Journal of Advances and Scholarly Researches in Allied Education
Vol. 18, Issue No. 6, October-2021, ISSN 2230-7540

A Study on Role of Smart Cities in IOT

Puli Sunitha[1]*, Dr. Sunil Gupta[2], Dr. Maram Ashok[3]

[1] Research Scholar, Shridhar University

[2] Research Supervisor, Shridhar University

[3] Research Co-Supervisor, Shridhar University

Abstract - A smart city is a city where data and technology are used to better the lives of its residents. One of the most important factors in the evolution of "smart cities" is the advent of the Internet of Things (IoT). The Internet of Things (IoT) enables cities to better allocate their resources, save expenses, and enhance the quality of services they provide to their residents by providing a centralized hub for collecting, analyzing, and acting on data. The Internet of Things allows for the collection of data from a wide variety of sources, the real-time monitoring of infrastructure and services, the use of predictive analytics to foresee potential problems, and the improvement of citizen services through the provision of timely information and feedback. The Internet of Things is essential to the growth of smart cities because it improves the effectiveness of municipal services and infrastructure while also raising the standard of living for the local populace.

Keywords - Smart Cities, Internet of Things, Technology

- X -

1. INTRODUCTION

The Internet of Things (IoT) has brought about profound changes in the way we interact with both our devices and the physical environment. The Internet of Things (IoT) is the network that connects all of our common electronic gadgets so they can communicate with each other and with us. The Internet of Things (IoT) has limitless potential, from boosting productivity in manufacturing to bettering healthcare via remote monitoring and diagnosis.[1]

The notion of "smart cities" has recently gained attention as a possible Internet of Things (IoT) use case. A "smart city" employs Internet of Things (IoT) technology to improve municipal infrastructure, public services, and residents' standard of living. By networking sensors and other devices across the city, we can gather information that can be utilized to enhance urban planning, transit, public safety, and environmental sustainability.

Smart cities play a crucial part in the Internet of Things since they may help to make cities more eco-friendly and productive. Smart cities can optimize energy usage, minimize traffic congestion, increase public safety, and boost healthcare services because of the interconnectedness of their gadgets and systems. Furthermore, smart cities may provide municipal authorities access to real-time data and insights, letting them make better choices for the city and its residents.[2]

The city may be seen as a service provider to its residents, similar to a business that caters to locals. To improve our ability to predict and manage urban streams, as well as coordinate the measures of the physical, advanced, and institutional spaces of a provincial agglomeration, there is a need for urban communities that are more bright, viable, productive, and practical.

The focus of urban development and transformation has shifted to novel approaches. Intelligent cities make use of a variety of data and communication innovations. Brilliant foundation, clever operation, keen administration, shrewd industry, brilliant training frameworks, or brilliant security frameworks are all components that are inevitably included in any such plan. A "keen city" is a metropolis where the physical, institutional, and digital environments are all precisely measured and coordinated. The approach's primary purpose is to help readers understand the relatively natural growth, maintenance, and progress of urban areas by presenting viewpoints including connectivity, input, self-association, and adjustment.[3]

2. THE INTERNET OF THINGS

The term "Internet of Things" (IoT) is used to describe a network in which everyday items are equipped with sensors, processors, software, and other technologies that allow them to communicate and share data with other devices and systems. The term "Internet of Things" has been criticized as misleading since IoT devices need simply communicate over a private network and have unique identifiers to function.

Converging technologies like mobile computing, cheap sensors, more advanced embedded systems, and machine learning have pushed the sector forward. Embedded systems, wireless sensor networks, control systems, and automation (including home and building automation) are all well-established areas that, individually and combined, make possible the Internet of things. In the consumer market, Internet of Things (IoT) technology is most commonly associated with "smart home" products, which include electronics and appliances (such as light bulbs, thermostats, home security systems, cameras, and other home appliances) that are compatible with one or more common ecosystems and can be managed by other devices within those ecosystems, such as smartphones and smart speakers. Medical infrastructures also benefit from the Internet of Things.[4]

Industry and government have begun taking steps to address the risks associated with the expansion of Internet of Things (IoT) technologies and products, particularly in the areas of privacy and security. These steps include the creation of international and regional standards, guidelines, and regulatory frameworks.

2.1 Definition

"The Internet of Things (IoT) is a key component of the Future Internet; it is best described as a dynamic global system framework with self-designing capacities based on standard and interoperable correspondence conventions; in this framework, both real-world and digital "things" have personalities, physical properties, and digital identifiers; they communicate with one another via intuitive user interfaces; and they are perfectly integrated into a unified data structure. In the Internet of Things, "things" are expected to become significantly active members in business, data, and social processes where they are empowered to communicate with each other and the earth by exchanging information and data "detected" about the earth, while also responding autonomously to events in the "real/physical world" by executing procedures that trigger actions and provide services with or without coordinated human intercession. Administrations in the form of interfaces promote working together with these "smart objects" through the Internet to inquire about or alter their current status or any data associated with them while also taking security concerns into mind."[5]

2.2 Characteristics of IOT

These are some of the defining features of the IoT: Interconnectivity: Anything, in the context of the Internet of Things, may be connected to the worldwide network of computers and other electronic devices:

i. Things-related services

The IoT may provide services relating to things, such as safeguarding personal information and ensuring semantic parity between physical and digital representations of the same object, within the bounds of what those things can do. Technology in the real and virtual worlds will advance in tandem to meet the demand for services associated with objects, within the constraints of those things.

ii. Heterogeneity

Since they are built on several hardware platforms and networks, IoT devices are said to be heterogeneous. These devices and service platforms may interact with one another through several networks. Contextual factors, such as a device's current position and velocity, as well as the device's active status (e.g., sleeping, waking up, connected, disconnected) all contribute to this dynamic variety. And the total number of gadgets might change.[6]

iii. Enormous scale

There will be orders of magnitude more devices than are now connected to the Internet that will need to be managed and communicate with one another. More emphasis must be placed on the need for data management and interpretation for practical use. This relates to the semantics of data and the effective processing of data.

iv. Safety

Although the benefits of the Internet of Things are undeniable, we cannot afford to disregard the need for security. As creators and consumers of IoT, we need to take precautions to ensure everyone's safety. The protection of our bodies and private data are both guaranteed. A scalable security paradigm is required for protecting endpoints, networks, and data in transit.

v. Connectivity

With connection, networks may be made accessible and compatible with one another. Connectivity to a network is what we mean by "accessibility," while "compatibility" refers to the ability to use and consistently generate data.[7]

3. THE SMART CITY

The three main dimensions of a city are as follows:

- Technologies applied in the city
- Citizens and other people living in the city.
- Communities running in the city.

Depending on how well these three components work together, a city may be labeled as a digital city, an omnipresent city, a creative city, a smart community city, and so on. A "smart city" puts in a lot of effort in all three dimensions and succeeds as a result. Governments across the world are very concerned about human reproduction. To meet the needs of its population, governments must deal with the challenge of keeping supply and demand in balance while keeping prices low. In addition, it should be resourceful without wasting any of them, and kind to the environment. Priorities include upholding safety standards and finding more manageable solutions to the increased traffic congestion on the roads. Plans for improving the quality of life in cities often include implementing various ICTs. The use of ICT raises the bar for municipal services everywhere. aids in saving money by reducing waste, and improving communication between the government and the public. The concept of "smart cities" emerged as a result of the integration of ICT into urban development plans; in these communities, infrastructure such as public buildings, utilities, transportation, and public safety systems are managed by cutting-edge technological tools. The city would monitor and maintain the necessary level of affordability on a large scale. Every home in a smart city would be integrated with the city's automated infrastructure. Every member of the household may use a sensor or detector to activate a wide variety of devices in a home automation system. They operate wirelessly and are hosted locally on a single server, which can be accessed from an Android device or a regular PC.[8]

4. APPLICATIONS OF IOT IN SMART CITIES

Air pollution, water shortages, trash mounds, and traffic congestion are just some of the issues that develop when city populations become too large. In what ways may we address these concerns and how soon might we expect to see results? Finextra suggests the following uses for the Internet of Things and other forms of smart technology in the context of smart cities:

i. Smart Infrastructure

To guarantee that cities have the conditions for long-term growth, digital technology is increasingly being used in the design of buildings and urban infrastructure. To lessen their carbon footprint, municipalities should purchase electric cars and autonomous vehicles. To build a sustainable and environmentally friendly infrastructure, high-end technology are essential. For example smart lights only turn on when someone walks by, saving energy; these lights also let you choose the amount of light they emit and keep tabs on how often they're used.[9]

ii. Air Quality Management

In addition, technology is being developed to monitor pollution in real time and estimate emissions in smart cities. Having an accurate forecast of pollution levels allows towns to investigate the sources of their emissions issues and develop plans to cut down on their pollution.

iii. Traffic Management

It is one of the most challenging issues that large cities confront to find ways to improve traffic. The search for a solution is not hopeless, however. Intelligent transportation was applied in Los Angeles, one of the world's most populated cities, to improve traffic management. A central traffic control platform receives data from sensors embedded in the pavement, analyses the information, and makes instantaneous adjustments to the timing of traffic signals. All of these algorithms are based on past data, therefore no human intervention is required.

iv. Smart Parking

These days, cities are now installing high-tech parking systems that can track when a vehicle has been moved from its designated space. A driver may find open parking places with the help of sensors in the ground that send that information to their smartphone. Some individuals utilize data from vehicles waiting in line to determine the most direct route to openings. Since that smart parking currently exists and does not need a complex infrastructure or a large investment, it is well suited for a medium-sized smart city project.[10]

v. Smart Waste Management

Trash management systems have the potential to remedy the environmental and financial issues caused by inefficient garbage collection and disposal. With such setups, a smartphone-based management platform is connected to the truck driver's garbage can and alerts them through push notification when a certain level is reached. The message empties what seems to be a full container, therefore warning the reader to avoid drains that are only half full.

5. INTERNET OF THINGS AND SMART CITY CONSTRUCTION CHALLENGES

Expanding smart city capabilities are made possible by developments in information and communication technology and methods of exchanging data. Its rapid growth, enabled by the Internet of Things, is changing the definition of "smart city" construction (IoT). [11]

i. Massive urban spatial-temporal data management, integration, and release

Digital urban information systems' current outputs are too static and unsophisticated, often taking the form of answers to basic queries and missing data analysis from several sources throughout the time that might improve urban management decision-making. Current urban information systems still can't represent time-dependent data well. The data structure and organization of temporal data from different sources cannot meet the particular needs of digital real-time updates, historical reconstruction, and future prediction. Hence, integrating multi-source heterogeneous urban data is crucial to the development of a modern smart city. In addition, the ability to rapidly update and visualize multi-dimensional geographical and temporal data is required for the management of urban infrastructure and its constituent parts.

ii. Internet of things and heterogeneous sensor data model

Improved sensor and cloud technologies, more processing and storage capacity, and decreased sensor production costs have all contributed to a rise in sensor deployments in recent years. In contrast to smart cities, which were spurred by user and application needs, the IoT emerged as a result of technical progress. The ability to connect at any time, from any location, through any path/network, and with any service, is a typical and widely cited description of the Internet of Things. Even though they're two distinct technologies, IoT and SC are moving in the same direction. Creating models expressing sensor information in terms of position attributes, visible objects, time, and status is difficult due to the wide variety of sensor platforms, observation methodologies, sensor processes, location information, and technical constraints.[12]

iii. Large-scale space-time information management

Information about a smart city's physical layout is generated by a wide variety of sensors, controllers, and computing terminals, and then stored in files and databases throughout the city's many administrative offices and facilities. As a result of their broad distribution and unique designs, managing and coordinating these devices is a complex task. As well as structured data like temperature readings and locations, smart cities generate a great deal of unstructured data, such as images, sounds, and videos. Keeping track of massive amounts of data in a variety of formats is a Herculean task. When it comes to public affairs, decision support, real-time tasks, and responding to user demands, "smart cities" are the ones who should be in control.

iv. Legal protection and information sharing

As Washburn puts it, "the application of Smart Computing technologies to make the main infrastructure components and services of a city more intelligent, interconnected, and efficient" is one description of a smart city. We must remove all possible roadblocks if we are to achieve efficient and effective information interchange across different municipal departments such as traffic, public security, media, utilities, and weather. Furthermore, there is a need to study the practices of industrialized countries to understand how to form alliances to share geographical information. It is also essential that all city departments have access to and share the same policies, procedures, and legal safeguards.

v. Los Angeles as an example of a Smart City

There has been a dramatic growth in the urban population of many countries, and this has prompted a serious debate about how to best enhance the lives of their residents. Some of them have launched "smart city" initiatives to provide their residents with cutting-edge amenities. The revitalization of energy infrastructure, public parks, traffic management, public transit, healthcare, and educational institutions at all levels are all included in this endeavor. There is no magic bullet that can guarantee a smart city's future prosperity. Here, we use Los Angeles as an example to highlight the progress that has been done in cities all around the world. The city government of Los Angeles is quite innovative when it comes to using new technologies. Since 2013, Los Angeles' digital city ranking has risen from the middle of the pack to first. The new mayor, Eric Garcetti, issued an Executive Directive on Open Data which mandated that the city provide raw data to the public in easily accessible formats, leverage public information as a civic asset, promote innovation from entrepreneurs and businesses, and require each city department to implement open data.

6. INTERNET OF THINGS FOR SMART CITIES MODEL

The internet of things (IoT) is the technology that has made extensive digitization possible, which in turn has given birth to the notion of smart cities. The phrase "internet of things" describes the widespread use of internet-connected devices that can send and receive information, store data in the cloud, and follow predetermined instructions. As part of the IoT, data is collected and analyzed to provide insight that may be used to improve policy and decision-making. By 2025, it is anticipated that more than 75 billion devices will be connected to the internet, driving increased demand for new applications. IoT sensors monitor city conditions and report them to a centralized cloud, where they may be mined or processed to conclude.[13]

6.1 Iot Architectures for Smart cities

Cloud services are used in the Internet of Things to coordinate the gathering, processing, and storing of data. The five layers that make up a typical IoT architecture all need access to data from the levels below it to function properly. It also illustrates the three distinct ideas behind IoT systems.

In the Sensing layer, also called the Perception layer, sensors like RFID readers for reading RFID tags and other similar devices are used to gather data on various applications, physical quantities, and physical items. By the use of wireless network technologies like Wi-Fi, cellular internet, Zigbee, and Bluetooth, the sensing layer's data may be sent to the Middleware layer and processed there. The Middleware layer offers several application programming interfaces (APIs) and database management services that may be used to process sensor data and deliver services to end users. The business layer interfaces with the application layer to establish guidelines and make strategies for system management as a whole.

i. Cloud Computing Model

Based on the idea that all data processing should occur in the cloud, this architecture was first proposed as the best way to construct Internet of Things systems. With cloud computing, you can use the internet to get to a pool of shared resources whenever you choose. It should be able to allocate these assets automatically, schedule or pool them based on demand, and share them across many environments. Hardware and software services for smart city applications are both available in the cloud. Data collected by Internet of Things systems may be analyzed and orders sent in response. Smart cities can make the most of the data collected by sensors since cloud systems can do complex tasks like data mining, pattern extraction, and conclusions from that data. There are dangers associated with using cloud computing for IoT. There is a considerable increase in network traffic when all data is transferred to the cloud, which may or may not be true for some applications but may increase network costs in other scenarios. Because of the vast amounts of data produced by the many sensors in the smart city scenario, data transmission prices may climb. Among cloud computing's downsides is the potential for data to arrive late.

ii. Fog Computing Model

Fog Computing was created to remedy the inadequacies of the IoT's cloud computing approach since most IoT data is created at the edge of the system. By offloading some processing to local devices in addition to the cloud, fog computing enables a more balanced distribution of workloads. Routers and other network equipment often perform "fog computing," or data processing on the network layer of the IoT. Due to their improved computing capability, network devices may now be used to do data modification. It may be possible to reduce the amount of data that is sent to the higher cloud layer by using techniques like sensor data collection, aggregation, and simple processing and decision-making. For instance, does the option call for averaging one quantity while using instantaneous data for another? The possibility of extrapolating data from one quantity and using its current measured value for another is at issue. To improve cloud resource utilization, it is feasible to give top tiers decision options rather than just data.[14]

iii. Edge Computing Model

The idea behind "fog computing" was to decentralize part of the network's decision-making to its periphery. In recent years, more competent devices that are coupled to 'edge' nodes have been created, which will allow for more scattered decision-making by decreasing the cost of the network and fog devices. The term "edge computing" describes the data processing done by sensors and other Internet of Things devices at the "thing" level. Edge computing, in this and other approaches outlined, is not seen as edge nodes but rather as an intermediary layer between the fog and the "things" (sensors). By acting as aggregation and decision-making units on a smaller scale than fog devices, which provide reliable connections and data over the IoT network, edge computing nodes are a key component of the IoT infrastructure. Both the Fog and Edge computing paradigms aim to decentralize the IoT system to reduce overhead costs, increase scalability, and strengthen the system's resistance to outages.

7. CONCLUSION

This study's objectives are to get a deeper comprehension of the role that "smart cities" play in the Internet of Things and to investigate the merits and drawbacks of the new paradigm that they represent. To construct smart cities, a variety of possible instruments, including sensors, wireless networks, the cloud, and big data analytics, will be investigated. In the end, the findings of this study will provide light on the possibilities for smart cities and the Internet of Things to enhance urban sustainability and quality of life in the future.

8. REFERENCES

1. Aggarwal, C, Ashish, N & Sheth, A (2016) The internet of things: A survey from the data-centric perspective", Managing and mining sensor data, Springer.
2. Evans, D (2017) The internet of things: how the next evolution of the internet is changing everything, White paper", Cisco internet business solutions group (IBSG), pp. 1-11.
3. Attia, I J & Ashour, H (2018) Energy saving through smart home", The online journal on power and energy engineering, vol. 2, no. 3, pp. 223-227.
4. Garcia, JLG, Venegas, GA & Cielos, PR (2015) An accelerated-time simulation for traffic flow in a smart city", Journal of computational and applied mathematics, vol. 27, pp. 557-563.
5. Bejczy, AK (2019) Sensors, controls and man-machine interface for advanced teleoperation", Science procedia, vol. 208, pp. 1327-1335.
6. Atzori, L, Iera, A & Morabito, G (2015) The internet of things: A survey", Computer Networks, vol. 54, no. 15, pp. 2787-2805.
7. Baig, F, Mahmood, A, Javid, N, Razzaq, S, Khan, N & Saleem, Z (2015) Smart home energy management system for monitoring and scheduling of home appliances using ZigBee", Journal of basic and applied scientific research, vol.3, no. 5, pp. 880-891.
8. Fischer, EA (2015) The internet of things: frequently asked questions, CRS Report prepared for members and committees of congress", Congressional Research Service, 7-5700, pp. 1-27.
9. Bandyopadhyay, D & Sen, J (2016) Internet of things Applications and challenges in

technology and standardization", Wireless personal communications, pp. 1-24.

10. Belim, N, Bhambure, H, Kumbhar, P & Tuteja, S (2018) Automate and Secure Your Home Using Zigbee Technology", International Journal of Innovative Research in Computer and Communication Engineering, vol. 1, no. 1, pp.63-66.
11. Ferrell, WR & Sheridan, TB (2017) Supervisory control of remote manipulation", IEEE spectrum, vol. 4, pp. 81-88.
12. Banzhaf, E & Hofer, R (2018) Monitoring urban structure types as spatial indicators with CIR aerial photographs for a more effective urban environmental management, IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, vol. 1, no. 2, pp. 129-138.
13. Gayathri, M & Hairsh, I (2016) Efficient power management in home using wireless sensor network", International journal of advanced research in electronics and communication engineering, vol. 3, no. 12, pp. 1766-1771
14. Hader, MA & Rodzi, A (2019) The smart city infrastructure development and monitoring", Theoretical and empirical researches in urban management, vol. 2, no. 11, pp. 87-94.

Corresponding Author

Puli Sunitha*

Research Scholar, Shridhar University