Smart Parking System in IOT Technology

Guntimadugu Pooja, Katta R G Varshini, Shaik Saba Farheen, M Nirmala*

Department of CSE, New Horizon College of Engineering, Bangalore, Karnataka, India

* Associate Professor, Computer Science and Engineering, New Horizon College of Engineering, Bangalore,

Karnataka, India

ABSTRACT

A simple and easy task such as parking is thought as a tedious and time-consuming process due to mismanagement of parking system. Current parking systems involve huge manpower for management and requires user to search for parking space floor by floor. Such conventional systems utilize more power, along with user's valuable time. This paper presents a Smart Parking Energy Management solution for a structured environment such as a multi- storied office parking area. The system proposes implementation of state-of-the-art Internet of Things (IoT) technology to mold with advanced Honeywell sensors and controllers to obtain a systematic parking system for users. Unoccupied vehicle parking spaces are indicated using lamps and users are guided to an empty parking space, thus eliminating need for searching for a parking space. The occupied parking spaces are virtually stored to the cloud to be accessed by central system and direct the upcoming cars to empty spaces. The automatically controlled light illuminance helps reduce energy usage, along with lighting up the parking space to the user whilst in the parking space. The entire system being fully automatic leads to reduced manpower involved and improves illuminance aesthetics of the parking area.

Keywords: Internet of Things; Cloud Computing; Smart Parking; Smart City; Cloud of Things

I. INTRODUCTION

The concept of Internet of Things (IoT) started with things with identity communication devices. The devices could be tracked, controlled or monitored using remote computers connected through Internet. IoT extends the use of Internet providing the communication, and thus inter-network of the devices and physical objects, or 'Things'. The two prominent words in IoT are "internet" and "things". Internet means a vast global network of connected servers, computers, tablets and mobiles using the internationally used protocols and connecting systems. Internet enables sending, receiving, or communicating of information. Thing in English has number of uses and meanings. Dictionary meaning of 'Thing' is a term used to reference to a physical object, an action or idea, situation or activity, in case when we do not wish to be precise. IoT, in general consists of inter-network of the devices and physical objects, number of objects can gather the data at remote locations and communicate to units managing, acquiring, organizing and analyzing the data in the processes and services. It provides a vision where things (wearable, watch, alarm clock, home devices, surrounding objects with) become smart and behave alive through sensing, computing and communicating by embedded small devices which interact with remote objects or persons through connectivity. The scalable and robust nature of Cloud computing is allowing

developers to create and host their applications on it. Cloud acts as a perfect partner for IoT as it acts as a platform where all the sensor data can be stored and accessed from remote locations[11]. These factors gave rise to the amalgamation of both technologies thus leading to the formation of a new technology called Cloud of Things(CoT). In CoT the things(nodes) could be accessed, monitored and controlled from any remote location through the cloud. Due to high scalability in cloud any number of node could be added or removed from the IoT system on a real time basis. In simple terms IoT can be explained in form of an equation stating: Physical Object + Controller, Sensor and Actuators + Internet = Internet of Things The ideal of creating a Smart City is now becoming possible with the emergence of the Internet of Things. One of the key issues that smart cities relate to are car parking facilities and traffic management systems[3]. In present day cities finding an available parking spot is always difficult for drivers, and it tends to become harder with ever increasing number of private car users. This situation can be seen as an opportunity for smart cities to undertake actions in order enhance the efficiency their parking resources thus leading to reduction in searching times, traffic congestion and road accidents

II. METHODS AND MATERIAL

Cloud computing and IoT have witnessed large evolution. Both the technologies have their advantages, however several mutual advantages can be foreseen from their integration. On one hand, IoT can address its technological constraints such as storage, processing resources of Cloud[4]. On the other hand, Cloud can also extend its reach to deal with real world entities in a more distributed and dynamic fashion by the use of IoT. Basically, the Cloud acts as an intermediate between things and applications, in order to hide all the complexities and functionalities necessary for running the application. Below are some of the factors that led to the amalgamation of Cloud and IoT:

1. Storage capacity: IoT comprises of a large number of information sources (things), which produce huge amounts of non-structured or semi-structured data. As a result IoT requires collecting, accessing, processing, visualizing and sharing large amounts of data[14]. Cloud provides unlimited, low-cost, and on-demand storage capacity, thus making it the best and most cost effective solution to deal with data generated by IoT. The data stored on the Cloud can be accessed and visualized from anywhere through standard APIs

2. Computation power: The devices being used under IoT have limited processing capabilities. Data collected from various sensors is usually transmitted to more powerful nodes where its aggregation and processing can be done.

3. Communication resources. The basic functionality of IoT is to make IP-enabled devices communicate with one another through dedicated set of hardware. Cloud computing offers cheap and effective ways of connecting, tracking, and managing devices from anywhere over the internet[16]. By the use of built-in applications IoT systems could monitor and control things on a real-time basis through remote locations.

4. Scalability: Cloud provides a scalable approach towards IoT. It allows increase or decrease in resources in a dynamic fashion. Any number of "things" could be added or subtracted from the system when cloud integration is provided.

5. Availability: Any time any where availability of resources becomes very easy with cloud integration. Many of the cloud providers assure 5 nine availability. With cloud, the applications are always up and running and continuous services are being provided to the end users.

6. Interoperability: IoT involves the use of devices that are heterogeneous in nature. These devices may have different hardware or software configurations as a result causing compatibility issues. It becomes very difficult in an IoT environment to ensure interoperability among these devices[19]. Cloud helps in addressing this problem as it provides a common platform where various devices can connect and interact. Devices are allowed to share and exchange data in a format that is acceptable to them.

III. RESULTS AND DISCUSSION

This section describes the high level architecture for the smart parking system along with a mathematical model. The parking system that we propose comprises of various actors that work in sync with one another. Below is the mathematical model that defines our smart parking system.

A. Parking Sensors

For our parking system we have made use of sensors like Infrared, Passive Infrared(PIR) and Ultrasonic Sensors. The work of these sensors is the same i.e. to sense the parking area and determine whether a parking slot is vacant or not. In this case we are using ultrasonic sensors to detect the presence of a car. The ultrasonic sensors are wirelessly connected to raspberry pi using the ESP8266 chip. An ESP8266 WiFi chip comprises of a self contained SOC with integrated TCP/IP protocol stack that allows any microcontroller to access a WiFi network. The sensors are connected to a 5V supply either from raspberry pi or an external source. External source being more preferable..

B. Processing Unit

It comprises of Raspberry pi which is a processor on chip. The processing unit acts like an intermediate between the sensors and cloud. All the sensors are wirelessly connected to the processing unit. A single raspberry pi unit comprises of 26 GPIO pins i.e. 26 different sensors can be connected to it. However we can increase this number by attaching a multiplexer (MUX) to it. It is essential that the ground of raspberry pi and sensors must be connected in order to transfer data using the GPIO pins. There is a python script running on the chip that checks the status of various GPIO pins and updates this information onto the cloud. Data collected from various sensors is sent to the raspberry pi through the esp8266 chip. The raspberry pi then transmits this data to the IBM MQTT Server through MQTT protocol over a channel. MQTT[15] (Message Queue Telemetry Transport) Protocol is a publish-subscribe based "light weight" messaging protocol that is used on top of the TCP/IP protocol.

C. Mobile Application

The mobile application acts like an interface for the end users to interact with the system. The application is developed in Apache Cordova and Angular Js framework using Javascript as a programming language. The purpose of using Apache Cordova is to create applications that can run on both android and iOS platform with the same source code. The application is connected with the IBM MQTT server through a secure channel and a

2 factor authorization. The purpose of this mobile application is to provide information regarding availability of parking spaces and allowing the end user to book a slot accordingly. Transfer of data takes place in JSON format between IBM MQTT server and the mobile application. In order to ensure proper communication both the Raspberry pi and mobile application must be subscribed to a particular channel on IBM MQTT server.

IV. CONCLUSION

The concept of Smart Cities have always been a dream for humanity. Since the past couple of years large advancements have been made in making smart cities a reality. The growth of Internet of Things and Cloud technologies have give rise to new possibilities in terms of smart cities. Smart parking facilities and traffic management systems have always been at the core of constructing smart cities . In this paper, we address the issue of parking and present an IoT based Cloud integrated smart parking system. The system that we propose provides real time information regarding availability of parking slots in a parking area. Users from remote locations could book a parking slot for them by the use of our mobile application. The efforts made in this paper are indented to improve the parking facilities of a city and thereby aiming to enhance the quality of life of its people.

V. REFERENCES

[1].   Rico, J., Sancho, J., Cendon, B., & Camus, M. (2013, March). Parking easier by using context information of a smart city: Enabling fast search and management of parking resources. In Advanced Information Networking and Applications Workshops (WAINA), 2013 27th International Conference on (pp. 1380-1385)IEEE.

[2].   Zheng, Y., Rajasegarar, S., & Leckie, C. (2015, April). Parking availability prediction for sensor- enabled car parks in smart cities. In Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP), 2015 IEEE Tenth International Conference on (pp. 1-6). IEEE.

[3].   Botta, A., de Donato, W., Persico, V., & Pescapé, A. (2014, August). On the Integration of Cloud Computing and Internet of Things. In Future Internet of Things and Cloud (FiCloud), 2014 International Conference on (pp. 23-30) IEEE.