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Emergence of Smart City: Challenges and Opportunities

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ABSTRACT

With the progression of time, the world population is expanding. Appropriate usage of resources and different devices in the smart city, is extremely crucial to be able to quickly evaluate, monitor, and regulate the Internet of Things (IoT) resources. As a result, technology and equipment facilitate to make us smarter and more accessible and usable. Creating smart linked systems for our cities has several advantages for residents all over the globe, not only in terms of improving quality of life, but also in terms of ensuring sustainability and the most efficient use of resources. These solutions rely on a coordinated effort by the government, the private sector, and local citizens. Smart cities, on the other hand, may leverage technologies like the Internet of Things to improve the lives of people and develop connected living solutions for the expanding global urban populace with the right support and infrastructure. This chapter discusses the role of smart cities and also highlights its features, Technology used, benefits, limitations and challenges.

Keywords: Smart city, IoT, AI, block chain, ICT, digital city, smart healthcare, smart technology.

INTRODUCTION

Smart cities collect and analyze data using connected sensors, lighting, and meters that are examples of IoT devices. Cities then use this data to improve infrastructure, public utilities, and services, among other things. This ICT architecture includes a connected object network with intelligence and gadgets (also referred to as a "digital city") that sends data through wireless technologies and the cloud. Cloud-based IoT apps collect, analyse, and manage real-time data to help municipalities, organizations,

and individuals improve their quality of life by making better decisions (Thalesgroup). In the smart city, the uses of IoT are used without human association. Different IoT devices are associated for distinct activities and communicate with each other. IoT connects billions of devices, generating massive amounts of data that must be processed, managed, and stored on the cloud. IoT is often characterized as a real object that is widely scattered and has limited storage and processing capabilities, with the goal of improving the performance, reliability, security and their infrastructure (Talari, S). Smart energy, smart buildings, smart citizens, smart transportation, smart healthcare, smart infrastructure, smart technology, smart governance and education, and last but not least, smart security are all areas where smart technology may help. The features of a smart city are shown in Figure 1.1.

Figure 1.1 features of a smart city

• Smart Economy: It helps local firms contend on a universal basis whereas in addition creating high-quality, well-paying jobs.

• Smart People: They are competent personnel to facilitate that utilize of information and technology, values creativity and innovation, and is keen to try new things. They have the assistance of community leaders and mentors, and they meet the demands of today's and tomorrow's employers.

• Smart Governance: It guarantees that the resources available in the city are efficiently utilised to improve living conditions.

• Smart Environment: It aids in the attainment of good growth while preserving resources. It unifies the living and working environments. It maintains a balance between energy supply and consumption.

• Smart Living: It ensures that all residents have access to a healthy way of living healthcare, education, and securities are all important factors to consider.

• Smart Technology: It makes use of cutting-edge wireless technologies like as zigbee, zwave, bluetooth, and LoRaWAN. It aids in the automation of domestic gadgets, among other things.

• Smart Energy: It makes use of a smart grid to offer continuous electricity while also allowing for power/energy conservation.

• Smart Healthcare: To provide better healthcare, it makes use of the most up-to-date amenities for patients, such as remote monitoring.

• Smart Mobility: It makes use of current transportation infrastructure and cutting-edge technology to provide smart mobility solutions for people.

2. LITERATURE REVIEW

The notion of the smart city may be traced back to the 1960s and 1970s, when the Community Analysis Bureau began collecting data, issuing reports, and directing resources to the regions that needed them most in order to combat impending calamities and reduce poverty. There have been three generations of smart cities since then. Technology suppliers were the driving force behind Smart City 1.0. Despite the municipality's incapacity to completely comprehend the technology's potential consequences or the effects it may have on daily life, this generation concentrated on adopting technology in cities. Smart City 2.0, on the other hand, was driven by cities. In the second generation, forward-thinking municipal officials assisted in determining the city's future and how smart technology and other innovations may be used to achieve that goal. In the third generation, Smart City 3.0, neither technology suppliers nor city officials are in charge; instead, a citizen co-creation model is promoted. This most recent modification appears to be motivated by concerns about equality and a desire to build a smart community that is socially inclusive (Ahad,20). Vienna, Austria is one of the first cities to use this third-generation concept. Wien Energy, a local energy provider, has formed a cooperation with the city of Vienna. Vienna included residents as investors in local solar facilities as part of this cooperation. Citizen participation in topics such as gender equality and affordable housing has also been emphasised in Vienna. Vancouver, Canada, followed the Smart City 3.0 approach by including 30,000 residents in the development of the Vancouver Greenest City 2020 Action Plan (Ahad,20)

Another precursor to the smart city is the digital city, a technologically-defined city that uses widespread broadband infrastructure to support e-Governance and “a global environment for public transactions” (Mitchell, 2000) [12].The notion of smart city is established from the combination of the knowledge society and digital city. It is defined as a “multi-layer territorial system of innovation” made up of digital networks, individual intellectual capital, and the social capital of the city, which together constitute collective intelligence (Komninos, 2008) [13].

3. SMART CITY ARCHITECTURE

The Internet of Things consists of three levels including the perception layer, the network layer, and the application layer, as shown in Figure 1.1. The perception layer encompasses a collection of Internet-enabled devices capable of perceiving, detecting, gathering, and exchanging information with other devices over Internet communication networks. Perception layer consists of radio frequency identification devices, cameras, sensors, and global positioning systems . The network layer's job is to data from the perception layer is forwarded to the application layer within the constraints of device capabilities, network limitations, and application constraints. IoT systems make use of a variety of technologies like Bluetooth and ZigBee to send data from perception devices to a nearby gateway based on the communication parties' capabilities. (Huang) 2G, WiFi, 3G, 4G, and Power Line Communication (PLC) are examples of internet technologies Because apps intend to develop smart cities, smart homes, demand-side energy management, power system monitoring, , distributed power storage coordination, and renewable energy generator integration, the information is received and processed at the application layer. As a result, we may develop more effective electricity distribution and management systems.

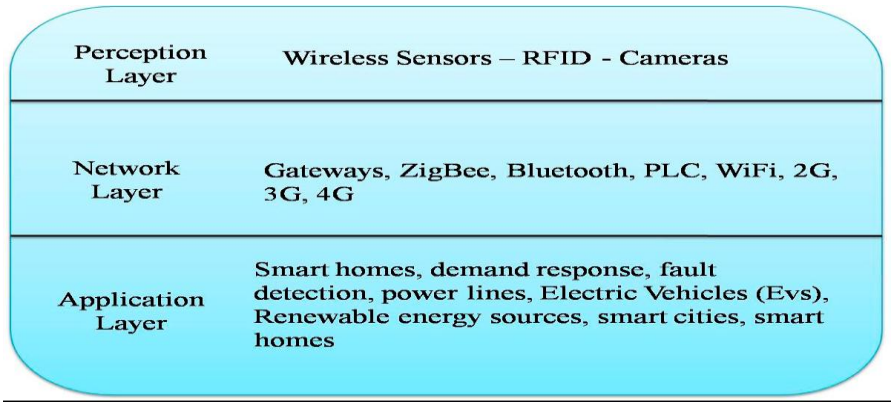

Figure 3.1 IoT layers.

4. Smart City Technologies

Technologies crucial for smart cities are as follows:

4.1 Information and Communication Technology

Figure: 4.1 ICT

For a city to be smart, establishing a two-way communication connection is crucial.. And here is where information and communication technology (ICT) comes in. ICT creates a link between citizens and government. The government can use ICT to study demand patterns.

4.2 Internet of Things

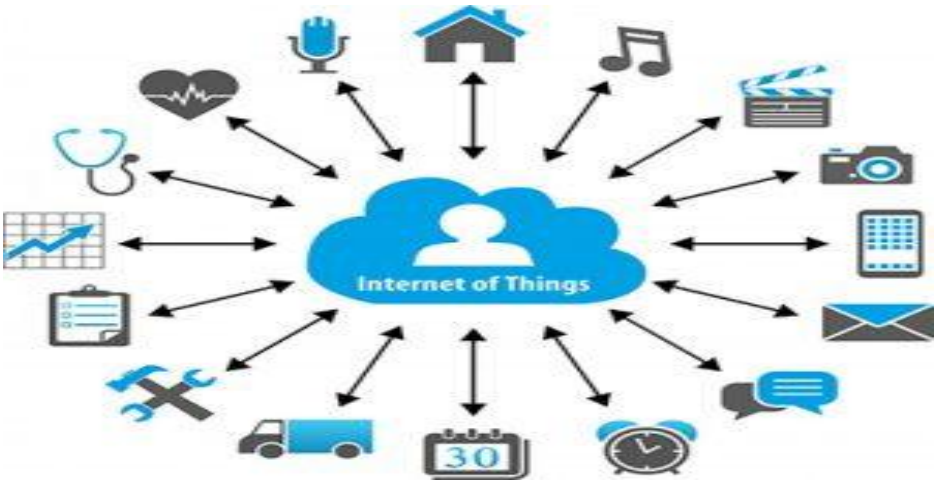

Figure: 4.2 IOT

Every device in a smart city must be coupled to one another so that it can communicate through one another and build decisions for itself, allow for the management of the resources of a megacity.

4.3 Sensors

Figure 4.3 Sensors

Sensors are unnoticed but pervasive in the metropolitan environment. Sensors are an important component of any intelligent control system..

4.4 Geospatial Technology

Figure 4.4 Geospatial Technology

whatsoever is build in a smart city must be right, and in order to build right, a right plan is required, which requires accurate, concise, as well as detailed data. It provides a location that enables for better pinpointing of the need.

4.5 Artificial Intelligence

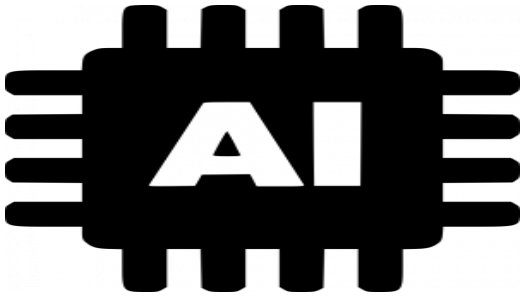

Figure 4.5 AI

AI enables machine-to-machine contact by digesting and making sense of data. AI may be able to figure out where they occur. most frequently and under what circumstances, and this information can be utilized to improve power management.

4.6 Blockchain

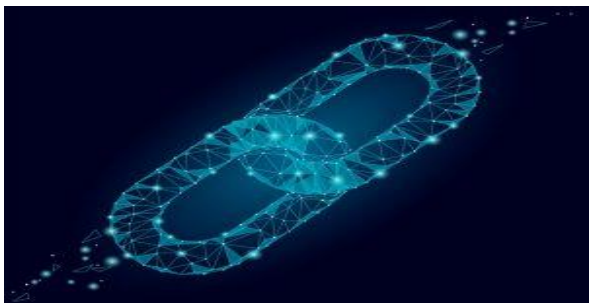

Figure 4.6 Block Chain

The block chain is a relatively latest application to the smart city notion. It is used to protect data transmission. (Syed,21)

5. Characteristics and Limitations of a Smart City

5.1 Characteristics of a Smart City

Dense environment, like that of cities and capitals, requires its subsystems to work as one system with intelligence being infused into each subsystem. Researchers who support this integrated view stress the importance of the organic integration of a city's various subsystems (transportation, energy, education, healthcare, buildings, physical infrastructure, and public safety) into one unified system to create a smart city

Figure 5.1 Characteristics of a Smart City [18]

5.2 Limitations of a Smart City

• Very limited Privacy:

Maintaining anonymity has become increasingly difficult with the emergence of surveillance cameras and sophisticated systems that are networked across multiple places. Face recognition technology, for example, has changed the way we think about personal privacy.

• Social control:

The ability to track and centralize data grants a great deal of power to the person in control of it. Anyone with access to people' data, whether it's a government or a corporation, may influence, control, and intimidate the public.

• Excess network trust:

Cities that rely nearly entirely on technologies and networks lose control over their decision-making and in the event that these tools are unavailable, you may be unable to react or act.

5.3 Smart Cities Mission

The Smart Communities Mission's goal is to promote cities that provide basic infrastructure and provide a fair quality of life for their residents, as well as a clean and sustainable environment and the use of "Smart" solutions. The emphasis is on sustainable and equitable development, with the goal of creating a repeatable model

that will serve as a beacon for other aspiring communities. The government's Smart Cities Mission is a bold new effort. Its purpose is to establish examples that may be repeated both within and outside of the Smart City, thereby catalysing the creation of similar Smart Cities across the country.
As a result, the Smart Cities Mission's goal is to spur economic growth and improve people's quality of life by facilitating local area development and utilising technology, particularly technology that leads to Smart results. Existing areas (retrofit and redevelop), including slums, will be transformed into better planned areas through area-based development, thereby improving the overall liveability of the city. To accommodate the growing population in metropolitan areas, new spaces (greenfield) will be constructed around cities. Smart Solutions will allow communities to improve infrastructure and services by combining technology, information, and data. This type of comprehensive development would improve people's quality of life, create jobs, and raise incomes for everyone, including the poor and disadvantaged, resulting in inclusive cities.

The ability of a city to produce well-being for its residents is described as "smart."

However, it is not just about how citizens benefit from the government's services. Citizen participation is a critical component of a smart city. It is based on the notion that citizens, rather than the city, construct it. This instrument is used by cities to collect data in real time on a variety of topics, such as traffic, air and water quality, and solar radiation. The government can respond quickly with this information to fix almost any situation. Installing sensors in the streets to detect things like empty parking places and traffic congestion, estimating how long it will take the next bus to arrive, and measuring air and water quality are just a few of the most well-known uses of this instrument. Others, such as sensors that detect the quantity of pedestrians, address environmental challenges. When there aren't any people nearby, the sensors can limit the amount of street lights, saving energy.

To make use of this data, governments must first figure out how to arrange it all in a way that is both meaningful and actionable. That's why Bismart invented bigov Better City Indicators, a tool that allows you to monitor and analyse data in graphical form so you can see trends and patterns clearly and fast. Governments aren't the only ones who have access to this kind of data. People may use data to better manage their days thanks to apps like ApparkB, Bicing, and others. Barcelona, for example, built a new intelligent bus network based on information on how passengers really used public transportation. This new network is more efficient, and it provides high-quality bus service to 95 percent of the city's people. Better and more frequent bus service is now available thanks to the upgraded bus network. Bus stations are very well connected to other modes of transportation.

GPS sensors are being used by the city to improve emergency medical services. Ambulances are detected by traffic lights, which adjust their output to allow emergency services to move through the city as rapidly as possible while avoiding dangerous circumstances. Bstia Ciutadana is another app that allows Barcelona people to better their life through technology. They may use the app to report problems such

as malfunctioning stoplights or overflowing trash. As a result, the authorities will be able to dispatch a team to address the issue as quickly as feasible.(Ahad, 20)

5.4 What makes a smart city tick?

Smart cities use a web of linked IoT devices and other technology to fulfil their aims of bettering people's lives and growing their economies. Smart towns that succeed follow a four-step process:

1. Collection - Data is collected in real time by smart sensors placed around the city.

2. Analysis - The information gathered by the smart sensors is analysed in order to derive useful conclusions.

3. Communication - Through robust communication networks, the insights discovered during the analytical process are disseminated to decision makers.

4. Action - Cities utilise data-driven insights to develop solutions, enhance operations and asset management, and improve people' quality of life.

5.5 Why do we require Smart Cities?

A smart city's main objective is to develop an urban environment that provides inhabitants with a high quality of life while simultaneously producing overall economic growth. As a result, one of the most significant advantages of smart cities is their potential to allow improved service delivery to people with less infrastructure and expense. As the population of cities grows, it becomes important for these cities to make better use of existing infrastructure and assets in order to handle the growing population. Smart city apps can help to make these changes, as well as improve city operations and people' quality of life. Cities may use smart city apps to discover and develop new value from their current infrastructure. The enhancements help governments and citizens save money by facilitating new income sources and operational efficiency. (Ahad, 20)

5.6 Are Smart Cities Sustainable?

As smart cities strive to enhance efficiency in urban areas and promote citizen wellbeing, sustainability is an essential consideration. Cities have a number of environmental benefits, such as smaller geographic footprints, but they also have certain drawbacks, such as the usage of fossil fuels to power them. Smart solutions, such as the deployment of an electric transportation system to decrease emissions, might help mitigate these detrimental consequences. While not in use, electric cars may serve to control the frequency of the electric grid. Such sustainable transport options should also see a reduction in the number of cars in urban areas as autonomous vehicles are expected to reduce the need for car ownership amongst the population.

Developing such long-term solutions might have both environmental and socioeconomic advantages.

5.7 Challenges in Smart Cities

Smart cities come with a lot of advantages, but they also come with a lot of problems. These include government officials who allow citizens to participate in large numbers. The private and public sectors must also work together with residents so that everyone may contribute positively to the community. Smart city initiatives must be open to the public and accessible through an open data site or mobile app. This allows individuals to interact with the data and accomplish personal activities such as paying bills, locating efficient transportation alternatives, and evaluating home energy consumption. To avoid hacking or misuse, all of this need a strong and secure data gathering and storage infrastructure. Data from smart cities must also be anonymized to avoid privacy concerns. With hundreds, if not millions, of IoT devices needing to connect and operate together, connectivity is likely to be the most difficult problem. As demand grows, this will allow services to be connected and continual improvements to be made.(samih, 19)

Aside from technology, smart cities must also include social aspects that contribute to a cultural fabric that is appealing to inhabitants and provides a feeling of place. This is especially crucial in cities that are being built from the bottom up and must attract citizens.(Sharon)

CONCLUSION

We offered a survey of several initiatives in the field of smart cities in this chapter. Europe, Paris, New York City, and London are at the forefront of smart city development around the world. In this chapter, we will look at the notion of smart cities, the perception layer, the network layer, and the application layer, as well as smart city technologies, their benefits, limitations and challenges. Creating smart linked systems for our cities has several advantages for residents all over the globe, not only in terms of improving quality of life, but also in terms of ensuring sustainability and the most efficient use of resources. These solutions rely on a coordinated effort by the government, the private sector, and local citizens. Smart cities, on the other hand, may leverage technologies like the Internet of Things to improve the lives of people and develop connected living solutions for the expanding global urban populace with the right support and infrastructure.

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