IoT based Car Parking and Display System with Minimized Parking Time using Raspberry Pi

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Abstract—In this research paper, an IoT based cloud integrated smart parking system is presented with raspberry Pi and the model is experimentally verified using Telnet app. 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. Moreover, an RFID tag is used in the work, which used to authenticate a user who reserves the parking slot on an hourly, daily, weekly or monthly basis. A scheduling algorithm is implemented to identify the nearest free slot based on the size of a vehicle. The owner of the parking space can get the analytics of the number of free and available slots for a given period, the occupancy rate on week days and weekend and the amount collected for a given period and can use it for fixing variable parking fees. The novel aspect of this work is the design of a mobile application to provide rich customer experience, thereby reducing the waiting time for the user in search of parking space. RFID technology is being used to avoid car theft.

Keywords— IOT (Internet of things), IR sensor, Smart parking, RFID, tags, Online registration.

I. INTRODUCTION

In recent times the concept of smart cities has become very popular. With the advancement of engineering, Internet of things (IoT) is emerging as the technology behind smart cities and automated electronics [1]. In large metropolitan cities large business places, famous shopping malls and tourist-attraction areas it is often very difficult to find a vacant parking space in the peak working hours. The time required for checking an available parking slot and the time required for parking is a function of the number of vehicles and this in turn leads to traffic problems in the places with limited parking space. Traffic congestion due to cars is an alarming trouble on a worldwide scale and it's been developing exponentially. Car parking hassle is a primary contributor and has been nonetheless the main trouble with constrained parking regions in city cities. Searching for a parking area is a normal and often frustrating task for lots of humans in cities.

Fig.1 Information parking system and smart parking system

and this process burns approximately a million barrels of the sector's oil every day. Most of the existing parking schemes are based on informative parking system (IPS) which provides information about location of parking areas and the number of vacant spaces in that parking area but it cannot locate the exact location of the vacant parking slot. This is shown in left hand side of Fig.1. To have a convenient parking facility it is required to also know the position of the free parking slot so that the parking time can be minimized effectively. Problems such as, traffic congestion, limited car parking facilities and road safety are being addressed by IoT. Therefore, most of the urban/developed countries are looking forward to smart parking system enabled by IoT with a low-cost and efficient working scheme as a solution to this problem.

An IoT based car parking system is shown in the right-hand side of Fig.1. Consistent efforts in research are being made in the field of IoT in order to maximize the productivity and reliability of urban infrastructure [2]-[8]. The working principle is that a citizen uses his/her cellular tool, a laptop having the Internet to get admission to the clever metropolis application from anywhere in the world to find a
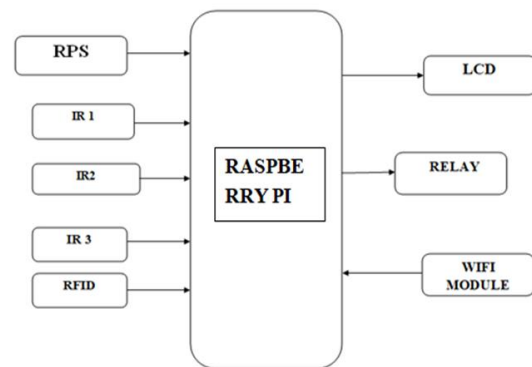

Fig.2 Block diagram of the proposed car parking system

free parking spot within the metropolis and get to recognize the position of the parking spot that continues to be free. The proposed IoT enabled car parking scheme affords inexperienced automobile parking management via some distance-flung parking spot localization and fast car retrieval. Presently, Car parking system is based totally on a reservation foundation, but this device has a drawback in phrases of time and region. This task management device can be grouped into multi-parking manipulate which can be used

to govern each outside and indoor parking location and single parking control which commonly objectives indoor parking plenty. A parking zone need to provide customers enough areas to park their automobile on the grounds that automobile plays a massive position in transportation, there's want for locating out parking place to park the cars.

In this paper, a new parking system based on internet of things technology is proposed. This system helps efficient management and an improved functionality is implemented for parking area. This enables the user about the information on the location of parking with accurate position followed by number of available parking slots and all other relevant parking information like level of the floor and signaling etc. This model is further extended to provide a rich application experience which is verified using Telnet app. The advantages of the proposed design are low-cost, high efficiency in showing the position of parking slot, minimized user waiting time and support for addition of extra features like total time of parking, number of users in queue, payment of parking bill. The working model, implementation of the algorithm and the experimental results are shown in the subsequent sections.

II.   LITERATURE REVIEW

Several solutions have been proposed previously to automate or improve the parking process in terms of slot availability and time consumption. A summary of the works is presented in this section.

Ultrasonic sensors are used for smart parking systems where the sensor is placed on the ceiling of the parking space. As ultrasonics sensors work on sound, the reflected sound is sent to the sensor and the LED display in front of the user is used to guide the driver for parking. When a car is present in the space, it will change the time of reflection and shows space unavailable. But such kind of ultrasonic sensors can detect any object not only a car and this may provide false information to the users. This system is not a smart parking system and it is only IPS based scheme as shown in Fig.1.

Neural networks are also used in parking applications which can very accurately detect a number plate. A specialized neural network chip is used for license plate identification and this system is highly stable and time-efficient. The video capturing mechanism of the car images along with the training data of artificial intelligence is used for car parking. But it requires video processing features and consumes the internet bandwidth of the user.

In another work, wide angle cameras are integrated with IoT systems that are connected to the cloud from where the transfer of data takes place. The advantage is cameras are used to detect free parking slots and only one camera is used for a set of slots. Convolutional neural network algorithm is used for this purpose and it is a complex and unreliable method for car parking application. There are some works which have used smart-phones for availability of parking slot This is a straightforward, easier and low-cost alternative to the car-parking problem where the QR codes are used to search cars and the QR codes are integrated for identifying the vacant parking position and the smart-phone navigation app will be used to guide the driver to the accurate location. The parking information must be encoded and fed as data for the QR code This model is not unique and flexible as it needs to be refreshed and fed with new encoded data each time a vacant slot is identified.

All these car-parking models can be implemented using some embedded systems collectively with Arduino, raspberry pi, ARM 7 which are used to expand internet of things applications. A few contemporary parking device which makes use of sensors to accumulate the records but the use of sensors like video sensors in a parking system are expensive so our purpose in this research work is to develop and design a method with much less fee with extra overall performance. As the range of population improved within the metropolitan towns, the want of vehicles additionally are increased. Ultimately, it causes issues in parking which leads to traffic congestion, using force frustration, and air pollution. Considering only-of-a-type public places like Shopping branch shops, multiplex cinema hall & accommodations throughout the competition time or weekends it creates parking trouble to many users. According to the modern research determined that it takes almost 8 mins to park his/her vehicle because of the fact that user spends more time searching the parking slot. These looking outcomes in 30 to 40% of visitor's congestion. So, the goal of the research is to lessen the parking problem and to do secured parking using the clever parking device. The parking device is designed on this type of manner that it should be applicable for blanketed parks, open parks and avenue facet parking.

III.   DESIGN IMPLEMENTATION OF THE PROPOSED SYSTEM

Fig.2 shows the block diagram of the proposed model in which the cloud is primarily based on absolutely IOT structure for smart parking device which includes cloud provider along with cloud garage to maintain records about the repute of parking slots in a parking vicinity and so on. The centralized server which manages to keep entire clever parking structures statistics collectively with number of slots, availability of motors and plenty of others. And these statistics might be accessed through a few secured gateways through the network.

Moving in the direction of smart metropolis, clever parking is a very good instance for a not unusual citizen of the way the IoT can be efficiently and correctly utilized in our everyday existence to offer distinctive services to special customers. Proposed software is person friendly or even non-technical character can use it via mobile device. Through this utility

Fig.3 Working model along with the display

consumer can search an unfastened parking slot from everywhere in the world. Proposed system gives properly-prepared vehicle parking management through remote parking spot localization. Conventional reservation-based vehicle parking approach has a hindrance of space and time. Proposed smart parking machine presenting the unfastened parking slot efficaciously that saves time and gas and reduces atmospheric pollution and congestion in towns. IOT primarily based new Parking platform allow to connect, analyze and automate records amassed from gadgets, and execute efficaciously that makes clever parking viable. Cloud storage is a cloud computing version, in which information is stored on faraway servers accessed from the net, or cloud. It is maintained, operated and managed with the aid of a cloud storage service issuer on garage servers which might be built on virtualization techniques. For a few pc proprietors, finding sufficient storage area to hold all of the data they've received is a real mission. Some human beings put money into large hard drives. Others select external garage devices like thumb drives or compact discs.

The working model along with display is shown in Fig.3. The controlling device of the entire system is a Microcontroller. Wi-Fi module, IR sensors are interfaced to the Microcontroller. IR sensors are fed as enter to the Microcontroller. The Microcontroller techniques this statistics and transmits over Wi-Fi, on the way to be obtained from mobile. In attaining the venture the controller is loaded with an application written using Embedded C language. The process of the online registration is captured as an image and it is shown in Fig.4. The user who wants to park the automobile is hooked up to the Wi-Fi community of that precise parking lot thru the password. The IR sensors ship the status to the microcontroller in which the data processing is completed. The microcontroller sends data to the webpage approximately the status of the slot to the consumer the usage of IOT. In this manner the consumer can park without problems and discover a parking spot with no congestion and in much less time. The results shown in Telnet app can be seen in Fig.5. Emp stands for Empty slot and full indicates that the parking slot is not vacant.

IV. CONCLUSION

A low-cost IoT based device that minimizes the parking time in a big-sized parking facility is proposed in this work. The system enables in maximizing the venue aera for the parking facility proprietors. It would also help lessen the need for manpower in the parking facility which would greatly reduce the value and mistakes of the technique. Also, this technique ought to decrease the usage of paper resulting in a green device for smart city. This device can be in addition prolonged to the reserving of parking's lots over a time frame. The cellular software can be extended to different operating systems which consist of iOS, Windows, and so on. In the server, data can even be extended to the protection measures together with heart, theft, and so forth. With these advantages the proposed car parking system is the most efficient model than the present systems.
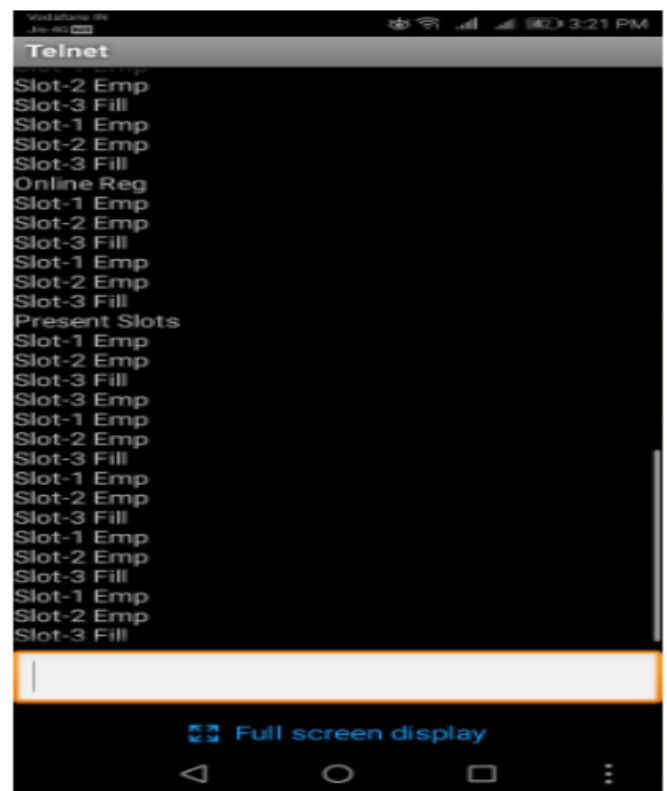

Fig.4 RFID card using for Online registration

Fig.5 Output results displayed Telnet app

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