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A Novel Smart City Using IoT and Open Source Technology

B.S.S.Tejesh, Md.Shabeena Begum, N.Mayuri, S.Neeraja, B.Purvaja Durga

Abstract*: Through IoT the cities are envisioned into smart cities. The IoT technology is deployed essentially in prevalence of all the applications and is playing a compelling role in day to day liveliness. The Smart cities integrated with the IoT technology can intensify to unravel the contention of the people. The considerable issues in the cities such as smart home automation, smart parking, smart agriculture, smart street lights and smart environment monitoring are addressed in this article. The smart city is refined with the open source technology. The information accumulated from peculiar devices and sensors is received to the Thing speak server and the representatives will visualize the data and engage in required action to take place. The prime aspiration of this article is to emphasize the obstacles in the smart cities. The features of the smart city are enhanced and give a provision to utilize IoT technology

Keywords: IoT, Open source technology, Smart city, Thing speak.

I. INTRODUCTION

The smart cities developed with IoT technology enhances the infrastructure and services to accommodate with the prerequisites. We are cooperating with the devices in a advent connected mode, with the technologies like Internet of Things. Through IoT the digital era is associated with the associated with the physical era [1]. The connectivity amidst the devices and people is boosting day by day. The fundamental perception of Internet of things is to develop a smart world that comprises of smart cities, smart homes, smart cars and smart phones. To accomplish some objectives the physical objects and the IoT are unified into an internet based system[2]. Some traits like safety, security, scalability and adaptability will be evolved if some enhancements are made in the cyber physical systems.

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* Correspondence Author
B.S.S.Tejesh*, Department of ECE, Assistant Professor, SRK Institute of technology, Vijayawada, India. Email: tejeshbss@gmail.com
Md.Shabeena Begum, Department of ECE, Assistant Professor, SRK Institute of technology, Vijayawada, India. Email: shabeena.md@gmail.com
N.Mayuri, Department of ECE, Assistant Professor, SRK Institute of technology, Vijayawada, India. Email:narasa.mayuri50@gmail.com
S.Neeraja, Department of ECE, Assistant Professor, SRK Institute of technology, Vijayawada, India. Email: srkneeraja8@gmail.com
B.Purvaja Durga, Student in Department of CSE, KL deemed to be University, Vijayawada, India. Email: purvajapuri@gmail.com

The IoT stationed systems facilitates with high ease of services in an intact and secure peculiarity.

The smart city enhances the profile of the city. In the smart city all the considerable combining the infrastructures such as social, business and physical [3]. In the favor of city and the citizens some value added services with the advanced technology makes the city as a smart city. The smart city is one of the considerable applications of IoT, which utilizes communication technology, sensor technology and intelligent controlling systems to elucidate the current and future confrontations. The perception of IoT for smart cities is to progress the accountability of cities [4]. In smart cities smart home automation, smart parking, smart street lighting system, smart agriculture, smart environment monitoring enables to facilitate an easy living.

In the Home habitat with the inclusion of smart home automation, the users are enabled to supervise and control the electrical appliances [5]. With the advent of IoT the traditional wired communication technologies are taken by wireless communication technologies. An ample range of devices such as sensors, CCTV's, Electrical appliances are entrusted with for mere access. The Smart Home automation facilitates the users with an ease to connect and control all the Electrical home appliances all the time around the world [6].

Throughout the world prevalent countries now prefer smart parking system. In the world almost the vehicles abundance is inflating day by day [7]. So as the vehicles count are in inflation, so there is an obligation for the parking slots. The people are not acquainted with the number of legitimate parking slots. With the inclusion of IoT in the parking system, many countries are facile with provision of information over a platform which is approached to the users [8].

The smart street lighting system is a fundamental segment of a city for the objective of security and contentment. The Light emitting diode lamps are utilized rather than high pressure sodium lamps for the intent to enhance the energy savings [9]. There are numerous methodologies employed to diminish the power consumption by the street lights. The smart street lighting system enhances the working of street lights based on the transition in the habitat situation. The intelligent lighting systems rely upon some sensors that are adequate to notice the intensity of sunlight. The smart Agriculture system is enhancing day by day with the inclusions of various methodologies. The agriculture fields can be regulated with the interpretation of contiguous transformation in the soil, crop [10].

In prevailing scenarios the agriculture system desires to acquire a lot of sustainment and supervision. The IoT technology in the agriculture domain is the utmost efficient solution. It eradicates the usage of surplus labor and enhances the quick access to specifics of crops and soils by effective communication methodologies [11].

The smart environment monitoring is an imperative aspect because in the smart cities pollution, contamination, gas leakages are at utmost [12]. With the involvement of IoT technology gas emission, fire accidents, abrupt variation in the temperature and humidity will unintentionally affect the city [13]. Based on the transition in the environment parameters the desired action will be employed as a service for the betterment of human lives.

II. PROBLEM STATEMENT

In fact due to the compelling resources, there is a massive percussion in the delivery of services. So as per the consequences the conception of smart city has been embraced to enhance the delivery of services to the users. With the involvement of IoT technology the smart cities are capable of delivering favorable services.

III. IoT ARCHITECTURE

To any device ranging from complex to simple can be accompanied to endeavor with IoT. A network or gateway comprises of IoT devices and retains a persuasive communication amidst the devices, the information from the devices is accumulated in the cloud [14]. With the support of cloud services the information from the IoT connected devices is more accessible to the user.

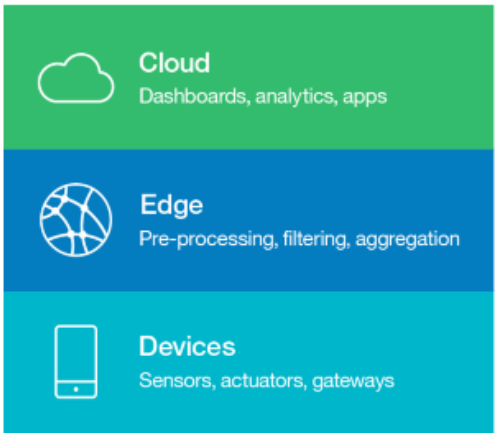

Fig. 1.Multi-tiered layered architecture.

IoT architecture as depicted in Fig.1 enables to enhance developments, ensure compelling strategies and productive IoT solutions in a robust and flexible manner. Utmost IoT architectures comprises of devices, sensors and communication protocols.

In the Device layer, the sensors and actuators are employed to sense the data and gets connected over to technologies like Wi-Fi, BLE, ZigBee. These devices are capable of sensing the data in either analog or digital form. Based on Gateway mechanism these devices can directly connect with the cloud. The gateway prime intention is to perform data acquisition activities.

The Edge layer prime task is to accomplish the analysis of data acquisition from the device layer. The aggregation, filtering and pre-processing activities are accomplished to transmit and receive the data.

In the cloud layer, the data can be visualized by the end users in their web applications. There are distinct cloud platforms to enhance the reliability in the smart cities.

IV. IoT CHALLENGES

IoT technology prime objective is to accomplish the services in smart city with scalability, security, privacy, reliability and performance [15].

The reliability predominantly focuses to contribute the services to the users favorably beyond any circumstances. In a heterogeneous network, the IoT systems impair in lack of contributing security and privacy. Some factors such as tracking of data and authentication prime features regarding security. The information apportioned must be ensured to be encrypted. Accordingly by 2020, approximately 50 million devices are to be interconnected. Hence enormous storage is required to transmit and receive the information from the devices. The information gathered must be further analyzed for better usage. For the better quality of services the built systems are to be enhanced in the circumstances of contemporary modules, technologies.

V. METHODOLOGY

In this project we are developing a smart city based on five major applications which strives to resemble the human life in a smart way. The five major domains we are concentrating are Smart home, smart gardening, smart agriculture, Smart Street and Smart parking. The Fig.2 depicts the working block diagram of the implemented system.

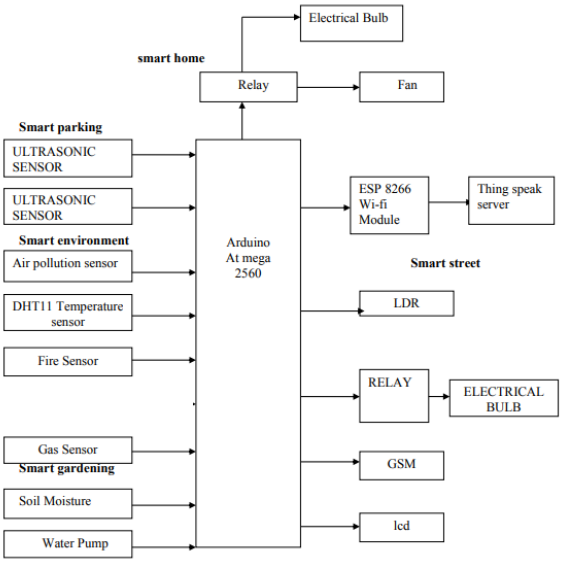

Fig. 2.Block diagram of Smart city.

In this smart city, Arduino Mega 2560 is the preeminent element for controlling and monitoring all the devices and sensors stationed at various zones of the city.

The Wi-Fi module NodeMcu facilitates the Microcontroller Arduino Mega 250 with the Internet Facility and the GSM module facilitates the users with SMS and calls in case of emergency plights. In the smart home, this module enables the user to eliminate manual control of electrical appliances like electrical bulb, electrical fan. Through IoT in the smart environment, we are able to control remotely electrical bulb and fan. So that the user can control the appliances from anywhere in the world with the help of Thing speak web server and MIT android app the user will be given particular credentials so that he can control the appliances.

In smart environment we are able to monitor the various environmental parameters that adversely affect the global warming. In this environmental monitoring we are monitoring parameters. To measure the temperature and humidity in the environment with the service of DHT11 sensor. To know the harmful content in the environment the sensors such as gas sensor and Air pollution sensor is utilized. To ascertain any fire accidents in the zones of the smart city a fire sensor is employed. With the help of fire sensor we are able to control fire accidents with in short amount of time with help fire sensor

In Smart street light system we are able to make the street lights on and off without involvement of any person. Here Light dependent resistor plays a crucial role for determining the light intensity and automatically switching the street lights on and off. With this smart street system manual labor will be eliminated which thoroughly influences the streets.

In a smart parking system which indicates the number of the parking slots and occupancy of those parking system with the help of ultrasonic sensor. The users in the city will know the parking slots and occupancy in the parking slots so that one can decide whether to park or not in the dedicated slots. The users will see the parking slot information through things speak server.

In the smart gardening system this approach provides an automatic watering system. The water motor will automatically on and off based upon the moisture content in the soil that is measured with the help of soil moisture sensor. The smart gardening system plays a crucial role in eliminating manual labor, excessive loss of nutrients in the soil. With the help of things speak web server we can monitor moisture content.

The developed smart city is concentrating these five applications. Day by day the people are becoming smart now it's time to make cities smarter.

VI. RESULTS AND DISCUSSIONS

The Fig.3 depicts the hardware organization of the smart city.

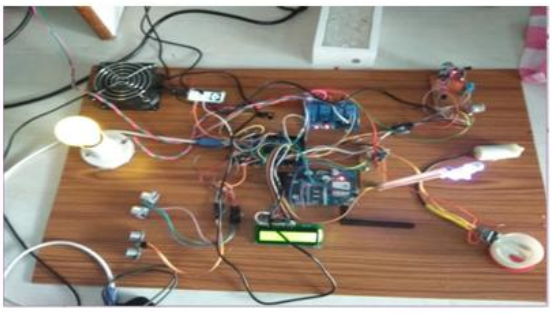

Fig. 3.Hardware organization of smart city.

The five major domains we are concentrating are Smart home, smart gardening, smart agriculture, Smart Street and Smart parking.

The results are gathered to the Thing speak web server from various sections in the smart city.

The Fig.4 depicts the outcome from the Gas sensor and air pollution sensor in a graphical way so that the user can conveniently monitor the data in the thing speak web server.

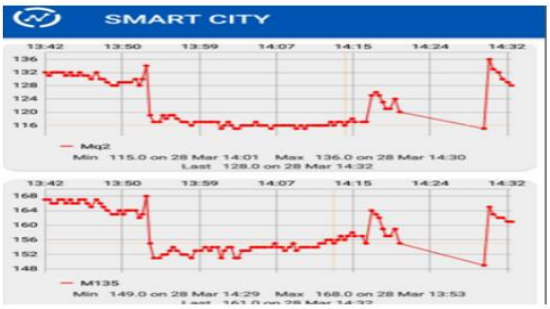

Fig. 4.Gas and Air pollution sensor data in Thing Speak web server

The Fig.5 depicts the outcome readings of Temperature and humidity in a graphical representation so that the user can visualize in the thing speak web server.

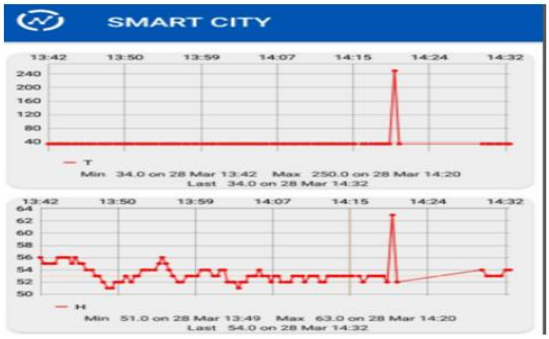

Fig. 5.Temperature and Humidity data in the Thing Speak

The Fig.6 depicts the immerse of the vehicles in the parking slots 1 and 2 in a graphical representation so that the user can visualize in Thing speak Web server.

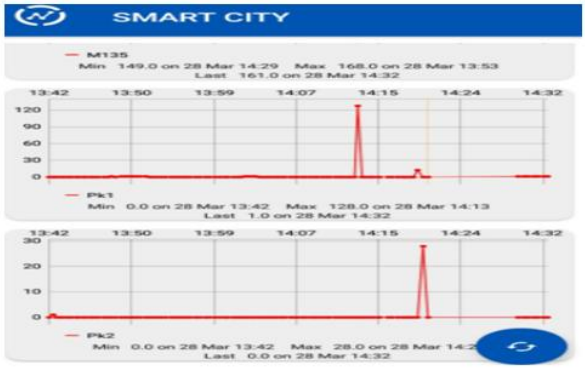

Fig. 6.Parking slot 1 and slot 2 data.

The Fig.7 depicts the radiance of light and is there any fire detected in the city in a graphical way so that the user can visualize in Thing Speak web server.

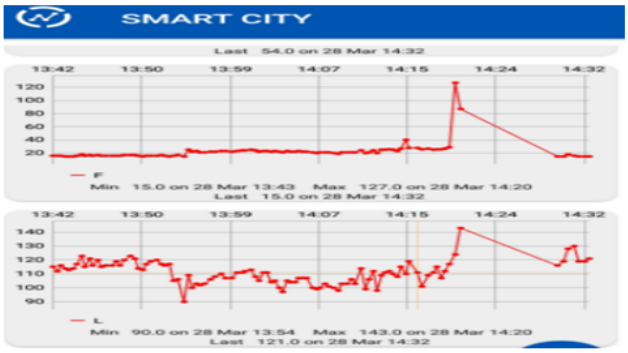

Fig. 7.Fire and light intensity data

In the Thing speak web server with a specified link with the inclusion of 0's and 1's the lights and fans are automatically supervised.

The Fig.8 and Fig.9 depicts the SMS and calls sent by the GSM module incase of any emergency situations in the smart city.

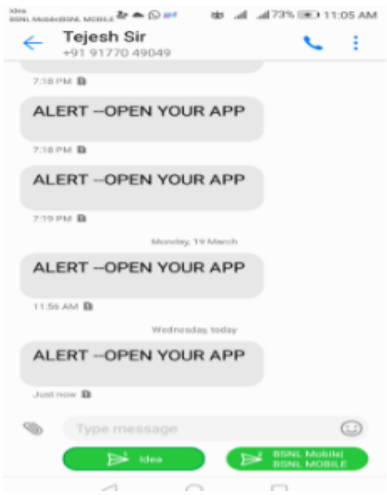

Fig. 8.Emerency Messages received by the user

Fig. 9.Call received by the user.

VII. CONCLUSION AND FUTURE SCOPE

Accompanying the rise in the growth of in habitants, more ideas have to be employed for transforming the cities in to smart cities. With the enhancements made in the IoT technology several domains such as smart home automation, smart parking, smart street lighting, smart gardening and smart environment monitoring came to efficiently provide the users with competent services. Despite the services contributed with IoT and Open source technology there are some privacy issues and security liability. In this paper, we contemporarily contributed an effective Smart city solution to facilitate the users with the enhancements of services. The smart city we developed can be further refined with more applications and equip with advanced services to the user. The IoT integrated with open source technology enhances the services to strive for betterment of citizens in the smart city.

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AUTHORS PROFILE

B.S.S.Tejesh working as an Assistant Professor in SRK Institute of technology,completed his M.Tech Embedded systems in KL University and B.Tech electronics and communication engineering in Vignan University. I published more than 12 journals in the areas of IoT, Embedded systems and Wireless sensor networks. I am certified in IoT by coursera.

Md.Shabeena Begum working as an Assistant professor in SRK institute of technology, completed her M.Tech VLSI and Embedded systems in Sri Vasavi engineering college and B.Tech in Nimra college of engineering and technology. She published various research papers on IoT, embedded systems. She is a certified IoT by coursera

Narasa Mayuri working as an Assistant professor in SRK institute of technology, completed her M.Tech in VRS &YRN engineering college and B.Tech electronics and communications engineering in Baptla engineering college. She published various research papers on IoT, embedded systems, VLSI.

S.Neeraja working as an Assistant Professor in SRK Institute of technology ,completed her M.Tech Embedded systems in KL University and B.Tech Electronics and communications engineering in Nalanda institute of technology. I published more than 12 journals in the areas of IoT, Embedded systems and Wireless sensor networks. I am certified in IoT by coursera.

B.Purvaja Durga studying B.Tech CSE in KL Deemed to be University. My areas of interest are IoT, Embedded systems and Wireless sensor networks. I participated in various events and workshops conducted in my KL university