Comprehensive study of Smart Parking System

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Abstract

Each and every vehicle trip ends in a parking situation. Truly, when one arrives at a destination by any motor vehicle one of the worst experiences is of parking. Increasing the number of vehicles in cities which also lead to problem of finding the parking place in public areas. Metro Cities noticed that during peak hours their drivers had real problems to find a parking space easily. At instant Driver not knowing where the parking spaces are available, it is root cause of parking difficulty. To nullify these inconveniences, in recent times many new technologies have been evolve that help in solving the parking problems to a huge level. In first section in this paper gives general idea about the model of smart parking system, their different categories and functionalities. Second section discusses the latest developments in parking system with technologies used and merits and demerits of each different smart parking system. Third section discuss solution of parking using Internet of Things (IoT). With the sensors, Wi-Fi module, RFID detector etc. the IoT maintains the database of the parked vehicles through a shared server. With the help of shared server drivers can find parking space via message on his/her mobile.

Keywords— Smart parking Systems, Sensors, Raspberry pi, RFID, ESP8266 , Internet of things (IOT).

1. INTRODUCTION

An intelligent parking system was developed to reduce the cost of hiring people and for best possible use of resources for car-park owners. Currently, the ordinary method of finding a parking space is manual where the driver usually finds a space in the street through luck and experience [1]. This method is time and effort consuming. If the driver is driving in a city with high vehicle density may lead to the worst case of failing to find any park space. In recent development, researcher has used vehicle to vehicle and vehicle to infrastructure interface with the support of various wireless technologies such as RFID, ZigBee, etc.

To solve the parking problems and take the benefit of the important development in technology, the IoT has created a revolution in many fields in life as well as in parking system technology. This paper proposes an effective cloud-based smart parking system solution based on the internet of things. Our system assemble each car park as an IoT network, and the data that include the vehicle GPS location, distance between car parking areas and number of free slots in car park areas will be transferred to the data center.

The Smart Parking System (SPS) is based on several innovative technologies and can automatically monitor and manage car parks. Furthermore, in the proposed system, each car park can function independently as a traditional car park. This research also implements a system prototype with wireless access in an open-source physical computing platform based on Arduino with RFID technology using a Smartphone that provides the communication and user interface for both the control system and the vehicles to verify the feasibility of the proposed system.

2. SMART PARKING SYSTEM

In today's world vehicles on the road are increasing by huge number. Sage(smart) parking system is an effective system which uses various components and technology to manage the parking area. Many cities have started using the concept of smart parking projects. It helps drivers to find satisfied parking places through technology which is used in communication and through information especially for on street parking.

It can also be defined as parking system that helps the drivers to find a vacant space using sensors that detect the presence of the vehicle and finally it will direct the drivers to available locations.

3. SURVEY ON PARKING SYSTEMS

Many cities viewed that the drivers had real time problems to find a parking space easily especially during peak hours, festivals season, etc. Even if the parking space is known, many vehicles may lead to small number of parking space which in turn leads to traffic congestion. Many approaches had been made to overcome the difficulties of parking area and as a result many system and technologies are developed for parking. With the help of various designs of smart parking system, it would be helpful for the people.

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The paper [2] proposed an IOT based parking system. This system includes RFID sensor, wireless senor, IR sensor, Raspberry pi, etc. Here the author uses the idea of online booking parking system. the parking area is divided into different slots. Each slot is allotted by one IR pair, one RFID, LEDs and buzzer. The slot is empty or not is known by the LEDs and AMR sensor. RFID tag is used for the entry of the vehicle as well as for the exit of the car. When RFID tag is not match with the car and vehicle is not parked at right place the Buzzer goes on. The whole data management of the system is governed by Raspberry pi.

In paper [3] the author proposed design and implementation of smart parking system which is based on wireless sensor that allow vehicle drivers to find the free parking space. The whole system is based on WSNs, Central Web server, Mobile application, etc. With the help of sensor node in parking slot the driver can detect the parking space and this report is passed to embedded web server and finally the information is sent to central web-server using Wi-Fi networks in real time.

The author [4] proposes a monitoring parking system with the help of wireless networks. System is divided in two modules: monitoring and master modules in order to help the drivers to find vacant parking slot. The presence of vehicles id detected by using infrared sensors which is infrared with the microcontroller and zigbee will receive the status information and master module will check for the available vacant places in parking.

The author proposes [5] an automatic smart parking system using IoT which helps the user to find the nearest parking area and free slot of parking in that area. The components included centralized server, Raspberry pi, image capture, etc. Cloud based Iot contains cloud service to store information about the status of parking slots and the centralized server which stores smart parking system information.

In [6] the author introduced parking system using cloud-based platforms as a service (Pass). The(Pass) provides the tools and services needed to create smart parking solution.

The author [7] presents the design and implementation for a wireless sensor network that can track available parking spaces in public parking areas in real time and communicate that to commuters. It consists of mica 2 wireless sensor and MTS310 integrated sensor board. The magnetometer is indicated on the sensor board.

The author [8] presents the issue of automation and modernization of car parking management by proposing a Car Parking Framework (CPF), and assessing its relevance with respect to the engineering and economic efficiency. The proposed framework is based on the integration of WSN and RFID technologies and builds around a modular approach to enable a variety of services. These include driver guidance, automatic payment, parking lot retrieval, security and vandalism detection. In this system author has proposed the clustering of a bunch of sensors and the use of hybrid wire/wireless communication.

In paper [9] the author has proposed a parking system which is secure and based on GSM technology. The system is divided into two parts: Iot monitoring and module based on security reservation. The important components used in the system are Pic microcontroller, LCD, motor driver, visual basic, GSM sim 900A, etc.

In paper [10] the author has designed an intelligent parking system and information system with the help of ARM8 microcontroller which can run on embedded system. An important feature of the system is that the status of the parking slot whether it is empty or not is updated simultaneously on the web or internet. The webcam helps to find the free slots for parking and it captures the images of slots at a time and displays it on LCD screen. If the slot is free it will display empty slot on the screen and if slot is not free it is will display red colour box. If someone wants to book parking slot, then he/she has to send slot number through SMS. The controller receives the information about the slot through GSM and after receiving the information the controller keeps the slot free. The components used are GSM module, LCD screen, ARM8 microcontroller, etc.

The author [11] proposes an automatic smart parking system using Bluetooth technology for exchanging data over short distances. In this system mechanical system is used to transport vehicles to and from parking lots without the help of any human being. When the driver enters the parking area the vehicle is placed on movable platform then he starts his Bluetooth and parking process starts. The Bluetooth reader fetches the user's Bluetooth id and stores in the database, the ARM microcontroller used here to compares the ID with numbers stored in database.

In [12] author proposes a low cost parking system which is also automated park management. These include security, guidance of driver, automatic payment, vandalism detection, etc. To implement this system, it includes: parking manager, gate manager and parking spots manager. In this paper author has used bunch of sensors and hybrid wireless communications instead of mote in every spot which has lots of drawback in terms of cost and consumption of energy.

The author in [13] presents a wireless smart parking system for locating parking slots with the help of smartphones. The system automatic processes the process of locating an available Parking spot and paying for it. If there is car parked on the parking slot or not can be known with the help of sensors which are placed on the parking spot. All the details of parking space are sending to backend with the help of servers. Once the user is within the range of 2km sever determines the closest available parking spot and sends the location to the user.

In [14] the author proposed the prototype which is designed through the MaSE methodology. The system considers 3 conditions: parking fees, the distance between the current location to the chosen car parking area and reservation or booking of car for parking. Negotiation algorithms are employed to bargain on parking prices and to calculate the shortest way for the driver.

4. DISCUSSION
From the above discussion we have made a table which shows the comparison of technology proposed by different user. Table also gives us advantages and disadvantages of each and every latest proposed technology. From the analysis of Table 1, we will propose a multi-tasking parking system which is based on expert systems that will help the drivers to park their vehicles in easy and comfortable way. Smart and automatic parking system helps to keep traffic congestion in control and reduces the noise and air pollution caused by vehicles.

Table 1: Advantages and disadvantages of different proposed smart parking system

Ref. no.	Method Used	Advantages	Disadvantages
Pham et. al[2]	IoT	• Control of theft of vehicle • Advance booking of parking • Proper management of vehicle • Parking slots state is saved in database	• Cost of the system is more • Complexity of design increases
Gandhi et. al[3]	Embedded technology	• WSNs technologies are easy to deploy in existing parking slots • With the help mobile device the driver can detect the parking slots state in real time • The information is saved in database	• No multilevel parking inside an infrastructure • Driver can't make a remote payment
Portilla et. al[4]	Zigbee	• Provides secured data transfer • System checks whether the vehicle that come to parking is registered • Check in information is stored in database • It is compatible	• Time consuming • Use of RFID increases the cost of the system • System allows one by one parking
Bhonge et. al[5]	IoT	• IoT plays vital role in connecting the surrounding environmental things to the network and made easy to access those things from any location • System reduces the time in finding parking slots and the fuel consumption	• Not provide guidance and payment for the driver • Addition of security features to protect the user privacy

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Basavaraju et. al[6]	Cloud based PaaS	• Faster smart parking system • Reducing time • Reducing cost and maintenance • One platform can flexible collaborate with another platform	• System does not provide guidance and payment for the driver • Availability of spaces could not be displayed on a smart phone • Addition of security features to protect the user privacy
Sinniah et. al[7]	Wireless sensor node	• Exact numbers of vehicles can be counted • Implementation of the system is easy • Portable device	• It is time consuming • Cost is more • If sensor fails then whole system fails
Boda et. al[8]	IoT	• Calculates the number of available parking spaces • Use of efficient data gathering protocol which further improves power efficiency	• Cost of the system is more • Complexity of design increases • It is not applicable to multi-parking management system.
Karbab et. al[9]	GSM and Zigbee	• Status of parking slot is provided in real time • Time saving as it will require less time to find space for parking • Low cost for implementation of Zigbee	• Cost of implementation is high • Drivers can't make reservation to enter and exit the parking
Mustapa et. al[10]	Embedded system and image processing	• Use of camera is effective and inexpensive • With the help of camera it will be easy to see the parking slots and presence of many cars • Theft of vehicles will be less	• Camera should be placed at proper place for the perfect view of parking • Weather condition may affect the visibility of the parking
DharmaReddy et. al[11]	Bluetooth	• CPF provides lots of services to drivers • Power consumption is less	• Parking can't help to prevent against car theft
Anand et. al[12]	GPS	• User can locate parking space from his/her Smartphone and can pay for it • With the help of GPS module user gets real time location	• Smartphone application works effectively if and only if the vehicle is in range of 2km.
Djenouri et. al[13]	Wireless	• Driver can search for parking space, pay for parking. Reservation of vehicle and can find the parking space • The system gives the user the distance from the current position to the chosen car park	• Cost of development of the system is high • Complexity of the design increases
Hancke et. al[14]	IoT	• Driver can find nearest parking area or slot for parking • System reduces fuel consumption	• Availability of spaces cannot be displayed on smart phones • System does not provide guidance to the drivers

5. FUTURE WORK

In the future work we will propose a smart parking system based on multi parking management. Our proposed system will be based on IoT. The working of the system is as under follow:

Form above study we found that lots of improvement is possible like power consumption, user friendly and use of latest technology for communication. We want to propose system where driver can book parking place online using mobile Application or at gate of parking place. Also our proposed parking system will use RFID to identify each vehicle. And Easy and Fast Communication Our proposed system will use ESP8266 and Raspberry-Pi. Our proposed parking location equipped with low cost ultrasonic sensor for the detection of vehicle.

Features:

- Easy to install
- Requires less power consumption.
- Maintenance is easy
- Easy to handle
- Low Cost.

6. CONCLUSION

The main idea of making smart parking system is to make parking area more effective and easy so that entire community can be benefited. This concept of smart parking system can solve many parking problems. This automatic parking system which is simple provides effective solution to reduce the carbon particles from the atmosphere. It reduces the time of the user and it is cost effective. The operation and quality performance of the system is dependent on the presence of parking vehicles. To implement this system in parking area would require a large space. The problem regarding power supply will be solved as there will be battery storage capacity for the system. Once by implementing this system, we will be able to control parking problems by hug number.

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