Automatic Car Parking System with Visual Indicator along with IoT

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Abstract*— This paper 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. 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).

Keywords-Internet of Things (IoT), Autonomous Car Parking, Arduino, ESP8266 Wi-Fi Module, Ultrasonic Sensors

I. INTRODUCTION

In this age of technology, we are working in a way to reduce our effort in every possible way and the introduction of the Arduino and IoT platforms have further broadened the scope of this possibility in our everyday lives. One of the major problems that we are facing in today's over-populated society is finding available parking spots in various public places like hospitals, office shopping malls, cinema halls, courts, schools and colleges.

The statistics show that approximately 20% of all the congestion in the city is caused by frustrated drivers driving around the block searching for parking spaces.

The rest of the paper is organized as follows: Section II gives us the basic review of the previous work done in this area. Section III contains in the solution to the problem faced. Section IV presents the objective of the research and the components used. Section V focuses on the algorithm part and the procedure followed to achieve the result. Section VI has the final results and Section VII has the conclusion and the future work related to this research.

II. PREVIOUS WORK

Various parking sensors are already installed in some of the public spaces in developed countries which use infrared sensors (hereinafter called as IR Sensors) in combination with ultrasonic sensors to detect the presence of a car in a particular spot. [1]

The motivation that drives the result is the pursuit of an alternative solution for the problem, that is instead of using IR Sensors, it would be more efficient to switch to Ultrasonic Sensor which is not affected by variations in the light intensity in a particular environment. Also, instead of using the Ethernet shield or connecting it through LAN cable, a Wi-Fi module (ESP8266) is used. Thus, reducing the cost of cable, increasing the efficiency and making it more feasible to get implemented. [2]

III. SOLUTION FOR THE PROBLEM STATEMENT

The following two methods are implemented to solve the parking space problem for the driver.

A. Using hardware: Indicators (in this case, two bulbs: 1 red and 1 green) are placed outside the parking slot, red bulb indicating an occupied parking space while the green bulb which indicates an empty space. This is done so that during the night time the driver can see from a distance that is the slot is empty or occupied.

B. Software(IoT): Before entering the place, the driver can check through the Internet/Mobile App that which slot or which area is empty and can directly go to that area and park his car, without anyone's help or the Security personnel in the public parking areas or the malls can check the spots in their systems and can direct the incoming cars to the particular locations.

IV. OVERVIEW

A. AIM

• To make it convenient for the driver to check whether the slot is empty or occupied during night time.

• On a local level that is in universities and in malls the main entrance Guard can have access to all the parking slots information. Therefore, even if the driver has no time to check the slot availability on his own then the guard can guide him where to park his car.

B. COMPONENTS USED:

• An Arduino Uno Board or ATmega 328 chip to program the hardware.

• Two Ultrasonic Sensors (SHC-SR04) are used for a more precise output

• A 5V-10A two channel relay module to switch between green light and red light according to the data of the ultrasonic sensor.

• A Wi-Fi module (ESP 8266 -01) is used to send the ultrasonic sensor's data to the Internet

• A thingspeak or any other open source platform to generate a graph of the Ultrasonic Sensor's reading.

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V. System Settings and Algorithm Used

Here two ultrasonic sensors are used, one should be placed right in front of the car and the other should be placed above the car. AND-Gate logic is used in the Arduino programming so that only if both the conditions are satisfied then only the Red Bulb/Indicator will grow indicating that the particular slot is occupied otherwise it will turn off and a Green bulb will glow showing that the slot is vacant. That is if any case if any person is changing in the parking slot then also it will be indicated as a vacant spot. 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. [3]

And finally, a Wi-Fi module is connected to the ultrasonic sensors. The Wi-Fi module should be first connected to the Internet that can be done through the AT commands of the ESP module. As soon as it gets connected to the Internet, it will receive the data from the Ultrasonic Sensor and send it to the IoT platform. [4]

The ESP8266 is programmed using AT commands; when received, it replies with an acknowledgment. AT commands are a bit strange at first but with a little usage become easier to understand. These are run commands that run directly on the ESP module and are responsible for controlling the interaction between the ESP module and the Wi-Fi source. [5][6]

There are many AT commands that can be used to program the ESP8266 Wi-Fi module. AT commands should be written in the Arduino's serial monitor to program the ESP8266. Some of them are listed below:

1) *"AT"* This will check if the module is connected prop-erly and its functioning, the module will reply with an acknowledgment.
2) *"AT + CWLAP"* This will detect the Access points and their signal strengths available in the area.
3) *AT + CWJAP = "SSID"; "PASSWORD"* This connects the *ESP8266* to the specified *SSID* in the *AT* command mentioned in the previous code.
4) *"AT + RST"* This will reset the Wi-Fi module. Its good practice to reset it before or after it has been programmed. (OPTIONAL)
5) *"AT + GMR"* This will mention the firmware version installed on the ESP8266. (OPTIONAL)
6) *"AT + CIFSR"* This will display the ESP8266's obtained IP address. (OPTIONAL)
7) If the user wants to disconnect from any access point then use the following AT command: *AT + CWJAP = ""; "":*

VI. Connections and Schematics

The circuit connections and schematics are shown in the figures below in Figure 2 and 3 respectively.

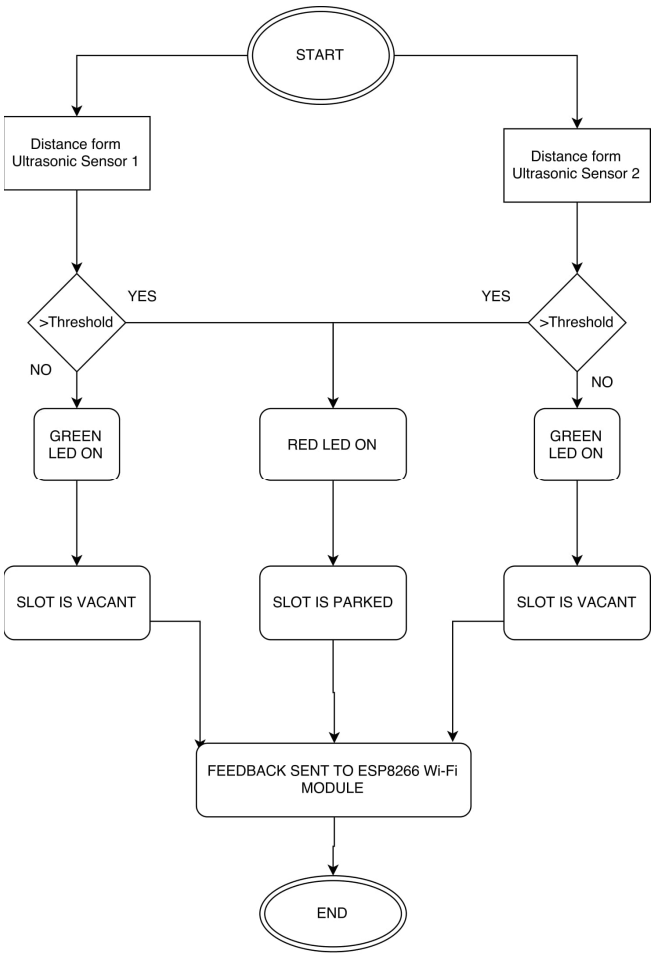

Fig. 1. Flow Chart of the Algorithm Followed

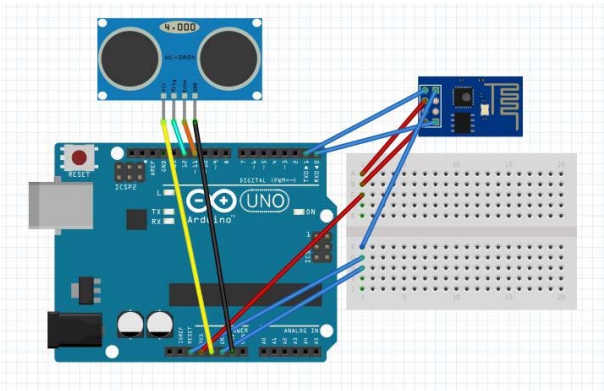

Fig. 2. Circuit Connections

VII. Results

To obtain the perfect result, we set the ultrasonic threshold according to the parking lot dimensions in the Arduino code using Embedded C Programming.

The problem faced during this research was that the ultra-sonic sensor was getting rust on its surface, thus leading the system to misbehave. Careful nanocoating for sensors and the Arduino board is must for a long-term implementation of the project. Based on the data that the ESP is getting from the Ultrasonic Sensor after connecting itself to a Wi-Fi, it is successfully able to send the data to the open source platform.

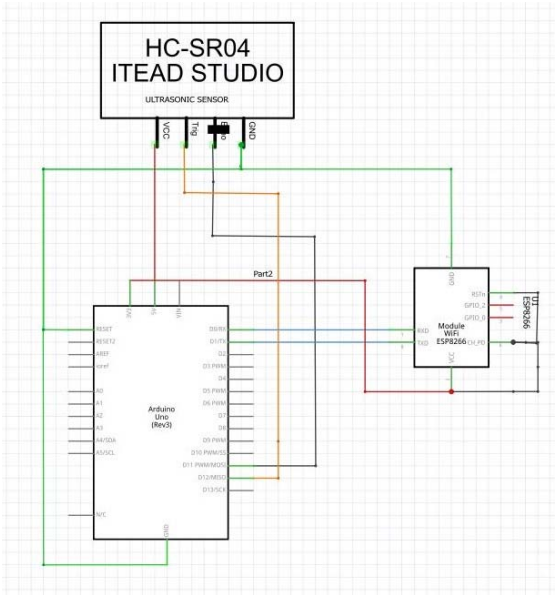

Fig. 3. Circuit Schematics

VIII. CONCLUSION

The status of the slot is shown with the help of the indicators and through IoT. The table 1 below shows the observation of the particular slot during the time of the day. In the table, various car models are shown, and the output is checked, thus confirming that the research was done up to the mark and showing the output correctly both in hardware and in thingspeak, irrespective of the car model.

TABLE I: OBSERVATION OF ONE PARKING SLOT DURING AN ENTIRE DAY

Time Duration	Car Model	Indicator Status	Status
1000-1300 Hrs	Hyundai I20	RED	Parked
1330-1615 Hrs	Swift Dezire	RED	Parked
1630-1730 Hrs	-	GREEN	Vacant

IX. FUTURE SCOPE:

The future work focuses on the commercialization of a business prototype and to make a website more reliable using much better version of the ESP module, thus having a great business value as:

1.) A mobile application can be made instead of using the public IoT platform, to make it better for business purpose.

2.) The camera can also be connected, and number plate detection mechanism can also be implemented to make the area safer in terms of security.

3.) Online parking ticket system can also be implemented in the same setup.

X. REFERENCES

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