

Analysis and Implementation of Smart Parking System Integrated with Customer Database using IoT

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Abstract: Due to increase in both population and in usage of cars the city experiences traffic congestion and air pollution. In order to overcome these issues, a scheduled parking system must be deployed. Roaming around the city for finding the free slots leads to traffic congestion and air pollution. For this problem many of them have suggested few solutions, but those solutions are not scalable and cost effective. This paper proposes a solution with pre-booking, cost effective and an scalable solution. This can be implemented using sensors and processors. The ultrasonic sensors are placed in each slots for finding the presence of cars and the data of ultrasonic sensor is fed to the Arduino Mega. The data from the Arduino Mega is transmitted to the cloud server using Node MCU and that information can be accessible by a user through mobile application or web page.

Keywords: Arduino Mega, Ultrasonic sensors, Node MCU, LCD, Cloud server, Mobile application and Web page.

Introduction

In India car sales has been rapidly increased in the last decade compared to all the other developing countries in the world. If the purchase of cars increases then the parking allotted for the cars must also be increased. Nowadays people visiting malls have been increased due to the reason that, all the goods are available in single market place and moreover theatres.

The IoT plays vital role in finding a solution to the parking. IoT is the emerging trend in 21st century. IoT is network of connecting devices; those devices could be tracked, controlled and monitored using remote processors that are connected through internet. Different protocols are used for communication between two devices. The cloud is the best technology to store the current data and information; it can also be processed for future reference. The processing speed is high compared to normal secondary storage device like hard disk. The major challenged faced by the parking management system in the Indian malls is finding a free slot. The manual slot finding increases the need of man power.

Arduino UNO is open source software for implementing our ideas in simple way. It has 14 digital IO pins of which six are used as PWM outputs six are analog inputs. The processor of an Arduino UNO is ATmega328P. It has 10 bit inbuilt ADC. Many of the real world sensors are analog sensors and thus use of Arduino UNO is more efficient than the use of other processors which doesn't have inbuilt ADC.

The ultrasonic sensor is used to find out the free slot in the parking place and the corresponding data is transfer into microcontroller for processing. The processed data is send to the cloud server or database and using webpage or mobile application corresponding free slot can be displayed in the web page. By this the information user can pre-book the slot or it is easy to find out the free slot in parking area. By using the app it can also display the exact amount of payment for the corresponding parking times.

Literature Survey

To Finding free parking slot in cities during peak hours is difficult for drivers. Especially for drivers new to city, because around 50 cars a day roam around the city in search of finding available parking spaces. In that paper they have developed Reservation-based Smart Parking System (RSPS) to optimize the parking. By making this reservation method the traffic volume of the city is reduced thereby the air pollution in the city is also reduced [1].

A Sensor network applications use Global synchronization which needs precise mapping of collected sensor data with the time of the events. It plays a vital role in energy conservation in MAC layer protocols. Four methods that is elaborated in the paper to achieve global synchronization is: node-based approach, diffusion-based method, and a fault-tolerant diffusion-based method [2]. Nowadays, increasing traffic congestion and auto theft are some of the major problems faced by the people in daily life. Vehicular communication is used in the paper for parking methods of larger parking lots. This provides the following information about the vehicles: real-time parking navigation service, intelligent antitheft protection, and friendly parking information dissemination [5]. The emerging technologies for future Intelligent Transportation Systems (ITS) for

vehicular based networks are Inter-Vehicle Communications (IVC) and Roadside to-Vehicle Communications (RVC) This paper presents RAR (Roadside-Aided Routing), a new efficient routing approach. This exploits the unique characteristics of vehicular networks [6].

System Overview

The sensor based car parking and pre-booking system is developed to finding a free slot in parking zone. The system detects the arrival and the departure of car for the can be find out using different types of sensors. The proposed system uses two ultrasonic sensors to identify the arrival and departure of car. The system also implements for pre-booking. Sensors are programmed using Arduino UNO micro-controller. The vehicle detection sensor is shown in the figure 1.



Figure 1. Vehicle Detection Sensors

Ultrasonic sensor

The Ultrasonic sensor is used to detect the presence of the car. Ultrasonic ranging module HC-SR04 provides 2cm -400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit.

Arduino UNO

The Arduino UNO has both analog and digital pins, since ultrasonic sensor is a digital sensor it is connected to the digital pin of the arduino. Arduino UNO interfaced with Node MCU is used to send the collected data from the ultrasonic sensor to the cloud. The Arduino UNO can be powered in two ways either by USB or barrel jack.

Block Diagram

Figure 2 shows block diagram of the proposed system with Arduino UNO and node MCU .The collected data is displayed on the LCD.

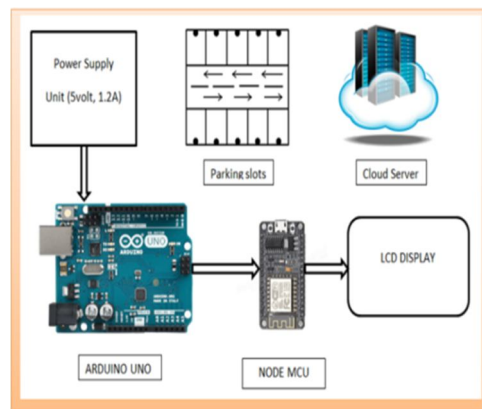


Figure 2. Block Diagram of the system

Figure 3 shows the block diagram the data stored in the cloud is displayed on the web page and mobile application.

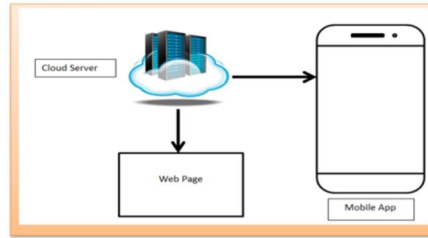


Figure 3. Block Diagram of the system

Flow Chart

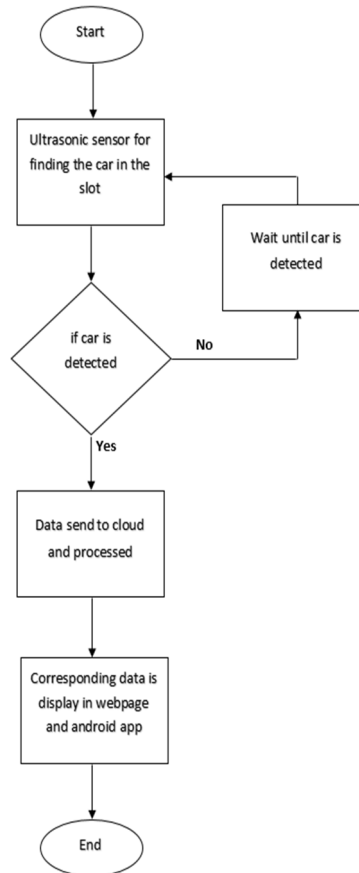


Figure 4. Flowchart of the system

- STEP 1: Initialization is done by powering up of the sensor and Node MCU.
- STEP 2: Two ultrasonic sensors is placed in each slot to detect the presence of car in that particular slot.
- STEP 3: If the car is not detected in the slot, wait until the car is sensed.
- STEP 4: If the presence of car in the slot is detected, the corresponding data is sent to the Node MCU.
- STEP 5: The Node MCU with the help of the processor pushes the data into the cloud.
- STEP 6: The data that is pushed into the cloud is displayed on the Mobile application and web page.
- STEP 7: This procedure is followed for all the slots in the parking lot.
- STEP 8: This process continues until the power supply to the sensor or Node MCU is stopped.

Experimental Results

The proposed system is practically experimented as a working model for Indian malls. The major components used in the model are shown in the figure 5 two ultrasonic sensors, one LCD to display number of car in the parking area.



Figure 5. Smart parking System

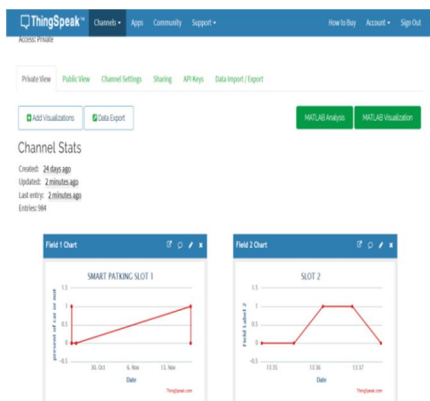


Figure 6. Data analytic page display

Figure 6 displays the data analytic page the scale of 0 to 1 and the value of 0 represents the least value that is the absence of car. The value 1 represents the highest value presence of car in the slot. The values are interfaced with the real time problem value and are displayed on the data analytic page. This graph based display is created using cloud known as ThingSpeak.

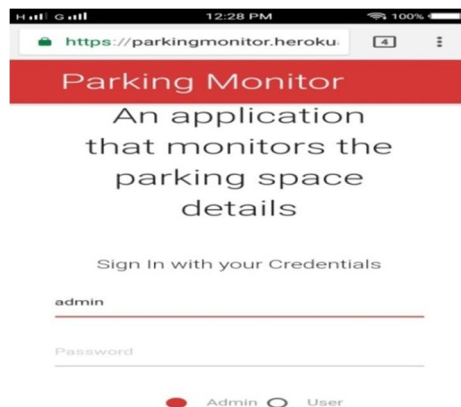


Figure 7. Web page display

Figure 7 displays the web page design and the both user and admin can access the web page after entering the corresponding credentials. The admin login will be provided with visitor name and basic information of the visitor. The user login will be provided with the vacant and the occupied slots.

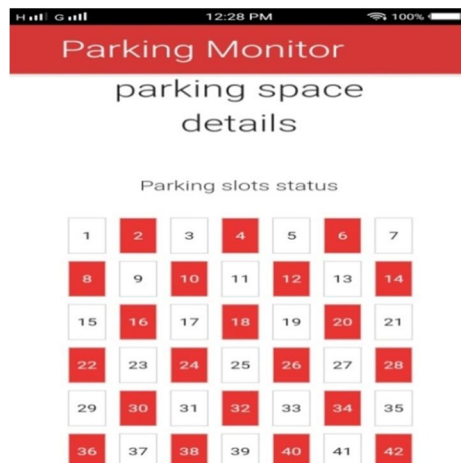


Figure 8. Web page display

Figure 8 displays the parking slot status in the web page display. The visitor once starting from home can use the parking slot status to get to know about the vacant and occupies slots. The red marking shows the occupied slots and the white marking shows the vacant slots. This parking slot status can be accessed by both admin and the user.

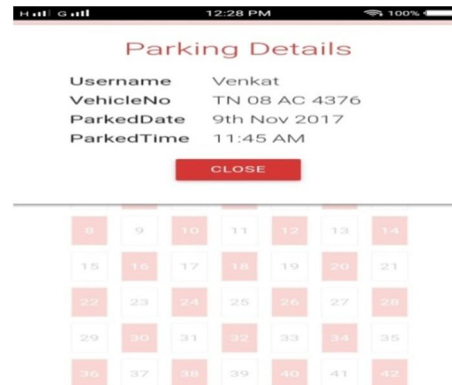


Figure 9. Web page display

Figure 9 displays the visitor's parking details in the web page. The details are basic visitor information like name, vehicle number, parked date and parked time is displayed on the web page. The RFID scanner is used to store this information and used when needed. User login cannot access this information and only the admin login can have access to this information.

Conclusion

This proposed system, we can find-out the free in the malls and pre-booking can be done using this system. This can be implemented in real time environment and the corresponding data can be compute and displayed in the web page or mobile application. This system can reduce the man power and it is effective solution for the real time problem. Thus this design finds its applications in many cases. The following advantages are;

- ✓ Reduced Man-power
- ✓ Cost effective
- ✓ Assured safety
- ✓ Low Power consumption
- ✓ Better accuracy
- ✓ Efficient time consumption
- ✓ Reduce the chance of human error

Future Enhancement

In future enhancement payment for parking time corresponding to particular car can be calculated and payment through online by connecting banking account to the mobile application.

The solution for calculating the parking time is by using camera. This captures the image of the incoming cars in the mall, that captured images can be converted into barcode. The barcode that contains image of the car have the date and time of the car entered in the mall. While the car exits the mall parking, the barcode retrieves the image and calculates the amount spent for parking. The metal detector sensor is used to sense or detect car that passes over it. These sensors that are placed on both entry and exit of the mall are used to control automatically the opening and closing of gates.

This paper shows the idea of Pre-Booking of parking slots and indicating the visitor if the car has been mis-aligned or parked in the slot. The Pre-Booking of slots help the visitor to save time in searching the presence of vaccant slot. If a visitor places the car in an mis-aligned manner, it even makes the nearby slot unusable. To avoid this problem by placing two ultrasonic sensors at both side of the marking made for each slot, and interfacing it with an buzzer, the visitor can be indicated to park the car in an appropriate position.

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