

Internet of Things for the Development of Smart Cities



P.Dhivya, A.Karthikeyan, V.K.Shunmuganaathan

Abstract: Internet of things plays an important role to make smart in all the areas like smart city, smart home etc [1]. It is used in more efficient water supply, an innovative solution for traffic congestion, to make reliable public transportation, improved the public safety, energy efficient building, Vehicle smart security system etc [4]. While the average cost for basic items is going up, there is a developing concentration to include innovation to bring down those costs for smart city development. In the following chapter will discussed the few innovation for the smart city development.

Keywords: Global Positioning System (GPS), Internet of Things (IoT), Internet Protocol (IP).

I. INTRODUCTION

The web of things or IoT is an arrangement of interrelated registering gadgets, mechanical and computerized machines, objects, animals or individuals that are provided with novel identifiers and the capacity to move information over a system without expecting human-to-human or human-to-PC interaction [3]. IoT is to achieve secure and fast in order to arranging, support, updating, information mining, slanting, revealing, checking, detecting, following, finding, alarming, booking, controlling, ensuring, logging, evaluating the information[2]. In our clamoring life, we are disregarding everything that we have to do. IoT consist the following activities such as

- Collect the data – acquire the data from world using sensor
- Processing – Done the process on the collected data
- Store and publish the data

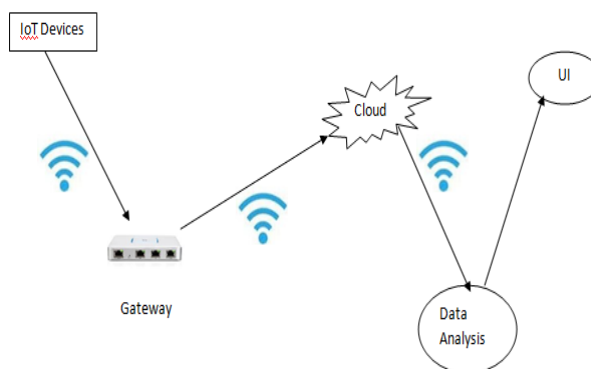
A. Components of IoT

- Sensors like to measure the temperature, Acoustic, sound, Automotive, transportation, vibration ,

humidity, environmental pollution sensor, Flow, fluid, Velocity, chemical, electric etc

- Devices
- Gateway, bridges and interconnector.

In fig 1 Smart device are attached with sensors and actuators. Sensors are used to continuously collect the information and transmitted to the other layer. Smart devices are having the



control over the sensors. IoT gateway is bidirectional that control the traffic between the protocols. It is bidirectional and provides interoperability [11]. The data can be analyzed and given to the user through User Interface (UI).

Fig. 1. Components of IoT

B. Functionalities of IoT system

- Information and analysis
- Automation and control

C. Characteristics of IoT

- Self configuring- devices configured with infrastructure automatically
- Self adapting – adapt to the environment eg. Surveillance system
- Integrated – one device can describe other device and communicated by themselves
- Interoperable – support different technology and protocol in the layer of IoT
- Unique Identification – Unique IP address will be given to each device in the environment[12]

D. Structure of IoT

In the fig 2 describes the structure of IoT system. The raw data collected from IoT nodes and devices using sensor. The data can be stored in the cloud server using service provider. The data can be filtered, preprocessed, categorized before storing in the cloud. Finally the data can be provided to the end user [13].

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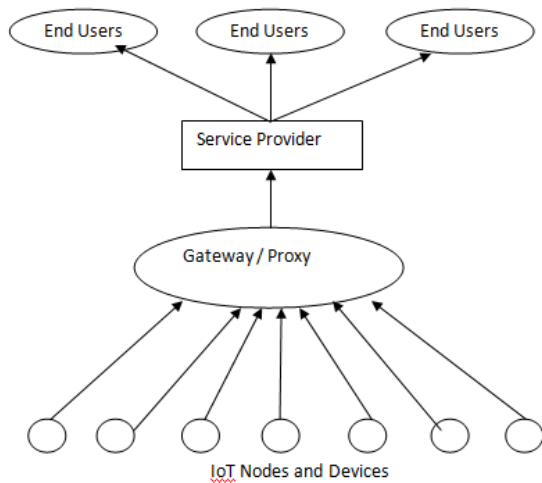


Fig. 2. Structure of IoT

E. Categories of IoT System

- Smart cities
- Intelligent building
- Intelligent living
- Health, retails, agriculture ,emergency services

F. 3 layers of IoT

- Application Layer
- Network Layer
- Sensor Layer

G. Architecture of IoT

The sensor layer used to sense the data and ability to emit accept and process the information. The data conversion from analog to digital is performed in the data acquisition system [5]. Once the data is collected from sensors it can be stored in the data center or cloud [14]. Before storing the information it can be analyzed or preprocessed for further [6].The architecture of IoT is given in fig 3.

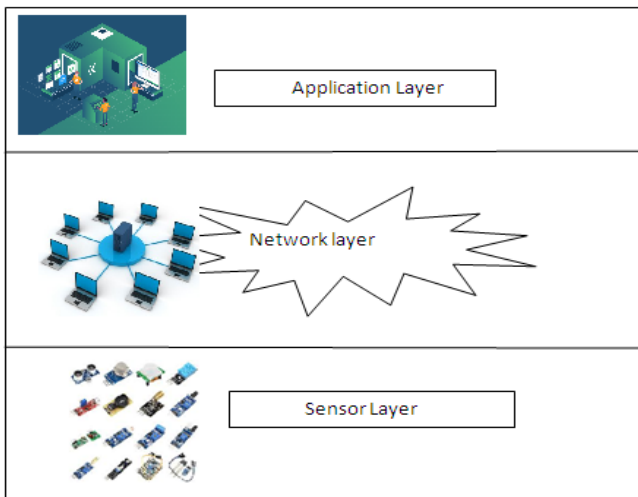


Fig. 3. Architecture of IoT

H. Wireless Communication Technologies of IoT

• RFID

RFID signals generate radio signals shown in fig 4. It is a wireless communication technology. The tag is used to track the object and store the information. RFID uses the

electromagnetic spectrum to uniquely identify an object such as pet animals or person. it can be classified into active tag, passive tag and semi passive tag. In active tag, it has a power resource to transmit the information back to the reader. In passive tag, reader has to send a radio wave to rely and submitting information back to the reader [15]. In semi passive tag, it uses the own power supply to manage the circuit and uses radio wave to get the information.

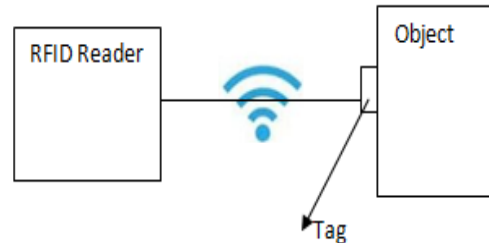


Fig. 4. Architecture of IoT

• Bluetooth

It is a wireless technology to send the information to the multiple people in a short distance. It can be classified into picconet and scatter net. The frequency of Bluetooth is 2.48 GHz [16].

• Zigbee

It enables the different vendors can share the information using interoperability. It is the protocol used in home automation and smart system. It follows the mesh topology and the nodes connected in mesh network. Zigbee in IoT provides low cost, low power consumption in a reliable network [23]. It uses the AES-128 encryption technique. So the communication in the network is more secure.

• wifi

It is an easily manageable network and connects the things very easily to the network. The frequency can be 2.4 to 5 GHz in the IEEE 802.11ax. It is a reliable solution to the issues in the connectivity. It provides the high security over the network. it is reliable, scalable and ease of deployment [17].

I. Wired communication technologies

The wired communication technology can be classified as internal and external communication.

• Internal Communication

- Inter Integrated Circuits
- Serial Peripheral Interface

• External Communication

- USB
- Ethernet
- RS-232
- USART

J. Mini Computer used in IoT

The Arduino and Raspberry Pi are commonly used in IoT development. Raspberry pi is fully functioned minicomputer and very small like debit card. But the Arduino is a microcontroller and not computer [18].

• Raspberry Pi

It is comprised of processor, graphics card, memory and display. It does not have internal memory and uses the cards as external memory. It provides independent network connectivity and mostly used in the linux environment. It can perform all the task as a computer. The components used in Raspberry Pi are SD Card, Micro USB, HDMI.

Advantages:

- Wireless Communication
- Interoperability
- Operating in Linux environment
- Can do multiple task
- Easy interface with sensor
- Low cost
- Support different languages

Disadvantages:

- Poor power consumption
- No internal Memory
- Closed source

• Arduino

Arduino is a microcontroller that can do only one program at a time. It is comprised into USB Connector, Automatic power switch, Digital & power pins and reset switch. It is very comfortable to use. It can easily interface with sensor and devices. It uses only Arduino language, C,C++. It have good battery pack. It will start when the plug is connected and automatically disconnected when the plug is removed[19].

Advantages:

- support windows and linux
- less expensive
- open source
- simple programming languages

Disadvantages:

- Less powerful
- Less memory
- connect with internet
- only one at a time

K. Challenges of IoT

- Authentication and authorized devices
- Secure communication between networks
- High availability
- Device update
- Privacy and integrity
- Detect the hacker
- Predict and resolve the issues

L. Applications of IoT

- Healthcare management using IoT
 - Wearable devices
 - Monitor the fitness & health
 - Cancer treatment
 - Glucose monitoring

- Insulin delivery
- Patient health monitoring
- Monitoring depression
- Disaster alert
 - Earthquake
 - Fire
 - Landslides
 - Tsunami
- Smart grid
 - Smart energy consumption
 - Reduce the peak load in batteries
 - Low cost for routing
 - Water management
- Smart farming
 - Smart irrigation
 - Crop monitoring
 - SMS Notifications in smart farming
 - Collecting information
 - Analyzing data for prediction
 - Low cost
- Home automation
 - Smart lighting
 - Gas and smoke detection
 - Intrusion detection
 - Theft detection
 - Smart appliances
- Telematics
 - Digital supply chains and ecosystems

II. INNOVATIVE SOLUTION FOR TRAFFIC CONGESTION

A. Traffic Light

In this topic discussed the innovative solution for traffic congestion using IoT. The smart city involves the smart highway, smart industry, smart factory and hospital [4]. The proposed city wise transportation framework is progressively adaptable also, solid contrasted with the other existing city transportation system. A structure for the traffic observing by means of advanced cell based estimation framework and the utilization based protection [3]. The reason for this proposed system is to display, see and control the traffic stream [20]. Its proficiency depends on the exactness in choosing and adjusting of the degree [2]. It requires streamlining the traffic stream. A factor that may be upgraded by inductions produced using real usage of the innovation. Subsequently to draw significant bits of knowledge, the meta information about the whole operational procedures will hold a key position in deciding how much worth include the framework gives and how it tends to be optimization.

B. Smart Parking

The smart parking technology is widely used nowadays. In this chapter proposed an idea for both 2 and 4 wheeler using the IoT technology.

Implementation of smart parking technology can reduce the traffic congestion automatically [1]. The sensors are available to send notification to the drivers. The empty parking spaces are apparent to the driver very easily. So we can park the vehicle easily in the smart parking. Sensor is used to detect whether the car is in free space or not. The green, red signals are used accordingly to send notification to the driver [7]. As

opposed to filtering the side of the street for free spaces, a, the driver can look straight ahead and see accessible, by using the green light [6]. This additionally enables them to design their parking well ahead of time, cautioning the driver behind them that they are going to maneuver into the space.

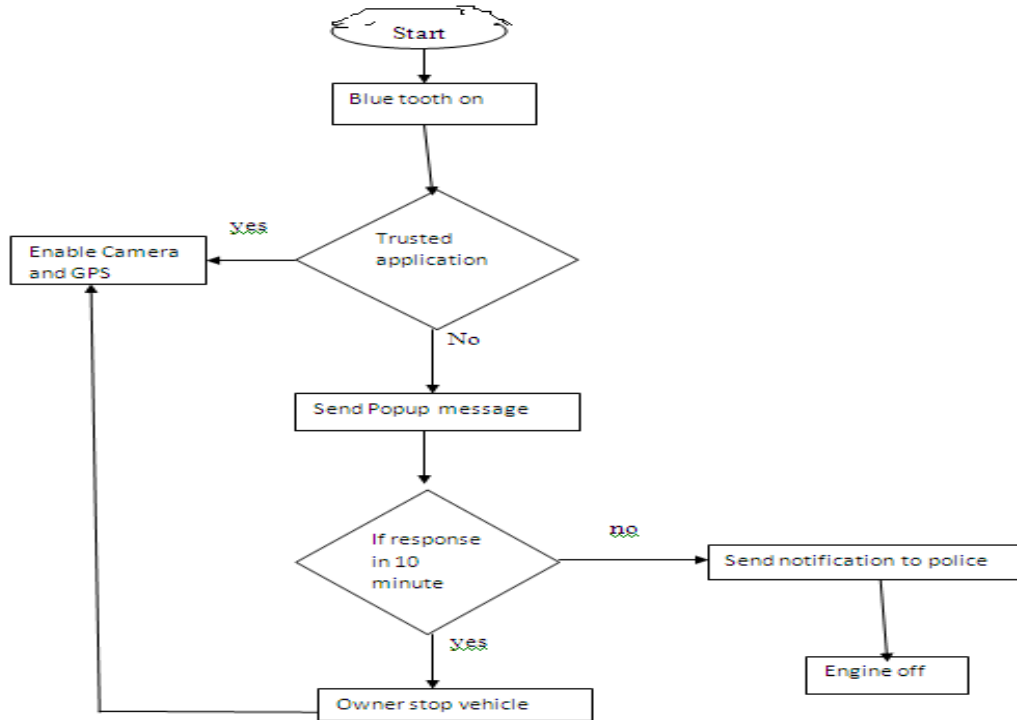


Fig. 5. Smart Security System

III. VEHICLE SMART SECURITY SYSTEM

A vehicle is wheeled motor used for transportation. In this system the vehicle will power by IoT. The microcontroller plays a vital role. The car will start the owners mobile connected through Bluetooth [2]. If it receives a command from owners mobile then we can operate the vehicle safely. If anyone steals the vehicle then the system sends a message to the owner mobile. Within time limit owners has to send the reply for notification. If not then the pin camera will start to focus and send detail along with GPS location[21]. If not yet get the response from the owner then automatically sent a complaint to the police [1]. It uses the Zigbee and GPRS technology. It comprises the electronic tag, detection device and an alarm device. A vehicle owner tag is carried with vehicle owner name and plate number. These two have both wakes up and sleep mode. The following fig 5 gives the working flow of smart security system.

In vehicle system the driver should connect with Bluetooth. Then it will search for the correct owner permission from trusted application. Both driver and owner application connected by the IoT [22]. The vehicle movement and running time and other details sent frequently to the owner. If some stealer tried to steal a vehicle, first the camera in the steering sent a photo in the driver seat to the owner through popup message [2]. If owner is not responded then the information along with the details of stealer sent to police

within 10 minutes. By using GPS technology the details was updated.

IV. CONCLUSION

The Internet is a huge system of interconnected PCs spread over the world. It has been a channel facilitating various roads of administrations and data. Individuals are presently associated with one another more than ever [1]. The wide applications of IoT in different places like smart grid, smart home, smart city etc. it can be used to collect the information for taking right decision, track the quality of things at home, monitoring the things in smart city and home, and it replaces the human with reduces cost[4]. In this chapter we proposed a solution for smart city by using the concept of traffic congestion control and smart parking in the roadways. The vehicle smart security system can predict the stealer from theft and periodic monitoring was happened and the details of vehicle sent to the owner using GPS technology [8].

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