APPLICATIONS OF IOT IN SMART CITY-A NEW PERSPECTIVE

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ABSTRACT

The IoT (Internet of Things) is a leading path to smart cities with ubiquitous computing and networking. It is used to interconnecting any kind of device using sensors. As the number of urbanization develops, the smart cities have new opportunities and challenges also grow. The IoT supports smart cities by providing communication technologies to prevent environmental degradation, traffic congestion, urban crime, freshwater scarcity, a pile of garbage, and air pollution. This paper describes the importance of IoT technologies in smart cities and their applications for the roadmap of a smart city. The intent is to utilize the most advanced information and communication technologies to support services for the administration of the city.

Keywords : Internet of Things (IoT), Smart City, Technology, urbanization, sensors, energy management.

Introduction

IoT

The Internet of Things is an emerging trend in terms of technical, social, and economic significance in today's world. With the help of computing and communication technology, daily things like goods, utility components, sensors, customer products are enhanced by connecting them with internet connectivity and data analytic capabilities to transform the way people live.

The devices could be connected according to the geographic locations and could be analyzed the system is one of the features of IoT [9].

All objects are connected to the internet via components like routers, bridges, hubs to transfer data between objects. In IoT, objects can be controlled remotely in existing network infrastructure which reduces human effort.

It provides autonomous manage devices without the help of the human interface.
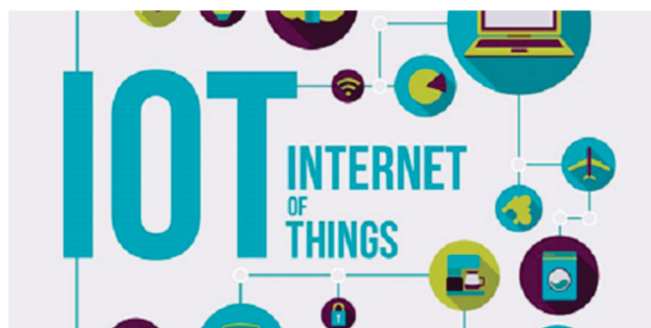
Source: [17]

Methodology :

This research paper is qualitative in nature and data collection is based on secondary sources that include journal articles, newspaper articles, business reports, websites, and other published sources.

Smart Cities

A city has given designations as a smart city that incorporates information technologies to progress the quality and performance of city services such as energy, transportation and infrastructure, and utilities to reduce resource consumption, wastage and overall costs. A city that reads continuously reads data through various

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sensors and analyzes it to predict the changes in its behavior according to change in data patterns. Smart cities operate on a mechanism that takes the information and processing our current needs while varying the enduring smart and physical resources. Input for smart cities will be in terms of sensors.

Review of Literature

Smart cities use information and telecommunication technology to enhance the life of their citizens by application of two principal objectives. First, by developing advanced infrastructure by the application of emerging technologies that include smart buildings, smart meters, big data, and connecting objects. Second by developing smart applications to reduce carbon dioxide levels and pollution to improve the quality of life. It is estimated 50 billion objects will be connected to each other by 2020 and has a potential risk of security and privacy (Hammi, Khatoun, Zeadally, Fayad, & Khoukhi, 2015). The concept of smart cities is gaining its popularity in international policies and scientific literature by an abundance of IT innovations makes the city smarter. The Government and many private sectors have deployed several Information and communication technologies for a solution to the challenges like energy, waste management, Education and many more. (H, 2019)

The IoT technology used for smart cities plays a vital role and acts as a driver of technology. It uses existing city infrastructure and transforms it into a smart infrastructure. Also, the application of IoT innovates new smart services in collaboration with emerging technologies like cloud computing, artificial intelligence, and big data. (Mijac, Androcec, & Picek, 2017). The success of smart cities depends on smart citizen participation in drawing out various schemes of products and services that are financially sustainable and respond to the challenges, in coordination with the Government agencies. (Gonsalves & Dr., 2019). The people with positivity in their mindset and understand the emerging technology will take advantage of the smart city using IoT solutions. According to Technology Adoption Model, easy to use and usefulness is based on one's perception in deciding parameters to adopt a technology. Millions of money are investing by many private companies and Government companies to set up the infrastructure using IoT. (Sarin, Gaurav, 2016).

Need for the smart city

In today's world almost half of the population lives in urban areas and it is expected to increase this ratio to near about 70% by 2050. With the growing population, urbanization will put in another two billion people to cities over the coming next two decades. To keep the tempo of rapid expansion of cities' resources we need Social, Environmental and economic sustainability.

Role of IoT in smart cities and its components

Internet of Things and connecting technologies play vital roles in remodeling cities into smart cities. It helps to enhance the performance, quality and interactivity of urban services, optimizes the use of resources and reduction in cost. As The IoT used to communicate and interact with each other in devices over the network, it offers opportunities for smart cities to use information and data to make better use of infrastructure, less pollution, waste management, manage traffic and many more to make the life ease and keep us safe.

1.   Road Traffic

Citizens in smart cities can travel safely and securely with minimum traffic, to ensure this we use IoT, to develop and implement smart traffic solutions.

The Cities With The Worst Traffic Congestion
Cities with the highest average traffic congestion levels in 2019*

City	Country	%
Bengaluru	India	71%
Manila	Philippines	71%
Bogota	Colombia	68%
Mumbai	India	65%
Pune	India	59%
Moscow	Russia	59%
Lima	Peru	57%
New Delhi	India	56%
Istanbul	Turkey	55%
Jakarta	Indonesia	53%

Source: [13]

The above diagram shows the worst traffic congestion levels in urban cities. The traffic makes the most patient anxious, and also it has a significant drag on

the economy of the country. IoT finds a solution to road traffic as smart traffic solutions.

The smart road traffic solution uses many different types of sensors. It also fetches GPS data used by people who are traveling using smartphones to find out the location and speed of the vehicles. The smart traffic lights which are connected to the cloud platform monitor timings of red and green lights and alter automatically based on the traffic situation to control congestion. In addition to smart traffic lights, traffic management also

foresees in which places the traffic is more to prevent traffic congestion.

For Example in New York City, they have Department of Transportation's Midtown in Motion, it is a congestion management system that has better travel times on the avenues in Midtown by almost 15%. Secondly, Los Angeles is one of the majority of traffic-affected cities in the world, they have implemented a smart road traffic solution to organize traffic flow.

2. Waste management
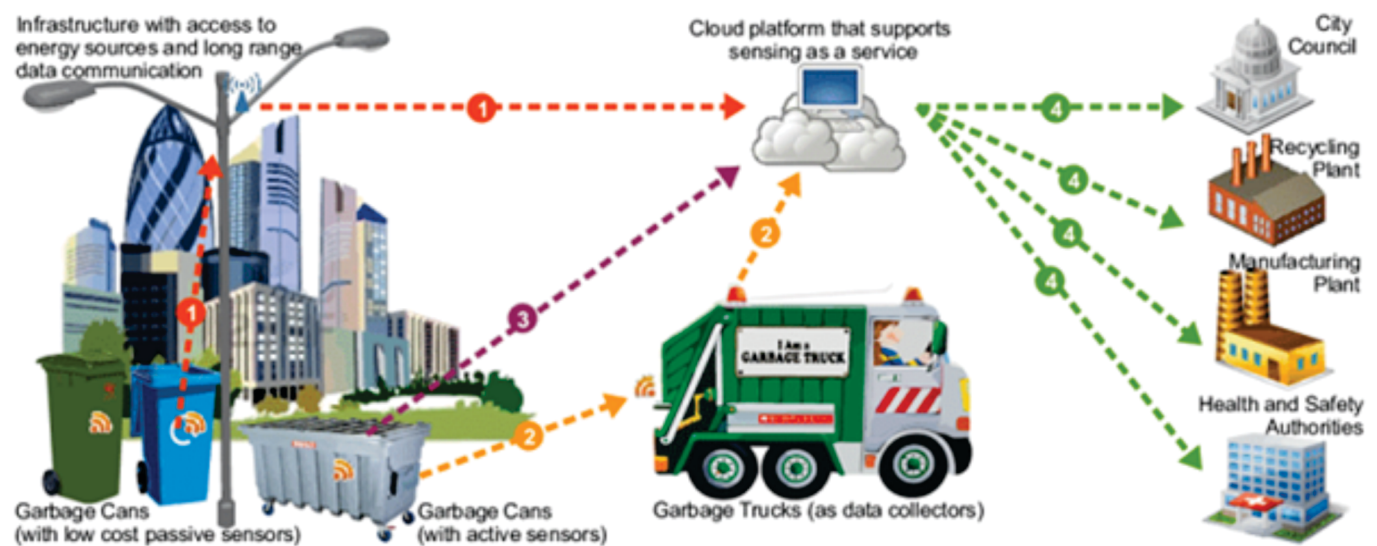
Source: [5]

IoT-based application for waste management is effectively improving waste management operations. The old method of waste collection by emptying containers according to predefined schedules is very inefficient since it leads to high fuel consumption of waste collecting trucks and better addresses the environmental issues related to inefficient waste collection. This outdated method is replaced by sensor-enabled waste bins and IoT based waste management applications.

The IoT based application can send and receive data in real-time with connected devices. The dustbins used for waste collection have sensor-enabled technology connected to the Internet as shown in the above diagram. These smart garbage bins are supervised, monitored with each waste dumping. With each waste

dumping into the smart dustbins, these bins scan the code and send the data to the waste collector immediately. This sensor also gathers the data about the level of the waste in the smart bins. If it reaches a certain threshold, the waste management solution receives the data process and sends the notification to the application [11]. Through the mobile app, the truck driver gets the notification. After getting notification, the truck driver empties the container.

3. Smart Lighting :

Nowadays, lighting has become smart and responsive, but when used with the IoT it could have greater functionalities. It can be used to accomplish different types of lighting effects, from dimming the lights and color-changing lights depending on the occupancy. Embedded Sensors are used to collect and

transmit which is connected to the cloud and that it helps the authorities to ensure maximum illumination and demand-based in different zones by saving energy. It also helps in daylight harvesting and saves energy by dimming out sectors with no occupancies. For example, In Mall/Apartment parking space the lights can be dimmed during day time and when a car or a person enters, the smart lights will be detected and a particular space or sector can be illuminated and others can be kept dim or set off.

Source: [11]

4. Environment

The IoT based solutions also used to keep track of parameters by using IoT sensors, which are critical for a healthy environment and maintains them at an optimal level. To screen water quality, the authorities in the city can have a network of sensors across the water grid and connect them to a cloud management platform. The Sensors are used to measure the pH level of water, the ions, and dissolved oxygen. If leakage occurs and the chemical composition of water changes, the cloud platform triggers an output defined by the users and it alerts the maintenance team to take some action.

Monitoring air quality - IoT sensors are deployed on busy roads and around plants in the city. The sensors collect data percentage of CO, nitrogen, and sulfur oxides, and it sends it to clouds. While the cloud platform analyses the data so that users can view the quality of air and can visualize this data and identifies the areas where air pollution is critical and to work upon it.

5. Smart Energy Management

Smart Grid : Smart grid contains energy measures like renewable energy resources, smart meters, smart appliances and a variety of operations. The main aspects of smart grids are the control of production and distribution systems and electronic power conditioning. Electricity or gas from generation resources is delivered by a smart grid which is self-heating energy systems, digitally monitored. to achieve energy conservation at the consumer level and transmission level IoT solutions like gateway can be useful. Gateway provides a comprehensive view of energy distribution patterns to service providers with real-time analytics and good connectivity. To enhance energy distribution it provides a Demand Response system.

Smart Meters : Smart meter is the upcoming intelligent creation over electricity meter and gas. It contains an in-home display screen which displays how much energy you have consumed in currency. In the near future, estimated bills could be over. it can be used in commercial and residential sectors for gas and electricity meters which needs to identify accurate data on energy consumption. With the help integration of mobile applications with smart meter reports, public dashboards, and energy analytics.

6. Smart Water Management :

With the help of connected devices and IoT enables smart water management as follows

- **Potable Water Monitoring :** It monitors the quality of tap water in the city area.
- **Chemical Leakage :** It finds wasters of factories in rivers and leakages.
- **Swimming Pool Remote Measurement :** It controls water conditions in the swimming pool remotely.
- **Pollution Levels in the Sea** : It controls the wastes in the sea and the occurrence of leakages.
- **Water Outflows :** It identifies pressure variations along pipes and liquid presence outside tanks.
- **River Floods** : It monitors water level variations in rivers and dams.

Conclusion

IoT provides the solution to almost all the problems from sectors like education, manufacturing, hospitality, fashion, etc. IoT solutions use cloud-based nature for smart cities that are suitable by sharing platform which is based on open data. The common urban ecosystem can be formed by using small and large cities,

which are networked and controlled through the central cloud platform. The data collected using IoT through sensors would be collected in the cloud node. In this paper, we explored recent trends and advancement in IoT based smart cities. There exist several challenges to implement IoT in smart cities, though one of the issues is a limitation of networking and bandwidth availability as it connects many devices on the network and more traffic to handle. Many of the research papers have offered a solution to security and privacy, but still, it is one of the major issues in smart cities in the era of IoT.

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