INFORMATION SCIENCE AND TECHNOLOGY FOUNDATION

Advanced Information Technology Components in e-Governance Systems and Projects for Healthy Smart Cities and Villages – A Theoretical Overview

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ABSTRACT

e-Governance or Electronic Governance is the application of ICT or Information and Communication Technology for providing government services, interchange of statistics, communication proceedings, and integration of various independent systems and services. Government services are made available to citizens in a suitable, systematic, and transparent mode by the way of e-Governance. Electronic Governance is the best utilization of ICT. By the using of e-Governance people can get authorization through access the information. To enhance and upgrade the government functions, e-Governance uses information and communication technologies at different levels of the government and the public sector. Generally, e-Governance is the process of change of the correlation of government with its components that is the people, the businesses, and its own parts, by the use of tools of information and communication technology. E-governance services make direct platform where people in the city receives the facilities and government services in online. Therefore, e-governance develop smart governance system to extent the smart city. Smart city encompassed with modern and innovative emerging technologies in each sphere. Inhabitants get modern sophisticated facilities in smart city. This paper gives the information about the uses of advanced Information Technology (IT) in e-Governance for smart city advancement.

Keywords: e-Governance, Smart City, ICT, IT, Cloud Computing, Big Data, IoT,AI, Edge Computing

Objective of the work

This paper entitled "Advanced Information Technology components in e-Governance Systems and Projects

for Healthy Smart cities and Villages- A Theoretical Overview" is conceptual nature and theoretical and concern about the following objectives:—

- ❖ To know about the basic of the e-Governance.
- ❖ To learn the definition of the e-Governance.
- ❖ To understand about the different types of the e-Governance.
- ❖ To know about the different types of emerging information technologies in e-Governance.
- ❖ To learn about the application of emerging information technologies in e-Governance.
- ❖ To know how e-governance govern smart city upliftment.

INTRODUCTION

e-Governance or electronic Governance is carrying out the function of governance through the utilization of information and communication technology (ICT). e-Governance is the application of information and communication technology (ICT) for providing government services, exchange of information, transactions, integration of previously existing services and information portals. Digital Governance indicates to carrying out governance process in a digital way to deliver digital services. Digital Governance is also called as electronic governance, internet governance, online governance, transformational governance, and connected governance. E-Governance refers to the use of ICT (Information and Communication Technology) by government or public agencies for public governance. So, e-Governance is mainly moving towards SMART governance. The aims and objectives of e-Governance are as follows-

- ❖ To provide better services to citizens
- ❖ Ushering in transparency and accountability
- ❖ Empowering people through information
- ❖ Improve efficiency within Government i.e. between Center-State or inter-state
- ❖ Improve interface with business and industry

Different researchers have defined the e-Governance as follows—

Kettl (2000) defined the e-Governance as follows[19] "e-Governance is a way of describing the links between government and its broader environment - political, social, and administrative. The application of electronic links that is the interaction between government and citizens and government and businesses, as well as in internal government operations for simplifying and improve democratic, government and business aspects of governance".

Gupta and Jana (2003) defined the e-Governance as[16] "e-Governance includes various activities like the design of a user friendly citizen interface in local languages, back-end database integration, communication using multiple channels, security of transactions, cyber law infrastructure, participating policy-making processes, transparency in government activity, and willingness among government agencies to embrace open styles of functioning".

Prabhu (2004) defined the e-Governance as[27] "Using information and communication tools for achieving the desired goals, SMART governance by focusing on citizens and prefixed with 'e' is e-governance".

Dawes (2008)[10] defined the e-Governance as "e-Governance consist of the use of ICT to support government administration, democratic processes, public services, and relationships among civil society, citizens, the private sector and the state".

Öktem *et al.* (2014)[21] defined the e-Governance as follows "Using Internet technologies governing with people is called e-Governance".

Broome (2015)[5] defined the e-Governance as follows " The broader concept of using and application of information and communication technologies to the management of relationships and networks within society is known as e-Governance".

TYPES OF E-GOVERNANCE

e-Governance can be four types such as:—

1. ***G2G (Government to Government):*** When the interaction and the exchange of information and services takes place within the government then it is called G2G interaction or Government to Government interaction. The G2G interaction can be both horizontal and vertical. Here horizontal interaction means among various government entities and vertical interaction means between national, state and local government entities and within different levels of the entity. For example, Administration, policy formation etc.
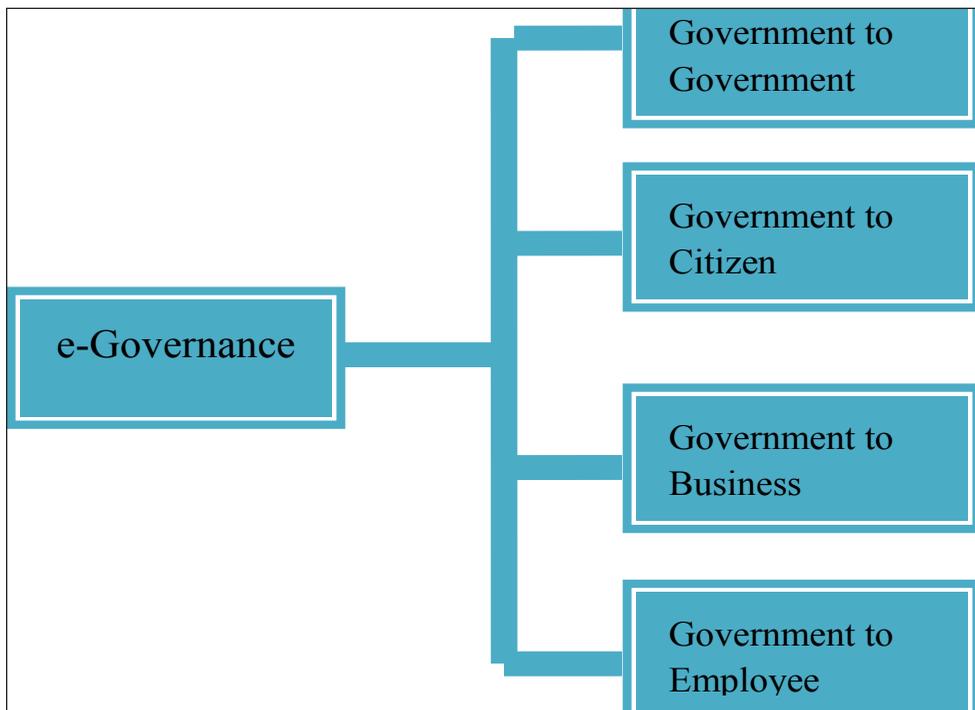

Fig. 1: Types of e-Governance

2. ***G2C (Government to Citizen)*:** When the interaction among the government and general public is termed as G2C interaction. In this case an interface is set up between government and citizens, which enables citizens to get access to wide variety of public services[18]. The citizens have the right of freedom to share their views and grievances on government policies anytime, anywhere. For example, Land record, birth certificate etc.

3. ***G2B (Government to Business)*:** In G2B interaction, the e-Governance helps the business class to interact with the government seamlessly. It targets at eliminating red-tape system, saving time, cost and establish transparency in the business environment, while interacting with government. For example, Taxation and Tender, etc.

4. ***G2E (Government to Employee)*:** The government is the biggest employer of any country and it deals with employees on a regular basis. With the help of ICT, the interaction between government and employee is very fast and efficient. For example, Income tax, Pension etc. The Fig. 1 depicts the four types of e-Governance.

e-governance have many benefits including accountability, speed, reduce cost, reduction of corruption, transparent work facility, GDP growth enhancement.

EMERGING IT IN E-GOVERNANCE

Emerging Information Technology that are used in e-Governance as follows—

1. Cloud Computing

2. Big Data

3. IoT

4. Blockchain

5. AI

6. Edge Computing

Here Fig. 2 depicts the different emerging IT in e-Governance.

Application of Cloud Computing in e-Governance

Cloud Computing is the use of remote server on the Internet to store, manage and process data rather than local server. It is one of the new technologies which can significantly improve the way a government functions, the services it provides to its citizens and institutions, and its cooperation with other governments[25][26]. Cloud Computing makes the computing ubiquitous and bring it within the reach of all type of users[23][24]. Cloud Computing based e-Governance would be intelligent enough to help the end users to take strategy planning in absence of human experts.

The elements for the cloud which is useful for implementing the cloud based e-Governance are as follows[4]—

❖ Internet over Cloud: Maximum Internet based services are dependent on cloud. Most probably 70% of the internet users are also using cloud in various applications[4].

- ❖ Distributed Data Centers: Distributed Data Centers provide protection from various types of threats. The e-Governance applications are facilitated by Distributed Data Centers. In this case data is distributed among different centers so single ownership on data is removed. It also provides more security to information related to citizens.

- ❖ DataCenter Operation: Data Center Operations allows to facilitate availability and continuity of services. Cost effective hardware are used for setting of Cloud Computing data centers. For different e-Governance application,the same data center can be shared in various ways. It provides scalability to the e-Governance system and also increases the resource utilization.
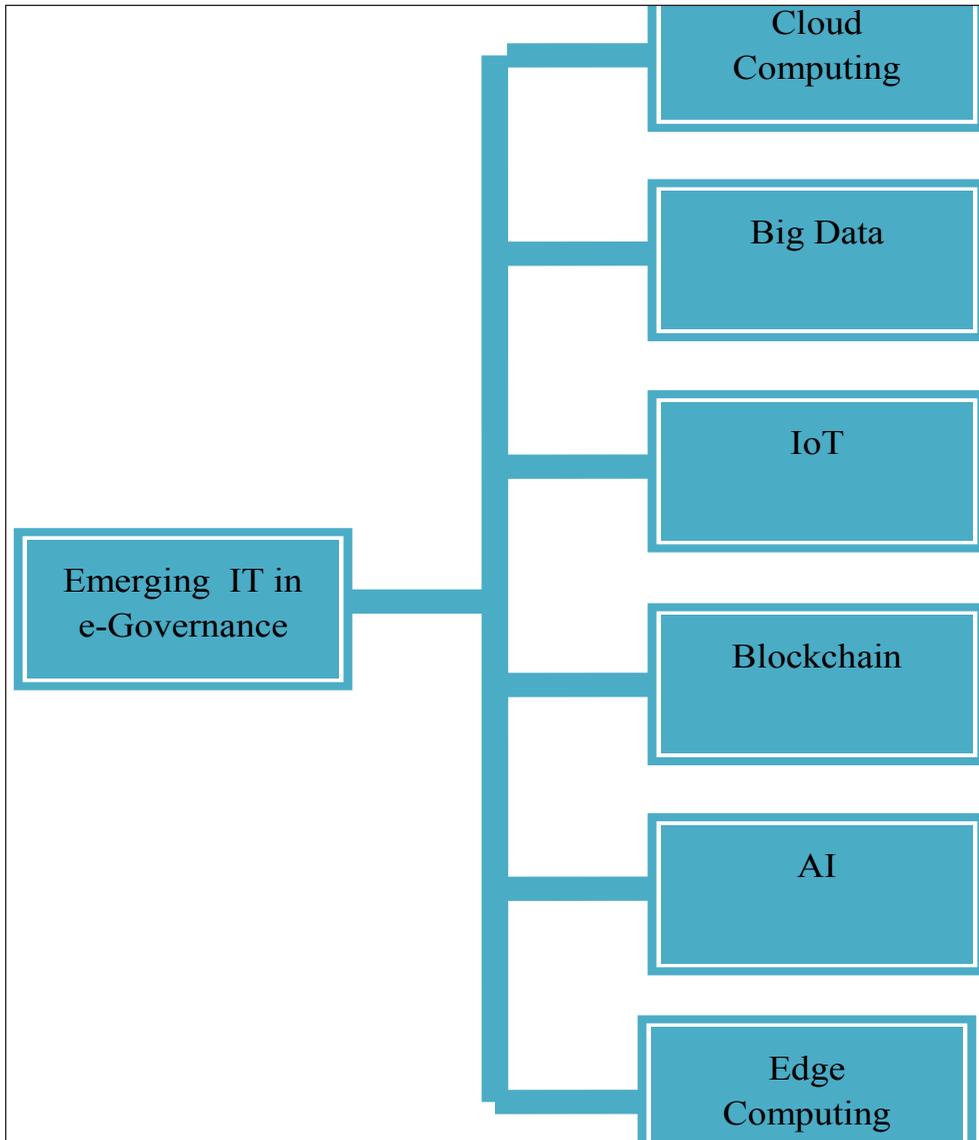

Fig. 2: Emerging IT in e-Governance

Cloud Computing technologies provides many benefits in different parts of e-Governance and these benefits are as follows[4].

❖ Scalability: In Cloud Computing, the IT resources can be increased or decreased as per the changing demand.

❖ Cost Saving: Using of Cloud Computing systems is also cost saving. It does not need to purchase and install the ICT equipment and software.

❖ Unlimited Storage Capacity: Cloud Computing provides unlimited storage capacity.

❖ Backup and Recovery: Because all the data are stored in the cloud, so user can back it up and restoring data and information is more ease.

❖ Availability and Accessibility: By using Cloud Computing, citizens can access the data and information at any time from any place.

❖ Green technology: In case of energy consumption, Cloud Computing is relatively good. It also provides ecosystems through virtual services.

Many countries in the world have launched e-Governance services using Cloud Computing for its various benefits. In India, the Government has embarked upon an ambitious initiative "GI Cloud" which is also called "MeghRaj". It is an Indian Government's initiative to adopt Cloud Computing Technology for e-Governance from December 2013[35]. The aim of Megh Raj in India is to accelerate the e-services in the country. It will be act as a bridge between Indian Government departments and various State Government departments and citizens and business organizations using the Internet and mobile services[35]. In India, Cloud-Based nodes were setup in National Data Centerof National Informatics Centre(NIC).

Cloud Computing Technology is used in e-Gram Panchayat to facilitate internal governments operations. NIVARAN which is a Grievance Portal Launched in India on Rail Cloud. This is a platform which provides solution of service related grievances of serving and former railway employees[36].

Application of Big data in e-Governance

Big data is an important and emerging part of IT(Information Technology). *Big data* is acombination of data that is large in volume. Generally, Big data is a collection of data in so large amount and complexity. *Big data* and its application is rising around the world. Application of Big data are rising in various areas such as e-Governance, Administration, Transportation & Tourism, Education & Training, Healthcare & Medicine etc[1][11][12]. Big data can be three types such as Structured, Unstructured and Semi-Structured[29].

Characteristics of Big data

The Big data have the following the characteristics —

❖ Volume- It is the amount of data and form.

❖ Variety-Variety of data that is text, image, audio, video and other multimedia contents.

❖ Variable-Variable means that the data is changeable.

❖ Veracity-Veracity is the quality and it is important to judge the perfectness and accuracy of the data[30].

❖ Velocity- *Velocity* means that the speed of generation of data. That is how fast the data is generated and also processed to meet the demands[30].
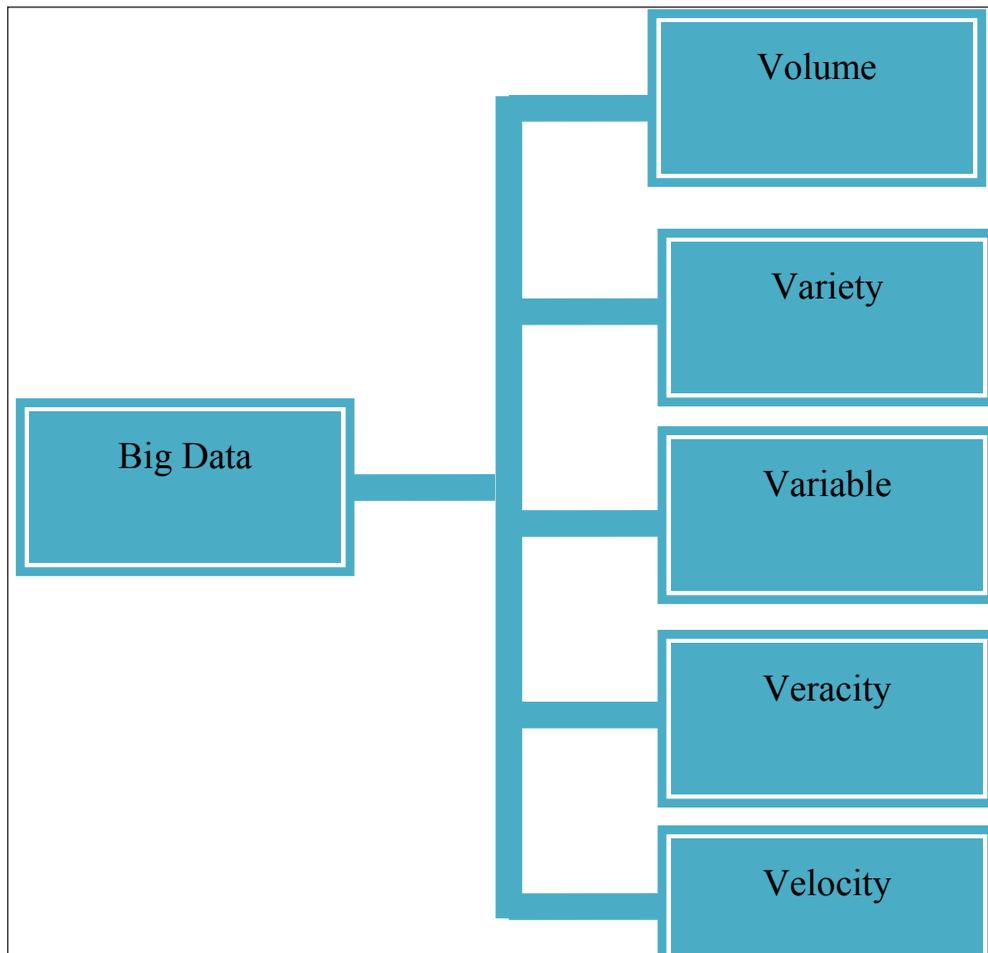
Here Fig. 3 depicts the characteristics of Big data.

Fig. 3: Characteristics of Big data

Some advantages of Big data are improved customer service, better operational efficiency, Better Decision Making etc. For these benefits of using big data, it is used in e-governance field with the concept of megacity, smart city[1]. Big data can be effective used in healthcare organizations ranging from single-physician offices and multi-provider groups to large hospital networks[1]. At the beginning stages of the implementation detecting diseases covered under the potential benefits. Patients can be treated with great effectiveness and management of individuals and health of population and any kind of fraud or any kind of other illegal activity can be found very easily and quickly. By using the analytics of data specific

outcomes or developments could be found or estimated such as patients who may or may not get benefit from surgery and what kind of complications could take place to patients.

Big data analytics can be used in Public Sector also. Government can provide better services with the analytics of the data. Some of the areas where big data can used such as campaign advertising, voter mobilization, policy discussion, donations, and many more other areas[1]. Big data generally playing a major role for the future actions and for providing best of the services.

Big data Analytics can be used for Drug discovery[37]. In order drug discovery it is necessary to analyze diversity of data types in large volumes. For this simple algorithms are required which should be effective, efficient and scalable.

Application of IoT in e-Governance

IoT stands for Internet of Things. Internet of Things is a system of correlated computing devices, mechanical and digital machines, objects, animals or people. IoT has the ability to transfer data over a network without human to human or human to computer interaction[7]. IoT is a model in which elements are connected with various sensors and actuating devices over the Internet[15][17]. IoT allows for collecting, sharing, and analyzing data to enable creative applications. IoT can assist the creation of numerous new services for people, corporations, and governments by allowing interaction with a wide range of things such as household items, CCTV, smartwatches, cellphones, corporate sensors, and automobiles[31]. This framework is used in various disciplines, including transport, electricity and utility, education, medical, equipment, public security, and defense[32][33]. Due to fast digital technology development, smart, innovative governance has been imagined as an evolution of e-governance. It allows to invent ways for the government to achieve better citizen participation, transparency, and connectivity[31].
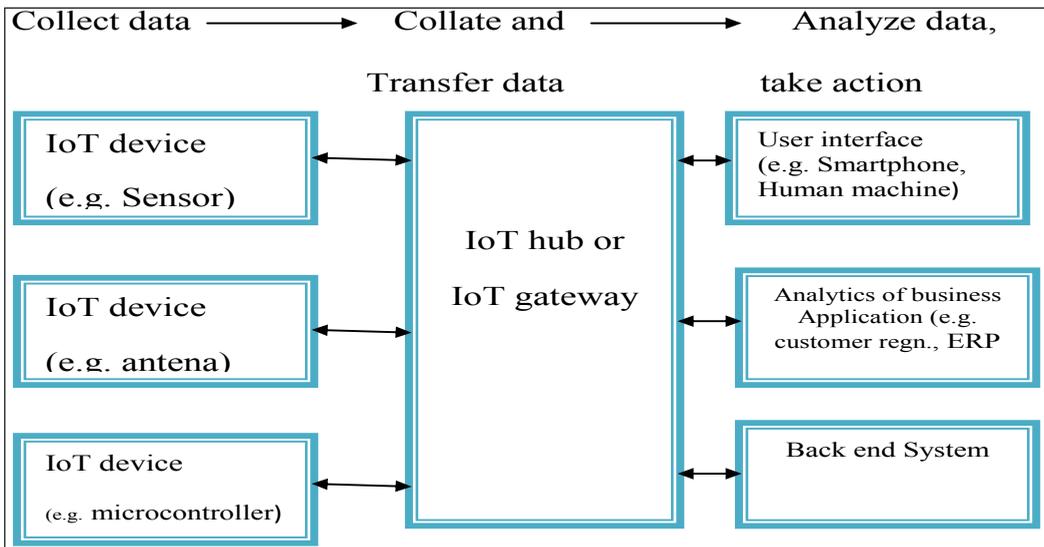
Example of an IoT system

Fig. 4: An example of how an IoT system works from collecting data to taking action[17]

IoT is important for e-Governance. IoT helps people lives and work smarter. IoT also gain control over people's lives. It also offering smart devices to automate homes. IoT also necessary for business[6][14]. It provides businesses with a real-time look into how their systems work, delivering insights into everything from the performance of machines to supply chain and logistics operations.

There are so many real-world applications of the IoT. The IoT applications ranging from consumer IoT to manufacturing IoT and enterprise IoT to industrial IoT. IoT applications are available in e-Governance. In a smart city, IoT sensors and deployments can help to alleviate traffic, conserve energy, monitor and address environmental concerns and improve sanitation.

Towards creating digital world related to health, IoT technology has revolutionized existing medical devices to act smartly. To monitor, identify, track, manage and store patients' information for ongoing healthcare, IoT based e-health systems involve significant technologies and connected things. For the successful deployment of IoT within e-health, a mechanism is required that assures interoperability between devices for processing and use of resources in an efficient manner[38]. Now a days, IoT can dramatically enhance medical research, devices, care, and emergency care.

The IoT applications in environmental monitoring are extensive. This helps the government to act on its protection, commercial farming, extreme weather monitoring, water safety, endangered species protection, etc.

IoT applied to government and safety which allows improved law enforcement, defense, city planning, and economic management of G2G applications[38].

Application of Blockchain Technology in e-Governance

Blockchain Technology is an important Information Technology component. Blockchain Technology is popular internationally and considered as worthy in peer-to-peer decentralized distributed ledger based systems. Blockchain Technology is valuable in digital asset transparencies. Blockchain technology stores and records data like a ledger technology. In Blockchain technology,the distributed list of transactions are constantly updated and reviewed. Blockchain technology is applicable in different areas and sectors such as business and commerce, education and training, health and medical systems, government and administration, entertainment, banking and trade, etc., and this types of applications are increasing gradually[8],[9],[34]. According to various experts, the Blockchain technology can be classified into following three categories such as[13],[22],[28].

- ❖ Public Blockchain,
- ❖ Private Blockchain, and
- ❖ Hybrid Blockchain.

Blockchain Technology has advantages such as—

- ❖ It reduces cost of overall transaction.
- ❖ It improves security and efficiency of transaction.
- ❖ Fraud can be minimized.
- ❖ It reduces systematic risks in transaction.

Applications of Blockchain Technology

Blockchain Technology is important and applicable in various fields such as —

❖ Blockchain Money: Cryptocurrencies provide citizenall over the world instant, secure, and frictionless money. For every cryptocurrency transaction taken place, Blockchains provide the permanent record storage. Since only verified transactions are permitted to be recorded in the blockchain, so the blockchain based cryptocurrencies work well [20].

❖ Blockchain Financial services: Blockchain financial services are redefining the existing current financial markets infrastructure. Blockchain financial services are active from backend clearing and settlement to global capital markets architecture[20].

Blockchain technology can be applied to financial services areas such as —

❖ Smart Securities via Smart Contracts,Loan Origination and Servicing foreign Exchange Markets.

❖ By using Blockchain technology Medical and health data can be shared effectively.

❖ Blockchain technology is being used in Cross-border payments with the real-time IoT operating systems[22].

❖ It is also useful in the personal identity security management and up-gradation.

❖ Blockchain Technology is being used in the Anti-money laundering tracking system too[22].

❖ In case of Voting mechanism, this technology is also effective[22].

❖ This technology is effectively used in Cryptocurrency exchange also.

❖ Therefore, Blockchain technology utilizations are gradually increasing in different fields like Financial Services, Education and Training, Healthcare, Government and Administration, Travel and Hospitality, Retail, etc[22].

Application of AI in e-Governance

AI or Artificial Intelligence is the intelligence demonstrated by machines in which computer systems perform tasks as humans like speech recognition, decision-making, language translation etc. AI has the ability to automate repetitive tasks, make connections, see relationships and make predictions with reasonable levels of accuracy. One requirement of using AI Technologies is to read and learn about various algorithms before applying as there are many options to choose from and being an emerging technology, new options are evolving fast[2]. The e-Governance services require secure means of exchanging confidential information and data. It also aims at securing electronic infrastructure[3]. AI technology can play a significant role in implementing e-Government services effectively.

e-Governance is vital for implementing government services. Using artificial intelligence (AI) and the Internet of Things (IoT), e-Governance services can be developed such that the citizens up to villages levels can get the benefits of e-Governance services easily. Generally, the Internet is the backbone for any e-Governance services. Different efforts are being made all over the world to make e-Government services available to their citizens from Smart cities to village levels. Artificial Intelligence (AI) technology can help in the surveillance and monitoring of the areas such as critical security and safety, controlling

traffic management, environmental pollution, fire detection, e-Health, e-Agriculture, e-Bill payment, e-Education, etc[2].

India's National Artificial Intelligence Strategy is not only focus on economic growth, but also on social inclusion. In India, Niti Aayog, in its National Strategy for Artificial Intelligence, has identified "AI for All". It has indicated five important areas for AI intervention, which are Healthcare, Agriculture, Education, Smart Cities & Infrastructure and Smart Mobility &Transportation[3].

Application of Edge Computing in e-Governance

Edge Computing is a distributed computing paradigm that brings enterprise applications closer to data sources. Data sources may be IoT devices or local edge servers. This adjacency to data at its sources provide some strong benefits such as faster insights, improved response times and better bandwidth availability.

Some edge computing components are as follows—

Edge devices: Edge devices are those which are able to collect and process data locally. IoT devices, point of sales systems, robots, vehicles and sensors are all edge devices if they compute locally and talk to the cloud.

Network edge : Separate edge network is not required in edge computing. Network edge is required in some cases where it too expensive and complex to compute on premises and high responsibility is required[34].

On-premises infrastructure: To manage the local systems and connecting to the network on-premises infrastructure is required and these may be servers, routers, containers, hubs or bridges.

Edge computing decreases latency: More mature technology like 5G makes edge more reliable, efficient and easier to manage. Blockchain and AI technology also make edge more powerful. As an example, while AI acts on the data at the edge, it decreases the need for centralized compute power[31]. Edge also makes Blockchain better as much more reliable data leads to greater trust and less chance of human error.

Edge computing provides benefits in e-Governance such as—

Rapid response: Edge computing provides rapid responses in some cases where the requirements for real-time or extremely rapid results.

High data volume: Edge Computing can process the large volume of data at lower cost.

Privacy: Users prefer to keep control of important data locally rather than sending it to cloud.

Edge computing is used various e-Governance applications. It is also used in transportation, retail, manufacturing, healthcare.

Transportation: Autonomous vehicles produce large amount of data and gathered information about location, speed, road condition, traffic condition and data must be analyzed in real time when the vehicles in motion. In this case each vehicle becomes an edge.

Improved healthcare: Nowadays the healthcare industry has collected large amount of patients data from various devices, sensors and other medical equipment. That large volume of data requires edge computing to apply automation and machine learning process to access the data and ignore the normal

data and identify the problem data so that the clinicians can take immediate action in order to help patients for avoidance of health incidents in real time.

Manufacturing: Edge computing can be deployed in manufacturing organizations to monitor manufacturing , enabling real-time analytics and machine learning at the edge in order to find production errors and for improvement of product quality.

Network optimization: To optimize the network performance edge computing can be used in e-Governance.

CONCLUSION

Digital Governance indicates to carrying out governance process in a digital way to deliver digital services. Digital Governance is also called as electronic governance, internet governance, online governance, transformational governance, and connected governance. e-Governance refers to the use of ICT (Information and Communication Technology) by government or public agencies for public governance. Government services are made available to citizens in a suitable, systematic, and transparent mode by the way of e-Governance. Electronic Governance is the best utilization of ICT. e-Governance is very popular around the world. The various Digital services are now available in our country and citizens are getting it even remote areas also. For implementation of e-Governance, various technologies are required such as database, network etc. and also different emerging IT such as Cloud Computing, Big Data, IoT, Blockchain, AI and Edge Computing. This paper gives description and uses of the emerging IT (Cloud Computing, Big Data, IoT, Blockchain, AI and Edge Computing) in e-Governance. Enhancement of e-governance extend the progress of smart city. So, smart e-governance is valuable aspects of the smart city.

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