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Vehicle Parking Management System

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***Abstract*- Due to the increasing population in urban cities, there is an exponential rise in the number of vehicles which is leading to major problems leading to poor traffic management and congestion. Another major problem faced by the vehicle owners is the availability of parking space. The idea of Smart Cities is slowly gaining pace with the ever increasing technologies. Therefore, in the proposed parking system we are integrating the Wireless Sensor Technology with the Android Application so that the user can book or pre- book a slot. The vehicle owner will be able to reserve a slot for his/her vehicle from anywhere and will be provided with a QR code which will be scanned on the entry of the parking area. Another feature our system provides is providing information about the near-by parking areas which comes handy when the current parking area is full.**

Keywords- WSNs, IR Sensors, Parking Area, QR code, Booking, Slot, Application

I. INTRODUCTION

In this system we focus to eradicate the problem of improper vehicle parking and unavailability of parking area. The basic technology our system uses is the WSN (Wireless Sensor Network) to detect if a vehicle is present in a specified slot. Wireless sensor networks (WSNs) organize and collect the data at a central location. WSNs measure environmental conditions like temperature, sound, pollution levels, humidity, wind, and so on. In our system, we will be making use of the IR sensors [1]. An infrared sensor is used to sense objects within its vicinity. IR sensors have the ability of measuring heat emissions and sensing motion. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion. IRsensors prove essential in detecting an obstacle within its range. Therefore, in our system they are used to detect if the vehicle is present or not in a particular slot. Further, the vehicle will be guided to the parking slot with the help of the application. The details of the vehicle owners and that of the vehicles are stored in the backend database and thereby the identity is verified right at the entrance. Therefore, our system provides security. Payment will be calculated on the basis of time. Our system provides flexibility of booking a parking slot through the application so they will not have to wander in search of a vacant slot in the parking area. Assistance will be provided to guide the vehicle owner to the empty parking slot thereby avoiding chaos. And the real time updates will help the user know which slot is available for parking the vehicle.

II. PROBLEM STATEMENT

As the city is developing and with increase in population, people are finding it difficult to park their vehicles. In some parking place there is no safety for the vehicle. There is a chance of theft or vehicles may get damaged. People waste their time to search vehicle parking place. To solve these problems „ Online Vehicle Parking Monitoring‟ is used. The basic concept of this project is that it reduces the time of the customer by providing proper packing facility. Any customer can book the available parking slot with particular time. This provides security to the customer. People keep roaming around in search of vacant parking slots, and after a lot of struggle, they find one. Due to lack of a proper mechanism to identify free parking slots, they keep wandering, searching for parking spaces frittering time. This problem can be solved if the drivers could check the availability of parking spaces in and around their intended destination.

III. OBJECTIVES

Based on the above problem statement, our system covers the following set of objectives:

- Faster reservation of a parking slot anytime and from anywhere.
- Providing information about nearby parking slots that are vacant.
- Online payment portal integration making it easier for the vehicle owners to complete the transaction.
- Graph Analysis depicting the typical peak hours when the parking area is most/least

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occupied.

- Directing the vehicle owner to the particular parking slot by providing directions in the application.
- QR code for verifying the user who has booked/reserved the parking slot.
- Payment calculation based on time for which the vehicle was parked.
- Storage of the vehicle and owner details in the backend.

IV. LITERATURE SURVEY

In the year 2017, D. Vakula and team proposed a vehicle parking system which was developed using the Internet of Things (IoT). The major technology used here is the Wireless Sensor Network Technology (WSNT). From this system we found out how ultrasonic sensors can be integrated with Raspberry Pi and Node MCU and how the information from Raspberry Pi can be transmitted to the front end GUI and back end database [1]. The information is fetched from the ultrasonic sensors that detect the presence or absence of a vehicle. This information is forwarded to the Node MCU. A single Node MCU takes care of 4-5 parking slots respectively. The Node MCU transmits this information to the Raspberry Pi that has an on- board Wi-Fi module which helps for internet connectivity. Hence the information of whether a parking slot is available or not is forwarded to the Front End (application/website) and the user/ administrator gets to know about the availability of the parking slot. Additionally, the vehicle entries are stored in the backend database hence keeping a record of the vehicles that have entered in the parking area, so that the details can be quickly and easily accessed. Database helps maintain all the vehicle and user records for future reference.

Advantages:

- It provides GUI so that you can see the available slots.

Disadvantages:

- No solution if parking slots are full. Does not display nearby parking area within the vicinity of the original parking area.

In 2017, Hemant Chaudhary, Prateek Bansal, Dr.B. Valarmathi came up with a Vehicle Parking System which is developed using IR sensors [2]. An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings. It does this by either emitting or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion. IR sensors prove essential in detecting an obstacle within its range. The major concern of their system was security. Therefore, they made use of RFID to authenticate a customer before he/she enters the parking area. Also, their system consisted of a gate at the entrance which would only open when the RFID scan was successful. For displaying if a slot is vacant or not, a LCD is used to display this information. If car is allowed to park, then mobile notification will be sent to the user about parking. It solves the parking issue in urban areas, also provides security to a vehicle and an unauthorized user is not allowed to enter into a parking place. It helps to park vehicle in multi -floored parking also as it will display which floor has free space.

Advantages:

- Every user gets an authorization RFID card which is verified and thereby only authentic car owners are allowed and only then will the gate open. Security is thereby taken care of.

Disadvantages:

- No GUI provided to see the available slots. Since Arduino was used external Wi-Fi module was required to transmit data to application.

Sarthak Mendiratta, Debopam Dey, Deepika Rani Sona developed an Automatic car parking system with visual indicator along with IoT and published a paper which focuses on the concept of car parking detection mechanism using the ultrasonic sensor, in combination with the usage of Internet of Things i.e. sending the status of the parking slot to the Internet [3] Through which the user at any place in the world can see which parking slot is empty and where to park. This is done by sending the data of ultrasonic sensor through our Wi-Fi module that is ESP8266 to any open source easy to use IOT platform that uses HTTP to display our data (thingspeak.com in this case). LEDs were used to display the availability status of a particular slot. If a particular slot is vacant, then green LED would glow and if the slot is occupied a red LED would glow. To switch between Red Bulb and the Green Bulb a relay module is used which is triggered by the 5 Volt pin of the Arduino Board and to glow the bulb, an AC power supply is used, which will be connected to the relay module. The two Ultrasonic Sensors are used to eliminate and minimize any manual or human interference thus increasing the efficiency of the overall system. Since they had used Arduino, so Wi-Fi connectivity was a major problem, so to eradicate this problem they had to use external Wi-Fi module i.e. ESP8266 for connectivity purpose.

Advantages:

- Does not provide a solution when the parking area is full.
- GUI is provided which helps the user to know beforehand which parking slot is empty. This system is cost effective.

Disadvantages:

- No online payment feature included. Nearby parking areas are not displayed in case the parking is full.

IoT based Vehicle Parking Manager was developed by the team of Desai, J., Bhanje, A., Biradar, S., & Fernandes in the year 2017 [4]. The main motive of this project was to provide a solution for resolving the parking issues that exist in public places such as malls, multiplexes, etc. especially on weekends. The objective was to achieve this by using the concept of Internet of Things (IoT), in which they developed an Android Application which provides brief details. This application provides certain functionalities that include identifying each vehicle uniquely, showing availablity of slots through the mobile application, and booking reservations for the same, maintenance of a database (for the management). Functionalities of the project for a user are: Representation of total parking slots in the parking lot, count of vacant parking slots, occupied parking slots and the reserved parking slots. Assigning QR code to customers/cars for identifying them uniquely. A user can check the balance, also check the transaction 'records of the previous parking done by them in the parking place, make reservations along with the timings. These transactional records and the QR code are displayed on the receipt that is generated. Features of the proposed project for managing the parking system are: A QR Code reader at the entry of the parking system to identify the unique ID associated with the vehicle and do the corresponding transactions (entry time, rate deduction etc.), An LCD at the gate to display the car number and the parking slot selected by the user, Parking slots status (fully reserved, totaltime slots), Earnings - Total/Per Customer/per week, View database of all the cars which entered the parking system along with the timings and the slots occupied., Recharge the customer's ID at the entry if required and Special reservations for VIP's (no time limit) Allow one time entries for vehicle without any unique ID.

Advantages:

- Provides a feature to view the availability of the parking slots through an application time. QR code scanning for authorization.

Disadvantages:

- Does not provide a solution when the parking area is full.

Khanna, A., & Anand, R. In the year 2016 came up with the IoT based smart parking system [5]. The paper they published, mainly focuses implementing a vehicle parking system using Wireless Sensor Network. The main sensors that were utilised in their system were the IR and the Ultrasonic Sensors to detect the presence or absence of a vehicle in a particular slot. Additionally, an application was provided to the users for interactive experience and for the ease of booking the parking slot from any location. The application showed which slot was currently vacant and could be booked while the ones which are occupied as well. Also, the user could be able to select the time for which the particular slot he/she was going to occupy (2 hours, 3 hours...5 hours.). The major highlight of this project we learnt was that the server was deployed on cloud. Therefore, all the storage of user and vehicle information was done on the cloud database. In case of a system failure, since cloud was used, it provided quick recovery thereby increasing the uptime and also provided the backup for the data. Time out notifications were sent to user through the mobile application thereby keeping them updated. The cost calculation was done on time basis. The timer used to start as soon as the vehicle occupied a particular slot. Once the driver had parked its car in the selected slot he/she needed to confirm its occupancy. This very scenario in which the driver had to specify its presence. This feature was added so that only a genuine driver can park its car in a particular parking slot. If a driver failed to confirm his occupancy in the next 30 secs of parking its car, an alarm would start ringing causing the authorities to know that a car has been parked in the wrong place

Advantages

- Provides cloud for the storage of vehicle and vehicle owner details. High detail view of system infrastructure.

- An application is provided through which customers are notified.

Disadvantages

- Does not provide a solution if the parking area is full.

Michel Owayjan, Bahaa Sleem, Elio Saad & Amer Maroun in the year 2017 [6] proposed a parking management system using a mobile application to address the parking problems in malls. The hardware part of this system consists of custom- made sensor units based on a phototransistor with an infrared transmitter that is responsible for determining if a cert ain parking space is occupied or free. The units were connect to a central controller wirelessly using Arduino microcontrollers with Ethernet shields. The central controller was a server hosting a database that is accessible through the developed mobile application. The software part of this system consisted of the mobile application which was developed using the Eclipse IDE and runs on the Android platform. It was connected to the database using JSON (JavaScript Object Notation) format. Using this mobile application, users were able to locate free parking spaces, check the parking fees, locate their cars, and can even perform the payment transactions.

Advantages

- Users can easily and quickly pre-book or book a slot through the GUI provided i.e. Android Application

Disadvantages

- On failure of main controller, the entire system fails.

V. EXISTING SYSTEM ARCHITECTURE

The architecture shown alongside [1] shows the overall functioning of the parking system. Each parking slot consists of

an ultrasonic sensor which will sense the presence of a vehicle. The information will further be forwarded to the node mcu which will be taking care of a few number of slots. There will be many such slot- nodemcu pairs will form a network and all of the will be connected to Raspberry Pi which will be connected to the internet due to the presence of inbuilt Wi-Fi module. The slot information will be displayed to the admin/user and all the details of the vehicle and its owners will be stored in database.

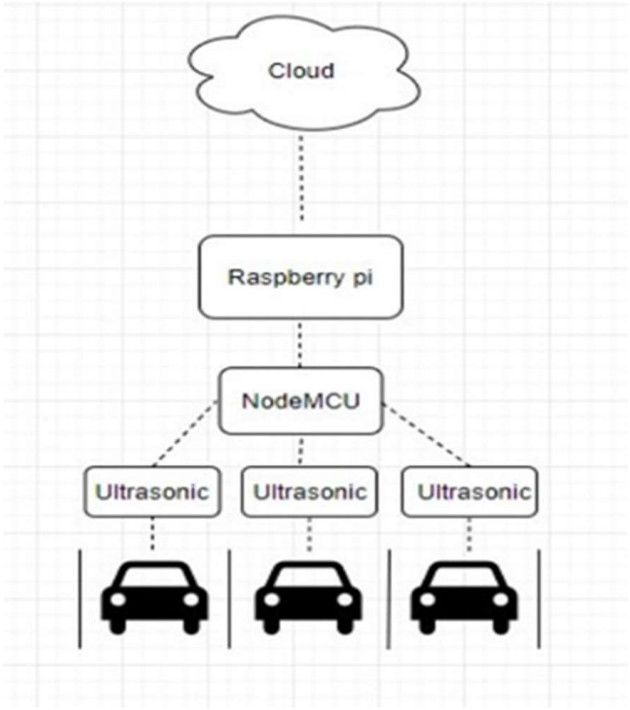

Fig1. Existing System Architecture

VI. PROPOSED SYSTEM ARCHITECTURE

Our proposed system works in the following way:

1. Vehicle Owner books/reserves the parking slot using the mobile application. In turn the user will get a QR code which will be used for verification later.

2. A window of 2 hours will be provided to the user within which he/she has to reach the parking area else, reservation is cancelled.

3. At the entrance, the user verifies the identity using the QR code and is assigned a particular parking slot based on the type of vehicle (car/bike).

4. Thereby, the application will guide the vehicle owner to the particular slot that has been assigned to him/her by giving the directions. Therefore, time won't be wasted in finding the parkingslot.

5. The details are stored at the backend when the QR code is scanned.

6. An additional feature our system provides is that it displays the vehicle density patterns in the parking area during different time periods of the day. This therefore will give an idea to the vehicle owner if he/she will get the reservation in that particular or not.

7. Suppose if the parking slot is full, our system will provide information for nearby parking areas within the vicinity of the main parking area.

8. If the user does not have an application or internet connectivity, then booking for that particular user will be done right at entrance of the parking area by providing a receipt or ticket. Therefore, additional features our system is providing is:

- Directions are provided to the parkingslot.
- Graph analysis of vehicle density in the parking area giving the user an idea of when the parking slot is vacant/full.
- Information about nearby vacant parking slots within the vicinity of the main parking slot.

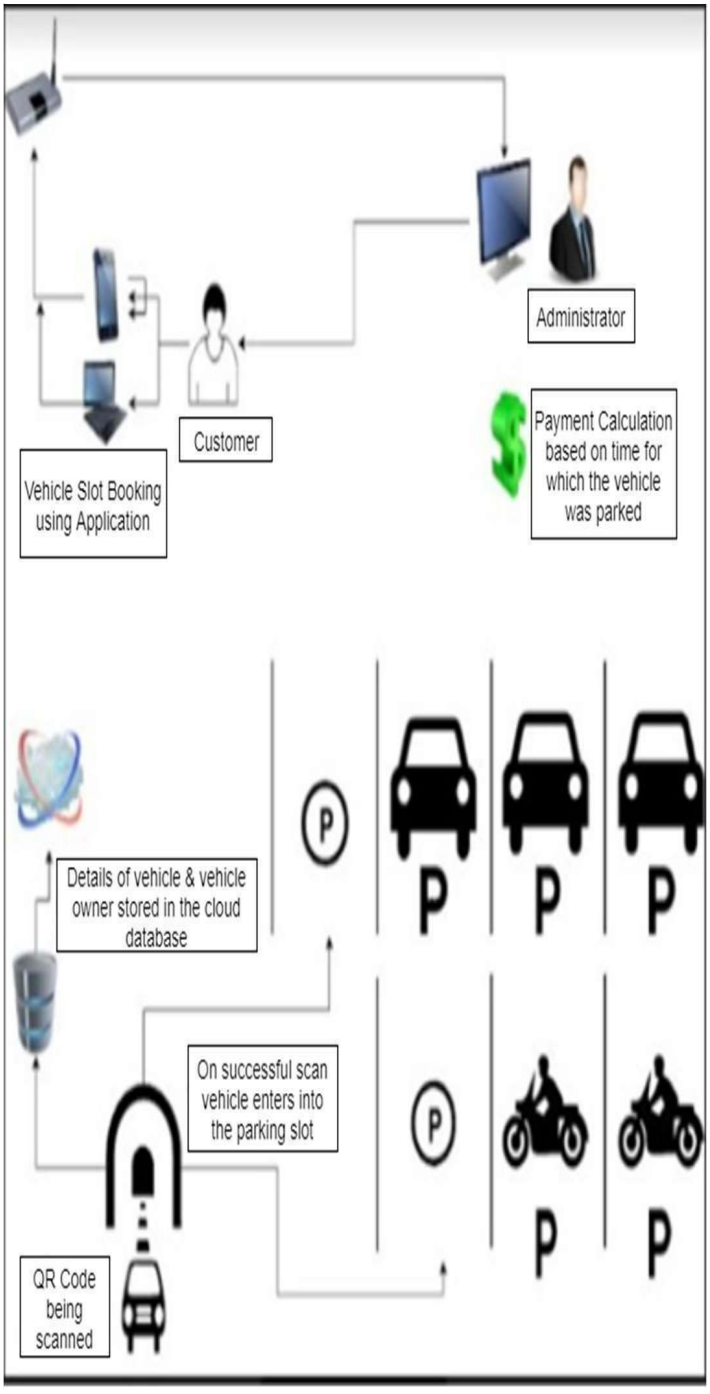

Fig 2. Proposed System Architecture

TABLE I. COMPARISON WITH EXISTING SYSTEMS

	GUI	Payment Portal	Application	Authentication	Nearby Parking Areas	Storing data on Cloud
Cost Smart Parking System for Smart Cities	✓	x	x	x	x	✓
Advanced car parking system using Arduino	x	x	x	✓	x	x
Automatic car parking system with visual indicator along with IoT	✓	x	x	x	x	✓
IoT based Vehicle Parking Manager	✓	x	✓	✓	x	x
IoT based smart parking system	✓	✓	✓	x	x	✓
Parking management system using mobile application.	✓	✓	✓	x	x	x
Vehicle Parking Management System (our paper)	✓	✓	✓	✓	✓	✓

VII. TECHNOLOGICAL STACK

1. Firebase which is a cloud service provided by google is basically used for storing car details, car owner details and parking slot details. This database will also store the time for which the vehicle was parked and fare calculation details. Also the data stored will be updated inreal-time.

2. Firebase cloud service is used for sending notifications to the user just before the timer is completed, as a warning, so that the user can extend the duration for parking the vehicle in that particular slot.

3. For the Software i.e. for application development:
   - Android Studio
   - Arduino IDE

4. For Hardware
   - IR Sensors and Node MCU

VIII. COMPARISON & RESULTS

Our system provides an upper hand in the following ways as shown in (Table 1):

1. Gives information about the nearby parking areas which helps users in case the main parking area is full.

2. The availability of GUI makes our system more user friendly and interactive and makes the overall process easier.

3. Dedicated application which helps to book slots from any time & anywhere.

4. User can check the availability of slots in real- time.

5. Pricing will be based on the time duration and it will be dynamic as per the number of hours.

6. Online payment option is available based on time for which the vehicle was parked.

7. Real Time updates for displaying availability of slots.

8. QR (Quick Response) code on the E-bill for user authentication.

9. Feedback mechanism for gaining user suggestions.

IX. CONCLUSION

By implementing this system, we are making the work of finding parking slots for private vehicles much easier. The interface provided by the system would be user friendly and interactive which will attract more customer base. This thereby will solve the problem of traffic jams causing inconvenience to the people on road. Finding parking slots will no more be a difficult task for the vehicle owners. Availability of these parking areas will be known beforehand. A proper bill and amount calculation based on the time for which the vehicle was parked is provided to the customers using this system.

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