

# SOLAR TRACKING: AN EFFICIENT METHOD OF IMPROVING SOLAR PLANT EFFICIENCY

Aman Garg<sup>1</sup>, Ketan Kumar<sup>2</sup>, Parveen<sup>3</sup>, Rohit Kumar<sup>4</sup>, Mrs. Sanju Saini<sup>5</sup>

<sup>1,2,3,4</sup> U.G. Students, <sup>5</sup> Assistant Professor, EE Department, DCRUST, Murthal, Haryana (India)

## ABSTRACT

Energy conservation is a necessity of present time. In order to keep a check on global pollution, the use of non-conventional sources of energy has also been necessitated. Photovoltaic systems using solar panels are commonly used for this purpose. To enhance the overall efficiency of solar panels by keeping them aligned along with the sun position, Solar tracking system is used nowadays. In this paper, a study of various types of solar tracking systems has been presented. In addition a new scheme of efficient street light system using single axis solar tracking with 89S51 microcontroller has been proposed.

**Keywords:** Solar Tracking, Light Detecting Resistors, 89S51 Microcontroller

## I. INTRODUCTION

The sun is the main source of energy for the earth's surface which is used directly or indirectly. Indirect form of energy comes from fossil fuels like coal, petroleum etc. We must use direct form of energy as the fossil fuels are in limited quantity & will extinct one day [1]. But, the efficiency of solar panels is very low, i.e. of the order of 10-12% [2]. Solar tracking is one of the various techniques used to increase the efficiency of solar panels.

Light gathering by solar panels is dependent on the angle of incidence of light rays to the solar cell's surface. If a flat solar panel is mounted on level ground, the sunlight will have an angle of incidence close to 90° in the morning as well as in the evening hours [2]-[4]. At such an angle, the light gathering ability of the cell is essentially zero, resulting in no output. As the day progresses to midday, the angle of incidence approaches 0°, causing a steady increase in power until the light incident on the panel is completely perpendicular, and maximum power is achieved [2]. Further, as the day continues toward dusk, the reverse happens, and the increasing angle causes the power to decrease again toward minimum again.

Hence, there is a need to maintain the maximum power output from the panel by maintaining an angle of incidence as close to 0° as possible [4]. The process of sensing and following the position of the sun is known as Solar Tracking [2]. In this work, various methods of solar tracking have been discussed along with their benefits & shortcomings. An efficient street lighting system using solar tracking with 8051 microcontroller has also been proposed.

## II. METHOD OF SOLAR TRACKING

Solar tracking is one of the most appropriate technologies so as to increase the efficiency of solar panels. Rather than purchasing additional solar panels, they can help to harness solar energy in more efficient way even with respect to cost. In this section, various types of solar trackers have been discussed along with their advantages and disadvantages.

## 2.1 Passive Solar Tracker

his passive tracking system (as shown in Fig. 1) realizes the movement of the system by utilizing a low boiling point liquid. This liquid is vaporized by the added heat of sun and the center of mass is shifted leading to move the system to a new equilibrium position [3]. Sun's heat moves the liquid from side to side. This action allows gravity alone to turn the Track rack to follow the sun [5]. Shipped partially assembled, it is easy to install and is module specific.

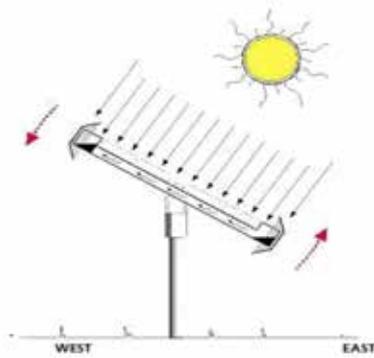


Fig.1 Passive Solar Tracking [3]

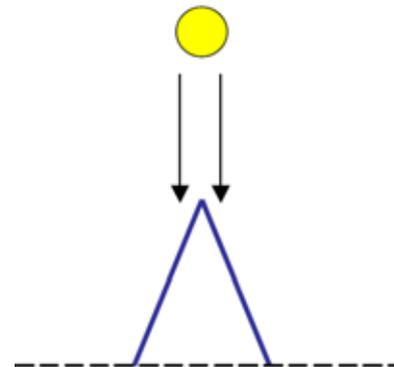


Fig.2 Triangular Solar Panel [2]

## 2.2 Active Solar Tracker

### 2.2.1 Triangular Solar Panel

In this panel, a simple triangular set-up uses two solar cells facing opposite directions as shown in Fig. 2. In its rest position, both the solar cells receive an equal amount of sunlight, as the angle of incidence, although not 90°, is equal in both cases [2]. As the sun moves in the sky, the angle of incidence of light to the reference panels will cause more light to fall on one cell than the other. This cause a voltage difference. It results in a detectable signal at each cell, which can be processed by a suitable circuit. The efficiency of triangular solar panel is 18% [2]-[8], i.e. higher than fixed solar panel.

### 2.2.2 Single Axis Tracking

Single axis tracking systems realizes the movement of either elevation or azimuth for a solar power system. A single-axis tracker can only pivot in one plane – either horizontally or vertically. This makes it less complicated and generally cheaper than a dual-axis tracker, but also less effective at harnessing the total solar energy available at a site. Trackers use motors and gear trains to direct the tracker (as commanded by a controller) towards maximum sunlight. Since the motors consume energy, one wants to use them only when necessary [10]. A horizontal-axis tracker (HSAT) consists of a long horizontal tube to which solar modules are attached. The tube aligned in a north-south direction, is supported on bearings mounted on pylons or frames, and rotates slowly on its axis to follow the sun's motion across the sky [11]. This kind of tracker is most effective at equatorial latitudes where the sun is more or less overhead at noon. For higher latitude, a vertical-axis tracker is better suited [4]. The efficiency of single axis tracking is 23% which is higher than the fixed panel & passive solar tracking [3].

### 2.2.3 Double Axis Tracker

Dual axis trackers have two degrees of freedom that act as axes of rotation (as shown in Fig.3). They can rotate simultaneously in horizontal and vertical directions, and so are able to point exactly at the sun at all times in any location. Dual axis tracking systems realize movement both along the elevation and azimuthally [8]. These tracking systems provide the best performance with efficiency is in the range of 27-40% [9].



**Fig.3 Double Axis Tracker [6]**



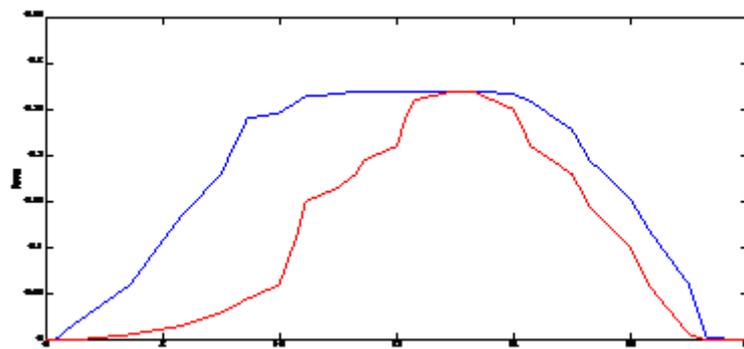
**Fig.4 Spin Cell [14]**

#### 2.2.4 Spin Cell

In contrast to the traditional solar panels, spin cells (as shown in Fig. 4), places the solar cells on a cone shaped frame which are covered with energy concentrators. Once in operation, the whole works spins, making unnecessary the need for tracking hardware and software. [14]. The efficiency of this technology is very high with same number of solar panels, it can give 20 times more current than the traditional flat panel.

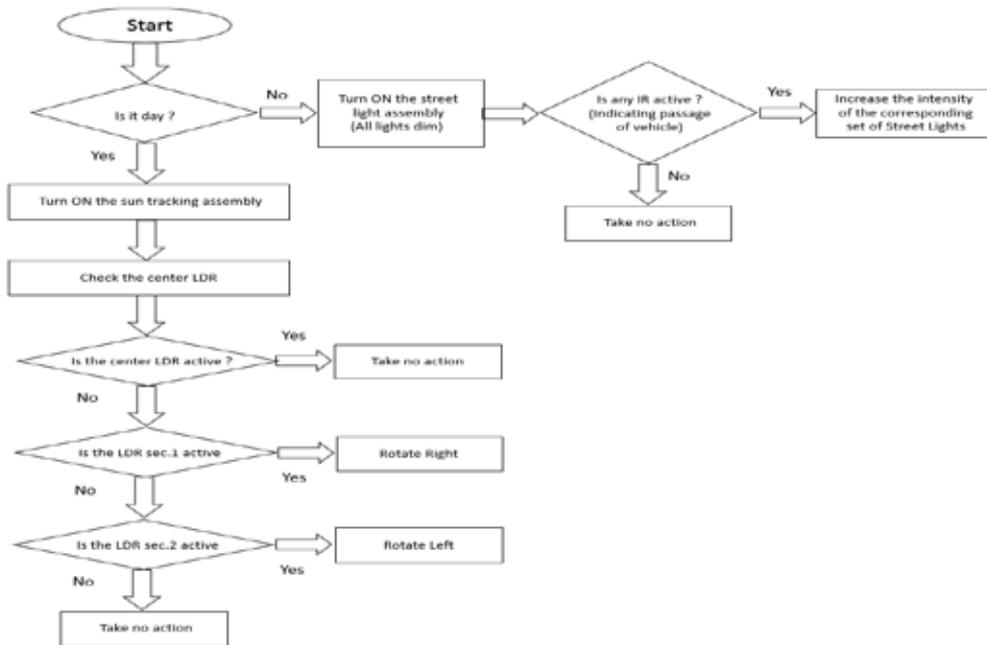
### III. ENERGY EFFICIENT STREET LIGHT SYSTEM WITH SOLAR TRACKER

Recently, a number of researchers are trying to improve the solar cell efficiency. In order to maximize the output power from solar panel, the process of maximum power point tracking is done. For this purpose a number of algorithms have been developed [15]. These algorithms help to receive the maximum power from a stationary array of solar panels. But, the power generation cannot be increased if the sun is not aligned with the system. For this purpose, automatic solar trackers are used. Use of these trackers increases the power output of solar panels to a great extent. A comparison of total energy received from the sun with and without tracker is represented in Fig.5.



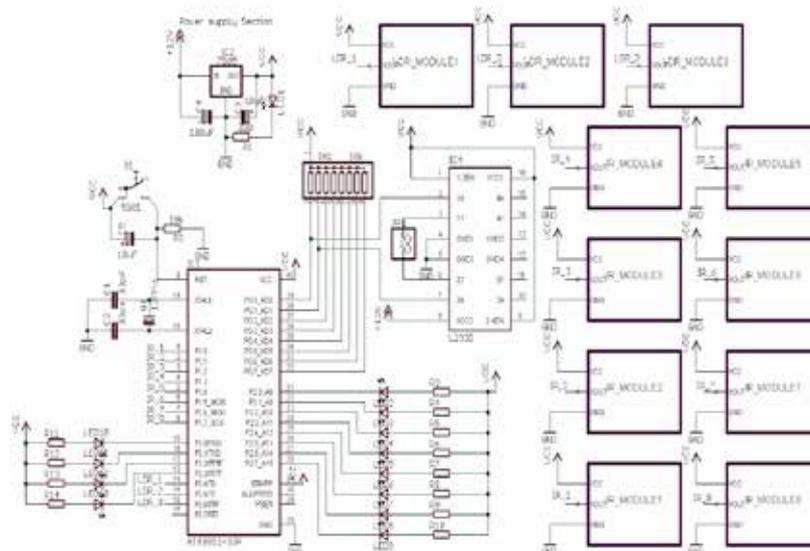
**Fig.5. Comparison of Total Energy Received From The Sun With (Blue) and Without (Red) Tracker**

In this work, a microcontroller based solar tracking system has been proposed. Solar tracker tracks the sun with the help of LDRs (Light detecting resistors mounted on the solar panel) which sense the intensity of the sunlight & pass signals to the 8051 microcontroller. The controller sends signal to the dc motor which rotates the panel. Rest position of the panel is achieved when central LDR becomes active by getting maximum sunlight at different hours of the day. Instructions are sent to the motor to rotate the solar panel in clockwise or anticlockwise directions depending on the state of LDRs '2' & '3' respectively. The overall process is shown in the flowchart of Fig. 6.



**Fig.6 Flow Chart of the Energy Efficient Street Light System With Sun Tracking**

The solar panel has a rating of 3- 4 V which draws 100mA current. 89S51 microcontroller has been used along with 7805 voltage regulator. As a result, the solar power harnessed by the solar panels is increased as shown in the graph of Fig. 5. The overall circuit arrangement of energy efficient street light system has been shown in Fig.7. During night, the street light assembly is turned ON with all the lights dim. As any vehicle passes by, the corresponding IR sensor senses the interruption and microcontroller gives the commands to increase the intensity of respective set of lights maximum. Thus, the overall energy consumption is reduced and maximum energy is harnessed from the Sun.



**Fig.7. Circuit Arrangement of Energy Efficient Street Light System**

#### IV. CONCLUSION

In this work, an efficient street light system with solar tracker is designed by using LDRs (Light detecting resistors) which sense the intensity of sun light & rotate the tracker with the help of DC motor. By using this

method, the solar tracker is able to maintain the angle of incidence near to 0° during day time. As a result, the power of HSAT (Horizontal Single Axis Tracker) increases up to 23%. The microcontroller is also programmed to minimize the energy consumption by decreasing the intensity of street light in the absence of traffic.

## REFERENCES

- [1] M. Yahyavi, M. Vaziri & S. Vadhva, "Solar energy in a volume & efficiency in power generation", IEEE IRI 2010, August 4-6, 2010, Las Vegas, Nevada, USA 978-1-244-8099©2010 IEEE
- [2] J. Rizk, and Y. Chaiko "Solar Tracking System: More Efficient Use of Solar Panels", World Academy of Science, Engineering and Technology Vol : 2, 2008.
- [3] Wichert B, Lawrance W, Friese T, "First Experiences with a Novel Predictive Control Strategy for PV-Diesel Hybrid Energy Systems" Australian Cooperative Research Centre for Renewable Energy, School of Electrical and Computer Engineering (CRESTA) Curtin University, GPO Box U1987, Perth 6001, Australia.
- [4] M. M. El-Wakil, "Power plant Technology, Solar Energy" McGraw-Hill 2nd printing, 1988.
- [5] Jui Sheng Hsieh, "Solar Energy Engineering", Prentice-Hall Inc., New Jersey, 1986.
- [6] Damm, J. Issue. "An active solar tracking system", Homebrew Magazine, June/July 1990
- [7] E Weise, R Klockner, R Kniel, Ma Sheng Hong, Qin Jia Ping, "Remote Power Supply Using Wind and Solar Energy" – a Sino-German Technical Cooperation Project", Beijing International Conference on Wind Energy, Beijing, 1995
- [8] Abdallah, S., "The effect of using sun tracking systems on the voltage current characteristics and power generation of flat plate Photovoltaics", Energy Convers. Manag. 2004, vol.45, pp. 1671-1679.
- [9] Helwa, N., Elshafei, A.L., and Elshenawy, E., "Maximum collectable solar energy by different solar tracking systems", Energy Sources, 2000, vol. 22, no. 1, pp.23–24.
- [10] Roth, P., Georgiev, A., and Boudinov, H., "Design and construction of a system for suntracking, Renew.Energy" ,2004, vol. 29, pp. 393–402
- [11] Mousazadeh, H., Keyhani, A., Javadi, A., et al., "A review of principle and sun tracking methods for maximizing solar system output" Reneable. Sust. Energy Rev., 2009, vol., 13, pp. 1800–1818.
- [12] Fahrenburch, A. and Bube, R., "Fundamentals of solar Cells", Academic Press, New York. 1983.
- [13] Partain, L.D., "Solar Cells and their applications", John Wiley & Sons. New York. 1995.
- [14] <http://v3solar.com/technology-2/>
- [15] Piao, kim, cho et. al., "A study on tracking photovoltaic system by program type", International conference on electrical machines & systems, September 2005, pp.971-973.

# EFFECT OF ICT ON EDUCATION

**Ekta Nehra**

*Student of C R college of Education Hisar (India)*

## ABSTRACT

*ICT stands for information and communication technology. it is combination of diverse technologies which are used for providing any kind of information by digital means and transferring your message to any person by using new technologies. It supports to store information on it from one place and access it from another place. in this paper firstly I introduce about ICT and its meaning and then the technologies which makes the term ICT complete like audio conferencing, video conferencing, radio, television, computer , smart board etc. and what pros and cons can be of using ICT, how much fast the use of ICT is growing and what initiatives are taken by whom to increase the use of ICT.*

**Keywords:** *ICT, Internet, Smart Boards*

## I. INTRODUCTION

Ict (information and communication technology) it is combination of two words information + communication whereas the term information is used for finding any kind of data from the internet and communication means to share any kind of information with others it can be any text file, image, any audio or video. In the year of 1992 email was introduced and it was the introduction of (ICT) information and communication technology[8].The developed countries are using many advanced technology for teaching like video conferencing for those who can't attend the class (it is also called online learning or virtual learning), use of projector in class, distance learning etc. from morning to evening we all are surrounded by many kind of media like newspaper, television, computer, mobile phones, radio and all such kind of media is called Icts. The knowledge of how to use the Ict in our daily life and in education is very important. Icts impact can be seen on complete education system like teaching, learning and research [10]. There can be two kind of Icts one is old and another is new. By old means using the radio television, newspaper etc. old means of communication and by new means using internet, projector, computers, satellite, and wireless technology. ICTs are becoming the basic building blocks of modern society. Now many countries have understood the importance of ICTs and now that countries are trying to get mastery of the basic skills and concepts of ICT as part of the core of education. Icts are combination of several technologies which are used for communication, storing, retrieving and sharing the information. As defined earlier that Icts are made by many technologies so each technology have diverse use according to the situation for example if you are to attend a meeting that is very far to you and if you are not able to go there then video conferencing is very useful in that situation and if you are to make the kids to understand any topic in the class then projector will be better option.

## II. MEANING OF ICTS

Full form of ICTs is information and communication technologies and we can defined it as it is made from different kind of technologies and resources which are used to communicate, and to store, create, and manage information[1]. As defined earlier that Icts is combination of two words whereas information means an

important data which is represented in front of any user or analyzer after processing it and it is very useful for decision making. now a day's computers are using in every corner of the world and internet is also using in every corner of the world. so any kind of information can be stored in the computer like e-books ,notes, assignments and projects etc. using the internet many services can also be provided like online shopping and selling like- quikr , snapdeal , form filling, railway reservation, online banking, paying bill online .social networking sites are also great hub of information like twitter, face book , what sup .educational groups are made on social networking sites and very important study material is provided. the importance of Ict will be when the teacher will take initiative to use new technologies in his classroom [5]. in general sense it can be said that anything in which data is used in electronic form that can be for storing , retrieving, transferring all are part of Icts.

### **III. TECHNOLOGIES HELPFUL IN EDUCATION**

After 1990 internet and World Wide Web started to gain popularity. Then many companies and people took initiative and have developed many technologies in many fields .here are some technologies which are used in educational field:-

#### **3.1 Audio Conferencing**

This technique is used for making the voice call only in between the people which are at remote locations. It provide very effective way of communication, it is very useful for distance learning and meetings. Audio conferencing can be in between two persons and more than two. it can be said as virtual interaction and common classroom tasks like providing information , asking questions, problem-solving can be done by doing audio conference. it is very cost effective technique.

#### **3.2 Computer**

The old classrooms have become modern classroom by using the computers. Now a day's homework of students is given on the computers using it they can see multimedia slides, images and any kind of information and topic find easily. Even learning through the computers gives great experience to the students as they can memorize it for long time. With introduction of computers distance learning have also increased people which were not able to study, and attend the class now can study easily using computer and internet connection.

#### **3.3 Television Lessons**

Televisions have got great importance in many countries as source and tool of teaching. It not only entertains but also provides many positive thoughts to the people. By showing programs social, moral and economical development of a child can be done. In the words, of Director BBC “next to home and school I believe television to have a more deep influence on human than any other medium of communication.” By watching the programs students can how to speak, how to behave. Television can teach in three ways that is formal, informal, and non-formal. Many educational programs are also shown on television. It plays very important role in primary education.

#### **3.4 Radio**

It is also a popular mass media. Its size is very small so it can be taken anywhere easily. it is used everywhere either that is developing country or developed country. It can broadcast information at a time to huge amount of

people. The best thing of radio is that it can broadcast signals in every type of climate. Like television in radio also educational programs are broadcasted. While doing any other work anybody can listen radio anywhere. It can also two ways that is formal and non-formal. Sometimes on educational topics group discussion are also broadcasted. Sometimes interactive program are also taken means feedback is also taken.

### **3.5 Social Networking**

A survey done by the Pew Internet & American Life Project has shown that 73% of teen ager uses social networking sites. Many educational groups are made on social networking sites like ugc net, htet, English-speaking and so many. After school they can keep connecting with their friends and teachers. Assignments and study material can be sending by the email to them. There are many advantages of social networking sites like for making the literature real, it is helpful to follow the famous people, for studying the geography, and it is helpful in conference with parents, for getting public updates.

### **3.6 Edublogs**

Blogs can provide information anytime and anywhere, on the social networking and interaction, and it have the ability to share thoughts and achievements openly. Edublogs are mainly used for making regular updates about assignments, events, and anything going on in class. We can use the blogs as private and public according to the situation. Blogs are very easy to create and maintain for students and teachers. edublogs can be used in many ways in our teaching. You can post any material and resources, you can host online discussions, you can easily share your lesson plans, and you can create a class publication.

### **3.7 Uses of Wikipedia**

It was launched in 2001.it is an encyclopedia on which work is done by the hundreds of writers and editor. Any person from any part of the world can write the article and can post on it. The goal of this is to collect the human knowledge and represent in front of all people. it is very useful for the students which are doing research work. Information of the wikipedia is very reliable because it ignores to the completely original work.

### **3.8 Uses of Smart Boards**

Making the presentation and student-centered learning is demand of time. Teachers have to be up to date according to changing technology. So for meeting to the both requirements white boards are introduced that are attached by the computer or laptops by using digital projector. There are many advantages of using it like it is interactive, need of limited motor skills, it is very attractive tool, if there is one computer in classroom then it can maximize the use of it.

## **IV. ADVANTAGES OF ICT IN EDUCATION**

### **4.1 Storage**

Ict made it easy to store information and to retrieve these information easily. On the internet every kind of information is stored that can be audio, video and in text form. Solution of any kind of problem can be found from the internet. So internet is huge source of information. Besides it data can be stored in C.D., D.V.D, floppy disc etc. libraries are converted into e-library so that any teacher and student can easily access it from anywhere. If you are to do research on any topic then you can find huge amount of data on the internet.

#### **4.2 Learning of Foreign Languages**

Only books are not sufficient for learning the languages. For learning the languages Ict performs very important role. Using new technology do audio conferencing, video conferencing, can use multimedia speakers, on youtube also lectures are provided that how to speak. C.D and D.V.D are also helpful for learning the languages. So it made very easy to learn the languages.

#### **4.3 Educational Research**

In the whole world many researches are continued. In each research there is need of many kind of information and there is also a condition that all information should be real and reliable because that are useful for finding the results. So with the help of Ict huge amount of data or information can be found out easily.

#### **4.4 Useful in Management**

In today's time without management no work can be done management is required everywhere. Now education system is completely depend on Ict. All the records about student, about teacher about fee everything is kept in computer and on the basis of this data decision are taken. Using the Ict information about the school can see anybody like admission forms, curriculum, research work done in school, teacher's information.

#### **4.5 Teaching Process**

Ict play's very important role in teaching-learning process .like you can join online tutorial, online library also available; you can solve your problem in few minutes at any time and from anywhere. You can take help by professor from any corner of the world with the help of Ict otherwise it was not possible. New researches are also available on the internet according to the need of time by seeing it you can change your teaching method and can adopt new technology. Using projector and audio-visual aids teacher can create a situation like reality and can make his students to understand easily.

### **V. LIMITATIONS OF ICT IN EDUCATION**

In India schools have limited knowledge about ICT and many schools can't afford it. Students found that ICT have less significance for teachers. Using of new technologies it costs money. There will be cost including hardware, software and than its maintenance. It is found very difficult to use the ICT in teaching learning process. Because some students do not do fair work they cut, copy and paste and download data from the Internet.

### **VI. RATE AT WHICH USES OF ICT IN INCREASIN**

By the last two decades, information and communication technology (ICT) of India is growing highest in the world. From 2000 to 2004, the Indian economy grew at a astounding rate of 6.2 per cent, and has since grown at an average annual rate of 8 percent [3], becoming "the world's leading exporter of software services" [4]. Today near about 40 percent population from the world have internet connection. Near about 1995, internet connection was less than 1%. A number of internet users are increasing very speedily and has increased ten times from 1999 to 2013. In 2005 in complete world were 1 billion users, in 2010 that were 2 **billion**. At the end of 2014, there was almost 3 billion Internet users, two-thirds of them was from the developing world and other was from

the developed world, and that the number of mobile-broadband subscriptions had reached 2.3 billion globally[2].

## VII. INITIATIVES TAKEN TOWARDS ICT IMPLEMENTATION AND AWARENESS

In the four year Azim Premji Foundation produced the largest single library of digital learning resources (DLR) in India for children. There were 125 CDs in it, and it contain thrilling lessons for children from classes I to VIII. And it was made in 18 languages [7].

We know that ICT play very important role in teacher education and that initiative was taken by Norwegian government in its national innovation project. This program was the government's main project within novel teacher education improved in the years 2000 to 2004. Research was done by some external researchers and project member which are directly connected with Program for Teacher Education Technology and Change (PLUTO)[9].

KCG keep conducting many workshops and seminars for creating awareness in students and educators about NME-ICT. It has covered the almost complete population of Gujarat for creating awareness about the use of ICT in education. A Task Force has been formed which named as "GUJARAT SAKSHAT MISSION" which is represented by many universities. [6].

## VIII. CONCLUSION

Internet and Communication Technology have become essential part of our life. it influence in every step of our life that can be in any way. Besides of other developed countries use of ICT is gaining popularity in India. Now a day's computer and internet has become very common and necessary for our everyday life. Before 1990, less than 1, 00,000 people were able access Internet in the world. In the present time every person everywhere uses internet like filling form, online shopping, to pay bill and all that is called cyber world. The increasing use of internet provide facility to common people to get information, store information, share information etc. ICT plays very important role in education, students who use new technologies in their studies perform better than who studies without using new technologies. It also prove very helpful for teachers because with using new Technologies teacher remains to up-to date about new inventions ,new teaching methods, and can make students understand easily and permanent by using smart board or by making situations like it is happening in real . However, there are many schools, institutes who have lack of knowledge or can't afford to costly ICT equipments. So government should take initiatives toward it and should create awareness towards technologies and should provide fund to that institutes who cannot afford it.

## REFERENCES

- [1]. Bhahima Sanou, director of ITU(2014) "ICT fact and figures". ICT FactsFigures2014-e.pdf
- [2]. Blurton,C.(1999),"New Directions of ICT-Use in Education".Available online <http://www.unesco.org/education/educprog/lwf/dl/edict.pdf>;
- [3]. Dahlman, Carl. 2007. "Technology, Globalization, and International Competitiveness: Challenges for Developing Countries." In *Industrial Development for the 21st Century: Sustainable Development Perspectives*, 29–75. United Nations Sustainable Development Knowledge Platform. Sustainable development. [un.org/content/documents/full\\_report.pdf](http://un.org/content/documents/full_report.pdf).

- [4]. Gregory, Neil, Stanley Nollen, and Stoyan Tenev. 2009. New Industries from New Places: The Emergence of the Software and Hardware Industries in China and India. Washington, DC: Stanford University Press and The World Bank.
- [5]. Harris, S. (2002). Innovative pedagogical practices using ICT in schools in England. Journal of Computer Assisted Learning, No. 18, Pp;449-458.
- [6]. consortium of Gujarat dept. of education "ICT in education"(2014)  
[http://kcg.gujarat.gov.in/initiatives\\_ICT\\_in\\_Higher\\_Education.php](http://kcg.gujarat.gov.in/initiatives_ICT_in_Higher_Education.php)
- [7]. live mint "limits of Ict in education" (16-12-2010).  
<http://www.livemint.com/Opinion/Y3Rh55CXmkGuUIyg4nrc3I/Limits-of-ICT-in-education.html>
- [8]. Pelgrum, W. J., Law, N. (2003) "ICT in Education around the World: Trends, Problems and Prospects" UNESCO- International Institute for Educational Planning. Available:  
[www.worldcatlibraries.org/wcpa/ow/02d077080fcf3210a19afeb4da09e526.html](http://www.worldcatlibraries.org/wcpa/ow/02d077080fcf3210a19afeb4da09e526.html).
- [9]. PLUTO-sluttrappport (2004): Tilgjengelig pr. 17. febr. 2006 på:  
<http://www.itu.no/Prosjekter/1079504497.79>
- [10]. Yusuf, M.O. (2005). Information and communication education: Analyzing the Nigerian national policy for information technology. International Education Journal **Vol.** 6 No . (3), Pp; 316-321.

# ROLE OF MBC PLANT IN TREATING STEEL PLANT EFFLUENT: A CASE STUDY

**Harika.D<sup>1</sup>, Swetha.D<sup>2</sup>, Vijay John T<sup>3</sup>**

<sup>1</sup> *Research Scholar, Department of Environmental Sciences,  
Acharya Nagarjuna University, A.P., (India)*

<sup>2</sup> *Assistant Professor, Dept. of BS&H, SVEC, Peda Tadepalli, Andhra Pradesh, (India)*

<sup>3</sup> *Research Scholar, JNTU, Hyderabad, (India)*

## ABSTRACT

*Steel Plant use a tremendous amount of water for various purposes like Sintering mills, Coke Plants, Blast furnaces, Chemical processes etc, From all these processes, waste water is generated in huge quantity containing Phenols, Cyanides, Oil & grease materials, solids etc, Different technologies can be employed to treat these effluents including physical, chemical and biological treatments. MBC is one of such treatment unit which is considered to be efficient to remove many impurities from the waste water.*

*In this regard a field work has been carried out at Visakhapatnam steel plant (VSP), in 2014 to analyze the efficiency of ETP and impact of effluents on environment. In this paper an attempt has been made to review the efficiency of MBC treatment plant practiced at Visakhapatnam steel plant.*

**Keywords: Impurities, MBC Treatment Plant, Waste water**

## I. INTRODUCTION

The steel Industry is one of the most important and vital industry of the present and the future. The development of innovative technologies for treatment of waste water from steel industries are a matter of alarming concern for us [1]. The Indian steel industry has shown a phenomenon growth in the last few decades. There are seven major integrated iron and steel plants in India, out of which five are under the Steel Authority of India Ltd. The total world annual production of steel is 715.4 million tonnes of which India contributes 14.5 million tonnes. [2] Visakhapatnam Steel Plant (VSP), the first coastal based integrated steel plant of India is located, 16 km west of city of VISAKHAPATNAM. At VSP there is emphasis on total automation, seamless integration and efficient up gradation, which result in wide range of long and structural products to meet stringent demands of discerning customers within India and abroad. Bestowed with modern technologies VSP products meet exalting International Quality Standards such as JIS, DIN and BS etc.

VSP has become the first integrated steel plant in the country to be certified to all three international standards for quality, for Environmental management & for occupational Health & safety. Major sources of Raw materials are Iron Ore Lumps & Fines, BF lime stone; SMS lime stone, BF Dolomite, Manganese ore, Boiler Coal, Coking Coal, and Medium coking coal.

Major Units are Coke ovens, Sinter plant, Blast Furnace, Steel Melt Shop, LMMM, WRM and MMSM. Main products of VSP are steel products such as Angels, Billets, channels, beams, Squares, Flats, Rounds, Re-bars, Wire Rods and the by-products are Nut coke, Coke Dust, Coal tar, Anthracene, HP Napthalene, Benzene,

toluene, xylene, Wash Oils respectively and others such as Granulated Slag, Lime Fines, Ammonical Sulphate. Coke oven gas contains about 55% hydrogen and may prove an important hydrogen source in the future [3].

Steel plant consumes huge quantities of water as high as 150-200 tonnes/ton of steel produced [4][5]. Water supply to the VSP plant is Operational water requirement of 36mgd is being met from the yeleru water Scheme. Power supply to the plant is Operational water requirement of 180 to 200MW is being met through captive power plant [6].

Nearly 2/3 of water consumed in steel plants is used for heat exchange only and requires no treatment except cooling. This water should be segregated, cooled and recirculated [7]. The type of effluent generated in the steel industry depends upon the process of the product and byproduct. However, the generated effluent can be controlled by adopting latest techniques. Coke plant effluents contained a large amount of suspended solids, high BOD, COD, phenols, ammonia and other toxic substances, are causing serious surface water pollution problem in the area [7].

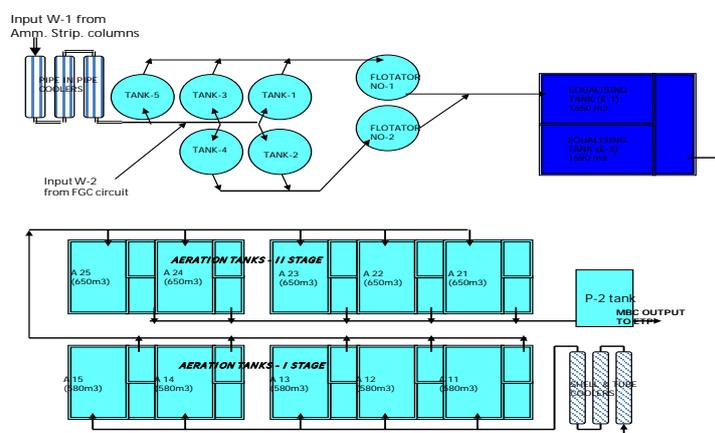
These effluents were treated by physical, chemical, biological treatment processes and here review was done to analyze the quality of effluent before and after MBC treatment.

## II. METHODOLOGY

### 2.1. Mechanical Biological & Chemical (MBC) Treatment plant

The wastewater from C&CCD is treated by physical, chemical methods followed by biological treatment. MBC Plant is designed to treat 120 cum/hr of effluents.

MECHANICAL BIOLOGICAL & CHEMICAL TREATMENT PLANT - FLOW DIAGRAM



MBC flow Diagram

The physical & chemical treatment units at MBC are tar settling tanks, oil flocculators and equalization tanks.

### 2.2 Steps Involved in the Treatment are as Follows

#### 2.2.1. Collection of Wastewater

Excess flushing liquor after Ammonia stripping (Input W1) is pumped to the pre-aerators (distribution tanks) through the double pipe heat exchangers where it is cooled from 90 ° C to 50 ° -55 ° C with the help of recirculating cooling water.

The cooling tower blow-down water from FGC Circuit (Input W-2) and BDS effluent is also be taken into the pre-aerators. Mixed effluent at a temperature of about 50° - 55 ° C is distributed in equal positions in tar settling tanks by gravity.

### **2.2.2 Tar Removal**

In pre-aerators effluents are mixed thoroughly with the help of air. The combined waste water carries traces of tar particles and emulsified oils, which need to be separated prior to biological treatment to avoid any adverse effect on the active biomass.

Five numbers of mild steel fabricated circular tar settling tanks each of size 230 cum. are installed. These are provided with steam heating coil and scrapper mechanism at the conical hopper bottom.

Tar settling tank is provided for removing tar and oil from the effluent. Oil floats on the surface of water and tar settles down in conical bottom. Tar collected at the bottom of each tank is pumped into tar collecting tank once in 3-5 days.

### **2.2.3 Oil Removal**

Two nos. of MS air flotation tanks of size 270 cum each are installed. The over flow from the tar settling tanks is collected in vertical steel tanks named phenolic water collecting tanks from where it is pumped to the oil flotation tank No.1 through pressurised head tank No.1. Air (5% by volume of water) is injected into the delivery line of the pumps before it is pumped to the pressure tank. In the flotation tank, air bubbles through the water as the water is de-pressurised and the oil is entrained by air bubbles and floats at the water surface. The entrained oil is skimmed with oil skimmer mechanism of floatation tank and is collected through the oil discharge through to a tank. Tar and oil from the collecting tanks are finally pumped to tar acid utilization plant.

### **2.2.4 Equalization Tank**

After removal of tar and oil the effluent is collected in equalization tank. Equalization tank is an RCC tank with two chambers each of 1650 cum capacity. Each chamber has one over flow tank. In equalization tank phenolic effluent is thoroughly equalized with the help of air. Ortho-phosphoric acid is added to the overflow of equalization tank as nutrient for the bacteria. 73% strong ortho-phosphoric acid is added at the rate of 20 g/cum of effluent.

### **2.2.5 Biological Treatment (1st stage)**

From Equalization tank the effluent is pumped to aeration tank of 1st stage purification through shell and tube heat exchangers to maintain effluent temperature between 35-38 ° C.

In the 1st stage of purification, purification is done with the help of phenol destructive bacteria. Five numbers of RCC aeration tanks are provided. Each aeration tank is a comprehensive treatment unit within built sludge settling and sludge regeneration chambers. To maintain the vital activity of bacteria compressed air from the air blower is supplied to the aeration tanks.

The over flow from each tank first goes to the settling chamber where sludge gets settled down and the supernatant water over flows to the 1st stage purified water collecting tank (P-1) of 90 cum capacity. The settled sludge then flows to the attached regeneration tank from where it is recycled back to the aeration tank with the help of air lifting pump. Phenol degradation is takes place with the help of phenol destructing bacteria of activated sludge process.

### **2.2.6 Biological Treatment (2nd stage)**

After degradation of phenol at 1<sup>st</sup> stage purification water from P-1 tank is pumped into aeration tanks of 2nd stage purification. In the 2nd stage purification, Rhodanides and cyanides are destroyed with the help of Rhodanide destructive bacteria. In second stage also five numbers RCC aeration tanks (650 cum capacity each) are provided. The construction and activity in 2nd stage is similar to 1<sup>st</sup> stage aeration tanks.

Treated effluent from 2nd stage aeration tanks is collected by gravity into two RCC tanks (P-2) of size 90 cum each. The treated effluent is then pumped to effluent treatment plant for further treatment along with plant faecal sewage water and to Sludge treatment plant of C&CCD for using in the dust extraction systems.

### 2.2.7 Sludge Drying Beds

RCC sludge drying bed with three compartments is provided with a facility to take back excess water. The sludge from any aeration tank and equalizing tank can be pumped to these beds. The dried sludge is taken out and recycled in coke oven batteries by adding it to the charging coal.

## III. RESULTS

### 3.1. Effects of Effluents on Environment

The toxic effluents of Effluent treatment plant contain various chemicals and having vital environmental impact when discharged to sea. Those includes

**Phenol:** This constituent is toxic to fish and aquatic life. This may lead to development of cancer. This may causes taste and odor problems in water.

**Cyanides:** Cyanides are toxic constituents and poisonous to aquatic life.

**Thio-cyanates:** Thio-cyanates are also toxic constituents and poisonous to fish and aquatic life.

**Ammonical Nitrogen:** Ammonical nitrogen depletes oxygen content. This causes blue baby syndrome for infants. This constituent is also toxic to fish and aquatic life.

**Oil & Grease-**The presence of oil & grease in the discharge to sea causes oxygen insufficiency to marine organisms. This will also contributes to higher chemical oxygen demand (COD) level.

The major pollutional effects of the untreated wastewaters of steel industry if discharged into the receiving water bodies are: toxicity to aquatic life, reduction of D.O., silting due to suspended solids, taste and odor problems, temperature rise affecting the dissolved oxygen and aquatic life and formation of oil slicks due to floating oil.

**Table-1: Results Observed at Various Stages of MBC Plant are as follows:**

Parameter	Inlet water	After tar settling tank	After oil flotators	After 1st stage purification	After 2 <sup>nd</sup> stage purification
Phenol	400 ppm	400	400	3-5	1 ppm
Rhodanides	400 ppm	400	400	350	10 ppm
Ammonia as NH <sub>4</sub>	100 ppm	100	100	90-100	50-100
Tar & Oils	50	60	35-40	30-35	25 ppm
Suspended solids	100	30	30	200-300	150-200 ppm
Cyanides	20	16 – 20	16	12	1.5-3.5
BOD	-	-	2000	1000	100 ppm(Avg)
COD	2500 ppm	2500	2500	1200	300 ppm

Toxicity to aquatic life due to ammonia, phenols (monohydric, Polyhydric and derivatives of phenols) and cyanide is well known. With the rise of pH value, the concentration of free ammonia increases. Hence, ammonia toxicity is particularly severe at high pH. Due to discharge of biodegradable organic substances from CO and BP plant into the water bodies, the soil and water bacteria utilize the organic matter as source of carbon and dissolved oxygen (D.O) in the water for the respirational requirement.

#### IV. CONCLUSION

MBC Plant is proved to be efficient to treat the effluent and to improve the quality by reducing the Conc. of Phenols, Rhodanides, Ammonia, Oil & tar, Solids, Cyanides, BOD & COD. Thus, it was proved to useful to treat the concentrated effluent before sending it into the ETP.

#### REFERENCES

- [1] S.K.Sinha, V.K.Sinha, S.Kr. Pandey and A.Tiwari,. A study on the Waste Water Treatment Technolohy for steel Industry: Recycle and Reuse, AJER, 3(4), 2014, pp. 309-315.
- [2] A.Sirajuddin, R.K. Rathi and U. Chandra, Wastewater Treatment Technologies Commonly Practiced in Major Steel Industries in India, 2010.
- [3] "The State-of-the-Art Clean Technologies, (SOACT) for Steelmaking", Asia-Pacific Partnership for Clean Development and Climate, 2007
- [4] Henri Faure, "The new technologies for iron & steel making, Article MMR Dec. 1993.
- [5] A. Chatterjee, "India - Recent developments in iron making and steel making" - Iron making and Steel Making, 22(2), 1995.
- [6] Cover story. Visakhapatnam Steel Plant - MMR Annual 1995.
- [7] Comprehensive Industry Document series – COINDS/27/1998 – CPCB, New Delhi.
- [8] M K Ghose, Physico-chemical treatment of coke plant effluents for control of water pollution in India, Indian Journal of Chemical Technology Vol. 9, 2002, pp. 54-59

# CREATING A ENCRYPTION ALGORITHM BASED ON NETWORK RFWKIDEA4-2 WITH THE USE THE ROUND FUNCTION OF THE GOST 28147-89

**Tuychiev G.**

*National University of Uzbekistan, Republic of Uzbekistan, Tashkent*

## ABSTRACT

*In this article we create a block encryption algorithm based on network RFWKIDEA4-2, with the use the round function of algorithm GOST 28147-89. The block length of created block encryption algorithm is 128 bits, the number of rounds is 8, 12 and 16.*

***Keywords: Feistel Network, Network, Round Function, Round, Round Keys, Output Transformation, Subblock, S-Box***

## I. INTRODUCTION

GOST 28147-89 is a standard encryption algorithm of the Russian Federation. It is based on the basis of a Feistel network. This encryption algorithm for hardware and software implementation, satisfies the necessary requirements for cryptographic resistance and therefore imposes no restrictions on the degree of secrecy protected information. Implements the encryption algorithm 64-bit blocks of data via a 256-bit key. In the round function employed eight S-boxes a size 4x4 and cyclic shift operation on 11 bits. So far, GOST 28147-89 is resistant to cryptographic attacks.

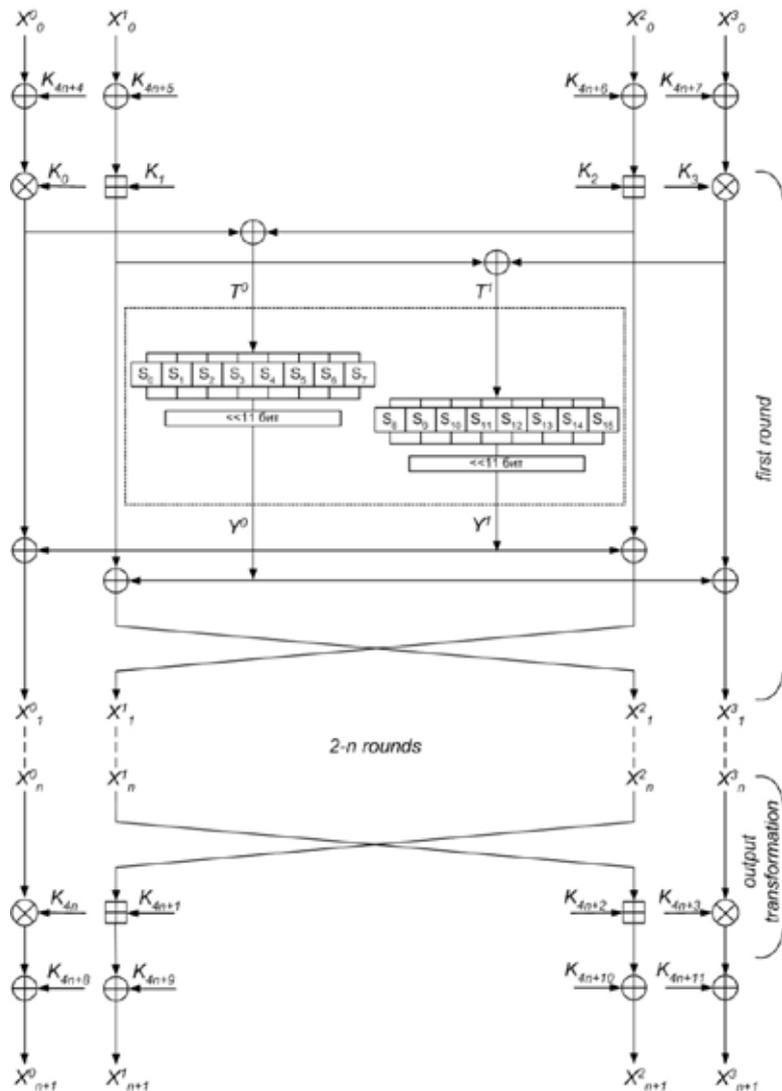
As the round function network IDEA4-2 [2] using the round function of the encryption algorithm GOST 28147-89 created by the encryption algorithm GOST28147-89-IDEA4-2 [8]. In addition, by using transformations SubBytes(), ShiftRows(), MixColumns(), and AddRoundKey() the AES encryption algorithm as round functions of networks IDEA8-1 [4], RFWKIDEA8-1 [4], PES8-1 [5], RFWKPES8-1 [6], IDEA16-1 [7] created encryption algorithms AES-IDEA8-1 [9], AES-RFWKIDEA8-1 [10], AES-PES8-1 [11], AES-RFWKPES8-1 [12], AES-IDEA16-1 [13].

The network RFWKIDEA4-2 presented in the paper [1] and as in a Feistel network, with encryption and decryption using the same algorithm. In a network RFWKIDEA4-2 applied two round functions and as the round function, you can use any transformation.

In this article, we applied round function encryption algorithm GOST 28147-89 as a round function network RFWKIDEA4-2, designed encryption algorithm GOST28147-89- RFWKIDEA4-2, which has the advantage of speed and resistance of encryption. The proposed encryption algorithm GOST28147-89-RFWKIDEA4-2 block length is 128 bits, key length is changed from 256 bits to 1024 bits in steps 128 bits and the number of rounds  $n$  is 8, 12, 16, that allows the user depending on the degree of secrecy of information and the speed select the number of rounds of encryption and key length. Below is the structure of the proposed encryption algorithm.

## II. THE STRUCTURE OF THE ENCRYPTION ALGORITHM GOST28147-89-RFWKIDEA4-2

In the encryption algorithm GOST28147-89-RFWKIDEA4-2 the length of subblocks  $X^0, X^1, X^2, X^3$ , length of round keys  $K_{4(i-1)}, K_{4(i-1)+1}, K_{4(i-1)+2}, K_{4(i-1)+3}, i = \overline{1..n+1}, K_{4n+4}, K_{4n+5}, \dots, K_{4n+11}$  and the length of the input and output blocks of round functions is 32 bits. This encryption algorithm round function GOST 28147-89 is applied twice and in each round function employed eight S-boxes, i.e. the total number of S-boxes is equal to 16. The structure of the encryption algorithm GOST28147-89-RFWKIDEA4-2 is shown in Fig.1.



**Fig. 1. The Scheme  $N$ -Rounded Encryption Algorithm GOST28147-89-RFWKIDEA4-2**

Consider the round function block encryption algorithm GOST28147-89-RFWKIDEA4-2. First to the 32-bit subblock  $T^0, T^1$  divided into eight four-bit sub-blocks, i.e.  $T^0 = t_0^0 \parallel t_1^0 \parallel t_2^0 \parallel t_3^0 \parallel t_4^0 \parallel t_5^0 \parallel t_6^0 \parallel t_7^0$ ,  $T^1 = t_8^1 \parallel t_9^1 \parallel t_{10}^1 \parallel t_{11}^1 \parallel t_{12}^1 \parallel t_{13}^1 \parallel t_{14}^1 \parallel t_{15}^1$ . The four-bit subblocks  $t_i^0, t_i^1, i = \overline{0..7}$  converted to S-box:  $R^0 = S_0(t_0^0) \parallel S_1(t_1^0) \parallel S_2(t_2^0) \parallel S_3(t_3^0) \parallel S_4(t_4^0) \parallel S_5(t_5^0) \parallel S_6(t_6^0) \parallel S_7(t_7^0)$ ,  $R^1 = S_8(t_8^1) \parallel S_9(t_9^1) \parallel S_{10}(t_{10}^1) \parallel S_{11}(t_{11}^1) \parallel S_{12}(t_{12}^1) \parallel S_{13}(t_{13}^1) \parallel S_{14}(t_{14}^1) \parallel S_{15}(t_{15}^1)$ . Received 32-bit subblocks  $R^0, R^1$

cyclically shifted to the left by 11 bits and get the subblocks  $Y^0, Y^1: Y^0 = R^0 \ll 11, Y^1 = R^1 \ll 11$ . The S-box encryption algorithm shown in Table 1.

**Table 1. The S-box of Encryption Algorithm GOST28147–89–RFWKIDEA4–2**

	0x0	0x1	0x2	0x3	0x4	0x5	0x6	0x7	0x8	0x9	0xA	0xB	0xC	0xD	0xE	0xF
S0	0xA	0x2	0x0	0xF	0x6	0x7	0x1	0x4	0x5	0x9	0xE	0xD	0xB	0xC	0x3	0x8
S1	0x1	0x7	0xF	0x2	0xE	0x4	0x5	0x6	0xC	0x3	0x8	0xA	0xB	0x0	0xD	0x9
S2	0xF	0xC	0xB	0x7	0xA	0x4	0x5	0xD	0x3	0x6	0x9	0x0	0x1	0xE	0x2	0x8
S3	0x1	0xA	0x4	0x5	0x7	0xE	0xD	0x9	0x0	0x6	0xC	0xB	0x8	0x2	0x3	0xF
S4	0x9	0xC	0x2	0x4	0x0	0x1	0x3	0xE	0xF	0x6	0x5	0xA	0x8	0xB	0xD	0x7
S5	0x9	0x3	0xD	0x5	0x8	0xF	0xA	0x6	0x1	0x0	0x2	0xB	0xE	0xC	0x4	0x7
S6	0x9	0xF	0x6	0x5	0x8	0x3	0xD	0x1	0xA	0xB	0xE	0xC	0x2	0x7	0x4	0x0
S7	0xB	0x2	0x0	0x3	0xF	0xA	0x5	0xD	0x8	0xC	0x6	0x1	0xE	0x4	0x7	0x9
S8	0xB	0x3	0x5	0x8	0x7	0x0	0x2	0x1	0x6	0xA	0xF	0xE	0xC	0x9	0x4	0xD
S9	0x4	0x1	0x5	0xC	0x7	0x9	0xB	0x3	0xD	0xE	0x2	0x8	0xA	0x6	0xF	0x0
S10	0x1	0x5	0xB	0xE	0x8	0xA	0x9	0x6	0x4	0xD	0xC	0x0	0x3	0x2	0x7	0xF
S11	0xC	0xB	0x5	0x0	0x6	0x7	0x4	0x8	0x9	0x3	0x1	0xE	0xD	0xF	0xA	0x2
S12	0x2	0x1	0x7	0xB	0x9	0x8	0x6	0xF	0xE	0x5	0xA	0xD	0x3	0xC	0x0	0x4
S13	0x5	0xE	0xC	0xF	0x1	0x4	0x9	0x3	0x6	0x2	0xA	0xD	0x0	0x8	0xB	0x7
S14	0xE	0x3	0x2	0x0	0xA	0xD	0x5	0xB	0xC	0x8	0x7	0x1	0x9	0x6	0x4	0xF
S15	0xE	0xC	0x2	0x3	0x6	0x1	0x5	0x8	0xF	0x7	0x4	0xD	0x9	0xA	0xB	0x0

Consider the encryption process of encryption algorithm GOST28147–89–RFWKIDEA4–2. Initially the 128-bit plaintext  $X$  partitioned into subblocks of 32 bits  $X_0^0, X_0^1, X_0^2, X_0^3$ , and performs the following steps:

1. subblocks  $X_0^0, X_0^1, X_0^2, X_0^3$  are summed to XOR with corresponding round keys  $K_{4n+4}, K_{4n+5}, K_{4n+6}, K_{4n+7}: X_0^i = X_0^i \hat{\Delta} K_{4n+4+i}, j = \overline{0...3}$ .
2. subblocks  $X_0^0, X_0^1, X_0^2, X_0^3$  respectively, multiplied and summed with the round keys  $K_{4(i-1)}, K_{4(i-1)+1}, K_{4(i-1)+2}, K_{4(i-1)+3}$  and calculated 32-bit subblocks  $T^0, T^1$ . This step can be represented as follows:  
 $T^0 = (X_{i-1}^0 \times K_{4(i-1)}) \hat{\Delta} (X_{i-1}^2 + K_{4(i-1)+2}), T^1 = (X_{i-1}^1 + K_{4(i-1)+1}) \hat{\Delta} (X_{i-1}^3 \times K_{4(i-1)+3}), i = 1$ .
3. to 32-bit subblocks  $T^0, T^1$  subblocks apply the round function and get the 32-bit subblocks  $Y^0, Y^1$ .
4. subblocks  $Y^0, Y^1$  are summed to XOR with subblocks  $X_{i-1}^0, X_{i-1}^1, X_{i-1}^2, X_{i-1}^3$ , i.e.  $X_{i-1}^0 = X_{i-1}^0 \hat{\Delta} Y^1, X_{i-1}^1 = X_{i-1}^1 \hat{\Delta} Y^0, X_{i-1}^2 = X_{i-1}^2 \hat{\Delta} Y^1, X_{i-1}^3 = X_{i-1}^3 \hat{\Delta} Y^0, i = 1$ .
5. at the end of the round subblocks swapped, i.e.  $X_i^0 = X_{i-1}^0, X_i^1 = X_{i-1}^2, X_i^2 = X_{i-1}^1, X_i^3 = X_{i-1}^3, i = 1$ .
6. repeating the steps 2–5  $n$  time, i.e.  $i = \overline{2...n}$ , obtained the subblocks  $X_n^0, X_n^1, X_n^2, X_n^3$ .
7. in output transformation round keys are multiplied and summed into subblocks, i.e.  $X_{n+1}^0 = X_n^0 \times K_{4n}, X_{n+1}^1 = X_n^2 + K_{4n+1}, X_{n+1}^2 = X_n^1 + K_{4n+2}, X_{n+1}^3 = X_n^3 \times K_{4n+3}$ .
8. subblocks  $X_n^0, X_n^1, X_n^2, X_n^3$  are summed to XOR with the round keys  $K_{4n+8}, K_{4n+9}, K_{4n+10}, K_{4n+11}: X_{n+1}^j = X_n^j \hat{\Delta} K_{4n+8+j}, j = \overline{0...3}$ . As ciphertext receives the combined 32-bit subblocks  $X_{n+1}^0 \parallel X_{n+1}^1 \parallel X_{n+1}^2 \parallel X_{n+1}^3$ .

In the encryption algorithm GOST28147–89–RFWKIDEA4–2 with encryption and decryption is used the same algorithm, only when decryption calculated inversion round keys depending on the operations and are applied in reverse order. One important task of encryption is key generation.

### III. KEY GENERATION ENCRYPTION ALGORITHM GOST28147–89–RFWKIDEA4–2

In the  $n$ -round encryption algorithm GOST28147–89–RFWKIDEA4–2 used in each round four round keys of 32 bits and the output transformation of four round keys of 32 bits. In addition, prior to the first round and after the output transformation is applied four round keys on 32 bits. The total number of 32-bit round keys is equal to  $4n+12$ . Hence, if  $n=8$  then need 44 to generate round keys, if  $n=12$ , you need to generate 60 round keys and if  $n=16$  need 76 to generate round keys. When encoding in Fig.1 instead  $K_i$  used the round keys  $K_i^c$ , and when decrypting the round keys  $K_i^d$ .

The key length of the encryption algorithm  $l$  (256 £ / £ 1024) bits is divided into 32-bit round keys  $K_0^c, K_1^c, \dots, K_{Lenght-1}^c$ ,  $Lenght = l / 32$ , here  $K = \{k_0, k_1, \dots, k_{l-1}\}$ ,  $K_0^c = \{k_0, k_1, \dots, k_{31}\}$ ,  $K_1^c = \{k_{32}, k_{33}, \dots, k_{63}\}$ , ...,  $K_{Lenght-1}^c = \{k_{l-32}, k_{l-31}, \dots, k_{l-1}\}$ . Then calculated  $K_L = K_0^c \hat{\wedge} K_1^c \hat{\wedge} \dots \hat{\wedge} K_{Lenght-1}^c$ . If  $K_L = 0$  then as  $K_L$  selected 0xC5C31537, i.e.,  $K_L = 0xC5C31537$ . Round keys  $K_i^c$ ,  $i = \overline{Lenght \dots 4n+11}$  calculated as follows:  
 $K_i^c = SBox0(K_{i-Lenght}^c) \hat{\wedge} SBox1(RotWord(K_{i-Lenght+1}^c)) \hat{\wedge} K_L$ . After each generation of round keys value  $K_L$  cyclically shifted left by 1 bit. Here  $RotWord32()$ –cyclic shift 32 bit subblock to the left by 1 bit,  $SubBytes32()$ –convert 32-bit subblock S-box and  $SBox0(A) = S_0(a_0) \parallel S_1(a_1) \parallel S_2(a_2) \parallel S_3(a_3) \parallel S_4(a_4) \parallel S_5(a_5) \parallel S_6(a_6) \parallel S_7(a_7)$ ,  $SBox1(A) = S_7(a_0) \parallel S_8(a_1) \parallel S_9(a_2) \parallel S_{10}(a_3) \parallel S_{11}(a_4) \parallel S_{12}(a_5) \parallel S_{13}(a_6) \parallel S_{14}(a_7)$ ,  $A = a_0 \parallel a_1 \parallel a_2 \parallel a_3 \parallel a_4 \parallel a_5 \parallel a_6 \parallel a_7$  and  $a_i$ – the four-bit sub-block.

The decryption round keys  $K_i^d$  calculated on the basis of encryption round keys  $K_i^c$  and decryption keys output transformation associated with the encryption keys as follows:

$$(K_{4n}^d, K_{4n+1}^d, K_{4n+2}^d, K_{4n+3}^d) = ((K_0^c)^{-1}, -K_1^c, -K_2^c, (K_3^c)^{-1}) \quad 1$$

Decryption round keys first round associated with the encryption round keys as follows:

$$(K_0^d, K_1^d, K_2^d, K_3^d) = ((K_{4n}^c)^{-1}, -K_{4n+1}^c, -K_{4n+2}^c, (K_{4n+3}^c)^{-1}) \quad 2$$

Likewise, decryption round keys second, third and  $n$ -round associated with the encryption round keys as follows:

$$(K_{4(i-1)}^d, K_{4(i-1)+1}^d, K_{4(i-1)+2}^d, K_{4(i-1)+3}^d) = ((K_{4(n-i+1)}^c)^{-1}, -K_{4(n-i+1)+2}^c, -K_{4(n-i+1)+1}^c, (K_{4(n-i+1)+3}^c)^{-1}), i = \overline{2 \dots n}. \quad 3$$

Decryption round keys, applied to the first round and after output transformation connected with encryption keys as follows:  $K_{4n+4+j}^d = K_{4n+8+j}^c$ ,  $K_{4n+8+j}^d = K_{4n+4+j}^c$ ,  $j = \overline{0 \dots 3}$ .

For example, if the number of rounds encryption algorithm is 16, then (1) and (2) formula as follows:

$$(K_0^d, K_1^d, K_2^d, K_3^d, K_4^d, K_5^d) = (K_{96}^{c^{-1}}, -K_{97}^c, -K_{98}^c, K_{99}^{c^{-1}}, K_{94}^c, K_{95}^c)$$

$$(K_{96}^d, K_{97}^d, K_{98}^d, K_{99}^d) = (K_0^{c^{-1}}, -K_1^c, -K_2^c, K_3^{c^{-1}})$$

Likewise, by formula (3) decryption round key second, third and sixteenth round calculated as follows:

$$(K_6^d, K_7^d, K_8^d, K_9^d, K_{10}^d, K_{11}^d) = (K_{90}^{c^{-1}}, -K_{92}^c, -K_{91}^c, K_{93}^{c^{-1}}, K_{88}^c, K_{89}^c),$$

$$(K_{12}^d, K_{13}^d, K_{14}^d, K_{15}^d, K_{16}^d, K_{17}^d) = (K_{84}^{c^{-1}}, -K_{86}^c, -K_{85}^c, K_{87}^{c^{-1}}, K_{82}^c, K_{83}^c),$$

$$(K_{90}^d, K_{91}^d, K_{92}^d, K_{93}^d, K_{94}^d, K_{95}^d) = (K_6^{c^{-1}}, -K_8^c, -K_7^c, K_9^{c^{-1}}, K_4^c, K_5^c).$$

Likewise, calculated decryption round keys when the number of rounds equal to 8 and 12.

#### IV. RESULTS

As a result of this study built a new block encryption algorithm called GOST28147–89–RFWKIDEA4–2. This algorithm is based on a network RFWKIDEA4-2 using the round function of GOST 28147-89. Length of block encryption algorithm is 128 bits, the number of rounds and key length is variable. Wherein the user depending on the degree of secrecy of the information and speed of encryption can select the number of rounds and key length.

It is known, that the S-box encryption algorithm GOST 28147-89 are secret and used as a long-term key. In Table 2 below describes the options openly declared S-box such as: *deg*-degree of algebraic nonlinearity; *NL*-nonlinearity; *l*-resistance to linear cryptanalysis; *d*-resistance to differential cryptanalysis; SAC-strict avalanche criterion; BIC-bit independence criterion. To S-box was resistant to cryptanalysis it is necessary that the values *deg* and *NL* were large, and the values *l*, *d*, SAC and BIC small.

In block cipher algorithm GOST28147–89–RFWKIDEA4–2 for all S-boxes, the following equation: *deg* = 3, *NL* = 4, *l* = 0.5, *d* = 3/8, SAC=4, BIC=4, i.e. resistance is not lower than the algorithm GOST 28147-89.

**Table2 Parameters of the S-Boxes Algorithm GOST 28147-89**

№	Parameters	S1	S2	S3	S4	S5	S6	S7	S8
1	<i>deg</i>	2	3	3	2	3	3	2	2
2	<i>NL</i>	4	2	2	2	2	2	2	2
3	<i>l</i>	0.5	3/4	3/4	3/4	3/4	3/4	3/4	3/4
4	<i>d</i>	3/8	3/8	3/8	3/8	1/4	3/8	0.5	0.5
5	SAC	2	2	2	4	2	4	2	2
6	BIC	4	2	4	4	4	4	2	4

Studies have shown that the speed of the encryption block cipher algorithm GOST28147–89–RFWKIDEA4–2 faster than the GOST 28147-89. Created 16-round algorithm encrypts 1.25 times faster than the 32-round GOST 28147-89.

In this way, built a new block encryption algorithm called GOST28147–89–RFWKIDEA4–2 network-based RFWKIDEA4-2 using the round function of GOST 28147-89. Installed that the resistance offered by the author block cipher algorithm not lower than the resistance of the algorithm GOST 28147-89.

#### REFERENCES

- [1] GOST 28147–89. National Standard of the USSR. Information processing systems. Cryptographic protection. Algorithm cryptographic transformation.
- [2] Aripov M.M. Tychiev G.N. The network IDEA4–2, consists from two round functions // Infocommunications: Networks–Technologies–Solutions. –Tashkent, 2012, №4 (24), pp. 55–59.

- [3] Tuychiev G.N. About networks PES4–1 and RFWKPES4–2, RFWKPES4–1 developed on the basis of network PES4–2 // Uzbek journal of the problems of informatics and energetics. –Tashkent, 2015, №1, pp. 97–103.
- [4] Tuychiev G.N. About networks IDEA8–2, IDEA8–1 and RFWKIDEA8–4, RFWKIDEA8–2, RFWKIDEA8–1 developed on the basis of network IDEA8–4 // Uzbek mathematical journal, –Tashkent, 2014, №3, pp. 104–118
- [5] Tuychiev G.N. About networks PES8–2 and PES8–1, developed on the basis of network PES8–4 // Transactions of the international scientific conference «Modern problems of applied mathematics and information technologies–Al–Khorezmiy 2012», Volume № II, –Samarkand, 2014, pp. 28–32.
- [6] Tuychiev G.N. About networks RFWKPES8–4, RFWKPES8–2, RFWKPES8–1, developed on the basis of network PES8–4 // Transactions of the international scientific conference «Modern problems of applied mathematics and information technologies–Al–Khorezmiy 2012», Volume № 2, –Samarkand, 2014, pp. 32–36
- [7] Tuychiev G.N. About networks IDEA16–4, IDEA16–2, IDEA16–1, created on the basis of network IDEA16–8 // Compilation of theses and reports republican seminar «Information security in the sphere communication and information. Problems and their solutions» –Tashkent, 2014
- [8] Tuychiev G. Creating a data encryption algorithm based on network IDEA4-2, with the use the round function of the encryption algorithm GOST 28147-89 // Infocommunications: Networks–Technologies–Solutions. –Tashkent, 2014, №4 (32), pp. 49–54.
- [9] Tuychiev G. New encryption algorithm based on network IDEA8-1 using of the transformation of the encryption algorithm AES // IPASJ International Journal of Computer Science, 2015, Volume 3, Issue 1, pp. 1-6
- [10] Tuychiev G. New encryption algorithm based on network RFWKIDEA8-1 using transformation of AES encryption algorithm // International Journal of Computer Networks and Communications Security, 2015, Vol. 3, №. 2, pp. 43–47
- [11] Tuychiev G. New encryption algorithm based on network PES8-1 using of the transformations of the encryption algorithm AES // International Journal of Multidisciplinary in Cryptology and Information Security, 2015, vol.4., №1, pp. 1-5
- [12] Tuychiev G. New encryption algorithm based on network RFWKPES8-1 using of the transformations of the encryption algorithm AES // International Journal of Multidisciplinary in Cryptology and Information Security, 2014, vol.3., №6, pp. 31-34
- [13] Tuychiev G. New encryption algorithm based on network IDEA16-1 using of the transformation of the encryption algorithm AES // IPASJ International Journal of Information Technology, 2015, Volume 3, Issue 1, pp. 6-12

# IMPACTS OF CLOUD COMPUTING ON E-COMMERCE BUSINESSES IN INDIA

**Satinder<sup>1</sup>, Niharika<sup>2</sup>**

<sup>1</sup> Assistant Prof. (Extn.), Department of Computer Science, Govt. College for Women,  
Hisar, Haryana, (India)

<sup>2</sup> Assistant Prof. (Extn.), Department of Commerce, Govt. College, Hisar, Haryana, (India)

## ABSTRACT

Cloud computing is one of the most emerging technology in information technology sector. In last few years, cloud computing has become from a theoretical concept into the real applications in different industries such as telecommunication and healthcare. Cloud Computing, uses Internet and remote servers to maintain user's data and applications. It give permission to customers and businesses to use applications without installation and access their personal files, data and information at any corner of the world with the help of internet. There are different types of software applications are running on the environment of cloud computing. E-Commerce is one of the major service of cloud computing. E-commerce in Small and medium business is need to provide better services to satisfy them. In this paper, we discussed how E-Commerce business effected by the cloud computing. Except this, it analyzed the driving-forces which led to the changes of E-commerce in era of cloud computing. In this paper e-commerce application model based oncloud computing and manage with the problem of e-commerce and the shortage of resources byestablishing the framework of e-commerce application based on cloudcomputing environment and how cloud computing effect E-Commerce services and applications.

**Keywords: Cloud Computing, E-Commerce, Network Security, Business Models**

## I. INTRODUCTION

Since 2007, cloud computing has become from a theoretical concept into the real applications in different industries such as telecommunication and healthcare.[1] Cloud Computing, uses Internet and remote servers to maintain user's data and applications. Cloud Computing is a new and emerging technology innovation that bring the concept of virtualization of data and information storage in local infrastructure. It give permission to customers and businesses to use applications without installation and access their personal files, data and information at any corner of the world with the help of internet. It also provide the service of dynamic storage capacity, computing capacity, data and information exchanging capability using networking. The "cloud" is an allegory – it is abstraction hiding the complicated infrastructure of the Internet Technology. It is a low-cost usable option to the end users in which IT-related capabilities are given "pay-as-a-service", allowing users to access Internet technology, which supply and deliver to the users with Information Technology services according to their demands. According to the International Data Corporation in 2008 survey cloud computing is the best service for those developers or research projects and even for E-Commerce enterprises who are seeking quick solution and services for startup their work. Some experts evaluated the influence of cloud computing is higher than E-Commerce. E-Commerce is basically selling and buying of goods and services over network

using internet technology. E-Commerce Includes online shopping, Tickets Booking, Hotel Booking, Educations etc.. E-commerce providing services are very costly. Cloud computing provide feature to E-Commerce enterprises to reduce manpower, financial and material cost to implement E-Business system and also maintenance of back-end services or software. These all task can be maintained by cloud computing service providers. E-Commerce is a typical industry which is being effected by the features of the cloud computing services. In this paper we discuss the effects of cloud computing on E-Commerce business and gives suitable suggestion on improvement of E-business in the Cloud environment.

## II. RELATED WORK

The paper concentrates on how cloud computing environments impacts on E-Commerce, the main background of the influences of cloud computing has to be established.

The impact of cloud environment has been discussed by different literatures. Firstly, Kasherfi, F., Et al.[2] consider the impacts of cloud environment on the processes and present a new method of cloud computing. The paper discuss the positive impacts of cloud environment on e-commerce small and big companies and organizations such as yahoo, Google, etc. In this, authors highlight the technical influence of cloud computing rather than its business impacts. Lai, S.[4] examine the influence of cloud computing on traditional software project and figures out the softwares replaced by cloud computing. Mainly, it process the security strategies, migration and the corresponding tools. Li J. and Liu J.[1] examine that the lack of teaching resources which are averting the educational in rural China. According to the authors, cloud computing help to solve the problems. However, all these possible benefits of cloud computing environment are only discussed. Zhang, H.[12] point out that cloud technology will become the best choice of the virtual operation process due to its features such as security and reliability and cloud computing can be applied in different levels in management process.

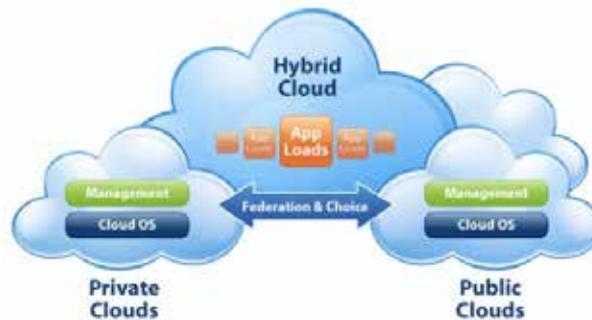
In the Related work review, there are mainly three problems with the existed researches: firstly, few research mentions the impact of cloud computing environment on E-commerce. Actually, the fastly development of E-commerce requires the participation of cloud computing environment into its technical framework, business architecture and services. As a result, the development of e-commerce businesses and industry will be significantly impacted. Secondly, the existed research usually focuses on one or two aspects of cloud computing's impacts on a specified field. There is no paper that offers the comprehensive analysis of the impact of cloud computing on e-commerce business. Finally, few researches gives the case analysis to make the points more persuasive. By virtue of describing the changes of E-commerce in the cloud era, the paper analyzes the impacts of cloud computing on E-commerce enterprises and industry chain in detail.

## III. THE APPROACH OF CLOUD COMPUTING

Today, there are many detonations of cloud computing. As according to Wikipedia, Cloud computing includes deploying groups of multiple remote servers and software networks that permit different kinds of data sources which can be uploaded for real time processing for the generation of results without the need to store (processed) data on the cloud. In short, it uses the public for calculation or other way to shared information and resources.

## IV. DEPLOYMENT MODEL OF CLOUD COMPUTING

It is most primary to decide which type of cloud model is selected for secure cloud services. There are basically three types of deployment model in cloud computing.



**Figure 1. Development Model of Cloud Computing**

### 4.1 Public Cloud

A cloud is called a "public cloud" when the cloud computing service are given over a network that is open only for publicly use. This model is based on pay-per-use method, same as prepaid electric meter technology. It is ideal for businesses seeking less complex Information technology hosting. Public cloud allows user's access to the cloud via interfaces using mainstream web browser. Applications run on it have either seasoned demand or unforeseeable traffic. It is less secure cloud models

### 4.2 Private Cloud

Private cloud model is designed with organization's internal enterprise data center. Here scalable resources and virtual services are provided by the cloud vendors are combine together and available for cloud users to share and use Only the organization people and designated stakeholders may have use to operate on a specific private cloud. Thus, private cloud model is much more secure than public cloud model. Just like Intranet, all the resources and applications are managed by organization itself.

### 4.3 Hybrid Cloud

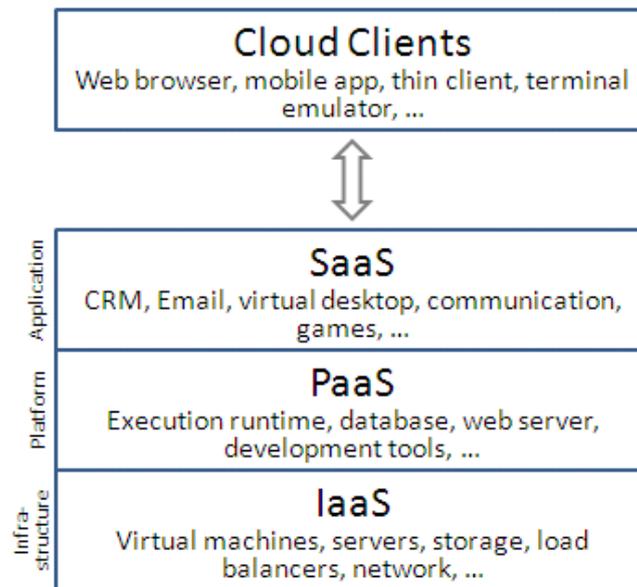
Hybrid cloud is a combination of both public cloud model and private cloud model which is centrally circumscribed and managed by a secure network. It gives more secure control of the data and applications and provides various parties to access data and information over the Internet.

## V. CLOUD COMPUTING DELIVERY MODEL

After cloud deployment models, there are three types of cloud delivery models. Delivery models are as follows-

### 5.1 Infrastructure as a Service (IaaS)

IaaS is a single layer cloud model where cloud computing vendor's dedicated resources are only shared with contracted users at pay-per-use service. This model is also provides different degrees of financial and functional pliability which is not found in inside data servers or with co-location services, because computing resources can be added or released much more quickly and cost-effectively than in an internal data servers As a initial investment cost of computer servers, results, networking devices, processing power etc. are minimized.



**Figure 2. Delivery Model of Cloud Computing**

### 5.2 Software as a Service (SaaS)

SaaS is based on pay-per-use basis costing model where software applications are leased out to contracted organizations by specialized SaaS sellers. SaaS giver may host the software either in their own data network center. Initially software has limited functionality, it can be easily customized based on demand which is billed accordingly Softwares are accessed using secured web browser over the Internet. Web services (WS) security, XML encryption, Secure Socket Layer (SSL) etc is used in enforcing data protection transmitted over the Internet.

### 5.3 Platform as a Service (Paas)

PaaS cloud model layer is similar to IaaS model with an additional “rented” features. Virtual machines are secured against unauthorized attacks such as cloud malware and hackers. PaaS model services are expensive than IaaS and SaaS. Cloud sellers and users need to maintain cloud computing network security at all interfaces. In a virtual platforms physical resources, infrastructures as well as business applications and middlewares environment are being consumed as services in the cloud models

## VI. E-COMMERCE AND ITS MODELS

Electronic commerce is one of the main criteria of revolution of Information Technology and communication in the field of economy. The Current edge for business today is Electronic Commerce, it refer to electronic transaction such as buying, selling, information flow and fund transfer over the internet. E-commerce broadly encompasses all business activities taking place over internet. E-commerce has the following Models:

- Ø Business-to-Business (B2B): the transaction between business enterprises.
- Ø Consumer-to-Business (C2B): this mean the customers selling products and services to the Business Enterprises.
- Ø Business-to-Consumer (B2C): this means the transaction among Business Enterprises and customers.
- Ø Consumer-to-Consumer (C2C): this mean the business transaction among users or consumers.

## VII. CLOUD COMPUTING AND ELECTRONIC COMMERCE (E-COMMERCE)

Cloud Computing and E-commerce are now two important part in our daily uses. Due to cost beneficial both are famous. Cloud computing service saves enterprise's the cost of Information Technology infrastructure, on the other hand E-commerce provides traders to do business without renting or buying a business entity shop. Cloud gives positive opportunities for e-commerce, but before use it, organization should have a trade-off between costs. Many researcher illustrate that cloud computing and E-commerce the most attractive industries. That has been developed at fastly in recent years, with the Economic, Political, Technological and Sociological factors have had a positive impact on its development. E-commerce and cloud computing are described as follow by several researchers:

- Ø The quick growth of the global economy increase the developing of online web based transactions.
- Ø Online shopping is becoming a new trend as it is more convenient comparing to traditional way of shopping.
- Ø The security of data and information technologies are improved rapidly.
- Ø Because of this, the level of education and IT skills of customers have been improved.
- Ø The developing of telecommunications techniques accelerate the implement of e-commerce Industry across all over the world.
- Ø Cloud Computing give chances for small-scale and middle-scale business companies to move to the Internet technology with less efforts

## VIII. A FRAMEWORK FOR E-COMMERCE BASED ON CLOUD COMPUTING

Cloud computing enables the users to make use of the network resources in cost-effective and free manner in place of traditional architectural model and it also helps to get rid of the effect caused by failure of single computer equipment like the loss of data, unavailable devices and so on. With the help of cloud computing, the large number of users need not to buy their own software and hardware, even need not to bother about that who is providing the service, so that you can focus on the core services and resources that you really needed. If the cloud-based e-commerce service is based on the basic application form known as e-commerce cloud .we can describe the overall picture of infrastructure of the e-commerce cloud, as shown in Figure 2.

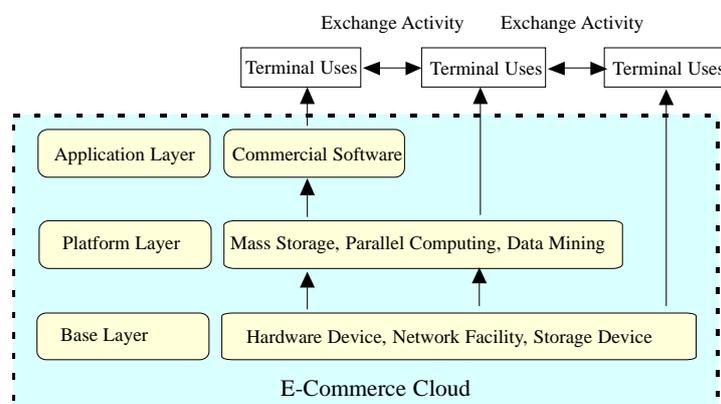


Figure 2. A Framework for E-commerce Cloud

### **8.1 The Base Layer of E-Commerce Cloud**

IT infrastructure resources are shared by the base layer of e-commerce cloud and also connects the various service providers huge system and pool them together to provide services. Cloud computing allows to access data resource in secure and scalable way and allows to share the hardware resource and make use of hardware layer to run in the most likely way. A technology called Virtualization is used to separate the physical hardware from operating system. And it results in one hand that it can make computation, division of storage capacity of the Existing server into smaller size and then its re-integration make possible the utilization of IT resources in improved way and provide flexibility And on other hand it enables large scale cloud computing integration on a common interface and also enables the publication of calculation. Basic hardware resources for the platform layer can be provided by base layer and just like ordinary local devices it can also be used by users.

### **8.2. The Platform Layer of E-Commerce Cloud**

The task which had been difficult to complete now with the help of powerful hardware can be possible to done, like :- task of data storage carried out by platform layer, computation and software development, task of computation of original mass storage can be achieved, business intelligence processing possible and so on. Now choosing of devices by the users and on the basis of complexity of dealing with content the number of devices depends. Strong level of flexibility is possible by Virtualization technology.

### **8.3. The Application Layer of E-Commerce Cloud**

Professional company of e-commerce provides the application software or services and use the e-commerce system to pay for getting the benefit of lower cost and remove wastage and make able to use more resources which help to run the business activities smoothly. Cost is determines on demand-access

## **IX. INFLUENCES ON E-COMMERCE BACKEND SERVICE MODE**

Cloud computing offers new mode of services which are different from traditional IT services. First of all, E-commerce enterprises service by virtue of the cloud platform offers IT resources like software, hardware, infrastructure and data. Secondly, E-commerce Company is allowed to access the IT resources just like the utility services on the cloud platform and pay for them for their services. Through renting system, no firm has required to incur high expenses on purchasing of devices, they can choose appropriate and suitable devices and pays rent for their services. In short, due to the emergence of cloud computing ,the concept of traditional IT licensing mode changed and a new philosophy of services is came into existence which provides the benefit of low cost. Cloud computing migrates outsourcing into E-commerce is a significant contribution because with the help of it standardized and uniform service platform can be established by a business which performs as per customers' demand. A contract based outsourcing is done in which E-commerce delivers the backend process that it has to be completed. The close end services which are changed by the service provider to conduct local technical support is called outsourcing. Reduction of cost, improving efficiency as well as service quality and improving the core competencies of an organization are the primary objectives of outsourcing. Cloud computing enables the E-commerce enterprises to focus on the core businesses and sets them free from the complicated technical architectural planning, designing and maintenance. Typical example of the new outsourcing based on cloud computing is virtual business.

## **X. INFLUENCES ON E-COMMERCE BUSINESS STRATEGIES**

Due to expanding era of business towards cloud computing, long term strategies are made by involving cloud computing by famous e-commerce businesses such as Google, Amazon, Alibaba. Reasons or forces responsible for migration of cloud computing into e-commerce strategies are:- 1) As the improved services are given by e-commerce due to rapid information technology like lower cost benefit, higher efficiency, diversity and more flexibility its demand increases. For instance, online loan services are offered by the Alibaba, the biggest B2B e-commerce enterprise by virtue of cloud computing as it helps in credibility evaluation of the customers. 2) As due to emergence of cloud computing in e-commerce enables to store data in small size and then re-integrate that so small and medium scale firms can also afford it. 3) High quality architectural facility and quick access of information lead its demand

## **XI CONCLUSION**

In this research we believe that, we can create an E-Commerce service model based on cloud computing by means of cloud computing services such as mass data storage, high-speed computing capabilities, as well as its perfect allocation and the sharing of resources. The new emerging technology of cloud computing is creating a new ecosystem service which will combine all the E-commerce services and facilitate the new service modes. Cloud computing help companies to attain more efficient use of their Information Technology hardware and software investments and give a means to speed up the acceptance of innovations. Cloud computing service has enabled teams and organizations to streamline lengthy acquisition processes.

Cloud computing is still a very new technology and we still having more room for improve the service of cloud computing. In the traditional E-commerce enterprises, an proper strategy of implement in the cloud computing era is to cuddle cloud computing rather than avoiding on it. Only when the E-commerce include cloud computing in the business strategy and establish the core competencies, can they realize the sustainable development

## **XII. SUGGESTIONS**

E-Commerce business is a new business mode by computer networking through internet, so it should concentrate on the core competencies and activities of the business. It should give due attention on the effective management and operation of the business. As E-commerce enterprises lays more stress on online software, there market share starts decreasing greatly so, E-commerce business enterprise should not pays much stress of cost increment as cloud computing will cope up with that. Reduction of information technology cost is not a big issue today due to introduction of cloud computing. So, it is suggested that E-Commerce business have to take full benefit of cloud computing to increasing quality in their work and in this way with the cooperation of cloud computing a new pathway will open for the small and medium level businesses and e-commerce can reach at new heights.

## **REFERENCES**

- [1] J. Li and J. Z. Liu, "Influence of Cloud Computing on Educational Informationization of China Rural Areas," *The Proceedings of Information Science and Engineering Conference*, Hangzhou, 4-6 December 2010, pp. 281-283.

- [2] F. Kashefi, M. Majd, M. Darbandi, H. Purhosein, K. Ali-zadeh and O. Atae, "Perusal about Influences of Cloud Computing on the Processes of These Days and Present- ing New Ideas about Its Security," *The Proceedings of the 5th International Conference on Application of Informa- tion and Communication Technologies (AICT)*, Baku, 12-14 October 2011, pp. 1-4.
- [3] S. Qin, "What Will Cloud Computing Provide for Chi- nese M-Learning?" *The Proceedings of International Con- ference on E-Education, Entertainment and E-Manage- ment*, Bali, 27-29 December 2011, pp. 171-174.
- [4] S. L. Lai, "The Influences of Cloud Computing to the Traditional Software Project and Our Corresponding Stra- tegies," *The Proceedings of the 3rd International Con- ference on Intelligent System Design and Engineering Applications*, Hong Kong, 16-18 January 2013, pp. 1461- 1464.
- [5] H. X. Zhang, "Research on the Influences of Cloud Com- puting on the Virtual Operation Performance Manage- ment," *The proceedings of the 7th International Confer- ence on Computer Science & Education*, Melbourne, 14- 17 July 2012, pp. 235-238.
- [6] Wang D, (May,2013), "Influences of Clouds Computing on E-Commerce Businesses and Industry", *Journal of Software Engineering and Applications*, Vol. 6, pp. 313-318
- [7] Leavitt N, (2009), "Is Clouds Computing Really Ready for Prime Time?", *Computer*, Vol. 42, pp.15-20.
- [8] Weinhardt C, Anandasivam A, Blau B, and Stosser J, (2009), "Business Models in the Service World", *IT Professional*, Vol. 11, pp. 28-33
- [9] Gens F, (2009), "New IDC IT Clouds Services Survey: Top Benefits and Challenges", *IDC eXchange*, viewed 18 February 2010
- [10] Juncai S and Shao Q, (June, 2011), "Based on Clouds Computing E-commerce Models and Its Security", *International Journal of e-Education, e-Business, e-Management and e-Learning*, Vol. 1, No. 2
- [11] [http://en.wikipedia.org/wiki/Cloud\\_computing\\_and\\_e\\_commerce](http://en.wikipedia.org/wiki/Cloud_computing_and_e_commerce)
- [12] H. X. Zhang, (July), "Research on the Influence of Clouds Computing on the Virtual Operation Performance Management", *The proceedings of the 7th International Conference on Computer Science & Education*, Melbourne, 14-17 July 2012, pp. 235-238.
- [13] Dooley B, (2010), "Architectural Requirement Of The Hybrid Cloud", *Information Management Online*, viewed 10 February 2010
- [14] Global Netoptex Incorporated , (2009), "Demystifying the clouds. Important opportunities, crucial choices"
- [15] Brodtkin J, (2008), "Gartner: Seven clouds-computing security risks", *Infoworld*, viewed 13 March 2009
- [16] ISO. ISO 7498-2:1989. *Informations processing systems- Open Systems Interconnection. ISO 7498-2*

# STUDY OF CONTENT MANAGEMENT SYSTEM: WORDPRESS

**Vinay<sup>1</sup>, Satinder<sup>2</sup>**

<sup>1</sup> *Computer Programmer, Computer Section, College of Basic Sciences & Humanities,  
CCS HAU, Hisar, Haryana, (India)*

<sup>2</sup> *Extension Lecturer, Department of Computer Science, Govt. College for Women,  
Hisar, Haryana (India)*

## ABSTRACT

*A content management system (CMS) is a software that help us to make websites easier, faster, browser compatible and responsive website in a very short time with the powerful inbuilt features. Today there are several CMS available based on usage, functionalities, compatibility and platforms. Till now no CMS is available that is best suited for every user but when we concerned content management principles only two to three CMS names comes in our mind Joomla, Wordpress and Drupal, all these CMSs are perform best in their preferred conditions. The main challenge is to select the appropriate CMS, that fulfill all the current users' requirements with different features like easy to install, use, update, security features, powerful architecture, best performance, fast searching, compatibility with the different platforms and security features. This study attempt to analyze Wordpress on the basic of design, usage, function, available plugin and themes, editor, security features, architecture, inbuilt feature, installation and update process, compatibility with different browser under the General Public License which provides core freedomsto execute the application, forthe different purpose.This paper attempt to analyze the pros and cons of the wordpress so that user can choose the best cms according to the application requirement*

**Keywords:** *CMS, Wordpress*

## I. INTRODUCTION OF CMS

CMS Content Management System is a computer application. CMSs are mostly used to develop web application containing blogs, news, events and shopping. Many Govt. Organization, Corporate, Shopping and Marketing website use CMS. CMS is normally used to avoid to write the code. CMS provide the default structure of the website in which one has to create page, articles, news etc. and put the content in that and CMS automatically display the contents on the website<sup>[1]</sup>. A content management system (CMS) is a stand-alone application to create, manage and the store content. As we know that a webpage's have text, graphics, photos, video, audio etc that display content or interacts with the user. CMS provides all above inbuilt features and many more.

## II. WORDPRESS

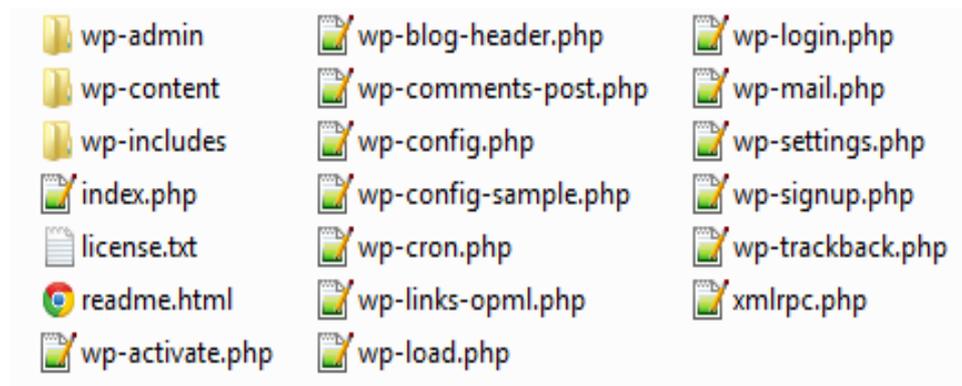
Wordpress is a completely free open source used to create dynamic website very fast in a limited budget. Originally, Wordpress was developed for creating a Blogging software.

### III. WHAT IS A BLOG

A blog is a type of website or part of a website that is maintained on regular basis by its owner reviews, opinions, and video. In the verb form “BLOGGING” means to post to your blog<sup>[1]</sup>.

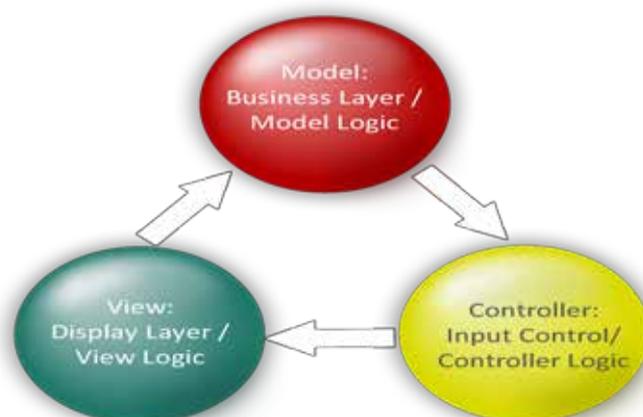
Wordpress is an open source blogging tool powered by PHP and uses MySQL as the backend. Wordpress can be customized into a content management system. Easy to install and configure the files which allows businesses to set up and run a website or blog at less price. <sup>[1]</sup>.

### IV. WORDPRESS FILE STRUCTURE



### V. MVC FRAMEWORK FOR WORDPRESS

Word press Model View Controller (MVC) is an MVC framework that makes Word press development easier, faster and more graceful. It is a completely developed framework with conventions that are similar to those of Zend and Cake PHP. Developers can consequently use it to rapidly build websites that take advantage of both Wordpress's native functionality and vast plug in library and all of the many advantages of an MVC framework <sup>[3]</sup>. The basic idea for creating the word press MVC is range of the word press plug in from extremely simple to very complex and large. Because as the complexity application increases, then it is difficult to manage the application, even read the code. MVC architecture can greatly reduce that complexity and create blocks of code that are extremely simple to reuse and for understand the code. It also helps to reduce unreasonable code and allowing our plug in to operate more efficiently, faster and graceful<sup>[4]</sup>.



### VI. WORDPRESS CORE FEATURES

**Simplicity** Word press simplicity makes it possible for the users to get online and get publishing, quickly.

**Flexibility** Because of the Wordpress flexibility user can create any type of website, personal blog , a business, a professional, a magazine or news website etc.

**Publish with Ease** User can create Posts and Pages, format the page, post easily, add media, and with the click of a button user content is live on the web.

**Publishing Tools** Wordpress makes it easy for user to manage content, drafts,private or public post, secure post or page using password protection, schedule publication, and see the content without publishing<sup>[5]</sup>.

**User Management**Wordpress also provide the facility of the user management by that user can any number of the users with the different access level or different level of permission.

**Media Management** Wordpress have a very powerful media management with lots of media extension support.

**Easy Theme System** Wordpress bundled have default two themes, but if they aren't for suitable according to the user requirement then there's a theme directory with thousands of themes for the users, to create a beautiful website.

**Extend with Plugins** Wordpress have also the power of the plugin by that user can extent the features and functionalities using the plugins. If any plugin not fulfill the users current requirement than user can easily customize the plugin as per the requirement also can create own plugin.

**Multilingual** Wordpress support more than 60 languages<sup>[4]</sup>.

**Easy to Install and Upgrades** Wordpress admin panel automatically get the notification of the install the new plugin or update the plugin existing plugin and some others notification regarding to update to wordpress version.

**Importers** Wordpress comes with importers for blogger, LiveJournal, Movable Type, TypePad, Tumblr<sup>[5]</sup>, and Wordpress. By that help users can easily move the files.

**Freedom** Wordpress is licensed under the GPL which was created to protect your freedoms and provides the freedom to execute the application. User can install it, use it, modify it, distribute it as per the requirement<sup>[5]</sup>.

**Community** Wordpress has a powerful, vibrant and very supportive community.

**Password Protection** User can give password to individual post to hide them from the public and also can make the private posts which is viewable only to the author<sup>[6]</sup>.

**Time Travel** By the wordpress user can schedule the post timing, for some time in the future or in the backdate.

**Never Lose a Word** One of the great feature of the wordpress as the user type the words wordpress automatically saves the words.

**Plugin System**Wordpress have a powerful APIs that make it possible for the user to create own plugins to extend the features of the wordpress<sup>[6]</sup>.

**Theme System** Wordpress API provides the extensibility to create the themes as simple or complex<sup>[6]</sup> as the

user wants and wordpress have the Theme Repository from where the user can get the free theme very easily.

## VII. DISADVANTAGES OF THE WORDPRESS

- Ø Multisite configuration process require of the wordpress requires deeply technical knowledge.
- Ø Wordpress tutorial are inconsistent and inadequate.
- Ø Wordpress Documentation is incomplete and inconsistent.
- Ø Use MySQL as a backend,that is easily hacked if the proper security is not used.
- Ø Paid themes and plugins mostly become way too expensive.
- Ø SQL queries are complex.
- Ø Page and post search options inside the admin panel are immature.

## VIII. WHY WE USED WORDPRESS

Wordpress is web application software user can use it to create a beautiful dynamic website or blog. Wordpress is free open source and supported by a thriving community of developers and users all over the world.

Wordpress is the preferred choice of thousands of companies and private and govt. organizations including LIN Media, The Times, Metro UK, and USA Today, Sony etc. User have to only put the content, there is no limit to what type of website you can create using Wordpress. Below some more features that clear the user vision to choose the wordpress. According to W3Techs, almost 55% of the 1 million most visited websites that are run on a content management system (CMS) are run on Wordpress<sup>[7]</sup>. Wordpress incurs less installation, maintenance and customization cost as compared to other cms. And more important, it is easier to find developer and designer, if the further customization is necessary in future.



- Ø Truly free the open source.
- Ø Plugin give more functionality and easily update as per the requirements.
- Ø Powerful visual editor.
- Ø Easy to add a blog, page and post to our website.
- Ø Easy to keep wordpress secure.

## IX. FUTURE SCOPE OF THE WORDPRESS

The main question arise into mind of the every those users who are working on it and for those who are willing to work on, what is the future scope of the wordpress. If we are looking at current market we can assure a good future of Wordpress<sup>[8]</sup>. However, in technical era none of the technology can be constant. But for choosing a better option for the new users, PHP is best. In this paper we are try to list out some points for the same. In this paper we are providing some concepts to clear about the future scope of php, for those who are working on it as well as those who are willing to work on.

## X. CONCLUSION

Wordpress, Joomla and Drupal are the three most popular content management systems (CMS), free open source and built on PHP + MySQL and vary significantly in terms of features, capability, flexibility and ease to use<sup>[2]</sup>. Above in this paper we study the some advantages and disadvantages of the wordpress. Everything listed above represents personal standpoints and experience of the user whose faced problems or issued during the development of the website using wordpress. But the advantages to use thewordpress surely outweigh all of the above drawback. Wordpress is often called a 'mini CMS'. It isn't nearly as powerful or capable as JoomlaorDrupal, but it is veryeasy for any layman user. If the user wants to built a simple, responsive, easy to use blogging solution, with multiple feature like easy to use, security, upation, multiple authors accessibility features then use Wordpress. Free and often powerful, open source content management systems can help you create a powerful website on a limited budget<sup>[8]</sup>. Wordpress is well suited to build smaller sites quickly. Wordpress is the best choice for the simply arranged website. Because it is easy to install, understand, maintain and update. Also updating and editing image and text is quite straightforward with the so many predefined graphic themes available that fulfill the user particular needs of the website within a limited budget.

## REFERENCES

- [1] Wordpress, [www.wordpress.org](http://www.wordpress.org)
- [2] [www.wpbeginner.com/category/wp-tutorials/](http://www.wpbeginner.com/category/wp-tutorials/)
- [3] <http://wpmvc.org/>
- [4] <http://www.renegadetechconsulting.com/tutorials/an-mvc-inspired-approach-to-wordpress-plugin-development>
- [5] <http://buildyourwpsite.com/install-wordpress/>
- [6] <https://en.wordpress.com/features/>
- [7] <http://www.smashingmagazine.com/2011/11/29/wordpress-cms-crown-drupal-joomla/>
- [8] <http://www.phpchandigarh.com/future-scope-php-web-development/>

# IMPROVING TRAFFIC MANAGEMENT USING GENETIC ALGORITHMS AND ANT COLONY OPTIMIZATION METHODS

Sankar. A<sup>1</sup>, Vijay Sekar. E<sup>2</sup>, M. Yamuna<sup>3</sup>

<sup>1,2</sup>, SCSE, VIT University (India)

<sup>3</sup>SAS, VIT University (India)

## ABSTRACT

*Traffic Congestion is a major issue in several cities of the world. Our paper proposes a solution to tackle this problem with the help of rerouting and finding best paths for faster travel time. The objective is to achieve a significant reduction in traffic congestion by plotting the best path between two points and also taking into account the traffic densities of the constituent edges at the same time. The proposed work is to achieve an optimal solution by using the concepts of Genetic Algorithms and Ant Colony Optimization techniques to develop a hybrid algorithm that produces significantly better results.*

**Keywords:** *Ant Colony Optimization, Artificial Intelligence, Genetic Algorithms, Graph Theory, Traffic Management*

## I. INTRODUCTION

Managing Traffic in a city has always been a problem despite trying various different technologies to cope up with it. There are various factors that influence the equation. Just knowing the route from the source to destination is not sufficient. Along with the best path from two places, we also need to consider the traffic density along the roads that make up the path. Also, the traffic management is dynamically changing issue, meaning the state of traffic in a particular area is rapidly changing with time. So if we have a best path from A-B, it might still not be the same after a time interval of about 10 minutes, for the traffic density along those roads would have significantly increased by the re-routing done.

## II. GENETIC ALGORITHMS

Genetic algorithms are imitation of the natural process of selection from a population of abstract representations of candidate solutions to generate solutions to optimization problems. The candidate solutions are often represented as binary strings. A genetic algorithm requires a standard representation of solution in the form of an array of bits. The binary representation allows simple crossover functions to be used [ 1 ].

The major components in genetic algorithms is discussed in the following sections [ 2 ], [ 3 ], [ 4 ] since we use genetic algorithm in the proposed method.

## 2.1 Initialization

Initially, several solutions are generated using a random function. This set of solutions serves as the initial population. The population size is usually huge to allow simultaneous verification of large portions of the solution set.

## 2.2 Selection

During creation of each successive generation, a proportion of existing population is selected to breed the new generation. The fitness function (fitness based process) assigns a fitness value to each member of the population. The solutions with better fitness values are chosen for breeding purposes. The fitness function must be chosen such that less proportion of the total solution set fit the better values of the fitness function. A small portion of weak solutions are allowed to pass the fitness test so that premature convergence doesn't occur.

## 2.3 Crossover

The new generation is created using crossover. The solution string is divided at a certain point and one half of the solution is exchanged for another half from a different solution. And two new solutions are created. Crossover doesn't always occur; there is a 60-70% possibility of it happening.

## 2.4 Mutation

After selection and crossover, new solutions are created. But, it is possible that some unexplored feature, which currently doesn't exist in the current population, might be part of the actual result. In order to ensure inclusion of these results, we leave a very small probability of one of the bits of the solution being flipped forcibly.

## 2.5 Termination

This indicates to end of the genetic algorithm process. The final generation of a GA either contains the required solutions, or the maximum number of iterations has been reached. Expiry of budget/time limit might also lead to termination.

## III. ANT COLONY OPTIMIZATION

Ant Colony optimization is a nature inspired algorithm that uses the behaviour of ants in modelling optimization algorithms. The algorithm is developed on the basis of working of the ant colony and how the food collection by the ant colony happens. The ants do not communicate to one another but instead leaves down a pheromone trail indicating a favourable path.

As time passes, the frequently traversed paths will keep accumulating the concentration of pheromone while the less frequently visited ones will not have such high concentrations. So the other ants could follow the best path by choosing that one which has a greater pheromone concentration which can easily sensed by the ant colony.

Also the pheromone deposit evaporates over time; this implies that only the frequently used paths will have the greater pheromone deposit while other less-frequented paths would be ignored over time with declining concentrations of the pheromone.

We can map the ant's behaviour to develop a system to replicate various different situations & scenarios and help in finding the best path in the road network of a given city.

We can also use the pheromone concentration levels to map out frequently travelled paths. This would help us in finding the busiest path, those that need to be avoided in a real-time system scenario [ 5 ].

## IV. PROPOSED WORK

We propose to solve the above said traffic management issue by using the principles of the Genetic Algorithms and Ant Colony optimization. Initially we take a given state of traffic as input to the system and the source and destination the user would be going to. Using the given input, the best possible paths between them are computed. Then the traffic densities in the roads are computed and are checked if any of them exceed the threshold value. If they do, those paths are rejected. For basics of graph theory we refer to [ 6 ].

### 4.1 Representing the Road Network as a Graph

**Step 1:** Draw the Road System as a graph by taking the intersections as vertices and the roads as edges. Every edge has a length (length of the road), current traffic density and threshold traffic density. We assume the car has to travel from Start Vertex 's' to Destination Vertex 'd'.

**Step 2:** Label each of the edges from  $e_1$  to  $e_n$ .

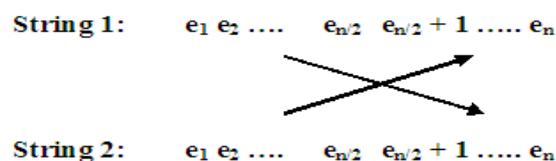
### 4.2 Selecting Short Paths using Modified Genetic Algorithm

**Step 3:** Create binary strings of length  $n$  ( $n = \text{no. of edges}$ ) and if  $k^{\text{th}}$  digit is 1, then edge  $e_k$  is a part of the solution, else  $e_k$  is not present in the solution path.

**Step 4:** Find fitness value of each string using the fitness function given as:

$$\begin{aligned} \text{Fitness (string)} = & (\text{Sum of edge lengths} * \text{No. of components} + \\ & (2 * \text{Sum of edge lengths (if s is not included)}) + \\ & (2 * \text{Sum of edge lengths (if d is not included)}) + \\ & \sum [-1 * (\text{average edge weight} * \text{max length of path from s to d} / 2) * \\ & (\text{Length of component}) \text{ For all Components} + \\ & (\text{Sum of edges of component}) + \\ & (\text{Sum of edge lengths (If any vertex has degree} > 3) * \\ & (\text{No. of vertices with degree} > 3))] \end{aligned} \quad (1)$$

**Step 5:** We select strings with low fitness values and perform crossover.



**Fig.1 Crossover Method**

**Step 6:** Then, perform mutation with a probability of 0.01%. Mutation is done by changing one of the digits of the solution from 1 to 0 or 0 to 1.

**Step 7:** Repeat steps 4 to 6 for several iterations till we get solutions with Minimum Fitness values.

### 4.3 Choosing the Efficient Path Using Ant Colony Optimization

**Step 8:** Select the path with least fitness value and check if the traffic density on this path is below threshold values. If they are, then route traffic through this path.

**Step 9:** As the traffic density changes with time, density at the path selected in step 8 keeps increasing. This implies that the pheromone deposit is constantly increasing along this path. If any of the edges exceed the threshold density value, another path is selected, generated from the Genetic Algorithm in **Step 7** and the pheromone deposit along the initial path starts decreasing.

**Step 10:** Now, the traffic congestion in the first path reduces after certain amount of time, and the pheromone deposit along that path reduces while the traffic is being routed on an alternate path. When the traffic density falls below the threshold value, switch to the initial path again, as it is shorter to travel and the pheromone level starts to increase again.

#### 4.4 ACO Algorithm

Procedure ACO

while(not\_termination)

{

    generateSolutions(GA);

    routeTraffic(solutions);

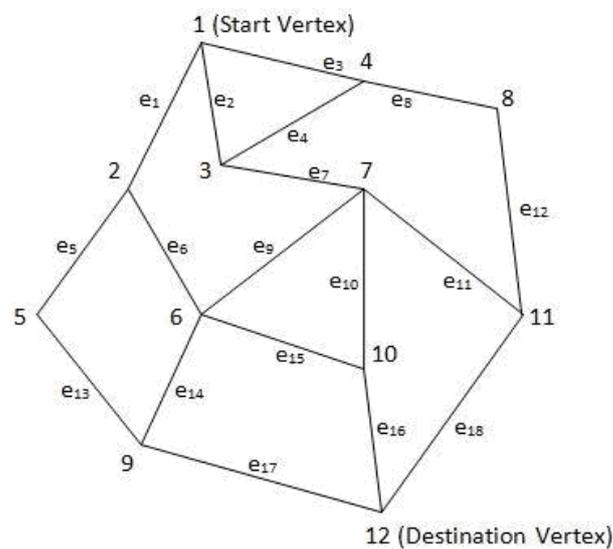
    pheromoneUpdate(edges);

}

End

#### V ILLUSTRATION

##### 5.1 Draw the Road Network as a Graph (Vertices are Intersections and Edges are Roads)



**Fig 2: Graph Representation of Road Network**

##### 5.2 Creation of Edge Matrix E by Assigning Edge Numbers to All Possible Paths in the Given Network.

**Table 1: Edge Matrix**

Edge No.	Edge	Edge weight
1	1-2	8

2	1-3	6
3	1-4	5
4	3-4	7
5	2-5	7
6	2-6	5
7	3-7	4
8	4-8	5
9	6-7	6
10	7-10	7
11	7-11	8
12	8-11	5
13	5-9	8
14	6-9	4
15	6-10	6
16	10-12	9
17	9-12	6
18	11-12	7

### 5.3 Generating Initial Population

If the edge is part of the solution, the value is 1, else the value is 0. Use a random generator to create the solutions.

Initial Population (with fitness function F(x)):

$$\text{Fitness} = (113 * \text{No. of components} + (2 * 113 \text{ (if s is not included)}) + (2 * 113 \text{ (if d is not included)}) + \sum [-(7 * 4) * (\text{Length of component}) \text{ For all Components} + (\text{Sum of edges of component}) + (113 * (\text{No. of vertices with degree} > 3))] )$$

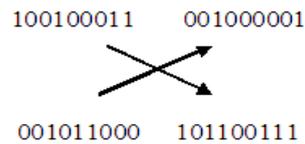
Select the strings with lower fitness values and discard those with higher values.

**Table 2: Fitness Value of Initial Solutions**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	F(x)
1	0	0	1	0	0	0	1	1	0	0	1	0	0	0	0	0	1	322
0	1	0	0	1	0	1	1	0	0	0	0	0	0	1	0	0	0	566
0	0	1	0	1	1	0	0	0	1	0	1	1	0	0	1	1	1	367
1	0	0	0	1	1	0	1	0	0	0	1	0	1	1	0	0	0	517
0	0	0	1	0	0	1	1	0	1	0	1	1	0	0	0	0	0	659
0	0	0	0	1	1	0	0	1	0	0	1	0	1	1	0	0	0	656

### 5.4 Cross Over

Swap the halves of two strings in the population to create two new string.



By this we generate new strings:

100100011101100111

001011000001000001

### 5.5 Mutation

Forcibly change one digit of the string generated after crossover.

001011000001000001 ® 001011000101000001

**Table 3: Genetic Strings of the Solutions after 50 iterations**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	0	0	0	1	0	1	0	1	0	0	0	0	1	0	1	0	0
0	0	1	0	1	0	0	1	0	0	0	1	1	0	0	0	0	1
0	1	0	0	0	1	1	1	0	0	0	1	0	0	1	0	1	0
0	1	0	1	1	0	0	0	0	0	0	0	1	0	1	1	0	0
1	0	0	1	0	1	0	0	0	1	1	0	0	1	1	0	0	1

**Table 4: Genetic Strings of the Solutions after 500 iterations**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0
1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0
0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1
0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0
0	1	0	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0
0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1

Paths generated by the Genetic algorithms are

Path 1:  $e_3 e_8 e_{12} e_{18}$  Length = 22

Path 2:  $e_1 e_6 e_{14} e_{17}$  Length = 23

Path 3:  $e_2 e_7 e_{11} e_{18}$  Length = 25

Path 4:  $e_2 e_7 e_9 e_{14} e_{17}$  Length = 26

Path 5:  $e_2 e_7 e_{10} e_{17}$  Length = 27

Path 6:  $e_1 e_5 e_{13} e_{17}$  Length = 29

### 5.6 Generating Solutions

We select the shortest 3 paths for applying Ant Colony Optimization based on traffic density

Path 1:  $e_3 e_8 e_{12} e_{18}$  Length = 22

Path 2:  $e_1 e_6 e_{14} e_{17}$  Length = 23

Path 3:  $e_2 e_7 e_{11} e_{18}$  Length = 25

The chosen paths have been highlighted in the graph (Fig 3)

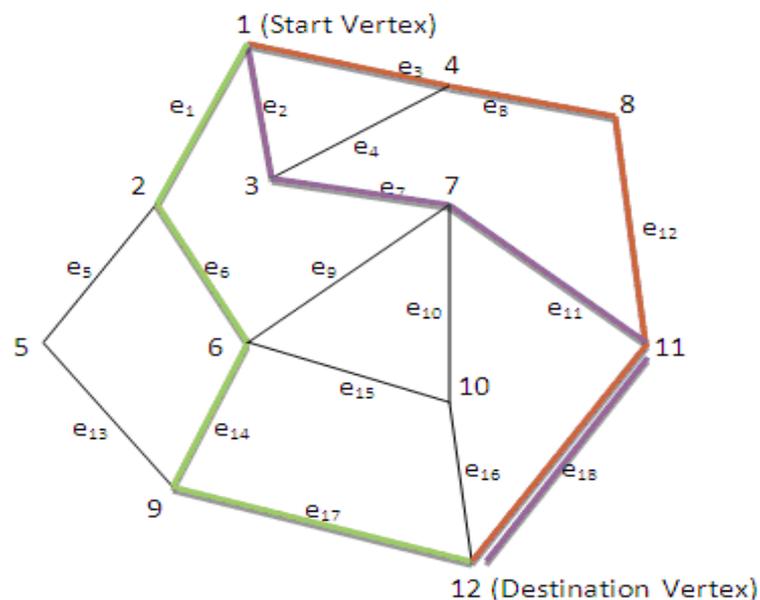


Fig 3: Top 3 Optimal Solutions

### 5.7 Route Traffic() Function

The traffic from 1 to 12 is routed through Path 1. The traffic densities of the edges on the path are increased.

### 5.8 Pheromone Update() Function

The pheromone value of Path 1 keeps on increasing till one of the edge densities reach threshold. When the threshold value is exceeded, then the pheromone value of Path 1 is decreased, and the pheromone value for the next best path (Path 2) is increased.

After a few iterations, the densities of the edges in Path 1 decreases again. Hence, the pheromone value can be increased again.

## VI. CONCLUSION

The proposed solution can be used to solve traffic congestion between two locations. By applying it on every pair of vertices (intersections) iteratively, we can reduce congestion further. The Genetic Algorithm ensures that the path is of shorter length, and the Ant Colony Optimization ensures that traffic density along any edge[road] doesn't go too high. Although the genetic algorithm doesn't always guarantee optimal solution for all cases, the overall outcome of the modified algorithm with ant colony optimization seems to be promising as explained in the illustration.

## REFERENCES

- [1] [http://en.wikipedia.org/wiki/Genetic\\_algorithm](http://en.wikipedia.org/wiki/Genetic_algorithm)
- [2] <http://www.obitko.com/tutorials/genetic-algorithms/ga-basic-description.php>

- [3] H. Bhasin and N. Singla, (2012), Modified Genetic Algorithms Based Solution to Subset Sum Problem, IJARAI, Vol. 1 (1).
- [4] H. Bhasin and S. Bhatia, (2011), Application of Genetic Algorithms in Machine learning, IJCSIT, Vol. 2(5).
- [5] [http://en.wikipedia.org/wiki/Ant\\_colony\\_optimization\\_algorithms](http://en.wikipedia.org/wiki/Ant_colony_optimization_algorithms)
- [6] Narsingh Deo *Graph theory with applications to engineering and computer science* ( Prentice Hall India 2010 ).

# VHDL MODELING OF THE SRAM MODULE AND STATE MACHINE CONTROLLER OF RC4

Poonam Minj<sup>1</sup>, Shriya Sharma<sup>2</sup>, Dinesh Kumar<sup>3</sup>

<sup>1,2</sup>Student, <sup>3</sup>Faculty, Department of Electronics and Telecom,  
Kirodimal Institute of Technology, (India)

## ABSTRACT

In this paper, VHDL modeling of the SRAM module and State Machine Controller (SMC) module of RC4 stream cipher algorithm for Wi-Fi encryption is proposed. In cryptography RC4 is the most widely used software stream cipher and is used in popular protocols. The design of RC4 avoids the use of LFSRs, and is ideal for software implementation, as it requires only byte manipulations. The RC4 algorithm will be implemented by FPGA using VHDL software Platform STATE MACHINE CONTROLLER (SMC).

**Key Words:** FSM, RC4 Stream Cipher, SRAM Module, State Machine Controller, VHDL Simulation

## I. INTRODUCTION TO RC4 STREAM CIPHER

Cryptographic algorithms that can provide fast implementation, small size, low complexity, and high security for resource-constrained devices such as wireless sensor devices are imperative. Conventional cryptographic algorithms are very complex and consume significant amount of energy when used by resource constrained devices for the provision of secure communication, and public key algorithms are still not feasible in sensor networks for several reasons including limited storage and excessive energy usage [1]. Therefore, security schemes should rely on a symmetric key.

## II. SIMULATION OF SRAM (256× 8) MODULE

In “fig.1” Shows Pin diagram of SRAM, the module SRAM is similar to KRAM. It is used to store the data from 0 to 255 at the address from 0 to 255 i.e. same data is assigned to the same memory location.

The address is assigned by the output of Addr1. In this if Memory Write is 1 and Memory Rd is 0, then data is written into the RAM and if Memory Write is 0 and Memory Rd is 1, then data is read out one by one from the RAM. Data is given in parallel form and is read out in parallel [6].

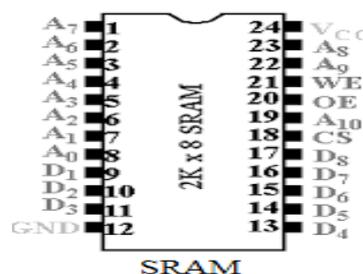


Figure1. Pin Diagram of SRAM

### III. ANALYSIS OF RC4 ALGORITHM STATE MACHINE DIAGRAM

Different states of state machine Algorithm state machine diagram.

#### 3.1 Idle State

Data is at original state.

#### 3.2 Initial State

In this state, first we fill the SRAM and KRAM. To fill both the RAM, the data is given directly to the KRAM for filling the data randomly as a Data Bus.

### IV. STATE MACHINE CONTROLLER (SMC) MODULE

This is considered as the Controller (SMC) module. By this, "fig.2" shows below it can control all the modules. This state machine will work whenever Initial Over and Key Set up over are high step. First it controls Address, SRAM and KRAM. When enable is high means that it was writing key data in it. Then it is going to the input and it is given to the SRAM and this process run up to 256 times key data bytes is performed. Then it goes to Adder 2Generation. In this state, it takes the data from S\_Register and gives it to the Adder that is in Adder 2Ld. It adds the given the help of Address Multiplexer, which swap it and then gives it to the K\_ Steam Sterilizer. At the same time, with the help of FIFO, the available parallel data input to serial output [5].

This means that all the modules will work step by another state i.e. Adder 2Ld. In this state, adder will add the given in this process, swapping of input and then gives it to the SRAM with Key Data is given to the Data Sterilizer. Both sterilizers convert out EX-OR to give the encrypted data serially

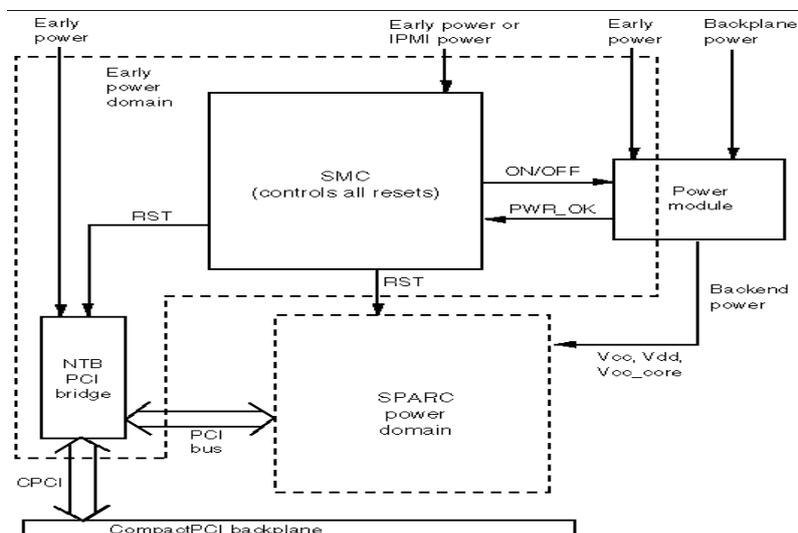


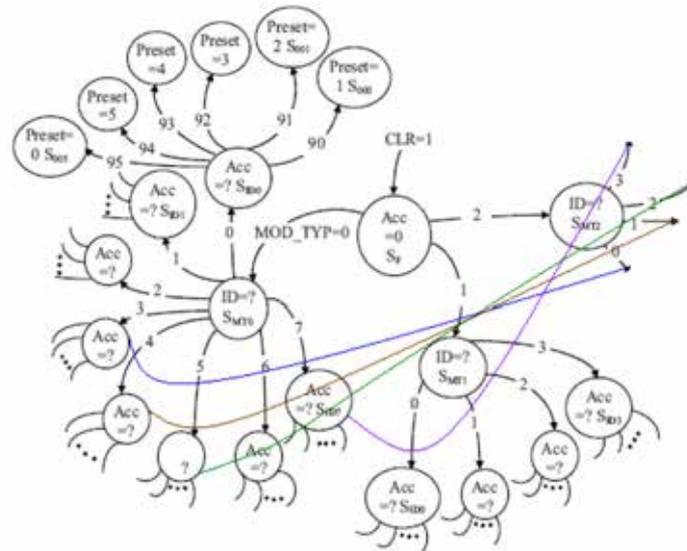
Figure2. State Machine Controller

### V. PRESET LOGIC AS FSM

The preset logic in "fig.3" shows hierarchical FSM whose principal function is to generate the correct beginning addresses for all subsequent iterations. This block contains a 4-bit counter keeping track of end of states during the iteration. The FSM enters into the first state (SF) with CLR = 1. Based on the value in MOD\_TYPE it makes transition to one of the four possible next states (SMT0, SMT1, SMT2 or SMT3).

Each state in this level represents one of the possible modulation schemes. The FSM thereafter makes transition to the next level of states (e.g. S000, S001 and so on) based on the value in the accumulator [4].

When the FSM at this level reaches to the terminal value of that iteration (e.g.45 in SMT0), it makes transition to a state (e.g. S000) in which it loads the accumulator with the initial value (e.g. preset=1) of the next iteration. This process continues till all the inter leaver addresses are generated for the selected MOD\_TYP. If no changes take place in the values of MOD\_TYP, the FSM will follow the same route of transition and the same set of inter leaver addresses will be continually be generated.



**Figure3. Preset logic as FSM**

## VL. INTER LEAVER MEMORY FOR WLAN

The inter leaver memory block comprises of two memory modules (RAM-1 and RAM-2), three MUX .In block interleaving when one memory block is being written the other one is read and vice-versa. Each memory module receives either write address or read address with the help of the MUX connected to their address inputs (A) and set line. RAM-1 at the beginning receives the read address and RAM-2 gets the write address with write enable (WE) signal of RAM-2 active [3].

## VII. SRAM CELL

A SRAM cell must be designed in such a way, so that it provides a non destructive read operation and a reliable write operation. In the conventional 6T SRAM cell this condition is fulfilled by appropriately sizing all the transistors in the SRAM cell. Sizing is done according to the cell ratio (CR). Traditional SRAM cells are symmetrically composed of transistors with identical leakage and threshold characteristics [2].

The two lines between the inverters are connected to two separate bit-lines via two n-channel pass-transistors (left and right of the cell). The gates of Those transistors are driven by a word-line. The 6T SRAM cell has a differential read operation. This means that both the stored value and its inverse are used in evaluation to determine the stored value.

## VIII. CONCLUSION

Various individual modules of RC4 stream cipher for Wi-Fi security have been designed, verified functionally using VHDL Simulator, synthesized by the synthesis tool and a final net list has been created. The An innovative 6T SRAM cell concept has been proposed and validated in 45nm MCFET technology.

The simulation results have shown great potential of the proposed approach for optimizing both the cell stability and the power consumption (higher than 25%) without any area penalty and for the same read access time .well adapted for all applications ,low power and high performance.

## REFERENCES

- [1] Sharma K Ghose MK Kumar D, Singh RPK, Pandey VK, “A comparative study of various Security approaches used in wireless sensor networks” Int J Adv Sci Technol, 177(77), 2010.
- [2] Gupta SS, Chattopadhyay A, Sinha K, Maitra S, Sinha B, “ High-performance hardware Implementation for RC4 stream cipher” IEEE Trans Comput 62(4):730–743,2013.
- [3]. Ahmad S, Beg MR, Abbas Q, Ahmad J, Atif S, “ Comparative study between stream cipher And block cipher using RC4 and Hill Cipher” Int J Comput Appl (0975–8887), 1(25),2010.
- [4]. Disha Handa, Bhanu Kapoor “ State of the Art Realistic Cryptographic Approaches for RC4 Symmetric Stream Cipher”, International Journal on Computational Sciences & Applications (IJCSA) Vol.No.4, August 2014.
- [5]. A.M.Bhavikatti, S. Srinivas Rao “VHDL Modeling of the payload data processor and controller of RC4 stream Cipher for Wi-Fi encryption” ,ICVED-2008, Proceedings of International Conference on Embedded system & VLSI Design, 20-21 March 2008, at PDVVP College of Engineering, Ahmdnagar.
- [6]. Dr.A.M.Bhavikatti, “VHDL Simulation of KRAM, Multiplexer and K Stream serializer Modules of RC4 Stream Cipher for Wi-Fi Security” ,International Journal of Advances in Wireless and Mobile Communications (AWMC) ,ISSN 0973-6972, Volume 6, Number 1, pp17-23,2013.

# CLASSIFICATION OF RICE DISEASE USING DIGITAL IMAGE PROCESSING AND SVM CLASSIFIER

<sup>1</sup>Amit Kumar Singh, <sup>2</sup>Rubiya .A, <sup>3</sup>B.Senthil Raja

<sup>1,2</sup> PG Scholar, Embedded System Technologies, S.K.P Engineering College, Anna University (India)

<sup>3</sup>Assistant Professor, Dept of ECE, S.K.P Engineering College, Anna University (India)

## ABSTRACT

The proposed methodology is an approach to identify the mostly occurring disease in rice plant namely Leaf blast using Support Vector Machine classifier (SVM). The images were taken from International Rice Research Institute (IRRI) database. Segmentation is carried out using K-mean clustering algorithm to acquire the infected portion of leaf. The texture feature vectors which were extracted from the segmented images were given as an input to the classifier. The Support Vector Machine is able to classify the disease more accurately (82%) compared to the other classifiers and neural network.

**Keywords:** IRRI, K-mean, Leaf blast, SVM

## I. INTRODUCTION

Research in agriculture is aimed towards increase of productivity and food quality at reduced expenditure by accurate diagnosis and timely solution of the field problem. With the recent advancement in image processing and pattern recognition techniques, it is possible to develop an autonomous system for disease classification in crops. Most common rice diseases are leaf blast, brown spot, and leaf blight. We have restricted our work within the rice diseases only and considered the most common diseases in the North India, namely Leaf Blast. The paper has been divided into five sections. Section I deals with Image Acquisition. , Section II consists of Image Pre-processing Section III describes about Image segmentation technique, Section IV deals with Feature selection and Feature extraction and Section V describes about SVM classifier used for disease classification and VI consist of Result analysis and at last conclusion.

## II. LEAF BLAST

Blast disease was first found for the first time in California rice. It is generally considered as the principal disease of rice because of its wide distribution and destructiveness and potential to cause more than 50% yield loss when condition is favourable. Blast can affect rice from seedling to maturity stage.

## III. CAUSAL ORGANISM

Rice blast is caused by the fungus named Pyricularia Oryzae .The life cycle of the fungus starts when conidia are deposited on a rice plant.

#### IV. SYMPTOMS

Infection is followed by the colonization of host tissue, and after four to five days the first symptoms are visible to the naked eye. In susceptible host genotypes rapid whitish or grey lesions emerge that often develop a brown margin

and a yellow halo in a later stage. The lesions are elliptical or spindle-shaped. It get spread by wind or by rain splash.

#### V. FAVOURABLE ENVIRONMENTAL CONDITION

It include extended periods of free moisture on plant surfaces and temperatures at night between 63-73 F with little or no wind and high relative humidity.

#### VI. PROPOSED WORK

This section includes the brief explanation of the different stages of the image processing and at last classification. The flow of the work is given in fig 1

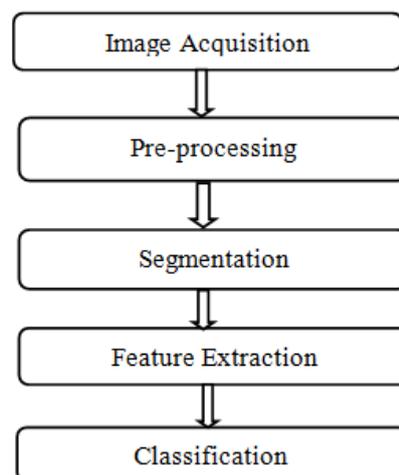


Figure 1: Block Diagram of the Proposed System

##### 6.1 Image Acquisition

The input images of the rice leaf were acquired from the standard IRRI database or can directly be taken from a high resolution camera to avoid preprocessing overload.

##### 6.2 Preprocessing

Pre-processing deals with filtering of unwanted noise from the acquired image and contrast enhancement in order to acquire a high quality image for the analysis purpose. In the proposed work, preprocessing is carried out using Weiner filter to remove the blurring effect. Adaptive histogram is used in order to carry out contrast enhancement by equalizing the pixel intensity value .After equalization the image edges become more prominent compared to the original image.

### 6.3 Image Segmentation

K-means clustering is used as segmentation algorithm. Clustering is the process of organizing a set of data points into smaller number of clusters by randomly initializing the cluster head and parameter like Euclidean distance is used to form the clusters. In general, we have n data points  $x_i, i=1\dots n$  that have to be partitioned into k clusters. The goal is to assign a cluster to each data point.

K-means is a clustering method, in which the image is clustered into the K- number of clusters which needs to be specified. Consider the positions  $x_i, i=1\dots n$  of the clusters that minimize the *distance* from the data points to the cluster head.. K-means clustering is given by (1)

$$J = \sum_{i=1}^k \sum_{x \in C_i} |x - \bar{x}_i|^2 \dots (1)$$

Where x is the point of the data set,  $\bar{x}_i$  is the centroid of the i-th cluster. The K-means clustering uses the square of the Euclidean distance for clustering.

The algorithm is composed of the following steps:

1. Specify the number of clusters.
2. Randomly initialize the cluster head for each cluster and calculate the distance of each member from the cluster head.
3. Once the initial clusters were generated the member of the clusters then again calculates the Euclidean distance from the different cluster head.
4. If the distance of the members comes closer to other cluster then the members change their cluster and again a new cluster heads were selected per cluster till we get an optimized result

The optimal cluster heads will be calculated by repeating the steps 2 to 4. The iteration will be continued until it converges, that is the difference between the i -th and (i-1) th iteration is very low. This gives a separation between the clusters.

## VII. FEATURE SELECTION AND EXTRACTION

Feature selection is the process of selecting the features which can efficiently determine the characteristic of an image followed by feature extraction .In feature extraction the selected features were extracted from the images for classification of the disease. The features have to be selected efficiently in order to reduce the computational complexity.

There are texture features which are taken from the output cluster images :

### 7.1 Entropy

It gives us information about the spatial arrangement of color or intensities in an image or selected region of an image.

$E \{k\} = \text{entropy}(\text{segmented image } \{k\});$

### 7.2 Standard Deviation

It is a measure that is used to quantify the amount of variation of a set of data points. Low standard deviation indicates that the data point tends to be very close to the mean or the expected value of the set.

$B \{k\} = \text{std2}(\text{segmented image } \{k\});$

### 7.3 Classification

Classification is the process of analyzing the various properties of image features and categorizing them into various declared classes.

## VIII. SUPPORT VECTOR MACHINE (SVM)

Support Vector Machine which is used as a classifier is a nonlinear classifier which is able to classify the features into two classes. The feature vectors were separated into classes by introducing a hyper plane. The main objective of SVM is to achieve maximum distance between the hyper plane and the class boundary to avoid the misclassification of the vectors into other class. The feature vectors which are present at the border of the class and based on which the distance of the hyper plane is decided are called as support vector.

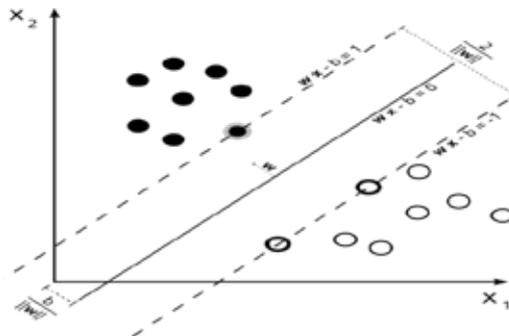


Figure 2: SVM Classification

## IX. RESULT ANALYSIS

In this section, the result of the stages involved in detection of the Leaf blast disease was shown:

### 9.1 Normal and Infected Image

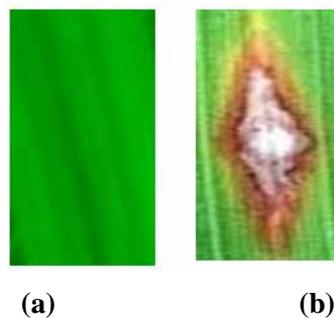


Figure 3: Input Image (a) Normal leaf (b) Infected leaf

### 9.2 Image Preprocessing



Figure 4: Contrast Enhancement

### 9.3. Segmentation Output

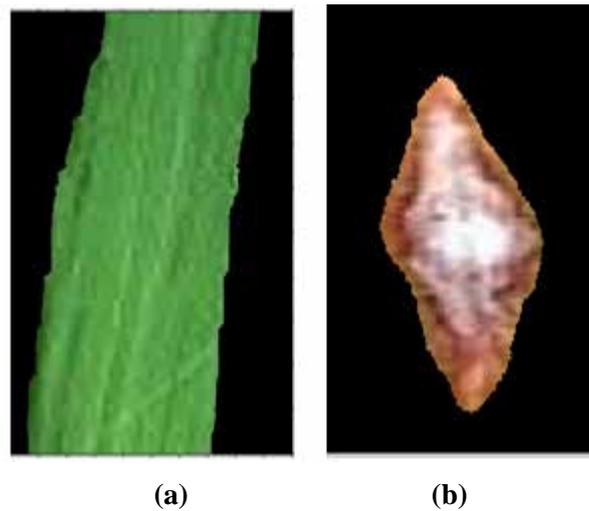


Figure 5: Segmented Image (a) Normal image (b) Infected image.

### 9.4. Classification Output

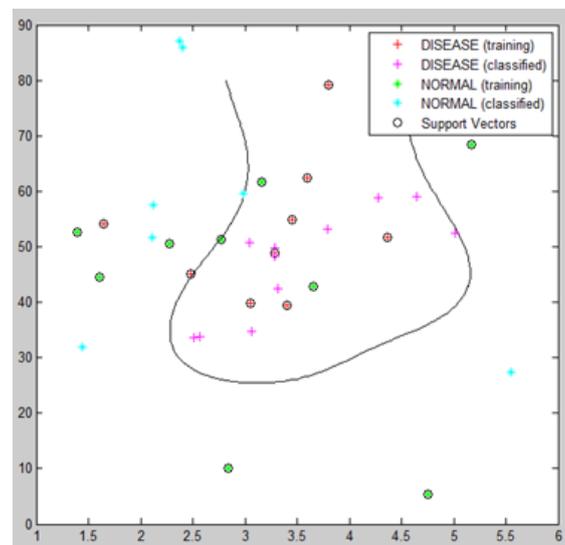


Figure 6: SVM Output

## X. CONCLUSION AND FUTURE SCOPE

The proposed work is able to classify the disease more efficiently using SVM classifier (82%) compared to the other classifiers. The future scope of this work is to improve the segmentation process and to classify the disease using different classifier in order to carry out a comparative study.

## REFERENCES

- [1] Rafael C Gonzalez, Richard E. Woods, "Digital Image Processing"
- [2] Auzi Asfarian, Yeni Herdiyeni, Aunu Rauf and Kikin Hamzah Mutaqin. Paddy Diseases Identification with Texture Analysis using Fractal Descriptors Based on Fourier Spectrum.
- [3] Santanu Phadikar and Jaya Sil. Rice Disease Identification using Pattern recognition techniques.

- [4] Florindo JB, Bruno OM. 2012. Fractal descriptors based on Fourier spectrum applied to texture analysis. *Physics A*. 391:4909-4922.
- [5] Qin Z, Zhang M. 2005. Detection of rice sheat blight for in-season disease management using multispectral remote sensing, *International Journal of Applied Earth Observation and Geo information* 7:115-128.
- [6] Wang H, Li G, Ma Z, Li X. 2012. Application of neural networks in image processing for detection of plant diseases. 2012 International Conference on Systems and Informatics (ICSAI); Yantai, Cina; 2012 May 19-20. pp 2159-2164. doi.10.1109/ICSAI.2012.6223479.

# OZONE SIMULATIONS FOR HGB AREA USING DIFFERENT CHEMICAL MECHANISMS WITHCAMX

**Samarita Sarker<sup>1</sup>, Raghava R. Kommalapati<sup>2</sup>, Ziaul Huque<sup>3</sup>**

<sup>1</sup>Graduate Research Assistant, Center for Energy & Environmental Sustainability,  
Prairie View A&M University, (USA)

<sup>2</sup>Director, Center for Energy & Environmental Sustainability and Professor,  
Department of Civil and Environmental Engineering, Prairie View A&M University (USA)

<sup>3</sup>Professor, Department of Mechanical Engineering and Researcher Center for  
Energy & Environmental Sustainability, Prairie View A&M University (USA)

## ABSTRACT

Areas with air pollution problems often tend to use sophisticated Air Quality Models (AQM) and these models simulate the emissions, dispersion, chemical reactions, and removal of pollutants in the troposphere by solving different equations for each chemical species. Chemical mechanisms play a critical role in predicting the pollutant concentrations. In this study Comprehensive Air quality Model with Extensions (CAMx), photochemical dispersion model is used to predict the air quality of Houston-Galveston-Brazoria (HGB) area. This area has been a non-attainment area for ozone ( $O_3$ ), which is a secondary pollutant. Accurate prediction of air quality can be very effective in reducing harmful air pollutants and help policy makers to make better emission control strategies. In this study, two different versions of CAMx; CAMx 4.53 and CAMx 5.40 simulation results are evaluated for prediction of ozone ( $O_3$ ). These models use different chemical mechanisms namely, CAMx 4.53 uses Carbon bond 5 (CB5) and CAMx 5.40 uses Carbon bond 6 (CB6). CAMx 4.53 and CAMx 5.40 results are then compared with the observations from TCEQ monitoring sites in the HGB area. CAMx 5.40 (CB6) is found to give an optimal prediction of ozone ( $O_3$ ). On 9th June, 2006, CAMx 4.53 predictions of ozone were 15% lower than the maximum ozone ( $O_3$ ) concentration from CAMx 5.40 simulations for HGB area.

**Keywords:** Air quality, CAMx 4.53, CAMx 5.40, CB5, CB6, Ozone

## I. INTRODUCTION

Urbanization and industrial development is causing serious air pollution problems in many areas of the world. Air quality control has become very important to protect public health and environment. Sophisticated Air Quality Models (AQM) are widely used nowadays to study and understand air pollution problems and various control strategies. Dispersion modeling, photochemical modeling, receptor modeling are some of the popular AQMs. Among these models, photochemical models are more appropriate for areas like Houston-Galveston-Brazoria (HGB) where ozone ( $O_3$ ) pollution is and has been a major concern. This secondary pollutant is produced from the photochemical reaction of Nitrogen Oxides ( $NO_x$ ) and Highly Reactive Volatile Organic Compounds (HRVOC) [1]. Ozone concentration in HGB is found to be higher than 0.075 parts per million

(ppm), the 8-hour average ozone standard from National Ambient Air Quality Standards (NAAQS) [2]. To improve air quality and determine proper air quality control strategies and planning, modeling air quality and being able to model various scenarios is of great value. Air quality models simulate the emissions, dispersion, chemical reactions, and removal of pollutants in the troposphere by solving simultaneously different equations for each chemical species. In this study Comprehensive Air Quality Model with Extensions (CAMx), a popular photochemical dispersion model is used to predict the air quality in the Houston-Galveston-Brazoria (HGB) area. Two versions of CAMx; CAMx 4.53 and CAMx 5.40 are used to simulate the air quality. These models use different chemical mechanisms. CAMx 4.53 uses Carbon bond 5 (CB5) and CAMx 5.40 uses the revised Carbon bond 6 (CB6) mechanism [3]. Several additional chemical species were added to the CB6 mechanism for CAMx 5.40 version, which is supposed to give more accuracy for optimal ozone ( $O_3$ ) predictions.

Presence of sunlight favors ground level ozone formation [4]. June 9, 2006 is selected for this study from Texas Commission on Environmental Quality (TCEQ) summer episodes base case scenarios. CAMx results show that maximum hourly ozone concentration is higher than the NAAQS on June 9, 2006 for most of the daytime. In comparison, CAMx 5.40 (CB6) shows higher hourly ozone concentration than CAMx 4.53. During ozone formation hours, CAMx 4.53 is found to predict about 15% lower maximum ozone ( $O_3$ ) concentration for HGB area than CAMx 5.40. The model results are also compared with the observed ozone concentrations at TCEQ monitoring sites.

## II. MODEL DESCRIPTION

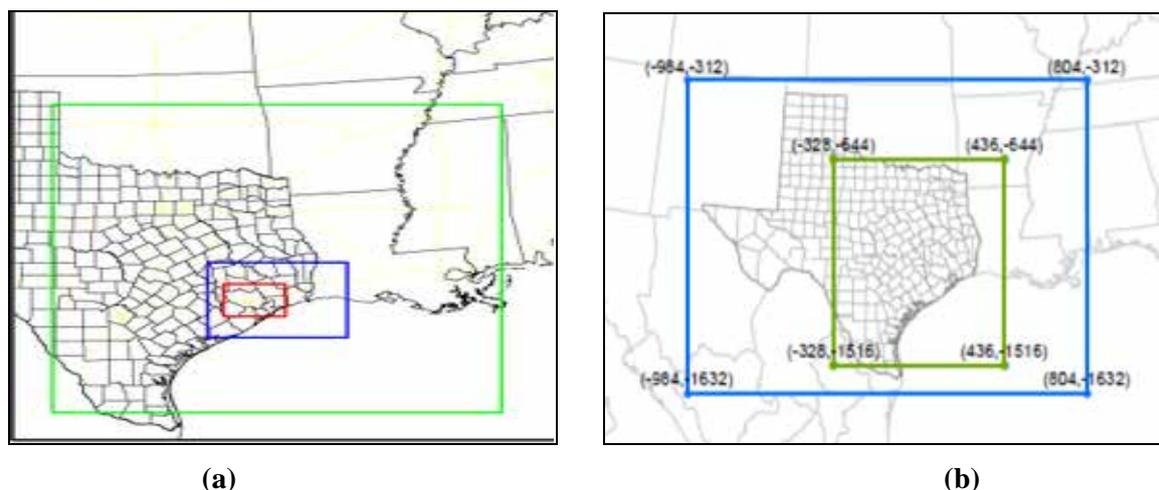
Comprehensive Air quality Model with Extensions (CAMx) is a three-dimensional photochemical dispersion model. CAMx uses a nested grid system and Eulerian continuity equation to simulate the emissions, dispersion, chemical reactions, and removal of pollutants in the troposphere for each chemical species. CAMx model output can have up to 28 layers ranging from 0 to 16,000 meter above the ground. The first layer is 33.9 meter above the ground. In HGB area ground level Ozone is a major concern, so while extracting the data from the CAMx simulation output, the air pollutant concentration of the first layer was used.

The major difference between CAMx 4.53 and CAMx 5.40 is their chemical mechanisms other than general revisions. CAMx 4.53 uses Carbon bond 5 (CB5) mechanism, which comprises of 156 reactions and up to 89 species (54 state gases, up to 22 state particulates, and 13 radicals) whereas CAMx 5.40 uses chemical mechanism 7, known as Carbon bond 6 (CB6). This mechanism uses 218 reactions and up to 114 chemical species (69 state gases, up to 22 state particulates, and 23 radicals) [3].

In CB6, major revisions to the chemistry for aromatics, isoprene, alkenes, alkanes and oxygenates. To improve oxidant formation propane, acetone, benzene and ethyne (acetylene) are included in CB6. This mechanism modified peroxy radical chemistry, which improved formation of hydrogen peroxide ( $H_2O_2$ ) [5]. In several studies, sensitivity analysis of ozone ( $O_3$ ) to  $NO_x$  and VOC was conducted by using photochemical indicator ratio of  $[H_2O_2]$  to  $[HNO_3]$  [6]. The inclusion of formation mechanism of hydrogen peroxide ( $H_2O_2$ ) in CB6 improves ozone ( $O_3$ ) prediction.

In this work, CAMx Lambert Conformal Conic (LCC) map projection is used. CAMx uses nested grid domain for simulations, i.e. master grid input data moves into finer grid input data. CAMx 4.53 and CAMx 5.40 modeling domain parameters are shown in Table 1 and Table 2 respectively. For CAMx 4.53, HGB/BPA Sub-domain 4 km grid is available [7], shown in Fig. 1(a). CAMx 5.40 Tx\_4km domain covers Houston-Galveston-Brazoria (HGB)

area and portion of surrounding states. Due to lack of input data file for HGB sub-domain, tx\_4km data is used for data interpretation [8], as shown in Fig. 1(b).



**Figure 1: (a) CAMx 4.53 HGB/BPA Sub-domain 4 km grid (blue rectangle) (b) CAMx 5.40 Texas 4km domain (Green rectangle)**

**Table 1: Modeling domain CAMx 4.53 [7]**

Domain (km)	Easting (E)	Northing (N)	Number of cells	
			(E)	(N)
<b>eus_36km</b>	-108,2376	-1584,828	69	67
<b>etx_12km</b>	-12,1056	-1488, -42	89	89
<b>hgbpa_04km</b>	-356,688	-1228,-968	83	65

**Table 2: Modeling domain CAMx 4.53 [8]**

Domain (km)	Easting (E)	Northing (N)	Number of cells	
			(E)	(N)
<b>rpo_36km</b>	-2735,2592	-2088,1944	148	112
<b>tx_12km</b>	-984,804	-1632, -312	149	110
<b>tx_4km</b>	-328, 436	-1536,-644	191	218

### III. METHODOLOGY

Air quality modeling for the Houston-Galveston-Brazoria (HGB) area was done using two different versions of Comprehensive Air Quality Model with Extensions, namely; CAMx 4.53 and CAMx 5.40. Model inputs were processed by Texas Commission on Environmental Quality (TCEQ) and the Base case from May 31 to July 2, 2006 episode is used for this simulation [7].

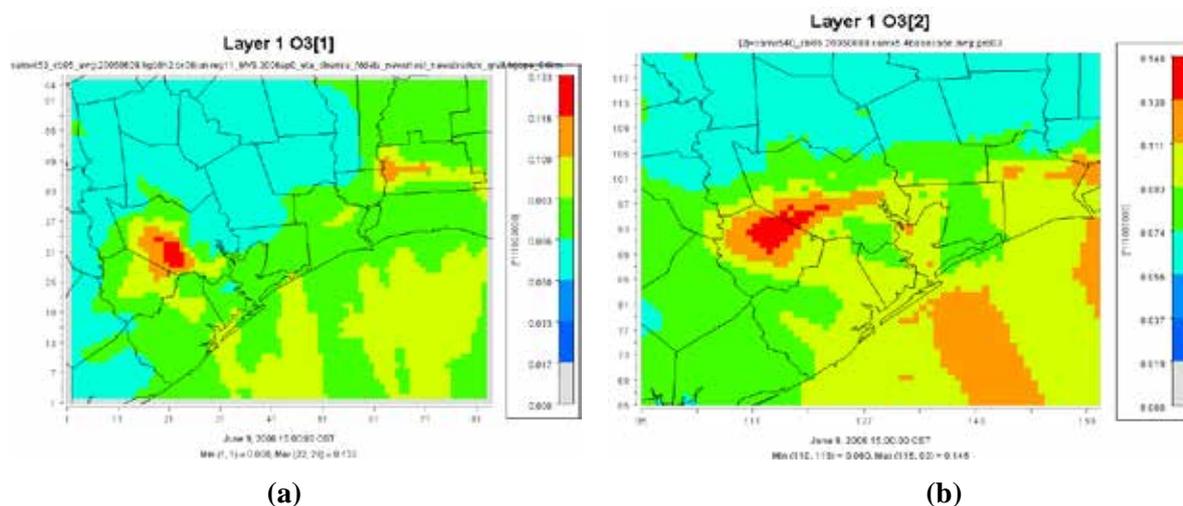
CAMx requires input files that configure each simulation, define the chemical mechanism, and describe the photochemical conditions, surface characteristics, initial and boundary conditions, emission rates, and various meteorological fields over the entire modeling domain. In meteorology inputs temperature, wind, pressure, humidity, diffusivity, cloud data are incorporated. WRF and GEOS-Chem models are used to generate meteorological data and boundary condition data files, respectively. Point source, area source, on-road source, non-road source and biogenic source emissions are considered for preparing emission data file which were

generated by Emission Processing System (EPS3), MOtor Vehicle Emission Simulator (MOVES), NON-ROAD and Global Biogenic Emissions and Interactions System (GloBEIS) model, respectively [9].

Model simulation results are compared to observations from TCEQ monitoring sites to evaluate the effectiveness of predicting ozone concentrations using CAMx 4.53 and CAMx 5.40. Daily maximum eight-hour ozone averages for June 9th, 2006 for forty one monitoring sites of HGB area [10] are compared to the simulation values obtained from the two versions of CAMx.

#### IV. CAMX SIMULATIONS, ANALYSIS AND DISCUSSIONS

The output from CAMx is visualized using Visualization Environment Rich Data Interpretation (VERDI) [12]. Tile plots of CAMx 4.53 HGB/BPA Sub-domain 4 km grid and Interpreted HGB area from CAMx 5.40 Texas 4 km grid are shown in Fig. 2 (a) and 2 (b). Tile plots show the spatial maximum ozone concentration for each hour. As shown in Fig. 2(a), CAMx 4.53 (CB5) predicted maximum ozone concentration of 130 ppb at 15:00 CST for June 9, 2006. CAMx 5.40 (CB6) predicted maximum ozone concentration 145 ppb at 15:00 CST for the same day.



**Figure 2: Maximum ozone (O<sub>3</sub>) concentration at 15:00 CST for June 9, 2006 (a) CAMx 4.53 (CB5), (b) CAMx 5.40 (CB6)**

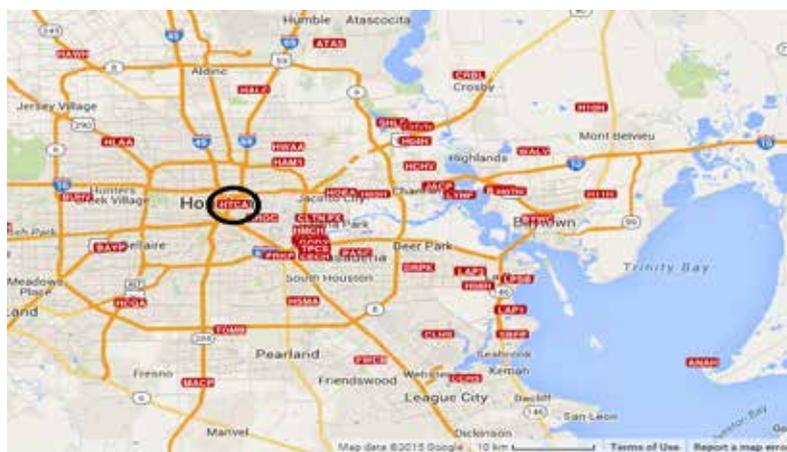
To analyze the ozone concentration differences for CAMx 4.53 (CB5) and CAMx 5.40 (CB6), maximum ozone concentration values are collected for the June 9, 2006. During mid-day when abundant sunlight is present, ozone production is usually at peak during these conditions. Table 3 shows maximum ozone concentration values for this day using both CB5 and CB6 mechanisms. AS can be seen from the table, CB6 mechanism used in CAMx 5.40 model predicted much higher ozone concentration than CB5, used in CAMx 4.53. From this data, it is found that CB6, CAMx 5.40 predicted about 16% more of ozone concentration than CB5, CAMx 4.53.

**Table 3: Maximum Ozone Concentration Values for the June 9, 2006**

Time (CST)	Ozone CB5 (ppb)	Ozone CB6 (ppb)
10	84	111
11	96	116

12	103	127
13	112	134
14	122	140
15	130	145
16	122	148
17	120	142

Houston-Galveston-Brazoria (HGB) area consisting eight counties; Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties have about 41 monitoring sites. Daily maximum eight-hour ozone concentrations from all these sites are monitored [10]. For most of the sites, Air Quality Index (AQI) values ranged between 60-100 (minimum 62, maximum 106). AQI range explains that if the value is between 51-100, it indicates a mean 8 hour ozone value in the range of 0.06 - 0.075 ppm [10]. At three of the stations, ozone exceeded 8-hour ozone AQI of 100 (ozone concentration range of 0.076 - 0.095). On average 8 hour ozone concentration is 0.080 ppm.



**Figure3: TCEQ Air Quality monitoring Stations in HGB area (Black circle: Houston Texas Avenue Station, C411) [11]**

The main objective of this study is to assess the role of the revised chemical mechanism (CB6) used with the CAMX 5.40 compared to the older CB5 mechanism used with CAMx 4.53 and its influence on the pollutant concentrations. To compare the model results with TCEQ monitoring station data, Houston Texas Avenue Station C411 (HTCA-C411) is selected. This station is within the Houston-Galveston-Brazoria (HGB) area and provided measured hourly averages for ozone (O<sub>3</sub>) pollutant [13]. Table 4 shows the hourly averages for ozone (O<sub>3</sub>) concentration in that station on June 9, 2006.

**Table 4: Hourlyobserved Ozone Values for selected Monitoring Station on June 9, 2006 [13]**

Time (CST)	Ozone (ppb)	Time (CST)	Ozone (ppb)	Time (CST)	Ozone (ppb)
Midnight	28	8	15	16	87
1	28	9	31	17	77
2	28	10	47	18	81
3	26	11	62	19	69

4	19		12(noon)	75		20	48
5	6		13	77		21	34
6	5		14	77		22	39
7	8		15	89		23	42

To compare model results with observed ozone concentrations, CAMx 5.40 and CAMx 4.53 results were plotted in time series. Time series graph in Fig. 3 shows, CB5, CAMx 4.53 ozone concentration values for June 9th, 2006. Maximum average ozone value is 0.070 ppb. Fig. 4 represents time series ozone concentrations predicted by CAMx 5.40 (CB6). The maximum ozone concentration is found 0.075 ppb for June 9th, 2006. From time series graphs, hourly ozone concentrations simulated by CAMx 4.53(CB5) and CAMx 5.40 (CB6) are extracted to compare with the observed values from Houston Texas Avenue Station C411 monitoring site. It should be noted that the predications are given for broader HGB area where there are 41 monitoring sites and only one such site is selected for this comparison. In Fig. 6, hourly ozone concentration from Houston Texas Avenue Station C411(observed), CAMx 4.53(CB5) and CAMx 5.40 (CB6) are compared for hours CST 12:00 to CST 18:00. Usually peak ozone concentration is found during these hours. From Table 4 and Fig. 6, it is found that maximum ozone concentration observed at Houston Texas Avenue Station is higher than the CAMx 4.53(CB5) and CAMx 5.40 (CB6) predicted values. Highest ozone concentration is measured at 15:00 CST and value is 89 ppb. Maximum 8-hour ozone value is 79 ppb.

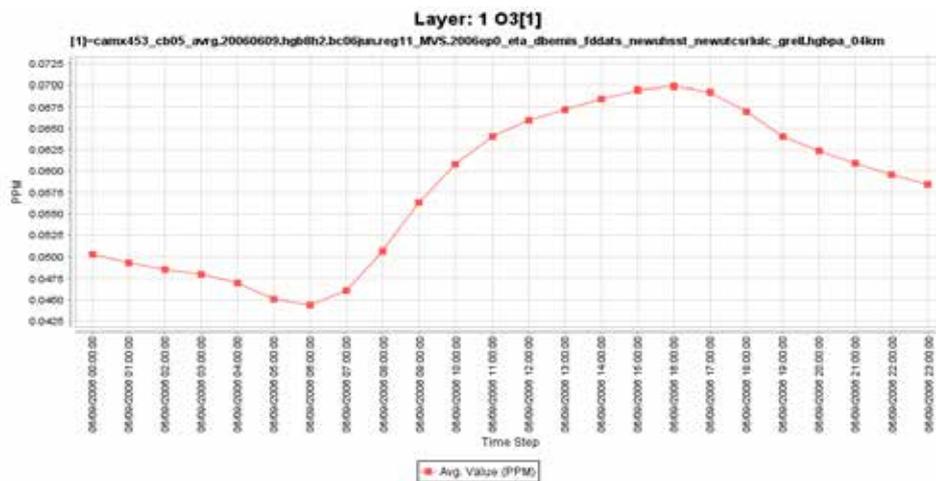


Figure 4: CAMx 4.53 (CB5) Time Series Graph of Ozone Concentration on June 9th, 2006.

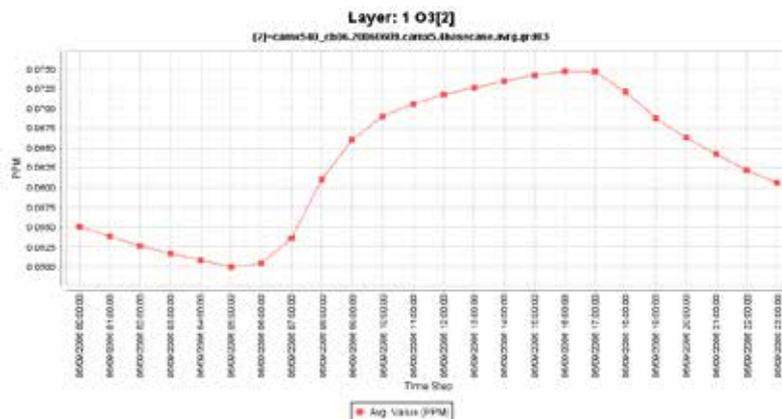
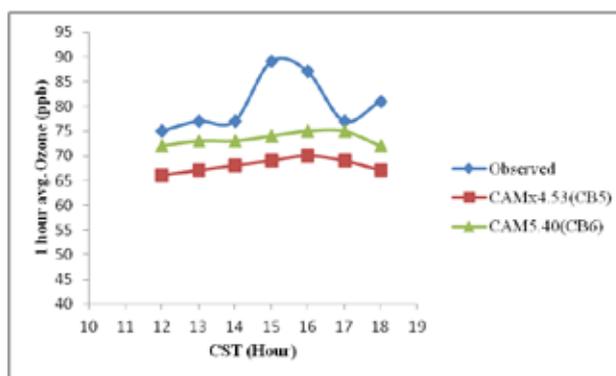


Figure 5: CAMx 5.40 (CB6) Time Series Graph of Ozone Concentration on June 9th, 2006.



**Figure 6: Ozone Concentration Comparison Graph at 12:00 CST to 18:00 CST on June 9th, 2006.**

Houston Texas Avenue Station observed hourly ozone concentrations are in general higher than the CAMx 4.53(CB5) and CAMx 5.40 (CB6) predicted hourly values. CB6, CAMx 5.40 predicted higher hourly ozone concentrations are in general are higher and more closer to observed values than those predicted from CB5, CAMx 4.53. It is assumed that even though CB6 has better chemical mechanism to predict air quality than CB5, yet more modifications may be required to improve air quality parameter prediction. As stated earlier, it should be noted here only one monitoring station data is used for comparison here out of the 41 monitoring stations in the HGB area. Plans are currently underway to use the average from the 41 sites for comparison purposes.

## V. CONCLUSION

Ozone ( $O_3$ ) is a secondary pollutant that is produced from complex chemical reactions in the atmosphere. Thus, chemical mechanisms used in the air quality models play a very significant role in predicting the pollutant's concentration. Reliable and precise chemical mechanisms are necessary to help policy makers to better understand the impact of various emission control strategies. This study is an initial attempt to understand the effect of chemical mechanisms while simulating and analyzing air quality data. CAMx 5.40 (CB6) is found to give better prediction of ozone ( $O_3$ ) compared to CAMx 4.53 (CB5). From spatial tile plot results, ozone predictions from CAMx 4.53 are found to be about 15% lower than the CAMx 5.40 for HGB area. Chemical mechanism CB6 has improved air quality prediction for CAMx but needs modification to predict accurate pollutant concentration. Due to time constraint only ozone pollutant has been studied. Comprehensive analysis of the other pollutants can give us a better insight to improve CAMx chemical mechanism and also to identify which pollutants are responsible for higher ozone production in the HGB area.

## VI. ACKNOWLEDGMENTS

This work is supported by the National Science Foundation (NSF) through the Center for Energy and Environmental Sustainability (CEES), a CREST Center, award no. 1036593

## REFERENCES

- [1] H. Simon, Y. Kimura, G. McGaughey, D. T. Allen, S. S. Brown, H. D. Osthoff, J. M. Roberts, D. Byun, and D. Lee, Modeling the impact of CINO<sub>2</sub> on ozone formation in the Houston area, *Journal of Geophysical Research*, 114, 2009, D00F03, doi:10.1029/2008JD010732.

- [2] Texas Commission on Environmental Quality (TCEQ) website. See <http://www.tceq.texas.gov/airquality/sip/criteria-pollutants/sip-ozone>
- [3] ENVIRON, Users Guide: Comprehensive Air Quality Model with Extensions Version 5.40, ENVIRON International Corporation, 2011, 3-1, 3-17, 6-10
- [4] J. Flynn, B. Lefer, B. Rappengluck, M. Leuchner, R. Pern, J. Dibb, L. Ziemba, C. Anderson, J. Stutz, W. Brune, X. Ren, J. Mao, W. Luke, J. Olson, G. Chen, J. Crawford, Impact of clouds and aerosols on ozone production in Southeast Texas, Atmospheric Environment, 44, 2010, 4126–4133
- [5] Yarwood, G., Jung, J., Whitten, G. Z., Heo, G., Mellberg, J., Estes, E., Updates to the Carbon Bond Mechanism for Version 6 (CB6). Presented at the 9th Annual CMAS Conference, Chapel Hill, 2010
- [6] Sillman, S., The Use of NO<sub>x</sub>, H<sub>2</sub>O<sub>2</sub> and HNO<sub>3</sub> as indicators for Ozone –NO<sub>x</sub>-Hydrocarbon Sensitivity in Urban Location, Journal of Geophysical Research, 100, 1995, 14175-14188
- [7] Texas Commission on Environmental Quality (TCEQ) website. See <http://www.tceq.state.tx.us/airquality/airmod/data/hgb8h2>
- [8] Texas Commission on Environmental Quality (TCEQ) website. See <http://www.tceq.state.tx.us/airquality/airmod/data/domain>
- [9] Texas Commission on Environmental Quality (TCEQ), Protocol for Eight-Hour Ozone Modeling of the Houston/Galveston/Brazoria Area, 2009
- [10] Texas Commission on Environmental Quality (TCEQ) website. See [http://www.tceq.state.tx.us/cgi-bin/compliance/monops/8hr\\_monthly.pl](http://www.tceq.state.tx.us/cgi-bin/compliance/monops/8hr_monthly.pl)
- [11] Texas Commission on Environmental Quality (TCEQ) website. See <https://www.tceq.texas.gov/airquality/airmod/data/site>
- [12] Environmental Protection Agency (EPA), Visualization Environment for Rich Data Interpretation (VERDI 1.4): Users Manual, 2011
- [13] Texas Commission on Environmental Quality (TCEQ) website. See [http://www.tceq.state.tx.us/cgi-bin/compliance/monops/daily\\_summary.pl](http://www.tceq.state.tx.us/cgi-bin/compliance/monops/daily_summary.pl)