gradient Descent)** is a very simple and efficient method to discriminative learning of linear classifiers.[8]

# IV) EXPERIMENTAL RESULT ANALYSIS

Performance of classifier is easily understood by the confusion Matrix. The confusion matrix have 4 different combinations of actual and predicted values as shown in Table 1.

Performance of classifier is easily understood by the confusion Matrix. The confusion matrix have 4 different combinations of actual and predicted values as shown in Table 1.

Actual

Values	Predicted Values				
		Negative Positive			
	Negative	TN	FN		
	Positive	FP	TP		
Cipli					

Table 1: Confusion Matrix

Most Common parameter for Performance Measure evaluation is Accuracy and it is calculated as the ratio of total number of properly projected reviews to the total number of reviews available in the dataset. The Accuracy is calculated as:

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

In the same manner precision, recall and F<sub>1</sub>Measure is calculated using the following formulae:

 $Precision = \frac{TP}{TP + FP}$  $Recall = \frac{TP}{TP + FN}$ 

 $F_1 = 2 \times \frac{precision \times recall}{precision + recall}$ 

Here the accuracy, precision, recall and F<sub>1</sub>-Measure of LinearSVM and Naïve Bayes Classification Algorithm implemented on "Reviews" dataset is shown in below Table 2.

Algorithm	Precision	Recall	F <sub>1</sub> - Score	Accuracy
Linear SVM	0.73	0.73	0.73	0.73
Naïve Bayes	0.70	0.65	0.65	0.65

Table 2: Results of Linear SVM and Naïve Bayes

From the above table SVM shows the highest accuracy of 0.73% whereas Naïve Bayes shows the lowest Accuracy of 0.65%. The graphical format of above result is shown in figure 2





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# V. CONCLUSION

In this paper analysis on the basis of precision, recall,  $F_1$ -score and accuracy is done for "Reviews" dataset with the help of SVM, Naïve Bayes classification Algorithm and compared. The comparison result shows that the Linear SVM classifier gives the better results as compared to Naïve ayes Classifier. Here in this study only comparison is done on the basis of precision, recall,  $F_1$ -score and accuracy. In future other classifiers like KNN, Multiclass SVM even hierarchical classifier can be trained and their results can be compared.

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# Feature Detection of EAR Images Using FAST and SURF Techniques

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# Abstract

Feature detection is a low-level image processing method.. That is, it is usually achieved as the first operation on an image, and explores every pixel to see if there is a feature present at that pixel. If this is part of a larger algorithm, then the algorithm will typically only explore the image in the region of the features. Once features have been detected, a local image reinforce around the feature can be extracted. Feature extraction take part a very important role in the area of image processing. Feature extraction goal is to extract useful properties from the data, which in computer vision corresponds to measuring values from input images. A feature is defined as a function of one or more measurements, specifying some quantifiable characteristics (i.e. color, texture, or shape) of the image or object. Before extracting features, numerous image preprocessing techniques will be applied on the sampled image like binarization, thresholding, resizing, normalization etc. After that, feature extraction techniques are applied to obtain features that will be convenient in classifying and recognition of images. Feature extraction techniques are assist in lots of image processing applications e.g. character recognition. As features determine the performance of an image, they display its place in terms of storage taken, efficiency in classification and obviously in time utilization also. Here in this paper, we are going to discuss Detect corners using FAST (Features from Accelerated Segment) algorithm and return corner Points and Detect SURF (Speeded-Up Robust Features) features and return SURF Points object feature detection techniques Hereby in this paper, we are going to refer feature detection methods in case of ear recognition application.

Keywords:detectFASTFeatures, detectSURFFeature, thresholding, binarization, feature extraction

# I. Introduction

Feature can refer to a definitive structure on the image. Feature detection in image processing integrate way for enumerating abstractions of image information and making local outcome at every image point whether there is an image feature of a given type at that point or not. An essential part of image registration is feature detection. The 2D feature points are mediated as corners. Corners account for imperative local features in images. The feature points in images which make gradients of more prominent values in both the dimensions are refer to be corners. A very fast variation in pixel values is seen in corners. Extraction of corners can reduce the processing of data, without loss of information in the image.

#### FAST (Features from Accelerated Segment) Algorithm

Corner is a generally used classic low-level feature described by the intersection of two edges that represents a variation in the gradient in the image. Over variations of viewpoint, corner detection normally obtains more stable features over changes of viewpoint than patch matching method. The FAST algorithm is an alternative to the Harris Corner Detection example. The FAST algorithm defines if a corner is present by testing a circular area around the potential center of the corner. The test detects a corner if anadjacentsection of pixels are either brighter than the center plus a threshold or darker than the center minus a threshold. Points = detectFASTFeatures (I)

Returns a corner Points object, points. The object contains information around the feature points detected in a 2-D grayscale input image, I. The detectFASTFeatures function uses the Features from Accelerated Segment Test (FAST) algorithm to discover Corner points object returned as a corner Points object. The object encompasses information about the feature points detected in the 2-D grayscale input image [4].

# SURF (Speeded-Up Robust Features) features Algorithm

Points = detectSURFFeatures (I) Returns a SURF Points object, points, containing information about SURF features detected in the 2-D gray scale input image I. The detectSURFFeatures function implements the Speeded-Up Robust Features (SURF) algorithm to find blob features SURF features, returned as a SURF Points object. This object contains information about SURF features detected in a gray scale image [5]. The following is the block diagram of feature detection technique.



Figure: 1 Block diagram of the proposed FAST/ SURF feature detection technique

The following steps are performing for feature detection.

- 1. Read an image.
- 2. Convert an input image into grayscale.
- 3. Normalize the given image.
- 4. Apply Gabor filter on given image.
- 5. Detect the features of an image using FAST/SURF feature detection technique.
- 6. It gives the feature vector as an output.

# **II. RELATED WORK**

PoojaGhosh et.al used feature detection algorithms, Harris, SURF (Speeded-Up Robust Features), FAST (Features from Accelerated Segment) and FREAK (Fast Retina Key point) feature detection algorithms are compared in terms of accuracy and time complexity for mosaicing of images correctly. First, these algorithms have been they applied on a single image and then, different set of images are tested for the comparison. It is concluded that the FREAK algorithm is superior to the rest of the feature detection algorithm in terms of accuracy and run time[1] Shimiao Li reviewed algorithms for feature detection, which is an vital step in achieving vision-based localization and mapping and present mathematical models of the algorithms one after another.[2] AnchalKumawat1, SuchetaPanda2 focus on a comparative analysis of BRISK, FAST and proposed algorithm in terms of time to detect feature points. In this paper they has taken five feature key points in every Remote-sensing images and also deals with feature detection using the above three algorithms. It can be observed from the results and tables that in case of hybrid feature detector, it takes less time to detect five feature points. [3]

#### **III. PROPOSED WORK**

In this work we implement FAST (Features from Accelerated Segment) Algorithm and SURF (Speeded-Up Robust Features) features Algorithm feature detection method on 10 persons ear images both right as well as left .Then we get statistical features (mean,min,max,standard Deviation) of an images. We get the following results on the images. The following shows the original images.



#### Figure: 2 original images



Figure: 3 Feature detected by FAST (Features from Accelerated Segment) Algorithm



Figure: 4 Feature detected by SURF (Speeded-Up Robust Features) Algorithm

Feature detection using FAST Feature detection

Person	Image	Mean	Standard Deviation	Min	5 Max
ayl	Right Ear	112.02	50.12	51	247
	Left Ear	98.65	42.31	51	242
2	Right Ear	102.57	45.92	51	247
	Left Ear	103.14	45.78	51	247
3	Right Ear	109.57	47.02	51	247
X	Left Ear	114.37	49.17	51	247
4	Right Ear	101.47	41.41	51	247
	Left Ear	// 2106.53	-63 43.77	51	247
5	Right Ear	112.28	47.78	51	247
	Left Ear	102.99	43.34	51	244
6	Right Ear	104.23	C44.48	51	250
	Left Ear	113.76	51.06	51	247
7	Right Ear	107.84	46.12	51	247
	Left Ear	105.15	41.64	51	247
8	Right Ear	105.28	42.9	51	247
Ũ	Left Ear	113.29	47.31	51	247
9	Right Ear	100.39	46.04	51	247
	Left Ear	102.86	45.75	51	247
10	Right Ear	104.66	41.64	51	242
	Left Ear	102.58	44.13	51	244

Feature detection usingSURF Feature detection

Person	Image	Mean	Standard Deviation	Min	Max
1	Right Ear	7.43E+03	8.39E+03	1.03E+03	5.72E+04
1	Left Ear	5.31E+03	5.62E+03	1.01E+03	3.35E+04
2	Right Ear	4.12E+03	4.62E+03	1.00E+03	3.19E+04

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	Left Ear	5.37E+03	6.54E+03	1.00E+03	5.44E+04
3	Right Ear	5.24E+03	6.02E+03	1.01E+03	4.05E+04
5	Left Ear	5.49E+03	6.39E+03	1.01E+03	5.68E+04
4	Right Ear	5.64E+03	5.53E+03	1.03E+03	5.68E+04
	Left Ear	5.11E+03	4.36E+03	1.01E+03	2.76E+04
5	Right Ear	5.49E+03	6.16E+03	1.02E+03	4.44E+04
	Left Ear	4.66E+03	5.80E+03	1.01E+03	3.85E+04
6	Right Ear	4.74E+03	6.53E+03	1.00E+03	4.28E+04
	Left Ear	4.16E+03	4.23E+03	1.01E+03	2.89E+04
7	Right Ear	7.64E+03	6.24E+03	1.01E+03	3.22E+04
	Left Ear	7.33E+03	7.34E+03	1.06E+03	5.22E+04
8	Right Ear	6.04E+03	5.79E+03	1.04E+03	3.41E+04
	Left Ear	7.87E+03	7.80E+03	1.05E+03	5.61E+04
		Inter	aiscipliz		
9	Right Ear	4.70E+03	5.43E+03	<u>1.00E</u> +03	3.62E+04
	Left Ear	5.35 <mark>E+03</mark>	6.47E+03	1.01E+03	5.03E+04
	x O.			P	
10	Right Ear	7.01E+03	6.06E+03	1.02E+03	3.39E+04
	Left Ear	6.40E+03	6.50E+03	1.02E+03	3.79E+04

#### **CONCLUSION AND FUTURE WORK**

This work implements FAST (Features from Accelerated Segment) Algorithm and SURF (Speeded-Up Robust Features) features detection Algorithm on EAR images and the outcome of this work gives the feature vector of an image. The extracted images can be used further for feature extraction using various techniques.

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# Web Mining: An Application of Data Mining

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#### Abstract-

The World Wide Web is the largest, popular and most widely used information source, which is increasing day by day. The information over the web is available in the form of web pages, the content of web pages may include texts, images, audios, videos, lists, charts, tables, hyperlinks etc. Web page structure, users' navigation on the web sites and server logs also provides useful information. To extract meaningful information from the web and discover knowledge, web mining techniques are used. Web mining uses data mining techniques to extract knowledge from web. This paper presents the study of web mining and its types.

Keywords-Web mining, Web Content Mining, Web Structure Mining, Web Usage Mining.

#### I. INTRODUCTION

The World Wide Web is the largest, popular and most widely used information source. It is much popular among users because it can easily accessible and searchable. The information over the internet is increasing day by day. The web is continuously growing as the new information is added over it every day. Because of the web, users not only allow to search needed information on the web, but also easily share the information and knowledge with others. The information available on the webis in the form of web pages. The contents of web pages may include texts, images, audios, videos, links, lists, charts, tables etc. Analyzing such data can helps to extract meaningful information from web.

The web has number of applications like e-commerce, communication, social networking, etc. Ecommerce is an important wayto performonline business; users can buy anything from large number of online stores. Users can search the needy items by selecting the appropriate options on e-commerce web sites. These selections or users navigation on these sites is an important data. Analyzing such data can help theonline stores to determine the choice, trend and demand of clients. That will not only helps these stores to decide the business strategies, user behaviour, services, campaigns, and predict future trends but also guides to provide more personalized content to particular visitors. The web also provides a handy way for users to communicate with each other through e-mail, and express the views through blogs and social sites. Analyzing and obtaining relevant information from large data available on web, which is not possible manually, for this automated extraction tools are required to extract targeted information.

Data mining is a method of discovering knowledge from huge centralized database calleddata warehouse, where the entire data is stored in a single huge database [1].

#### II. OVERVIEW OF WEB MINING

Basically data mining technique are employed in web mining. Web mining is the applications of data mining methods to find out pattern from the WWW.Web mining is also known as text mining. It is extended version of data mining. Data mining is works upon off-line data whereas web mining is works upon on-line data. It is helpful to extract the information, image, text, audio, video, documents and multimedia. Web mining are often viewed as the use of data mining techniques to automatically retrieve, extract and determine information for knowledge innovation from web documents and services [2].It is the method of using data mining techniques and algorithms to take out information from the web by extracting it from web documents, web content, hyperlinks and server logs, etc.The main objective of web mining is to look for useful patterns in web data by collecting and analyzing information.The basic initiative of web mining is to aid users or site owners in finding relatively useful information[3].



Fig.1: Subtasks of Web Mining

Web mining has various applications such that it helps to improve searching power of search engines and used to predict users behaviour. The four subtasks of web mining are shown in the Figure 1.

# III. WEB MINING CATEGORIES

Web mining can be broadly classified into three different types as shown in Fig. 2[4]:

- Web Content Mining (WCM)
- Web Structure Mining (WSM)
- Web Usage Mining (WUM)





# 1. Web Content Mining

Web Content Mining is the method of extractingvaluable information from the contents of web documents. Web content consists of different type of data such as text, image, video and audio [5].

Web content mining uses two approaches: Agent based approach and database approach [6,7]. The agent based approach looked for appropriate information and helps in organizing the searched information. There are three types of agents [8] intelligent search agents which automatically searches for information according to a particular query using domain characteristics and user profiles, information filtering, categorizing agent uses number of methods to filter data as per the predefine information, and personalized web agents learn user preferences and determine documents related to those user profiles [6,7]. The database approach aids in retrieving the semi-structured data from web documents. web content mining has the following approaches to extract data:

- 1 Unstructured text mining,
- 2 Structured mining,
- 3 Semi-structured text mining, and
- 4 Multimedia mining.[9]

There are various web content mining tools that helpfor downloading the crucial information. Some of them areweb Info Extractor, Mozenda, Screen-Scrapper, Rapid Miner, Web Content Extractor, Automation Anywhere v6.1[5].

# 2. Web Structure Mining

Web structure mining is a process to discover useful knowledge from the hyperlink of www. It analyzes the out-links and in-links of web pages. Generally it is used in ranking of web pages [4]. It basically discovers the relationships between web pages linked by link connection. Four steps are required to perform in web structure mining [10]. The first step is data collection, in which hyperlinks are collected from web pages associated with seed URLs from various servers. The second step is preprocessing, in which data cleaning, link validation, link identification etc is performed. The third step is knowledge discovery, in which various data mining techniques such as statistical explication, association, clustering, pattern analysis etc are applied for processing data. The forth step is knowledge analysis, in which irrelevant information is filtered and interesting patterns are find out [10]. Different algorithms are used in Web Structure Mining to rank the relevant pages, two well known algorithms are: PageRank algorithmand HITS [11].

# 3. Web Usage Mining

Web usage mining is required to process web data for guessing and recognizing accessed information. It is the type of web mining that helps in automatically finding out user access pattern [12].Web usage mining seeking to use the data produced by the users' session or behaviours. It mines the data which is drawn from the users' interactions with the web. The data used in the Web usage mining includes the data from the web server access logs, proxy server logs, browser logs, user profiles, user sessions, cookies, bookmark data, mouse clicks and navigations, and any other data [13].

Web Usage Mining applications are worked on data gathered from three key sources [15].

- (i) Web servers: This gathers huge information in their log files and the databases log files. These logs typicallyinclude basic information like the IP address of clients, the access time, web page requested, etc. [13]
- (ii) Proxy servers: Thiscollectsnavigation data at the proxy level is basically the similar as collecting data at the server level[15], and
- (iii) Web clients: Thistracks client side data by usingJava Script or java applets. This data avoid the problems of users' sessionidentification and provide detailed information about actual user behaviours [13].

There are various current web mining applications. Figure 3 shows fraction of web usage mining application [14].



Fig. 3: Web Usage Mining Applications

# **IV. CONCLUSION**

This paper deals with the study of web mining. Web mining is a powerful technique used to retrieve the online data from web.Web Content Mining is the process of extracting useful information from the multimedia contents of web documents. Web structure mining is a process to discover useful knowledge from the hyperlink of web and web usage mining is a process that discoversinformation from user access pattern, web server access logs, browser logs, user profiles, user sessions, cookies, etc.

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# A Survey On Web Mining Ideas and Usage

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#### Abstract

Web mining is the usage of data mining methods to repeatedly determine and extract material from web. Web mining helps to resolve the problem of determining how users are using a website. It includes mining logs or log analysis and acquire meaning full data from web logs. Web mining is the application of data mining methods to web data where at least one of structure otherwise usage data is used in the mining process. The current paper deal with primary conversation of web mining.

Keywords-Web, Mining.

#### **I** Introduction

Web mining is the application of data mining methods to extract knowledge from web data, including web z documents, hyperlinks between documents usage of web sites. The web is the interesting area of research. Its help to extract knowledge from web data. In which at least one of structure or usage data is used in the mining process. according to analysis target, web mining can divide into three different types.

#### **Ii Reasons For Web Mining**

In web area world wide web is act as a two side one is a user side and another one is an information provider. Both a side are face problems while dealing with the web data. So, Web Usage mining retrieve useful data. But there will be many copies of the same useful data available. So, Web usage mining makes use of SOM model cluster only the similar data and eliminate redundancy. Self-Organizing Map (SOM) is one of the unsupervised learning methods in the family of artificial neural network (ANN) and it's also used in web usage mining for getting similar data and avoid *redundancy*.

#### 1) User Problem

#### **Finding Relevant information**

- > Users browse or use the search service to find a relevant information from the web. We face two problems here.
- Low Precision: We get an irrelevant information from various search result.
- > Low Recall: We get a relevant information from the web, but the pages are not properly indexed.

# 2) The Information Providers Problem

- What do customers do?
- what do the customers want?
- > How effectively use the web data to market products and service to the customers?

#### **III WEB MINING**



Fig.1 Web mining classification

# **IV WEB MINING**

Web mining can be broadly divided into three distinct categories, according to that data to be mined.

#### A Web Content Mining

Web content mining is the process of mining valuable material from the content of the web documents. Content data is the gathering of truths a web page is intended to contain. It can deliver useful and stimulating designs about user needs and influence behaviour. Web content mining also recognized as text mining, is generally the second step in web data mining. Content mining is the scanning and minining, it consists of images, text, audio, video or structured records such as lists and tables, application of text mining to web content has been the most widely researched. Issues addressed in the text mining include topic discovery and tracking, extracting associated patterns, clustering of web documents and classification of web pages. Web content mining also distinguishes personnel home pages with other web pages. Research in web content mining includes resource discovery from the web, document categorization and clustering, and information extraction from web pages.

# **B** Web Structuring Mining

The structure of typical web graph consists of web pages as nodes, and hyperlinks as edges connecting related pages. Technically Web content mining mainly focus on the structure of inner document but web structure mining tries to discover the connection structure of the hyperlinks at the inter document level. Based on the topology of the hyperlinks and generate the information, such as the similarity and relationship between different web sites.

Web structure mining is the procedure of discovering structure information from the web. This can be further divided into two kinds based on the kind of structure information used.

# C Hyperlinks

A hyperlink is a structural unit that connects a location in the web page, either within the same web page or on a different web page.

A hyperlink that connects to a different part of the same page is called as intra-document hyperlink and the hyperlink that connects two different pages is called as inter document hyperlink.

Document structure in addition, within a web page can also be organised in tree structured format, based on various HTML and XML tags within the page.

Mining efforts here have focused on automatically extracting document object model (DOM) structures out of the document.

#### D Web Usage Mining

Web usage mining is the application of data mining techniques to discover interesting usage patterns from the web usage data in order understand and better serve the needs of web-based application origin of web users along with their browsing behaviour at a web site.

Web usage mining itself can be classified further depending on the kind of usage data considered: web server data user log is collected by the web server and typically include IP address, page reference and access time.

# V) WEB MINING BENIFICIALS AREAS:

Application of web mining is connected with the rapid growth of world wide web, web mining becomes a very hot and popular topic in web research area. Web mining it also plays an important role for E-Commerce and E-Service web site to understand their web sites and service are used and provide better service for both customers and users. Few applications are:

# A E-Learning

Web mining can be used for improving and enhancing the process of E-learning environments. Applications of web mining to e-learning are usually web usage based. Machine learning techniques and web usage mining enhance web-based learning environments.

# **B** Digital libraries

Digital libraries services provide precious information distribute all around world, eliminating the necessity to be physically present at different libraries in different parts of world.

#### **C E-Government**

Organisations that interact with the citizen of the country lead to better social services. The main characteristics of the e-government systems are related to the use of technology to deliver services electronically, focusing on the citizen needs by providing better information and enhanced service in the support of government. E-government system may provide customized services to citizen resulting in user satisfaction and quality of services and support in citizens decision making, which leads to social benefits.

#### **D** Electronic commerce

A main challenge of E- commerce is to understand visitors or customers' needs and to value orientations as such as possible.it can progress capacity of service for consumer and competitive advantages. **E E-Politics and E-Democracy** 

E-politics provides political information and politics on demands to the citizen improving political transparency and democracy. Election information, parties, members of parliament, members of local government on the web are part of e-politic services. Despite the importance of e-politics in democracy there is limited web mining methods to meet citizen needs.

#### F Security and Crime Investigation

Web mining techniques are also used for protection of user system or logging information against such cybercrimes as hacking, internet fraud, fraudulent websites, illegal online gambling, virus spreading, child pronograpy distribution and cyber terrorism. Clustering and classification techniques of web mining can reveal identies of cyber criminals whereas neural network, decision trees, genetic algorithm and support vector machines can be used to trace criminal patterns and network visualization on websites.

# **G Electronic Business**

Web mining techniques can support a web enabled electronic business to improve on marketing, customer support and sales operations.

#### **VI) CONCLUSION**

Web and web usage are continuing to grow, so too grows the opportunity to analyse web data and extract all manner of useful knowledge from it. In this paper briefly described the web mining and applications of web mining nearly areas of future research. It can also be used to provide fast and efficient services for business. It is projected that more applications of web mining will be established.

#### **FUTURE SCOPE**

Research actions on this topic have drawn heavily on methods developed in other disciplines such as Research activities on this topic have drawn heavily on techniques developed in other disciplines such as Information Retrieval (IR) and Natural Language Processing (NLP). While SRIVASTAVA, DESIKAN and KUMAR 401 there exists significant body of work in extracting knowledge from images in the field of Image Processing and computer vision, the application of these techniques to web content mining has been limited. In this paper, a study on Web mining has given with research point of view. Misperceptions regarding the usage of the term Web mining is elucidated and discussed briefly about web mining categories and various approaches. In this survey, we focus on representation issues, various techniques of web usage mining and web structure mining and information retrieval and extraction issues in web content mining, and connection between the web content mining and web structure mining. SN 2349-63

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#### Smart IOT Enabled Fuel Level Monitoring For Ambulances Using NodeMCU

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#### Abstract:

We all know the importance of fuel in our day-to-day life. The transport system mainly works on the fuel. In the hospitals, the one and only vehicle which is on highest priority is Ambulance. The fuel tank of Ambulance has certain fuel limit. The worst case will be the low fuel level or empty fuel tank in emergency conditions. There can be number of Ambulance vehicles in particular hospitals. The proper monitoring of the fuel levels is needed for each available Ambulance in the hospitals. The existing systems use costly and complex circuits and firmware. There is no proper authority monitoring available and hence the system lacks proper management. This paper presents a system that uses NodeMCU as a firmware and works on a IoT platform. The system has a ultrasonic sensor for level detection and a onspot buzzer for low fuel levels. The fuel levels of individual or more Ambulance can be monitored by a concerned hospital authority on a mobile app or website through IoT and hence system guarantees fuel management. Besides this, the proposed system is cost effective and requires less components.

Keywords: NodeMCU, Ultrasonic Sensor, IOT.

#### Introduction

Hospitals are considered as one of the important organization.We all are familiar with the services provided by the Ambulance in the hospitals. The life of a patient depends more on Ambulance if he or she is referred to another hospital.The fuel tank needs to be maintained regularly. The low level fuel alerts is needed for the concerned driver as well as concerned hospital.Continuous proper monitoring is needed so that the fuel tanks does not get empty in any situation.

The previously developed systems does not have proper fuel monitoring and on spot buzzer alert. The proposed system uses NodeMCU which acts as system on chip. The system is IOT based and the fuel level details can be viewed on a IOT platform or cloud by the hospital authority. The proposed IOT based system is expected to be more efficient and reliable than previously developed systems.

#### I. literature review

J.N Nandimathet al. [1] proposed the system of IoT based fuel monitoring for future vehicles. The system has a tracking unit and uses reed switch which works according to the principle of Hall Effect for sensing the amount of fuel filled in the vehicle. So as soon as agent starts filling petrol in your bike/car, the flow sensor is activated. The results can also be viewed on mobile phone. The system is not that much efficient..

Saurabh Choudharyet al. [2] presented a smart digital fuel indicator system. This project predominantly focuses about the sign of fuel level in bike tanks and predicting the user location by using latitude and longitude value which is send by GPS to the system. The system uses PIC microcontroller. The system is not IOT based and hence there will be no proper management when consider hospital scenario of Ambulance vehicle.

Pooja Kanase and Sneha Gaikwad[3] proposed an approach of smart hospitals using internet of things (IoT). The system usescombination of sensor technology and Internet of Things(IoT). The system has ATMEGA Atmel 328PU microcontroller. Using this system one can control switch of the electricity and monitor level of the saline bottle from distant position. The concept of smart hospital is proposed in this project. A. Albarbaret al. [4]proposed a diesel engine fuel injection monitoring system. The work firstly investigates diesel engine air-borne acoustic signals characteristics and the benefits of joint time–frequency domain analysis. Secondly, the air-borne acoustic signals in the vicinity of injector head were recorded using three microphones around the fuel injector and an independent component analysis (ICA) based scheme was developed to decompose these acoustic signals. The system is not IOT based and uses complex Wigner–Ville distribution (WVD) technique.

# **III. Block Diagram Of The System**



Block diagram consist of a NodeMCU as a heart of the system. NodeMCU is powered with the help of battery. The ultrasonic sensor and buzzer are connected to the system. The ultrasonic sensor is used for fuel level detection and indication. The IOT platform or cloud is used for real time fuel level data monitoring.

# **Fig.1.Block Diagram**

#### **IV. Working**

The system will be implanted somewhere inside the fuel tank near the lid. NodeMCU will act as a main controller. NodeMCU is a firmware which includes Wifi system on chip (SoC). NodeMCU will get a supply from the battery. The ultrasonic sensor and buzzer will be connected to the NodeMCU.

The system will be connected to a Wifi hotspot of the driver's mobile or a Wifi hotspot which will be fixed in the Ambulance. The ultrasonic sensor will continuously monitor the fuel level in the tank. If the level gets below the pre-decided threshold, the buzzer goes On at the spot as well as an alert message will be send to the hospital authority through IOT cloud. The concerned hospital authority will be able to view the complete details of the fuel level and can take necessary steps if emergency condition arises. Hence the fuel management can be carried out efficiently.

# The IOT platforms which can be generally used are :



Thingspeak

Blynk

The IOT platforms can be selected according to required representations and interface. The libraries used in particular platforms should be installed properly. The programming of the system can be done in Arduino IDE.

# V. Conclusion

The proposed system is less bulky and less costly. The system will be efficient and reliable in continuous fuel level monitoring. The fuel level will be properly manage with the help of discussed IOT concept. The circuit is simple. The system with such a simple circuit will contribute to Smart Hospitals as well.

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# Arduino UNO based Teaching Pendant 4 DOF Robotic Arm in less Jitter Environment of Servos

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### Abstract

The ability of human is limited so far as the physical strength is concerned. This robotic arm can surmount the problem of physical ability and also we can teach this robotic to carry out a specific task repeatedly with the control of "teach" and "play" buttons. The project uses Arduino UNO along with 4 Servo Motors, 4 wire wound variable resistors and a handful of other passive components.

We have painstakingly worked on fine tuning of this robotic arm. Number of different practical problems and possible solutions are explained with step-by-step procedure, experimental findings, equivalent components suggestions are systematically presented in this paper.

**Keywords:** Robotic arm, teaching pendant, Arduino UNO, servo motor, map() function, constrain() function, integer math, servo jitter, servo murmuring

#### Introduction

The project of teaching pendant 4 DOF robotic arm is divided into four parts: the arm containing servo motors, the potentiometers arm, Arduino UNO and "Teach-Play" module with indicator LEDs.

#### The Servo Arm

The servo arm consists of 4 servo motors. We have used simple servo motors <u>SG90 Tower Pro</u> for our module. There are 3 wooden strips of 80x15x1.5mm used to build the arm like structure. The structural idea of the arm will be clearer by observing the images below:



1. Vertical arm

2. Horizontal arm

3. Arm with gripper



Photo of completely assembled robotic arm

#### **Experimental Findings (Arm Assembly)**

The length of the wooden strips should not be more than the above specified values, otherwise it imbalances the servo arm and can't adjust the weight balance of the servos. The gripper strips are made up of Polyurethane material to provide flexibility in gripper action.

#### **Potentiometers Arm**

This is the controlling section of robotic arm. It consists of 5 wire wound potentiometers fitted next to the servo arm so that the servo arm can be controlled by moving potentiometer arm accordingly. There are 3 wooden strips of 80x15x1.5mm used to build the arm like structure, as shown below.



#### Experimental Findings (Potentiometer Arm Assembly)

If we use carbon type potentiometers, then we found lots of jittering in the servo motors. So we used wire wound potentiometers with quite successful results.

*Note:* As shown in right image, left terminal of each pot, in the potentiometer arm, is connected to –ve& right to +ve. This is very important point to note in order to get correct direction of motion of servo arm.

#### Arduino UNO

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P (Arduino Nano 3. x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one.

# Teach-Play module with indicator LEDs

This section consists of 2 pull-up resistors with 2 micro push-to-on switches. The 4 LEDs are used to indicate that particular action is recorded i.e. "taught" to the robotic arm. We can record maximum 4 actions in any sequence by pressing the "Teach" switch each time while maneuvering the servo arm with the help of pot arm.

# ADC Process in Arduino

The Arduino ADC or Analogue to Digital Converter takes an input voltage and converts it into a digital value. With the standard setup you can measure a voltage between 0V and 5V with a resolution of 4.9mV so you can get a lot of detail when measuring analogue voltages.

There are six pins on the Arduino Uno (shown below A0  $\sim$  A5) that can be selected for an ADC measurement; A multiplexor feeds one of the six analogue input pins into the ADC.Arduino Analog pin numbers for different Arduino devices.To read an analogue voltage from pin A4 you use the following function:

#### Analog Read(A4)

Setting of the multiplexor is done in that function for you automatically.


# Arduino ADC size

The Arduino ADC has a 10 bit converter, and that means there are 1024 distinct values that can be returned as a result from the ADC, since,

# pow(2,10) = 2^10 = 1024

Divide by 1023 or 1024?

There is always some confusion about whether to divide by 1024 or 1023 to get the voltage value for each bit.

However the ATMega328P datasheet gives the following formula, as stated in the data sheets.

# ADC= (Vin\*1024)/Vref

"0x000 represents analog ground, and 0x3FF represents the selected reference voltage minus one

LSB."

The reason that you will see the wrong equation on the web is so that the output "feels" right i.e.

1023\*(5/1023)=5.000. This is the wrong equation to use and means there is an offset added to all values.

# How the Arduino ADC works?

This ADC is known as a successive approximation ADC and requires several clock cycles to zoom in on the correct ADC output.

The ADC converter compares the input analogue voltage to a portion of Vref using a divide by two sequence. The sample and hold capacitor is charged to the input voltage and then the input disconnected so that the same voltage is measured throughout the conversion process.

It first checks whether the input voltage is higher or lower than half the Vref voltage, by using a DAC to generate half the reference voltage. The DAC voltage is the fed into a comparator.

The output of the DAC forms the high bit of the result (stored in a shift register). If the input voltage is higher then the bit is one, otherwise the bit zero.

If the input is lower than half Vref then control logic generates a DAC voltage that is 1/4 the reference voltage. The comparison is made again and this forms the next bit in the ADC output. The process continues until all the bits are collected.

# ADC Clock

For the Arduino the conversion process takes 13 cycles of the ADC clock - which you set using a prescaler in the ADC module. The ADC clock must be between 50kHz and 200kHz so you choose the prescaler value to get a valid ADC clock.

The ADC clock prescaler can be set as a 2n division from 2 to 128. You obviously want the fastest conversion rate for the clock in use so for a 16MHz system clock you would calculate 16e6/200e3 = 80 so the closest could be 64.

However 16e6/64 is 250kHz and is too big. Therefore choosing a divisor of 128 must be used so the ADC clock will be 16e6/128 = 125kHz. A conversion will take (check these settings are used in the Arduino Source code! - I have not - they are extremely likely though)

# Arduino Uno sampling rate (16MHz Crystal)

# 1.0/(13\*1.0/125e3)=9615Hz

Actually, reading the Arduino reference page it says the sample rate is about 10kHz so this calculation matches that information. So the maximum Arduino ADC sampling rate is:9.615kHz

# ADC clock calculations

If you set the system clock to 20MHz you get 20e6/128 = 156250.0 - for a bit faster conversion. Interestingly if you go the other way as a design decision you want the fastest ADC clock rate of 200kHz, then you have to ask the question. "What crystal clock results in a 200kHz rate after ADC prescaling?" i.e.

# Xtal = 200e3 \* prescale - trying 64 gives 12800000 or 12.8Mhz

# 12.8e6/64 = 200e3

So reducing the crystal clock allows a faster conversion rate of 200kHz!Giving a max sampling rate of: **1.0/(13\*1.0/200e3)=15384Hz** (*This is for the 12.8MHz XTAL*) and yes you can get crystals made to your spec! But you'll probably use a 12MHz crystal, as its easier to get, so the sample rate above will be a bit lower.

# Example operation of 4bit ADC

This is a diagram of the action or the successive approximation ADC using *Vref as 5V*. Here a 4 bit ADC is shown but the principle is the same however many bits are used.

# Arduino Uno ADC resolution

As we saw earlier the resolution of the ADC, when Vref=5V is 4.88mV per step. The ArduinoanalogRead resolution which is the same as the resolution of the ADC is governed by two things

1. The ADC size - 10bits for the Uno.

2. The ADC reference voltage.

**Note:** The Arduino function **analog Read Resoution**() allows the **analogRead**() function to return a different number of bits.

Some of the Arduino e.g. DUE have 12 bit ADCs built in, so returning 10bits will keep the code in these boards compatible with other Arduino boards that only have a 10 bit ADC. This is the default operation - to get 12 bits you will need to use **analog Read Resoution(12)**.

### ADC bits

Using an ADC with more bits makes the minimum step size (LSB) smaller to give higher resolution. The Arduino Uno is fixed at 10 bits.

## **ADC Reference voltage**

The other way to affect the Arduino ADC resolution is to use a different reference voltage. The reference voltage is the full-scale voltage applied to the ADC converter operating as described above.Say you changed the Vref value to 1V then the minimum LSB you could detect would be 1/1024 or0.976mV.

TIP:You can select the internal 1.1V reference and this will give a step size of about 0.1V: Exact calculation is 1.1/1024 = 0.00107V ~0.11mV per step. This does mean the ADC can't read voltages above 1.1V - they will just return 1024.

## The Code

The code of this project is fairly simple given on our github profile at following link. It is necessary that the map function must be properly handled in this code. We tried following different combinations:

# void loop()

```
{
pot1Val = analogRead(pot1);
pot1Angle = map(pot1Val, 0, 1023, 0, 179);
```

```
pot2Val = analogRead(pot2);
pot2Angle = map(pot2Val, 0, 1023, 0, 179);
```

```
pot3Val = analogRead(pot3);
pot3Angle = map(pot3Val, 0, 1023, 0, 179);
```

```
pot4Val = analogRead(pot4);
pot4Angle = map(pot4Val, 0, 1023, 0, 179);
```

But it found that with this mapping the jitter in the servos is more. So we modified the values as follows and got very stable results. The jitter in servos is reduced by more than 80% with this modification. **pot1Angle = map(pot1Val, 0, 512, 0, 179)**;

The code is given on github profile at this link: <u>https://gist.github.com/dsvakola/c096cc9a11abcef74ec1d901e9d1b3dd</u>



disciplinar Successfully tested final assembly of the project

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# **Consideration Of Some Electrical And Physical Properties Of Electrode Materials**

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### Abstract:

In order to work with any electronic or electrical circuits, the brief study of conductors, semiconductors and electrodes is an essential part. Depending upon the basic contents and the properties of the materials, they are used particularly for positive or negative electrodes. An electrode terminal is an electrical conductor used to make the contacts with the metallic or nonmetallic part of the circuit or the system. Whereas, the cell is a proper arrangement and combinations of different electrodes in order to get the desired value of output quantity. Electrodesand cells consist of high-conductivity and more reactive materials for reduction-oxidation (red-ox) chemical reactions. It is considered that the electrode materials should have low cost, easily available, long term connectivity and corrosion resistance properties with respect to the sap flow and other chemicals present within the plants. Also the electrode materials to be used should have ability to prepare wires, plates, blocks and electrodes of various sizes and shapes.

Throughout these research papers, after designing proper electrodes and cells of particular materials, its response has been tested in different ambient conditions. Various electrical and physical properties of the electrode materials has been studied and analyzed for further study. We have design and utilized these electrodes for the measurements of the comparative potential differences developed in various plants and trees.

*Keywords:* Electrodes, redox reaction, corrosion resistance, specific resistance, thermal conductivity.

### Important Properties Of Electrode Materials:

Electrodes and cells plays very prominent role in case of electronic circuits and various systems. Few important properties of electrode and cell materials are conductivity, corrosion resistance, malleability, current capability, chemical reactivity, availability of material and its cost factor. Many of these properties are determined by inherent characteristics of the material. Few important properties are explained as follows:

i) Conductivity: Conductivity is the measure of a materials ability to carry or conduct an electric current. Mostly, it is given as the percent of the standard copper, which is 100 % IACS (International Annealed Copper Standard). Silver metal has an IACS percentage of 105 % and has highest conductivity of all.

ii) Corrosion resistance: Corrosion resistance is the materials ability to oppose chemical decay. The material which has little corrosion resistance will degrade speedily in corrosive environments and result in a shorter lifespan. Normally, most of Platinum group metals are recognized for their high resistance to corrosion.

iii) Malleability: Malleability is the degree of softness of the material by which it can be easily converted into wires, sheets or any other desired shapes.

iv)Current capability:Current capability is the capacity of the material to carry the electric current without damaging the wire or conductor. Electrode material of higher current carrying capability is preferred over others.

v) Hardness: Hardness of the material is the measure of how resistant the material is to various kinds of permanent deformations resulting from an applied external force. Hardness property is dependent on ductility, elasticity, plasticity, tensile strength, and toughness of the material.

vi) Shape:Shape refers to the form, wherein an electrical material must fit in order to carry out its operation. Size relates to the thickness, length, and width or outer diameter of the form a material takes. Typically it is measured in terms of particular area. Material should be able to take any desired shape of the electrode.

**vii**) **Chemical reactivity:**Chemical reactivity of the material electrode is one of the prominent characteristics. It should be able to take active part in reduction and oxidation (red-ox) reactions effectively.

**viii**) Low cost and availability of material: Easy availability of the electrode material is also helpful to reduce the overall cost of the system. Therefore, low cost and easy availability of the electrode material are also important parameters for the betterment of the setup or system.

By considering these parameters, we have the materials like Copper, Aluminum, Zinc, Platinum, Iron, Silver, Gold, Carbon, Iron, Magnesium and Stainless Steel to design and developed the electrodes and cells of

various sizes and shapes. Most of them are locally prepared by us in our laboratory, few by the goldsmith and very few are ready made. The anode terminal is defined as the electrode at which electrons leave the cell and oxidation process takes place, whereas the cathode is the electrode at which electrons enter the cell and reduction process takes place. Any electrode in the system may become either an anode or the cathode depending on the direction of actual current through the circuit.

#### Materials used to prepare electrodes and cells:

Amongst various types of electrode materials, we have used some of the most prominent materials and alloys, which are mentioned as copper, zinc, gold, silver, aluminum, platinum, iron, magnesium, brass, stainless steel and carbon. The brief information about physical, chemical and electrical properties of these materials are given as below.

**i)** Silver: Silveris a chemical element with symbol Ag (Latin: Argentum), and having atomic number 47. It has the highest conductivity of all metals. The high electrical conductivity, softness, and high resistance to oxidation process make silver an excellent choice for contact materials.

**ii**) **Copper:**Copper is a natural chemical element with symbol Cu (Latin: Cuprum), and having atomic number 29. It is on second high rank after silver in terms of bulk electrical conductivity. Copper has better strength than silver, but it offers inferior oxidation resistance.

**iii**) **Gold:**Gold is also a chemical element with symbol Au (Latin: Aurum), and having atomic number 79. In its purest form, it is a bright, slightly reddish yellow in colour, dense, soft, malleable and ductile material. It is solid under standard conditions and is one of the least reactive chemical elements. It is one of the higher atomic number elements that occur naturally in the universe.

iv) Zinc:Zinc is a chemical element with atomic number equal to 30 and symbol Zn. In some manners zinc is chemically similar to magnesium. Zinc is the 24th most abundant element in Earth's crust and has five different isotopes. This metal is hard and brittle at normal temperature and becomes malleable between the range of 100 and 150 °C.

**v) Platinum:**Platinum is a chemical element with symbol Pt and atomic number 78. It is highly unreactive, highly dense, malleable, more ductile, most precious, and gray-white coloured metal. Because of its lack in Earth's crust, it is highly valuable and is the most precious metal commodity in the world. This metal is the least reactive, precious, remarkable resistance to corrosion, even at high temperatures, and therefore considered a noble metal.

vi) Aluminum: Aluminum is a chemical element with symbol Al, appeared in the boron group whose atomic number is 13. It is a silver-white in colour, soft, nonmagnetic, and highly ductile metal. Aluminum element is the third most abundant material and more chemically reactive. Aluminum metal is having low density and the phenomenon of passivation can increase its ability to resist corrosion.

vii) Iron:Iron is a chemical element with symbol Fe (Latin: Ferrum) and an atomic number 26. By mass it is the most abundant element on Earth, including its inner and outer core. It is the fourth most common element in the Earth's crust. The iron material is significantly hardened and strengthened by impurities, particular with carbon using the smelting process. Steel is produced from iron with certain proportion of carbon, which may be up to 1000 times harder than pure iron.

viii) Carbon:Carbon (Latin: Carbo) is a chemical element with symbol C and an atomic number as 6. Carbon is nonmetallic and tetravalent element, which make four outer electrons available to form covalent chemical bonds with neighbors.

ix) Magnesium: Magnesium is a chemical element with symbol Mg and atomic number as 12. It is a shiny and graywhite solid. Magnesium element is the ninth most abundant element on the earth. It is produced in large extent, when the aging stars explode as supernova.

**x)** Stainless steel: The word 'Stainless' was adopted as a standard name for cutlery applications steel and now it covered a wide range of steel types and grades for corrosion or oxidation resistant applications. Basically, the stainless steels are iron alloys with a minimum of 10.5 % chromium contents. Also other alloying elements can add to enhance their structure and other properties such as formability, strength and cryogenic toughness.

#### **Electrical And Physical Properties Of Metal Electrodes:**

Some important electrical and physical properties of metals and other conductive materials used for construction of electrode areelectrical conductivity, thermal conductivity, electrical resistivity, material density and its melting point or degradation point. Electrical conductivity and resistivity are important characteristics of the metal electrode, which are material and geometry dependent parameters.

Electrical resistance, R is given as:

- $R = \rho l/a = l/\sigma a$ where, l - is length
  - a is area of cross section  $\rho$  is specific resistance and
  - $\sigma$  is conductivity of the material

For metal electrodes, electrical conductivity increases by reducing deformation, reducing imperfections and by decreasing ambient temperature.

The electrical characteristics of the metal bio-potential electrodes are generally nonlinear and a function of the current density at their surface. The device represented by such a way requires that they are operated at low potentials and currents. Under these idealized conditions, electrodes can be represented by an equivalent circuit of the form shown in following figure (1).



Figure (1): An equivalent circuit for bio-potential electrode

In this circuit, Rd and Cd represents the impedance associated with the electrode interface and polarization at this interface. Resistance Rsis series resistance associated with interfacial effects and electrode material itself. Battery  $E_{hc}$  represents the half-cell potential regarding the materials used.

Electrical conductivity of the material is the opposite of the electrical resistivity. Conductivity corresponds to the conductance of a material of 1 meter length and 1m<sup>2</sup> cross sections. The electrical conductance is also the opposite of the resistivity of the material and its unit is taken as Siemens/meter.

Some other important electrical and physical properties of metals and other conductive materials discussed here are electrical conductivity, thermal conductivity, electrical resistivity, material density and its melting point. These properties are briefly summarized in following table (1).

S. N.	Electrode material	Electrical conductivity ( x10 <sup>6</sup> Simens/m)	Electrical resistivity ( x 10 <sup>-8</sup> Ohm-m)	Thermal conductivity (W/m-k)	Density (g/cm <sup>3</sup> )	Melting point (°C)
1)	Silver	62.1	1.6	420	10.5	961
2)	Copper	58.5	1.7	401	8.9	1083
3)	Gold	44.2	2.3	317	19.4	1064
4)	Aluminum	36.9	2.7	237	2.7	660
5)	Zinc	16.6	6.0	116	7.1	419
6)	Carbon 📏	5.9	26.949-6	129	1.8	2500
7)	Iron	10.1	9.9	80	7.9	1528
8)	Platinum	9.3	10.8	107	21.4	1772
9)	Sta. Steel	1.32	.76.0	1 (15)	7.9	1535
10)	Magnesium	2.30	4.39	156	1.74	650

Table (1): Important electrical and physical properties of electrode materials

The electrical characteristics of electrodes are affected by many other physical parameters of the electrodes. Following Table (2) showsfew common physical parameters of electrodes and comparatively indicates how these can affect electrode impedance.

Table (2): Effect of few physical parameters on electrode impedance

S. N.	Physical parameters of electrode	Relative change in parameters	Relative change in Electrode Impedance
1)	Surface area	↑ (	Ļ
2)	Polarization	↑ (	1
3)	Surface roughness	↑ (	$\downarrow$
4)	Radius of curvature	1	Ļ
5)	Surface contamination	↑ (	↑ (

In the giventable, upward arrow indicates incremental whereas downward arrow indicates decremented value.

#### **Conclusion:**

Electrodes and cells of different materials have been designed and developed using various size and shapes. With the help of these electrodes and cells, response of various plants for different type of circuit combinations has been studied. Also, the response of various plants and trees has been studied and analyzed, for the electrodes of different sizes and shapes. These results are well utilized by the researchers, for the measurements of the comparative potential differences developed in various plants and trees.

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# Use Of Technology (Screencast-O-Matic Screen Recorder) In Teaching & Learning Curriculum At +2Level

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### Abstract

In today's era of Information Communication Technology (ICT) it has become essential for teachers as well as students to make use of readily & easily available technology to enhance teaching and learning process. Also it has become a part of life to inculcate good manners and healthy ethical culture. Students need to become familiar with the proper use of technologies available to them.

Technology assisted learning can be viewed as computer assisted learning, and as pedagogy for studentcentered and collaborative learning. Early developments in this focused-on computer assisted learning, where part or all the learning content is delivered digitally. More recently the pedagogical dimension of learning has become prominent. Technological revolution supports all forms of electronically supported learning and teaching. The information and communication systems, whether networked learning or not, serve as specific media to implement the learning process.

Being a teacher, my aim is to always encourage students and other colleague teachers to make optimum use of PC machine which one has purchased and full functionality of the software available with that machine.

Present student generation is a "Digital Generation". Technology and related tools are available to preschoolers immediately and without any struggle. So teachers teaching to this generation needs also to be an expert in using and applying this available technology to the present model of teaching curriculum.

The present paper describes various ideas and experiments which are implemented and being practiced in Fergusson College, Pune

Keywords: Virtual laboratory, open source learning material, Screen-O-Matic for learning, Teachers Aid, Energy Booster for a Teacher

## Introduction

According to my experience of about 20 years in teaching field, I found that the use of computer in education is limited. One can afford to buy a latest PC but after that forget to make an optimum use of that machine. Also many times the powers of the software installed with the PC are also underutilized or many times not used at all.

Many of us buy a fully functional laptop PC, but fails to utilize it completely, to its fullest capability. Also there happens to be a need for the student to get the teaching material from the teacher if he/she has missed a lecture.

Keeping this need in mind me and my student Yash, developed an idea of explaining the topics to the students through a series of video lectures. In these, the idea is to keep the length of the videos restricted up to 7 to 8 minutes maximum. So that we can easily share these videos with the students using their WhatsApp groups. Present paper narrates the experiments which we have conducted and are conducting for our Junior college students of Vocational Electronic Science. A fully functional laptop is the only requirement.

## **System Requirements**

A fully functional laptop PC of any make will be enough for this experiment. A quiet room is required for the audio recording. A free screen recording software is needed to be installed on the laptop. There are many free screen recording software are available. But here we are using **Screencast-O-Matic** screen recorder software which is available for free download and can be downloaded from <u>www.screencast-o-matic.com</u> web site.

## About Screencast-O-Matic

Screencast-O-Matic is a screen capture and video service, taking visual collaboration to the next level. It allows individuals, learning institutions and the companies to create video solutions for the learning and collaboration. **Screencast-O-Matic** is a privately held company headquartered in Seattle, WA.

### How To Use Screencast-O-Matic

**Screencast-O-Matic** free screen recorder is used by millions around the world, from educators to businesses to bloggers. There are numerous ways one can use a screen recorder. You can record how-to videos, tutorials, product demos and more! There's so much one can do with *Screencast-O-Matic* free screen recorder.

- 1. Launch the website <u>www.screencast-o-matic.com</u>
- 2. Click on 'Start recording for free'
- 3. You'll be taken to the Screen Recorder page. Click on 'Launch Screen Recorder'
- 4. A pop-up will appear indicating that the recorder is being launched. If it doesn't appear, you have the option to download the recorder.
- 5. Within seconds, you'll notice the recorder on your screen, and you can start recording.

### **Recorder Basic Controls**

There are several options to choose from when recording our own video. Let's learn about the controls so that one can see how much one can do with his/her own recording. There are three options while recording our own video. One can find these options on the top of the recorder box.

- 1. Screen: This allows us to record anything within our recording frame.
- 2. Webcam: One can record using our webcam.
- 3. **Both:** This option allows us to show our webcam AND our computer screen at the same time. This can be used when we want to point out something on our screen but still have our webcam up.

### Max Time

The maximum time to record is 15 minutes. With an upgrade, one can record for as long as one want.

# Size

We can adjust our recording frame with pre-set sizes (480p, 720p, Active Window or Full Screen) or one can adjust it by dragging the corners and sides of the frame.

#### Narration

The app will detect audio sources connected to our computer.

#### **Computer Audio**

The free recorder will only capture narration. To capture computer audio requires an upgrade to Deluxe plan.

#### **Advanced Recording Techniques**

Trim, Upload and Publish

Once we finished recording, there are several options one can use in our recording manager.

#### Trim

One can trim the beginning or end of our video by dragging the bars of our video.

#### Captions

We can add our own captions to our videos during the publish process. By clicking on CC, one can choose to add our own captions by uploading a captions file. As par the plan of an upgrade, one can use speech-to-text or type in our own using 'blank captions.'

#### **Upload Options**

There are a few upload/publish options one can use in the free screen recorder.

#### Save As A Video File

One can save our recording as a video file. One can choose either an mp4, avi or flv video file. One can save our recording in a folder on our computer or laptop. Fill out the filename and hit Publish.

## **Upload To Screencast-O-Matic**

One can upload and get a link to share your recording. To do this, you'll need to sign up for an account or connect your existing one.

### Share On Youtube

If you haven't linked your account, all you need to do is click on 'launch web browser' and follow the steps. Once that's all done, fill in the information and it will upload directly to your YouTube account.

#### **Upgrade For More Uploading Options**

By clicking on the '+' button on top of your menu, you can publish to other sites including Vimeo, Google Drive, and Dropbox. There are numerous ways to create a video just by doing a screen recording.

#### The Experiment

In our experiment, we selected topics from the FYJC Vocational Electronics (C2) course. Referring to the prescribed textbook, we took the circuit diagram and then started recording our narration on it, using the **Screencast-O-Matic** recorder. Then we saved this recording as a video file on our laptop PC. Then uploaded this recorded video (not more than 7 to 8 minutes) to our Google drive.

Then we shared this link with our student's through their WhatsApp group and ask students to study it carefully and ask their doubts on it. Then in the regular class, we cleared their doubts, and took a small test on this shared video in the form of a quiz to check the grasping and understanding of the student about the topic.

#### Results

The results and the response of students to this activity was amazing. This innovative technique was found excellent, motivating, encouraging students towards the study of the subject and helpful to inculcate the erg for new learning idea into the students. This idea and experiment was also demonstrated to our college teachers and authorities and they also appreciated the success of it. There happens to be an increase in the presence of the students in the college classroom sessions.

#### Conclusion

The Project is very easy to handle and too simple to experiment with. Technical expertise is not essential to understand the working. This Project was demonstrated to the group of teachers. The teachers found this highly useful for classroom teaching as well as learning the basic concepts in the subject. This Project can be demonstrated in the classroom with the projector presentation. This can also be used by individual students to study the preliminary subject concepts virtually.

These tools were demonstrated to teachers and students. This idea helps teachers to make subject more illustrative and interesting. It has been proved to be an excellent teaching & evaluation aid for innovative classroom teaching. It has also been accepted by all teachers as this tool saves their energy and allows more time to concentrate on the progress of the students. The classroom attendance of students has also been boosted by 40% due to application of this tool. This idea can be used as a learning material for open source learning and distance learning.

#### **Future Scope & Development**

This project can further be modified with verbal instructions and with addition of some exercises based on the concepts learned by the students through this project. Also, True /False type questions, fill in the blank type questions, Multiple choice with single / multiple correct answer questions can be designed and student's knowledge acquired can be judged. This idea can further be extended to any subject and any topic.

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# "Excel-Lent" Technological Tool for Enhancement of Quality Learning In "Analog Electronics and Physics" For Network Analysis

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#### Abstract

Present student generation is a "Digital Generation". Technology and related tools are available to preschoolers immediately and without any struggle. So teachers teaching to this generation needs also to be an expert in using and applying this available technology to the present model of teaching curriculum. This paper presents an idea of how one can develop teaching & learning aids useful for teachers as well as students of "Analog Electronics & Physics" with the help of readily and most commonly available software on PCs.

One must use the available technology to its full extent & with its complete functionality. As an example, here we are illustrating the use of EXCEL to learn Network Analysis. This includes verification of Ohm's law, Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL), Maximum Power Transfer Theorem, Thevenin's and Norton's Theorems. Laws of Resistances and Capacitances in Series and Parallel can also be studied and easily verified using this tool.

The extensive use of various functions available in various categories in EXCEL is made to obtain these results. A simple menu driven interface has been designed using hyperlinks. This was demonstrated to teachers and students studying Electronics and Physics at +2 levels & above studying in Science stream. This has been proved to be an excellent teaching aid for innovative class room teaching.

This idea can be used as a learning material for open source learning and distance learning. This tool also can be used to generate a bank of variety of questions and their model answers related to the topic of Network analysis. This is the sequel of my earlier paper titled "EXCEL DIGI LAB" published in IEEE March, 2012 issue.

**Keywords :** Virtual Laboratory, Open source learning material, Effective tool for class room teaching, Analog Electronics, Network Analysis, KVL, KCL, Ohm's law, Functions in EXCEL, Using EXCEL for learning.

## Introduction

According to our experience of about 24 years in teaching field, we found that the use of computer in education is limited. One can afford to buy a latest PC but after that forget to make an optimum use of that machine. Also many times the powers of the software installed with the PC are also underutilized or many times not used at all.

MICROSOFT's EXCEL is one of such software which is learnt just for the sake of data entry, or plotting graphs or creating data base and that's all. Present student generation is a "Digital Generation". Technology and related tools are available to preschoolers immediately and without any struggle. So teachers teaching to this generation needs also to be an expert in using and applying this available technology to the present model of teaching curriculum.

So an idea came to my mind to develop teaching & learning aids useful for teachers as well as students of "Analog Electronics & Physics" with the help of readily and most commonly available software on PCs.. Many of the topics Analog Electronics are such that they have a specific relationship between input and output or if not at least the outputs follow a particular sequence with respect to time. So with the help of EXCEL it is very easy to make a teaching aid. Hence here is an attempt to illustrate the use of EXCEL to learn & teach Network Analysis one of the important and tricky topics in Analog Electronics and Physics. The project known as "EXCEL-LENT" Technological tool for the study of Network Analysis.

#### **System Requirements**

Though here we have used Microsoft Office 2007, but really speaking this project can run in any version of office. The functions/commands or techniques used in this project are as follows. (1) Logical

functions available in EXCEL viz. AND, OR, NOT (2) IF function (3) Conditional Formatting of cells (4) Data validation for cells (5) Insertion of Image (6) Hyper linking the cell contents to a particular worksheet sheet in a single workbook (7) Renaming a worksheet (8) Format painter tool to keep uniformity in the complete project through various worksheets (9) Nesting of IF functions along with all the logical functions (10) Protection of worksheets and protection of cells so that the choice is given for the user to select only a few cells and then depending upon the choice of the user the outputs are to be calculated. (11) Uses of smart graphics and their alignments, formatting etc.

### Verification of Ohm's law, Kirchhoff's Laws (KVL & KCL)

Here one has to begin with INDEX. A separate worksheet named index has been created which lists about 10 topics in a single column. In next column, in front of each topic there is a hyperlink associated with the words "show me" which leads the user to the respective topic. (Refer to Figure 1) We have started by defining Ohm's law along with its verification for different resistor values. For each of the resistor, though all possible combinations are listed out, the user can change the inputs and verify the corresponding outputs for each of the resistors and can compare them. All the outputs are derived with the help of formulas. Refer to Figure 3.

### Verification of Kirchhoff's Laws (KVL & KCL)

We have started by defining KCL & KVL. Some simple circuits for verification of these laws have been taken for example here. For each of these circuits, the user can change the inputs and verify the corresponding outputs for each of each circuit and can compare them. All the outputs are derived with the help of formulas

## Verification of Maximum Power Transfer Theorem

Now, after learning basic laws in Network analysis, one of the important theorems in Network Analysis, viz. Maximum PowerTransfer Theorem is to be verified. For this purpose a simple circuit consisting of two resistors, one DC source and one ammeter has been taken in to consideration. The circuit has been drawn with the help of "Circuit Maker 5" software and then it is converted into a .jpeg image with the help of "PAINT" accessory software available freely with windows.

The user has to select the input resistor values by clicking on it, and then choose the value of the input as per their wish. The corresponding output (i.e. Current taken by the circuit and power delivered to the load resistor) is then calculated and displayed next to the output of the circuit.

The output cell is applied conditional formatting. So that the background filling of the cell changes as per the value of the output. (Green for maximum power (when Ri = RL) and Red otherwise).

After learning the basic theorems in Network analysis, now it's time to learn, Thevenin's and Norton's theorems used to simplify various DC circuits consisting of combination of resistors. Once again, user has to select values to the input resistors by clicking on the input cells and inserting the proper value of the input resistor.

The corresponding final outputs and intermediate outputs can then be observed in the respective cells. All the output cells have been given conditional formatting. They change colours as per the value of the output. (Red for zero and Green otherwise) Refer to Figure 4 and Figure 5.

#### Laws of Resistances in Series and Parallel

Now, there is a time to study how resistors change their effective or equivalent or total value when they are connected in series combination or in parallel combination or in a series-parallel combination. Some sample circuits have been chosen as an illustration as there can be infinite number of combinations, which can exist. After selecting the values of individual resistors, their total or equivalent or effective value is calculated and shown as an output. Refer to Figure 6.

#### Laws of Capacitances in Series and Parallel

Now, there is a time to study how capacitors change their effective or equivalent or total value when they are connected in series combination or in parallel combination or in a series-parallel combination. Some sample circuits have been chosen as an illustration as there can be infinite number of combinations, which can exist. After selecting the values of individual capacitors, their total or equivalent or effective value is calculated and shown as an output.

# Conversion of T to $\pi \& \pi$ to T network of Resistances

Another important conversion in Network analysis is conversion of T to  $\pi$  network and  $\pi$  to T network of resistors. Two illustrations have been taken into consideration here. Though, there is no limit for this exercise. One can extend this to each and every situation. Actual calculations of each conversion seem to be very complicated and time consuming for students as well as to the teachers setting new questions in the question paper and also writing the model answers of these questions. This tool provides an easy and effective way of setting various examples and their answers for quick understanding of the topic for teachers as well as for students.

# **Results and Conclusion**

Outputs of all the circuits have beentasted according to their true (expected) results. The Project is very easy to handle and too simple to experiment with. Technical expertise is not essential to understand the working. The outputs displayed for various circuits are shown in figures1 to6. This Project was demonstrated to the group of teachers. Teachers found this highly useful for class room teaching as well as learning the basic concepts in Network Analysis. This Project can be demonstrated with the power point presentation on the subject by clipping the outputs for various input combinations with the help of Microsoft Office One Note software. This can also be used by individual students to study the preliminary analog electronics concepts virtually related to Network analysis.

#### **Future Development**

This project can further be modified with verbal instructions and with addition of some exercises based on the concepts learned by the students through this project. Also True /False type questions, Fill in the blank type questions, Multiple choice with single / multiple correct answer questions can be designed and student's knowledge acquired can be judged. This idea can further be extended to any subject and any topic.

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#### **Graphical Impressions**



**Figure-1: The index** 



#### Figure-2: Circuit of Ohm's Law

	Inputs						Output				
R		I		V	Power		Power		Power	S	
80	Ω	1.5	Α	120.0000	180	w	180	w	180	W	-
100	Ω	0.01	A	1.0000	0.01	w	0.01	W	0.01	W	
5	Ω	4	Α	20	80	w	80	w	80	w	
220	Ω	5.60E-03	Α	1.232	0.0069	w	0.0069	w	0.0069	w	
2.00E+04	Ω	3.60E-06	A	0.072	3E-07	w	3E-07	W	3E-07	W	
3.30E+06	Ω	2.40E-06	Α	7.92	2E-05	w	2E-05	w	2E-05	w	
5.00E-01	Ω	1.20E+01	A	6	72	w	72	w	72	w	

Figure-3: Ohm's Law calculations



Figure-5: Maximum Power Transfer Theorem Circuit with calculations

BACK

Laws of	Resistances	in Series	& Parallel
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L In Or F	aws of R aputs: R utput: E ormula:	tesistan 1, R2 & ffective RT = F	ces in S R3 or Tota R1 + R2	eries l or Eq + R3	uivalent	resistance (RT)			1k0 1k0
Lav	ws of Re uts: R1, put: Effe	sistance R2 & I	es in Pai R3 r Total (	rallel or Equi	)	esistence (DT)	]		R4 1k0
For	mula: R	Γ = (R1	*R2*R3	6) / (R13	*R2 + R	1*R3 + R2*R3)			R6
Fors	ohm	Γ = (R1 R2	*R2*R3	R3	R2 + R	RT(Series)	Ohm	RT(Parallel)	ne 1ko Ohm
For R1 1000	Ohm Ohm	Γ = (R1 R2 1000	*R2*R3 Ohm Ohm	R3	Ohm	RT(Series) 3000	Ohm Ohm	RT(Parallel)	Ohm Ohm
For R1 1000 500	Ohm Ohm Ohm Ohm	Γ = (R1 R2 1000 500	Ohm Ohm Ohm	R3 1000 500	Ohm Ohm Ohm	RT(Series) 3000 1500	Ohm Ohm Ohm	RT(Parallel) 333.3333333 166.66666667	Ohm Ohm Ohm
For: R1 1000 500 330	Ohm Ohm Ohm Ohm Ohm	T = (R1 R2 1000 500 1000	Ohm Ohm Ohm Ohm Ohm	R3 1000 500 330	Ohm Ohm Ohm Ohm	RT(Series) 3000 1500 1660	Ohm Ohm Ohm Ohm	RT(Parallel) 333.3333333 166.6666667 141.6309013	Ohm Ohm Ohm Ohm
Forn R1 1000 500 330 750	Ohm Ohm Ohm Ohm Ohm Ohm	R2 1000 500 1000 820	Ohm Ohm Ohm Ohm Ohm Ohm	R3 1000 500 330 5100	Ohm Ohm Ohm Ohm Ohm Ohm	RT(Series) 3000 1500 1660 6670	Ohm Ohm Ohm Ohm Ohm	RT(Parallel) 333.333333 166.6666667 141.6309013 363.7787056	Ohm Ohm Ohm Ohm Ohm Ohm Ohm
R1 1000 500 330 750 2200	Ohm Ohm Ohm Ohm Ohm Ohm Ohm	T = (R1 R2 1000 500 1000 820 100	Ohm Ohm Ohm Ohm Ohm Ohm Ohm	R3 1000 500 330 5100 120	Ohm Ohm Ohm Ohm Ohm Ohm Ohm	RT(Series) 3000 1500 1660 6670 2420	Ohm Ohm Ohm Ohm Ohm Ohm	RT(Parallel) 333.333333 166.6666667 141.6309013 363.7787056 53.22580645	Ohm Ohm Ohm Ohm Ohm Ohm Ohm
R1 1000 500 330 750 2200 280	Ohm Ohm Ohm Ohm Ohm Ohm Ohm Ohm	R2 1000 500 1000 820 100 680	Ohm Ohm Ohm Ohm Ohm Ohm Ohm Ohm	R3 1000 500 330 5100 120 550	Ohm Ohm Ohm Ohm Ohm Ohm Ohm Ohm	RT(Series) 3000 1500 1660 6670 2420 1510	Ohm Ohm Ohm Ohm Ohm Ohm Ohm	RT(Parallel) 333.333333 166.6666667 141.6309013 363.7787056 53.22580645 145.7683742	Ohm Ohm Ohm Ohm Ohm Ohm Ohm Ohm
For R1 1000 500 330 750 2200 280 1000	Ohm Ohm Ohm Ohm Ohm Ohm Ohm Ohm	R2 1000 500 1000 820 100 680 200	Ohm Ohm Ohm Ohm Ohm Ohm Ohm Ohm Ohm	R3 1000 500 330 5100 120 550 470	Chm Ohm Ohm Ohm Ohm Ohm Ohm Ohm Ohm	RT(Series) 3000 1500 1660 6670 2420 1510 1670	Ohm Ohm Ohm Ohm Ohm Ohm Ohm	RT(Parallel) 333.333333 166.6666667 141.6309013 363.7787056 53.22580645 145.7683742 123.0366492	Ohm Ohm Ohm Ohm Ohm Ohm Ohm Ohm

Figure-6: Laws of Resistances Circuits with calculations

# **Biomedical Instruments And Applicability Of Electronics**

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#### Abstract:

It's an era where most of the biomedical Instruments are built around the electronic based technology for Measuring, Monitoring and recording body functions and the prominent reasons are aging population, increasing healthcare cost throughout and the need for access to medical diagnosis and treatment thereof at our homes and even in remote areas.

Biomedical devices like Blood Glucose Monitor, Blood Gas Analyzer, Brain Wave Machine (EEG), Electronic Cardiac Monitor (ECG), Digital Thermometer and many more prominentlyemploys electronic components, circuits and blocks. It's not only reduces the size of the biomedical device but also the cost, portability, reliability, efficiency and above all provides sophisticated equipment with precision and facilitates non medical professional also to monitor the health problems. In a nutshell it helps modify the medical treatment.

Keywords:Blood Glucose Monitor, Blood Gas Analyzer, Brain Wave Machine (EEG), Electronic Cardiac Monitor (ECG),Digital Thermometer.

#### I. Introduction

Since long time, in every field an efforts were taken by the mankind and still going on making thingsportable, easy to understand i.e. user friendly, cost effective and efficient with utmost accuracy and thereby biomedical electronics field has also going through the developing phase and becoming much familiar to human beings through the miniature designs of various healthcare biomedical electronic devices. With the biomedical electronic devices the medical professionals can do medical examinations in a very smart way.

#### **II. Biomedical Electronic Devices**

The most versatile application of Biomedical Electronic Devices is that the health problems can be monitored by the Non Medical Professionals also.

Medical electronics becoming the powerful tool finding cures for most of the diseases and providing the treatment thereof. This has drastically improved the awareness of a common person towards self health. [1]

Today in all ICUs and ICCUs of hospitals one can find number of such biomedical electronic devices.

Following discussion will clarify some popularly used biomedical electronic devices;

#### A. Blood Glucose Monitor

Is a very handy gadget type medical electronic device used to calculate the glucose level in a diabetic patient. When a small drop of blood is placed on the chemical strip having sensors; chemical reaction takes place between blood and the chemical on the sensor strip and on passing of the current through, it immediately calculates and digitally displays the glucose in blood using LCD display. Here one has to go for pricking finger with a lancet which becomes painful for many and result in less frequent testing and consequently a poorer control of blood sugar levels. To combat the problem many non invasive techniques were developed but the measurements are not as accurate as using a blood test.GlucoTrack

which is developed by Integrity Applications in Israel measures sugar level in blood through combination of ultrasonic, electromagnetic and thermal waves. To provide readout. Here the sensor is clipped on the ear. The device is indicated for adults with type 2 diabetes and is approved in Europe, where the company has started to commercialize the glucose monitor.[2]





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#### **B. Blood Gas Analyzer**

The latest Blood Gas Analyzers focus on fast and reliable testing with improved testing time. It is mainly used to calculate the pressure of the chemical elements like carbon monoxide, nitrogen, oxygen in blood therebyany blood disorder can be analyzed through the results.

Patient's blood sample comes in contact with the chemical device strip having particle selective electrodes. Upon the chemical reaction the resultant electrical output is amplified and processed by the microcontroller and converted to digital form using ADC. Then the output is displayed within the digital display module in terms of millimeters of mercury (mmHg), kilopascals (kPa).[3]

#### **C.Brain Wave Machine**

Brain wave machine is a type of instrument in medical electronics, which is used to record the electrical activity of the brain by Electroencephalography (EEG), by firing of neurons within the brain. It processes the data that picked up from the electrodes placed on the scalp and displayed within the screen. It's also useful in treatment of brain abnormalities and disorders like mental unhealthiness, brain death and sleeping disorders. Its also useful in treating various mental issues in hospitals. It's a noninvasive test recording electrical patterns in the brain[4]



#### **D. Electronic Cardiac Monitor**

For knowing the electrical activity of the patients heart Electronic Cardiac Monitor is used in medical electronics applications. This medical electronic device is used to display the electrical and pressure waveforms of the cardiac system relating to the heart. By inserting specific electrodes on the various parts of the body we can get ECG (Electrocardiograph) of the cardiac system. From which one can diagnose irregularities incardiac systems and heart issues. It is used throughout medical treatment and especially while surgery. [5]

#### **E. Digital Thermometers**

Basically used to sense the temperature of the body. These devices are portable having permanent probe and an easily readable display. These devices are used in different industries to control processes in scientific research, the study of weather and inmedicine. [6]



#### F. IR Thermometer

Is use to measure the temperature detectively from the radiations generated by the body. Generally these devices are often use at airports for detectively knowing the passenger's health from the distance to observe the viral diseases like EBOLA, SAARC etc. The system consist of a lens to focus the infrared energy (IR Energy)

Onto a target body and detects the energy and display it in the form of electrical signal with the units of temperature.







Defibrillator is used in emergent conditions like heart attack which affects the rhythm of heart such as ventricular fibrillation, Cardiac arrhythmia and pulse less ventricular tachycardia. Main function of defibrillator is delivering shock to the heart causing depolarization of the muscles of the heart and to regenerate the normal condition of the electrical pulse of the heart.



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#### **III. Limitations**

- a. In a biomedical miniature devices, built with embedded circuits repairing is costlier than replacement leading to e-waste.
- b. Sensors associated with the devices needs to be very effective which may lead to rise in the cost.
- c. Being built around electronic components the reliability can't be guaranteed

#### **IV. Conclusion**

It can be concluded from the above discussion that the use of electronics in biomedical electronic devices has added a flavor of common utility amongst the non medical personals and thereby the health awareness has tremendously gone up. Due to fast response, handiness and clear display of various medical readings its gaining wide popularity. Also most of the miniatures are having compatibility with the cell phones and thus the life become even easier so far the precautionary measures are concerned.

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# Flexible Electronics: Recent Developments and its Applications

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### Abstract:

Flexible electronics is new trend which promises an entirely new design tool. Flexible electronics could transform the way we make and use electronic devices. The technology is finding increasing application in various fields. This article focuses mainly on recent development of flexible electronic devices and their applications.

Keywords: Flexible electronics, Foldable electronics, Flex circuits, Flexible printed circuits

### **Introduction:**

Flexible electronics is an emerging field of science and manufacturing technology, which enables planting of electronic devices onto conformable plastic substrates. The flexible electronics sector, similar to large-area or macro electronics, organic electronics, plastic electronics and printed electronics verticals, is driven by the global demand for lighter and smaller electronic products that consume lesser power. Due to the fact that these devices are more shock-resistant, cost-effective to manufacture and can be flexed or bended, they have the capability of being integrated into portable devices, clothing and packaging materials.

Flexible electronics opens the door to foldaway smartphone displays, solar cells on a roll of plastic and advanced medical devices. Flexible electronics, also known as "flex circuits", is <u>technology</u> for assembling electronic circuits by mounting electronic devices on <u>flexible plastic substrates</u>, such as polyimide, <u>PEEK</u> or transparent conductive polyester film. Additionally, flex circuits can be <u>screen printed</u> silver circuits on <u>polyester</u>. Flexible electronic assemblies may be manufactured using identical components used for rigid <u>printed circuit boards</u>, allowing the board to conform to a desired shape, or to flex during its use. An alternative approach to flexible electronics suggests various etching techniques to thin down the traditional silicon substrate to few tens of micrometers to gain reasonable flexibility, referred to as <u>flexible silicon</u>

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# Necessity of Flexible electronics:

Flexible electronics promises an entirely new design tool for example, tiny smart phones that wrap around our wrists, and flexible displays that fold out as large as a television, photovoltaic cells and reconfigurable antenna that conform to the roofs and trunks of our cars Or flexible implants that can monitor and treat cancer or help paraplegics walk again.

Flexible electronics might cost less, to make conventional semiconductors require complex processes and multi-billion dollar foundries. Researchers hope to print flexible electronics on plastic film the same way we print ink on newspapers. If we could make flexible electronics cheap enough, we could have throwaway electronics, we could wear our phone on our clothing.

#### **Manufacturing:**

Flexible printed circuits (FPC) are made with a photolithographic technology. An alternative way of making flexible foil circuits or flexible flat cables (FFCs) is laminating very thin (0.07 mm) copper strips in between two layers of polyetherimide (PET). These PET layers, typically 0.05 mm thick, are coated with an adhesive which is thermosetting, and will be activated during the lamination process. FPCs and FFCs have several advantages in many applications. Most flexible circuits are passive wiring structures that are used to interconnect electronic components such as integrated

circuits, resistors, capacitors and the like; however, some are used only for making interconnections between other electronic assemblies either directly or by means of connectors.

# Materials for Flexible Electronics:

Each element of the flex circuit construction must be able to consistently meet the demands placed upon it for the life of the product. In addition, the material must work reliably in concert with the other elements of the flexible circuit construction to assure ease of manufacture and reliability. Following are brief descriptions of the basic elements of flex circuit construction and their functions.

# **Base material:**

The base material is the flexible polymer film which provides the foundation for the laminate. Under normal circumstances, the flex circuit base material provides most primary physical and electrical properties of the flexible circuit. In the case of adhesiveless circuit constructions, the base material provides all of the characteristic properties. While a wide range of thickness is possible, most flexible films are provided in a narrow range of relatively thin dimension from 12  $\mu$ m to 125  $\mu$ m (1/2 mil to 5 mils) but thinner and thicker material are possible. Thinner materials are of course more flexible and for most material; stiffness increase is proportional to the cube of thickness. Thus for example, means that if the thickness is doubled, the material becomes eight times stiffer and will only deflect 1/8 as much under the same load. There are a number of different materials used as base films including: polyester, polyimide (PI), polyethylene naphthalate (PEN), polyetherimide (PEI), along with various fluropolymers (FEP) and copolymers. Polyimide films are most prevalent owing to their blend of advantageous electrical, mechanical, chemical and thermal properties.

# Bonding adhesive:

Adhesives are used as the bonding medium for creating a laminate. When it comes to temperature resistance, the adhesive is typically the performance limiting element of a laminate especially when polyimide is the base material. Because of the earlier difficulties associated with polyimide adhesives, many polyimide flex circuits presently employ adhesive systems of different polymer families. However some newer thermoplastic polyimide adhesives are making important inroads. As with the base films, adhesives come in different thickness. Thickness selection is typically a function of the application. For example, different adhesive thickness is commonly used in the creation of cover layers in order to meet the fill demands of different copper foil thickness which may be encountered.

# Metal foil:

A metal foil is most commonly used as the conductive element of a flexible laminate. The metal foil is the material from which the circuit paths are normally etched. A wide variety of metal foils of varying thickness are available from which to choose and create a flex circuit, however copper foils serve the vast majority of all flexible circuit applications. Copper's excellent balance of cost and physical and electrical performance attributes make it an excellent choice. There are actually different copper The Association Connecting Electronics many types of foil. Industries (IPC) identifies eight different types of copper foil for printed circuits divided into two much broader categories, electrodeposited and wrought, each having four sub-types.) As a result, there are a number of different types of copper foil available for flex circuit applications to serve the varied purposes of different end products. With most copper foil, a thin surface treatment is commonly applied to one side of the foil to improve its adhesion to the base film. Copper foils are of two basic types: wrought (rolled) and electrodeposited and their properties are quite different. Rolled and annealed foils are the most common choice, however thinner films which are electroplated are becoming increasingly popular.

In certain non standard cases, the circuit manufacturer may be called upon to create a specialty laminate by using a specified alternative metal foil, such as a special copper alloy or other metal foil in the construction. This is accomplished by laminating the foil to a base film with or without an adhesive depending on the nature and properties of the base film.

# **Applications of Flexible Electronics:**

Flex circuits are often used as connectors in various applications where flexibility, space savings, or production constraints limit the serviceability of rigid circuit boards or hand wiring. **In health care:** 

Flexible electronics has attracted a lot of attention for its enormous potential in many important applications, such as wearable health monitoring devices and medical implants. While a number of approaches to making flexible sensors or electronics have been developed over the last two decades, flexibility in electronic materials is very attractive for medical and bioengineering. Living organisms are intrinsically flexible and malleable. Thus, flexibility is a necessity for successful integration of electronics in biological systems. Furthermore, in order to carry out daily tasks, flexibility is less likely to hinder over stiffness.

Recently, some electronic devices have been integrated into human bodies. One example is the bionic eye. Here a vision-compromised patient requires an electrically-active addressable matrix array, with each unit or pixel recording an image and transmitting this to the patient via the optic nerve. Such technology is not restricted to vision and is applicable to many other types of sensation.

A microarray thin film can also be integrated into bed linen and patient dormitories, and can operate in similar ways to monitor and identify abnormalities in body temperature, as well as sweat-



Figure 1 battery structure



Figure 2 Schematic diagram of the<sup>1</sup> active-sensor-matrix thin film for the artificial nose and tongue

elemental analysis. As with the lab-on-a-chip (LOC) applications, these thin films will become a key component of our approach to next-generation healthcare. Heat distribution in the body, sweat content and frequency or postural pressure on part of the body can all reveal vital information on pathological symptoms or recovering stages.

Further applications of microarray systems based on such flexible thin-film technology are a facilitator for artificial noses and tongues, as shown in Fig. 2. Sensory receptors in olfactory (nose) and gustatory (taste) systems have a range of chemical receptors. Many of these receptors sense particular chemical properties, including acidity, salt concentration and enzyme affinity. It can also be used to monitor the pulses from brain and analyse the changes and design the treatment based on the present situation of the patient.

#### In automotive industry:

In the automotive field, flexible circuits are used in instrument panels, under-hood controls, circuits to be concealed within the headliner of the cabin, and in ABS systems.

Advances in thin-film battery technology through the use of nanostructures for enhanced energy density and hybrid super capacitor allowed increased energy and power densities. Lightweight substrates, such as polyethylene terephthalate (PET) and paper, have led to a reduction in battery weight. Flexible, thin-film technology is especially beneficial in this instance, as it allows batteries to be moulded into suitable shapes at relatively low costs.

Flexible thin-film technology may also find applications in road signs and markings. Intelligent roads will be engineered with the aim of improving road safety, lowering road congestion and energy consumption. The road and vehicle will be able to interact to dynamically adjust either party to energetically optimise their systems. The advantage of flexible thin-film technology is its mechanical durability and ease of inexpensive integration within the existing road networks.

### In energy management

Nano-optoelectromechanical systems (NOEMS) could access energy sources arising at the nanoscale, converting energy from environmental sources, such as ambient noise or electromagnetic radiation, to mechanical vibrations. This route opens up many possibilities where device deformation allows for transformability and new paradigms of user interaction, such as in the Nokia Morph Concept.

There are different ways to harvest or scavenge energy from the surrounding or ambient environment, such as the collection of low-frequency vibrations, heat (via temperature gradients), biomechanical motion and solar energy. Among these, solar energy is perhaps the most promising. Silicon is by far the most widely used photon absorber and currently dominates the market of PV devices, with energy conversion efficiency ( $\eta$ ) of up to 25%. Despite significant development over the past decades, the high cost of Si-based solar cells is still a bottleneck for the implementation of solar electricity on a large scale. The development of new materials and concepts for PV could be a way to reduce the overall production costs, as well as increase efficiency. The latter is crucial in view of applications in mobile devices that have a limited surface area.

Thin-film solar cells, such as silicon, cadmium telluride (CdTe), copper indium gallium diselenide (CIGS) and thin-film crystalline silicon are termed 'second-generation PVs'. The development of thin-film solar cells has been driven by the potential of cost reduction in manufacturing. An even cheaper and versatile approach lies in the exploitation of organic photovoltaic (OPV) cells and dye-sensitized solar cells (DSSCs). These can be manufactured economically compared with silicon cells, for example, by roll-to-roll processing, even though they have low η.

## Flexible mobile devices:

The innovative gadgets that we are presently experiencing are made possible by flex circuits in the industry. Today, mobile and other electronic gadgets manufacturers are designing the products keeping in view the future scope of the product and its use in more than one way. The ease of handling the device is also an important factor that needs to be noted while manufacturing. Now-a-days the devices are manufactured in such a way that these are embedded in our daily life beyond the limit of



Figure 3 Philips 'fluid' Smartphone concepts

separation.



Figure 4 The Morph mobile phone concept, where flexibility and transparency become important (By Nokia)



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Figure 5 Demonstration of a flexible OLED device

### In displays and human-machine interactivity:

One of the most demanding applications of flexible electronics is in OLED displays. An OLED is a light-emitting diode (LED) in which the emissive electroluminescent layer is a film of organic compound that emits light in response to an electric current. This layer of organic semiconductor is situated between two electrodes. Generally, at least one of these electrodes is transparent. OLEDs are used to create digital displays in such devices as television screens, computer monitors and portable devices like mobile phones and PDAs. A major area of research is the development of white OLED devices for use in solid-state lighting applications.

There are two main families of OLEDs. Those based on small molecules and those employing polymers. Adding mobile ions to an OLED creates a light-emitting electrochemical cell or LEC, which has a slightly different mode of operation. OLED displays can use either passive-matrix (PMOLED) or active-matrix addressing schemes. Active-matrix OLEDs (AMOLEDs) require a thin-film transistor backplane to switch each individual pixel on or off, but allow for higher resolution and larger display sizes.

An OLED display works without a backlight. Thus, it can display deep black levels and can be thinner and lighter than a liquid crystal display (LCD). In low ambient light conditions, such as a dark room, an OLED screen can achieve a higher contrast ratio than an LCD, whether the LCD uses cold-cathode fluorescent lamps or LED backlight.

# E-skin for human-machine integration:

The research used existing semiconductor technology to imprint integrated circuits onto a thin, flexible silicon film that can be applied directly on the skin. With the interactive e-skin, we could form an elegant system on plastic that can be wrapped around different objects to enable a new form of



Figure 6 Electronic Skin

human-machine interface. In addition to giving robots a finer sense of touch, the engineers believe that the new e-skin technology could also be used to create things like wallpapers, which double as touch screen displays and dashboard laminates that allow drivers to adjust electronic controls with the wave of a hand.

## **Other Applications:**

In computer peripherals flexible circuits are used on the moving print head of printers, and to connect signals to the moving arm carrying the read/write heads of disk drives. Consumer electronics devices make use of flexible circuits in cameras, personal entertainment devices, calculators, or exercise monitors.

Flexible circuits are found in industrial fields where many interconnections are required in a compact package. Flexible <u>solar cells</u> have been developed for powering <u>satellites</u>. These cells are lightweight, can be rolled up for launch, and are easily deployable, making them a good match for the application. They can also be sewn into backpacks or outerwear. Flexible electronics in future will play a part in field of security, entertainment and may lead to innovative applications.

### **Conclusion:**

Flexible electronics could transform the way we make and use electronic devices. The market for flexible, printed, and organic large-area electronics is rapidly growing. The demand for flexible electronic products may be noticed in near future, there would be huge demand and preference will be given to the flexible products in market.

Recent advancements in materials, integration, and processing methods have enabled dramatic advancements in the capabilities of systems. Technologies for fabricating flexible devices are well developed and strategies for making stretchable systems using shape engineering of brittle active materials are approaching maturity. Because of the need for extensive materials development, intrinsically stretchable devices have seen slower implementation, but several potential advantages provide motivation for future development. The rapid rate of advancements suggests a bright future for the field and may become part of our day to day life.

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# Forecasts Analysis of Area, Production of Pulses in Maharashtra India using ARMA Method

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#### Abstract:

This study relates to the trend analysis of forecasts with respect to area under crop of pulses, and their production in Maharashtra, India. The data is extracted from department of Agriculture, Government of India for the period 2001-02 to 2017-18. Autoregressive Moving Average method of time series analysis is adopted for the study of trend and forecasts using MINITAB19. The forecasts for the period 2019-20 to 2033-34 are generated along with 95% confidence limits. Keywords: Pulses, Area, Production, ARMA Method, Maharashtra

#### I. Introduction

Pulses, composed of grain legumes consisting crops viz. Gram (Chichpea), Tur (Pegion pea), Urid (black Gram), Mung (Green Gram), Lentils, Khesari, beans and peas, has the most important role in the nutritional security of large section of Indian people[3]. Pulses are the major source of protein in many developing countries, particularly for the poorer and vegetarian sections of the population for the requirement of protein and energy. India is the leading producer, consumer of pulses in the world and the consumption of pulses in India is increasing day by day with the increase in the population. Ambreesh Singh Yadav et. al [1] has projected 32 Million tones requirement of pulses for the Indian population. The significant growth in total production of pulses was recorded during the last XII th plan 2012-13 to 2016-17 and the major increment was recorded in Kharif season crops of pulses. [2]. Sunit Kumar & V.A. Bourai [4] has conducted the survey of villages in Assan Valley of Uttarakhand, India and they found that the production of pulses has declined sharply in the Assan Valley since 1990. They also recorded the decline trend in pulses production in Uttarakhand as well as in India. The study about the production of major food grains like rice, wheat, pulses, oilseeds and sugar cane in India was made by S.V. Halawar<sup>[5]</sup> adopting statistical techniques viz. trend analysis, forecasts of production and nalysis of variance technique. Dr. Parul Mittaland Mrs. Shiksha [6] tried to show the trends in production, area and yield of food grains in the pre economic reforms period by using Average Compound Growth Rate (ACGR) for analyzing the data. The analysis of productivity and poverty trend by applying the exponential model was carried out by Isah Musa Ahmad et.al. [7] for the time series data collected from National Sample Survey Organization, National bureau of statistics, R. P. Singh and Rupam Renu [8] attempted to study the growth rate of production and productivity of major pulses in Uttarakhand, India by fitting Compound growth rate model of time series.

#### **II. Methodology**

The secondary data is extracted from Department of Agriculture, Government of India, for the period 2001-02 to 2017-18 and the Autoregressive moving average (ARMA) model is adopted for the analysis and prediction of the future forecasts using MINITAB19 software. The forecasts for the period 2018-19 to 2033-34 are generated with respect to area under the crop and the production of pulses in Maharashtra, India. data is analyzed An autoregressive moving average model ARMA(p, q) is the combination of AR(p) and MA(q) models for univariate cases of time series data. In an AR(p) model the future value is assumed to the linear combination of p past observations and a random error as a constant term. Mathematically AR(p) model is expressed as;

$$\begin{split} Y_t &= c + \sum_{i=1}^p \phi_i Y_{t-i} + \epsilon_t \ .....(1) \\ \text{Where } Y_t \text{ - observed value at time } t, \\ \epsilon t \text{ - random error at given time } t, \\ \phi i \text{ - are the model parameters } (i = 1, 2, ..., p), \\ p \text{ - the parameter of the model and} \\ c \text{ is the constant.} \\ \text{The moving average model } MA(q) \text{ is as;} \end{split}$$

 $Y_t = \mu + \sum_{j=1}^{q} \theta_j \varepsilon_{t-j} + \varepsilon_t \dots \dots (2)$ 

 $\mu$  - Mean of the series.

 $\theta j$  - are the model parameters (j = 1, 2, , , ,q)

q - the order of the moving average model.

 $\epsilon$ t - are random constants known white noise assumed to have Normal distribution N(0,  $\sigma$ 2)

ARMA model is the combination of AR(p) and MA(q) models. The ARMA(p, q) model is mathematically expressed as;

$$Y_{t} = c + \varepsilon_{t} + \sum_{i=1}^{p} \varphi_{i} Y_{t-i} + \sum_{j=1}^{q} \theta_{j} \epsilon_{t-j} \dots (3)$$

Ljung-Box-Pierce statistic for testing an independence of random terms is defined as;

 $Q = n(n+2)\sum_{i=1}^{k} \frac{{\rho_i}^2}{n-i} \dots (4)$ 

pi is the autocorrelation at ith lag and k is the number of lags to be tested.

Q has chi-square distribution with k-p-q degrees of freedom.

Table-1 Area (in Lakh Hectare), Production (in Lakh Tons) of Pulses, Maharashtra.

Year	Gr	am 🔨	Mı	ıng	T	ur	U	rid	Ot	her
	Ar	Prod	Ar	Prod	Ar	Prod	Ar	Prod	Ar	Prod
2001-02	7.56	4.51	7.11	2.91	10.17	7.71	5.88	2.56	3.16	0.48
2002-03	7.96	0 4.49	7.62	3.76	10.6	7.77	6.34	3.6	2.95	0.49
2003-04	7.95	4.21	7	3.91	10.46	6.93	6.01	3.59	2.94	0.41
2004-05	8.3	4.66	6.56	2.28	10.74	6.58	5.31	2.17	2.95	0.71
2005-06	10.2	7.05	5.34	1.89	11	7.92	4.68	1.99	3.09	0.56
2006-07	13.08	9.25	5.73	2.36	11.23	8.15	4.9	2 C	3.34	0.64
2007-08	13.53	11.16	6.61	3.67	11.59	10.76	5.64	3.2	3.2	0.75
2008-09	11.43	7.74	4.27	1.06	10.09	6.05	3.24	1 C	1.9	0.28
2009-10	12.91	11.14	4.38	1.42	10.93	9.19	3.54	1.17	2.09	0.35
2010-11	14.38	13	5.54	3.72	13.02	9.76	4.82	3.29	2.62	0.61
2011-12	10.75	8.57	4.33	2.54	12.33	8.71	3.64	2.49	1.92	0.36
2012-13	11.35	8.68	4.31	2.11	12.14	10.06	3.6	2.14	1.83	0.18
2013-14	15.2	14.01	4.31	2	11.41	10.34	3.34	2.06	2.27	0.44
2014-15	14.27	10.88	3.15	0.84	12.1	3.53	2.77	0.92	1.84	0.29
2015-16	14.42	7.77	3.66	0.69	12.37	4.44	2.86	0.61	2.13	0.36
2016-17	19.29	19.41	4.44	2.6	14.36	20.89	3.38	1.83	2.11	0.4
2017-18	22.34	20.49	4.32	1.59	13.75	12.5	3.51	1.21	1.85	0.54
2018 10	- 12.03	0.86	412	1.59	121	691	3.06	1 53	1.08	0.41

Source: Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India Ar:- Area, Prod:- Production

#### III. Results and Discussion:

The estimates of the parameters, constants and forecasts are obtained by using MINITAB19. Also an independence of error terms is tested using Ljung-Box Chi-Square Statistic.

### a.ARMA Models:

**Table-2:** Final Estimates of Parameters Gram

		Area		Production			
		SE	P-		SE	P-	
Parameter	Coef	Coef	Value	Coef	Coef	Value	
AR 1	0.375	0.284	0.206#	0.100	0.283	0.729#	
MA 1	-0.877	0.263	$0.005^{\$}$	-0.929	0.193	$0.000^{\$}$	
Constant	7.50	1.18	$0.000^{\$}$	8.77	1.48	$0.000^{\$}$	
Mean	12.00	1.89		9.74	1.65		

 Table-3: Final Estimates of Parameters Mung

		Area		Production			
		SE			SE		
Parameter	Coef	Coef	P-Value	Coef	Coef	P-Value	
AR 1	0.999	0.102	0.000\$	-0.391	0.295	0.206#	
MA 1	0.408	0.286	0.174#	-0.909	0.157	0.000\$	
Constant	0.003	0.413	0.995#	3.181	0.419	0.000\$	
Mean	2	276		2.287	0.301		

		Area		Production						
		SE	P-		SE	P-				
Parameter	Coef	Coef	Value	Coef	Coef	Value				
AR 1	0.494	0.315	0.138#	0.593	0.340	0.101#				
MA 1	-0.325	0.343	0.359#	0.912	0.279	0.005\$				
Constant	5.869	0.293	0.000\$	3.559	0.147	0.000\$				
Mean	11.589	0.578		8.751	0.362					

**Table-4: Final Estimates of Parameters Tur** 

<b>Table-3.</b> Final Estimates of Farameters Unit	Table-5:	Final	Estimates	of Parameters	Urid
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		Area		Production			
		SE	P-		SE	P-	
Parameter	Coef	Coef	Value	Coef	Coef	Value	
AR 1	0.954	0.125	0.000\$	-0.355	0.297	0.250#	
MA 1	0.364	0.312	0.261#	-0.913	0.149	0.000\$	
Constant	0.213	0.135	0.135#	2.825	0.373	0.000\$	
Mean	4.67	2.95	SC	2.084	0.275		

#### **Table-6: Final Estimates of Parameters Other**

		Area			Production			
20	1	SE	P-		SE	P-		
Paramete	r Coef	Coef	Value	Coef	Coef	Value		
AR 1	0.939	0.157	0.000\$	0.648	0.867	0.466#		
MA 1	0.397	0.317	0.230#	0.487	0.991	0.630#		
Constant	0.1529	0.0669	0.037\$	0.1617	0.0195	0.000\$		
Mean	2.49	1.09		0.4593	0.0553	-		

#- Non significant parameter; \$- Significant parameter

# Table- 7: Forecasts of Area and Production

Year	QG	ram	M	ung	Т	ſur	U	Jrid	Ot Ot	her
	Are a	Produ ction	Are a	Produ ction	Are a	Produ ction	Are a	Produ ction	Area	Produ ction
2019-20	7.11	7.65	4.16	2.51	11.6 5	7.09	3.82	2.24	2.02	0.45
2020-21	10.1 7	9.52	4.16	2.19	11.6 2	7.77	3.86	2.03	2.05	0.45
2021-22	11.3 1	9.72	4.15	S12.32 2	11.6 3 0-9	-638	3.9	2.10	2.08	0.46
2022-23	11.7 4	9.73	4.15	2.27	11.5 9	8.40	3.93	2.08	2.10	0.46
2023-24	11.9 0	9.74	4.15	2.29	11.5 9	8.54	3.97	2.09	2.13	0.46
2024-25	11.9 6	9.74	4.14	2.28	11.5 9	8.63	3.99	2.08	2.15	0.46
2025-26	11.9 8	9.74	4.14	2.29	11.5 9	8.68	4.03	2.08	2.17	0.46
2026-27	11.9 9	9.74	4.14	2.29	11.5 9	8.71	4.06	2.08	2.19	0.46
2027-28	11.9 9	9.74	4.13	2.29	11.5 9	8.73	4.09	2.08	2.21	0.46
2028-29	11.9 9	9.74	4.13	2.29	11.5 9	8.73	4.11	2.08	2.23	0.46
2029-30	11.9 9	9.74	4.13	2.29	11.5 9	8.74	4.14	2.08	2.24	0.46
2030-31	11.9 9	9.74	4.12	2.29	11.5 9	8.75	4.16	2.08	2.26	0.46
2031-32	11.9 9	9.74	4.12	2.29	11.5 9	8.75	4.19	2.08	2.27	0.46
2032-33	11.9 9	9.74	4.12	2.29	11.5 9	8.75	4.21	2.08	2.29	0.46
2033-34	11.9 9	9.74	4.11	2.29	11.5 9	8.75	4.23	2.08	2.23	0.46

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Area Under	Lag	Chi-Square	DF	Р-
crop				Value
Gram	12	10.90	9	0.283
Mung	12	11.97	9	0.215
Tur	12	8.13	9	0.521
Urid	12	6.61	9	0.678
Other	12	9.87	9	0.361

#### Table- 8: Ljung-Box Chi-Square Statistic- For Area

# Table- 9: Ljung-Box Chi-Square Statistic- For Production

Production of crop	Lag	Chi-	D	Р-
	-	Square	F	Value
Gram	12	9.63	9	0.381
Mung	12	7.19	9	0.617
Tur	12	5.73	9	0.767
Urid	12	5.24	9	0.812
Other	12	10.69	9	0.297









An estimated parameters in ARMA model with respect to area and production are presented in the Table-2 to Table-6. The significance/non significance of the parameters in respective model is denoted by special characters # and \$ respectively in the tables. By comparing the p-value of Ljung-Box Q statistics (Table-8, Table-9) the hypotheses of independence of error terms is accepted at 5% level of significance. The future predictions under ARMA model for area and production of pulses along with 95% confidence limits is presented in Table-7.

#### Conclusion

The forecasts of the area under Gram and production have an increasing trend (Figure-1 and Figure-6). From the period 2024-25 onwards the area under gram will be 11.96 Lakh hectares with the production of 9.74 lakh tons. The future trend of area under Mung and its production showed decreasing tendency (Figure-2 and Figure-7). The area under Mung will be having range between 4.11 to 4.16 lakh hectares and its production range 2.19 to 2.51lakh tons . It is observed that the future trend with respect to area under Tur is decreasing but the production trend has upward tendency (Figure-3 and Figure-8). The future trend of area for the crop Urid has increasing tendency but its production has decreasing tendency. (Figure-4 and Figure-9). The production of Urid will be 2.08 lakh tons from the year 2022-23 onwards. the area of other pulses is varying from 2.02 to 2.19 lakh

hectares with the production 0.45 to 0.46 lakh tons. The future production of other pulses is observed to 0.46 lakh tons from the year 2023-24 to 2033-34. (Figure-5 and Figure-10).

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### **Comparative Study Of Schools Under Government And Private Management**

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#### Abstract

The main objective of this study is to investigate why people prefer high charging private schools over free public schools (That charge nothing)? We use primary data collected through constructed questionnaire and survey method was applied for collection of data from the target respondents of Private and Government Schools located in District Amravati, India. In our study Safety, Facilities and Co-curriculum activities and also Education and Experience of Teachers were considered for comparing Private and Government Schools. A sample of 160 participants were selected in which 60 Students, 60 Parents and 40 Teachers were there. For the analysis of data, scoring of percentage was done and ANOVA Test was applied.

The result of Students and Parents revealed that Private Schools are better than Government Schools in term of Safety, Facilities and co-curriculum activities. And for Teachers Government Schools are better than Private Schools.

#### Introduction:

**Education** is a term which is more easily understood than define. It has been derived from the regarded as "A process of drawing out from within". According to different writers definition of education can be changes.

School plays very important role to develop a child as a personal and professional life and also give knowledge, ideas, tradition of society of develop a child.

Depending on the level of education you will get success. School is also important for Education under the direction of teachers. It is a Birth place of Ideal Citizen. It's were we learn to live a life of selfless service on behalf of the community, it's where we find path to virtue.

In Education there are different types of institutions available like Private and government institutions,. These institutes are having the triangle of three main pillars; consisted of Teachers, Students and Curriculum. There are two main types of schools in Amravati and all over the world. Private and public school system. Now a days private schools are becoming more favorite and attractive for majority of the students due to their better education systems, test criteria and knowledge vis-à-vis Government Schools, which comparatively very cheap but inefficient are losing their attraction. Parents prefer to send their children in Private Schools and avoid Government Schools.

### **Comparison of Private and Government Schools are based on following Factors:**

- 1] Quality of Education: The biggest difference parent finds between private and government schools is medium of learning. It attracts parents whereas children in government institutions are taught in regional language.
- **2]Discipline with learning**: Besides providing the quality education, Private schools pay attention toward of every student. In government schools, these things are hardly taken care of.
- **3**] **Co-curricular activities**: Private schools bring more ideas related to extra-curricular and social activities or inter-school competitions for students. Besides some good government schools, these activities are less or absent.
- **4] Academic provided**: The Education imparted in both private and government school is based on different standards. While most of the private schools are affiliated to CBSC board, government schools are affiliated to ice Or state board. There is not much difference between the curriculum set by these two different boards.
- **5]** Facilities provided: Most of the government institutes lack basic facilities like electricity and proper classrooms etc. Whereas private school tries to provide an environment that help in learning better.

- 6] Dedication of faculty: Certainly, teachers in government institutes are highly qualified yet government are not able to show a better result than private schools. Private schools are accountable for the result of their students and hence their teachers are more dedicated & hardworking.
- 7] Proper attention: Most of the government teachers are kept busy in non-teaching work.
- **8] Fee structure**: Though private schools try to provide top-notch facilities for overall development of children, they also charge high for all this. They sustain on student fee for any maintenance in school. High fee make it difficult for low-income families to afford it. Whereas government schools impart free education up to class 8 so that lower section of society can afford it.

## **Objectives Of The Study:**

- To study the Education Level and Experience of Teachers.
- To study Parents Opinion about Facility and Safety.
- To study Parent Opinion about Education & Co-curriculum activities.
- To study Child's Safety in School Premises.
- To study Co-curriculum activities conducted at Private and Government.

### Need Of The Study:

Schools are considered as a Temple of Knowledge. Private or Government Schools both impart the knowledge. However, there is a great difference between the two schools. The debate between the comparison of Private and Government Educational Institutes will go on till eternity. Both have their own significance in their respective fields. Both type of institutes have much to nurture and reproduce the future champions of India. The discussion on Private and Government should be made on three important parameters that are Type of Facilities, Quality of Teaching, Safety and fee Structure.

# Statistical Techniques Methodology

The present study is based on Comparative Study of Schools. Sources of primary data is discussed. The questionnaire method is used for the purpose of collecting primary data, The study is conducted in Amravati city by taking 160 respondents(including students, parents and teachers) from 10 Private and 10 Government Schools using convenient random sampling method.

#### • The Research Design Used for The study:

The research design used for the study is descriptive. Descriptive research study are those, which are concerned with describing the characteristics of a particular individual or group. The studies concern with specific prediction with narration of facts and characteristics concerning individual group or situation are all example of descriptive research studies.

#### • Data and Types:-

There are many sources of data collection that can be used like Newspaper, Media, Internet, Surveys, Questionnaire and Personal Interviews. We take primary data by using questionnaire which were filled by students, parents of same students and teachers. This study is the survey study and is a descriptive type of research. Two groups were involved is this; one group was from private school and other one from government schools.

• Population Size:-

All the Private and Government Schools of Amravati city were included in the population of the study.

• Sample

We used stratified sampling technique in the selection of sample. First we have selected some schools from Amravati city, and then we have selected students from these schools. We collected information from teachers who taught the students in these schools. And also we collected the data from parents of selected students. The sample size for study is 160.

# • Method of Data Collection:-

There are various statistical methods available for data collection and the one used in this sampling is random ones, convenience sampling. As much as 160 samples were collected to ensure the proper sampling by distribution the questionnaire. The survey was conducted for approximately three weeks.

# Statistical Technique Used

1] Frequency distribution

- 2] Graphical representation of data
- 3] ANOVA

# Analysis of Variance:

ANOVA is technique which is useful to compare more than two group means. It is termed as Analysis of Variance. It is a collection of statistical models and their associated estimation procedures used to analysis the differences among group mean in sample.

### Assumption

The result of one way ANOVA can be considered reliable as long as the following assumptions are met:

- Response variable residuals are normally distributed.
- Variances of Population are equal.
- Response is for given group are independent and identically distributed normal random variable.

## Result

- In the opinion of student Government schools on the average score of Facility, Safety and cocurriculum activities are less than compared to Private schools.
- In the opinion of Parents Government schools on the average score of Facility, Safety and cocurriculum activities are less than compared to Private schools.
- Government schools are better than Private Schools in Experience and Qualification level of Teachers.

## Conclusion

After making the whole report we are concluding that, Private schools are definitely better than government schools as they would provide better facilities in schools, safety and co-curriculum activities conducted in schools. It also Provide better environment for student with options of personality development, have clean and hygienic facilities and also better infrastructures.

As a result, government schools are affordable and provide few of the facilities mentioned above but they are not maintained properly. As the important part of school is well experienced and qualified teachers that are available in government schools. So, while discussing about Teachers government schools is better than private school.

"Finally we concluded that both schools have their own significance in their respective field".

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# The Sustainable Development Goals India Index

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#### Abstract

This paper describe the sustainable development goals of India status at the initial stage of agenda 2030, UN Sustainable Development Summit 2015, New York. The UN 2030 Agenda for Sustainable Development was published setting up 17 Millennium Development Goals which should be achived by 2030. Actually this mission was started too early immediately after world war II, in 1969 UN published a report Man and His Environment or U Thant report, activity focused to avoid global environmetal degradation.

Key words: sustainable, development, goals, index, estimates, status, parameters, capacity.

#### Introduction :

Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The concept of needs goes beyond simply material needs and includes values, relationships, freedom to think, act, and participate, all amounting to sustainable living. These goals are united in the framework of the Millennium Development Goals 2015 which outline the challenges that humanity has to fight not only to achive sustainable development but to service on earth as well. The concept of sustainable development has undergone various development phases since its introduction. The historical development of the concept results in participation of various country, organisation and institutions which now a days work intensively on the implementation of its principal and objectives. Overall development of humanity over the last decades has led to the increasingly unfavourable climate changes and natural disasters, but also wars and political and socio-economic instability. Through their action, humans have negatively impacted on the environment, endangering the survival of the Earth and the future generations. These conditions have indicated changes in the behaviour aiming towards more rational and efficient management of all resources that will allow less pressure and environmental impact. Such responsible behaviour that will ensure the long-term exploitation of resources, without harming the future generations. Our Prime Minister Narendra Modi addresses World Sustainable Development Summit on February 16, 2018 held at New Delhi that"As a nation, we are proud of our long history and tradition of harmonious co-existence between man and nature. Respect for nature is an integral part of our value system".

The **Sustainable Development Goals** (**SDGs**) are a collection of 17 global goals designed to be a "blueprint to achieve a better and more sustainable future for all". The SDGs, set in 2015 by the United Nations General Assembly and intended to be achieved by the year 2030, are part of UN Resolution 70/1, the 2030 Agenda.

The Sustainable Development Goals are:

- 1. No Poverty
- 2. Zero Hunger
- 3. Good Health and Well-being
- 4. Quality Education
- 5. Gender Equality
- 6. Clean Water and Sanitation
- 7. Affordable and Clean Energy
- 8. Decent Work and Economic Growth
- 9. Industry, Innovation, and Infrastructure
- 10. Reducing Inequality
- 11. Sustainable Cities and Communities

- 12. Responsible Consumption and Production
- 13. Climate Action
- 14. Life Below Water
- 15. Life On Land
- 16. Peace, Justice, and Strong Institutions
- 17. Partnerships for the Goals

The goals are broad based and interdependent. The 17 sustainable development goals each have a list of targets which are <u>measured</u> with indicators. In an effort to make the SDGs successful, data on the 17 goals has been made available in an easily-understood form. A variety of tools exist to track and visualize progress towards the goals.

The SDG India Index is a product of a chain of three stages, Stage 1:- SDGs and targets; here Each of the 17 Sustainable Development Goals are mapped with a set of 169 targets to be achieved by 2030. These were used as the foundation for building the SDG India Index; Stage 2:- National Priority Indicators lists; The next stage was to identify the national level Priority Indicators and map them to the 169 targets of the SDGs for 2030.

NITI Aayog selected a list of 62 Priority Indictors that was guided by the MoSPI's National Indicator Framework.

MoSPI was entrusted with the responsibility of identifying the nationally available datasets that align with the 17 SDGs and their 169 targets. MoSPI thus developed the draft National Indicator Framework for measuring India's progress against SDGs and associated targets.

The National Indicator Framework is the largest monitoring framework in the country, comprising of 306 indicators. It consists of nationally defined indicators corresponding to national priorities and needs. Guided by the MoSPI's National Indicator Framework, NITI Aayog constructed a draft list of 62 Priority Indicators. These Priority Indicators were selected by following a set of criteria.

## Criteria Adopted in selecting National Indicators

- 1. Relevance to the UN SDG targets
- 2. Drawn from National Indicator Framework
- 3. Availability of data at national level for States from official statistical systems
- 4. Consent from respective Ministries
- 5. Ownership of data by the data source Ministries
- 6. Sufficient data coverage, such that data for at least 50 percent of the States is available

There were some data challenges which are need to measure progress against SDGs recalled an interest in the quality and availability of data for measuring country's performance, scheme design and management. Although some progress has been made in strengthening the statistical system, this progress is uneven and India continues to lack in uniform statistical systems. All 29 States use varied data monitoring systems. Domestic requirements for good governance and accountability as a tool for evaluating government performance have increased demand for reliable data. A national framework will enable the development of reliable, high quality data on a range of subjects. Data is currently not available for some of the 306 National Indicators developed by MoSPI. However, to initiate the monitoring process, NITI Aayog decided to prioritise some indicators on which State-wise data is available and consider those indicators for designing the SDG India Index. There were some data challenges to measure progress against SDGs recalled an interest in the quality and availability of data for measuring country's performance, scheme design and management. Although some progress has been made in strengthening the statistical system, this progress is uneven and India continues to lack in uniform statistical systems. All 29 States use varied data monitoring systems. Domestic requirements for good governance and accountability as a tool for evaluating government performance have increased demand for reliable data. A national framework will enable the development of reliable, high quality data on a range of subjects. Data is currently not available for some of the 306 National Indicators developed by MoSPI. However, to initiate the monitoring process, NITI Aayog decided to prioritize some indicators on which State-wise data is available and consider those indicators for designing the SDG India Index.

#### **Stage 3: Computing the SDG India Index Scores**

SDG India Index score was computed for India and each of its States based on the 62 Priority Indicators. The Index measures India's progress towards the 13 of the 17 Sustainable Development Goals, leaving out SDG 12, 13, 14 and 17 from the purview of this Index. Progress on SDG 12, 13 and 14 could not be measured because relevant state level data could not be consolidated or found. SDG 17 was left out because the Goal is focused on international partnerships, being less relevant for domestic level policy actions.

The SDG India Index was used to rank the States/UTs according to their progress on the 62 Priority Indicators.



# The steps involved in computing the Index are as follows.

- 1. Raw data: Raw data for each of the 62 Priority Indicators was compiled for each State, UT and at the national level.
- 2. Missing data: The purpose of the SDG Index is to guide States/UTs on their SDG priorities. Data for some States/UTs is missing for some indicators. This missing data has been marked as "Null". In computing the Index, these "null" values have not been given any weightage. In the report, the missing data is flagged so that in future steps can be taken to fill the missing values.
- 3. Target setting: For each indicator, a national target value for 2030 has been set. This target value has been set in one of the three different ways:
  - a. A quantifiable national target specified by the Government of India, or
  - b. A quantifiable UN SDG target specified under the UN SDGs for 2030, or
  - c. The average of the values of the top 3 performing States/UTs
- 4. Normalizing: To make data comparable across indicators, State-wise data values of each of the Priority National Indicators was rescaled from its raw form into a score ranging from 0 to 100— with 0 denoting lowest performer and 100 indicating that the target has been achieved. For indicators where increasing value means better performance, score x' was computed as follows:

$$x' = \frac{x - \min (x)}{T(x) - \min (x)} x \ 100^{-} - - - - - (1)$$

where x = raw data value

min(x) = minimum observed value of the indicator in the dataset

- T(x) = national target value of the indicator
- x' = normalized value after rescaling

For indicators where increasing value means worse performance & score x' was computed as follows:

$$\mathbf{x}' = \left[1 - \frac{x - T(x)}{\max(x) - T(x)}\right] \mathbf{x} \ 100 - - - - -$$

where x = raw data value 4

max(x) = maximum observed value of the indicator in the dataset

T(x) = national target value of the indicator

x' = normalized value after rescaling

In instances where States performed better than the target, their Index Score has been capped at 100.

**5. SDG index score:**For each of the Goals under SDGs (except Goals 12, 13, 14 and 17), SDG India Index score was computed for each State/UT. This was calculated as the arithmetic mean of the normalised values of all the National Indicators within the Goal. In calculating the average, equal weights were assigned to each indicator and the arithmetic mean was rounded off to the nearest whole number.

$$I_{ij}(N_{ij}, I_{ijk}) = \sum_{k=1}^{N_{ij}} \frac{1}{N_{ij}} I_{ijk}$$

Where  $I_{ij}$  = Goal score for state I under SDG j

 $N_{ij}$  = Number of non-null indicators for state i under SDG j

 $I_{ijk}$  = Normalized value for state i of indicator k under SDG j

The Goal Score  $I_{ij}$  for State I under SDG j was then rounded off to the nearest whole number to give the SDG Index Score. Based on the SDG India Index, States and UTs were classified into 4 categories under each of the

SDGs (except Goals 12, 13, 14 and 17):

- 1. Achiever when SDG India Index score is equal to 100
- 2. Front Runner when SDG India Index score is less than 100 but greater than or equal to 65
- 3. Performer when SDG India Index score is less than 65 but greater than or equal to 50

4. Aspirant - when SDG India Index score is less than 50
**6.** Composite SDG India Index score: Every State's and UT's composite SDG India Index score was finally computed to quantify the overall progress of the States and UTs towards the SDGs. This was calculated as the arithmetic mean of the Goal scores across 13 out of the 17 Goals. This was done by assigning equal weight to every Goal score and the arithmetic mean was rounded off to the nearest whole number.

$$I_{i}(N_{i}, N_{ij}, I_{ijk}) = \frac{1}{N_{i}} \sum_{j=1}^{N_{i}} I_{ij}(N_{ij}, I_{ijk}) - - - - -$$
(3)

Where  $I_i$  = Composite SDG index score of state i

 $N_i$  = Number of Goal scores for which state i has non-null data

 $I_{ij}$  = Goal score for statei under SDG j

The arithmetic mean of Goal scores were then rounded off to the nearest whole number to give the composite SDG India Index score for each State. The States were again classified into the four categories; Achiever, Front Runner, Performer and Aspirant

State-wise performance across SDGs															
S.No.	State	Comp.Ind	G1	G2	G3	G4	G5	G6	<b>G</b> 7	G8	G9	G10	G11	G15	G16
1		64	67	50	68	77	44	59	76	81	31	75	26	87	90
	Andhra		20	1					ar						
	Pradesh														
2	Arunacha	51	52	58	38	42	32	64	44	72	16	47	44	73	77
3	Assam	49	53	53	30	54	36	42	18	61	35	75	32	100	53
4	Bihar	48	45	39	40	36	24	31	67	58	38	<mark>8</mark> 2	43	56	60
5	Chhatisgarh	58	50	46	42	53	39	98	36	56	30	73	54	100	65
6	Goa	64	62	80	65	71	35	65	61	90	0	50	71	100	87
7	Gujarat	64	48	49	52	67	31	100	67	80	65	79	52	71	73
8	Harayana	55	50	53	57	65	31	80	50	72	50	55	30	43	78
9	Himachal	· 69	60	58	62	82	42	95	62	71	43	98	41	93	91
10	J&K	53	61	60	53	51	39	52	58	43	35	<b>_7</b> 1	23	74	69
11	Jharkhand	50	37	35	40	58	32	51	20	52	47	72	52	96	64
12	Karnataka	64	52	54	69	76	43	62	77	72	57	68	36	88	74
13	Kerala	69	66	72	92	87	50	62	60	61	68	72	46	75	82
14	MadhyPrad	52	44	41	38	49	33	63	58	57	27	75	39	91	59
15	Mahara	64	47	47	60	74	43	81	69	74	53	76	34	86	82
16	Manipur	59	44	74	67	65	25	44	39	33	72	98	31	100	70
17	Meghala	52	68	43	52	38	36	40	11	62	42	100	39	94	53
18	Mizoram	59	71	69	53	54	43	67	78	65	0	100	32	69	71
19	Nagaland	51	59	69	34	45	42	58	45	40	0	80	<i>»</i> 32	75	87
20	Odisa	51	59	46	54	46	43	46	23	53	32	78	34	100	55
21	Panjab	60	56	71	71	63	43	60	61	57	48	62	36	67	84
22	Rajashtan	59	59	45	49	73	37	43	63	57	62	79	45	68	81
23	Sikkim	58	64	67	52	47	50	78	47	57	1	67	56	98	66
24	Tamilnadu	66	76	61	77	75	38	66	89	71	46	85	33	74	61
25	Tripura	55	71	58	53	56	38	38	32	52	38	89	38	76	71
26	UP	42	48	43	25	53	27	55	23	55	29	98	37	55	61
27	Uttarkhand	60	65	53	36	68	41	78	55	67	33	62	41	100	86
28	WestBegal	56	57	50	66	51	40	54	40	63	45	76	25	88	72

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## Comparison Of Cost Effect Of Various Factors Of Six Sigma : A Case Study

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## Abstract:

A cost matrix indicates the level of progress and relationship between the various factors. Here, we have considered the Six Sigma factors which are Management Support, Performance, Improvement Tools and Techniques, System Process, and Education and Training. It is observed that most of the factors are having positive relationship. It has been mentioned in cost matrix table.

Key Words :- Management Support (MS), Performance, Improvement (P & I) Tools and Techniques (TT), System Process (SP), and Education and Training (E&T).

### Introduction:

Over past two decades has been observed that Six Sigma has been incorporated in industrial organization to enhance the competitiveness. In 1980's there are much successful evidence of Motorola, GE, and Allied Signal which are related to manufacturing sector to get the expected benefits in the financial sector. But service sectors are lacking behind in applying and realizing the benefits of Six Sigma. Different types of guide line can be applied to various types of services. According to R Dhakshayani Kumar 2014[5] the main objective of this research is to help to widen the scope of Six Sigma in service sector particularly in banking sector . The main approach of Six Sigma is to improving the capability of business process and reducing or eliminating the process of variation by using some statistical tools and technique. To meet the customer expectation Citibank is the first bank in the banking sector which has implemented Six Sigma. Some of the Indian Private banks ICICI, HDFC, New York life are using Six Sigma comparison can make the point clear whether to implement or not.

### **Review:**

Jason J Lin, Jane C Sung, kirk Y Lin 2009 in regression Analysis is concerned with the study of dependence of one variable, the dependent variable, on one or more other variables, the explanatory variables with a view of estimating and predicting the mean or average value of the former in terms of the known of fixed values of the latter. If we study the dependence of a variable on only single explanatory variable, such a study is known as two variable regression analyses however, we can study the dependence of one variable on more than one explanatory variable. In two variables regression there is only one explanatory variable where as in multiple regression there is more than one explanatory variable [3], . In the paper Six Sigma in the financial Service Industry the impact of Six Sigma can be measured by regression equation of the from

 $R_i - R_j = \alpha + \beta_j (E(R_{mi}) - R_j) + \beta_2 D + \varepsilon_i$ 

In which risk premium and percentage change the company share price that can be attributed to Six Sigma, Damodar N Gujarathi [2].

Here, management technique is used for tourism purpose in Keyana Wildlife Services which are facing some problems in management process. Total quality management is employed. Efforts are made to find the loops between customer and service quality. (Karani, Sharon R 2012) By using correlation and Regression analysis the study finding also infer that in defining the use of process approach, necessary to achieve expected result. So, this implies that proper implementation of methodology results in proper organizational performance. [4].

According to A. Ansari, Diane Lockwood 2007 [1] Accounting and Finance Six Sigma methodology is used to reduce error in invoice processing, reducing cycle time and to optimized cash flow. In existing process rectifying an error in billing process involved too much rework process., results 60 percent of customer account has been charged less than due amount and about 40% being overcharged. A drastic change has been observed after implementation of Six Sigma cycle time has been reduced from 4 week to three days and defect rate reduce to zero.

Further Suryakant Sharma et al. 2013 noticed that in the year 2013 [6] finance and credit department tries to reduce cash collection cycle time and variation in collection performance by implementing Six Sigma in financial institution. Here, Six Sigma project reduces bank charges, automatic payments improve accuracy in report, reducing documentary credits defects, reduce time in check collection.

## **Objective of Study:**

The main objective of the case study is to find the relationship between the various factors of Six Sigma which affects the service quality and performance of the service.

- 1. To determined Management Support & and Commitment affect Performance
- 2. To determine Management Support & Commitment, and Improvement Tools & Techniques.
- 3. To determine Management Support & Commitment and System Process
- 4. To determine Management support & Commitment and Education and Training
- 5. To determine Performance and Improvement Tools and Techniques.
- 6. To determine Performance and System Process.
- 7. To determine Performance and Education and Training.
- 8. To determine System Process, and Education and Training.

## Data Collection:-

Here, data is collected from banking sector by using questionnaire method. Factors of expected benefits of Six Sigma and level of Significance (P- value) in banking sector are considered to establish the relationship between the various factors. In all 125 samples are considered for analysis from the banking sectors. The same data is considered which is used for expected benefits of Six Sigma. Five, Six Sigma expected factors are considered from Management Support &,Commitment Performance, Improvement Tools and Techniques, System Process, and Education and Training. Then, first fours sub factors of each factors are considered and correlation and regression coefficient is obtained.

## Method:-

To find the relationship between the various factors of Six Sigma, correlation coefficient is obtained for each factors. According to objectives, we obtained the relationship which is determined almost positively. Coefficient of variation is determined to know the total variation in the mean. Here, we obtained smaller coefficient of variation so it is homogeneous which reflects less variable than other. Further t-test for significance of an observed sample correlation coefficient is used to find correlation between the variables. Regression coefficient is obtained to measure the relationship between two factors. The various factors are denoted as:

- X1: Management Support& Commitment
- X2: Performance.
- X3: Improvement Tools and Technique.
- X4: System Process.
- X5: Education and Training.

So C.V.is = 
$$100 \times \frac{\sigma_x}{\overline{x}}$$

## **Hypothesis :-**

Ho: There is positive correlation between various factors

## Analysis :-

To determine the effect of various factors of Six Sigma we used correlation coefficient and regression Analysis. t- test is used to measure the significance of any correlation between the variable or it is just due to fluctuation of sampling.

S.No	1	2	3	4	5
1	2.76	2.553333	2.52	2.506667	2.62
2	2.513333333	2.553333	2.48	2.486667	2.466667
3	2.513333333	2.533333	2.86	2.433333	2.553333
4	2.56	2.163333	2.64	2.406667	2.273333
Mean	2.586666667	2.450833	2.625	2.458333	2.478333
Sd	0.117630936	0.191898	0.170783	0.046308	0.150395
CV	4.547587721	7.829925	6.506	1.883721	6.068374

Mean and coefficient of variation is obtained as:

Coefficient of variation of first factor that is Management Support is 4.54, second factor Performance is 7.8, third factor is Improvement Tools and Technique is 6.50, fourth factor as System Process is 1.88 and coefficient of variation of Education and training is 6.06. Here, we observed that coefficient of variation is greater than mean in almost all factors. This indicates that there should be coordination between the employees and employer. Although it is the service quality which does not acquire the exact figure, but it maintains the level of perfection considering service quality.

Further, relationship is obtained by using correlation coefficient which is given in cost matrix table.

	IN A	CO	st matrix table.		
Factors	X1	X2	X3	X4	×5
X1	1	0.93	-0.08	0.77	0.6
X2 -	2	1	0.144	0.55	0.64
X3	2		1	-0.69	- <mark>0</mark> .53
X4	P			1	0.716
X5	S I				7 1
	7				0.

Cost matrix table.

The correlation coefficient between(X1, X2) is 0.93, which indicates that there is highly positive correlation between Management Support and Performance. Without management support, it is not possible to improve the service quality and performance. Hence, it is positively correlated.

The correlation coefficient between (X1, X3) is -0.08 which is low negative correlated. Here, we observed that some factors do not support to factors of improvement tools and techniques. It is found training and technique of factors improvement tools and technique are not associated with the correlation matrix.

The correlation coefficient between (X1, X4) is 0.77, which shows that there is positive correlation with high degree of relationship between Management Support and System process. All the facilities must be provided by management support such as Six Sigma training at local places, monitoring the process minutely and thoroughly to implement the Six Sigma in banking service.

Correlation coefficient between (X1, X5) is 0.60, which is also highly positive correlated between Management Support and Education and Training which is legal right. Hence, it is positive correlated.

Correlation coefficient between (X2, X3) is 0.14; it indicates low degree positive relationship between Performance and Improvement Tools and Techniques. Appropriate statistical technique should be applied to improve the performance of the banks. Skilled person can organize the training of statistical methods and technique to improve the performance.

Correlation coefficient between (X2, X4) is 0.55, which shows good relationship between Performance and System process. As there is, improvement in the structured system the performance would be definitely increased.

Correlation coefficient between (X2, X5) is .064, which reflects low degree positive correlation between performance and education and training. Positive correlation indicates that training camp should be organized in local places.

Correlation coefficient between (X3, X4) and (X3, X5) are -0.69 and -0.53 respectively. It is which is contradiction, which shows negative correlation between factor Improvement tools & technique and system

process with education and training. As some of the factors of system process are not correlated with other factors, it is due to lack of ignorance of Six Sigma method.

The last correlation coefficient (X4, X5) is 0.716, which indicates highly positive correlation in between system process and education and training. All primary facilities must be provided in training and education to maintain the goodwill of the employees. All these factors affect the Six Sigma levels. Most of these factors are positively correlated. Hence, we accept the Hypothesis that mostly the factors are positively correlated. Therefore, it is beneficial to implement Six Sigma Benefit Factors. Here, we have obtained the correlation of all the objectives.

## Test of Significance.

## t-test.

From the cost matrix table we observed that most of the correlation coefficient are positively associated with low degree level. To measure the correlation between that variables in the population or it may be due to sampling fluctuation t- test is used.

## **Hypothesis:**

Ho: The various factors are uncorrelated.

H1: The Factors are correlated.

To test the significance of the observed sample correlation coefficient t- test is used.

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$
, where

n is the sample size, r is the correlation coefficient

t- follows student t distribution with (n-2) degrees of freedom.

Table It-calculated value for various Six Sigma factors is given below.									
t12	t13	(t14)	t15	t23	t24	t25	t34	t35	t45
3.59	0.11	1.73	1.07	0.2	0.94	1.18	1.34	0.89	1.45

From the table  $t_{13} = 0.11$ ,  $t_{34} = 1.34$  and  $t_{35} = 0.89$ . Tabulated t-value is 2.31 at 5 percent level of significant. The calculated t12-value is 3.59 and tabulated t-value at 5 percent level of significance is 2.31. Here, we reject the null hypothesis that the variable X1 and X2 are not correlated. That is t is significant at 5 percent level of significant. Hence, we accept the alternative hypothesis.

Table 1.We observe that except t12 all the values are not significant. Hence, calculated value is less than tabulated value we accept the hypothesis that the variable are uncorrelated in the population data. It is due to most of the officers and administer are not familiar about Six Sigma, Some of them are unknown about the method tools and techniques. Therefore, it is very essential to organize the training camps for bank employees to make familiar about Six Sigma. Therefore, the data in not significant. ICICI and HDFC are using the Six Sigma method and SBI is using partially. However, BOM, BOI, UCO, PNB, CBI and Canara Bank are not aware about Six Sigma methods. Though most of the correlation coefficient is positively associated, it means that there is relationship between the variables. This relationship arises due to SBI, HDFC and ICICI banks.

### **Result:-**

Here, we observed that Six Sigma is an unknown method though it is established from last twenty years. That is why; Management must take initiatives to implement the Six Sigma project to increase the service quality and performance in Nationalized Banks of India.

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# **Cosmological Model In Self-Creation Theory of Gravitation**

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### Abstract:

In this paper, we have investigated the Barber second self-creation cosmology with macroscopic body as a source of matter in Bianchi type-III space time. Exact cosmological model is obtained by using relation between metric coefficients i.e. and radiation universe. Also, we have discussed the features of the obtained solutions. Keywords: Bianchi type –III metric, macroscopic body and self-creation Theory.

## **I** Introduction

Bianchi type cosmological model are important in the sense that these are homogenous and anisotropic, from which the process of isotropization of the universe is studied through the passage of time. Moreover, from the theoretical point of view anisotropic universe have a greater generally than isotropic models. The simplicity of the field equations made Bianchi space time useful in constructing models of spatially homogenous and anisotropic cosmologies.

Barber has invented two continuous self-creation theories by modifying the Brans and Dicke theory and general relativity. These modified theories create the universe out of self-contained gravitational scalar and matter fields. Brans has pointed out that the Barber's first theory is not only in agreement with experiment but also inconsistent in general. Barber's second theory is a modification of general relativity to a variable G-theory. In this theory the scalar field does not directly gravitate but simply divides the matter tensor acting as a reciprocal gravitational constant.

The Barber field equation in second self-creation theory (Barber, 1982) can be expressed as

$$R_{ij} - \frac{1}{2} Rg_{ij} = -8\pi \phi^{-1} T_{ij}$$
 We aii (1) umal.<sup>C</sup>

and

$$\Box \phi = \phi_{k}^{k} = \frac{8\pi\lambda}{3}T \tag{2}$$

where  $\phi$  is the Barber's scalar,  $T_{ij}$  is the energy momentum tensor,

 $\Box \phi$  is the invariant D'Alembertian, T is the trace of energy momentum tensor  $T_{ij}$ ,  $\lambda$  is a coupling constant to be determined from experiment and  $0 \prec |\lambda| \prec \frac{1}{10}$ .

In the limit  $\lambda \to 0$ , this theory approaches the Einstein's theory in every respect. Due to the nature of the space time Barber's scalar  $\phi$  is a function of 't'.

Reddy (1987 a, b), Maharaj et al (1988), Shanti and Rao (1991), Mohanty et al (2000,2002), Adhav et al (2008) etc. are some of the authors who have investigated various aspects of Barber's selfcreation theories. Singh and Suresh Kumar (2007) have studied Bianchi type-II space times with constant deceleration parameter in self creation cosmology. Also, Reddy DRK (2005), Adhav et al (2009), Khadekar et al (2011), Nimkar et al (2014), Katore et al (2015), Pawar et al(2015), Mete, V.G. (2017) have studied some topological defects in Bianchi type space time.

The purpose of the present work is to obtain Bianchi type-III cosmological model in presence of macroscopic body. Our paper is organized as follows. In section II, Metric and field Equations. Section III, is mainly concerned with the physical and Kinematical properties of the model. The last section contains some conclusion.

## **II Metric and field Equations**

Let's consider the Bianchi type-III space-time in the form

$$ds^{2} = dt^{2} - A^{2}dx^{2} - B^{2}e^{-2ax}dy^{2} - C^{2}dz^{2}$$
(3)

Where A, B, C are functions of time t alone and a is constant.

The energy momentum-tensor for a macroscopic body (Landue L. D. and Lifshitz E.M) is given by

$$T^{ik} = (p + \varepsilon) u^{i} u^{k} - pg^{ik}$$

Here p is the pressure,  $\varepsilon$  is the energy density and  $u_i$  is the four velocity vectors of the distribution respectively.

From Eq. (4), we have

$$T_1^1 = T_2^2 = T_3^3 = -p \text{ and } T_4^4 = \varepsilon$$
 (5)

The trace of energy-momentum tensor is given by

$$T = T_1^1 + T_2^2 + T_3^3 + T_4^4 = -3p + \varepsilon$$
(6)

Using the equations (1), (2) and (4), the field equations of metric (3) are

$$\frac{B_{44}}{B} + \frac{C_{44}}{C} + \frac{B_4 C_4}{BC} = -8\pi\phi^{-1}p$$
(7)

$$\frac{A_{44}}{A} + \frac{C_{44}}{C} + \frac{A_4C_4}{AC} = -8\pi\phi^{-1}p$$
(8)

$$\frac{A_{44}}{A} + \frac{B_{44}}{B} + \frac{A_4 B_4}{AB} - \frac{a^2}{A^2} = -8\pi\phi^{-1}p$$
(9)  
$$\frac{A_4 B_4}{AB} + \frac{A_4 C_4}{AC} + \frac{B_4 C_4}{BC} - \frac{a^2}{A^2} = 8\pi\phi^{-1}\varepsilon$$
(10)

$$\frac{A_{44}}{A} + \frac{B_{44}}{B} + \frac{A_4B_4}{AB} - \frac{a^2}{A^2} = -8\pi\phi^{-1}p \qquad (9)$$

$$\frac{A_4B_4}{AB} + \frac{A_4C_4}{AC} + \frac{B_4C_4}{BC} - \frac{a^2}{A^2} = 8\pi\phi^{-1}\varepsilon \qquad (10)$$

$$\frac{A_4}{A} - \frac{B_4}{B} = 0 \qquad (11)$$

$$\phi_{44} + \left(\frac{A_4}{A} + \frac{B_4}{B} + \frac{C_4}{C}\right)\phi_4 = \frac{8\pi\Lambda}{3}(\varepsilon - 3p) \qquad (12)$$

$$\varepsilon_4 + (\varepsilon + p)\left(\frac{A_4}{A} + \frac{B_4}{B} + \frac{C_4}{C}\right) + p\frac{a}{A^2} = 0 \qquad (13)$$

Where the subscript '4' after A, B and C denotes ordinary differentiation with respect to t. From equation (11), we have

$$A = B \tag{14}$$

With the help of equation (14), the set of equation (7)-(13) reduces to

$$\frac{B_{44}}{B} + \frac{C_{44}}{C} + \frac{B_4 C_4}{BC} = -8\pi\phi^{-1}p$$
(15)  
$$2\frac{B_{44}}{B} + \left(\frac{B_4}{B}\right)^2 - \frac{a^2}{B^2} = -8\pi\phi^{-1}p$$
(16)

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$$\phi_{44} + \left(2\frac{B_4}{B} + \frac{C_4}{C}\right)\phi_4 = \frac{8\pi\Lambda}{3}\left(\varepsilon - 3p\right)$$
(18)

$$\varepsilon_4 + \left(\varepsilon + p\right) \left(2\frac{B_4}{B} + \frac{C_4}{C}\right) + p\frac{a}{B^2} = 0$$
(19)

The field equation (15) to (18) are Four equations in five unknown *B*, *C*,  $\phi$ ,  $\varepsilon \& p$ . Hence to get a determinate solution one has to assume the relation between metric coefficients i.e.  $C = B^n$  and radiation universe

$$\varepsilon = 3p$$

The above equations admits an exact solution given by

$$A = (K_{3}t + K_{4})$$
(20)  

$$B = (K_{3}t + K_{4})$$
(21)  

$$C = (K_{3}t + K_{4})^{n}$$
(22)

and the scalar field is given by

$$\phi = \frac{K_7}{\left(K_3 t + K_4\right)^{n+1}} + K_6 \tag{23}$$

The pressure and energy density is given by

$$\varepsilon = \frac{-3}{8\pi} \left\{ \left[ \frac{K_7 K_3^2}{(K_3 t + K_4)^{n+3}} - \frac{a^2 K_7}{(K_3 t + K_4)^{n+3}} \right] + K_6 \left[ \frac{K_3^2}{(K_3 t + K_4)^2} - \frac{a^2}{(K_3 t + K_4)^2} \right] \right\} (24)$$

$$p = \frac{-1}{8\pi} \left\{ \left[ \frac{K_7 K_3^2}{(K_3 t + K_4)^{n+3}} - \frac{a^2 K_7}{(K_3 t + K_4)^{n+3}} \right] + K_6 \left[ \frac{K_3^2}{(K_3 t + K_4)^2} - \frac{a^2}{(K_3 t + K_4)^2} \right] \right\} (25)$$

Using equations (20), (21) and (22),

Bianchi type-III cosmological model in equation (4) takes the form

$$ds^{2} = dt^{2} - (K_{3}t + K_{4})^{2} dx^{2} - (K_{3}t + K_{4})^{2} e^{-2ax} dy^{2} - (K_{3}t + K_{4})^{2n} dz^{2}$$
(26)

## **III. The Physical and Kinematical Properties**

The expression for the energy density W, energy flow vector S and stress tensor  $\sigma_{\alpha\beta}$  are

$$W = \frac{-1}{8\pi} \left( 3 + \frac{\gamma^2}{C^2} \right) \\ \frac{\left\{ \left[ \frac{K_7 K_3^2}{(K_3 t + K_4)^{n+3}} - \frac{a^2 K_7}{(K_3 t + K_4)^{n+3}} \right] + K_6 \left[ \frac{K_3^2}{(K_3 t + K_4)^2} - \frac{a^2}{(K_3 t + K_4)^2} \right] \right\}}{\left( 1 - \frac{\gamma^2}{C^2} \right)}$$
(27)

$$S = \frac{-1}{2\pi} \frac{\left\{ \left[ \frac{K_7 K_3^2}{(K_3 t + K_4)^{n+3}} - \frac{a^2 K_7}{(K_3 t + K_4)^{n+3}} \right] + K_6 \left[ \frac{K_3^2}{(K_3 t + K_4)^2} - \frac{a^2}{(K_3 t + K_4)^2} \right] \right\}}{\left( 1 - \frac{\gamma^2}{C^2} \right)}$$

$$\sigma_{\alpha\beta} = \frac{-1}{8\pi} \gamma_{\alpha} \gamma_{\beta}$$

$$\frac{\left[ \frac{K_7 K_3^2}{(K_3 t + K_4)^{n+3}} - \frac{a^2 K_7}{(K_3 t + K_4)^{n+3}} \right] + K_6 \left[ \frac{K_3^2}{(K_3 t + K_4)^2} - \frac{a^2}{(K_3 t + K_4)^2} \right] \right\}}{C^2 \left( 1 - \frac{\gamma^2}{C^2} \right)}$$

$$+ \frac{-1}{8\pi} \left\{ \left[ \frac{K_7 K_3^2}{(K_3 t + K_4)^{n+3}} - \frac{a^2 K_7}{(K_3 t + K_4)^{n+3}} \right] + K_6 \left[ \frac{K_3^2}{(K_3 t + K_4)^2} - \frac{a^2}{(K_3 t + K_4)^2} \right] \right\}$$
(28)

If the velocity v of the macroscopic motion is small compared with the velocity of the light, then we have approximately  $S = (p + \varepsilon)v$ .

Since  $S/c^2$  is the momentum density and  $(p+\varepsilon)/c^2$  plays the role of the mass density of the body.

(30)

From the expression (5), we get

$$T_i^i = \varepsilon - 3p$$

$$T_{i}^{i} = \sum_{a} m_{a} c^{2} \sqrt{1 - \frac{v_{a}^{2}}{c^{2}}} \,\delta(r - r_{a})$$
(31)

Compare the relation (30) with the general formula (31) which we saw was valid for an arbitrary system. Since we are at present considering a macroscopic body, the expression (31) must be averaged over all the values of r in unit volume.

We obtain the result

$$\varepsilon - 3p = \sum_{a} m_a c^2 \sqrt{1 - \frac{v_a^2}{c^2}}$$

Here the summation extends over all particles in unit volume The right side of this equation tends to zero in the ultra-relativistic limit, so in this limit the equation of state of matter is

$$p=\frac{\varepsilon}{3}$$
.

Also,

The Scalar expansion,

$$\theta = \frac{(n+2)K_3}{3(K_3 t + K_4)}$$
(32)

Shear scalar,  $\sigma^2 = \frac{1}{2}\sigma_{ij}\sigma^{ij}$ 

$$\sigma^{2} = \frac{K_{3}^{2}}{(K_{3}t + K_{4})^{2}} \left\{ \frac{486 + 243n^{2} - 13(n+2)^{2}}{486} \right\}$$
(33)

Aayushi International Interdisciplinary Research Journal (ISSN 2349-638x) (Special Issue No.66) Impact Factor 6.293 <u>Peer Reviewed Journal www.aiirjournal.com</u> Mob. 8999250451 Spatial Volume

$$V = \sqrt{-g}$$
  
$$V = (K_3 t + K_4)^{n+2} e^{-ax}$$
(34)

Hubble Parameter

$$H = \frac{(n+2)K_3}{(K_3 t + K_4)}$$
(35)

Graphs are plotted for particular values of the physical parameters and other integration constants.



Fig. 1 Plot of Expansion Scalar Vs. Time for  $K_3 = K_4 = 1$  Fig.





## **IV.** Conclusion

In this paper, we have considered Bianchi type-III cosmological model in Barber second selfcreation theory in presence of macroscopic body. For solving the field equations, relation between metric coefficients i.e.  $C = B^n$  and radiation universe are used. Also, it is interesting to note that as Tgradually increases, the scalar expansion  $\theta$  and shear scalar  $\sigma^2$  decrease and finally they vanish when  $T \rightarrow \infty$ .

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# Bianchi Type Cosmological Model in Saez-Ballester Theory of Gravitation

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## Abstract:

In this paper, we have obtained Bianchi Type  $VI_0$  cosmological model with strange quark matter attached to the string cloud in scalar tensor theory of gravitation proposed by Saez-Ballester (1985). For solving the field equations relation between metric coefficient C and A is used. i.e. ( $C = A^n$ ). Also, some physical and kinematical properties of the model are discussed.

Key words: Bianchi type-VIo space time, Quark matter, Saez-Ballester Theory of Gravitation.

## Introduction

In recent years there has been lot of interest in several alternative theories of gravitation. The most important among them are scalar-tensor theories of gravitation formulated by Brans and Dicke(1961), Nordvedt(1970) and Saez –Ballester (1985). All version of the scalar-tensor theories are based on the introduction of a scalar field  $\phi$  into the formulation of general relativity, this scalar field together with metric tensor field then forms a scalar-tensor field representing the gravitational field.

The field equations given by Saez and Ballester (1985) for the combined Scalar and tensor fields are

$$G_{ij} - \omega \phi^n \left( \phi_{,i} \phi_{,j} - \frac{1}{2} g_{ij} \phi_{,k} \phi^{,k} \right) = -T_{ij}$$
(1)

$$2\phi^{n}\phi_{;i}^{i} + n\phi^{n-1}\phi_{,k}\phi^{,k} = 0$$
(2)
(2)
(2)
(2)
(2)

Where  $G_{ij} = R_{ij} - \frac{1}{2}Rg_{ij}$  is the Einstein tensor,  $R_{ij}$  is the Ricci tensor, R is the scalar curvature, n an arbitrary

constant,  $\omega$  is a dimensionless coupling constant and  $T_{ij}$  is the matter energy-momentum tensor. Here comma and semicolon denote partial and covariant differentiation respectively (we have chosen the units such that  $8\pi G = 1 = C$ ).

The equation of motion

$$T_{;i}^{ij} = 0 \tag{3}$$

is a consequence of field equation (1) and (2).

In this study, we will attach strange quark matter to the string cloud. Because, one of such transitions during the phase transitions of the universe could be quark glucon plasma (QGP) harden gas (called quark-hard phase transition) when cosmic temperature was  $T \approx 200$  Mev. Strange quark matter is modeled with an equation of state based on the phenomenological bag model of quark matter, in which quark confinement is described by an energy term proportional to the volume. In this model, quarks are through as degenerate Fermi gas, which exists only in a region of space endowed with a vacuum energy density  $B_c$  (called as the bag

constant). In the framework of this model the quark matter is composed of mass less u, d quarks, massive s quarks and electrons. In the simplified version of the bag model, assuming quarks are mass less and noninteracting. We then have quark pressure

$$p_q = \frac{\rho_q}{3} \tag{4}$$

( $\rho_a$  is the quark energy density).

The total energy density is

$$\rho = \rho_a + B_c$$

But the total pressure is

total pressure is  

$$p = p_a - B_c$$
(6)

Yilmaz (2005, 2006) have studied quark matter attached to the string cloud and domain wall. Mak and Harko (2004) have studied charged strange quark matter in the spherically symmetric space-time admitting conformal motion. Very recently Yavuz et al (2005) has studied strange quark matter attached to the string cloud in the spherical symmetric space-time admitting conformal motion. Also a detailed discussion of Saez and Ballester cosmological model is contained in the work of Reddy and Venkateswara Rao(2001), Adhav et al. (2007), Ugale(2014) and Pund & Nimkar (2015), Reddy and Subbarao (2006), katore et al (2011) and Pund & Avachar (2014).

(5)

(6)

The purpose of the present work is to obtain Bianchi Type VIo strange quark matter in scalar-tensor theories of gravitation proposed by Saez-Ballester (1985).

Our paper is organized as follows. In Section II, we derive the field equations in Saez-Ballester with strange quark matter attached to the string cloud .Section III, deals Solutions of Field equations. Section IV is mainly concerned with the physical properties with graphical representation of the model. The last section contains some conclusions.

### **II. Metric and Field Equations**

We consider the Bianchi type VI<sub>0</sub> space time in the form ournal.com

$$ds^{2} = -dt^{2} + A^{2}dx^{2} + B^{2}e^{2x}dy^{2} + C^{2}e^{-2x}dz^{2}$$
 (7)  
Where, A, B and C are the functions of time 't' only.

The energy-momentum tensor for strange quark matter attached to the string cloud is given by

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$$T_{ij} = (\rho_q + \lambda + Bc) u_i u^i - \lambda x_i x^i$$

$$T_1^1 = -\lambda \quad , \quad T_2^2 = T_3^3 = 0 \quad , \quad T_4^4 = -\rho$$
(8)

Using the equations (1), (2), (3) and (8), the field equations of metric (7) are

$$\frac{B_{44}}{B} + \frac{C_{44}}{C} + \frac{B_4 C_4}{BC} + \frac{1}{A^2} + \frac{\omega}{2} \phi^n \phi_4^2 = \lambda$$
(9)

$$\frac{A_{44}}{A} + \frac{C_{44}}{C} + \frac{A_4C_4}{AC} - \frac{1}{A^2} + \frac{\omega}{2}\phi^n \phi_4^2 = 0$$
(10)

$$\frac{A_{44}}{A} + \frac{B_{44}}{B} + \frac{A_4B_4}{AB} - \frac{1}{A^2} + \frac{\omega}{2}\phi^n \phi_4^2 = 0$$
(11)

$$\frac{A_4B_4}{AB} + \frac{A_4C_4}{AC} + \frac{B_4C_4}{BC} - \frac{1}{A^2} - \frac{\omega}{2}\phi^n \phi_4^2 = \rho \quad (12)$$

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$$\frac{B_4}{B} - \frac{C_4}{C} = 0$$
 (13)

$$\phi_{44} + \phi_4 \left( \frac{2B_4}{B} + \frac{A_4}{A} \right) + \frac{n\phi_4^2}{2\phi} = 0 \tag{14}$$

$$\rho_4 \left(\rho - \lambda\right) \frac{A_4}{A} + \rho \left(\frac{C_4}{C} + \frac{B_4}{B}\right) = 0 \tag{15}$$

## **III. Solutions of Field Equations**

From equation (10) we get,

 $B = \mu C \tag{16}$ 

Now with the help of Eqs. (6) - (12) and use (13), the field equation reduces to

$$2\frac{C_{44}}{C} + \left(\frac{C_4}{C}\right)^2 + \frac{1}{A^2} + \frac{\omega}{2}\phi^n\phi_4^2 = \lambda$$
(17)  

$$\frac{A_{44}}{A} + \frac{C_{44}}{C} + \frac{A_4C_4}{AC} - \frac{1}{A^2} + \frac{\omega}{2}\phi^n\phi_4^2 = 0$$
(18)  

$$\frac{2A_4C_4}{AC} + \left(\frac{C_4}{C}\right)^2 - \frac{1}{A^2} - \frac{\omega}{2}\phi^n\phi_4^2 = \rho$$
(19)  

$$\phi_{44} + \phi_4\left(\frac{2C_4}{C} + \frac{A_4}{A}\right) + \frac{n\phi_4^2}{2\phi} = 0$$
(20)  
((--1))^{A\_4} = 2 (C\_4) = 0 (21)

$$\rho_4 \left(\rho - \lambda\right) \frac{A_4}{A} + 2\rho \left(\frac{C_4}{C}\right) = 0 \tag{21}$$

Where suffix 4 after field variable denotes ordinary differentiation with respect to time t. The equations (17) to (19) is a system of independent equations with five unknown

A, C,  $\rho$ ,  $\lambda$  and  $\phi$ . Hence to get deterministic solution, we use relation between metric coefficients

 $C = A^n$ and geometric string  $\lambda = \rho$ 

The above equations admits an exact solution given by

$$A = K_{3}t + K_{4}$$

$$C = (K_{3}t + K_{4})^{n}$$

$$B = \mu (K_{3}t + K_{4})^{n}$$
(23)
(24)
(24)
(25)

Using equations (23)-(25),  $VI_0$  cosmological model for strange quark matter attached to string cloud in equation (7) takes the form

$$ds^{2} = -dt^{2} + (K_{3}t + K_{4})^{2} dx^{2} + \mu^{2} (K_{3}t + K_{4})^{2n} e^{2x} dy^{2} + (K_{3}t + K_{4})^{2n} e^{-2x} dz^{2}$$
(26)

The string density is given by

$$\lambda = \frac{1}{(K_3 t + K_4)^2} \left[ K_5 + \frac{\omega}{2(K_3 t + K_4)^{4n}} \right]$$
(27)  

$$\rho = \frac{1}{(K_3 t + K_4)^2} \left[ K_6 - \frac{\omega K^2}{2(K_3 t + K_4)^{4n}} \right]$$
(28)  

$$\rho_p = \frac{1}{(K_3 t + K_4)^2} \left[ 2 \left( n K_3^2 - n \right) - \frac{\omega K^2}{(K_3 t + K_4)^{4n}} \right]$$
(29)

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$$\rho_{q} = \frac{1}{(K_{3}t + K_{4})^{2}} \left[ 2 \left( nK_{3}^{2} - n \right) - \frac{\omega K^{2}}{(K_{3}t + K_{4})^{4n}} \right] - B_{c}$$
(30)

$$p_{q} = \frac{1}{3(K_{3}t + K_{4})^{2}} \left[ 2(nK_{3}^{2} - n) - \frac{\omega K^{2}}{(K_{3}t + K_{4})^{4n}} \right] - \frac{B_{c}}{3}$$
(31)

### **IV. The Physical Properties**

The physical quantities that are important in cosmology are spatial volume  $v^3$ , the expansion scalar  $\theta$ , shear scalar  $\sigma^2$ . Which have the following expression for the model (26) as given below Spatial Volume

(32)

$$V = \sqrt{-g}$$
$$V = (K_2 t + K_4)^{2n+1} A$$

The Scalar expansion,

$$\theta = \frac{(2n+1)K_3}{3(K_3t + K_4)}$$
(33)

Hubble constant

$$H = \frac{(2n+1)K_3}{(K_3 t + K_4)}$$
(34)

Shear scalar,

$$\sigma^{2} = \frac{1}{2}\sigma_{ij}\sigma^{ij} \qquad \sigma^{2} = \frac{K_{3}^{2}}{(K_{3}t + K_{4})^{2}} \left\{ \frac{729 + 1458n^{2} + 169(2n+1)^{2}}{1458} \right\}$$
(35)

#### V. Discussion

Graphs are plotted for particular values of the physical parameters and other integration constants From Fig.1 and Fig. 2, it is initially observed that expansion scalar and Hubble Parameter decreases as time increases. As  $T \to \infty$ , expansion scalar as well as Hubble Parameter will be zero. From Fig. 3 it is observed that Spatial Volume increases as increase in time as  $V \to \infty$  as  $T \to \infty$ . From Fig. 4, it is observed that as  $T \to \infty$ ,  $\sigma \to \infty$  i.e. shape of the universe is changing with increasing time.



Fig. 1 Plot of Scalar expansion Vs. Time for  $k_1 = k_6 = 0.1$ 

Fig. 2 Plot of Hubble parameter Vs. Time for  $k_1 = k_6 = 0.1$ 

for  $k_1 = k_6 = 0.1$ 



Fig. 3 Plot of Spatial volume vs. Time for the CONSCIDIE Fig. 4 Plot of Shear Scalar vs. Time

 $k_1 = k_6 = 0.1$ 

#### Conclusion

In this paper, we have obtained Bianchi Type  $W_0$  cosmological model with strange quark matter attached to the string cloud in scalar tensor theory of gravitation proposed by Saez-Ballester (1985). For solving the field equations relation between metric coefficient C and A is used, obtain model is expanding, shearing, non-rotating and do not approach isotropy for large value of time. The rest energy density for the cloud of string with particles attached to them  $(\rho)$ , string tension density  $(\rho_s)$  and particle energy density tends to zero as  $T \rightarrow \infty$ . Also the kinematical variable  $\theta$  and  $\sigma$  tends to zero as T becomes large.

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## FRW Cosmological Model with Electromagnetic Field in F(R, T) Theory

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#### Abstract:

In this communication, we have investigate the FRWcosmological model with electromagnetic field in f(R, T) modified theory of gravity as proposed by Harko et al. (Phy. Rev. D. 024020), where gravitational Lagrangian function is replaced by an arbitrary function of Ricci Scalar R and trace T stress energy tensor. But we used  $T^{=E}T_{ij} + {}^{S}T_{ij}$  of stress energy tensor where  ${}^{E}T_{ij}$  is the energy momentum tensor for electromagnetic field and  ${}^{S}T_{ij}$  is the energy momentum tensor for string cloud. Stability analysis of the solutions through cosmological perturbation is performed and it is concluded that the expanding solution is stable against the perturbation with respect to anisotropic spatial direction. We have also studied the string cosmological model by considering the time dependent deceleration parameter with the presence of electromagnetic field. Some cosmological parameters are also discussed and studied.

Keywords: FRWcosmology, f(R, T) theory of gravity and Electromagnetic field.

### Introduction:

The recent scenario of early inflation and late time accelerated expansions of the universe (Rises et al. 1998; Perlmutter et al. 1999) is not explained by general theory of relativity. Hence to incorporate the above desirable features there have been several modifications of general relativity. Significant among them are scalar-tensor theories of gravitation formulated by Brans and Dicke (1961), and Saez and Ballester (1986) and modified theories of gravity like f (R) theory of gravity formulated by Nojiri and Odinstov (2003) and f (R,T) theory of gravity proposed by Harko et al. (2011). In recent years there has been an immense interest in constructing cosmological models of the universe to study the origin, physics and ultimate fate of the universe. In particular, cosmological models of Brans-Dicke and Saez- Ballester scalar-tensor theories of gravitation are attraction more and more attention of scientists. Brans-Dicke (1961) theory is a well known competitor of Einstein's theory of gravitation. It is the simplest example of a scalar-tensor theory in which the gravitational interaction is mediated by a scalar field  $\phi$  as well as the tensor field gij of the Einstein's theory. In this theory, the scalar field  $\varphi$  has the dimension of the universal gravitational constant. Subsequently, Saez and Ballester (1986) developed a scalar-tensor theory in which the metric is coupled with a dimensionless scalar field  $\varphi$  in a simple manner. In spite of the dimensionless character of the scalar field an anti gravity regime appears in this theory. Also, this theory gives satisfactory description of the weak fields and suggests a possible way to solve 'missing matter' problem in non-flat FRW cosmologies. Friedmann-Robertson-Walker (FRW) models, being spatially homogeneous and isotropic in nature, are best suited for the representation of large scale structure of the present universe. However, it is believed that the early universe may not have been exactly uniform in its expansion phase. Thus, the models with anisotropic background seemed the most suitable to describe the early stages of the universe.

Motivated by the above investigations and discussions we focus our attention, in this paper, to explore the five dimensional FRW Cosmological models with electromagnetic field in f(R, T). The paper is organized as follows. In Sect. 2, we derive the field equations of f(R, T) theory for a five dimensional FRW space-time in electromagnetic field. In Sect. 3, some cosmological models representing stiff fluid, radiation, dust and inflation are obtained. A consolidated physical behavior of the models is studied in Sect. 4. The last section contains some conclusions.

## *f*(**R**,**T**)gravity theory:

In modified f(R,T) gravity theory models, the field equations are obtained from the Hilbert-Einstein type variational principle. The action for the modified f(R, T) gravity is

(6)

(7)

 $S = \frac{1}{16\pi} \int \sqrt{-g} (f(R,T) + L_m) d^4x$ (1)

where f(R, T) is an arbitrary function of the Ricci scalar R and of the trace T of the energy momentum tensor  $T_{ij}$  of the matter.  $L_m$  is the matter Lagrangian. The energy momentum tensor of the matter is defined as

$$T_{ij} = -\frac{2}{\sqrt{-g}} \frac{\delta(\sqrt{-g}L_m)}{\delta g^{ij}}$$
(2)

If we assume that  $L_m$  of matter depends only on the metric tensor  $g_{ij}$ , and not on its derivatives, we obtain

$$T_{ij} = g_{ij}L_m - 2\frac{\partial L_m}{\partial g^{ij}} \tag{3}$$

By varying the action S of the gravitational field with respect to the metric tensor  $g_{ij}$ , we obtain

$$f_R(R,T)R_{ij} - \frac{1}{2}f(R,T)g_{ij} + (g_{ij} \boxdot -\nabla_i\nabla_j)f_R(R,T) =$$

 $8\pi T_{ij} - f_r(R,T)T_{ij} - f_r(R,T)\theta_{ij}(4)$ Where

$$\theta_{ij} = -2T_{ij} + g_{ij}L_m - 2g^{\alpha\beta} \frac{\partial^2 L_m}{\partial g^{ij} \partial g^{\alpha\beta}}$$
(5)  
where, 
$$\Box = \nabla^i \nabla_i, f_R(R,T) = \frac{\partial f(R,T)}{\partial R}, f_T(R,T) = \frac{\partial f(R,T)}{\partial T}$$

And  $\nabla_i$  denotes the covariant derivative and  $T_{ij}$  is the standard matter energy momentum tensor derived from Lagrangian  $L_m$ 

A contraction of (4) gives 7

$$f_R(R,T)R + 3 \supseteq f_R(R,T) - 2f(R,T) = (8\pi - f_r(R,T))T - f_r(R,T)\theta$$

where  $\theta = \theta_i^i$ . Equation (6) gives a relationship between **R** and *T*. Using matter Lagrangian  $L_m$ , the energy momentum tensor of matter is given by

$$T_{ij} = (\rho + p)u_i u_j - p g_{ij}$$

Here  $\rho$  is the energy density and p the pressure of the matter, and  $u^i$  is the four velocity vector  $u^i u_i =$  1. The matter Lagrangian can be taken as  $L_m = -p$  since there is no unique definition of the matter Lagrangian. Then with the use of (7), we obtain the variation of the stress energy of a perfect fluid the expression for  $\theta_{ij}$  as

 $\theta_{ij} = -2T_{ij} - pg_{ij} \tag{8}$ 

Generally, the field equations also depend through the tensor  $\theta_{ij}$  on the physical nature of the matter field. Hence, several theoretical models corresponding to different matter sources in f(R, T) gravity can be obtained. Harko et al. (2007) gave three classes of these models.

$$f(R,T) = R + 2f(T)$$
  
=  $f_1(R) + f_2(T)$  (9)  
=  $f_1(R) + f_2(R)f_3(T)$ 

Much attention has been focused on the first class. We have studied the cosmological consequences of the class for which  $f(R, T) = f_1(R) + f_2(T)$ . Here we use this model to obtain the exact solutions of the field equations for the Bianchi type V metric in the presence of massive strings for the class of model, the gravitational field equation (4) becomes

$$(R)R_{ij} - \frac{1}{2}f_1(R)g_{ij} + (g_{ij} \boxdot -\nabla_i\nabla_j)f_1'(R) = 8\pi T_{ij} + f_2'(T)T_{ij} + (f_2'(T)p + \frac{1}{2}f_2(T))g_{ij}$$
(10)

Where a prime denotes differentiation with respect to the argument, The equation for standard f (R) gravity can be recovered for p=0 and  $f_2(T) = 0$ . Here we consider the particular form of the functions  $f_1(R) = \lambda_1(R)$  and  $f_2(T) = \lambda_2(T)$  we further assume that  $\lambda_1 \neq \lambda_2$ So that  $f(R, T) = \lambda(R, T)$ . Equation (10) can be rearranged as

$$\lambda_1 R_{ij} - \frac{1}{2} \lambda_1 (R+T) g_{ij} + (g_{ij} - \nabla_i \nabla_j) \lambda = 8\pi T_{ij} - \lambda_2 T_{ij} + (2\lambda_2 T_{ij} + \lambda_1 p g_{ij}) (11)$$
Assuming $(g_{ij} - \nabla_i \nabla_j) \lambda = 0$ , we obtain
$$R_{ij} - \frac{1}{2} R g_{ij} = \left(\frac{8\pi + \lambda_2}{\lambda_1}\right) T_{ij} + (p + \frac{1}{2}T) g_{ij}$$
(12)

## FRW Space Time Field equations:

We consider the five dimensional FRW space time in the form

 $ds^{2} = -dt^{2} + B^{2}(t) \left[ \frac{dr^{2}}{1 - kr^{2}} + r^{2}d\theta^{2} + r^{2}sin^{2}\theta d\varphi^{2} \right] + A^{2}(t)dx^{2}$ (13)Where Aand B are functions of time t only.

The energy momentum tensor for the matter under the discussion is given by

 $T_{ij} = {}^{S}T_{ij} + {}^{E}T_{ij}$ (14)Where  ${}^{S}T_{ij}$  is the energy momentum tensor for string cloud and  ${}^{E}T_{ij}$  is the energy momentum tensor for electric magnetic field. The energy momentum tensor for string cloud is given by

$$T_{ij} = \rho u_i u_j - \lambda x_i x_j$$
(15)

With  $u_i u^j = -x_i x^i = -1$ ,  $x^i u_i = 0^{10}$ Where  $\rho$  is the rest energy density of the cloud of strings with particles attached to them and  $\lambda$  is the tension

density of the string, ui is the cloud four velocities and xi is the direction of anisotropy. In the commoving coordinates the magnetic field is taken along  $\varphi$  direction. So that only non vanishing components of electromagnetic field tensor  $F_{ij}$  is  $F_{12}$ .

Therefore 
$$F_{12} = constant = H(say) = F_{21}$$

 $F^{12} = \frac{H(1 - kr^2)}{r^2 B^4}$ (16)Where  $\rho_{\rm p}$  is the density of the cloud of string, The electromagnetic energy momentum tensor is  $^{E}T_{ij} = 1/4\pi \left[ -F_{is} F_{jp} g^{sp} + \frac{1}{2} g_{ij} F_{sp} F^{sp} \right]$ (17)where  $F_{ij}$  is the electromagnetic field tensor derived from potential  $\phi_j$  defined as  $F_{ij} = \phi_{i,j} - \phi_{j,i}$ (18)(19)

So the first set of Maxwell equation

We consider  $\rho = \rho_p + \lambda$ 

$$F_{ij,k} + F_{jk,i} + F_{ki,j} = 0$$

Here  $F_{12}$  = constant = H and other all components are zero. from equation 3 and 5 the non vanishing components of  ${}^{S}T_{ij}$  and  ${}^{E}T_{ij}$ can be respectively written as

$${}^{S}T_{1}^{1} = {}^{S}T_{2}^{2} = 0, {}^{S}T_{3}^{3} = -\lambda, {}^{S}T_{4}^{4} = -\rho, {}^{S}T_{5}^{5} = 0$$
 (20)

And 
$${}^{E}T_{1}{}^{1} = {}^{E}T_{2}{}^{2} = -{}^{E}T_{3}{}^{3} = -{}^{E}T_{4}{}^{4} = -{}^{E}T_{5}{}^{5} = \frac{-H^{2}(1-Rr^{2})}{8\pi r^{2}B^{4}}$$
 (21)  
Here we consider  $f_{1}(R) = \lambda_{1}R \& f_{2}(T) = \lambda_{2}R$  (22)

The Einstein field equation are  $G_i^{j} = R_i^{j} - 1/2 \delta_i^{j} R$  $G_{i}^{\ j} = (8\pi + \lambda_{2}) T_{i}^{\ j} / \lambda_{1} + \lambda_{2} (P + T/2) \delta_{i}^{\ j} / \lambda_{1}$ If f(R, T) theory (23)

$$\Gamma = -\lambda - \rho \tag{24}$$

### For line elements equations (13) are

$$\frac{k}{B^2} + \frac{2\ddot{B}}{B} + \frac{\dot{B}^2}{B^2} + \frac{2\dot{B}\dot{A}}{BA} + \frac{\ddot{A}}{A} = \frac{-(8\pi + \lambda_2)}{\lambda_1} \left(\frac{H^2(1 - kr^2)}{8\pi r^2 B^4}\right) + \frac{\lambda_2}{\lambda_1} \left(P - \frac{\lambda}{2} - \frac{\rho}{2} + \frac{H^2(1 - kr^2)}{8\pi r^2 B^4}\right)$$
(25)

$$\frac{k}{B^2} + \frac{2\ddot{B}}{B} + \frac{\dot{B}^2}{B^2} + \frac{2\ddot{B}\dot{A}}{BA} + \frac{\ddot{A}}{A} = \frac{-(8\pi + \lambda_2)}{\lambda_1} \left(\lambda + \frac{H^2(1 - kr^2)}{8\pi r^2 B^4}\right) + \frac{\lambda_2}{\lambda_1} \left(P - \frac{\lambda}{2} - \frac{\rho}{2} + \frac{H^2(1 - kr^2)}{8\pi r^2 B^4}\right) (26)$$

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$$\frac{k}{B^{2}} + \frac{2\ddot{B}}{B} + \frac{\dot{B}^{2}}{B^{2}} + \frac{2\ddot{B}\dot{A}}{BA} + \frac{\ddot{A}}{A} = \frac{(8\pi + \lambda_{2})}{\lambda_{1}} \left( \frac{H^{2}(1 - kr^{2})}{8\pi r^{2}B^{4}} \right) + \frac{\lambda_{2}}{\lambda_{1}} \left( P - \frac{\lambda}{2} - \frac{\rho}{2} + \frac{H^{2}(1 - kr^{2})}{8\pi r^{2}B^{4}} \right)$$
(27)  
$$\frac{3\dot{B}^{2}}{B^{2}} + \frac{2\dot{B}\dot{A}}{BA} + \frac{3k}{B^{2}} = \frac{(8\pi + \lambda_{2})}{\lambda_{1}} \left( -\rho + \frac{H^{2}(1 - kr^{2})}{8\pi r^{2}B^{4}} \right) + \frac{\lambda_{2}}{\lambda_{1}} \left( P - \frac{\lambda}{2} - \frac{\rho}{2} \right) \frac{H^{2}(1 - kr^{2})}{8\pi r^{2}B^{4}}$$
(28)  
$$\frac{3\ddot{B}}{B} + \frac{3\dot{B}^{2}}{B^{2}} + \frac{3k}{B^{2}} = \frac{(8\pi + \lambda_{2})}{\lambda_{1}} \left( \frac{H^{2}(1 - kr^{2})}{8\pi r^{2}B^{4}} \right) + \frac{\lambda_{2}}{\lambda_{1}} \left( P - \frac{\lambda}{2} - \frac{\rho}{2} + \frac{H^{2}(1 - kr^{2})}{8\pi r^{2}B^{4}} \right)$$
(29)

#### Solution of the field equation:

In this section we find the solution of the Einstein field equation 26, 27, 28 and 29 (here equation 25 and 27 are same) in the presence of cosmic string with electromagnetic field. The set of equation contains four equations with seven unknowns as A, B,  $\lambda$ , P and  $\rho$ . For complete determinacy of the system extra condition is needed. Therefore we assume a relation

$$A = B^{n}$$
(30)  
Where n is an arbitrary constant.  
Subtract (16) from (18) we get  

$$\frac{\ddot{B}}{B} + \frac{(n+2)\dot{B}^{2}}{B^{2}} - \frac{2k}{(1-n)B^{2}} = 0$$
(31)  
The solution of equation (20) is  

$$B^{2} = \frac{2k}{n^{2}+n-2} + DB^{-2n-4}$$
(32)  
This equation has a first integral form of B as  

$$\int \frac{dB}{\sqrt{\frac{2k}{n^{2}+n-2} + DB^{-2n-4}}} = \int dt$$
(33)

Where, D &t<sub>0</sub> are the integration constants. This equation cannot be solve for arbitrary values of n. here we can find the exact solution only for n = -2, -3 and -5/2 Case I: n=-2

$$\int \frac{dB 349}{\sqrt{\frac{2k}{n^2 + n - 2} + 0}} = \pm (t - t_0)$$

$$\frac{1}{\sqrt{D}} \int \frac{dB}{\sqrt{\frac{k}{2D} + B^2}} = \pm (t - t_0)$$

After integration we get

Not possible Case II: n= -3

$$B = \left(\frac{k}{2D}\right)^{\frac{1}{2}} sinh \quad (\sqrt{D}(t - t_0))$$
(34)  
= -3  
$$A = \left(\frac{k}{2D}\right)^{\frac{-3}{2}} sinh^{-3}(\sqrt{D}(t - t_0))$$

Here  $A = B^n$  put n = -3

**Case III:** n = -5/2

$$\frac{1}{\sqrt{D}} \int \frac{dB}{\sqrt{\frac{8k}{7D} + B}} = \pm (t - t_0)$$

(36)

(37)

After integration we get

$$B = \left(\frac{D}{4}(t - t_0)^2 - \frac{8k}{7D}\right)$$
(35)

Here  $A = B^n$  put n = -5

$$A = \left(\frac{D}{4}(t - t_0)^2 - \frac{8k}{7D}\right)^{-5/2}$$

#### Some Physical Properties of the model:

**Expansion Tensor:** 

 $\theta = U^{i}_{;i} + U^{i}\Gamma^{i}_{ki}$  $\theta = - \left[ \begin{array}{cc} \dot{A} & + \frac{3\dot{B}}{B} \end{array} \right]$  $\theta = -\left[n\frac{\dot{B}}{B} + \frac{3\dot{B}}{B}\right]$  put n = -3 then  $\theta = 0$  it is not possible so we take n = -5/2 $\theta = -\frac{1/2}{\frac{B}{B}} = -\frac{D(t-t_0)}{2(\frac{D}{4}(t-t_0)^2 - \frac{8k}{7D})}$ Since,  $B = \frac{D}{4} (t - t_0)^2 - \frac{8k}{7D}$  And  $\dot{B} = \frac{D(t - t_0)}{2}$ Therefore,  $\frac{\dot{B}}{B} = \frac{D(t - t_0)}{\frac{D}{2}(t - t_0)^2 - \frac{16k}{7D}}$ 

So this is possible, for n=-3, this model is a contracting model of the universe and so it is not a physical intrest. So we have worked out its solution for n=-5/2 only.

Spatial Volume V = 
$$\sqrt{-g}$$
  
V =  $\frac{r^2 A B^2}{2}$ Sin

$$T = \frac{r^2 A B^2}{\sqrt{1-kr^2}} \sin \theta$$

For n = -5/2

$$V = \frac{r^2}{\sqrt{1 - kr^2}} \left[ 0 - \frac{8k}{7D} \right]^{1/2} = constant$$

at  $\theta = 90$ ,  $t = t_0$ 

The tensor density  $\lambda$  of the string can be obtained as Subtract (26) from (29) we get

$$\frac{2k}{B^{2}} + \frac{2\ddot{B}}{B} + \frac{2\dot{B}^{2}}{B^{2}} - \frac{2\ddot{B}\dot{A}}{BA} - \frac{\ddot{A}}{A} = \frac{(8\pi + \lambda_{2})}{\lambda_{1}} \left(\lambda + \frac{2H^{2}(1 - kr^{2})}{8\pi r^{2}B^{4}}\right)$$

$$\lambda = \left[\frac{\lambda_{1}}{8\pi + \lambda_{2}}\right] \left[\frac{7\dot{B}^{2}}{2B^{2}} + \frac{2k}{B^{2}}\right] - \frac{H^{2}(1 - kr^{2})}{4\pi r^{2}B^{4}}$$
Since,  $\frac{\dot{B}}{B} = \frac{D(t - t_{0})}{\frac{D}{2}(t - t_{0})^{2} - \frac{16k}{7D}}$ 
(38)

When  $H \neq 0$ 

If H = 0 then  $\lambda \neq 0$ . So the tensor density is constant at t = 0 and infinite at  $t \rightarrow t_0$ . Subtract (27) from (28) we get

$$\lambda \left[ \frac{8\pi + \lambda_2}{\lambda_1} \right] = 0$$
  
$$\lambda = 0 \text{ but } \left[ \frac{8\pi + \lambda_2}{\lambda_1} \right] \neq 0$$
(39)

Then the tensor density is zero **Rest energy densityp:** 

Subtract (28) from (29) we get

$$-\frac{\dot{3}\dot{A}\dot{B}}{AB} + \frac{\ddot{2}\ddot{B}}{B} = \frac{(8\pi + \lambda_2)}{\lambda_1}\rho$$

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$$9\frac{\dot{B}^{2}}{B^{2}} - \frac{12k}{B^{2}} = \frac{(8\pi + \lambda_{2})}{\lambda_{1}}\rho$$
$$\rho = \left(\frac{\lambda_{1}}{8\pi + \lambda_{2}}\right) \left[\frac{9\dot{B}^{2}}{B^{2}} - \frac{12}{7}\frac{k}{B^{2}}\right]$$

Hence,

$$\rho = \left(\frac{\lambda_1}{8\pi + \lambda_2}\right) \frac{1}{\left[\frac{D}{4}(t - t_0)^2 - \frac{8k}{7D}\right]^2} \left[\frac{9D^2(t - t_0)^2}{4} - \frac{12k}{7}\right]$$
(40)

This is the rest energy density for cloud of string.

### **Pressure P:**

Add equation (25) and (29)

$$\frac{4\mathbf{k}}{\mathbf{B}^2} + \frac{5\ddot{\mathbf{B}}}{\mathbf{B}} + \frac{4\dot{\mathbf{B}}^2}{\mathbf{B}^2} + \frac{2\dot{\mathbf{B}}\dot{\mathbf{A}}}{\mathbf{B}\mathbf{A}} + \frac{\ddot{\mathbf{A}}}{\mathbf{A}} = \frac{\lambda_2}{\lambda_1} \left( \mathbf{P} - \frac{\lambda}{2} - \frac{\rho}{2} \right)$$
$$P = \frac{\lambda_1}{\lambda_2} \left[ \frac{9\dot{B}^2}{B^2} + \frac{18k}{7B^2} \right] + \left( \frac{\lambda}{2} + \frac{\rho}{2} \right)$$

Substitute the values of B from (35),  $\lambda$  from (38) and  $\rho$  from (40) we get  $P = \frac{\lambda_1}{\lambda_2} \left[ \frac{1}{[\frac{D}{4}(t-t_0)^2 - \frac{8k}{7D}]^2} [\frac{9D^2(t-t_0)^2}{4} + \frac{8k}{7D} + \frac{1}{12} \frac{1}{[\frac{D}{4}(t-t_0)^2 - \frac{8k}{7D}]^2} \right]$ 

 $\begin{array}{c} 18k7] + 12[\lambda 18\pi + \lambda 225B22B2 - 26k7B2 - H2(1 - kr2)4\pi r2[D4t - t02 - 8k7D]4]\\ (41)\end{array}$ 

Pressure tends to constant at t = 0 and the Pressure tends to infinite at  $t = t_0$ Shear Scalar:

$$\sigma^{2} = \frac{1}{2} \sigma_{ij} \sigma^{ij}$$
where  $\sigma_{ij} = \frac{1}{2} [u_{i;j} - u_{j;i}] + \frac{1}{2} [u_{i;k} u^{k} u_{j} - u_{i} u_{j} u^{k}] - \frac{1}{3} \theta [g_{ij} - u_{i} u_{j}]$ 

$$\sigma^{2} = \frac{1}{2} [\sigma_{11} \sigma^{11} + \sigma_{22} \sigma^{22} + \sigma_{33} \sigma^{33} + \sigma_{44} \sigma^{44}]$$

$$\sigma^{2} = \frac{4}{9} \frac{D^{2}(t - t_{0})^{2}}{[\frac{D}{4}(t - t_{0})^{2} - \frac{8k}{7D}]^{2}}$$
(42)

We observe that the shear scalar tends to infinite at  $t = t_0$  and the shear scalar tends to constant at t = 0.

#### **Average Scale Factor:**

$$R = V^{1/3} = AR^{21/3}$$

$$H_A = \frac{\dot{R}}{3} \frac{D(t-t_0)}{2(\frac{D}{4}(t-t_0)^2 - \frac{8k}{7D})}$$
(43)

We observe that the Average scale factor tends to infinite at  $t = t_0$  and the Average scale factor tends to constant at t = 0.

#### The deceleration parameter q:

$$q = -\frac{RR}{\dot{R}^2}$$
Using R= V<sup>1/3</sup>= (AB<sup>2</sup>)<sup>1/3</sup> we get
$$= -12 \left[ \frac{\left(\frac{D}{4}(t-t_0)^2 - \frac{8k}{7D}\right)}{D(t-t_0)^2} + \frac{11}{2} \right]$$
(44)

We get negative values of deceleration parameter q as  $t \to t_0$ , the negative value of the deceleration parameter q shows that model is inflated.

We have

q

$$\lim_{t \to \infty} \frac{\sigma}{\theta} = \frac{2}{3} \neq 0 \tag{44}$$

The model does not approach isotropy for large values of  $t = t_0$ .

## **Conclusion:**

FRW Cosmological models are important to discuss the early stages of evolutions of the universe. In this paper, we have studied a FRW Cosmological model of five dimensions in the presence of string with electromagnetic field in f(R, T) gravity. It is observed that the following result

- For this model, we observed that the spatial value is constant at  $t \rightarrow t_0$  and t = 0
- Scalar expansion and shear scalar and average scalar factor tends to infinity as  $t \rightarrow t_0$ .
- Declaration parameter q is constant.
- The negative value of the deceleration parameter q shows that model is inflated.
- The model does not approach isotropy for large values of  $t = t_0$ .
- Scalar expansion and shear scalar and average scalar factor tends to Constant as t = 0
- The tensor density is constant at t = 0 and infinite at  $t \to t_0$ .
- Pressure tends to constant at t = 0 and the Pressure tends to infinite at  $t = t_0$

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## Bianchi Type-I Cosmological Model with Linearly Varying Decelerating Parameter and Varying Cosmological Constant in C-field Cosmology

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### Abstract:

Bianchi type-I cosmological model with varying cosmological constant  $\Lambda$  has been studied in Hoyle-Narlikar's Creation-field (C-field) theory of gravitation. We consider cosmological constant in the form of  $\Lambda \propto H^2$ , where  $H = \frac{\dot{a}}{a}$  is Hubble parameter (Carvalho, Lima and Waga, 1992). The field equations have been solved by applying linearly

varying deceleration parameter proposed by Akarsu and Dereli (2011). The physical aspects of the models are also discussed.

Keywords: C-field cosmology, Linearly varying deceleration Parameter, Cosmological constant  $\Lambda$ .

## 1. Introduction:

The Deceleration parameters (q) are useful in studying expansion of the universe. We know that the universe has (i) Decelerating expansion if q > 0, (ii) An expansion with constant rate if q = 0 and (iii) Accelerating expansion if q < 0. Special law of variation for Hubble's parameter proposed byBerman [1] to obtain the cosmological solutions called the models with Constant Deceleration Parameter (CDP) by assuming the deceleration parameter q as constant. Akarsu and Dereli [2] have modified Berman's special law of variation for Hubble's parameter by setting q = -kt + m - 1, where k and m are constants which yields Linearly Varying Deceleration Parameter (LVDP) models of universe. They have investigated accelerating cosmological solutions for Robertson-Walker space-time by considering LVDP. Ramesh and Umadevi [3] have investigated Cosmological models with linearly varying deceleration parameter in f(R,T) gravity.Recently, Desikan[4] analyzed Cosmological Models in Lyra Geometry with Linearly Varying Deceleration Parameter.

The present day observations of smallness of Cosmological constant ( $\Lambda \le 10^{-56} \ cm^{-2}$ ) support to assumed the cosmological constant  $\Lambda$  is time dependent. Ram & Verma [5] have studied cosmological models in favor of time dependent  $\Lambda \sim t^{-2}$  in different contexts. Ghate *et al.* [6] have studied N-Dimensional FRW dust filled universe with time dependent  $\Lambda(t)$  in creation field theory of gravitation.

In the late eighties, the astronomical observations revealed that the predictions of the big-bang model do not always exactly meet our expectations as was believed earlier [7]. So, alternative theories of gravitation were proposed by the researchers. The most popular theory was put forward by Bondi & Gold [8] called steady state theory. The remarkable approach of this theory is that the universe neither have any singular beginning nor an end on the cosmological background and statistical properties of large scale features of the universe do not change. To maintain the constancy of matter density, they contemplate a very slow but continuous creation of matter in contrast to explosive creation at t = 0 of standard model. The theory fails for not giving any physical justification for continuous creation of matter and the principle of conservation of matter was violated in this formalism. To overcome this difficulty, Hoyle &Narlikar [9] adopt a field theoretical approach by introducing a massless and chargeless scalar-field *C* in the Einstein-Hilbert action to account for matter creation. The theory proposed by Hoyle and Narlikar called as*C*-field theory which has no big-bang type singularity as in Bondi & Gold steady state theory. Some Researchers [10-12] investigatedsome cosmological models in Creation field cosmology. Recently Malekolkalami and Khalafi [13] have studied LRS Bianchi Type I inC-Field Cosmology withVarying $\Lambda(t)$ .

In this paper, we have investigated Bianchi type-I space-time with varying cosmological constant  $\Lambda$  in creation field theory of gravitation. By using special form of deceleration parameter, the solutions of field

(4)

(5)

equations are obtained. This work is organized as follows. In Section 2, the Metric and field equations have been presented. The field equations have been solved in Section 3. The physical aspects of the model have been discussed in Section 4. In the last Section 5 concluding remarks have been expressed.

## 2.Metric and Field Equations:

We consider the Bianchi type-Imetric in the form of

$$ds^{2} = dt^{2} - a_{1}^{2} dx^{2} - a_{2}^{2} dy^{2} - a_{3}^{2} dz^{2},$$
(1)

where metric potentials  $a_1, a_2, a_3$  are functions of cosmic time t only.

It is assumed that creation field C is a function of time t only

*i.e.* 
$$C(x,t) = C(t)$$
 and  ${}^{m}T_{j}^{i} = diag(\rho,-p,-p,-p).$  (2)

The Einstein field equations modified by Hoyle and Narlikar[9]by introducing a massless scalar field called as creation field viz. C - Fieldwere given by

$$R_{i}^{j} - \frac{1}{2} R g_{i}^{j} = -8\pi G \left( T_{i}^{j} + T_{i}^{j} \right) - \Lambda(t), \qquad (3)$$

where  $T_i^j$  is matter tensor of Einstein's theory given by

$$T_{(m)_i}^{j} = (\rho + p)v_iv^j - pg_i^j$$

Here  $\rho$  is the energy density of massive particle and p is the pressure.  $v_i$  are co-moving four velocities which obeys the relation  $v_i v^j = 1$ .

 $T_i^j$  is matter tensor due to creation field given by (c)

$$T_{(c)_i}^{j} = -f(c_i c^j - \frac{1}{2}g_i^j C^{\alpha}C_{\alpha})$$

where f > 0 is the coupling constant between matter and creation field.

The Hoyle-Narlikarfield equations (3) for the metric (1) with the help of equations (4) and (5) given by

$$\frac{\dot{a}_{1}\dot{a}_{2}}{a_{1}a_{2}} + \frac{\dot{a}_{2}\dot{a}_{3}}{a_{2}a_{3}} + \frac{\dot{a}_{1}\dot{a}_{3}}{a_{1}a_{3}} = 8\pi G \left(\rho - \frac{1}{2}f\dot{C}^{2}\right) + \Lambda,$$

$$\ddot{a}_{1} = \ddot{a}_{2} - \dot{a}_{1}\dot{a}_{2} - c + c \left(1 + c\dot{c}^{2}\right) + \Lambda,$$
(6)

$$\frac{a_1}{a_1} + \frac{a_2}{a_2} + \frac{a_1 a_2}{a_1 a_2} = 8\pi G \left( -p + \frac{1}{2} f \dot{C}^2 \right) + \Lambda,$$
(7)

$$\frac{\ddot{a}_2}{a_2} + \frac{\ddot{a}_3}{a_3} + \frac{\dot{a}_2 \dot{a}_3}{a_2 a_3} = 8\pi G \left( -p + \frac{1}{2} f \dot{C}^2 \right) + \Lambda,$$
(8)

$$\frac{\ddot{a}_1}{a_1} + \frac{\ddot{a}_3}{a_3} + \frac{\dot{a}_1 \dot{a}_3}{a_1 a_3} = 8\pi G \left( -p + \frac{1}{2} f \dot{C}^2 \right) + \Lambda , \qquad (9)$$

where overhead dot  $(\cdot)$  denotes differentiation with respect to time t.

## 3. Solution of the Field Equations:

The average scale factor a of Bianchi type-I metric is defined as

$$a = (a_1 a_2 a_3)^{\frac{1}{3}}.$$
 (10)

The Spatial Volume is given by

$$V = a^3 = a_1 a_2 a_3, (11)$$

From equations (10) and (11), the generalized Hubble parameter H for Bianchi type-I metric given by

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$$H = \frac{\dot{a}}{a} = \frac{1}{3} \sum_{i=1}^{3} H_i = \frac{1}{3} \left( H_x + H_y + H_z \right) = \frac{1}{3} \frac{\dot{V}}{V}, \qquad (12)$$

where the directional Hubble parameter  $H_i$  (i = 1, 2, 3) in the direction x, y and z, respectively defined as

$$H_x = \frac{\dot{a}_1}{a_1}, \qquad H_y = \frac{\dot{a}_2}{a_2} \qquad \text{and} \qquad H_z = \frac{\dot{a}_3}{a_3}$$
(13)

Subtracting equation (8) from (9), we get

$$\frac{d}{dt}\left(\frac{\dot{a}_1}{a_1} - \frac{\dot{a}_2}{a_2}\right) + \left(\frac{\dot{a}_1}{a_1} - \frac{\dot{a}_2}{a_2}\right)\left(\frac{\dot{a}_1}{a_1} + \frac{\dot{a}_2}{a_2} + \frac{\dot{a}_3}{a_3}\right) = 0,$$
(14)

From equations (11) and (14), we have

$$\frac{d}{dt}\left(\frac{\dot{a}_{1}}{a_{1}} - \frac{\dot{a}_{2}}{a_{2}}\right) + \left(\frac{\dot{a}_{1}}{a_{1}} - \frac{\dot{a}_{2}}{a_{2}}\right)\frac{\dot{V}}{V} = 0,$$
(15)

Integrating above equation, we get

$$\frac{a_1}{a_2} = d_1 \exp\left(x_1 \int \frac{dt}{V}\right),\tag{16}$$

where  $d_1$  and  $x_1$  are integration constant.

Similarly, Subtracting equation (8) from (7) and equation (9) from (7), we obtained

$$\frac{a_1}{a_3} = d_2 \exp\left(x_2 \int \frac{dt}{V}\right), \tag{17}$$

$$\frac{a_2}{a_3} = d_3 \exp\left(x_3 \int \frac{dt}{V}\right), \tag{18}$$

where  $d_2, d_3, x_2$  and  $x_3$  are integration constants.

In view of the relations  $V = a_1 a_2 a_3$ , we find the relation between constants  $d_1$ ,  $d_2$ ,  $d_3$ ,  $x_1$ ,  $x_2$  and  $x_3$  as  $d_2 = d_1 d_3$ ,  $x_2 = x_1 + x_3$ .

Using equations (16), (17) and (18), the directional scale factors in the explicit form are

$$a_{1}(t) = D_{1}V^{\frac{1}{3}} \exp\left(X_{1}\int\frac{dt}{V}\right),$$
(19)  

$$a_{2}(t) = D_{2}V^{\frac{1}{3}} \exp\left(X_{2}\int\frac{dt}{V}\right),$$
(20)  

$$a_{3}(t) = D_{3}V^{\frac{1}{3}} \exp\left(X_{3}\int\frac{dt}{V}\right),$$
(21)

where  $D_1 = \sqrt[3]{d_1 d_2}$ ,  $D_2 = \sqrt[3]{\frac{d_3}{d_1}}$ ,  $D_2 = \sqrt[3]{\frac{1}{d_2 d_3}}$ 

and 
$$X_1 = \frac{x_1 + x_2}{3}$$
,  $X_2 = \frac{x_3 - x_1}{3}$ ,  $X_3 = \frac{-(x_2 + x_3)}{3}$ .

These constants  $D_i$  (i = 1, 2, 3) and  $X_i$  (i = 1, 2, 3) satisfies the following relations

$$D_1 D_2 D_3 = 1, \quad X_1 + X_2 + X_3 = 0.$$
 (22)

In order to solve this system completely, we use a linearly varying deceleration parameter. Akarsu and Dereli proposed this linearly varying deceleration parameter which is linear in time with a negative slope. The linearly varying deceleration parameter q is defined as

$$q = -\frac{aa}{\dot{a}^2} = -kt + m - 1,$$
(23)

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where  $k \ge 0$ ,  $m \ge 0$  are constants.

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For k = 0, the equation (10) reduces to the Berman'slaw of constant deceleration parameter.

Assuming that the deceleration parameter is not a constant quantity *i.e.*  $k \neq 0$  and solving equation (10), we get  $\sum_{k=1}^{2} \exp\left(\frac{kt-m}{2}\right)$ 

$$= a_0 e^{\sqrt{m^2 - c_1 k} \arctan m \left(\frac{m^2 - c_1 k}{m^2 - c_1 k}\right)}, \quad \text{for } k > 0 \text{ and } m \ge 0 \text{ are constants}$$
(24)

where  $a_0$  and  $c_1$  are constant of integration.

For  $c_1 = 0$ , the volume of the universe is

$$V = a_0^{3} e^{\frac{6}{m} \arctan h \left(\frac{kt}{m} - 1\right)}.$$
 (25)

Using equations (13), (19), (20), (21) and (25), the directional Hubble parameter as

$$H_{x} = \frac{-2}{(kt^{2} - 2mt)} + \frac{X_{1}}{a_{0}^{3}e^{\frac{6}{m}\arctan h\left(\frac{kt}{m} - 1\right)}},$$

$$H_{y} = \frac{-2}{(kt^{2} - 2mt)} + \frac{X_{2}}{a_{0}^{3}e^{\frac{6}{m}\arctan h\left(\frac{kt}{m} - 1\right)}},$$

$$H_{z} = \frac{-2}{(kt^{2} - 2mt)} + \frac{X_{3}}{a_{0}^{3}e^{\frac{6}{m}\arctan h\left(\frac{kt}{m} - 1\right)}},$$
(26)
(27)
(28)

Substituting equations (26), (27) and (28) in equation (12), the generalized Hubble parameter H obtained as

$$H = \frac{-2}{(kt^2 - 2mt)}.$$
 (29)

We consider cosmological constant in the form of  $\Lambda \propto H^2$ , where  $H = \frac{\dot{a}}{a}$  is Hubble parameter (Carvalho, Lima and Waga, 1992 [14]). Hence cosmological constant ( $\Lambda$ ) becomes

$$\Lambda = \frac{4}{(kt^2 - 2mt)^2}.$$
(30)

To obtain energy density  $(\rho)$ , add equation (6) and equation (7), we get

$$\frac{\ddot{a}_1}{a_1} + \frac{\ddot{a}_2}{a_2} + 2\frac{\dot{a}_1\dot{a}_2}{a_1a_2} + \frac{\dot{a}_2\dot{a}_3}{a_2a_3} + \frac{\dot{a}_1\dot{a}_3}{a_1a_3} = 8\pi G(\rho - p) + 2\Lambda.$$
(31)

The energy density  $\rho$  is related to the pressure p by the equation of state as

$$\rho = \gamma \rho$$
,

where the of equation of state parameter varies between the interval  $0 \le \gamma \le 1$ . The  $\gamma = 0$  describes the dust universe,  $\gamma = \frac{1}{3}$  presents radiation universe,  $\frac{1}{3} \le \gamma \le 1$  shows hard universe and  $\gamma = 1$  corresponds to stiff matter.

Using equation (19), (20), (21), (30) and (32), equation (31) yields the value of the energy density ( $\rho$ ) as

$$\rho = \frac{1}{\pi G(1-\gamma)} \left[ \frac{kt - m + 2}{(kt^2 - 2mt)^2} \right].$$
(33)

Using equations (19),(20), (21), (30) and (33) in equation (6), we get

$$\dot{C} = \sqrt{\frac{1}{4\pi Gf} \left[ \frac{8(kt - m + 1 + \gamma)}{(1 - \gamma)(kt^2 - 2mt)^2} - X \cdot \left( a_0^{-3} e^{\frac{6}{m} \arctan h \left(\frac{kt}{m} - 1\right)} \right)^{-2} \right]},$$
(34)

where  $X = X_1 X_2 + X_2 X_3 + X_1 X_3$ .

Aayushi International Interdisciplinary Research Journal (ISSN 2349-638x) (Special Issue No.66) Impact Factor 6.293 <u>Peer Reviewed Journal</u> <u>www.aiirjournal.com</u> Mob. 8999250451 (32)

From equation (32) and (33), we obtained the pressure (p) as

$$\rho = \frac{\gamma}{\pi G(1-\gamma)} \left[ \frac{kt - m + 2}{\left(kt^2 - 2mt\right)^2} \right]. \tag{35}$$

The cosmological model using equation (19), (20) and (21) in equation (1) written as

$$ds^{2} = dt^{2} - \left[ D_{1}V^{\frac{1}{3}} \exp\left(X_{1}\int\frac{dt}{V}\right) \right]^{2} dx^{2} - \left[ D_{2}V^{\frac{1}{3}} \exp\left(X_{2}\int\frac{dt}{V}\right) \right]^{2} dy^{2} - \left[ D_{3}V^{\frac{1}{3}} \exp\left(X_{3}\int\frac{dt}{V}\right) \right]^{2} dz^{2}$$
(36)

#### 4. Physical Aspects of the Model:

The physical parameters of cosmological model (36) such as the Expansion Scalar ( $\theta$ ), the mean anisotropic parameter ( $\Delta$ ) and Shear Scalar ( $\sigma^2$ ) are defined as

$$\theta = 3H = \frac{-6}{(kt^{2} - 2mt)},$$

$$\Delta = \frac{1}{3} \sum_{i=1}^{3} \left(\frac{H_{i} - H}{H}\right)^{2} = \frac{X_{1}^{2} + X_{2}^{2} + X_{3}^{2}}{12} \left[\frac{(kt^{2} - 2mt)}{a_{0}^{3}e^{\frac{6}{m}\arctan h\left(\frac{kt}{m} - 1\right)}}\right]^{2},$$

$$\sigma^{2} = \frac{3}{2}\Delta H^{2} = \frac{X_{1}^{2} + X_{2}^{2} + X_{3}^{2}}{2} \left[a_{0}^{3}e^{\frac{6}{m}\operatorname{actan} h\left(\frac{kt}{m} - 1\right)}\right]^{-2}.$$
(37)
(38)

#### 8. Conclusion:

Bianchi type-I cosmological models with varying cosmological constant  $\Lambda$  has been investigated in Hoyle-Narlikar's creation field theory of gravitation. The creation field C is directly proportional to time t. Hence the creation of matter increases as time increases which follows the results as obtained by Hoyle and Narlikar.

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## Bianchi Type-VIII Universe with Scalar and Electromagnetic Field in Theory of Gravity with Deceleration Parameter

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## Abstract:

This paper deals with the study of scalar and electromagnetic field in Bianchi type-VIII space time by considering the case of .We consider the modified theory of gravity, where the Lagrangian is given by an arbitrary function of the Ricci scalar and of the trace of the stress-energy .Some physicalparameters are also analyzed. Keyword:Bianchi Type-VIII, electromagnetic field, theory of gravity, isotropy, constant vector potential.

## 1. Introduction

In recent years, modified gravity theories have gained serious attention for their capabilities in describing the observed accelerated expansion of the present day universe. The important modified theories of gravity which are drawing attention during the last decade, are [Carollet .al (2004)] and theory of gravity[Harko et .al (2011)].

In the modified theory of gravity, now a days there has a lot of interest of cosmologists in the view of the direct evidence of late time accelerated the expansion of the universe which comes from high redshift supernova experiment[Riesset.al,(2004)].One is negative pressure known as dark energy (DE) which induces a late-time accelerating cosmic expansion. The other one is the modified gravity, which originates from the idea that the general relativity is inadequate in the cosmic scale and therefore needs to be modified.

In order to explain the nature of the DE and accelerated expansion, a variety of theoretical models have been proposed in the literature. In our opinion, one of theinteresting and prospective version of modified gravity theories is the gravity proposed by Harkoet. al.,(2010,2011). In theory of gravity, cosmic acceleration may result not only due to geometrical contribution to the total cosmic energy density but it also depends on matter contents. The interesting feature of this theory is that it may explain the current acceleration without involving dark energy. Many authors have investigated different problems within the scope of theory. The exact solutions of field equations for locally rotationally symmetric Bianchi type-I cosmological model discussed by Adhav,(2012),Samanta, (2013) has studied the universe filled with dark energy from a wet dark fluid in theory of gravity.Bijan Saha,(2015) explored the interacting scalar and electromagnetic fields in Bianchi type-I universe. Solanke and Karade, (2016) have studied plane symmetric universe filled with a combination of a perfect fluid and scalar field with electromagnetic fields in .

The Magnetic field plays a vital role in the description of energy distribution in the universe as it contains highly ionized matter. Strong magnetic fields can be created due to adiabatic compression in a cluster of galaxies. The presence of magnetic fields in galactic and intergalactic spaces is evident from recent observations by Grasso and Rubinstein (2001). The large scale magnetic field can be detected by observing their effects on the cosmic microwave background (CMB) radiation. These fields would enhance anisotropies in the CMBsince the expansion rate will be different depending on the direction of field lines by Madson(1989).

Melvin, (1975)in his cosmological solution for dust and electromagnetic field, has suggested that the presence of magnetic field is not unrealistic as it appears to be because, during the evolution of the universe, matter was in highly ionized state, smoothly coupled with the field subsequently form neutral matter due to universe expansion.Tikekar and Patel (1992) have obtained some Binchi-III type cosmological solution of massive string in presence of a magnetic field.Sharma et.al (2014) have investigated Bianchi Type-IIstring cosmological model in presence of a magnetic field in the context of theory of gravity.Sarita Rani et.al (2014) have investigated Bianchi Type-III magnetized string cosmological model for perfect fluid distribution in gravity. Mete and Mule (2017) have investigatedBianchi-VIO magnetized cosmological model in gravity.

## 2. The Metric and Field Equations

We consider the Bianchi type- VIII universe specified in the form

$$ds^{2} = dt^{2} - A^{2}dx^{2} - [A^{2}\cosh^{2}x + B^{2}\sinh^{2}x]dy^{2} - B^{2}dz^{2} - 2B^{2}\sinh xdydz , (2.1)$$

where A and B are functions of time t.

The field equation of f(R, T), theory (Harko *et.al*, 2011) are deduced by varying the action

$$S = \int f(R,T) \sqrt{-g} d^4 x + \int L_m \sqrt{-g} d^4 x, \qquad (2.2)$$

where f(R,T) is an arbitrary function of Ricci scalar R, T is a the trace of the stress energy matter and  $L_m$  is the matter of Lagrangian

$$T_{ij} = L_m g_{ij} - 2 \frac{\partial L_m}{\partial g^{ij}}$$
(2.3)

Varying the action (2.2) with respect to  $g^{ij}$  which yields as

$$\delta = \frac{1}{2x} \int \left\{ f_R(R,T) \frac{\partial R}{\partial g^{ij}} + f_T(R,T) \frac{\partial T}{\partial g^{ij}} + \frac{f(R,T)}{\sqrt{-g}} \frac{\partial \sqrt{-g}}{\partial g^{ij}} + \frac{2\chi}{\sqrt{-g}} \frac{\partial \left(L_m \sqrt{-g}\right)}{\partial g^{ij}} \right\} \sqrt{-g} d^4x \quad , \quad (2.4)$$

Here ,we obtain

$$\theta_{ij} = g^{\alpha\beta} \frac{\partial T_{\alpha\beta}}{\partial g^{ij}}$$
(2.5)

where  $f_R(R,T) = \frac{\partial f(R)}{\partial R}$ ,  $f_T(R,T) = \frac{\partial f(R)}{\partial T}$  and  $\nabla_i$  is the covariant derivative.

Defining the generalized kroneker symbol  $\frac{\delta g^{\alpha\beta}}{\delta g^{ij}} = \delta_i^{\alpha} \delta_j^{\beta}$ 

We can deduced  $\frac{\delta g^{\alpha\beta}}{\delta e^{ij}} T_{\alpha\beta} = T_{ij}$ 

Using above equation we can write

$$\frac{\delta T}{\delta g^{ij}} = \frac{\delta(g^{\alpha\beta}T_{\alpha\beta})}{\delta g^{ij}} = \frac{\delta(g^{\alpha\beta})}{\delta g^{ij}}T_{\alpha\beta} + \frac{\delta(T_{\alpha\beta})g^{\alpha\beta}}{\delta g^{ij}} = T_{ij} + \theta_{ij}$$

Considering  $\delta S = 0$  from equation (2.3) upon integration we obtain

$$f_{R}(R,T)R_{ij} - \frac{1}{2}f(R,T)g_{ij} + (g_{ij} \Box - \nabla_{i}\nabla_{j})f_{R}(R,T) = \chi T_{ij} - f_{T}(R,T)[T_{ij} + \theta_{ij}], (2.6)$$

Taking trace of equation

Taking trace of equation (2.6), we get  

$$\Box f_{R}(R,T) = \frac{2}{3}f(R,T) - \frac{1}{3}f_{R}(R,T)R + \frac{1}{3}\chi T - \frac{1}{3}f_{R}(R,T)[T+\theta]. \quad (2.7)$$
We define the equation (2.6) is the set of (0, T) is the s

We consider the case f(R,T) given by

$$f(R,T) = R + \lambda T.$$

In this case, we have

$$f_R(R,T) = \frac{\partial f(R,T)}{\partial R} = 1 \text{ and } f_T(R,T) = \frac{\partial f(R,T)}{\partial T} = \lambda$$
 (2.8)

Hence equation (2.6), leads to

$$R_{ij} - \frac{1}{2} f(R + \lambda T) g_{ij} = \chi T_{ij} - \lambda [T_{ij} + \theta_{ij}].$$
(2.9a)

From equations (2.8) and (2.7), we get  

$$R + \lambda T = \lambda \theta - \chi T$$
. (2.9b)

Using equations (2.9a) and (2.9b), we obtain the field equation as

$$R_{j}^{i} = \chi \left[ T_{j}^{i} - \frac{1}{2} T g_{j}^{i} \right] - \lambda \left[ T_{j}^{i} + \theta_{j}^{i} \right] + \frac{1}{2} \lambda \theta g_{j}^{i}, \qquad (2.10)$$

Let us now calculate Tensor  $\theta_{ij}$ . Varying the equation (2.3) with respect to metric tensor  $g^{ij}$  and using the

(3.2)

(3.4)

(3.5)

(3.6)

definition (2.5), we obtain

$$\theta_{ij} = -T_{ij} + 2 \left[ \frac{\partial L_m}{\partial g^{ij}} - g^{\alpha\beta} \frac{\partial^2 L_m}{\partial g^{ij} \partial g^{\alpha\beta}} - \frac{\partial L_m}{\partial g^{ij}} \right].$$
**3. Matter Field Lagrangian:**  
The electromagnetic field tensor is given by
$$P = \frac{\partial A_i}{\partial A_i}$$
(2.11)

## 3. Matter Field Lagrangian:

The electromagnetic field tensor is given by

$$F_{ij} = \frac{\partial A_i}{\partial x^j} - \frac{\partial A_j}{\partial x^i} .$$
(3.1)

Where  $A_i$  is ectromagnetic four potential.

Let 
$$L_m = \left[\frac{1}{4\pi}F_{ij}F^{ij} - \frac{1}{2}\phi_i\phi^i\phi\right],$$

where  $\varphi = \varphi(I)$ 

The matter tensor in (2.3) canconveniently expressed in mixed tensor form as

$$T_i^{\ j} = \left[F_{\alpha}^i F_j^{\alpha} + \frac{1}{4}g_j^i F_{\alpha\beta}F^{\alpha\beta}\right] - \left[\frac{1}{2}\varphi g_j^i - \dot{\varphi}A^i A_j\right]\phi_{,\eta}\phi^{,n} + \varphi\phi^{,i}\phi_{,j}.$$
 (3.3)

Similarly equation (2.11), can be written as

$$\theta_i^j = -T_i^j - (\varphi I \dot{\varphi}) \phi^i \phi_{,j} + I \ddot{\varphi} \phi_{,n} \phi^n A^i A$$

The equations(3.3) and (3.4), after contraction yield

$$T = -(\varphi - I\dot{\varphi})\phi_{,n}\phi^{,n}$$

 $\theta = I^2 \ddot{\varphi} \phi_n \phi^n$ 

4.Electromagnetic field tensor:

We assume electromagnetic vector potential in the form

$$A_{i} = [u(x)v_{1}(t), v_{2}(t), v_{3}(t), v_{4}(t)]$$
(4.1)

$$F_{14} = u\dot{v}_1, F_{24} = \dot{v}_2, F_{34} = \dot{v}_3,$$

$$F_{14} = u\dot{v}_1, F_{24} = \dot{v}_2, F_{34} = \dot{v}_3,$$

$$(4.2)$$

$$F^{14} = F_4^1 = \frac{-uv_1}{A^2}, F^{24} = F_4^2 = \frac{-v_2}{A^2 \cosh x^2} + \frac{\sinh x}{A^2 \cosh x^2} \dot{v}_3, \tag{4.3}$$

$$F^{34} = F_4^3 = \frac{\sinh x}{A^2 \cosh x^2} \dot{v}_2 - \left(\frac{1}{B^2} + \frac{\tanh^2 x}{A^2} \dot{v}_3\right),\tag{4.4}$$

From equations (4.2) and (4.3), we write

$$F_{ij}F^{ij} = -2\left[\frac{u^2\dot{v}_1^2}{A^2} + \frac{\dot{v}_2^2}{A\cosh^2 x} - 2\frac{\sinh x}{A^2\cosh^2 x}\dot{v}_2\dot{v}_3 + \left(\frac{1}{B^2} + \frac{\tanh^2 x}{A^2}\right)\dot{v}_3^2\right].$$
 (4.5)  
$$\phi^{,i}\phi_{,j} = \dot{\phi}^2$$
(4.6)

From equation (3.3), we deduced the nonzero components of the energy momentum tensor of material fields.

$$T_{1}^{1} = \frac{1}{2} \frac{u^{2} \dot{v}_{1}^{2}}{A^{2}} - \frac{1}{2} \frac{\dot{v}_{2}^{2}}{A \cosh^{2} x} - \frac{1}{2} \left( \frac{1}{B^{2}} + \frac{\tanh^{2} x}{A^{2}} \right) \dot{v}_{3}^{2} + \frac{\sinh x}{A^{2} \cosh x^{2}} \dot{v}_{2} \dot{v}_{3}$$

$$- \frac{1}{2} \phi \dot{\phi}^{2} - \dot{\phi} \dot{\phi}^{2} \frac{u^{2} v_{1}^{2}}{A^{2}}$$

$$T_{2}^{1} = \frac{u \dot{v}_{1} \dot{v}_{2}}{A^{2}} - \dot{\phi} \dot{\phi}^{2} \frac{u v_{1} v_{2}}{A^{2}},$$
(4.7a)
$$T_{2}^{1} = \frac{u \dot{v}_{1} \dot{v}_{2}}{A^{2}} - \dot{\phi} \dot{\phi}^{2} \frac{u v_{1} v_{2}}{A^{2}},$$
(4.7b)

$$T_3^1 = \frac{uv_1v_3}{A^2} - \dot{\phi}\dot{\phi}^2 \frac{uv_1v_3}{A^2}, \qquad (4.7c)$$

$$\begin{split} T_{2}^{2} &= -\frac{1}{2} \frac{u^{2} \dot{v}_{1}^{2}}{A^{2}} + \frac{1}{2} \frac{\dot{v}_{2}^{2}}{A \cosh^{2} x} - \frac{1}{2} \left( \frac{1}{B^{2}} + \frac{\tanh^{2} x}{A^{2}} \right) \dot{v}_{3}^{2} - \frac{1}{2} \varphi \dot{\phi}^{2} \\ &\quad -\dot{\phi} \dot{\phi}^{2} \left[ \frac{v_{2}^{2}}{A^{2} \cosh^{2} x} - \frac{\sinh x}{A^{2} \cosh x^{2}} v_{2} v_{3} \right] \end{split} \tag{4.7d} \\ T_{3}^{2} &= \frac{\dot{v}_{2} \dot{v}_{3}}{A^{2} \cosh^{2} x} - \frac{\sinh x}{A^{2} \cosh^{2}} \dot{v}_{3}^{2} - \dot{\phi} \dot{\phi}^{2} \left[ \frac{v_{2} v_{3}}{A^{2} \cosh^{2} x} - \frac{\sinh x}{A^{2} \cosh^{2} x} v_{3}^{2} \right] \qquad (4.7e) \\ T_{3}^{3} &= -\frac{1}{2} \frac{u^{2} \dot{v}_{1}^{2}}{A^{2}} - \frac{1}{2} \frac{\dot{v}_{2}^{2}}{A \cosh^{2} x} + \frac{1}{2} \left( \frac{1}{B^{2}} + \frac{\tanh^{2} x}{A^{2}} \right) \dot{v}_{3}^{2} - \frac{1}{2} \varphi \dot{\phi}^{2} \\ &\quad -\dot{\phi} \dot{\phi}^{2} \left[ \frac{\sinh x}{A^{2} \cosh^{2} x} v_{2} v_{3} - \left( \frac{1}{B^{2}} + \frac{\tanh^{2} x}{A^{2}} \right) \dot{v}_{3}^{2} \right] \end{aligned} \tag{4.7e} \\ T_{4}^{4} &= \frac{1}{2} \frac{u^{2} \dot{v}_{1}^{2}}{A^{2}} + \frac{1}{2} \frac{\dot{v}_{2}^{2}}{A \cosh^{2} x} + \frac{1}{2} \left( \frac{1}{B^{2}} + \frac{\tanh^{2} x}{A^{2}} \right) \dot{v}_{3}^{2} - \frac{\sinh x}{A \cosh^{2} x} \dot{v}_{2} \dot{v}_{3} + \frac{1}{2} \varphi \dot{\phi}^{2} \\ &\quad + \frac{1}{2} \dot{\phi} \dot{\phi}^{2} + \dot{\phi} \dot{\phi}^{2} v_{4}^{2} \end{aligned} \tag{4.7g} \end{aligned}$$

From equation (3.3), we can deduced the tensor  $\theta_i^j$  as 49–6381

$$\theta_{1}^{1} = -T_{1}^{1} - I\dot{\varphi}^{2}\dot{\phi}^{2}\frac{u^{2}v_{1}^{2}}{A^{2}}$$

$$\theta_{2}^{1} = -T_{2}^{1} - I\dot{\varphi}^{2}\dot{\phi}^{2}\frac{uv_{1}v_{2}}{A^{2}}$$

$$\theta_{3}^{1} = -T_{3}^{1} - I\ddot{\varphi}^{2}\dot{\phi}^{2}\frac{uv_{1}v_{3}}{A^{2}}$$
(4.8a)
(4.8b)
(4.8b)
(4.8c)

$$\theta_2^2 = -T_2^2 - I\ddot{\varphi}^2\dot{\phi}^2 \left[\frac{v_2^2}{A^2\cosh^2 x} - \frac{\sinh x}{A^2\cosh^2 x}v_2v_3\right]$$
(4.8d)

$$\begin{aligned} \theta_{3}^{2} &= -T_{3}^{2} - I \,\ddot{\varphi}^{2} \dot{\phi}^{2} \bigg[ \frac{v_{2}v_{3}}{A^{2}\cosh^{2} x} - \frac{\sinh x}{A^{2}\cosh^{2} x} v_{3}^{2} \bigg] \end{aligned} \tag{4.8e} \\ \theta_{3}^{3} &= -T_{3}^{3} - I \ddot{\varphi}^{2} \dot{\phi}^{2} \bigg[ \bigg( \frac{1}{B^{2}} + \frac{\tanh^{2} x}{A^{2}} \bigg) v_{3}^{2} - \frac{\sinh x}{A^{2}\cosh^{2} x} v_{2}v_{3} \bigg] \end{aligned} \tag{4.8e} \\ \theta_{4}^{4} &= -T_{4}^{4} - \big( \varphi - I \dot{\varphi} \big) \dot{\varphi} + I \ddot{\varphi}^{2} \dot{\phi}^{2} v_{4}^{2} (4.8g) \\ \theta &= g^{ij} \theta_{ij} = I^{2} \ddot{\varphi}^{2} \dot{\phi}^{2} (4.8h) \end{aligned}$$

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Following Bijan Saha(2015) variation of Lagrangian  $L_m$  with respect to electromagnetic field gives

$$\begin{aligned} \frac{1}{\sqrt{-g}} \frac{\partial}{\partial x_i} \left( \sqrt{-g} F^{ij} \right) - \left( \phi^i \phi_i \right) \dot{\rho} \dot{A}^i &= 0, \end{aligned} \tag{4.9} \\ \left( \dot{\frac{v}{v_i}} \right)^i + \dot{\frac{v}{v_i^2}} + \dot{\frac{v}{v_i}} \left[ \frac{\dot{B}}{B} \right] &= \phi \phi^2, \end{aligned} \tag{4.9a} \\ \left( \frac{\dot{\frac{v}{v_i}}}{v_i} \right)^i + \frac{\dot{\frac{v}{v_i^2}}}{v_i^2} + \frac{\dot{\frac{v}{v_i}}}{v_i} \left[ \frac{\dot{B}}{B} \right] &= \phi \phi^2, \end{aligned} \tag{4.9a} \\ \left( \frac{\dot{\frac{v}{v_i}}}{v_i} \right)^i + \frac{\dot{\frac{v}{v_i^2}}}{v_i^2} + \frac{\dot{\frac{v}{v_i}}}{v_i} \left[ 2\frac{\dot{A}}{A} - \frac{\dot{B}}{B} \right] &= \phi \phi^2, \end{aligned} \tag{4.9c} \\ u = c_1 \sec hx, \end{aligned} \tag{4.9d} \\ where c_i is constant of integration. \end{aligned} \tag{4.9d} \\ \text{Consider the components of Ricci tensor  $R_i^1, R_i^1, R_i^2$  in the filed equation (2.10), we can deduce  $\frac{\dot{v}_i \dot{v}_i}{v_i v_i} &= \phi \dot{\phi}^2 - \frac{\lambda}{\chi} I \ddot{\phi} \phi^2 \qquad (4.10a) \end{aligned}$   
$$\frac{\dot{v}_i \dot{v}_i}{v_i v_i} &= \phi \dot{\phi}^2 - \frac{\lambda}{\chi} I \ddot{\phi} \phi^2 \qquad (4.10a) \end{aligned}$$
  
$$\frac{\dot{v}_i \dot{v}_i}{v_i v_i} &= \phi \dot{\phi}^2 - \frac{\lambda}{\chi} I \ddot{\phi} \phi^2 \qquad (4.10a) \end{aligned}$$
  
$$\frac{\dot{v}_i \dot{v}_i}{v_i v_i} &= \dot{\phi} \dot{\phi}^2 - \frac{\lambda}{\chi} I \ddot{\phi} \phi^2 \qquad (4.10c) \end{aligned}$$
  
From equations(4.10a,b,c), we can write   
$$\frac{\dot{v}_i \dot{v}_i}{v_i v_i} &= \frac{\dot{v}_i \dot{v}_i}{v_i v_j} &= \frac{\dot{v}_i \dot{v}_j}{v_i v_j} &= \dot{\phi} \dot{\phi}^2 - \frac{\lambda}{\chi} I \ddot{\phi} \phi^2 \qquad (4.11) \end{aligned}$$
  
Where h is some function of t  
From equations(4.12) and (4.11), we get   
$$\left( \frac{\dot{h}}{h} \right)^2 &= \left( \frac{\dot{h}}{h} \right)^2 &= \phi \dot{\phi}^2 - \frac{\lambda}{\chi} I \ddot{\phi} \phi^2 \qquad (4.13) \end{aligned}$$
  
Integrating equations (4.12), we get   
 $v_i = c_i h, v_2 = c_i h, v_3 = c_i h. \qquad (4.14) \end{aligned}$   
Where  $c_i c_i c_i$  are constant of integration   
Consider the expression and using equation (4.13), yields   
$$\frac{d^2 \dot{v}_i^2}{A^2} + \frac{\dot{v}_i^2}{A \cosh^2 x} + \left( \frac{1}{B^2} + \frac{\tanh^2 x}{A^2} \right) v_i^2 - \frac{2 \sinh x}{A \cosh^2 x} v_i v_j = \\ \left( \frac{u^2 v_i^2}{A^2} + \frac{v_i^2}{A \cosh^2 x} + \left( \frac{1}{B^2} + \frac{\tanh^2 x}{A^2} \right) v_i^2 - \frac{2 \sinh x}{A \cosh^2 x} v_i v_j$$$$

$$=\frac{\lambda}{\chi}I^{2}\ddot{\varphi}\phi^{2}-\ddot{\varphi}I\dot{\phi}^{2}$$
(4.15)

For simplicity we convert  $T_j^{i}$  in (4.7) in terms of  $T_4^{4}$  as

$$T_{4}^{4} = \frac{1}{2} \frac{\lambda}{\chi} I^{2} \ddot{\varphi} \phi^{2} - \ddot{\varphi} I \dot{\phi}^{2} - \frac{1}{2} I \ddot{\varphi} \phi^{2}$$
(4.16a)

$$T_1^{1} = -T_4^{4} - \frac{\lambda}{\chi} I \ddot{\varphi} \dot{\phi}^2 \frac{u^2 v_1^{2}}{A^2}$$
(4.16b)

$$T_{2}^{2} = -T_{4}^{4} - \frac{\lambda}{\chi} I \ddot{\varphi} \phi^{2} \left[ \frac{v_{2}^{2}}{A^{2} \cosh^{2} x} - \frac{\sinh x}{A^{2} \cosh^{2} x} v_{2} v_{3} \right]$$
(4.16c)

$$T_{3}^{3} = -T_{4}^{4} - \frac{\lambda}{\chi} I \ddot{\varphi} \phi^{2} \left[ \left( \frac{1}{B^{2}} + \frac{\tanh^{2} x}{A^{2}} \right) v_{3}^{2} - \frac{\sinh x}{A^{2} \cosh^{2} x} v_{2} v_{3} \right]$$
(4.16d)  
$$T = -(\varphi - I \dot{\varphi}) \dot{\phi}^{2}$$
(4.16e)

## **5.Solution of Field Equations:**

The field equation (3.1) for the metric equations (4.16) with help of equations and (4.8), can be written as

$\frac{\dot{A}^2}{\dot{A}^2} + \frac{\ddot{A}}{\dot{A}} + \frac{\dot{A}\dot{B}}{\dot{A}B} - \frac{B^2}{2\dot{A}^4} - \frac{1}{\dot{A}^2} = 0,$	(5.1a)	rch
$A^2  A  AB  2A^2  A^2$		C
$\frac{A^{2}}{A^{2}} + \frac{A}{A} + \frac{AB}{AB} - \frac{1}{A^{2}} = 0,$	(5.2b)	oun
$\frac{\ddot{B}}{B} + 2\frac{\dot{A}\dot{B}}{AB} + \frac{B^2}{A^4} = 0,$	(5.3c)	ha/
With the help of (4.12), we can write equation (4.9) as	E	
$\left(\frac{\dot{h}}{h}\right) + \left(\frac{\dot{h}}{h}\right)^2 + \frac{\dot{h}}{h}\left(\frac{\dot{B}}{B}\right) = \dot{\phi}\dot{\phi}^2$	(5.4a)	
$\left(\frac{\dot{h}}{h}\right) + \left(\frac{\dot{h}}{h}\right)^2 + \frac{\dot{h}}{h}\left(2\frac{\dot{A}}{A} - \frac{\dot{B}}{B}\right) = \dot{\phi}\dot{\phi}^2$	(5.4b)	
Equating the equations (5.4a) and (5.4b), we get		
$\frac{\dot{A}}{A} = \frac{\dot{B}}{B}$	(5.5)	
which on integration yield		
A = B	(5.6)	
For existing solution the constant of integration is absorbed in $A$ and $B$	•	
With the aid of equation (5.6) the equations (5.1) reducing to $\frac{1}{2}$		
$\frac{A}{A} + 2\frac{A^2}{A^2} - \frac{1}{A^2} = 0$	(5.7a)	

$$\frac{\ddot{A}}{A} + 2\frac{\dot{A}^2}{A^2} + \frac{1}{A^2} = 0$$
(5.7b)

Ussing equations (5.7a)and(5.7a), we get

$$\frac{\ddot{A}}{A} + 2\frac{\dot{A}^2}{A^2} = 0$$
(5.8)

Integrating equation (5.8), we get

$$A = B = (3c_5 + 3c_6)^{\frac{1}{3}}$$
(5.9)
From equations (5.4) and (5.0), we get

From equations (5.4) and (5.9), we get

1

$$\left(\frac{\dot{h}}{h}\right) + \left(\frac{\dot{h}}{h}\right)^2 + \frac{\dot{h}}{h} \left(\frac{c_5}{3c_5 + 3c_6}\right) = \dot{\phi}\dot{\phi}^2.$$
(5.10)

But from equation (4.13), we obtain

$$\dot{\varphi}\dot{\phi}^{2} = \left(\frac{\dot{h}}{h}\right)^{2} + \frac{\lambda}{\chi}I\ddot{\varphi}\phi^{2}, \qquad (5.11)$$

$$\left(\frac{\dot{h}}{h}\right)^{\bullet} + \left(\frac{\dot{h}}{h}\right)^{2} + \frac{\dot{h}}{h}\left(\frac{c_{5}}{3c_{5} + 3c_{6}}\right) = \left(\frac{\dot{h}}{h}\right)^{2} + \frac{\lambda}{\chi}I\ddot{\varphi}\phi^{2}$$

$$\left(\frac{\dot{h}}{h}\right)^{\bullet} + \frac{\dot{h}}{h}\left(\frac{c_{5}}{3c_{5} + 3c_{6}}\right) = \left(\frac{\dot{h}}{h}\right)^{2} + \frac{\lambda}{\chi}I\ddot{\varphi}\phi^{2} \qquad (5.12)$$

If we confine the function  $\varphi(I)$  as linear function  $\ddot{\varphi} = 0$  or  $\varphi = c_7 I + c_8$  then (4.26) has the solution

$$h = c_9 \exp\left[\left(c_8 t + 3c_6\right)^{\frac{2}{3}}\right]$$
 (5.13)  
With the aid of (5.13) the equations (4.14), convert in to

$$v_{1} = c_{11} \exp \left[ c_{10} (3c_{5}t + 3c_{6})^{2/3} \right]$$
(5.14a)  

$$v_{2} = c_{12} \exp \left[ c_{10} (3c_{5}t + 3c_{6})^{2/3} \right]$$
(5.14b)  

$$v_{3} = c_{13} \exp \left[ c_{10} (3c_{5}t + 3c_{6})^{2/3} \right]$$
(5.14b)  
From equation (4.13), we obtain  

$$\phi = c_{15} (c_{6}t + 3c_{6})^{2/3} + c_{14},$$
(5.15)

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where  $c_i$  are constant of integration

## 6. Cosmological solution for variable declaration parameter

We consider the deceleration parameter to be a variable

$$q = -\frac{a\ddot{a}}{\dot{a}^2}.$$
 (6.1)

where $a$ is average scale factor given by		
$a^2 = AB$ .	(6.	.2)
From equations $(6.2)$ and $(5.9)$ , we have		
$a = (3c_5t + 3c_6)^{2/3}.$	(6.	3)
Using equations $(6.3)$ and $(6.1)$ , we get		

$$g = \frac{7}{2c_5} (3c_5 t + 3c_6)^{\frac{1}{9}}.$$
 (6.4)

## 7. The Physical and Kinematical Properties of the Model:

The physical quantities of observational interest in cosmology are The spatial volume is obtained as

 $V = (3c_5t + 3c_6)\cosh x \,.$ 

(7.1)
(7.3)

(7.4)

(7.5)

(7.6)

(7.8)

The mean Hubble parameter is given by

$$H = \frac{c_5}{(3c_5t + 3c_6)}.$$
(7.2)

The expansion scalar is obtained as

$$\theta = 3H = \left(2\frac{\dot{A}}{A} + \frac{\dot{B}}{B}\right)$$
$$\theta = 3H = \frac{3c_5}{(3c_5t + 3c_6)},$$

The shear scalar gives

$$\sigma^{2} = \frac{1}{2} \sum_{i=1}^{3} H_{i}^{2} - \frac{\theta^{2}}{6},$$
  
$$\sigma^{2} = 0$$

The mean anisotropic parameter  $A_m$  as  $\Im$ 

$$A_m = \frac{1}{3} \sum_{i=1}^{3} \left( \frac{H_i - H}{H} \right)^2$$

 $A_{m} = 0.$ 

The deceleration parameter is given by

$$q = \frac{7}{2}$$

The cosmic Jerk parameter is given by,

$$J = q + 2q^2 - \frac{q}{H}$$
$$= 28.$$

The state finder (r, s) parameters is given by

$$r = \frac{224}{27}c_5 \frac{1}{(3c_5t + 3c_6)}, s = \frac{224}{243}c_5 \frac{1}{(3c_5t + 3c_6)}$$
(7.9)

#### Conclusion

In this paper, we have considered the particular case of theory of gravity in Bianchi type- metric. It is observed that the convergent, non-singular isotropic solution is evolved along with the component of vector potential. Investigated model shows that the universe expands algebraically in theory of gravity. The metric function (scalar factor) in non-static space time admit constant value at early time of the universe and after that metric function starts increasing with increasing in cosmic time, and finally diverges to as . This show that universe expands and approaches to infinite volume. The variable deceleration parameter increases with cosmic time. The spatial volume increases with time and tends to infinitely large time. The average Hubble parameter and the scalar expansion tend to zero as t becomes infinitely large and they all become infinitely large as t goes to zero. It is also observed that the model does not remain anisotropic throughout the evolution of the universe so that it exhibits a transition from decelerated phase to accelerated phase at late times which is in agreement with the late time acceleration of the universe in modern cosmology. It is well known that if q >0 the universe decelerates in the standard way and accelerates when q <0. Here the models decelerate in the standard way. Cosmologists believe that deceleration to acceleration transition of the universe occurs for models with positive value of jerk parameter. The jerk parameter and state finder parametersremains positive.

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# Bianchi type-V Cosmological model with G and $\Lambda$ in Scale Covariant Theory of Gravitation

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#### Abstract:

In this paper, we have investigated some features of anisotropic accelerating Bianchi type-V cosmological models in the presence of perfect fluid, variable gravitational and cosmological constants towards the gravitational field equations for scale covariant theory of Gravitation. With the help of special law of variation of Hubble's parameter proposed by Berman (1983) which yields constant deceleration parameter of the models, we achieve a physically realistic solution to the field equations. Some geometrical and physical aspects of derived model are discussed with the help of solution and make the models at late times turn out to be flat Universe.

Keywords: Bianchi type-V cosmological model; scale covariant theory of gravitation.

#### Introduction:

Since, the Einstein field equation has two parameters; one is the gravitational constant G and second is the cosmological constant  $\Lambda$ . As, the Newtonian constant of gravitation G plays the role of a coupling constant between geometry and matter in the Einstein field equation. In an evolving universe, it appears to look at this constant as a function of time. There are significant observational evidence that the expansion of the Universe is undergoing a late time acceleration [1–5]. This, in other words, amounts to saying that in the context of Einstein's General Theory of Relativity some sort of dark energy, constant or that varies only slowly with time and space dominates the current composition of cosmos.

Among many possible alternatives, the simplest and most theoretically appealing possibility for dark

energy is the energy density stored on the vacuum state of all existing fields in the universe, i.e.,  $\rho = \frac{\Lambda}{\rho_{eq}}$ 

where  $\Lambda$  is the cosmological constant. However, a constant  $\Lambda$  cannot explain the huge difference between the cosmological constant inferred from observation and the vacuum energy density resulting from quantum field theories. In an attempt to solve this problem, variable  $\Lambda$  was introduced such that  $\Lambda$  was large in the early universeand then decayed with evolution. Cosmological scenarios with a time-varying  $\Lambda$  were proposed by several researchers such as Vishwakarma [6], Cunha and Santos [7]; Carneiro and Lima [8]. A modification linking the variation of G with that of variable  $\Lambda$  term has been considered within the framework of General Relativity by a number of workers such as Berman [9] Kallingas *et al.* [10]. This modification is appealing as it leaves the form of Einstein's equations formally unchanged by allowing a variation of G to be accompanied by a change in  $\Lambda$ . Cosmological models with time-dependent G and  $\Lambda$  in the solutions  $\Lambda \approx R^2$ ,  $\Lambda \approx t^{-2}$  were first obtained by Bertolami [11]. The cosmological models with variable G and  $\Lambda$  have been studied by several authors like Arbab [12]; Sattar and Vishwakarma [13]; Pradhan *et al.* [14-16]; Singh *et al.* [17, 18].

The Scale-Covariant Theory of Gravitation by associating the mathematical operation of scale transformation with the physics of using different dynamical systems to measure space-time distances [19], also, which provides the necessary theoretical framework to logically talk about the possible variation of the gravitational constant G without compromising the validity of General Relativity. In this theory, we measure physical quantities in atomic units whereas Einstein's field equations in gravitational units. The metric tensor in the two systems of units are related by a conformal transformation,

$$\overline{g}_{ij} = \phi^2 g_{ij} \,, \tag{1}$$

where the metric  $\overline{g}_{ij}$  giving macroscopic metric properties and  $g_{ij}$  giving microscopic metric properties. Here we consider the gauge function  $\phi$  as a function of time.

(3)

The general Einstein's field equations by using the conformal transformations equations (in scalecovariant theory of gravitation) is,

$$R_{ij} - \frac{1}{2}g_{ij}R + f_{ij}(\phi) = -8\pi G T_{ij} + \Lambda g_{ij}, \qquad (2)$$

where

$$\phi^2 f_{ij}(\phi) = 2\phi\phi_{i;j} - 4\phi_i\phi_j - g_{ij}(\phi\phi_{;\lambda}^{\lambda} - \phi^{\lambda}\phi_{\lambda}).$$

Here comma denotes ordinary partial differentiation whereas a semi-colon denotes a covariant differentiation.

## 2. Field equations, metric and general expressions

We consider the line element for an anisotropic Bianchi type-V space-time is of the form as

$$ds^{2} = dt^{2} - A^{2} dx^{2} - e^{2mx} B^{2} dy^{2} - e^{2mx} C^{2} dz^{2},$$
(4)

where the scale factors *A*, *B*, *C* being functions of cosmic time only and*m* be the any arbitrary constants. The source of gravitational field is considered as a perfect fluid. So for aperfect fluid, the energy momentum tensor is given by

$$T_{ij} = (p + \rho)u_i u_j - pg_{ij},$$
(5)

where  $\rho$  is the energy-density, p the pressure and  $u^i$  is the four velocity vector of the fluid following  $u^i u_j = 1$ .

The general formulas of certain physical parameters for the metric equation (4) are given as follows: The average scale factor and spatial volume respectively as

$$R = (ABC)^{\frac{1}{3}}, \qquad V = ABC \tag{6}$$

The generalized mean Hubble parameter which expresses the expansion rate of the space-time, can be given as

$$H = \frac{1}{3} (H_1 + H_2 + H_3), \tag{7}$$

where  $H_1, H_2, H_3$  are the directional Hubble parameter in the direction of x, y, and z-axis respectively. It should be noted that the parameters *H*, *V* and *R* are connected by the following relation

$$H = \frac{1}{3}\frac{\dot{V}}{V} = \frac{\dot{R}}{R},$$
(8)

To discussed whether the models either approach isotropy or not, we define an anisotropy parameter of the expansion as

$$A_m = \frac{1}{3} \sum_{i=1}^{3} \left( \frac{H_i - H}{H} \right)^2. \tag{9}$$

where  $H = (\ln R)^{\tilde{}} = \frac{\dot{R}}{R} = \frac{1}{3}(H_1 + H_2 + H_3)$ ,  $H_1 = \frac{\dot{A}}{A}$ ,  $H_2 = \frac{\dot{B}}{B}$ ,  $H_3 = \frac{\dot{C}}{C}$  are the directional Hubble

parameters of *x*, *y* and *z* axes respectively.

The expansion scalar and shear scalar respectively are defined as follows

$$\theta = u^{\mu}_{;\mu} = \frac{\dot{A}}{A} + \frac{\dot{B}}{B} + \frac{\dot{C}}{C},$$
(10)
$$\sigma^{2} = \frac{3}{2}H^{2}A_{m}.$$
(11)

Another important dimensionless kinematic quantity is the deceleration parameter, which showswhether the universe exhibits accelerating volumetric expansion or not:

$$q = -1 + \frac{d}{dH} \left(\frac{1}{H}\right),\tag{12}$$

For  $-1 \le q < 0$ , q > 0 and q = 0 the universe exhibit accelerating volumetric expansion, decelerating volumetric expansion and constant-rate volumetric expansion respectively.

The components of the field equations given in equations (2) and (3) for the metric equation (4) using the source as a perfect fluid provided in equation (5), are given as follows

$$\frac{\ddot{B}}{B} + \frac{\ddot{C}}{C} + \frac{\dot{B}}{B}\frac{\dot{C}}{C} - \frac{m^2}{A^2} = \left(-8\pi\right)pG - \Lambda + 2\left(\frac{\dot{B}}{B} + \frac{\dot{C}}{C} - \frac{\dot{\phi}}{\phi}\right)\frac{\dot{\phi}}{\phi} + 2\frac{\ddot{\phi}}{\phi},\tag{13}$$

$$\frac{\ddot{A}}{A} + \frac{\ddot{C}}{C} + \frac{\dot{A}}{A}\frac{\dot{C}}{C} - \frac{m^2}{A^2} = \left(-8\pi\right)pG - \Lambda + 2\left(\frac{\dot{A}}{A} + \frac{\dot{C}}{C} - \frac{\dot{\phi}}{\phi}\right)\frac{\dot{\phi}}{\phi} + 2\frac{\ddot{\phi}}{\phi},\tag{14}$$

$$\frac{\ddot{A}}{A} + \frac{\ddot{B}}{B} + \frac{\dot{A}}{A}\frac{\dot{B}}{B} - \frac{m^2}{A^2} = \left(-8\pi\right)pG - \Lambda + 2\left(\frac{\dot{A}}{A} + \frac{\dot{B}}{B} - \frac{\dot{\phi}}{\phi}\right)\frac{\dot{\phi}}{\phi} + 2\frac{\ddot{\phi}}{\phi},\tag{15}$$

$$\frac{\dot{A}}{A}\frac{\dot{B}}{B} + \frac{\dot{B}}{B}\frac{\dot{C}}{C} + \frac{\dot{A}}{A}\frac{\dot{C}}{C} - \frac{3m^2}{A^2} = (8\pi)\rho G - \Lambda + 2\left(\frac{\dot{A}}{A} + \frac{\dot{B}}{B} + \frac{\dot{C}}{C} - \frac{\dot{\phi}}{\phi}\right)\frac{\dot{\phi}}{\phi},\tag{16}$$

$$2\frac{\dot{A}}{A} + \frac{\dot{B}}{B} + \frac{\dot{C}}{C} = 0, \qquad (17)$$

Here in what follows an over dot denotes ordinary differentiation with respect to time *t*. The Vanishing divergence of the Einstein's tensor is

$$\left(R_{ij} - \frac{1}{2}g_{ij}R\right)_{;i} = 0, \qquad (18)$$
which leads to
$$8\pi\dot{G}\rho + \dot{\Lambda} + 8\pi G\left[\dot{\rho} + (p+\rho)\left(\frac{\dot{A}}{A} + \frac{\dot{B}}{B} + \frac{\dot{C}}{C}\right)\right] = 0. \qquad (19)$$
The law of conservation of energy is
$$\left(T_{;j}^{ij}\right) = 0, \qquad (20)$$
which leads to
$$\left[\dot{\rho} + (p+\rho)\left(\frac{\dot{A}}{A} + \frac{\dot{B}}{B} + \frac{\dot{C}}{C}\right)\right] = 0. \qquad (21)$$

Using the above equations (19) and (21), this gives  $320-638^{\circ}$ 

$$\dot{G} = -\frac{\dot{\Lambda}}{8\pi\rho},\tag{22}$$

Assume that the fluid obeys the condition of barotropic equation of state as  $p = \gamma \rho$ . Equation (17) yields  $A^2 = BC$ .

## 3. Solution of field equations

As the field equations (13)–(16) are a system of four equations with sevan unknown parameters. The system is thus initially undetermined and we need additional constraints to close the system. The observations of the velocity red-shift relation for extragalactic sources suggest that Hubble expansion of the Universe is isotropictoday with in  $\approx 30$  percent. To put it more precisely, red-shift studies place the limit as  $\sigma_H \leq 0.3$  on the ratio of shear  $\sigma$  to Hubble's parameter H in the neighborhood of our galaxytoday. Collin et al. (1980) have pointed out that for spatially homogeneous metric the normal congruence to the homogeneous expansion satisfies the condition that  $\sigma_H$  is constant, i.e., the expansion scalar is proportional to the shear scalar, which gives the relation between two metric potentials as

(23)

(24)

$$A = B^{1/\alpha},$$
(25)

where  $\alpha$  be the any positive constant.

In addition, with the help of special law of variation of Hubble's parameter proposed by Berman that yields constant deceleration parameter models of the universe,

$$q = -\frac{R\dot{R}}{\dot{R}^2} = \text{constant.}$$
(26)

where R be the overall scale factor. The constant is taken as negative to obtain an accelerating model of the universe.

From (26) we obtain

$$R = \left(at+b\right)^{\frac{1}{1+q}},\tag{27}$$

where  $a \neq 0$  and b are the constants of integration. Equation (6) yields

$$(ABC)^{\frac{1}{3}} = (at+b)^{\frac{1}{1+q}}.$$
Using (24) in (28) we find
$$A = (at+b)^{\frac{1}{(1+q)}},$$
(28)

 $B = \left(at + b\right)^{\underline{\alpha}}_{(1+q)},$ 

 $C = \left(at+b\right)^{\frac{2-\alpha}{(1+q)}}$ Hence, using the equations from (29) to (31) the line element for an anisotropic Bianchi type-V space-time is defined as

$$ds^{2} = dt^{2} - (at+b)\frac{2}{(1+q)}dx^{2} - (at+b)\frac{2\alpha}{(1+q)}e^{2mx}dy^{2} - (at+b)\frac{2(2-\alpha)}{(1+q)}e^{2mx}dz^{2}.$$
 (32)

The model (32) represents Bianchi type-V cosmological model with G and  $\Lambda$  in Scale-covariant theory of gravity with negative constant deceleration parameter. As the derived model is anisotropic with respect to constant  $\alpha$  (for  $\alpha \neq 1$  the model is anisotropic while for  $\alpha = 1$  the model is isotropic) along with the model has a singularity and the singularity observed at point. Atan initial stage, all the metric potentials are constants. Hence, initially the model has no singularity but at the point  $t_s = \frac{-b}{a}$ , above equation represent a singular model. As a special case for  $\alpha = 1$  our derived universe approaches isotropy.

# **4.** Physical Parameters **Energy Density**

$$\rho = \frac{k}{(at+b)^{\frac{3(1+\gamma)}{(1+q)}}}$$

It is observed that, the energy density obtained in the equation (33) is always positive except at  $a_1$  and decreasing function of cosmic time. The behavior of energy density versus cosmic time is clearly shown in figure (i) with the appropriate choice of constants.

Figure (i): The behavior of energy density versus cosmic time with the appropriate choice of constants.



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(30)

(31)

(33)

**Cosmological Constant**,

$$\Lambda = \frac{3a^2\beta}{(1+q)^2(at+b)^2} \,. \tag{34}$$

The cosmological constant derived in equation (34) is also always positive and decreases with cosmic time, the relation between are  $\Lambda \propto \frac{1}{t^2}$  i.e.  $\Lambda \propto t^{-2}$  as expected. The routine of cosmological constants versus cosmic time is clearly revealed in figure (*ii*) with the appropriate choice of constants. Hence in our investigation the behavior of Cosmological Constant resembles with the work investigated by Bertolami [11].



Figure (ii): The behavior of Cosmological constant versus cosmic time with the appropriate choice of constants.

As the behavior of cosmological constant is on the sign of the constants  $\alpha$  and  $\beta$ , if both  $\alpha > 0$  and  $\beta > 0$  or  $\alpha < 0$  and  $\beta < 0$  both the situations provided that  $\Lambda > 0$ . If either  $\alpha > 0$  and  $\beta < 0$  or  $\alpha < 0$  and  $\beta > 0$  the  $\Lambda < 0$ .

#### Gravitational Constant,

$$G = \frac{3a\beta}{8\pi k(1+q)(3\gamma - 2q + 1)} \left(at + b\right)^{\frac{(3\gamma - 2q + 1)}{(1+q)}}$$

The behavior gravitational constant versus cosmic time is clearly depicted in figure (*iii*) with the appropriate choice of constants.



Figure (iii): The behavior of Gravitational constant versus cosmic time with the appropriate choice of constants. As the gravitational constants is always constant, and increases with cosmic time hence  $G \propto t$  as expected.

#### Anisotropic Pressure,

$$p = \left(\frac{-1}{8\pi G}\right) \left(\frac{a^2(2+\alpha^2-2\alpha-2q-4n+n^2-2nq+3\beta)}{(1+q)^2(at+b)^2} - \frac{m^2}{(at+b)^2}\right).$$
(36)

(35)

From the equation (36), it is observe that the pressure in the derived model is always positive (which shows that there is no chance of dark energy) and decreases with respect to time (see the figure-*iv*). Hence the model is fully occupied with only barotropic fluid with radiation dominated era.



Figure (iv): The behavior of isotropic pressure versus cosmic time with the appropriate choice of constants.

#### 5. Kinematical Parameters

The kinematical properties which are important in cosmology for discussing the geometrical behavior of the universe that are spatial volume, Hubble parameter, expansion scalar, shear scalar and anisotropic parameter which have the following expressions

#### **Spatial volume**

$$V = (at+b)^{3/(1+q)} e^{2mt}$$

It is observed that the spatial volume V has constant value at an initial time t = 0, expands exponentially as t increases and becomes infinitely large at  $t = \infty$ .

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Hubble's parameter

$$H = \frac{a}{(1+q)(at+b)}$$

**Expansion scalar** 

$$\theta = \frac{3a}{(1+q)(at+b)}.$$

Shear scalar

$$\sigma^2 = \left[\frac{a(1-\alpha)}{(1+q)(at+b)}\right]^2$$

Anisotropy parameter

$$A_m = \frac{2}{3} (1-\alpha)^2.$$

It is observed that the kinematical parameters such as Hubble's parameter, expansion scalar, shear scalar and anisotropic parameter all are the functions of cosmic time with decreasing behavior. Hence at initially all are attending a constant value and with the expansion all are contracted and at an infinite expansion and at a singular point all are diverge. The ratio of  $\theta_{\sigma}$  tends to constant, thus the model approaches anisotropy and matter isdynamically negligible near the origin.

# **Deceleration parameter**

q = -0.5.

To describe the dynamics of the universe the deceleration parameter q is currently a serious candidate among all the physical quantities of interest in cosmology. According to the prediction of standard cosmology, the universe has a phase transition from decelerating to accelerating and also reveals that expansion of the universe is speeding up instead of slowing down in outlook of recent observational evidences of the high red shift of type-Ia supernova. The sign of q indicates whether the model accelerates or not. The positive sign of qcorresponds to decelerating models whereas the negative sign indicates acceleration.

## 6. Conclusion:

In the investigation anisotropic accelerating Bianchi type-V cosmological models in the presence of perfect fluid, variable gravitational and cosmological constants towards the gravitational field equations for scale covariant theory of gravitation using special law of variation of Hubble's parameter which yields constant value of deceleration parameter, it is observed that the models at late times and for  $\alpha = 0$  turn out to be flat Universe. The energy density is always positive and decreasing function of cosmic time except for  $a_1 > 0$ . Along with the cosmological constant also shows the same behavior as that of energy density i.e. always positive and decreases with cosmic time and the relation between them is  $\Lambda \propto \frac{1}{t^2}$  i.e.  $\Lambda \propto t^{-2}$  as expected which resembles with the work investigated by Bertolami [11]. The gravitational constants is always positive and increases with cosmic time. Due to the positive pressure in the derived model there is no chance of dark energy. Hence the model is fully occupied with only barotropic fluid. Also, The solutions correspond to a Big-bangsingular model at point  $t_s = -\frac{b}{a}$  where  $a \neq 0$ . At this point the kinematical quantities such as Hubble's parameter, expansion scalar, shear scalar and mean anisotropy parameter all are diverge but the spatial volume and scale factor vanishes.

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# Analysis of Cosmological Model Filled With Anisotropic Dark Energy Using Variable Deceleration Parameter

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#### Abstract:

In the present analysis, a new class of exact solutions has been obtained for Bianchi type-III cosmological models filled with anisotropic dark energy by considering a time dependent displacement field for variable deceleration parameter. Some physical and kinematical parameters are also discussed in details. *Keywords:* Cosmological model, dark energy, variable deceleration parameter.

#### 1. Introduction:

The most striking discovery of modern cosmology indicates that the current universe is not only expanding but also accelerating. Today, this behavior of the universe is confirmed by various independent observational data, including the Type-Ia Supernovae (SNe-Ia) Perlmutter et al. [1-4], fluctuation of cosmic microwave background radiation (CMBR) [5] and large scale structure (LSS) [6,7]. In addition, measurements of the cosmic microwave background (CMB) and the large scale structure (LSS) strongly indicate that our universe is dominated by a component with negative pressure, dubbed as dark energy. The dark energy model has been characterized in a conventional manner by the equation of state (EoS) parameter, which is not necessarily constant. The EoSlies close to -1. If it would be equal to -1 (standardL CDM cosmology), a little bit more than -1 (the quintessence dark energy) or less than -1 (phantom dark energy), while the possibility <<-1 is ruled out by current cosmological data from SNe-Ia. The simplest candidate for the dark energy is a cosmological constant L, which has pressure. Barber [8] proposed two self-creation cosmologies by modifying the Brans-Dicke theory [9] and General Relativity. These modified theories create the universe out of selfcontained gravitational and matter fields. Brans [9] has pointed out that Barber's first theory is not only in disagreement with experiments but it actually is inconsistent. Barber's second theory is a modification of general relativity. Various aspects of the self-creation theories have been investigated by Pimentel [10], Soleng [11,12], Reddy et al. [13], Singh [14], Maharaj et al. [15], Venkateswarlu et al. [16-18], Reddy [19], Pradhan et al. [20-22], and Katore et al. [23,24].

An important theoretical astronomic observation by Misner in 1968 and the modern experimental data have revealed that on large scale the universe is an isotropic and homogeneous in its present state of evolution but it might not be the same in the past. Therefore the models with anisotropic background that approach to isotropy at late times are most suitable for describing the entire evolution of the universe. The spatially homogeneous and anisotropic Kantowski-Sachs space-time provides such a framework along with it has astrophysical important because they are considered as possible candidates for an early era in cosmology. Hence the authors have interested to investigate the features of Kantowski-Sachs space-time in recent paper. Advantages of these anisotropic models are their flat spatial sections but the expansion or contraction rates are direction-dependent and they have a significant role in the description of the early phase evolution of the Universe. In other contexts, a numbers of authors [25-30] have considered homogeneous and anisotropic Bianchi type-I space-time, while Pradhan et al. [31], Tripathi et al. [32], Saha et al. [33], Amirhashchi and Zainuddin [34] and Katore et al. [35, 36] have studied string cosmological models in an altered situation.

Incited by above discussions, in this paper we propose the evolution of the dark energy parameter within the framework of a Bianchi type-III cosmological model filled with dark energy by considering a numerous form of scale factors.

## 2. Metric and field equations:

Consider the Bianchi type-III space-time in the form,

$$ds^2 = dt^2 - A^2 dr^2 - B^2 (d\theta^2 + \sinh^2 \theta d\phi^2), (1)$$

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(4)

where the scale factors A and B are functions of cosmic time t only.

Bianchi type-III class of metric represents homogeneous but anisotropically expanding (contracting) cosmologies and provide models where the effects of anisotropy can be estimated.

The Einstein Field equation equations are given by

$$R_{ij} - \frac{R}{2}g_{ij} = GT_{ij} \tag{2}$$

where the symbols have their usual meaning i.e.  $R_{ab}$  is Ricci Tenser, R is the Ricci Scalar and  $T_{ab}$  is the usual stress energy momentum tensor of the matter.

The simplest generalization of EoS parameter of perfect fluid may be to determine the EoS parameter separately on each spatial axis by preserving the diagonal form of the energy momentum tensor in a consistence way with the considered metric. Therefore, the energy momentum tensor of fluid can be written, most generally, in anisotropic diagonal form as follows: The Energy momentum tensor of fluid is taken as  $T_{i}^{i} = diag[T_{0}^{0}, T_{1}^{1}, T_{2}^{2}, T_{3}^{3}],$ (3)

Allowing for anisotropy in the pressure of the fluid, and thus in its EoS parameter, gives rise to new possibilities for the evolution of the energy source. To see this, we firstparameterize the energy momentum tensor given in (3) as follows:

$$T_{j}^{i} = diag[\rho, -p_{x}, -p_{y}, -p_{z}],$$
  
=  $diag[1, -\omega_{x}, -\omega_{y}, -\omega_{z}]\rho,$ 

$$= diag[1, -\omega, -(\omega + \delta), -(\omega + \delta)]\rho$$

where  $\rho$  is the energy density of the fluid  $p_x$ ,  $p_y$ ,  $p_z$  are the pressure and  $\omega_x$ ,  $\omega_y$ ,  $\omega_z$  are the directional *EoS* parameter along the *x*, *y*, *z* axis respectively and  $\omega(t) = p/\rho$  is the deviation free EoS parameter of the fluid . We have parameterized the deviation from isotropy by setting  $\omega_x = \omega$  and then introducing skewness parameter  $\delta$  which is the deviation from  $\omega$  along both *y* and *z* axes. Here  $\omega$  and  $\delta$  are not necessarily constants and might be function of the cosmic time *t* [sometimes it is convenient to consider  $\omega$  as a constant quantity because current observational data has limited power to distinguish between a time varying and constant equation of state. Some useful limits on  $\omega$  came from SNIa data,  $-1.67 < \omega < -0.62$ , whereas refined values were indicated by the combined SNIa data with CMB anisotropy and galaxy clustering statistics which is  $-1.33 < \omega < -0.79$ .

In a commoving co-ordinate system, the field equations for the metric (1) with the help of equation (2) and (4) can be written as

$$2\frac{B_{44}}{B} + \frac{B_4^2}{B^2} - \frac{1}{B^2} = -\omega\rho$$
(5)
$$\frac{A_{44}}{A} + \frac{B_{44}}{B} + \frac{A_4}{A}\frac{B_4}{B} = -(\omega + \delta)\rho$$
(6)
$$2\frac{A_4}{A}\frac{B_4}{B} + \frac{B_4^2}{B^2} - \frac{1}{B^2} = \rho$$
(7)

The energy-momentum conservation equation  $T^{\mu}_{\nu;\mu}$  leads to the equations for the anisotropic fluid.

Now we define some parameters for the Bianchi type III model which are important in cosmological observations. The average scale factor and spatial volume are defined as

$$a = (AB^2)^{\frac{1}{3}}, \quad V = a^3 = (AB^2)$$
, (8)

The anisotropy parameter of the expansion is expressed in terms of mean and directional Hubble parameters as

$$A_m = \frac{1}{3} \sum_{i=1}^{3} \left( \frac{\Delta H_i}{H} \right)^2, \tag{9}$$

where

$$H = \left(\ln a\right)^{\bullet} = \frac{\ddot{a}}{a} = \frac{1}{3} \left(\frac{\dot{A}}{A} + 2\frac{\dot{B}}{B}\right)$$
(10)

is the mean Hubble parameter and  $H_i(i=1,2,3)$  represent the directional Hubble parameters in the directions of x, y and z axes respectively. The anisotropy of the expansion shows isotropic behavior for  $A_n = 0$ . The physical parameters which are observational interest in cosmology are the expansion scalar  $\theta$ , the shear scalar  $\sigma^2$  and the deceleration parameter q defined as

$$\theta = u_{;m}^{m} = \left(\frac{\dot{A}}{A} + 2\frac{\dot{B}}{B}\right) \tag{11}$$

$$\sigma^{2} = \frac{1}{2}\sigma_{ij}\sigma^{ij} = \frac{1}{3}\left(\frac{\dot{A}}{A} + 2\frac{\dot{B}}{B}\right)^{2}$$

$$\ddot{a}a = d\left(1\right)$$
(12)

$$q = -\frac{\ddot{a}a}{\dot{a}^2} = \frac{d}{dt} \left(\frac{1}{H}\right) - 1$$
(13)

According to the conditions given by Collins and Hawking, the model approaches to isotropy continuously if  $V \rightarrow +\infty$ ,  $A_n \rightarrow 0$  and  $\rho > 0$  (for commoving fluid to be realistic) as  $t \rightarrow +\infty$ .

## 3. Solution of field equation:

Since the field equations are highly non linear to get determinate solution the system of equations (11) to (13) supply only three equations in five unknowns  $A, B, w, \rho$  and  $\delta$ . In order to solve the field equations, (we use the kinematical condition that the expansion scalar is proportional to shear scalar. According to Thorne (1961) observations of the velocity red shift relation suggest that Hubble expansion of the universe is isotropic within about 30% range approximately (Kantowski and Sach 1966; Kristian and Sachs 1966 and red shift studies place the limit  $\frac{\sigma}{H} \le 0.3$  where  $\sigma$  is the shear and H is the Hubble constant). Collins (1977) discussed the physical significance of this condition for perfect fluid and barotropic EoS in more general case. In many papers like Roy et al 1985; Roy and Banerjee 1995, Bali et al 2008) this condition is proposed to find the exact solutions of cosmological models.

It is given by

 $A = B^{n}$ , (14)

 $n \neq 0$  and is positive constant.

In some literatures, it is common to use a constant deceleration parameter. The motivation to choose such time dependent deceleration parameter is behind the fact that the universe is accelerated expansion at present as observed in recent observations of Type-Ia supernova and CMB anisotropies and decelerated expansion in the past. So, there is no scope for a constant deceleration parameter at present epoch. So, in general, the deceleration parameter is not a constant but time variable.

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We consider the deceleration parameter to be variable

$$q = -\frac{\dot{a}a}{\dot{a}^2} = b, \text{(variable)}$$
(15)

In order to solve the (15), we assume b = b(t). It is important to note here that one can assume b = b(t) = b(a(t)) as *a* is also a time dependent function. But this is only possible when one avoid singularity like big bang or big rip because both *t* and *a* are increasing function. Above equation may be rewritten as

$$\frac{\ddot{a}}{a} + b \left(\frac{\dot{a}}{a}\right)^2 = 0.$$
(16)

The general solution of equation (18) is given by

$$\int \left( e^{\int \frac{b}{a} da} \right) da = t + k.$$
(17)

where k is integrating constant. So in order to solve the problem completely, we have to choose  $\int \frac{b}{a} da$  in such a manner that equation (17) ha integrable. Without any loss of generality we consider

a manner that equation (17) be integrable. Without any loss of generality we consider.

$$\int \frac{b}{a} da = I_n L(a)$$

which does not affect the nature of generality of solution. Hence from equation (17) and (18) we obtain  $\int L(a) da = t + k$ , (19)

We solve equation (19) for the different values L(R).

The choice of L(a), in (19), is quite arbitrary but, since we are looking for physically viable models of the universe consistent with observations, we consider

## **Solution In The Polynomial Form**

Let us consider  $L(a) = \frac{1}{\alpha_1 \sqrt{\alpha_2 + a}}$  where  $\alpha_1$  and  $\alpha_2$  is an arbitrary constant. In this case, on integration

of Eq. (19) gives the exact solution

 $a(t) = k_1 t^2 + k_2 t + k_3$ 

where  $k_1 = \alpha_1^2 k_2 = 2\alpha_1^2$  and  $k_3 = k^2 \alpha_1^2$  are arbitrary constants. Using equation (8), (14) and (20). We get,

 $A = \left(k_1 t^2 + k_2 t + k_3\right)^{\frac{n}{n+2}},$  $B = \left(k_1 t^2 + k_2 t + k_3\right)^{\frac{1}{n+2}}.$ 

Hence equation (1) reduces to

$$ds^{2} = dt^{2} - \left(k_{1}t^{2} + k_{2}t + k_{3}\right)^{\frac{2n}{n+2}} dr^{2} - \left(k_{1}t^{2} + k_{2}t + k_{3}\right)^{\frac{2}{n+2}} (d\theta^{2} + \sinh^{2}\theta d\phi^{2})$$

## Physical aspects of dark energy model:

The cosmological model given by (23) represents Bianchi Type-III inflationary universe in general relativity. It can be observed that the model has no initial singularity i.e. at t = 0. Scale factor:

 $a(t) = k_1 t^2 + k_2 t + k_3,$ 

(24)

(18)

(20)

(21)

(22)

(23)

These scale factors admit constant values at early times of the universe  $[t \rightarrow 0]$  after that scale factors start increasing with the increase in cosmic time without showing any type of initial singularity and finally diverge to  $\infty$  as  $t \rightarrow \infty$ .

The Spatial Volume:

$$V(t) = (k_1 t^2 + k_2 t + k_3)^3,$$



Figure-I: Spatial volume versus time with an appropriate choice of constants.

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From the above results, it can be seen that the spatial volume is constant at t = 0 and zero at  $t = k_3 = 0$ . This shows that the Universe starts evolving with constant or zero volume at t = 0 and  $t = k_3 = 0$ . respectively, expands with cosmic time *t*.

The Generalized Hubble's parameter:

$$H = \frac{\left(2k_1 t + k_2\right)}{\left(k_1 t^2 + k_2 t + k_3\right)}.$$
(26)

From above equation, we observed that Hubble parameter is constant at t = 0, whereas directional Hubble parameters are dynamical. As time approaches from zero to infinity, the directional Hubble parameters start reducing towards the constant value of H and become equal as  $t \rightarrow \infty$ .

The Shear Scalar:

The Stata Stata.  

$$\sigma^{2} = \frac{(2k_{1}t + k_{2})^{2}}{6(k_{1}t^{2} + k_{2}t + k_{3})},$$
(27)  
The Scalar Expansion:  

$$\theta = \frac{3(2k_{1}t + k_{2})}{(k_{1}t^{2} + k_{2}t + k_{3})},$$
(28)  
From (27) and (28), it can be seen that all the physical parameters for  $t = 0$ ,  $\theta$  and  $\sigma$  are constant for  
 $k_{3} > 0$ , and diverge at  $k_{3} = 0$ . This shows uniform expansion from  $t = 0$  to  $t = \infty$  i.e. universe expands  
homogeneously.  
Deceleration parameter:  

$$q = \frac{-(2k_{1}^{2}t^{2} + 2k_{1}k_{2}t + k_{1}k_{3})}{(4k_{1}^{2}t^{2} + 4k_{1}k_{2}t + k_{2}^{2})},$$
(29)  

$$decelaretion parameter Vs time$$

$$universe expanded to the second parameter Vs time the second parameter for th$$

Figure-II: Deceleration parameter versus time with an appropriate choice of constants.

From above Figure (it is observed the deceleration parameter appears with negative sign which implies accelerating expansion of the universe). As *q* decreases very rapidly and reaches values -1/2 i.e -0.5 then after it remains constant. The negative deceleration parameter indicating that the universe is accelerating which is consistent with the present day observations. Perlmutter et al. (1999) and Riess et al. (1998, 1999, 2004) proved that the decelerating parameter of the universe is in the range  $-1 \le q \le 0$ , and the present day universe is undergoing accelerated expansion.

$$\rho = \frac{9(2n+1)(2k_1t+k_2)^2}{(n+2)^2(k_1t^2+k_2t+k_3)^2} - \frac{1}{(k_1t^2+k_2t+k_3)^{6/n+2}},$$
(30)

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Figure-III: Energy density versus time with an appropriate choice of constants.

Above figure shows the plot of energy density of the fluid  $(\rho)$  versus time (t) in accelerating mode of the universe. Here we observe that  $(\rho)$  is a positive decreasing function of time (t) for  $n \ge 0$  and negative decreasing function of time (t) for n < 0. Also it approaches to zero as  $t \to \infty$ . Energy density is constant at early stages t = 0 of the universe and show monotonic behavior in the evolving cosmic time.

$$-\omega\rho = \frac{4k_2}{(k_1t^2 + k_2t + k_3)} + \frac{(1 - 2n^2 - 4n - 6)(2k_1t + k_2)^2}{(n + 2)(k_1t^2 + k_2t + k_3)^2} - \frac{1}{(k_1t^2 + k_2t + k_3)^{2/n+2}},$$

$$-\delta\rho = \frac{2k_2(n - 1)}{(k_1t^2 + k_2t + k_3)} - \frac{(n^3 + n^2 + 3n + 1)(2k_1t + k_2)^2}{(n + 2)(k_1t^2 + k_2t + k_3)^2} + \frac{1}{(k_1t^2 + k_2t + k_3)^{2/n+2}},$$
(31)
(32)

#### **Conclusion:**

In the present analysis, we have investigated a new class of exact solutions for Bianchi type-III cosmological models filled with anisotropic dark energy by considering a time dependent displacement field for numerous form of variable deceleration parameter.

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# **Study Of Derivatives And Integral Of Fractional Order With Their Applications**

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#### Abstract:

In recent years Fractional order derivatives and Fractional order integrals (Fractional Calculus) is highly growing field in research because of its wide applicability and interdisciplinary approach. The main reason for the success of Fractional Calculus applications is that these new fractional-order models are often more accurate than integer-order ones, i.e. there are more degrees of freedom in the fractional order model than in the corresponding classical calculus. In this article we study some special functions, various approaches of fractional calculus, Integral transform of some fractional approaches, and some applications of Fractional calculus.

#### AMS subject classification 2010: 33B15, 33E12,26A33, 44A10

**Keyword:** Special Functions, MittagLeffler function Fractional Calculus, Grumwald-Letnikovdifferintegro, Riemann-Liouville Fractional integral, Caputo's Fractional derivative, Integral Transform, Laplace Transform, Mellin Transform.

# 1. Introduction:

# **Fractional Calculus:**

Origin of classical calculus and fractional calculus has found to be very close in  $17^{\text{th}}$  century but its name as "Fractional Calculus" and work on it found later in  $20^{\text{th}}$  century. Answer given by great mathematician Leibnitz on  $30^{\text{th}}$  September 1695 to the question raised by another great mathematician L'Hospitalthrough letter as "What will be the meaning of  $\frac{d^n f}{dx^n}$ , if n=1/2?" as "This is an apparent paradox from which one day a useful consequence will be drawn". After  $30^{\text{th}}$  September 1695 mathematicians who are working on classical calculus with special case of differentiation and integration of arbitrary ordernamed the field as **Fractional calculus**. Though the study of Fractional calculus begins at the end of  $17^{\text{th}}$  century but good work held's only since last three to four decades. Special functions such as Gamma Function, Beta Function, MittagLeffler Function, Incomplete Gamma Function etcare very closely related with Fractional calculus and plays important role in development of fractional calculus [7]. Different approaches of Fractional calculus are given throughout the history such Riemann approach, Liouville approach, Caupto approach , Wely approach, Lacorix approach, Grunwald approach, Letnikov approach, Riemann-Liouville approach, Grunwald-Letnikov approach and many more with applications of Fractional Calculus. Integral Transform such as Laplace Transform, Millin Transform Sumdu Transform etc applied to solve fractional calculus approaches called fractional integral transform.

This paper consist of seven sections which are Introduction to Fractional Calculus, Historical development of Fractional Calculus, Special Functions, Study of different approaches of Fractional Calculus, Fractional Integral Transform, Applications of Fractional Calculus and Conclusion.

#### 2. Historical Development of Fractional Calculus:

In the classical calculus, students are taught to understand the concepts of differentiation and integration through their physical significance. The derivative has an important geometric interpretation; namely, it is associated with the concept of tangent, velocity, acceleration etc, and the integration has important geometric interpretation; namely, it is associated with the concept of area under curve, volume, Arc length etc in comparison to what occurs in the case of Fractional Calculus. This difference can be seen as a problem for the slowprogressofFractional Calculusupto3 to 4 centuries from its origin. In 1695 Leibniz, in 1738 Euler [6,7]noticed the problem for a derivative of non integer order. In 1819, Lacroix devoted two pages to the discussion of the derivative of arbitrary order, in his book with seven hundred pages.

In 1822, Fourier [2, 6, 7] suggested an integral version in order to define the derivative, and his representation can be considered the first definition for the derivative of arbitrary(positive) order. In 1826, Abel [2,5-7] solved an integral equation associated with the tautochrone problem (Tautochrone: It is to determine a curve so that an object under the effect of gravity on it tumbles without friction, the time motion is independent of the starting point), which is considered to be the first application of Fractional Calculus. In 1832-1837Liouville [3, 5] developed a definition based on the formula for differentiating the exponential function. This definition is known as the first Liouville definition. The second definition formulated by Liouville in terms of an integral of non integer order. In 1847most important paper was published by Riemann, ten years after Liouvilles death. In 1867-1872 Gr<sup>u</sup>nwald [6, 7] and in 1868-1872Letnikov[7], independently, developed an approach to non integer order derivatives in terms of a convenient convergent series. In 1892Hadamard published a paper where the non integer order derivative of an analytical function must be done in terms of its Taylor series. For solving some particular problems, other definitions were proposed by respective mathematicians, name of some of these areWeyl,Riesz. In 1927Marchaud introduced a new definition for noninteger order of derivatives. In 1940 Erd'elvi-Koberdeveloped definition for noninteger order of integration which is useful in applications involving integraland differential equations. In 1967 Caputo proposed more restrictive definition then others. After the first conference at the University of New Haven, in 1974, FC has developed and several applications emergedin many areas of scientific knowledge. As a consequence, distinct approaches to solve problems involving the derivative proposed and distinct definitions of the fractional derivative are available in the literature. Oldham and Spanier (1974) [6], Samko, Kilbas&Marichev (1987), Miller & Ross (1993) [7] and I. Podlubny (1999) [2] gives in brief historical development of Fractional Calculus.

# 3. Special Functions:

## 3.1 Gamma function

Gamma function very closely related special function with fractional calculus. Swiss mathematician Leonhard Euler (1707 – 1783) invented the gamma function and known as Euler's integral of second kind. The gamma function belongs to the special transcendental function category [1-11]. It is the generalization of factorial function. Euler's Gamma function is the improper integral of another function, for  $z \in C \setminus \{0, -1, -2, -3 \dots\}$  is defined as

$$\Gamma(z) = \int_{0}^{\infty} e^{-t} t^{z-1} dt, \quad Re(z) > 0$$
 (1)

In limit form Euler's Gamma function is defined as

$$\Gamma(z) = \lim_{n \to \infty} \left\{ \frac{n! \ n^z}{z(z+1)(z+2)(z+3) \dots (z+n)} \right\}$$
(2)

And in product form it is defined as

$$\Gamma(z) = \frac{1}{z} \prod_{n=1}^{\infty} \left\{ \left( 1 + \frac{1}{n} \right)^{z} \left( 1 + \frac{z}{n} \right)^{-1} \right\}$$
(3)

#### 3.2 Beta Function

Beta function is also known as Euler's integral of first kind. Beta function which is related with gamma function widely useful in different field, mostly used in solving definite integral, which is defined as [1, 2, 10, 11]

$$B(x,y) = \int_0^1 t^{x-1} (1-t)^{y-1} dt, Re(x), Re(y) > 0$$
(4)

 $B(x,y) = \frac{\Gamma(x)\Gamma(y)}{\Gamma(x+y)}$ (5)

#### 3.3 Mittag-Leffler function (MLF)

Mittag-Leffler function is the generalization of exponential function, which plays very important role in fractional calculus. One parameter Mittag-Leffler function was introduced by G. M. Mittag-Leffler as (see [1, 2, 10, 11])

$$E_{\alpha}(z) = \sum_{k=0}^{\infty} \frac{z^k}{\Gamma(1+\alpha k)}, \quad \alpha, z \in \mathcal{C}, \quad Re(\alpha) > 0.$$
(6)

Two parameter Mittag-Lefflerfunction is defined as

$$E_{\alpha,\beta}(z) = \sum_{k=0}^{\infty} \frac{z^k}{\Gamma(\beta + \alpha k)}, \quad \alpha, \beta, z \in C, \quad Re(\alpha), Re(\beta) > 0.$$
(7)

Equation (7) is the generalization of equation (6) which is introduced by R.P. Agrawal in 1953. For  $\beta = 1$  MLF of two parameter is reduces to MLF of one parameter. The importance of the Mittag-Leffler function was re-discovered when its connection to fractional calculus was fully understood.

#### 4. Some definitions of Fractional calculus :

The three most frequently used definitions for the general fractional differintegral are the Grunwald-Letnikov (GL), the Riemann-Liouville (RL) and the Caputo derivative

## 4.1 Grumwald-Letnikov Definition :

Anton Karl Grunwald proposed the Grunwald definition of differintegrals in 1867 at Prague. Same type of definition was also given by Aleksey VasilievichLetnikov in 1868 at Moscow. Hence this definition is sometimes known as the Grunwald-Letnikov definition [1-9]. Given by

$${}_{a}D_{x}^{\alpha}f(x) = \lim_{N \to \infty} \left\{ \frac{\left(\frac{x-a}{N}\right)^{-\alpha}}{\Gamma(-\alpha)} \sum_{j=0}^{N-1} \frac{\Gamma(j-\alpha)}{\Gamma(j+1)} f\left(x-j\left[\frac{x-a}{N}\right]\right) \right\}$$
(8)

where  $\alpha \in C$  and [x] means the integer part of x, a and x are the bounds of the operation.

The Grunwald-Letnikov definition is used to compute a differintegral numerically, without having to differentiate or integrate a function directly. This definition can also be applied to numerical data which is not necessarily described by a function.

#### 4.2 Riemann-Liouville Definition :

The most commonly used definition of a fractional differintegralwas proposed by Riemann and Liouville [1-9]. The Riemann-Liouville definition allows for the calculation of a differintegral of any real order. There are two forms of the Riemann-Liouville definition. The first one, used to calculate the integral of a function, Given by

$$I_{a+}^{\alpha}f(x) = \frac{1}{\Gamma(\alpha)} \int_{a}^{x} \frac{f(t)}{(x-t)^{1-\alpha}} dt , \quad where \alpha \epsilon(-\infty,\infty)$$
(9)

The procedure required to obtain a fractional derivative using the Riemann-Liouville Definition requires first taking a fractional integral of the function in question, followed by an integer order derivative. Here, n is the integer of lowest possible value that is greater than the real number  $\alpha$ . The Riemann-Liouville derivative operator is as follows:

$$D_{a+}^{\alpha}f(x) = \frac{d^{n}}{dx^{n}} \left[ \frac{1}{\Gamma(n-\alpha)} \int_{a}^{x} \frac{f(t)}{(x-t)^{1-(n-\alpha)}} dt \right],$$
 (10)

where  $n - 1 < \alpha < n$ 

However, definitions of the fractional differentiation of Riemann-Liouville type create a conflict between the well-established and polished mathematical theory i.e. it is not properly applicable with initial value problems and nonzero of differentiation of a constant.

#### 4.3 M. Caputo (1967) :

The main advantage of using the Caputo definition is that it is easily interpreted initial conditions and it is also bounded, meaning that the derivative of a constant is equal to 0. The definition is as follows:

$${}_{a}D_{x}^{\alpha}f(x) = \frac{1}{\Gamma(\alpha - n)} \int_{a}^{x} \frac{f^{n}(t)}{(t - x)^{1 - (n - \alpha)}} dt,$$
(11)

Let  $\alpha > 0$  and  $n-1 < \alpha < n$ ,  $n \in N$ , and a < x < b, Left hand and Right hand Caputo Fractional derivative is defined as

$${}^{C}D_{a+}^{\alpha}f(x) = \frac{1}{\Gamma(n-\alpha)} \int_{a}^{x} (x-t)^{n-\alpha-1} f^{(n)}(t) dt , \qquad (12)$$
$${}^{C}D_{b-}^{\alpha}f(x) = \frac{(-1)^{n}}{\Gamma(n-\alpha)} \int_{x}^{b} (x-t)^{n-\alpha-1} f^{(n)}(t) dt . \qquad (13)$$

Caputo in1967 [1–9] formulated a definition, more restrictive definition than the Riemann-Liouville but more appropriate to discuss problems involving a fractional differential equation with initial conditions. Due to the importance of the Caputo version, we will compare this approach with the Riemann-Liouville formulation. The definition as proposed by Caputo inverts the order of integral and derivative operators with the non integer order derivative of the Riemann-Liouville. We summarize the difference between these two formulations. In the Caputo: first integer order derivative calculated and after non integer order integral calculated. In the Riemann-Liouville: first non integer order integral calculated and after integer order derivative calculated.

# 5. Integral transform of some fractional approaches:

5.1 Laplace Transform of the Riemann-Liouville Fractional Integral:

The Riemann-Liouville Fractional Integral is given by al.com

$$D^{-\alpha}f(x) = \frac{1}{\Gamma(\alpha)} \int_{a}^{x} (x-t)^{\alpha-1} f(t) dt$$

$$\mathcal{L}\{D^{-\alpha}f(\mathbf{x})\} = \frac{1}{\Gamma(\alpha)}\mathcal{L}\{\mathbf{x}^{\alpha-1}\}\mathcal{L}\{f(\mathbf{x})\} = \mathbf{s}^{-\alpha}F(\mathbf{s}), \ \alpha > 0.$$

#### 5.2 Laplace Transform of the Riemann-Liouville Fractional Derivative

The Riemann-Liouville Fractional differential operator is given by

$$D^{\alpha}f(x) = \frac{1}{\Gamma(n-\alpha)} \left(\frac{d}{dx}\right)^n \int_a^x (x-t)^{n-\alpha-1} f(t) dt,$$

The Laplace transform of Riemann-Liouville Fractional differential operator [3, 4,12-14] is given by

$$\mathcal{L}\{D^{\alpha}f(\mathbf{x}):s\} = s^{\alpha}F(s) - \sum_{k=0}^{n-1} s^{k} \left[D^{(\alpha-k-1)}f(0)\right]$$

$$= s^{\alpha}F(s) - \sum_{k=0}^{n-1} s^{n-k-1} [D^k I^{n-\alpha} f(0)]$$

#### 5.3 Laplace Transform of the Caputo Fractional Derivative

The Caputo Fractional Differential operator is given by

$${}_{a}^{c}D_{x}^{\alpha}f(x) = \frac{1}{\Gamma(n-\alpha)}\int_{a}^{x}(x-t)^{n-\alpha-1}f^{(n)}(t) dt$$

The Laplace transform of Caputo Fractional Differential operator [3, 4, 12-14] is given by

$$\mathcal{L}\{{}_{a}^{c}D_{x}^{\alpha}f(x):s\} = s^{\alpha}F(s) - \sum_{k=0}^{n-1} s^{\alpha-k-1}f^{(k)}(0), \ n-1 < \alpha < n.$$

5.4 Mellin Transform of the Riemann-Liouville Fractional Integral:

Mellin transform of Riemann-Liouville fractional integral operator [3, 4, 12-14] is given by

$$\mathcal{M}\{D^{-\alpha}f(\mathbf{x})\} = F(s) = \frac{\Gamma(1-s-\alpha)}{\Gamma(1-s)} F(s+\alpha)$$

## 5.5 Mellin Transform of theRiemann-Liouville and Caputo Fractional Derivative:

Mellin transform of Riemann-Liouville and Caputo fractional derivative operator[3, 4, 12-14] is given by

$$\mathcal{M}\{D^{\alpha}f(\mathbf{x})\} = \mathbf{F}(\mathbf{s}) = \frac{\Gamma(1-\mathbf{s}+\alpha)}{\Gamma(1-\mathbf{s})} \mathbf{F}(\mathbf{s}-\alpha)$$

#### 6. Applications of Fractional Calculus:

#### 6.1 Diffusion Equation:

Diffusion equation is an interesting application of fractional calculus. The study of thermal flux on a given surface is important due to its influence on material wear and performance. In addition once the thermal flux is known, the temperature can be obtained. The brake disks are treated as semi-infinite bodies and assumed to have a constant temperature distribution.

Agrawal (2004) [15] published a paper which analyzes the effectiveness of using fractional order derivatives to obtain the heat flux at a given point. Traditionally this was achieved by performing a transient analysis of two nearby points. His motive was the thermal study of disk brakes. The following diffusion equations govern the thermal distribution of the body.

$$\frac{\partial T(x,t)}{\partial t} = \frac{K}{\rho c} \frac{\partial^2 T(x,t)}{\partial x^2}$$

Where T(x, t) is the temperature at point x and time t, K is the thermal conductivity,  $\rho$  the mass density and c the specific heat of the disk material. After non-dimensional zing and applying Laplace Transform it is converted in fractional partial differential equation given by

$$\frac{1}{\sqrt{\alpha}} \frac{\partial^{1/2} \theta(x,t)}{\partial t^{1/2}} = \frac{\partial \theta(x,t)}{\partial x}$$

Using this fractional equation heat flux Q(t) and temperature at that point obtained.

Lot of Mathematicians work on diffusion equation some of them, Kulish gives more information on thermal flux analysis with fractional order derivatives in his paper [16], LokenathDebnathalso gives more detailed applications of fractional calculus relating to the diffusion equation in an paper [17].

## 6.2 $PI^{\lambda}D^{\mu}$ Controller

The concept of a fractional order  $P I^{\lambda}D^{\mu}$  is proposed In a paper written by Igor Podlubny in 1999 [2], where the integrator and differentiator are of a fractional order. A fractional order transfer function is provided as

$$G_c(s) = \frac{U(s)}{E(s)} = K_P + K_I s^{-\lambda} + K_D s^{\mu}, \qquad \lambda, \mu > 0$$

Here  $\lambda$  is the order of the integrator,  $\mu$  is the order of differentiator,  $G_c(s)$  is the transfer of controller, U(s) is the controller's output and E(s) is an error. If  $\lambda = 1$  and  $\mu = 1$  equation becomes traditional P I D controller equation If  $\lambda = 1$  and  $\mu = 0$ , equation converts to a P I controller equation. If  $\lambda = 0$  and  $\mu = 1$  equation converts to a P D controller equation.

In the time domain, it becomes an open-loop systemisdescribed by

$$\sum_{k=0}^{n} a_k \mathcal{D}^{\beta_k} y(t) = K_P w(t) + K_I \mathcal{D}^{-\lambda} w(t) + K_D \mathcal{D}^{\mu} w(t)$$

Here w(t) is the input, y(t) is output of the system,  $\beta_k$  (k= 0,1,2...,n) arbitrary real number and  $a_k$  (k= 0,1,2...,n) arbitrary constants.

Effectiveness of this controller can be analyzes by an example of  $PD^{\mu}$  controller. The transfer function and timedomain fractional order differential equation are



With initial condition y(0) = 0, y'(0) = 0, y''(0) = 0. Following figure shows the effectiveness of the controllers.



figure 1 is the comparison of conventional P D controller (thick line) and fractional  $PD^{\mu}$  controller (thin line).

#### 7. Conclusion :

Fractional calculus acts as an powerful mathematical tool used to obtain solution to real world problems. Applicability of fractional calculus attracted mathematicians to work in their field using this branch of mathematics. The purpose of this paper is to attract new researcher to work in this field since though beginning of fractional calculus may be same as traditional calculus but actual work found in last three to four decades.

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## Two Fluid Cosmological Model Coupled with Mass Less Scalar Field in f(T) Gravity

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#### Abstract:

We present a class of solutions of field equations in f(T) gravity describing the interaction and non-interaction between barotropic and dark fluid for spatially homogeneous and isotropic flat FRWuniverse with mass less scalar field. In this universe, the field equation correspond to the particular choice of  $f(T) = \alpha T + \beta T^n$ . An exact solution of field equations are obtained by applying the law of variation of Hubble's parameter which yields a constant value of the deceleration parameter. The physical and geometrical parameters along with some kinematical test of the model discussed in detail.

Keywords: - Barotropic fluid, dark energy, f(T) theory of gravity, cosmology.

#### 1. Introduction:

Experimental evidence [1, 2] has established that our universe undergoing a late-time accelerating expansion and the recent observations of SN Ia [3,4] have confirmed. The measurements of the cosmic microwave background (CMB) and large scale structure (LSS) strongly indicate that an expansion of the universe isaccelerating which is dominated by a component with negative pressure, dubbed as dark energy (DE) and has a flat geometry. The DE model has been characterizing in a conventional manner by the equation of state (EoS) parameter  $w_D = p_D / \rho_D$  where  $\rho_D$  and  $p_D$  represent the energy density and pressure of dark fluid. The EoS parameter of DE,  $w_D$  lies close to (-1) and if it would be equal, a little bit upper or less than (-1) corresponds to standard  $\Lambda CDM$  cosmology, the quintessence region or phantom region respectively while the possibility  $w_p \ll -1$  is ruled out by current cosmological data from SN Ia. Several authors [5-9] have examined and discussed the DE models in different context of use while some authors have investigated an interaction and non-interaction between DE and barotropic fluid using cosmological models like Chenand Wang [10] investigate the Evolution of the interacting viscous DE model in Einstein cosmology using FRW universe. Aveilino [11] investigates an interaction between DE and bulk viscosity using spatially flat FRW universe. Saha [12] explored two-fluid scenario for DE models in FRW universe. Interacting two-fluid viscous DE models in non-flat universe and two-fluid DE models in an anisotropic universe inspected by Amirhashchi et al. [13, 14].

On the other hand, awesome abundance of observational evidence in favor the late-time accelerating expansion does not fit within the framework of General Relativity (GR). In order to explain accelerated expansion of the universe there is an alternative modification of general relativity, these alternatives goes back to 1928 with Einstein's attempt to unify gravity and electromagnetism through the introduction of a tetrad (vierbein) field along with the concept of absolute parallelism or teleparallelism [15] known as TeleparallelGravity (TG) or f(T) gravity. The gravitational field equation of TG is described in terms of torsion instead of curvature [16]. An advantage of f(T) theory is that its field equation is only second order. Various aspects of f(T) theory have been investigated by [17-20].Jamil et al. [21, 22] tried to resolve the Dark Matter (DM) problem in the light of f(T) gravity and successfully obtained the flat rotation curves of galaxies containing DM as component with the density profile of DM in galaxies. Also gives the interacting DE model in the framework of same theory for a particular choice of f(T). Setare and Darabi [23]have studied the power-law solution when the universe enters in phantom phase and shown that such solutions may exist for some f(T) solutions.Particle creation in flat FriedmanRobertsonWalker universe in the framework of f(T) gravity

(1)

(2)

(3)

investigated by Setare and Houndjo [24] Chirde and Shekh [25] investigate barotropicbulk viscous cosmological model in f(T) gravity.

The study of interacting fields, one of them being zero-mass scalar field which is fundamental challenge to look into the yet unsolved problem of the unification of the gravitational and quantum theories. In the last few decades there has been renewed interest focused on the theory of gravitation representing zero-mass scalar fields coupled with gravitational field. The zero-mass scalar field has acquired particular importance. Maniharsingh [26], Singh &Bhamra [27] and Singh [28,29] studied different one-fluid models coupled with a scalar field. Singh and Deo [30] have investigated the problem of zero-mass scalar field interactions in the presence of a gravitational field for FRW space-time in GR and shown that the 'Big-Bang' of universe at the initial stage can be avoided by introducing a zero-mass scalar field along with this some authors [31, 32] investigated some cosmological model with zero-mass scalar field.

Incited by above discussions, in this paperwe investigate two-fluid model coupled with a scalar field in f(T) gravity in order to be able to understand the hidden properties of such universe, in doing so we consider both non-interacting and interacting cases. The outline of the paper is as follows. In section 2, we describe the brief review of f(T) theory. In section 3, the metric and the basic equations are described. Sections 4, deals with solution of field equations. In section 5, we consider both interacting and non-interacting cases. The physical stability of solutions analyzed in section 6.Section 7, deals with some kinematical properties of the universe and finally conclusions are summarized in the last section 8.

## 2. A brief review of f(T) Gravity:

The line element of the Riemannian manifold is given by

$$dS^2 = g_{\mu\nu} dx^{\mu} dx^{\nu}.$$

This line element can be converted to the Minkowskian description by the transformation called tetrad, as follows

$$dS^{2} = g_{\mu\nu}dx^{\mu}dx^{\nu} = \eta_{ij}\theta^{i}\theta^{j},$$
  
$$dx^{\mu} = e_{i}^{\mu}\theta^{i}, \quad \theta^{i} = e_{\mu}^{i}dx^{\mu},$$

where  $\eta_{ij} = diag[1, -1, -1, -1]$  and  $e_i^{\mu} e_v^{i} = \delta_v^{\mu}$  or  $e_i^{\mu} e_{\mu}^{j} = \delta_i^{j}$ .

The root of metric determinant is given by  $\sqrt{-g} = \det[e_{\mu}^{i}] = e$ . For a manifold in which the Riemann tensor part without the torsion terms is null (contribution of the Levi-Civita connection) and only the non-zero torsion terms exist, the Weitzenbocks connection components are defined as

$$\Gamma^{\alpha}_{\mu\nu} = e^{\alpha}_{i}\partial_{\nu}e^{i}_{\mu} = -e^{i}_{\mu}\partial_{\nu}e^{\alpha}_{i} .$$
<sup>(4)</sup>

Through the connection, we can define the components of the torsion and contorsion tensors as

$$T^{\alpha}_{\mu\nu} = \Gamma^{\alpha}_{\mu\nu} - \Gamma^{\alpha}_{\mu\nu} = e^{\alpha}_{i} \left( \partial_{\mu} e^{i}_{\nu} - \partial_{\mu} e^{i}_{\mu} \right),$$
(5)  
$$K^{\mu\nu}_{\alpha} = \left( -\frac{1}{2} \right) \left( T^{\mu\nu}_{\ \alpha} + T^{\nu\mu}_{\ \alpha} - T^{\mu\nu}_{\alpha} \right).$$
(6)

For facilitating the description of the Lagrangian and the equations of motion, we can define another tensor  $S_{\alpha}^{\mu\nu}$  from the components of the torsion and contorsion tensors, as

$$S^{\mu\nu}_{\alpha} = \left(\frac{1}{2}\right) \left( K^{\mu\nu}{}_{\alpha} + \delta^{\mu}_{\alpha} T^{\beta\nu}{}_{\beta} - \delta^{\nu}_{\alpha} T^{\beta\mu}_{\beta} \right).$$
(7)

The torsion scalar T is

$$T = T^{\alpha}_{\mu\nu} S^{\mu\nu}_{\alpha}.$$
(8)

The equation of motion for the TGwith two fluid sources and in the presence of zero mass scalar fields is defined as

$$S^{\nu\rho}_{\mu}\partial_{\rho}Tf_{TT} + \left[e^{-1}e^{i}_{\mu}\partial_{\rho}\left(ee^{\alpha}_{i}S^{\nu\rho}_{\alpha}\right) + T^{\alpha}_{\lambda\mu}S^{\nu\lambda}_{\alpha}\right]\left(1 + f_{T}\right) + \frac{1}{4}\delta^{\nu}_{\mu}\left(T + f\right) = 4\pi T^{\nu}_{\mu} - \left(\varphi_{,\mu}\varphi^{,\nu} - \frac{1}{2}\varphi_{,k}\varphi^{,k}\delta^{\nu}_{\mu}\right), \quad (9)$$

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where  $T_{\mu}^{\nu}$  is the energy momentum tensor, f(T) denotes an algebraic function of the torsion scalar *T*,  $f_T = df(T)/dT$  and  $f_{TT} = d^2 f(T)/dT^2$ , by setting  $f(T) = a_0$  = constant this is dynamically equivalent to GR.

## 3. Metric and Field Equations:

We consider the spatially homogeneous and isotropic flat Friedman-Robertson-Walker (FRW) line element in the form

$$ds^{2} = -dt^{2} + a^{2}(t) \Big[ dr^{2} + r^{2} d\Omega^{2} \Big],$$
(10)

where *a* be the metric potential or average scale factor and  $d\Omega^2 = d\theta^2 + \sin^2 \theta d\phi^2$ .

From the equation of motion (9), the Friedman equation for two fluid scenarios with zero mass scalar fields can be written as

$$\frac{\dot{a}}{a}\dot{T}f_{TT} + \left\{\frac{\ddot{a}}{a} + 2\frac{\dot{a}^2}{a^2}\right\} (1+f_T) + \frac{1}{4}(T+f) = (16\pi)p + 2\dot{\phi}^2,$$
(11)

$$3(1 + f_T)\frac{\dot{a}^2}{a^2} + \frac{1}{4}(T + f) = (16\pi)(-\rho) - 2\dot{\phi}^2, \quad \text{(12)}$$
  
$$\ddot{\phi} + 3\frac{\dot{a}}{a}\dot{\phi} = 0. \quad (13)$$

The overhead dot represents the differentiation with respect to time t and  $p = (p_m + p_D)$ ,  $\rho = (\rho_m + \rho_D)$ .  $p_m$  and  $\rho_m$  are pressure and energy density of barotropic fluid,  $p_D$  and  $\rho_D$  are pressure and energy density of dark fluid respectively also  $p_m = w_m \rho_m$  and  $p_D = w_D \rho_D$ .

## 4. Solution of the field equations:

In order to solve the field equations completely, we first assume that the perfect fluid and DE components interact minimally. Therefore, the energy momentum tensors of the two sources may be conserved separately.

The energy conservation equation  $(T_{\nu}^{\mu\nu} = 0)$  of the perfect fluid leads to

$$(\dot{\rho}_m) + 3\frac{\dot{a}}{a}(\rho_m + p_m) = 0.$$

whereas the energy conservation equation  $(T_{\nu}^{\mu\nu} = 0)$  of the DE component yields

$$(\dot{\rho}_D) + 3\frac{\dot{a}}{a}(\rho_D + p_D) = 0.$$
 (15)

We assume that EoS parameter of the perfect fluid to be a constant, which is already considered byAkarsu [33] and Kumar [34] i.e.

$$w_m = \frac{p_m}{\rho_m} = \text{constant},\tag{16}$$

while  $w_D$  has been admitted to be a function of time.

Since, the field equations (11) - (13) are coupled system of highly nonlinear differential equations and we seek physically realistic solutions to the field equations for applications in cosmology and astrophysics. The solutions to the field equations generated by applying the law of variation for Hubble's parameter, initially proposed by Berman[35] for FRW universewhich yields a constant value of the deceleration parameter.

$$H = \alpha_1' a^{-m}, \tag{17}$$

where  $\alpha'_1 > 0$ ,  $m \ge 0$  are constants and *H* be the Hubble parameter defined as

$$H = \frac{\dot{a}}{a}.$$
 (18)

For this choice of Hubble's parameter, the deceleration parameter q comes out to be constant i.e. q = m - 1, (19)

(14)

Among the physical quantities of interest in cosmology the deceleration parameter q is currently a serious candidate to describe the dynamics of the universe. Universe with constant deceleration parameter have received considerable attention. The sign of q indicates whether the universe inflates or not, if m > 1 the sign of q becomes positive which correspond to the standard decelerating behavior whereas for m > 1 the sign of q become negative which correspond to the standard accelerating behavior, and if m = 1, we obtain  $H = 1/(\alpha_1 t + \alpha_2)$  and the deceleration parameter becomes zero at this situation every galaxy moves with constantspeed.

Using equations (17) and (18), we obtain

$$a = \left[ \left( \alpha_1 t + \alpha_2 \right) \right]^{\frac{1}{m}},\tag{20}$$

where  $\alpha_1$  and  $\alpha_2$  be the constants of integration.

## 5. Interacting and non-interacting two fluid models:

Let us first review the interaction and non-interaction between barotropic and dark fluid in FRW universe investigated by Saha et al. [12] and Amirhashchi et al. [13]. Although, our approach in dealing with the problem differ to some extent from those of [12, 13].

## 5. (A)Non-interacting two fluid models:

In this section we assume that two-fluid do not interact with each other. Here is, of course a structural difference between equations (14) and (15). Because equation (14) is in the form of  $W_m$  which is constant and hence equation (14) is integrable, but equation (15) contains  $W_D$  which is admitted a function time t i.e. an unknown time dependent parameter. Hence we cannot integrate equation (15). From equations (14) and (20) we attained the energy density of barotropic fluid as

$$\rho_m = \rho_0(\alpha_1 t + \alpha_2)^{\frac{1}{m}}$$

where  $\rho_0$  be the constant of integration.

-3(1+w)

Using an expression (21) we find some other parameters of dark fluid/energy such as Energy density,

$$\rho_{D} = \frac{1}{(-16\pi)} \left\{ \frac{6\alpha_{1}^{2}(\alpha+1)}{m^{2}(\alpha_{1}t+\alpha_{2})^{2}} + \beta(-6)^{n}(1-2n) \left\{ \frac{\alpha_{1}^{2}}{m^{2}(\alpha_{1}t+\alpha_{2})^{2}} \right\}^{n} + \frac{2}{(\alpha_{1}t+\alpha_{2})^{3/m}} \right\} - \frac{\rho_{0}}{(\alpha_{1}t+\alpha_{2})^{3(1+w_{m})}/m}.$$
(22)  
Isotropic pressure,

Isotropic pressure,

$$p_{D} = \frac{1}{(-16\pi)} \left\{ \frac{2(\alpha+1)(3-2m)\alpha_{1}^{2}}{m^{2}(\alpha_{1}t+\alpha_{2})^{2}} + \alpha_{5} \left\{ \frac{-6\alpha_{1}^{2}}{m^{2}(\alpha_{1}t+\alpha_{2})^{2}} \right\}^{n} - \frac{2}{(\alpha_{1}t+\alpha_{2})^{3/m}} - \frac{w_{m}\rho_{0}}{(\alpha_{1}t+\alpha_{2})^{3(1+w_{m})/m}} \right\}$$
(23)  
FoS parameter

EoS parameter,

$$w_{D} = -\frac{\left\{\frac{2(\alpha+1)(3-2m)\alpha_{1}^{2}}{m^{2}(\alpha_{1}t+\alpha_{2})^{2}} + \alpha_{5}\left\{\frac{-6\alpha_{1}^{2}}{m^{2}(\alpha_{1}t+\alpha_{2})^{2}}\right\}^{n} - \frac{2}{(\alpha_{1}t+\alpha_{2})^{3/m}} - \frac{(-16\pi)w_{m}\rho_{0}}{(\alpha_{1}t+\alpha_{2})^{3(1+w_{m})/m}}\right\}}{\left\{\frac{6\alpha_{1}^{2}(\alpha+1)}{m^{2}(\alpha_{1}t+\alpha_{2})^{2}} + \beta(-6)^{n}(1-2n)\left\{\frac{\alpha_{1}^{2}}{m^{2}(\alpha_{1}t+\alpha_{2})^{2}}\right\}^{n} + \frac{2}{(\alpha_{1}t+\alpha_{2})^{3/m}} - \frac{(-16\pi)\rho_{0}}{(\alpha_{1}t+\alpha_{2})^{3(1+w_{m})/m}}\right\}}.$$
 (24)

Effective EoS parameter,

$$\Omega = \frac{2(\alpha+1)}{(-16\pi)} + \frac{\beta(-6)^n (1-2n)}{3(-16\pi)} \left\{ \frac{\alpha_1^2}{m^2 (\alpha_1 t + \alpha_2)^2} \right\}^{n-1} + \frac{2m}{3(-16\pi)\alpha_1} (\alpha_1 t + \alpha_2)^{2-\frac{3}{m}} + \frac{2m^2 \rho_0}{3\alpha_1^2} (\alpha_1 t + \alpha_2)^{2-\frac{3(1+w_m)}{m}}.$$
(25)

## 5. (B)Interacting two fluid models:

Next we extend the discussion for interacting case to study the changing aspects of physical behavior of the universe. In this case, the energy densities of DE and matter no longer satisfy independent conservation laws, they obey instead

(21)

$$(\dot{\rho}_m) + 3\frac{\dot{a}}{a}(\rho_m + p_m) = Q, \qquad (26)$$

$$(\dot{\rho}_D) + 3\frac{a}{a}(\rho_D + p_D) = -Q.$$
 (27)

The quantity Q(Q > 0) expressed the interaction term between the DE barotropic matter components. Since we are interested to investigate the interaction between DE and matter, it should be noted that an ideal interaction term must be motivated from the theory of quantum gravity. In the absence of such a theory, we rely on pure dimensional basis for choosing an interaction Q. In our work we consider the interaction term in the form  $Q \propto H\rho_m$  which is already considered by Saha [12] and Amirhashchi [13]

$$Q = 3Hk\rho_m$$

(28)

where *k* is a coupling coefficient which can be considered as a constant or variable parameter of redshift. Using equation (28) in (26), we obtain an energy density of barotropic fluid for interacting case as

$$\rho_m = \rho_0(\alpha_1 t + \alpha_2)^{\frac{-3(1+w_m-k)}{m}}, \qquad (29)$$

where  $\rho_0$  be the constant of integration.

Using an expression (29) we find some other parameters of dark fluid/energy in interacting two fluid models such as

Energy density,

$$\rho_{D} = \frac{1}{(-16\pi)} \left\{ \frac{6\alpha_{1}^{2}(\alpha+1)}{m^{2}(\alpha_{1}t+\alpha_{2})^{2}} + \beta(-6)^{n}(1-2n) \left\{ \frac{\alpha_{1}^{2}}{m^{2}(\alpha_{1}t+\alpha_{2})^{2}} \right\}^{n} + \frac{2}{(\alpha_{1}t+\alpha_{2})^{\frac{3}{2}m}} \right\} - \frac{\rho_{0}}{(\alpha_{1}t+\alpha_{2})^{\frac{3}{2}m}}$$
(30)

Isotropic pressure,

$$p_{D} = \frac{1}{(16\pi)} \left\{ \frac{2(\alpha+1)(3-2m)\alpha_{1}^{2}}{m^{2}(\alpha_{1}t+\alpha_{2})^{2}} + \alpha_{5} \left\{ \frac{-6\alpha_{1}^{2}}{m^{2}(\alpha_{1}t+\alpha_{2})^{2}} \right\}^{n} - \frac{2}{(\alpha_{1}t+\alpha_{2})^{3/m}} \right\} + \frac{w_{m}\rho_{0}}{(\alpha_{1}t+\alpha_{2})^{3(1+w_{m}-k)}/m}$$
(31)

EoS parameter,

$$w_{D} = -\frac{\left\{\frac{2(\alpha+1)(3-2m)\alpha_{1}^{2}}{m^{2}(\alpha_{1}t+\alpha_{2})^{2}} + \alpha_{5}\left\{\frac{-6\alpha_{1}^{2}}{m^{2}(\alpha_{1}t+\alpha_{2})^{2}}\right\}^{n} - \frac{2}{(\alpha_{1}t+\alpha_{2})^{3/m}} - \frac{(-16\pi)w_{m}\rho_{0}}{(\alpha_{1}t+\alpha_{2})^{3(1+w_{m}-k)/m}}\right\}}{\left\{\frac{6\alpha_{1}^{2}(\alpha+1)}{m^{2}(\alpha_{1}t+\alpha_{2})^{2}} + \beta(-6)^{n}(1-2n)\left\{\frac{\alpha_{1}^{2}}{m^{2}(\alpha_{1}t+\alpha_{2})^{2}}\right\}^{n} + \frac{2}{(\alpha_{1}t+\alpha_{2})^{3/m}} - \frac{(-16\pi)\rho_{0}}{(\alpha_{1}t+\alpha_{2})^{3(1+w_{m}-k)/m}}\right\}}.$$
(32)

Effective EoS parameter,

$$\Omega = \frac{2(\alpha+1)}{(-16\pi)} + \frac{\beta(-6)^n (1-2n)}{3(-16\pi)} \left\{ \frac{\alpha_1^2}{m^2 (\alpha_1 t + \alpha_2)^2} \right\}^{n-1} + \frac{2m}{3(-16\pi)\alpha_1} (\alpha_1 t + \alpha_2)^{2-\frac{3}{m}} + \frac{2m^2 \rho_0}{3\alpha_1^2} (\alpha_1 t + \alpha_2)^{2-\frac{3(1+w_m-k)}{m}}.$$
 (33)

Equation (23) and (31) represent the DE pressure in non-interacting and interacting case respectively. It is observed that at the initial epoch when universe start to expand the fluid pressure is infinitely large throughout the universe and decreases with the expansion of the universe. In this universe, the scalar field is found to be decreasing with time.

The behavior of physical parameters like energy density and EoS parameter of DE verses time t is shown in the figures (1) and (2) respectively.

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Figure (1): the behavior of energy density of dark fluid verses time t with the particular choice of constants in both non-interacting and interesting case.

From the figure (1) it is observed that the energy density of DE in both non-interacting and interacting cases, it is a positive decreasing function of time tand approaches a small positive value at late timebutnever go to infinity. Thus, in both cases the universe is free from big rip.



Figure (2): the behavior of EoS parameter of dark fluid verses time t with the particular choice of constants in both non-interacting and interesting case.

From the figure (2) it is observed that in flat universe EoS parameter of DE is a decreasing function of time*t*. In both interacting and non-interacting case we find that at an early stage, the evaluation of the EoS parameter was positive i.e. themodel behaves as like matter dominated once at early stages while at late times EoS becomes negative. It is interesting to note that EoSparameter takes a negative value which is an acceptable value observed by SN-Ia data. We also observed that the EoS parameter varies from Phantom ( $w_D < -1$ ) region to quintessence ( $w_D > -1$ ) region; this is a situation in early universe where the quintessence dominated universe may be playing an important role of the EoS parameter, which resembles with Saha et al. [12] and Caldwell [36].

#### 6. Kinematics Tests:

In these section we deals with some kinematics tests to discussed the stability of our universe such as Look Back time redshift, Luminosity distance, Distance modulus, Cosmic Jerk parameter.

Equation (20) represents the value of average scale factor a(t) which may be used to extend the kinematical tests for any arbitrary large value of redshift *z*.

## 6. (a)Look back time redshift:

The best-known way to trace the evolution of the universe observationally is to look into the redshift luminosity distance relation [37, 38]. The well- measured quantity of a far distant object is the redshift of light emitted due to the expansion of the universe. Look back time, is the difference between the age of the universe at present time (z = 0) and the age of the universe when a particular light ray at redshift zwas emitted i.e.  $\Delta t = t_0 - t$ . The expansion scale factor a(t) and the redshift z are related through the equation

$$(1+z) = \frac{a_0}{a},$$
(34)

where  $a_0$  represent the present value of scale factor.

Now we solve the equations (20) and (34) we get

$$1 + z = \frac{a_0}{a} = \left(\frac{\alpha_1 t_0 + \alpha_2}{\alpha_1 t + \alpha_2}\right)^{\frac{1}{m}}, \quad \text{for } m \neq 0. \quad (35)$$
Above equation gives
$$(\alpha_1 t + \alpha_2) = (\alpha_1 t_0 + \alpha_2)(1 + z)^{-m}, \quad (36)$$
this equation can also be expressed as
$$H_0(t_0 - t) = \frac{1}{m} \left[ 1 - (1 + z)^{-m} \right], \quad (37)$$
where  $H_0$  is the Hubble's constant at present.
For the small value of redshift *z*, above equation reduces to
$$H_0(t_0 - t) = \frac{1}{m} \left[ mz - \frac{m(m-1)}{2} z^2 + \dots \right]. \quad (38)$$
Using equation (19) we get
$$H_0(t_0 - t) = \left[ z - \frac{q}{2} z^2 + \dots \right], \quad (39)$$
for  $m = \frac{3}{2}$ , we get the well-known Einstein de-Sitter result
$$H_0(t_0 - t) = \frac{2}{3} \left[ 1 - (1 + z)^{-\frac{3}{2}} \right], \quad (40)$$

this can be used to describe look back time in Einstein de-Sitter universe. If we take the limit as  $z \to \infty$ , we obtain

$$t_0 = \frac{2}{3} H_0^{-1}. \tag{41}$$

## 6. (b)Luminosity distance:

Another important observational quantity is the luminous distance. There are several ways of measuring distances in the expanding universe. The luminosity distance in a spatial flat homogeneous and isotropic universe is described by the simple expression

$$d_L = r_1 (1+z) a_0, (42)$$

for the determination of  $r_1$ , we assume that a photon emitted by source with coordinate  $r = r_0$  to  $t = t_0$ and received at a time t by an observer located at r = 0, then we determine  $r_1$  from following relation

$$r_{1} = \int_{t}^{t_{0}} \frac{dt}{a} = \int_{t}^{t_{0}} \frac{dt}{(\alpha_{1}t + \alpha_{2})^{1/m}}.$$
(43)

Hence, using above equation (43) we get the expression for luminosity distance as

$$d_L = \frac{(1+z)H_0^{-1}[1-(1+z)^{1-n}]}{(n-1)}.$$
(44)

## 6. (C)Distance modulus:

The distance modulus in a spatial flat, homogeneous and isotropic universe is given by the simple expression  $\mu(z) = 5\log d_L(z) + 25$ , (45)

where  $d_L(z)$  is the luminosity distance.

(46)

(48)

(49)

From equation (44)

$$\mu(z) = 5\log\left\{\frac{(1+z)H_0^{-1}[1-(1+z)^{1-n}]}{(n-1)}\right\} + 25.$$

#### 6. (d)Cosmic Jerk parameter:

In cosmology, a convenient method to describe the universe close to  $\Lambda CDM$  is based on the cosmic jerk parameter *j*, a dimensionless third derivative of the scale factor with respect to the cosmic time [39, 40]. A deceleration to acceleration transition occurs for models with a positive value of *j* and negative *q*. From SN-Ia supernova and X-ray cluster gas mass fraction measurement we obtain clear statistical evidence for late time transition from a decelerating to an accelerating phase, for a flat model with constant jark *j*(*t*) we measure

 $j = 2.16^{+0.14}_{-0.18}$  hence the jerk parameter is defined as

$$j = \frac{\ddot{a}}{H^3 a} = \frac{\left(a^2 H^2\right)''}{2H^2},$$
(47)

where dot and prime denotes differentiation with respect to time and scale factor respectively. The above equation can be written as

$$j = q + 2q^2 - \frac{\dot{q}}{H}$$

Hence using equation (18) and (19) we get

$$j = (1 - m)(1 - 2m)$$
,

This value overlaps with the measure value j = 2.16 for m = 1.08 obtained from the combination of kinematical data sets: the gold sample of type SNe-Ia supernovae and the X-ray galaxy cluster distance measurements [41].

#### 6. (e)State finder diagnostics:

Since more and more DE models have been constructed for describing the cosmic acceleration of the universe, for characterizing the expansion history of the universe, one defines the geometric parameters  $H = \dot{a}/a$  and  $q = -a\ddot{a}/\dot{a}^2$ . It is clear that  $\dot{a} > 0$  means the universe is undergoing an expansion and  $\ddot{a} > 0$  means the universe is experiencing an accelerated expansion. From the cosmic acceleration, q < 0 one infers that there may exist DE with negative equation of state, w < -1/3 and likely but it is hard to deduce the information about the dynamical property of w (namely the time evolution of w) from the value of q. In order to extract the information on the dynamical evolution of w, it seems that we need the higher time derivative of the scale factor  $\ddot{a}$ , for this purpose a diagnostic proposal that makes use of parameter pair  $\{r, s\}$  the so-called "state finder" was introduced by Sahni et al. [42].Since different cosmological models involving DE exhibit different evolution trajectories in the  $\{r, s\}$  plane, the state finderparameter can be used to diagnose different DE models.

The pair of state finder diagnostic has a following form

$$r = 1 + 3\frac{\dot{H}}{H^2} + \frac{\ddot{H}}{H^3} \text{ and } s = \frac{r-1}{3\left(q - \frac{1}{2}\right)}.$$

In our model the parameters  $\{r, s\}$  can be explicitly written as

$$r = (2m^{2} - 3m + 1), \text{ and}$$
  
$$s = \frac{(2m^{2} - 3m + 1) - 1}{\frac{3}{2}(2q - 1)},$$

and the relation between r and s is

$$2r = (3s - 2)(3s - 1).$$

The state finder pair  $\{1,0\}$  represents the cosmological constant with a fixed equation of state w = -1and a fixed newton's gravitational constant. The pair  $\{1,1\}$  represents the cold dark matter model containing no radiation. The Einstein static universe corresponds to the state finder diagnosis pair  $\{\infty, -\infty\}$ . The relation between *r* and *s* resembles with the values of results investigated by AbdussattarandPrajapati [43], Shri Ram et al. [44]

## 7. Kinematical Properties of the Universe:

The kinematical properties of the Universe that are important in cosmology are spatial volume (V), Hubble parameter (H), expansion scalar ( $\theta$ ), anisotropic parameter ( $A_m$ ), and shear scalar ( $\sigma^2$ ) which have the following expressions

Spatial volume  $V = t^{3n}$ .

Hubble parameter  $H = \frac{n}{2}$ 

Expansion scalar  $\theta = \frac{3n}{t}$ .

Anisotropic parameter  $A_m = 0$ .

Shear scalar  $\sigma^2 = 0$ .

We observe that the spatial volume is zero at  $t \to 0$ . Thus, the singularity exists at  $t \to 0$  in the universe, our universe starts evolving with a big-bang on  $t \to 0$ . The expansion scalar decreases as time increases. Also the mean Hubble parameter is initially large at  $t \to 0$  and null at  $t \to \infty$ . The expansion scalar  $\theta \to \infty$  as  $t \to \infty$  indicates that the universe is expanding with increase of time and the rate of expansion decreases with increase of time (Figure (3)). Anisotropic parameter and shear scalar found to be zero, hence the universe does not approach anisotropy and the universe is shearing free.



*Figure (3): the behavior of Hubble parameter and Expansion scalar parameter of the universe verses time t with the particular choice of constants in both non-interacting and interesting case.* 

## 8. Conclusions:

In this paper, we have deliberate the interaction and non-interaction between barotropic and dark fluid coupled with mass less scalar field for a spatially homogeneous and isotropic FRW cosmological model within the framework of f(T) gravity. Keep in mind the prediction of standard cosmology and recentobservational evidences of [1-4] we have presented an alternative and straightforward approach to get the exact solution of typical non-linear differential equation by applying the special law of variation of Hubble's parameter, by finding an explicit form of physical and kinematical parameters along with kinematical test, the behavior of the universe has been discussed. For  $n \neq 0$  all the matter is concentrated at the big bang epoch and the cosmic expansion driven by the big bang impulse. The model has a point type singularity at the initial epoch t = 0 as the scale factor and volume vanishes at this moment. The rate of the expansion slows down and finally drops to zero as  $t \rightarrow 0$ , which would bounce essentially an empty universe.

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#### Abstract:

In this paper we introduce the concept of d-small M-principally projective module (for short d-small M-p-projective) and established some results related to d-small MP-projective modules with examples.

Key words: d-small M-p-projective module, d-small epimorphism, d-Hollow module, M-cyclic submodule, small submodule.

#### Introduction:

Throughout this paper, all rings are associative with identity and all modules are unital R-modules. Let R be a ring and M is an R-module. We will denote the submodule N of M by N $\leq$  M. Let M be an R-module and N $\leq$  M. If L = M for every submodule L of M such that M = N + L, then N is called a small submodule of, denoted by N  $\ll$  M. Let L = M for every direct summand submodule L of M such that M = N + L, then N is called a d-small submodule of M , denoted by N  $\ll_d M$ . [4].A module U is called d-small projective module if for each d-small epimorphism g  $\in$  Hom<sub>R</sub>(M,K), where M, K are any modules and for each homomorphism f  $\in$  Hom<sub>R</sub>(U,K), there exists a homomorphism h  $\in$  Hom<sub>R</sub>(M).

**Definition:** Let M and U be R-modules. An R-module U is called d-small M-p-projective module, if for each R-homomorphism from U to M-cyclic submodule s(M) of module M lifted to an R-homomorphism from U to M, the following diagram ;

is commutative.

Example: 1. The Z-module Z<sub>2</sub> is d-small Z-Principally projective is not Z-projective.
2. Z<sub>2</sub> is not d-small Z<sub>4</sub>-principally projective if the diagram:

$$Z_2 \xrightarrow{s} \frac{Z_4}{\left\{\bar{0}, \bar{2}\right\}} \to 0$$

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Where  $g: Z_2 \to \frac{Z_4}{\left\{\bar{0}, \bar{2}\right\}}$  is the usual isomorphism and  $\pi$  is the natural epimorphism. Now, if  $Z_2$  is  $Z_4 - \left\{\bar{0}, \bar{2}\right\}$ 

Projective, then there exists a non-zero R-homomorphism  $f: Z_2 \to Z_4$  such that  $\pi f = g$ . But the non-zero R-homomorphism  $f: Z_2 \to Z_4$  defined by  $f(\overline{1}) = f(\overline{2}) \Longrightarrow \ker f = 0$ , contradiction. 3. In  $Z_2$  as Z-module, clearly  $\{\overline{0}\}$  is a direct summand of  $Z_2$  and  $\{\overline{0}\} \cap Z_2 = (0) \ll Z_2$ , but  $Z_2$  is not d-small projective as Z-module. **Lemma1**: Let M and U be R-modules, then U is d-small M-p-projective module if and only if for each  $s \in S$ , Hom<sub>R</sub>(U, (s(M)) = sHom<sub>R</sub>(U, M).

**Proof:** Assume that U is d-small M-p-projective. Let  $s \in S$ .

Since  $sHom_R(U, M) \subseteq Hom_R(U, (s(M)) \dots (1))$ 

Let  $g \in Hom_R(U, (s(M)))$ , since U is d-small M-p-projective, then there exists

 $f \in Hom_R(U, M)$  such that s.f = g it follows that  $g \in Hom_R(U, (s(M)))$  this implies

 $\operatorname{Hom}_{\mathbb{R}}(U, (s(M)) \subseteq s\operatorname{Hom}_{\mathbb{R}}(U, M) \dots (2), \text{ Thus } \operatorname{Hom}_{\mathbb{R}}(U, (s(M)) = s\operatorname{Hom}_{\mathbb{R}}(U, M).$ Converse, clear by definition.//

**Theorem1**: Let M be an R-module and  $\left\{ U_{\alpha} \atop_{\alpha \in \wedge} \right\}$  be the family of modules. Then  $\bigoplus_{\alpha \in \wedge} U_{\alpha}$  is a d-small M-p-

projective module if and only if for every  $U_{\alpha}$  is a d-small M-p-projective module.

**Proof**: Let  $\oplus U_{\alpha}$  is a d-small M-p-projective module. Consider the diagram,



Where  $i_{\alpha}$  and  $p_{\alpha}$  are injection and projection homomorphisms respectively.

Since  $\bigcup_{\alpha \in \Lambda}$  is a d-small M-p-projective module. Therefore there exists  $h_{\alpha} \in Hom_{R}(U_{\alpha}, M)$  such that  $s.h_{\alpha} = f.i_{\alpha}$ . Now the homomorphism  $h : \bigoplus \bigcup_{\alpha \in \Lambda} \longrightarrow M$  defined by

$$\begin{split} h(a) &= (\sum_{\alpha \in \wedge} h_{\alpha}.p_{\alpha}.(a_{\alpha}) \ \, \forall \ \, a \in \oplus U_{\alpha} \ . \ Clearly \ H \ \, is \ \, well \ \, defined \ \, and \ \, homomorphism \ \, for \ \, a \in \oplus U_{\alpha} \ . \ \, We \\ \text{have } s.h(a) &= s(\sum_{\alpha \in \wedge} h_{\alpha}.p_{\alpha}.(a_{\alpha})) = \sum_{\alpha \in h_{\alpha}} (s.h_{\alpha})(p_{\alpha}.(a_{\alpha})) \ \, \forall \ \, a \in \oplus U_{\alpha} \end{split}$$

Therefore 
$$s.h(a) = \sum (f.i_{\alpha})(p_{\alpha}.(a_{\alpha}) = f \sum (i_{\alpha}.p_{\alpha}).(a_{\alpha}) = f(I(a) = f(a))$$

 $\Rightarrow \oplus \bigcup_{\alpha \in \land} \text{ is a d-small M-p-projective module//}$ 

Proposition1: Let M, U be R-modules. If U is a d-small M-p-projective module and every M-cyclic submodule of M is U-injective and every submodule of U is a d-small M-p-projective module. The converse is true, if M is d-Hollow module.

**Proof:** LetU be a d-small M-p-projective module. Assume that every M-cyclic submodule is U-injective. Since M is trivially M-cyclic, then M is U-injective. Let  $s \in End_R(M)$ , and  $s \in Hom_R(M,s(M))$  be a d-small epimorphism., with  $U_1 \leq U$ . Consider the diagram:



Where  $i: U_1 \rightarrow U$  is a inclusion monomorphism. Since s(M) is M-cyclic module, thus by assumption s(M) is U-injective module, therefore there exists a homomorphism  $1: U \rightarrow s(M)$  such that 1.i = s.g, but U is a dsmall M-p-projective module, so there is an homomorphism  $t: U \rightarrow M$  such that  $t_i = g$  Now l, i = s.t.i = s.g = f.

Conversely; Let module M be hollow. Suppose M is U-injective and every submodule of U is a d- small M-pprojective module. Thus U is a d- small M-p-projective module and s(M) is M-cyclic submodule of M. Consider the diagram:



Where  $i: U_1 \to U$  is an inclusion monomorphism,  $f: U_1 \to s(M)$  is any homomorphism and  $s: M \to s(M)$ is required epimorphism. It is clear that s is a d-small epimorphism, s(M) is M-cyclic. Given that M is hollow; by assumption  $U_1$  is a d-small M-p-projective. Thus U is a d-small M-p-projective, therefore there exists a homomorphism  $h: U_1 \to M$  such that  $t_i = h$  the homomorphism  $\psi: U \to s(M)$  defined by  $\psi = s_i f_i$ . Then  $\psi .i = s.l.i = s.h = f.//$ 

**Theorem2:** Let U be a d-small M-p-projective module. Then  $A \ll_d U$  and M/A is isomorphic to direct summand of M if and only if A = 0.

**Proof:** Let  $\pi: M \to \frac{M}{A}$  be the natural canonical epimorphism, where  $A \ll_d U$  and M/A is isomorphic to direct summand N of M. Let  $f: N \to \frac{M}{A}$  be the isomorphism. Consider the diagram:



Where i and p are the inclusion and projection homomorphisms respectively with identity map  $I: U \to M/_A$ . Since U is a d-small M-p-projective module. , then there exists a homomorphism  $h_1: U \to M$  such that  $\pi \cdot h_1 = f.p.$  Now the homomorphism  $h_2 : M \longrightarrow M$  defined by  $h_2 = h_1 \cdot i.f^{-1}$ . There fore  $\pi.h_2 = \pi\pi._1.i.f^{-1} = f.p.i.f^{-1} = f..I..f^{-1} = I$
Hence  $\pi: \mathbf{M} \to \mathbf{M}/_A$  split.  $\Rightarrow \mathbf{A} = 0$ .

**Theorem3:** Let and U be R-modules. The module U is a d-small M-p-projective if and only if U id d-small K-p-projective module for every M-cyclic submodule K of M. In particular if K is a direct summand of M and U is a d-small M-p-projective, then U is a d-small K-p-projective and d-small M/K-p-projective.

**Proof:**Assume that U is a d-small M-p-projective. To prove that U is a d-small K-p-projective. Let B be K-cyclic sub module of K. Consider the diagram:



Where  $f: U \to B$  is any homomorphism,  $g: K \to B$  is R- Epimorphism and  $\pi: M \to K$  is natural projection, Since U is a d-small M-p-projective. Then there exists a homomorphism  $h: U \to M$  such that  $g.\pi.h = f$ . now the map  $h_1: U \to K$  defined by  $g.h_1 = \pi.h \Rightarrow g.h_1 = f$ . Thus U is a d-small K-p-projective. Converse; is clear, since M is self m-cyclic.//

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# Plane Symmetric Space Time with Cosmological Constant $\Lambda$ - Term In Saez-Ballester Theory of Gravitation

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#### Abstract:

In the present work we study Plane Symmetric Space Time with Cosmological Constant  $\Lambda$  - Term in scalar tensor theory formulated by Saez-Ballester Theory of Gravitation. For the<sub>simplicity of</sub>  $\xi(t)$ , we assume to be a simple power function of the energy density  $\xi(t) = \xi_0 \rho^n$  where  $\xi_0$  and n are constant and an equation of state of the form  $p = \gamma \rho$ , where  $\gamma(0 \le \gamma \le 1)$  is a constant. Time dependent cosmological term  $\Lambda$  is found to be a decreasing function of time in each model. We also discussed some geometrical and physical aspects of the models. **Keywards:** Bulk viscous fluid, scalar tensor theory, time dependent term  $\Lambda$ , plane symmetric space time.

#### **1.Introduction:**

Inhomogeneous cosmological model plays an important role in understanding some essential features of the universe such as the formation of galaxies during the early stages of evolution and process of homogenization. The early attempt at the construction of such models has done by Tolman [1] and Bondi [2] who consider spherically symmetric models. Inhomogeneous plane symmetric model was first consider by Taub [3] and later by Tomimura [4], Szekeres [5]; Collins and Szafron [6]. Pradhan et al.[7] studied plane symmetric inhomogeneous model in presence of perfect fluid. The generalized Einstein's theory of gravitation with time dependent *G* and  $\Lambda$  has been proposed by Lau [8]. The possibility of variable *G* and  $\Lambda$  in Einstein's theory has also been studied by Dersarkissian[9]. The cosmological model with variable *G* and  $\Lambda$  have been recently studied by several authors. Some of the recent discussions on the cosmological constant and cosmology with a time varying cosmological constant by Ratra and Peebles [10], Sahni and Starobinsky [11], Peebles [12], J.P.Singh et al.[13-14], M.K.Verma et al. [15-16] and Pradhan et al. [17-18]. Also the role of viscosity is important in cosmology for a number of reason. Weinberger [19], Heller and Klimek [20], Misner [21-22] has studied the effect of viscosity on the evolution of cosmological models. Collins and Stewart [23] have studied the effect of viscosity on the formation of galaxies. Xing-Xiang Wang [24] discussed Kantowski-Sachs string cosmological model with bulk viscosity in general relativity.

Since last few decades there is a growing interest in alternative theories of gravitation, especially scalartensor theories of gravity, which are very useful tools in understanding early universe models. The most important among them are scalar tensor theories of gravitation formulated by Brans and Dicke [25], Nordtvedt [26] and Saez and Ballester [27]. All version of the scalar tensor theories are based on the introduction of a scalar field  $\phi$  into the formulation of general relativity, this scalar field together with the metric tensor field then forms a scalar tensor field representing the gravitational field.

Also several aspects of viscous fluid cosmological model in early universe have been extensively investigated by many authors Raj Bali and Dave S.[28], Adhav et al. [29], M.K.Verma and Shri Ram [30]. Recently Mete etal. [31] have presented axially symmetric bulk stress cosmological model In Saez-Ballester Theory of Gravitation.

The purpose of the present work is to study inhomogeneous bulk viscous fluid cosmological model with time dependent  $\Lambda$  term in general theory of relativity. Our paper is organize as follows, in section 2, we have discussed the metric and field equations in general theory of relativity. Section 3 contains solution of the field equations with different cases. The last section contains conclusion.

#### 2. The metric and Field Equations

We consider the plane-symmetric space –time in the general form

$$ds^{2} = D^{2}dt^{2} - A^{2}dx^{2} - B^{2}(dy^{2} + dz^{2})$$
(1)

Where A, B and D are functions of x and t.

The Einstein's field equations in the scalar tensor theory proposed by (Saez and Ballester,(25) with cosmological term  $\Lambda g_{ii}$  may be written as

$$R_{ij} - \frac{1}{2} Rg_{ij} - \omega \phi^n \left( \phi_{,i} \phi_{,j} - \frac{1}{2} g_{ij} \phi_{,k} \phi^{,k} \right) + \Lambda g_{ij} = -8\pi T_{ij}$$
(2)

where  $T_{ii}$  is the energy momentum tensor of matter and  $\phi$  is the scalar field satisfying the equation

$$2\phi^{n}\phi_{;i}^{i} + n\phi^{n-1}\phi_{,k}\phi^{,k} = 0$$
(3)

Here n is the arbitrary constant  $\omega$  is the dimensionless coupling constant. Comma and semi-colon respectively denote partial and covariant derivative with respective to t.

The energy momentum tensor in the presence of bulk stress has the form

$$T_{ij} = (\rho + \vec{p})u_i u_j - \vec{p}g_{ij} (4) \text{ and } \qquad \qquad \vec{p} = p - \xi u_{i}^i \tag{5}$$

Here  $\rho$ , p,  $\vec{p} \xi$  and  $\Lambda$  are energy density, isotropic pressure, effective pressure, bulk viscous coefficient and cosmological constant respectively and  $u_i$  is the four velocity vector satisfying the relation

$$g^{ij}u_iu_j = 1$$
 (6)

Hereafter, the semicolon(;), denotes covariant differentiation. Now use the commoving coordinates as  $u_i = (0,0,0,D)$  Thus, using commoving coordinates system, the set of field equations (2) for the metric (1) reduces to the following forms,

$$\frac{2}{BD^{2}} \left[ B_{44} - \frac{DB_{1}D_{1}}{A^{2}} - \frac{B_{4}D_{4}}{D} \right] - \frac{1}{B^{2}} \left[ \frac{B_{1}^{2}}{A^{2}} - \frac{B_{4}^{2}}{D^{2}} \right] - \frac{\omega}{2} \phi^{n} \dot{\phi}^{2} - \Lambda = -8\pi\bar{p}$$
(7)  

$$\frac{1}{BD^{2}} \left[ B_{44} - \frac{DB_{1}D_{1}}{A^{2}} - \frac{B_{4}D_{4}}{D} \right] - \frac{1}{A^{2}B} \left[ B_{11} - \frac{A_{1}B_{1}}{A} - \frac{AA_{4}B_{4}}{D^{2}} \right]$$
(8)  

$$+ \frac{1}{A^{2}D^{2}} \left( AA_{44} - \frac{AA_{4}D_{4}}{D} - DD_{11} + \frac{DA_{1}D_{1}}{A} \right) - \frac{\omega}{2} \phi^{n} \dot{\phi}^{2} - \Lambda = -8\pi\bar{p}$$
(9)  

$$\frac{2}{B} \left[ B_{11} - \frac{A_{1}B_{1}}{A} - \frac{AA_{4}B_{4}}{D^{2}} \right] + \frac{1}{B^{2}} \left[ \frac{B_{1}^{2}}{A^{2}} - \frac{B_{4}^{2}}{D^{2}} \right] + \frac{\omega}{2} \phi^{n} \dot{\phi}^{2} + \Lambda = -8\pi\bar{p}$$
(9)

$$\phi_{44} + \phi_4 \left(\frac{A_4}{A} + \frac{2B_4}{B} + \frac{D_4}{D}\right) + \frac{n}{2} \left(\frac{\phi_4^2}{\phi}\right) = 0 \tag{11}$$

The suffixes 1 and 4 at the symbols A, B, D and  $\phi$  denotes partial differential with respect to x and t respectively.

#### 3. Solution of the field equations.

The solutions of the field equations (7)-(11) are highly nonlinear, therefore we consider the explicit solutions of the field equations A, B and D are taken in the following form (Sahu et.al [32])

$$A = t^{l} (1 + x^{2})^{a}, B = t^{m} (1 + x^{2})^{b} \text{ and } D = (1 + x^{2})^{d}$$
(12)  
where  $l, m, a, b, d$  are real constant  $(l \neq 0, m \neq 0)$ 

(18)

Using the values of A, B and D from eq.(12) eqs.(7)-(11) leads to

$$\frac{3m^2 - 2m}{t^2(1+x^2)^{2d}} - \frac{4b(2d+b)x^2}{t^{2l}(1+x^2)^{2a+2}} = \frac{\omega}{2}\phi^n\dot{\phi}^2 + \Lambda - 8\pi\bar{p}$$
(13)

$$\frac{l^2 + m^2 - l - m + lm}{t^2 (1 + x^2)^{2d}} + \frac{(4ad - 4bd + 2d - 4d^2 - 4b^2 + 2b + 4ab)x^2 - 2(d + b)}{t^{2l} (1 + x^2)^{2a+2}}$$

$$=\frac{\omega}{2}\phi^{n}\dot{\phi}^{2} + \Lambda - 8\pi\bar{p} \tag{14}$$

$$\frac{4b\{(3b-2a-1)x^2+1\}}{t^{2l}(1+x^2)^{2a+2}} - \frac{m(2l+m)}{t^2(1+x^2)^{2d}} = -\frac{\omega}{2}\phi^n\dot{\phi}^2 - \Lambda - 8\pi\rho$$
(15)and

$$m(d-b) + lb = 0 \tag{16}$$

Using equation (12), equation (11) yields interaction

$$\frac{\phi^{\frac{n+2}{2}}}{\frac{n+2}{2}} = C\left(\frac{t^{-(l+2m)+1}}{-(l+2m)+1_1}\right) + \psi_0 \tag{17}$$

Where  $\psi_0$  is constant of integration and *C* is constant. After simplifying equation (17), the value of  $\phi$  is given by

$$\phi = K_1 \left(\frac{1}{t^{1-(l+2m)}}\right)^{\frac{1}{n+2}} + \phi_0$$
  
Where  $K_1 = \left\{ \left(\frac{n+2}{2}\right) \left(\frac{C}{1-(l+2m)}\right) \right\}^{\frac{2}{n+2}}$  and  $\phi_0 = (\psi_0)^{\frac{2}{n+2}}$   
Again Solving equations (13) and (14), we gives

Again Solving equations (13) and (14), we gives b+d=0,

2

$$3m^{2} - 2m = l^{2} + m^{2} - l - m$$

$$4ad - 4bd + 2d - 4d^{2} - 4b^{2} + 2b + 4ab = -4b(2d + b)$$
(20)

Now the corresponding to the equations (19) and (20), we have two sets of solutions, i.e. (i)b = d = 0 and l = m (ii)b = d = 0 and l = -2m + 1

**Case-I**: When 
$$b = 0, d = 0, l = m = k$$
 (say) (21)

In this case, the geometry of the space time(1) takes the form  

$$ds^{2} = dt^{2} - t^{2k} [(1+x^{2})^{2a} dx^{2} + dy^{2} + dz^{2}]$$
(22)

Using these values, equations (13) - (16) leads to

$$8\pi \bar{p} = \frac{2k - 3k^2}{t^2} + \frac{\omega}{2} \phi^n \dot{\phi}^2 + \Lambda$$
 (23) and

$$8\pi\rho = \frac{3k}{t^2} - \frac{\omega}{2}\phi^n \dot{\phi}^2 - \Lambda \tag{24}$$

For the simplification of  $\xi(t)$ , we assume that the fluid obeys an equation of state of the form  $p = \gamma \rho$ , (25) where  $\gamma(0 \le \gamma \le 1)$  is a constant.

Thus, given  $\xi(t)$  we can solve the cosmological parameters. In most of the investigations involving bulk viscosity is assumed to be a simple power function of the energy density(Pavon[33],Maartens[34], Zimdahl [35])

(29)

(30)

(33)

 $\xi(t) = \xi_0 \rho^n$  (26) where  $\xi_0$  and *n* are constants. If n = 1, Equation (21) may correspond to a radiative fluid

(Winberg[36]. However, more realistic models (Santos,[37]) are based on *n* lying in the regime  $0 \le n \le \frac{1}{2}$ .

# **Model-I:** Solution for $\xi = \xi_0$

When n = 0 equation (26) reduces to  $\xi = \xi_0 = \text{constant.With the help of (25), solving (23) and (24) we get$ 

$$8\pi\rho = \frac{1}{1+\gamma} \left[ \frac{24\pi\xi_0 k}{t} + \frac{2k}{t^2} \right] (27)$$

Eliminating  $\rho(t)$  between (24) and (27), we have

$$\Lambda = \frac{3k^2}{t^2} - \frac{1}{1+\gamma} \left[ \frac{24\pi\xi_0}{t} + \frac{2k}{t^2} \right] - \frac{\omega}{2} \phi^n \dot{\phi}^2 (28) \text{ where } \phi \text{ is given by equation (18).}$$

# **Model-II:** Solution for $\xi = \xi_0 \rho$

When n = 1, Equation (26) reduces to  $\xi = \xi_0 \rho$ . With the help of (25), solving (23) and (24) we get

$$8\pi\rho = \frac{2k}{\left[1 + \gamma - \frac{3\xi_0 k}{t}\right]t^2}$$

eliminating  $\rho$  between (20) and (25), we obtain

$$\Lambda = \frac{3k^{2}}{t^{2}} - \frac{2k}{\left[1 + \gamma - \frac{3\xi_{0}k}{t}\right]t^{2}} + \frac{\omega}{2}\phi^{n}\dot{\phi}^{2}$$

where  $\phi$  is given by equation (18)

From Equations (28) and (30) we observed that cosmological constant is a decreasingfunction of time and approaches a small value in the present epoch.

# 3.1 The physical parameters of the model

The physical parameters such as spatial volume (V), Hubbel parameter (H), expansion scalar ( $\theta$ ) and shear scalar ( $\sigma$ ) of model (18) are given by 2349-638

$$W = R^{*} = \sqrt{-g} = t^{*} (1+x)^{*} (31)$$

$$H = \frac{k}{t} (32)$$

$$\theta = \frac{A_{4}}{AD} + \frac{2B_{4}}{BD} + \frac{D_{1}}{A^{2}} = \frac{3k}{t}$$
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and

$$\sigma^{2} = \frac{1}{2\sigma_{ij}\sigma^{ij}} = \frac{1}{12} \left[ \left( \frac{(g_{11})_{4}}{g_{11}} - \frac{(g_{22})_{4}}{g_{22}} \right)^{2} + \left( \frac{(g_{22})_{4}}{g_{22}} - \frac{(g_{33})_{4}}{g_{33}} \right)^{2} + \left( \frac{(g_{33})_{4}}{g_{33}} - \frac{(g_{11})_{4}}{g_{11}} \right)^{2} \right] = 0$$
(34)

**Case-II:** When 
$$b = 0, d = 0, l = -2m+1$$
 (35)

In this case, the geometry of the space time(1) takes the form  $ds^{2} = dt^{2} - t^{2(1-2m)} (1+x^{2})^{2a} dx^{2} - t^{2m} (dy^{2} + dz^{2})$ (36)

Using these values, equations (13) - (16) leads to

$$8\pi \vec{p} = \frac{2m - 3m^2}{t^2} + \frac{\omega}{2} \phi^n \dot{\phi}^2 + \Lambda$$
 (37) and

$$8\pi\rho = \frac{2m - 3m^2}{t^2} - \frac{\omega}{2}\phi^n \dot{\phi}^2 - \Lambda \tag{38}$$

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# **Model-I:** Solution for $\xi = \xi_0$

When n = 0 equation (26) reduces to  $\xi = \xi_0 = \text{constant}$ . Hence in this case equation (37) with the help of (25) becomes

$$8\pi\rho = \frac{1}{1+\gamma} \left[ \frac{2(2m-3m^2)}{t^2} + \frac{8\pi\xi_0}{t} \right] (39)$$

Eliminating  $\rho(t)$  between (34) and (35), we have

$$\Lambda = \frac{(2m - 3m^2)}{t^2} - \frac{1}{1 + \gamma} \left[ \frac{2(2m - 3m^2)}{t^2} + \frac{8\pi\xi_0}{t} \right] - \frac{\omega}{2} \phi^n \dot{\phi}^2 \qquad (40)$$

where  $\phi$  is given by equation (18)

# **Model-II:** Solution for $\xi = \xi_0 \rho$

When n = 1, Equation (26) reduces to  $\xi = \xi_0 \rho$ . Hence in this case equation (37) with the help of (25) becomes

$$8\pi\rho = \frac{2(2m - 3m^2)}{\left[1 + \gamma - \frac{8\pi\xi_0}{t}\right]t^2} (41)$$

Eliminating  $\rho$  between (34) and (37), we obtain

$$\Lambda = \frac{(2m - 3m^2)}{t^2} - \frac{2(2m - 3m^2)}{\left[1 + \gamma - \frac{8\pi\xi_0}{t}\right]t^2} + \frac{\omega}{2}\phi^n \dot{\phi}^2 \tag{42}$$

where  $\phi$  is given by equation (18)

From Equations (40) and (42) we observed that cosmological constant is a decreasing function of time and approaches a small value in the present epoch.

(44) www.aiirjournal.com

# 3.2 The physical parameters of the model

The physical parameters expansion scalar ( $\theta$ ) and shear scalar ( $\sigma$ ) of model (36) are given by

$$\theta = \frac{1}{t} (43)$$
$$\sigma^2 = \frac{1}{3} \left( \frac{3m - 1}{t} \right)^2$$

# **Conclusion :**

In this paper, we have investigated inhomogeneous cosmological model with bulk viscous fluid and time dependent cosmological term  $\Lambda$  by using a simple power function of energy density  $\xi(t) = \xi_0 \rho^n$ , where  $\xi_0$  and *n* are constant in scalar tensor theory of relativity. The value of parameters can be obtained by using explicit solutions of the field equations. The cosmological term  $\Lambda$  is a decreasing function of time and this approaches a small value as time increases. It is observed that at t = 0, the involved parameters in both physical and kinematical of the models diverges while the parameters remain finite and well behaved for t > 0.

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#### Abstract:

With an appropriate choice of the function f(R,T) an anisotropic Axially Symmetricspace – time filled with

perfect fluid in general relativity and also in the framework of f(R,T) gravity proposed by Harko et. al. (in arXiv:1104.2669[gr-qc],2011) has been studied. The field equations have been solved by using the anisotropy features of the universe in Axially Symmetricspace – time. We have been discussed some physical properties of the models. We observed that the involvement of new function f(R,T) does not affect the geometry of the space-time but slightly changes the matter distribution.

Keywords: f(R,T) gravity, Perfect Fluid, Axially Symmetric Universe, General Relativity.

#### **1.Introduction:**

Cosmological observations on expansion history of the universe indicate that current universe is not only expanding but also accelerating. This late time accelerated expansion of the universe has been confirmed by high red-shift supernovae experiments. Also, observations such as cosmic background radiation and large scale structure provide an indirect evidence for late time accelerated expansion of the universe.

Recently several modified theories of gravity have been developed and studied, in the view of the late time acceleration of the Universe and the existence of dark energy and dark matter. Noteworthy amongst them are the f(R,T) theory of gravity proposed by Nojiri and Odintsov (2003a) and f(R,T) theory of gravity formulated by Harko et al. (2011). Bertolami et al. (2007) proposed a generalization of f(R) theory of gravity by including in the theory an explicit coupling of an arbitrary function of the Ricci scalar R with the matter Lagrangian density  $L_m$ . Nojiri and Odintsov developed a general solution for the modified f(R) gravity reconstruction from any realistic FRW Cosmology. They have showed that modified f(R) gravity indeed represents a realistic alternative to general relativity, being more consistent in dark epoch. Nojiri et al. developed a general program for the unification of matter-dominated era with acceleration epoch for scalartensor theory or dark fluid. Shamir proposed a physically viable f(R) gravity model, which showed the unification of early time inflation and late time acceleration.

Harko et al.(2011) developed f(R,T) modified theory of gravity, where the gravitational Lagrangian is given by an arbitrary function of the Ricci scalar R and the trace T of the energy-momentum tensor. It is to be noted that the dependence of T may be induced by exotic imperfect fluid or quantum effects. They have obtained the gravitational field equations in the metric formalism, as well as, the equations of motion of test particles, which follows from the covariant divergence of the stress-energy tensor. They have derived some particular models corresponding to specific choices of function f(R,T). They have also demonstrated the possibility of reconstruction of arbitrary FRW cosmologies by an appropriate choice of the function f(R,T). In f(R,T) gravity, the field equations are obtained from a variational, Hilbert-Einstein type, principle.The

action principle for this modified theory f(R,T) gravity is given by

$$S = \frac{1}{16\pi G} \int f(R,T) \sqrt{-g} d^4 x + \int L_m \sqrt{-g} d^4 x$$
(1.1)

Where f(R,T) is an arbitrary function of the Ricci scalar R, and T is the trace of stress energy tensor of matter  $T_{ii}$  and  $L_m$  is the matter Lagrangian density.

We define the stress energy tensor of matter as

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(1.4)

$$T_{ij} = \frac{-2}{\sqrt{-g}} \frac{\partial(\sqrt{-g})}{\partial g^{ij}} L_m, \Theta_{ij} = -2T_{ij} - pg_{ij}$$
(1.2)

By varying the action principle (1.1) with respect to metric tensor, the corresponding field equations of f(R,T) gravity are obtained as

$$f_{R}(R,T)R_{ij} - \frac{1}{2}f(R,T)g_{ij} + (g_{ij}\nabla^{i}\nabla_{i} - \nabla_{i}\nabla_{j})f_{R}(R:T)$$

$$= 8\pi T_{ij} - f_{T}(R,T)T_{ij} - f_{T}(R,T)\Theta_{ij}$$
(1.3)

Where

$$f_R = \frac{\delta f(R,T)}{\delta R}, \quad f_T = \frac{\delta f(R,T)}{\delta T} \text{ and } \Theta_{ij} = g^{\alpha\beta} \frac{\delta T_{\alpha\beta}}{\delta g^{ij}}$$

Here  $\nabla_i$  is the covariant derivation and  $T_{ij}$  is standard matter energy-momentum tensor derived from the Lagrangian  $L_m$ . It can be observed that when f(R,T) = f(R), then (1.3) yield the field equations of f(R) gravity.

It is mentioned here that these field equations depend on physical nature of the matter field. Many theoretical models corresponding to different matter contributions for f(R,T) gravity are possible. However, Harko et. al.gave three classes of these models

$$f(R,T) = \begin{cases} R+2f(T) \\ f_1(R) + f_2(T) \\ f_1(R) + f_2(R)f_3(T) \end{cases}$$

Assuming,

$$f(R,T) = R + 2f(T)$$

as a first choice, where f(T) is an arbitrary function of trace of the stress energy tensor of matter

Then from (1.3) and (1.4), we get the gravitational field equation as

$$R_{ij} - \frac{1}{2} Rg_{ij} = 8\pi T_{ij} - 2f'(T)T_{ij} - 2f'(T)\Theta_{ij} - f(T)g_{ij}$$
(1.5)

Wherethe overhead prime indicates differentiation with respect to the argument.

The Friedmann-Robertson-Walker models are the only globally acceptable perfect fluid space-times which are spatially homogenous and isotropic. The adequacy of isotropic cosmological models for describing the present state of the universe is no basis for expecting that they are equally suitable for describing the early stages of the evolution of the Universe. At the early stages of the evolution of Universe, it is, in general spatially homogenous and anisotropic. Bianchi spaces are useful tools for constructing spatially homogenous and anisotropic cosmological models in general relativity and scalar-tensor theories of gravitation. Reddy et. al. (2012a, 2012b) have obtained Kaluza-Klein cosmological model in the presence of perfect fluid source and Bianchi type *III* cosmological model in f(R,T) gravity using the assumption of law of variation for the Hubble parameter proposed by Bermann (1983), Shamir et al.(2012) obtained exact solution of Bianchi type-*I* and type-*V* cosmological model in f(R,T) gravity. Chaubey and Shukla (2013) have obtained a new class of Bianchi cosmological models in this theory. Recently Rao and Neelima (2013) have discussed perfect fluid Einstein-Rosen universe in f(R,T) gravity, Sahoo et al. (2014) have studied Axially symmetric cosmological model in f(R,T) gravity. Pawar et al.(2014) have discussed Cosmological models filled with a perfect fluid source in the f(R,T) theory of gravity

Sharif and Zubir (2012) investigated the anisotropic behavior of perfect fluid and massless scalar field for Bianchi type-I space time in this theory. The negative constant deceleration parameter in presence of

perfectfluid is studied in Bianchi type-III cosmological model(Reddy et al. 2012). Bianchi type-III dark energy model is derived in presence of perfect fluid using special law of variation for Hubble's parameter (Reddy et al. 2013). Yadav (2013) constructed Bianchi type-V string cosmological model with power law expansion in thistheory. Mishra and Sahoo (2014) solved the field equations of Bianchi type- $VI_{h}$  cosmological model in presence of perfectfluid in f(R,T) gravity. Sahoo et al. (2014) constructed an axiallysymmetric cosmological model in f(R,T) theory in the presence of a perfect fluid source. Ahmedand Pradhan (2014) constructed Bianchi type-V cosmological model for a specific choice of  $f(R,T) = f_1(R) + f_2(T)$ .

In this paper, We study anisotropic Axially symmetric models with perfect fluid matter source in f(R,T) gravity. We present the explicit field equations in f(R,T) gravity for Axially symmetric model in presence of a perfect fluid for a particular choice of f(R,T) = R + 2f(T). We obtained solution of field equations. We discuss some properties of the cosmological model.

#### 2. The Metric and Field Equations:

We consider axially symmetricspace-time given by

**d Field Equations:**  
lly symmetricspace-time given by  

$$ds^2 = dt^2 - A^2 (d\chi^2 + f^2 d\phi^2) - B^2 dz^2$$

(2.1)

(2.2)

(2.3)

(2.4)

Where A and B are the functions of cosmic time t f is function of  $\chi$  only.

Since there is no unique definition of the matter Lagrangian, the problem of perfect fluids described by an energy density  $\rho$ , pressure p and four velocity  $u^i$  is complicated. Therefore, here, we assume that the stress energy tensor of matter is given by

$$T_j^i = (\rho + p)u_i u^j - \delta_j^i p$$

And the matter Lagrangian can be taken as  $L_m = -p$ and we have

$$u^i \nabla_i u_i = 0$$
  $u^i u_i = 1$ 

The matter tensor for perfect fluid is

$$\Theta_{j}^{i} = -2T_{j}^{i} - \delta_{j}^{i}p$$

The field equations in f(R,T) theory of gravity for the function f(R,T) = R + 2f(T)When the matter source is perfect fluid are given by 349-05

$$G_{j}^{i} = R_{j}^{i} - \frac{1}{2} \delta_{j}^{i} R$$
  
=  $8\pi T_{j}^{i} + 2f'(T)T_{j}^{i} + [2pf'(T) + f(T)]\delta_{j}^{i}$  (2.5)

where the prime indicates the derivative with respect to the argument.

Now, choose the function f(T) as the trace of the stress energy tensor of the matter so that

$$f(T) = \lambda T \tag{2.6}$$

Where  $\lambda$  is a constant.

Using commoving coordinate system, the field equations for the metric (2.1) with the help of (2.4) to (2.6) can be written as

$$\frac{A_{44}}{A} + \frac{B_{44}}{B} + \frac{A_4}{A} \frac{B_4}{B} = (8\pi + 3\lambda)p - \rho\lambda$$
(2.7)

$$2\frac{A_{44}}{A} + \left(\frac{A_4}{A}\right)^2 - \frac{f_{11}}{A^2 f} = (8\pi + 3\lambda)p - \rho\lambda$$
(2.8)

$$\left(\frac{A_4}{A}\right)^2 + 2\left(\frac{A_4}{A}\right)\left(\frac{B_4}{B}\right) - \frac{f_{11}}{A^2f} = -(8\pi + 3\lambda)\rho + \lambda p \tag{2.9}$$

where the suffixes 1 and 4 after an unknown functions denote partial differentiation with respect to  $\chi$  and t respectively.

The functional dependence of the metric together with (2.8) and (2.9) imply that

$$\frac{f_{11}}{f} = k^2, \ k^2 = cons \tan t$$
 (2.10)

If k = 0 then  $f(\chi) = c_1 \chi + c_2, \chi > 0$ .

Where  $c_1, c_2$  are integrating constants. Without loss of generality by taking  $c_1 = 1$  and  $c_2 = 0$ , we get  $f(\chi) = \chi$  resulting in the flat model of the universe (Hawking and Ellis).

With the help of (2.10), (2.7) to (2.9) reduce to

$$\frac{A_{44}}{A} + \frac{B_{44}}{B} + \frac{A_4}{A} \frac{B_4}{B} = (8\pi + 3\lambda)p - \rho\lambda (2.11)$$

$$2\frac{A_{44}}{A} + \left(\frac{A_4}{A}\right)^2 = (8\pi + 3\lambda)p - \rho\lambda \qquad (2.12)$$

$$\left(\frac{A_4}{A}\right)^2 + 2\left(\frac{A_4}{A}\right)\left(\frac{B_4}{B}\right) = -(8\pi + 3\lambda)\rho + \lambda p \qquad (2.13)$$

These are three linearly independent equations with four unknowns  $A, B, \rho$  and P. Inorder to solve the system completely. We assume that

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$$A = B^{m}$$
(2.14)  
Equation (2.11) and (2.12) implies that,  

$$\frac{A_{44}}{A} + \left(\frac{A_{4}}{A}\right)^{2} - \frac{B_{44}}{B} - \frac{A_{4}}{A} \frac{B_{4}}{B} = 0$$
(2.15)  
Using equations (2.14) and (2.15), we get  

$$A = \left[(2m+1)(ct+d)\right]^{\frac{m}{2m+1}}$$
(2.16)  

$$B = \left[(2m+1)(ct+d)\right]^{\frac{1}{2m+1}}$$
(2.17)  
Then metric (2.1) can now be written in the form  

$$ds^{2} = dt^{2} - \left[(2m+1)(ct+d)\right]^{\frac{2m}{(2m+1)}} \left\{ d\chi^{2} + \chi^{2} d\phi^{2} \right\} - \left[(2m+1)(ct+d)\right]^{\frac{2}{2m+1}} dz^{2}$$
(2.18)

From equation (2.12),(2.13), (2.16) and (2.17), we obtained the pressure and density as

$$p = \frac{-m(m+2)c^{2}}{2(\lambda+4\pi)[(2m+1)(ct+d)]^{2}}$$

$$\rho = \frac{-m(m+2)C^{2}}{2(\lambda+4\pi)[(2m+1)(ct+d)]^{2}}$$
(2.19)
(2.20)

respectively.



The metric (2.18) together with (2.19) and (2.20) represents an anisotropic Axially Symmetric Bianchi type I perfect fluid cosmological model in f(R,T) gravity.

# **3.Some Physical Properties Of The Model:**

The volume element of model (2.18) is given by

$$V = \sqrt{-g} = \chi [(2m+1)(ct+d)]$$
(3.1)  
The scalar expansion  $\theta$ , shear scalar  $\sigma$  and average Hubble parameter  $H$  are given by  

$$\theta = \frac{c}{[ct+d]}$$
(3.2)  

$$\sigma^2 = \frac{7c^2}{18[ct+d]^2}$$
(3.3)  

$$H = \frac{c}{3[ct+d]}$$
(3.4)  
The deceleration parameter  $q$  is given by  

$$q = 2$$
(3.5)  
The average anisotropy parameter  $A_m$  is given by  

$$2(m-1)^2$$

$$A_m = \frac{2(m-1)^2}{(2m+1)^2}$$
(3.6)

The overall density parameter  $\Omega$  is given by

$$\Omega = \frac{-3m(m+2)}{2(\lambda + 4\pi)(2m+1)^2}$$
(3.7)

#### **5.**Conclusions:

The average

In this paper we have presented an anisotropic Axially Symmetric space-time filled with perfect fluid in the framework of f(R,T) gravity proposed by Harko et. al.(2011) and in general relativity. The model (2.18) has no initial singularity for positive values of m. The spatial volume increases with time.Since the mean anisotropy parameter  $A_m \neq 0$ , the models do not approach isotropy for  $n \neq 1$  For n = 1, from field equations, we can easily see that we willget only isotropic universe. As q = 2 > 0, the model decelerates. It is observed that the energy density and pressure tends to zero for large value of time t and spatial volume increases with time. For  $t = \frac{-d}{c}$ , the volume element of the model vanishes while all other parameters the scalar expansion  $\theta$ ,

shear scalar  $\sigma$  and average Hubble parameter H diverges. It is also observed that all the physical parameters are decreasing functions of time and they approach zero for large value of t.

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# Structural And Optical Properties Of Nanostructured Manganesedisulphidethin Film Grown By SILAR Method

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#### Abstract

Nanostructured manganese disulphide thin film has been grown by successive ionic layer adsorption and reaction (SILAR) method onto glass substrate using MnCl<sub>2</sub>.4H<sub>2</sub>O and Na<sub>2</sub>S as cationic and anionic precursors. X-ray diffraction study confirms the polycrystalline cubic structure of manganese sulphide [MnS<sub>2</sub>] with average crystallite size 94 nm. However, field emission scanning electron microscopy reveals porous nanocrystalline nature of manganese sulphide with diffused grain boundaries. The direct optical band gap energy of manganese sulphide thin film is found to be 2.90eV. **Keywords:** Nanostructure; Thin films; X-ray diffraction; optical properties

# 1. Introduction

Since past few decades, transition metal disulphide thin films having pyrite structures such as FeS<sub>2</sub>, CoS<sub>2</sub>, NiS<sub>2</sub>, MnS<sub>2</sub>, MoS<sub>2</sub>, WS<sub>2</sub> plays very important role in the fields of science and technology due to its interesting physical and chemical properties [1-5]. Amongst them manganese disulphide (MnS<sub>2</sub>) thin films have attracted the recent researchers due its prominent applications in various fields such as supercapacitor, energy storage devices, magnetic material, magnetic resonance imaging, cancer treatment, photocatalyst and antibacterial activity etc. [5-7]. Manganese disulphide is a magnetic semiconducting material having cubic pyrite structure. It exists with two forms,  $\beta$ -MnS<sub>2</sub> (sphalerite type) and  $\gamma$ -MnS<sub>2</sub> (wurtzite type) and undergoes paramagnetic to antiferromagnetic phase transition near 48K. Manganese disulphide exhibits p-type semiconducting nature with band gap energy ranges from 2.9 to 3.7 eV [7-8]. The manganese disulphide thin film shows electrical resistivity of the order of  $10^6 - 10^7 \Omega$  cm [8]. Recently, various methods have been used to deposit manganese disulphide thin films such as hydrothermal method [3], successive ionic layer adsorption and reaction [8], chemical bath deposition [9], physical vapor deposition [10] etc. Since very few reported the deposition of MnS<sub>2</sub> thin films by chemical methods, an attempt has been made in the present work to deposit nanostructured MnS<sub>2</sub> thin film by successive ionic layer adsorption and reaction (SILAR) method. SILAR method is simple, easy to handle, non-hazardous and ecofriendly in nature. In SILAR, deposition of thin film onto the substrate has been takes place sequentially by means of four steps such as adsorption, rinsing (I), reaction and rinsing (II). In the present study, structural and optical properties of manganese disulphide thin film have been studied by X-ray diffraction Field Emission Scanning Electron Microscopy, Energy dispersive X-ray analysis and UV-Visible spectra.

# 2. Experimental

In the present work, successive ionic layer adsorption and reaction (SILAR) method is used to deposit nanostructured manganesedisulphide thin film onto glass substrate at room temperature. To deposit nanostructured manganese disulphide thin film 0.1M manganese chloride ( $MnCl_2.4H_2O$ ) and 0.05M sodium sulphide [ $Na_2S$ ]were used as cationic and anionic precursors respectively. Initially, the well clean glass substrate is rinsed into the 0.1M manganese chloride solution for 20 s where the  $Mn^{2+}$  ions get absorbed onto the glass substrate. The substrate is then rinsed into deionized water for 20 s to remove excess ions or loosely bound materials. The substrate is removed from the deionized water and rinsed into the  $Na_2S$  precursor solution of pH 12 for 20s where  $Mn^{2+}$  ions react with the  $S^{2-}$  ions and the layer of manganese disulphide is deposited onto glass substrate. The substrate is then rinsed into the deionized water for 20 s to remove the excess material from the substrate surface. This completes one SILAR deposition cycle. 160 such SILAR deposition cycles were repeatedfor the deposition of manganesedisulphide thin film of terminal thickness 542 nm. The as deposited film is dried at room temperature and further annealed at  $573^{0}$ K to obtain the pure phase MnS<sub>2</sub>. The deposited thin film is then subjected for further study.

In the present work, the crystal structure of manganese disulphide was studied by X-ray diffraction analysis with Rigaku X-ray diffractometer. The surface morphology was observed by Field Emission Scanning Electron Microscopy (Model: SUPRA 40). The optical absorption studies were carried out in the wavelength range 350 to 750 nm using ELICO ® Double Beam SL 210 UV-VIS Spectrophotometer.

#### 3. Results and Discussion

X-ray diffraction study of manganese disulphide thin film has been carried out at 20 degree in the range 20 - 80 degree at room temperature to investigate the phase and crystal structure. The X-ray diffraction pattern of manganesedisulphide thin film is shown in **Fig.1.** The (2 1 0), (2 1 1) and (2 2 1) peak observed in the X-ray diffraction pattern at an angle 32.80, 36.04 and 44.540 is due to cubic (MnS<sub>2</sub>)structure of manganese sulphide in comparison with the standard X-ray diffraction data card [JCPDS: 72-0601]. The average crystallite size of the MnS<sub>2</sub> thin film was determined from the peaks at (2 1 0), (2 1 1) and (2 2 1) by using Debye - Scherer formula [11],  $D = 0.94\lambda/\beta cos\theta$ ; where ' $\lambda$ ' is the wavelength (0.154 nm); ' $\beta$ ' is the angular line width at half maximum intensity in radians and ' $\theta$ ' is the Bragg's angle. The average crystallite size of the MnS<sub>2</sub> thin film was found to be 94 nm indicates the nanocrystalline nature of MnS<sub>2</sub> film.



**Fig.1.** X-ray diffraction pattern of MnS<sub>2</sub> thin film.

The surface morphology of the  $MnS_2$ thin film was examined by using field emission scanning electron micrographs (FESEM) (**Fig. 2A**). The FESEM micrograph reveals the uniform growth of nanograins of  $MnS_2$  onto glass substrate having grain size 90 - 356 nm with diffused grain boundaries. In addition, the porous nature of  $MnS_2$  thin film indicating its applicability for sensing applications. The elemental analysis of the manganese disulphide thin film was carried out using energy dispersive X-ray (EDX) analysis (**Fig. 2B**). The elemental analysis carried only for Mn and S elements. The elemental peak present in the EDAX spectra confirms the formation of manganese disulphide (MnS<sub>2</sub>).



Fig. 2.A]FESEM image and B] EDX spectra of MnS<sub>2</sub>thin film.

Aayushi International Interdisciplinary Research Journal (ISSN 2349-638x) (Special Issue No.66) Impact Factor 6.293 <u>Peer Reviewed Journal www.aiirjournal.com</u> Mob. 8999250451 The optical absorption measurement for  $MnS_2$  thin film deposited by SILAR method was carried out in the wavelength range 350 to 750 nm at room temperature (**Fig.3A**). The optical band gap energy (Eg) of  $MnS_2$ was calculated by using the equation  $[12],hv = A(hv - Eg)^n$ ; where, ' $\alpha$ ' is absorption coefficient, 'Eg' is band gap energy, 'A' is a constant and 'n' is equal to 1/2 for direct and 2 for indirect transition. **Fig.3B**shows the plot of  $(\alpha hv)^2$  versus hv for MnS<sub>2</sub>thin film. The direct band gap energy 'Eg' of the MnS<sub>2</sub>thin film was estimated by extrapolating the linear portion of the plot to the energy axis and is found to be of the order of 2.90 eV, which is in good agreement with the earlier report[8].



Fig.3. A) UV-Visible spectra and B) plot of  $(\alpha hv)^2$  versus hvof MnS<sub>2</sub> thin film.

#### 4. Conclusions

Nanostructured manganese disulphide thin film of thickness 542 nmhas been successfully deposited by SILAR method onto glass substrate. The X-ray diffraction study confirms the cubic( $MnS_2$ ) structure and nanocrystalline nature of the manganese disulphidethin film. FESEM imagerevealsporous nature of  $MnS_2$  nanograins distributed uniformly over the entire substrate surface with diffused grain boundaries. However, direct optical band gapis found to be 2.90eV.

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# Dark Matter, Dark Energy and Cosmological Model

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#### Abstract:

A little under 14 billion years ago our universe wrinkled into existence in momentous event known as the Big Bang where previously there was nothing no matter, no energy, not even space and time.

Today the space of our universe is filled with invisible stuff matter which expanding under the action of gravity which was dark matter. In 1990's astronomical observation and theoretical calculation was leading astrophysicists to believe that not only the dark matter but also there is vacuum empty space filled in universe that is dark energy. It is suggested that the apparently disparate cosmological phenomenon attributed to so called "dark matter" and dark energy arise from quantum level of spacetime itself. This creation of spacetime results in metric expansion. A recent modification of Einstein's theory of general relativity by Chadwick, Hodgkinson and McDonald incorporate spacetime expansion. Recent evidence predicts that apparent amount of dark matter increases with age of universe. In addition proposal leads to the same result for the small but non-vanishing cosmological constant, related to dark energy. Keywords: Big Bang, Dark matter, Dark Energy.

#### Introduction

Since the 1990s it has become clear that the universe is expanding at an accelerating rate, a phenomenon that was historically attributed to so-called "dark energy"1. The hypothetical dark energy is invisible, and can be thought of as an intrinsic property of spacetime rather than usual matter (stress-energy) that is the source of spacetime curvature. The density of "dark energy" is constant, also in contrast to ordinary matter/energy. A popular method of accounting for the dark energy phenomenon is by attributing it to Einstein's "cosmological constant"  $\Lambda$  [3].

An ostensibly separate phenomenon—the flattening of galactic rotation curves with radial distance–is also well known. This unexpectedly large value of rotational velocities for the outer observable matter in galaxies is an anomaly for standard Newtonian and Einsteinian gravitational theories, and in order to preserve them, it has been attributed to an invisible hypothetical form of matter dubbed "dark matter." However, rather than postulate "dark matter," some researchers have been exploring modifications of Newtonian gravitational theory. One such effort, "Modified Newtonian Dynamics" or MOND, was introduced by Milgrom. MOND has been successful in fitting the observed rotation curves, but it has the drawback of being an ad hoc alteration to the basic gravitational theory.

The situation has recently progressed significantly: Chadwick et al. have proposed a modification of Einstein's general relativity based on the principle that (idealized) point masses give rise not only to the usual spacetime curvature, but also to spacetime expansion. For a particular value of the parameter governing the magnitude of the expansion, they find that their theory perfectly fits the galactic rotation data. It should also be noted that their expansion parameter does in principle have time dependence, although in the approximation studied by them so far, corresponding to the MOND formulation, the time dependence is suppressed.

Currently, there is no known physical mechanism or process underlying the phenomena attributed to dark matter and dark energy (or the finite value of  $\Lambda$  if that is an accurate expression of the latter effect). This paper proposes such a physical process: a specific kind of spacetime emergence underlying a form of matterbased spacetime expansion that has not been previously taken into account. Thus, given the quantification of spacetime expansion by the CHM theory, we may be able to physically account for the "dark matter" phenomenon through a previously unsuspected expansion generated by ordinary matter. In addition, "dark energy" may be understood as an artifact of the same emergence process, arising from the discreteness of spacetime and its quantum origins.

We should hasten to note that the current proposal is not itself a theory of quantum gravity, although it may serve as an ontological guide to such a theory. In any case, no particular theory of quantum gravity is required in order for the basic concept to be useful and applicable as a new kind of ontological understanding of the relationship between the quantum level and an emergent spacetime manifold. In what follows, we first

review the proposed general framework for spacetime emergence and then show that it naturally leads to the description provided by the CHM theory. Then we discuss another aspect of the emergence process that naturally leads to the non-vanishing, but very small, value of  $\Lambda$  that accounts for the "dark energy" phenomenon.



# The Cosmological Constant and "Dark Energy"

We now return to the issue of "dark energy." As noted above, the result of the transactional spacetime emergence process is to yield a causal set of the sort contemplated by, although the elements of the set have more structure in this picture; they are networked transactions I(Ei,Aj) (where the indices are a shorthand representing birth order, chain membership, conserved physical quantities transferred, etc.). In this regard, they more closely resemble the "influence network" of Knuth et al. Nevertheless, the fact that elements of causet are added in Poissonian fashion means that the current model yields the same non-vanishing, but very tiny, val ue for  $\Lambda$ .

Specifically, in natural units (h = G = 1)  $\Lambda$  has units of inverse length squared, and observations indicate that  $\Lambda \leq 1/V 1/2$  (1)

Based on empirical data,  $\Lambda$  must be very close to zero; but to a first order approximation, one might find a very small but non-negligible value5. Sorkin provides such a first-order approximation, as follows. One notes (based on unimodular gravity) that  $\Lambda$  and V are essentially conjugate; i.e.,

# $\Delta \Lambda \Delta V \sim 1$ (2)

(in natural units), analogously to the quantum mechanical uncertainty relations. Sorkin notes that this conjugate relationship between  $\Lambda$  and V is evident from the action integral,

$$S = -\Lambda \int (-g) 1/2 d4x = -\Lambda V$$

Thus, if  $\Lambda$  has a non-vanishing value, it may be due to its uncertainty  $\Delta\Lambda \sim 1/\Delta V$ 

(3)(4)

based on any uncertainty in V. In the causet model, V is proportional to the number of elements N, since the latter specifies how many "atoms of spacetime" exist; or, in the RTI picture, how many I(Ei,Aj) have been actualized. Now, given that elements are added to the (discrete) spacetime manifold in a Poissonian process, the number N of elements has an intrinsic uncertainty of N1/2 for any given value of the proper time  $\tau$ . Since V is a function of  $\tau$ , V inherits this uncertainty:  $\Delta V \sim V1/2$ . If the uncertainty is the only (significant) contribution to the value of A, then we get precisely.

#### Conclusion

We have proposed a specific mechanism of spacetime emergence from the quantum level that leads to the spacetime expansion quantitatively described in the theory of Chadwick et al., which correctly predicts observed galaxy rotation data attributed to "dark matter." In addition, we have shown that the same mechanism yields a discrete spacetime characterized by Poissonian uncertainties, similar to that proposed by, which results in the necessary value of  $\Lambda$  to account for the "dark energy" phenomenon, according to current observational data. In this model, we may understand "dark energy" as a property arising from the ever-present basic quantum uncertainty in the spacetime volume V.

This possible relation of dark energy and matter is intriguing, as it would unify apparently disparate and yet equally unexpected cosmological phenomena. If an expansion of spacetime around mass points can account for the excess rotation of the outskirts of galaxies (i.e., "dark matter"), and if this expansion is related to dark energy as outlined herein, we gain explanatory parsimony as well as evidence for a fascinating connection of spacetime with the quantum level. The latter could aid efforts to find a theory of quantum gravity.

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