

IoT and the Urbanization

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Abstract: IoT is one of the very booming research areas and as predicted there will be more than 75 billion IoT enabled devices by the end of 2025. Urbanization and the smart cities is one of the areas where IoT is getting used widely and is one of the popular research areas among the researchers. IoT uses the internet, sensors and other techniques to enable the seamless connection between the devices. Development in smart cities by integrating technology can help achieve sustainability, improvement in quality of life. The paper discusses the applications, benefits, challenges and the future scope for the research in this field.

Keywords: Machine Learning, IoT, smart cities, urbanization, sensors

1. Introduction

IoT and urbanization are changing the way the cities are managed and designed. With the expansion of urbanization, the way the cities were managed is changing. The UN has given the 17 Sustainable development goals out of which few are: Good Health and well being, Clean Water and sanitation, Sustainable cities and communities. IoT is a very powerful way in achieving the targets of SDG for sustainable city development.

Now already a lot of work has been done in making the cities smart by integrating the technology to achieve seamless data communication. IoT has played a very important role in achieving this. IoT stands for Internet of Things and involves sensors, interfaces, sensors, actuators, internet and cloud. It includes technologies like Artificial Intelligence, Nanotechnology, RFID, Machine Learning, etc. IoT devices contain embedded systems which then interacts with internal or external systems.

Sensors and actuators help collect data and perform action based on the data. Gateways help add the security level to the data. Cloud helps in achieving data storage. Clouds are the backbone for achieving scalability and accessibility.

Today in 21st century main concerns of a city management are:

- Traffic Management [16]
- Pollution Control [17] [18]
- Transportation Management
- Energy Management
- Waste Management
- Water Distribution
- Adequate Infrastructure

With the advancement of technology, it is possible to have smart traffic management by having mobile applications or a way to track their path which will reduce the commuters problems tracking their transport means. IoT can help tackle almost all the problems that are mentioned above for city management. It can help harness the technology and the data driven approaches for improving the quality of life in a city. It can help achieve the optimization of resources, safety and the quality of life of the residents. Many countries like Singapore, South Korea, Japan, etc have already developed a

lot in this area and India is also progressing in a nice way in achieving this target.

Even though there are enormous numbers of benefits using the IoT for urbanization. Still there are a lot of challenges while using IoT like privacy, security, dependence on the internet, supply chain attacks, etc.

This paper aims to discuss how the IoT has helped in achieving the sustainable development in cities for improving the quality of life and the challenges associated with using them.

2. Components for IoT

1) Arduino Microcontroller:

It is an open source prototyping platform which is known for flexibility and ease of use. It has both hardware and software. It facilitates a seamless interface and has additional add on modules which enables communication with other devices using USB and others. It lacks permanent storage. It retrieves Infrared codes from sensors from the home and then helps embeds for transmission.

2) Raspberry:

It is a single board computer which works on a Linux based operating system which boasts the connectivity with the peripherals attached to the computer and is a very versatile computing platform. It helps achieve computational robustness and connection. Arduino sensor and Raspberry helps achieve the data management and communication with the smart home systems.

3) Protocols:

RFID, email, HTTP, Instant Messaging and other social media platforms work as protocol and communication channel. MQTT also helps in optimizing the data transfer [13]. CoAP protocol helps in overcoming the challenges of limited capacity. BLE which is Bluetooth smart is also essential for the installation of IoT.

4) Data Analytics:

This module helps in finding the insights and the patterns for decision making and conclusions. Information generated by the module is transmitted to rule engine which then helps in actuation [15].

3. Applications

- 1) **Tourism:** It is one of the main sectors for economy generation which drives economic growth and helps in cultural exchange. With IoT techniques, tourist experiences can be enhanced. They can help provide personalized recommendations, interactive maps and real time information regarding the events going - on or upcoming for better tour plan. They can help monitor the traffic of visitors and then help in achieving proper resource utilization and allocation. [1]
- 2) **HealthCare:** Health care is one of the most important domains for the progress of a nation or a country. Smart cities help in achieving the accessibility of services to the residents. Remote patient monitoring; Wearable devices for calculating heart rate, pulse rate, etc; AI for disease diagnosis; tele medicine for preventing the need to travel for some cases; availability of patient data for coordinated care; Biometric sensors for monitoring patient movements for alerting health care, are few of the examples by which IoT and AI can help achieve this target [3].
- 3) **Ambient Assisted Living:** This is to support the elderly people in living independently in the urban cities. IoT can help achieve the monitoring of diseases, supply of fresh food, security, people - to - people communication, access to records for people intended, and feeling of safety through sensors and actuators. [4]. For achieving these targets, they use sensing layer which is through wearable devices or smart phones, network layer for collecting and transmitting the data, data processing to convert data collected to the information/knowledge, application layer for monitoring [5]
- 4) **Governance:** With IoT based systems, transparent decision making can be encouraged which is one of the main determining factor in a city with good governance. Data for air quality, waste and traffic can be obtained using smart systems which will help make better and timely decisions [15]. This will also help in making a responsive and accounting governance. [6] Smart city lighting as per the day condition, traffic management in which accident information can be immediately sent to the concerned authority, automated public transport for road safety, energy consumption data storage, reduction of carbon emission by use of smart equipments, smart garbage bins enabling segregation of waste for waste management, etc are few of the examples with the use of IoT which can facilitate the better governance. 5G networks are also helping facilitate the IoT technologies [7]. Urban planning can also be improved by collection of data produced or consumed by people in a city [8] [19].
- 5) **Infrastructure Management:** It is important for the safety of a city and for maintaining the city assets. IoT can be used for monitoring the health of infrastructure existing in a city like the condition of roads, bridges, etc. By detecting the condition of the road or any infrastructure, if the timely data can be sent then it can help in reducing the risks and the injuries because of the bad infrastructure [9]. Security Access Control, smoke detectors, Fire detectors, light control system, indoor air quality control system, etc can be installed in a smart home for their better living.
- 6) **Disaster Management:** Because IoT can help in collecting the real time data and IoT is connected to the data analytics engine. If the data can be analyzed properly, it can be used to give the early warnings. The buildings, and other infrastructure can be interconnected and thus data sharing and analysis between the devices can be easily achieved. Affected locations can be easily identified and thus they can be helped timely [11]. Earthquakes can be traced, and alerts can be sent through mobile applications. Remote sensors and drones can help reduce human interaction and help in finding the intensity of damage and where the damage repair needs to be done and thus proper and better rescue efforts can be taken. With IoT, it is possible to detect forest fires, quality of air, possibility of landslides, and avalanches in mountainous places, measuring the water leakages, radiation levels, etc. And the timely prediction of mentioned things will help a lot in managing the disasters and thus saving lots of lives.
- 7) **Energy Management:** IoT can help in pursuing more energy efficient practices and renewable power resources. Sensors can monitor the energy consumption data and thus can help analyze the opportunities from which the cost can be reduced [12], [13].

4. Challenges

- 1) **Privacy and cybersecurity:** Any breach in the data transfer and the data collection can result in bad experiences. Because the IoT based systems capture the personal data and transmit them to the other devices, it is a big challenge to ensure that data can not be leaked or eavesdropped which can then affect their security also [10] [14]. Ensuring that no software and firmware vulnerability exist is also a challenge. Coders need to be very cautious while developing the algorithms for these kind of applications.
- 2) **Public Acceptance:** Because IoT works with the integration of various devices interconnected and interoperated, and the personal data is monitored and analyzed. Thus the public acceptance is a big challenge in a city [10]. For this it is important that how the data is collected, processed and analyzed should be informed to the people so that they can build a trust for these systems.
- 3) **Technological Integration:** Because the population of a urban city is very high and the number of devices is also very high. Thus, ensuring the proper integration along with the follow up of proper policies is a big challenge [13].
- 4) **Network Dependency:** With the advancement of Internet infrastructure and the emergence of 5th generation internet, the internet has become very strong and stable. But because IoT mainly relies upon the network stability and performance. Thus, it can be a big challenge in successful implementation of IoT for the development of smart systems in a urban county with a mix population in terms of all the norms.
- 5) **Safety and Confidentiality:** Data confidentiality is one of the key challenge in implementing the IoT for urbanization. Because the number of devices attached is too high and the amount of data generated is also too high, thus ensuring no data leakage while capturing the analysis

is very important. The success of IoT for any application depends on the same. [14]

- 6) **Socio Economical Inequalities:** Because of the inequalities existing in a society and especially urban cities; how the accessibility can be ensured is a key challenge.

5. Future Directions

- 1) Data Analysis for better policies:
- 2) Development of new data science algorithms
- 3) Development of new sensor technologies
- 4) Research on encryption techniques and authentication protocols for data collection
- 5) Methods for preventing the unauthorized access to the public data
- 6) Safe methods for secure device discovery
- 7) Prevention of software and firmware vulnerabilities
- 8) Methods for reducing data loss for the this kind of big data generated by millions of interconnected devices
- 9) Methods for better communication among the sensor nodes
- 10) Better storage techniques for fast data retrieval and processing

Above mentioned are few of the areas where the researchers can contribute for a robust IoT based systems for urbanization.

6. Conclusion

The paper discusses the IoT for urbanization, areas where it is being used and can be used, various challenges associated in use of IoT for urbanization and also the future directions for new researchers in this area.

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