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IoT Based Smart Parking Platform

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Abstract: ***Parking space is becoming a serious problem due to increasing number of vehicles along with the mismanagement of available parking space. Particularly, in places where sports or artistic events are scheduled, searching for parking space is a major problem. In order to combat this problem, Smart Parking Platform is implemented using sensors to detect when a car enters or leaves a parking lot in order to track capacity and alert drivers about availability of parking space. Inefficient management of parking system effects traffic flow and also leads to wastage of time and fuel. Smart Parking Platform smoothens the parking experience and achieves convenience for users by displaying the status of the parking slots in web browser and guiding drivers towards empty parking slot.***

In this paper, each parking slot is equipped with an ultrasonic sensor which is interfaced to Arduino UNO microcontroller. Arduino UNO sends the trigger pulse to the ultrasonic sensor. Ultrasonic sensors senses whether the parking slot is empty or occupied and sends the data from echo pin to Arduino UNO, which is programmed in such a way that it processes the data and communicates to Node MCU. The status of the parking spaces is updated in the webpage regularly. The user can access the information regarding parking slots by connecting to the provided network. If a parking slot is empty, it is represented by green block. If it is filled, it is represented by red block. This project aims towards reducing traffic congestion and time while searching for parking space. It can be applicable in places such as convention centers, shopping malls, airports, bus stations, stadiums and theatres.

Keywords: IOT, Smart Parking, Node MCU

I. INTRODUCTION

Due to advancement in technology man is leading a comfortable life. But at the same time these advancements are becoming troublesome times. In past times, people used to travel by public transportation but now days the number of people using their own vehicles such as cars and motor cycles. The number of people who have cars is steadily increasing according to global car ownership and automotive manufacturing statistics. The number of vehicles in the world is expected to exceed 1 billion before 2020, and several countries are making multilateral attempts to alleviate congestion due to vehicle growth [1]. People who own cars would also want to know the available parking space before arriving at the parking space. Most drivers don't know the amount of parking blocks left in advance and are suffering from parking. Even if there is parking space, if there is inadequate location information for the empty blocks, drivers will encounter inefficient movement and waste their time.

Therefore, introducing an innovative parking management system that provides real-time parking status information to parking users [2] becomes a critical issue. A parking management system has arisen to satisfy this need, and work on the parking management system has been performed using various methods. Many researches, however, did not consider costs and applicability enough. Most existing car parks don't currently have a systematic system. Most of them are handled manually and somewhat ineffective [3]. Time is wasted in looking for available parking spaces, the question that always happens at the car park. Users will continue to circle the parking area until they find an empty place to park. This problem usually arises in urban areas, where the number of vehicles is greater than the parking spaces available. Those unsuccessful conditions existed due to lack of technology implementation [4].Different systems have been introduced to ensure traffic smoothness in car park areas. These also developed from manual implementations used in the old systems to fully automated, computerized systems. Parking entrances are operated by barrier gates, whereby tickets for parking are widely used for access purposes [5].

Due to the increase of vehicle exponentially and thus traffic increased a lot so parking became a big problem in highly populated cites. The major issue of parking comes into picture in case of vehicles like cars which required a big area. The main reason for this is increase in population in cites and also security concerned because of thefts in major cities. So parking our vehicle in a safe place with security is very important. To overcome this problem we have introduced such a system that would solve all these issues and will be intelligent too. We have developed a system using software and hardware module which provides an interface to the user and the parking area so that user can easily get access to the parking slots available. Our approach is cost effective and it covers all the features of a complete intelligent car parking management system [6]. This system takes the input from IR sensors whenever car enters or leaves the parking area and sends the information to Arduino. Arduino process the acquired information and send the information to the display devices. Different LEDs are used in order to indicate the present state of the slot and a display is also present at the entrance which clearly indicates the available and the occupied slots. The overall objective of the paper can be enhanced based on methodology, algorithm, and connection with different devices, results and finally conclusion of the paper has been described.

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II. METHODOLOGY

Smart parking platform is designed to avoid traffic congestion problems by guiding drivers the information about the empty parking slots.

Ultrasonic sensors are equipped in each parking slot to detect whether a vehicle is parked in that particular parking slot or not. This information about the status of the parking lots is displayed in web browser to make it easy for the user as soon as they head nearby the area. The prototype is designed using Arduino UNO microcontroller and node MCU for Wi-Fi connectivity.

The block diagram of the proposed project 'smart parking platform' is as shown in figure 1. There are three parking lots. Each of the parking lot has three parking spaces. Each of the parking space is equipped with one ultrasonic sensor. Each ultrasonic sensor is interfaced to microcontroller. Microcontroller sends high signal to trigger pin of ultrasonic sensor.

The ultrasonic sensor will transmit eight pulses of 40kHz sound wave for 10µs. Now the echo pin of the sensor will go low. Sensor keeps sensing continuously for the obstacle. When an obstacle is detected, the sound waves reflect to the receiver and the echo pin goes high. This means that the parking slot is filled, else the sensor continues sensing for obstacle and the status of the parking slot is considered as empty

Microcontroller is programmed in such a way that it sends a high pulse if the parking is filled to the Node MCU. The Node MCU keeps on checking the status of its GPIO pins and updates the webpage accordingly. The user can access the information regarding parking lots by entering the IP address of the respective node MCU in the web browser. The status of the parking slots is displayed in the webpage graphically. If a parking slot is empty, the block in the webpage is represented by green colour. If it is filled, it is represented by red block.

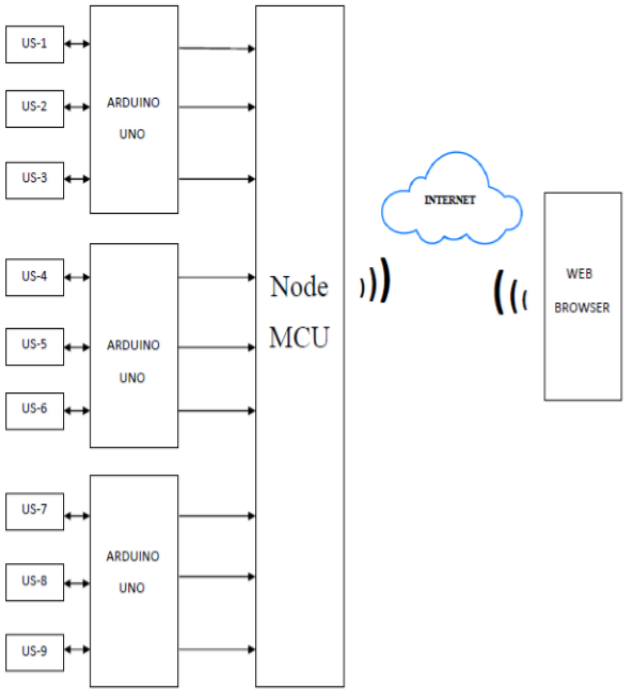

Figure1: Block diagram of smart parking system

III. ALGORITHM

Step 1: Send high trigger input signal to ultrasonic sensor.
Step 2: Wait for echo output signal to go high.
Step 3: Send the output of echo to microcontroller.
Step 4: High pulse is sent to Node MCU.
Step 5: Node MCU checks for the status of its GPIO pins continuously.
Step 6: Update this status of the parking lot in the webpage accordingly.

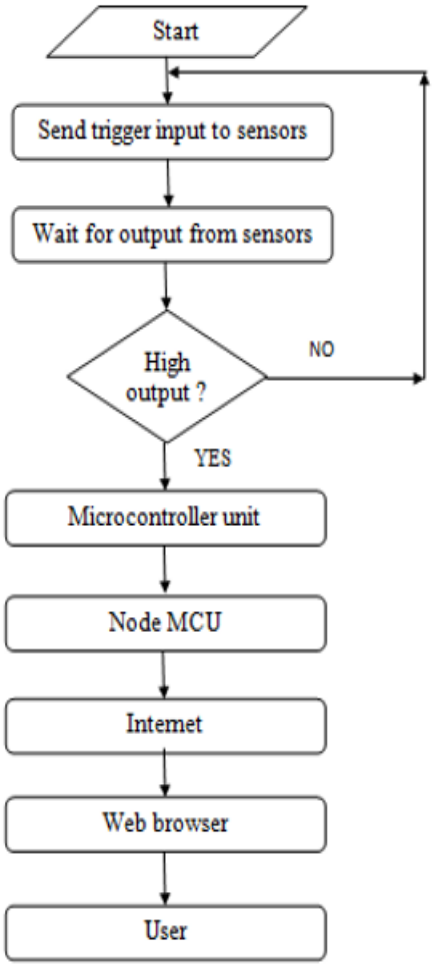

Figure 2: Flow diagram of smart parking system

IV. IMPLEMENTATION

A. Interfacing ultrasonic sensor to Arduino UNO

Figure 3 shows the connection of ultrasonic sensor to Arduino UNO. Each of the ultrasonic sensors is connected to Arduino UNO board. Ultrasonic sensor has four pins. The trigger and echo pins of the ultrasonic sensor are connected to pins 3 and 2 of Arduino UNO board respectively. The Vcc and GND pins are connected to +5V and GND pins of Arduino UNO board respectively. The sensor continuously keep sensing for the obstacle by transmitting sound waves. When a car is parked, it detects the car and the sound waves are reflected to the receiver.

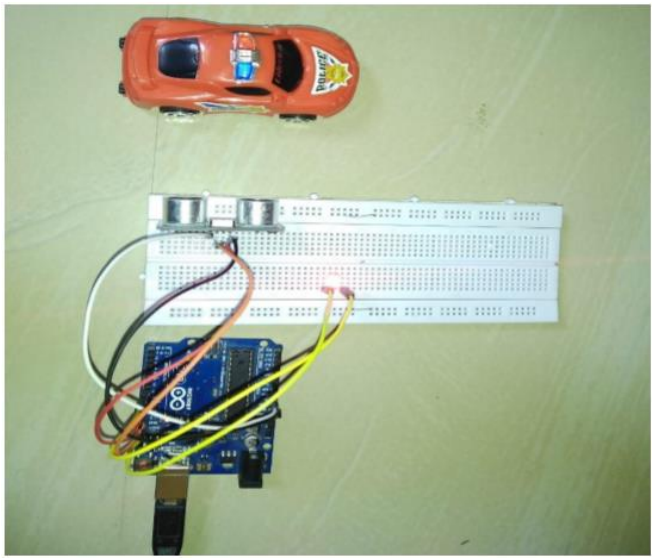

Figure3: Ultrasonic sensor detecting the parked car

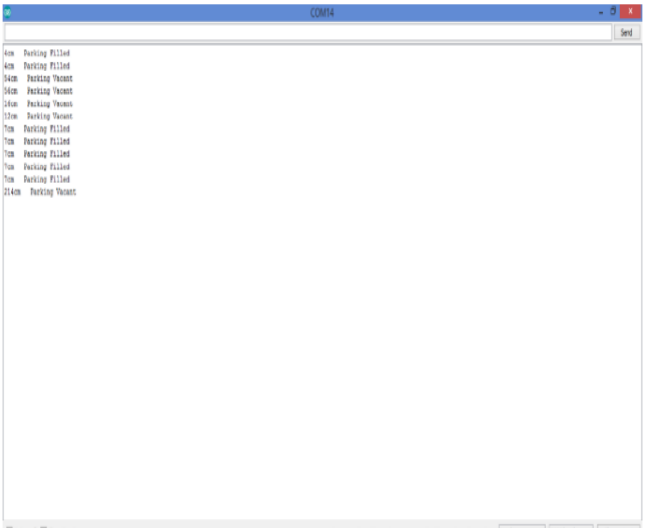

Figure4: Status of one parking slot displayed in serial monitor

The distance of the obstacle and the status of the parking slot is displayed in the serial monitor window of Arduino UNO. If the distance of the obstacle is less than 8cm, then status of the parking slot is displayed as “Parking filled”. If the distance of the obstacle is greater than 8cm, then the parking space is vacant.

B. Connection of Arduino UNO to node MCU

Each Arduino UNO is connected to three ultrasonic sensors. The trigger and echo pins of ultrasonic sensor 1 are connected to pins 3 and 2 of the Arduino UNO 1 respectively. Similarly trigger and echo pins of ultrasonic sensors 2 and 3 are connected to pins 4, 5 and 6, 7 of the Arduino UNO respectively.

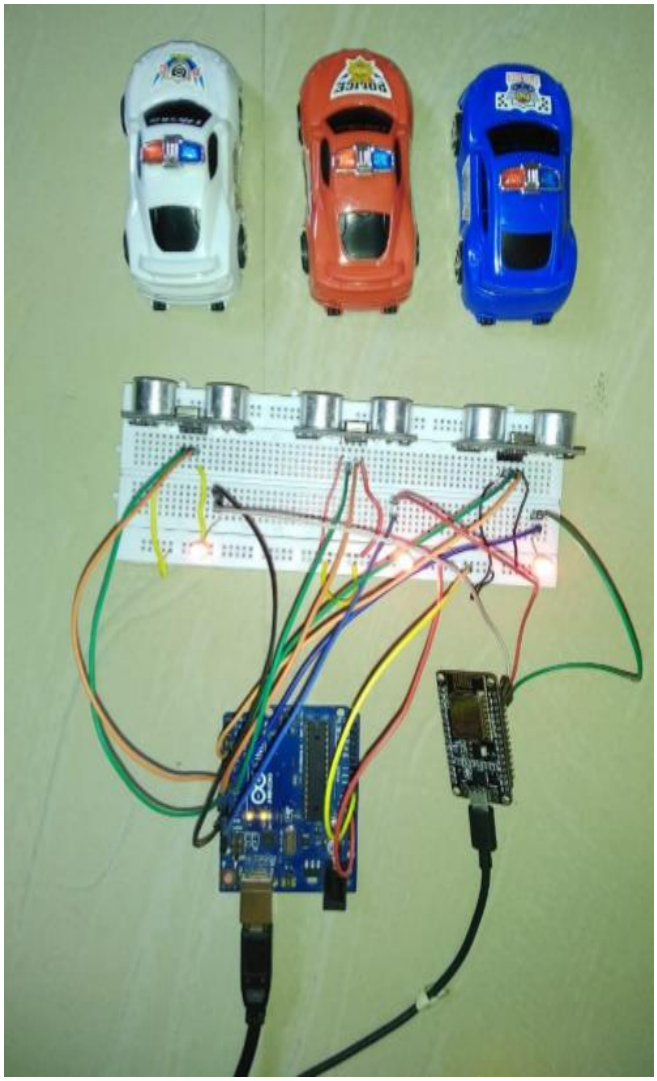

Figure5: Hardware connections of parking space 1

Three wires from Arduino UNO 1 goes to node MCU. This set of hardware contributes to parking space 1. Figure 4. Shows the status of all slots of a parking space in web browser. Parking slots 1 and 2 are filled and 3 is vacant. Figure 5.shows the Hardware connections of parking space 1, figure 6 shows Status of parking space 1 displayed in web page with all slots filled and figure 7 shows Status of parking space 1 displayed in web page with two slots filled.

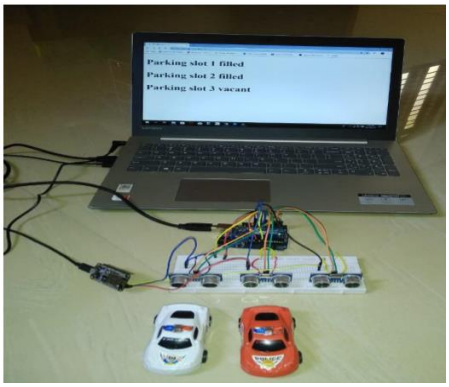

Figure 6: Status of parking space 1 displayed in web page with all slots filled

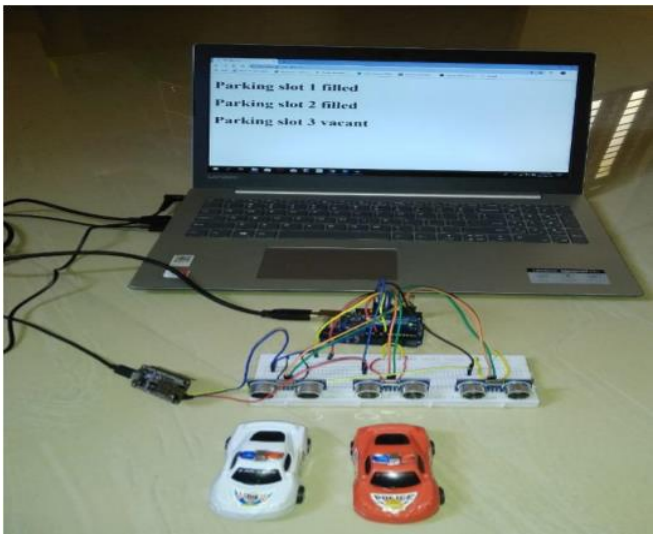

Figure7: Status of parking space 1 displayed in web page with two slots filled

V. COMPLETE SYSTEM IMPLEMENTATION

The below figure 8 shows the connection of complete hardware system used in the project. The hardware set used for parking space 1 is replicated for parking space 2 and 3. Three wires from each Arduino is connected to node MCU. Digital pins 10, 11 and 12 of each Arduino is connected to 9 I/O pins (from D0- D8) of node MCU.

Figure 9 shows the status of the parking space 1. Parking slot 1 indicated by green block is empty and available for parking. Parking slot 2 and 3 are occupied. Figure 10 shows the status of the parking space 2 displayed in the web browser. All three parking slots are occupied and not available for parking.

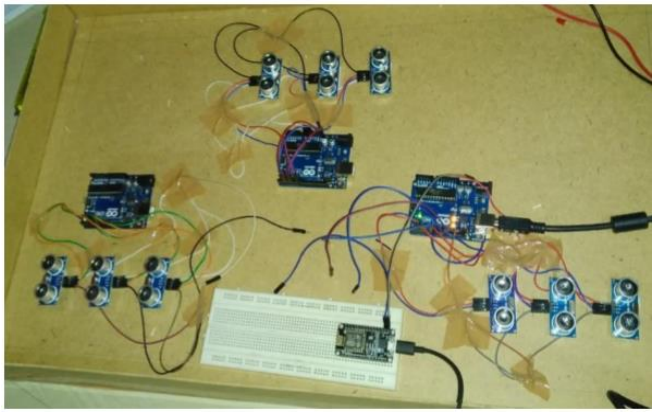

Figure8: Hardware connections of prototype

Figure 10 shows the prototype of the designed smart parking platform with three parking spaces. When the IP address of the network is entered in the web browser, it displays the status of the parking slots. If the parking slot if filled, it is displayed by a red block graphically and similarly green blocks indicate that the parking slot is empty. The status of other parking spaces is accessed through links provided in the webpage.

Figure9: Webpage displaying status of parking space 1

Figure 10: Webpage displaying the status of parking space 2

VI. RESULT AND DISCUSSION

The below table indicates the status of the parking slots filled or vacant. Depending on the remark table status, parking place can be chosen without wasting searching time for the parking place. From the above table 1 Indicates parking slots 2 and 3 are filled and parking slot 1 is vacant for the parking. Similarly, in table 2 parking slot 2 is filled and 1, 3 are not filled they are available for the parking. The table 3 indicates all the parking slots are filled and there is no vacant place for parking.

Table 1: Display of Parking slots status and Remarks: Case1

Parking Slots	Status	Remark
1	Not Filled	Vacant Place at Slot 1
2	Filled	No Vacant Place
3	Filled	No Vacant Place

Table 2: Display of Parking slots status and Remarks: Case2

Parking Slots	Status	Remark
1	Not Filled	Vacant Place at Slot 1
2	Filled	No Vacant Place
3	Not Filled	Vacant Place at Slot 3

Table 3: Display of Parking slots status and Remarks: Case3

Parking Slots	Status	Remark
1	Filled	No Vacant Place
2	Filled	No Vacant Place
3	Filled	No Vacant Place

VII. CONCLUSION

Smart parking platform is tested for all various conditions and desired results have been obtained successfully. Efficient management of parking spaces in this way saves valuable time of users by avoiding traffic congestion at the venue and it also saves fuel and helps in reducing pollution and global warming by reducing the distance travelled by users before finding a empty parking slot in multiple parking spaces separated by large distances. The merit of smart parking platform is cost effectiveness. Users can have the information about the availability of the parking slots before arriving at the venue and can save time in search of empty space. This system is user friendly and also reduces the additional man power required to divert the users towards other parking spaces when nearby parking space is filled.

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