SMART CAR PARKING SYSTEM USING IOT

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Abstract: In recent times the concept of smart cities has gained grate popularity. Thanks to the evolution of Internet of things the idea of smart city now seems to be achievable. Consistent efforts are being made in the field of IoT in order to maximize the productivity and reliability of urban infrastructure. Problems such as, traffic congestion, limited car parking facilities and road safety are being addressed by IoT. In this paper, we present an IoT based cloud integrated smart parking system. The proposed Smart Parking system consists of an on-site deployment of an IoT module that is used to monitor and signalize the state of availability of each single parking space. A mobile application is also provided that allows an end user to check the availability of parking space and book a parking slot accordingly. The paper also describes a high-level view of the system architecture. Towards the end, the paper discusses the working of the system in form of a use case that proves the correctness of the proposed model.

Index Terms **- Internet of Things; Cloud Computing; Smart Parking; Smart City; Cloud of Things**

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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. 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 nodes 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 idea of creating a Smart City is now becoming possible with the emergence of the Internet of Things. One of the key issues that are related smart cities is car parking facilities and traffic management systems. 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. Problems pertaining to parking and traffic congestion can be solved if the drivers can be informed in advance about the availability of parking spaces at and around their intended destination. Recent advances in creating low-cost, low-power embedded systems are helping developers to build new applications for Internet of Things. Followed by the developments in sensor technology, many modern cities have opted for deploying various IoT based systems in and around the cities for the purpose of monitoring, using a mobile application that is connected to the cloud. The system helps a user know the availability of parking spaces on a real time basis.

II. RELATED WORK

In Prepaid Energy Meter with GSM Technology, the prepaid card is recharged for a certain amount and can be fed as input to the Microcontroller. The microcontroller is programmed such that power supply will be switched off by using relay when the recharged amount gets used up. The GSM communication module is used to send a message to the person about which parking slot is empty or full and also LCD display is used to display the balance amount.

In [2], it focuses on android app. It consist a Bluetooth module. The Bluetooth module is interface to micro-controller. For the connection purpose Bluetooth module scan for new devices. To transmit or receive the signals to/from android cell phone we have to pair with that Bluetooth module or by default it will auto pair with cell phone. After successful pairing with Bluetooth

module we transmit or receive the signal. Depending upon the IR receiver signal to micro-controller it sends a signal to android cell phone.

In "Automated car parking system commanded by android application, Internet of Things (IoT) plays a vital role in connecting the surrounding environmental things to the network and makes it easy to access those un-internet things from any remote location. People are facing problems in finding available parking slots in a city. In this study they design a Smart Parking System (SPS) which helps the user to find the nearest parking area and provides information regarding the availability of parking slots in that respective parking area. This ensures on reducing the time in finding the parking slots and also it avoids the unnecessary travelling through filled parking lots, which in turn reduces the fuel consumption and pollution. This paper introduces an algorithm that increases the efficiency of the current cloud-based smart-parking system and develops a network architecture based on the Internet-of-Thing technology and it also calculates the user parking cost by considering the distance and the total number of free places in each car park [3].

In "Android based smart parking system using slot allocation and reservations", the proposed system is the combination of smart parking and the slot allocation with the Android application. In the existing system, a dynamic algorithm is carried out, which is a random allocation method. It randomly allocates parking lot to the users [4].
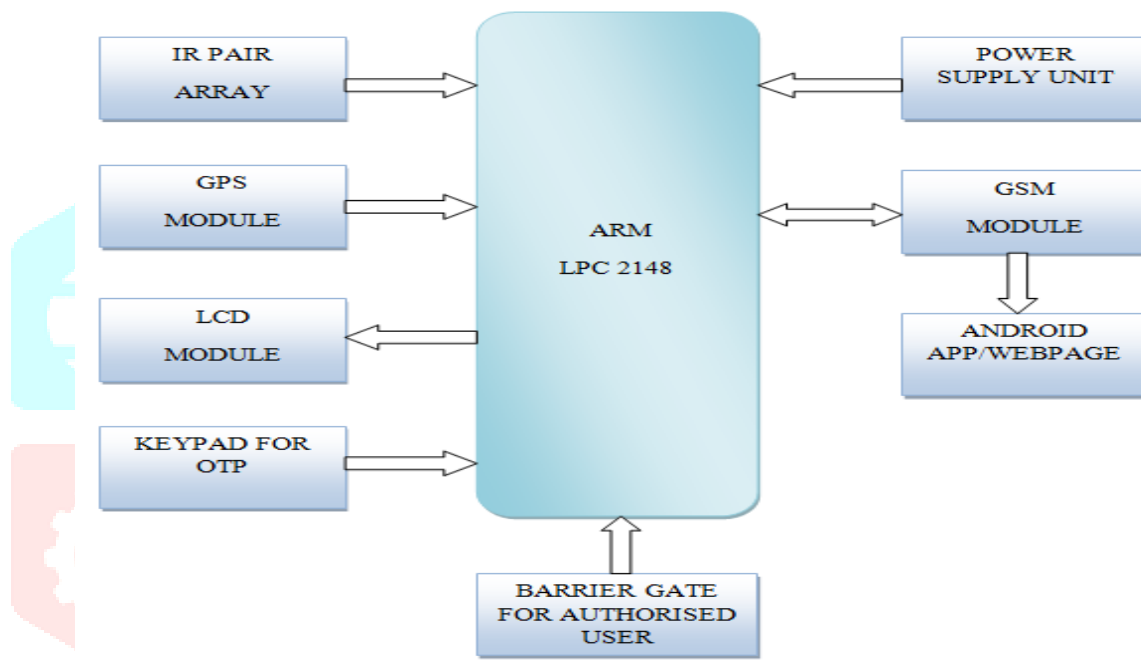
III. BLOCK DIAGRAM

Figure 1: Block Diagram

IV. SYSTEM DESIGN

This section describes the high level architecture for the smart parking system using IOT.
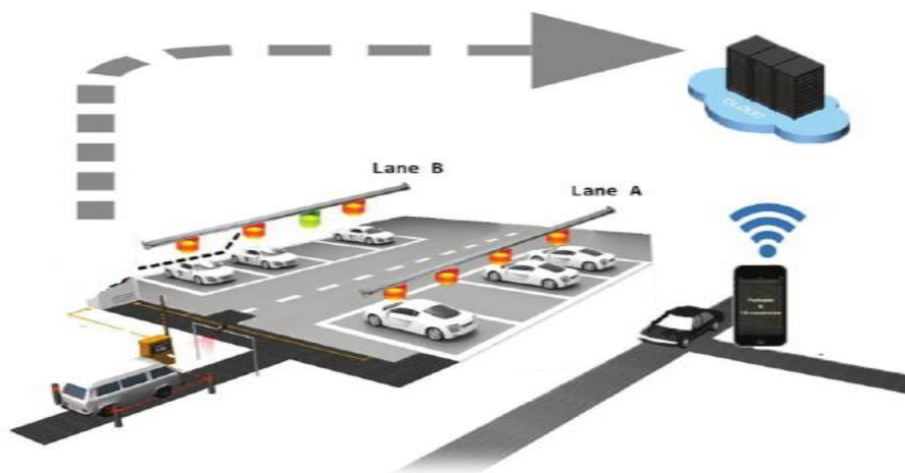

Figure 2: Smart Car Parking System

Talking of the above mentioned figure, it depicts a parking area where our parking system is implementation along with the way in which communication happens between various modules. The primary actors that constitute the parking system are:

☐ Parking Sensors: For our parking system we have made use of sensors like Infrared. The IR sensor senses the parking area and determines whether a parking slot is vacant or not. In this case we are using ultrasonic sensors to detect the presence of a car. The sensors are connected to a 5V supply either from LPC 2148 microcontroller or an external source.

☐ Processing Unit: It comprises of LPC 2148 microcontroller which is a processor on chip. The processing unit acts like an intermediate between the sensors and cloud.IR sensors are connected to the processing unit. A single microcontroller unit comprises of 26 GPIO pins i.e. 26 different sensors can be connected to it. It has 12MHz crystal for system clock and 32 KHz crystal for RTC. It has power on reset circuit with MCP130T brownout monitoring chip and power decoupling capacitors.

☐ Mobile application/Webpage: The mobile application/webpage acts like an interface for the end users to interact with the system. The purpose of this mobile application/webpage is to provide information regarding availability of parking spaces and allowing the end user to book a slot accordingly.

☐ The Cloud: Cloud acts as a data base to store all the records related to parking areas and end users that have access to the system. It keeps a track of every user connected to the system and maintains information such as time at which the car was parked, time duration for parking a car, amount paid by the user and mode of payment. It is due to the flexible nature of cloud which permits the system to add any number of users at any time of the day. Continuous backup is made of the data stored on cloud in order to ensure easy and quick recovery of data in case of any kind of system failure.

On closely looking at the figure one gets to see that empty parking spaces are indicated by red light in Lane A whereas green light in Lane B. This is due to the fact that in case of Lane A although there is no car currently parked but there still is a red light because the slot has already been booked by some user. On the other hand, the parking slot in Lane B shows green light because it neither has a booking nor a car parked in it.

V. IMPLEMENTATION

In the previous section we discussed about the architecture and technical stack related to the smart parking system. In this section we talk about the implementation and working of the system in a real world scenario. The complete process of booking a parking slot, parking a car in that slot and leaving the parking area is explained with the help of the following flow chart.
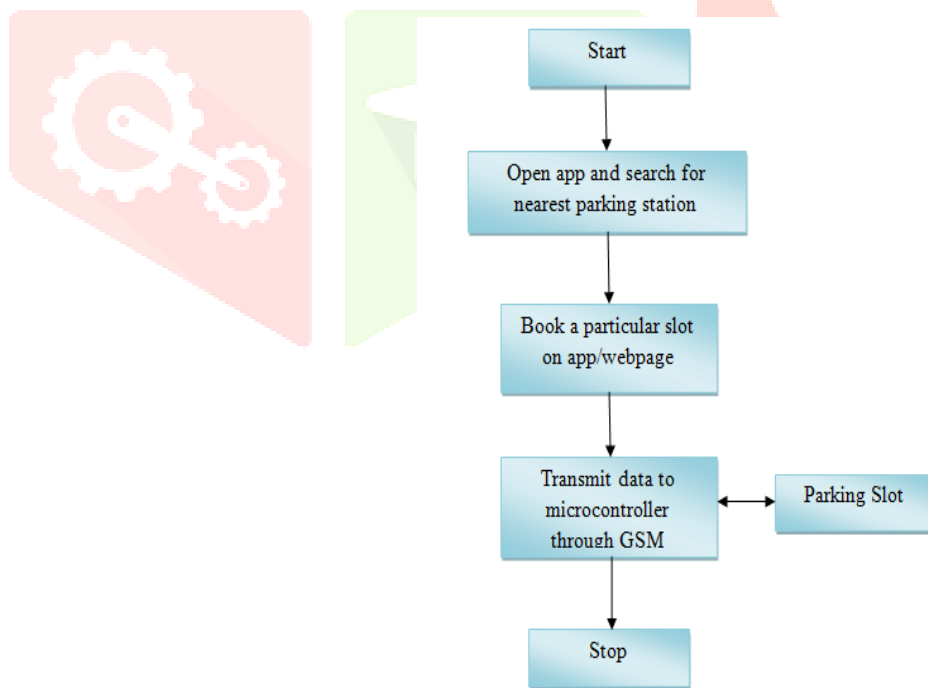

Figure 3: Flowchart of the system

We conducted an experiment in order to depict the working of our system at every stage from checking the availability of
parking space to actually park a car in a vacant parking slot. Below are the steps that a driver needs to follow in order to park its car using our parking system.

☐ **Step 1**: Install the smart parking application on your mobile device or open webpage of our system.
☐ **Step 2**: With the help of the mobile app or webpage search for a parking area on and around your destination.

☐ **Step 3**: Select a particular parking area.
☐ **Step 4**: Browse through the various parking slots available in that parking area.
☐ **Step 5**: Select a particular parking slot.
☐ **Step 6**: On booking barrier gate at the parking slot will be closed & OTP will be generated to user on his/her mobile device.
☐ **Step 7**: On reaching parking station user can enter OTP on keypad to open the barrier gate and user can park his/her car.

VI. CONCLUSION

This designed smart parking system which is simple, economic and provides effective solution to reduce carbon footprints in the atmosphere. It is well managed to access and map the status of parking slots from any remote location through android app or web browser. Thus it reduces the effort of finding the parking slots in any parking area and also it eliminates unnecessary travelling of vehicles across the filled parking slots in a city. So it reduces time and it is cost effective also.

VII. FUTURE SCOPE

The future scope to adopt this Smart Parking System so that availability of spaces could be displayed on a smart phone application or even to satellite navigation device so that drivers will always aware of whether there are free spaces are not. And also enhance to send some notifications to users smart phone when vehicle enters to particular shopping places and some streets in a city etc
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