



A Case Study on the Application of Internet of Things (IoT) Technologies in Smart City

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ABSTRACT

A significant number of Internet of Things (IoT) deployments are really making it possible for Smart City projects and efforts to be implemented all over the globe. Electronic devices and protocol suites are being installed in everyday objects in order to make them networked and connected to the Internet. This is being done in order to make the objects more useful. A research that was conducted by Gartner not so long ago found that by the year 2020, smart cities would have installed fifty billion linked items. Smart cities will be created via the use of these linked items. On the other hand, they will also introduce hazards and concerns over privacy. Not only have we observed the anticipated advantages, but we have also witnessed the hazards that have been introduced as a result of the many smart city programs and projects that have been implemented in recent years. There has been a description of the existing and future tendencies of smart cities in relation to the Internet of Things. Additionally, the link between Internet of Things and smart cities was examined. It has been stated what the driving forces are behind the emergence and development of smart cities and the Internet of Things. Finally, the shortcomings of the Internet of Things (IoT) and the ways in which they might be remedied when used to smart cities have been highlighted.

Keywords: Case Study, IoT Technologies, Smart City, Application.

1. INTRODUCTION

The significant degree of urbanization results in the creation of a burden when it comes to the cities. The depletion of resources is an additional factor that contributes to it. A forecast made by the United Nations indicates that by the year 2050, almost twice as many people will be living in urban areas as there are now living in urban areas. It's possible that this may put further strain on the resources that are necessary for maintaining the people's level of life. When it comes to the cities of the future, there are a great deal of chances as well as obstacles that emerge. It is possible that it may result in the worsening of the environment, the management of solid waste, the congestion of traffic, parking difficulties, and other

issues related to public safety.

The Internet of Things has the ability to save us from all of these difficulties. Using the Internet of Things (IoT), it is possible to alleviate the burden of urbanization and satisfy the requirements of a rising population of citizens. There is the potential for technology to play a significant part in making the inhabitants' day-to-day lives simpler, more pleasant, and more secure. The Internet of Things (IoT) is a concept that describes the accumulation of digital objects that are capable of communicating and interacting with one another across a network, as well as being able to be controlled and monitored remotely. Smart sensors and other gadgets are included in the Internet of Things. It is estimated that there are billions of such devices, and the number of them is expanding at an exponential rate as smart cities continue to develop. The transition of urban regions into smart cities brings up new prospects for providing optimal management of a variety of utilities, including traffic, trash, congestion, parking, public safety, and many more of a similar kind. These sorts of smart gadgets provide new kinds of dangers to human beings, such as concerns about privacy and the loss of data, among other things. According to the findings of the research, Internet of Things devices provide a number of advantages that are intrinsic to smart cities. Additionally, it outlines the potential dangers that are linked with it. The contemporary situation of smart cities has brought to the forefront the applications of technology that are now being used. Additionally, the potential uses of the Internet of Things in relation to smart cities have been considered. For the purpose of gaining an understanding of the real-time consequences of the technology, a case study of Smart city, which is the capital of Himachal Pradesh in India, has been conducted. As was indicated before, the study is going to be broken down into the goals.

2. LITERATURE REVIEW

Management of solid wastes is inferred from the findings of a research that was carried out in 2020 by Dubey and colleagues in the context of smart cities in India. The data gathering process for the projects involving the management of solid waste in smart cities was carried out via the use of the field study technique. Using the findings of the research, the authorities are better equipped to move to more sustainable waste management methods. Not only does it lack an integrated method for the administration of smart city systems, but it also lacks an efficient use of Internet of Things devices.

The importance of Internet of Things technologies in the birth and development of smart cities was brought to light by Hammi in the year 2015. IoT devices' advantages and disadvantages were pushed to the forefront as a result of this. Despite the fact that the Internet of Things (IoT) offers benefits to its users, the research asserts that it also presents hazards to users' privacy. It is possible to reap the advantages of interconnection among devices and their connections to the internet; nevertheless, the absence of security procedures for Internet of Things devices poses a threat to the safety and privacy of individuals. An empirical research was carried out by Sarin in the year 2016, with the purpose of determining the impact that different aspects have in the success of Internet of Things (IoT) in Indian smart cities. The purpose of this study was to determine the preferences of consumers in relation to the demographics of India. It identified important drivers of smart city initiatives, such as the Internet of Things policy of India and the evolution of smart city projects.

3. CURRENT TRENDS OF SMART CITIES APROPOS IOT

A fertile ground for ideas has emerged in the urban environment. One of the more problematic examples of such concepts is the incorporation of Internet of Things technology into smart cities. The movement of individuals to metropolitan regions is still a trend that is continuing right now. The increasing population density is causing an abundance of difficulties, including the accumulation of mountains of rubbish, the depletion of fresh water supplies, the contamination of the air, and the increase in traffic. Consequently, in order for cities to keep up with the ever-increasing populations, they are necessary to become more efficient. The applications of the Internet of Things have made their way into the mainstream in major urban areas all around the globe. In the following ways, Internet of Things technologies are the driving force behind smart cities:

3.1 Smart Waste Management

It has been found that the majority of the enterprises that are responsible for trash management engage in methods that are inefficient. Predetermined timetables are followed in order to collect the garbage. The ineffectiveness of this strategy may be attributed to the inefficient use of garbage containers, which non turn ultimately results in the waste collection vehicles using fuel that might have been avoided. The Internet of Things makes it possible to monitor the amount of trash, which is one of the smart solutions. Additionally, it may be useful in optimizing the routes that garbage collection vehicles take and in doing operational analytics respectively. The garbage containers that are fitted with sensors are able to collect data on the amount of waste that is contained inside the containers. A particular threshold is reached by the trash, and the waste management system then gets the sensor data to be processed once it has reached that threshold. As a consequence of this, a notice is sent to a truck driver. Afterwards, it begins to empty the whole container rather than the half containers. As a result, maximizing the efficiency of the fuel consumption associated with garbage collection.

3.2. Smart Infrastructure

When it comes to the implementation of the smart infrastructure, there is an urgent need for it. In order to design the urban infrastructure in a way that is both efficient and sustainable, it is necessary to place the Internet of Things technologies correspondingly. These days, it has been noted that the majority of nations are transitioning to the usage of electric automobiles in order to reduce the amount of carbon emissions that they produce. Increasingly, green buildings are becoming more popular as a means of achieving energy efficiency and making the structure more environmentally friendly. In order to make the most efficient use of power, smart lighting solutions are becoming more popular. The light is only turned on when someone walks by the smart light, and it also changes its brightness based on the lighting conditions that are present.

3.3. Air Quality Management

Real-time monitoring of the air quality and pollution levels is being implemented in smart cities via the use of various techniques. With the help of the Internet of Things, we are able to develop forecasts about emissions. Since this is the case, it might be useful in determining the underlying source of the issue. It is possible to create a strategy in order to restrict the emission.

3.4. Smart Parking

By using intelligent parking solutions, the Internet of Things is providing benefits to the cities. A number of different technologies are used in order to find a car inside the parking lot, to monitor the time at which vehicles are checked in and checked out, to detect unoccupied spots, and to assign them to vehicles that are already in line. Intelligent parking has become a reality in today's world, eliminating the need for complicated infrastructure and significant investments, making it an excellent utility for cities that are expanding.

3.5. Traffic Management

The increasing length of traffic lines is one of the most significant challenges that major cities face. Due to the fact that Los Angeles is one of the busiest cities in the world, the city has deployed an intelligent transportation system in order to manage the flow of traffic. Real-time updates of traffic flow are sent via sensors incorporated into the pavement to a centralised traffic management platform. The platform then performs an analysis of the data and automatically changes the traffic signals to reflect the current traffic condition within a matter of seconds. At the same time, past data is used to make predictions on the possible directions that traffic may go; none of these procedures need the participation of humans.

3.6. Environment

IoT makes it possible to monitor a variety of characteristics, all of which are essential to maintaining a healthy environment. In the process of preserving the optimal level of such parameters, it may be of assistance. The network of sensors may be installed across the water grid in order to monitor the quality of the water and ensure that it is suitable for use. Through the use of sensors, it is possible to keep track of the pH level, the amount of dissolved oxygen, the amount of water that is leaking out, and the chemical makeup of the water. The data may be used by the water management system in order to facilitate the transmission of notifications in the event that any pollution is detected in the water.

3.7. Public Safety

The surveillance system that is powered by the internet of things has the potential to bolster public safety. When it comes to preventing potentially dangerous circumstances or conflicts and forecasting

probable crime scenes, the analysis of CCTV data and the feed from social media platforms may prove to be of critical importance.

4. FUTURE TRENDS OF SMART CITIES APROPOS IOT

This article provides a preview of some of the Internet of Things devices that will be available in the future:

4.1. The Vision of Future cars

This car manufactured by Mercedes-Benz is equipped with a number of different technologies. An autonomous drone delivery within a radius of ten kilometers is advantageous since it helps save a significant amount of time that would otherwise be spent hauling packages. A significant amount of time is required for the manual distribution, on the other hand.

4.2. Smart Eye

The smart eye technology is extremely comparable to the concept that Google is working on called "The glass." In order to deliver alternatives and accessible features directly in front of your eye without there being any distractions, the eye is outfitted with sensors, wifi, and bluetooth. With the use of this technology, one is able to read messages, get access to the internet, and a great deal of other resources directly in front of their own eyes.

4.3. City Air Management

The control of air quality and pollution index in cities with a large population via the use of the internet of things is likely to be of great assistance. Internet of Things devices allow for the collection of real-time data on pollution, which may then be used to make forecasts. As a result, it is useful in the process of developing efficient methods for the reduction of emissions. For the purpose of achieving both short-term and long-term objectives for the reduction of emissions, it is recommended that a cloud-based method be used for the collecting and analysis of data in real time. "

5. RESULTS: CASE STUDY

A case study has been conducted in order to get an understanding of the consequences that Internet of Things technologies have on smart cities. The Smart city has been the contender for the case. A significant amount of history is associated with the smart city. Because of the tranquil beauty of the location, it draws a significant number of visitors. A further aspect that has contributed to the pressure that has been placed on the city's resources is the flood of visitors. The use of Internet of Things technology is essential for the effective management of resources. 2015 was the year when the government of India selected the city as the recipient of the smart city mission accolade. It has been noticed that a number of projects have been finished since the implementation of smart city management, while many more are still

in the process of being carried out. We have provided a sneak peek at some of the projects, which are as follows:

Smart parking

It refers to the usage of IoT technology for the better management of parking spaces. The efficient use of resources such as space and time for the purpose of faster and easier access of parking spaces in dense population areas. The population density in Smart city is also growing, giving a rise to the issue of parking. The steep terrain also counts to that. Under the smart city project a number of parking spaces have been developed and a lot more is still to come up at different locations. It is required to make adequate use of IoT technology for the effective use of parking spaces. An integrated approach for the management of these spaces is required. The city still needs to go a long mile to achieve the goal of smart parking.

Smart pedestrian path

In major cities across the globe, the demand for pedestrians is expanding in tandem with the population growth that is occurring in these areas. The pedestrians play a crucial role in the acceleration of traffic flow, which ultimately results in a reduction in congestion. An anticipated initiative for intelligent pedestrian circulation is going to be implemented in the smart city of Smart. An improvement in the convenience of use of pedestrians leads to an increase in the walkability of people, which in turn helps to reduce the use of other modes of transportation and prevents harmful emissions from being released into the environment. The walkway that is designated for pedestrians may also be used by bikers.

Smart bus stop

Before boarding the bus, passengers are provided with all of the necessary amenities via the implementation of the smart bus stop idea. For the reason that buses are the most widely used form of public transportation all across the world, including in India. It is anticipated that a smart bus stop will be furnished with all of the user-friendly amenities, including sitting facilities, a tray for newspapers and magazines, a vending machine for tea and coffee, and a display board that is able to show the pertinent information. The information about the weather, the routes to the most important locations in the city region, and the information regarding the arrival and departure of buses should all be included on the display board. In addition to that, it is required to show the information about the buses right now. The information presented here may prove to be highly beneficial not only to the locals but also to tourist visitors. With regard to the city of Smart, these intelligent bus stops have the potential to be of great assistance in giving inhabitants and visitors with important information pertaining to the city. It is possible that this will become an additional attraction for visitors that are visiting the city. Furthermore, it has the potential to be helpful in the development of a sense of ease and comfort among visitors, which is an essential component for a city that caters to tourists visiting the area. Not only that, but the intelligent bus stops may also be of great assistance to those with disabilities. At a number of different places across the city, the projects for intelligent bus stops are now under development.

Surveillance

When it comes to smart cities, the security system is the most fundamental components. Integrated surveillance across the network is one method that may be used to realise this goal. Devices that are enabled by the Internet of Things have the potential to be helpful in making cities safer for commuters. It is not only the promotion of public monitoring that smart cities support, but it also encourages individuals to have such systems installed at their places of home and place of employment. Consequently, making it possible for individuals to get more advanced connectedness. Furthermore, the applicant for the case is outfitted with monitoring devices that are installed in various parts of the city. The risk of theft of personal and public property is eliminated as a result of this measure.

Smart metering

The term "smart meter" refers to an electronic device that records data on the amount of power used, the current, the voltage level, and other relevant information. By use of a web-based system, these meters are linked to the power provider in order to facilitate communication. As a result, furnishing information in real time on the use of the subscriber and the behavior of its utilization. After that, it makes it possible for both the providers and the consumers to plan for the efficient usage of the available electricity resources. Smart city is now in the process of implementing the smart metering project. The city will then be able to gain the ability to make efficient use of its power resources and to prepare for the possibility of meeting its own energy requirements without outside assistance. Additionally, it is going to be an advantage in terms of increasing the sums of money.

6. CONCLUSIONS

In this particular research, the creation and validation of several aspects of Internet of Things (IoT) systems have been covered. A number of prevalent services that have made it possible to implement smart cities have been made available to the globe as a result of the Internet of Things idea. This has made it possible for people all over the globe to take advantage of new possibilities, such as the capability to remotely operate and monitor equipment, as well as concurrently analyze and act upon the data that is received. In light of the situation in smart city, the research illustrates the most effective method for developing a model for a smart city. According to the findings of the research, the Internet of Things (IoT) has the potential to be used in a wide variety of specific situations, including but not limited to smart parking, metering, environmental sustainability, waste management, pollution control, and the reduction of carbon footprints. This study has provided an overview of the Internet of Things (IoT) in relation to Smart city and highlighted the ways in which it might help to the enhancement of the smartness of the city. We also talk about the dangers and shortcomings of the mechanisms that are currently in place.

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