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A Comparative Study and application of IoT Technology in the design and development of Smart Cities.

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Abstract

Smart technology has brought about tremendous transformation creating enormous challenges and opportunities to the Information Technology sector. The Internet of things (IoT) is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to connect and exchange data. Smart City initiatives are being undertaken and the advancement of technology and smart devices are making life easier for the global community. This paper performs an in-depth study of advanced technologies and devices like RFID, WiFi Sensors, Smart Home Appliances, Zigbee, Raspberry Pi etc. which can be used to contribute to smart living. The primary focus of this paper is to compare IoT Technology and devices in development of Smart City framework. Design Issues, framework and Implementation issues are also the key attractions of this paper.

Keywords: *Smart Living, Information Technology, Smart Cities, IoT, Actuators, RFID, Sensors, Smart Home, Zigbee, Raspberry Pi, WIfi Sensors, Smart Home Appliances.*

1. Introduction

The **Internet of things** (**IoT**) is the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to connect and exchange data. IoT permits articles to be detected or controlled remotely crosswise over system framework, making open doors for a more honest aggregate of the physical international into PC primarily based frameworks and bringing approximately stronger proficiency, exactness, and monetary benefit however dwindled human intercession.

At the point when IoT is multiplied with sensors and actuators, the innovation turns into an incidence of the larger elegance of digital bodily frameworks, which likewise envelops advances, for example, eager lattices, virtual strength vegetation, first-rate homes, savvy transportation, and clever city communities.

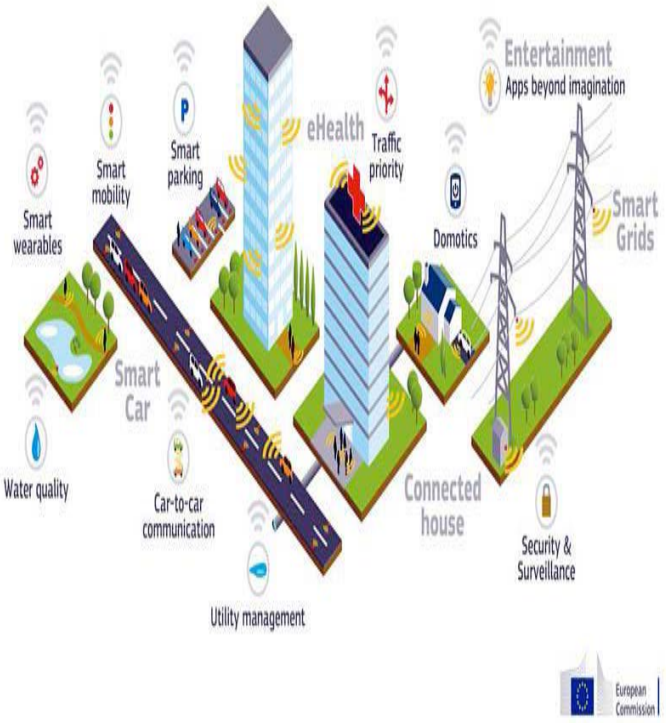

Fig-1 Understanding Smart City [12].

2. Role of IoT in Smart Cities

Nowadays the Internet of Things is very popular and booming in the market. Using some concept with IoT, we can easily live our lives and the needs can be fulfilled. In smart cities, there are so many facilities available. In big and crowded cities finding car parking during rush hours can be time-consuming and frustrating. Using IoT smart parking makes the search for your vehicle parking space very easier and convenient for drivers. A smart cities concept consists of

many smart ideas for making life easy. E.g. Smart lighting, Smart roads, Structural health monitoring, Surveillance, Emergency response etc.
For environment bases, Weather monitoring, Air pollution monitoring, Noise pollution monitoring, Forest fire detection, River floods detection, etc.

Smart Lighting: Smart lighting systems for roads, parks, and building can help in saving energy. Lighting is responsible for 19% of global electricity use and around 6% of global greenhouse gas emissions. [1]

Surveillance: In cities required to ensure safety and security using surveillance of infrastructure, and other public transport events. A crowded cities surveillance infrastructure comprising of a large number of distributed and internet connected video surveillance cameras can be created. A smart city surveillance model is described that leverages benefits of cloud data storage.
We can implement new innovative ideas for smart cities including smart roads, lighting, and health care etc. using IoT devices.

Street light: It is the leaf part of the tool where IoT nodes are placed. Each streetlight is geographically localized on the town map and uniquely associated with the IoT node related to it, simply so IoT data can be more high-quality with context information.

WSN gateway: The gateway has the position of interfacing the confined link layer era used in the sensors cloud with traditional WAN technologies used to provide connectivity to the crucial backend servers. The gateway, as a result, plays the role of 6LoWPAN border router and the RPL root node.

HTTP-CoAP proxy: These proxies' sets allow to transparent communication with CoAP devices. Using this functionality we identified unsets packages and total numbers of site visitors through the IoT community.

Database server: Using Internet of Things generates good quality data amount including streaming data or series data. The database server collects all things that need to be communicating via HTTP proxy servers, and also replying same things according to requesting on the server.

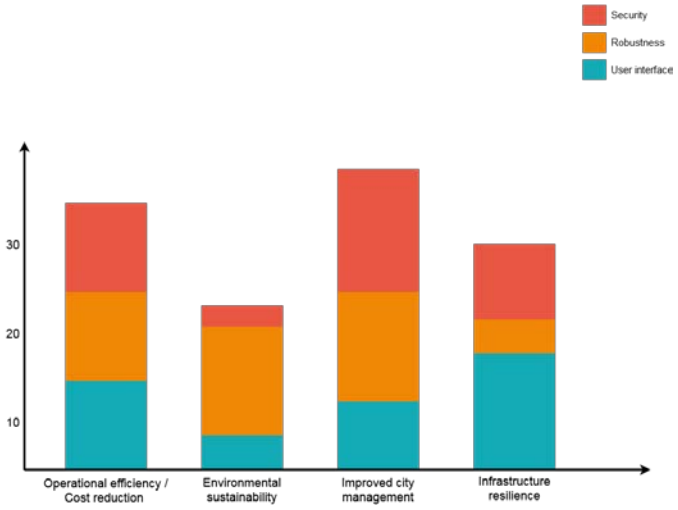

Fig-2 Change Agents for Smart Cities.

Operational efficiency / Cost reduction: The models should focus on increasing operational efficiency and reducing the cost to a considerable extent. In any case, there are a few contrasts in every nation. For example, a brilliant city is driving IoT in Japan and infotainment frameworks/keen signage in Indonesia. Infrastructure devices which can optimize efficiency by means of saving time, effort and cost would be the pioneer in Smart City solutions.

Environmental sustainability: Development should not be done at the cost of environmental degradation. Hence Environment-friendly solutions should be planned and executed to promote development through eco-friendly solutions. For instance, savvy buildings frameworks can identify when a territory is less populated and diminish the warming or cooling in that piece of the building.

Improved city management: The absolute most costly resources and expenses for the urban communities are the Lightings. Presently envision that lights can diminish to 75% of intensity when there is no movement around and quickly go 100% when action is recognized. This can be accomplished with the Internet of Things advancements and it spares urban communities billions in working costs every year.
Another major concern in the city is traffic. Parking space is very difficult to find leading to chaos. Organized traffic is the need of the hour and parking guidance through IoT devices can help solve this problem.

Infrastructure resilience: Developing smart infrastructure including roads, correspondence systems, conveyance channels, and utilities can't be an idea in retrospect.

3. Literature Review

Swapnil B. Kale et. al. have focused on enabling e-education, expanding opportunities for business and improving healthcare. This model allows based on communication between students and other members to happen physical objects, protocols, controller, and sensors have changed institutions effectively. [2]

Sanchit Bhasin et. al. have studied and analyzed the various IoT solutions available in the context of Smart Cities. They have also discussed the challenges involved in the implementation of such solutions. [3]

Mr. Kyusoo Chong et. al. have investigated the cases of road management and safety analysis in Korea and other countries. The development of technology for the service road/traffic using multiple data sets in real time information such as traffic Information, weather information, and status information of the road are necessary, and the analysis of multiple data sets. [4]

Nomusa Dlodlo et. al. have proposed an energy efficient solution for Smart Cities. The application of IoT in Smart cities has been listed. [5]

Andrey Giyenko et.al. have suggested an open source intelligent IoT platform for various applications like smart Home, smart energy grid, smart transportation system etc. Application of UAV in the agricultural domain, as well as Urban Surveillance has been highlighted. [6]

Robert R. Harmon et. al. have explored the smart city concept and proposed a model for IoT implementation in Smart City. Innovative applications of IoT can be effectively used in the development of Smart City and enhancing the optimization of resources. [7]

Jaehak Byun et. al. have given an overview of IoT devices. They have elaborated and compared two models based on their applicability and usage in smart cities domain. [8]

Saraswati Saha et. al. have proposed a model for Data center management by providing temperature alerts for effective management of temperature and detection of deviation.[9]

Alexey Medvedev et. al. have suggested a mechanism for effective waste management in smart cities. Data sharing and dynamic route optimization with a view to optimizing operations and easy navigation of vehicles involved in garbage transportation have been provided. [10]

Daniel Minoli et. al. have evaluated commercial buildings based on criteria like comfort, usability, security and energy Analysis of challenges and opportunities has been provided and discussed in detail. [11]

Table 1: Comparative Study of Smart Cities Model

Model	Security	Robust	Response Time	User Interface	Communication	Cost	Device Orientation
Smart Education System: Korean Government	3	No	3	3	3	Average	Yes
Smart Traffic System: Korean Government	3	No	4	3	3	Average	No
Weather monitoring using Humidity Sensors and cloud-based dashboard with a real-time alert system	3	Yes	3	4	4	High	Yes
A Cloud-Based Car Parking Middleware for IoT-Based Smart Cities	3	No	3	2	3	Low	Yes
Waste Management as an IoT-Enabled Service in Smart Cities	2	No	2	2	3	Low	Yes
An IoT based reference architecture for smart water management processes.	3	No	3	3	3	Average	No
Model on Energy Conservation and optimization using IoT Architectures	3	No	3	3	3	High	No

Rating:
0-2: Poor or Below Average. 3-4: Average. 5: Excellent.

Literature Study of the models proposed or implemented in Smart Cities can be compared based on certain parameters like Security, Robustness, and response time, User Interface, Communication, Cost and Device Orientation as shown in Table-1. These models have been compared on the mentioned parameters on a scale of 0-5 where 0-2 is poor or below average performance, 3-4 is average and 5 is excellent. This gives an idea of the performance of the model in terms of these predefined criteria.

4. Conclusion and Future Work

Smart cities in the future and to make it possible, IoT and other technologies are mandatory. This paper highlights various technologies and discusses the implementation issues in the context of Smart City. Comparative Study of different models is listed. The comparative criteria include Security, Robustness, Response time, User Interface, Communication, Cost, and Device Orientation. Future work would involve designing, developing and implementing an IoT based model to make Smart city a reality.

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