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Smart Parking System Using IoT with Ultrasonic Sensor

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Abstract: This report describes the Smart Parking System Using IoT with Ultrasonic Sensor project. In this modern world with a lot of vehicles, the demand for a mechanism to determine the availability of parking spaces in local parking garages. The project also seeks to give functionality and adaptability based on future "smart" gadgets and integrate the device into an Internet of Things (IoT) system. At the moment, cars must manually navigate the parking garage to find a parking spot. Drivers can see how many available parking spots are with our proposed method. Using a network of ultrasonic sensors, the final solution is achieved. These sensors send data to a database that may be viewed through a graphical user interface. This research is expected to give the data needed to implement the network in the real world. This system could be done cheaply, and future device growth could be incorporated.

Keywords: Internet of Things (IoT), Smart Parking, Raspberry Pi, Node-Red, Ultrasonic Sensor

1.0 INTRODUCTION

When parking in a public garage, certain floors have more spaces than others. During peak times, when the building is at or near capacity, some floors will have no places at all. Currently, the only way to find out is to drive around in circles looking for a parking spot. Depending on the structure's arrangement, you'll have to determine whether to keep walking around or try another floor. It can cause a waste of time and gas, and people mostly feel frustrating trying to park their cars. (Hassoune, Dachry, Moutaouakkil, & Medromi, 2016)

This project tries to address this issue by allowing users to see how many seats are available on each floor. We can track cars as they enter and exit each floor using ultrasonic distance sensors connected to a network of Raspberry Pi computers. We can show the number of available places on the software application by keeping track of how many vehicles are on each floor and knowing the overall number of spots on each floor. Currently, some parking services have provided the display of the total number of spots on each floor. The way data is made available is where this project is better than conventional platforms. The number of open places can be viewed using an application or visually, depending on the structure's implementation, by feeding the data to a database using a lightweight protocol (MQTT).

"A cloud-based intelligent car parking services for smart cities" (Ji, Ganchev, O'Droma, & Zhang, 2014). The Sensor layer, communication layer, and application layer are all part of the IoT subsystem. The basic purpose of the intelligent car parking system is to locate, allocate, and reserve the best available vehicle parking lot for a user driving a car at a specific location, as well as to provide directions to this lot. The occupancy of the car lot is detected by the sensor layer. Based on an autonomous threshold approach, a method for detecting car parking lots is proposed. A cloud layer, mobile apps tier, and OSGI web servers tier make up the architecture. Data storage and computational resources for the car parking services are provided by the cloud tier.

2.0 MATERIALS AND METHODS

There is the main component that will determine the functionality of the Smart Parking System, which are the hardware, website dashboard, and payment gateway. The user may choose their desired parking spot by choosing the spot on the dashboard and going to park at that parking lot. Once the user has parked their vehicle, the system will detect the vehicle and start counting the time and calculate the amount that the user needs to pay once they finish using that parking service. Then, the user can make the payment and the dashboard, and it will directly go the user to the payment gateway and pay the exact amount that they have got. After payment is successful, the user will be allowed to leave the parking area by passing

through the same gate. The researcher will explain more detail about this system later in this chapter.

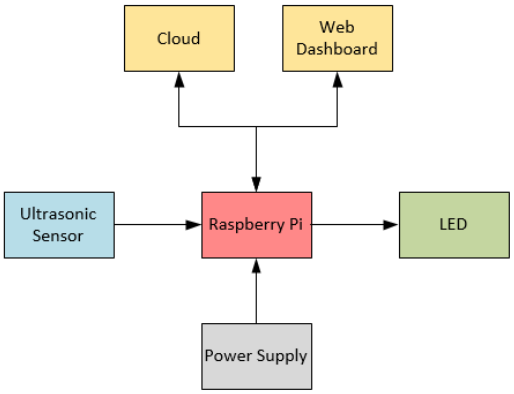

Figure 1: Block Diagram of the System

Figure 2 shows the block diagram of this system. The input for this system is an ultrasonic sensor that functions to detect the presence of a car in the parking lot. Then it has the Raspberry Pi act as the brain of this system and is powered up by a 5V power supply. This microcontroller will connect with the Internet and the cloud database to store the user information. By connecting to the Internet, the user can connect to the website system wirelessly by accessing the web dashboard that contains information about the parking availability in the parking area. Then, the output that is used in this system is LED, which indicates the availability of the parking spot where the user can watch it in hardware form. There are three colours of LED that will be used which are Green, Orange, and Red.

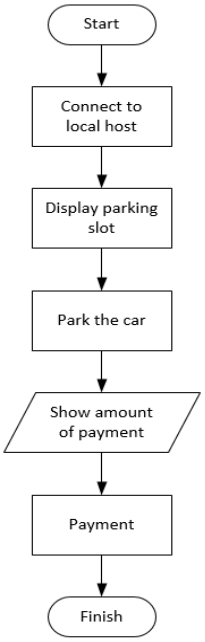

Figure 2: General Flowchart

Figure 2 illustrates the general flowchart for this system. It is a brief illustration of how the process will go through from one step to another. More details about the system will be explained later in the detailed flowchart of this system. Firstly, the user starts by connecting to the local host of the system by connecting the device that has an internet connection with the IP address of the system using. Once the local host has been connected, the user can view on the web dashboard the parking availability and pick their own desired parking location. Next, the user will park their car in the parking spot that they have selected. Once the car is parked, the system will start calculating the amount of payment that the user needs to pay based on the time they used the parking area, show the amount on the dashboard and make the payment.

3.0 RESULTS

This chapter presents the results and findings that have been accomplished in this system project. All figures shown in this chapter show the result of the Smart Parking System Using IoT and a few parameters that this project should be analyzed. There is one objective that cannot be achieved in this project and will be explained in more detail in this chapter.

The hardware development phase of the project began with the assembly of the circuit and components used with the Raspberry Pi board. The process then continues to software development, which involves detecting the process of the sensors and then running all the tools needed on the Raspberry Pi to produce and execute the program function. The function also including with the building of the website dashboard in this project. The achieved results recorded are based on the proposed system in FYP1.

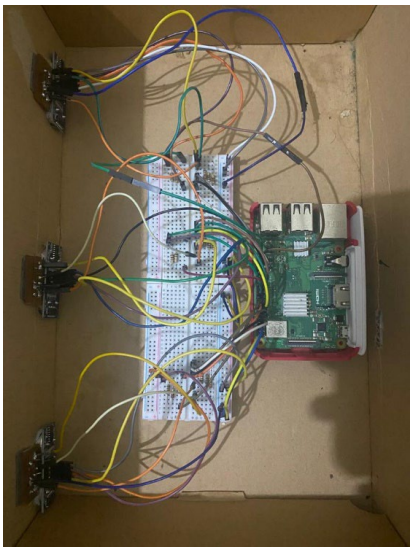

Figure 3: Circuit Assembly

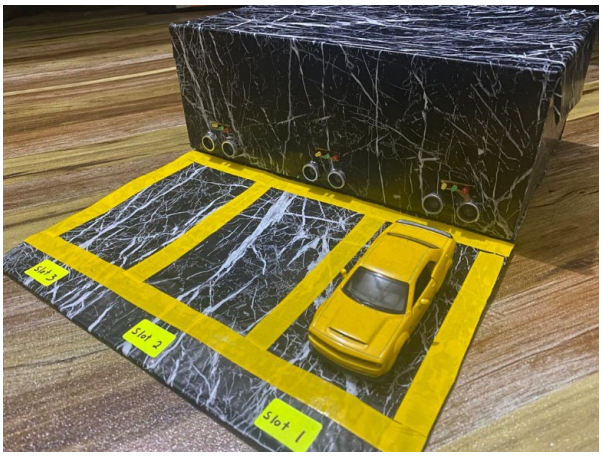

Figure 4: Complete Prototype

Figure 3 shows the circuit assembly of the Smart Parking System Using IoT. The constructed circuit is built based on the proposed that has been designed in chapter 3. The ultrasonic sensor is connected to the Raspberry Pi as the input and the LED as the output. The first phase of the hardware development is by linking all the hardware by programming in the Node-Red software and making sure all the hardware functions are normally based on the proposed system. The circuit assembly is stored in a box-like to make it more manageable and neater. LED is soldered to prevent the loose connection with the connector wire and to ease the installation. Figure 4 shows the complete prototype of this project. Car toys can be demonstrated in a real smart parking system.

Distance (cm)	Sensor Detected
1	Yes
2	Yes
3	Yes
4	No
5	No

Table 1: Sensing Distance

The above table shows the sensing distance that has been allowed for the ultrasonic distance to detect the presence of a car by programming it in the Node-Red. The sensors have been set that it can detect at 3cm or below, and if the distance is more than 3cm, it will not detect the car.

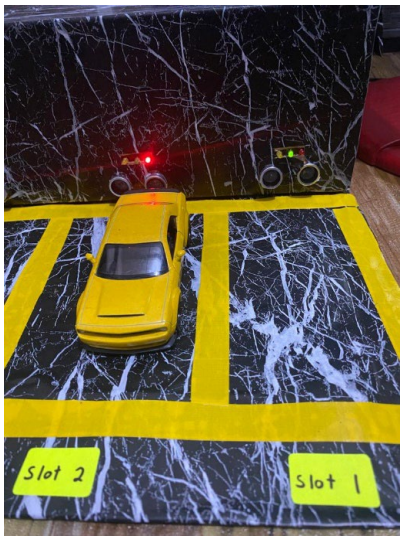

Figure 5: Red LED Light

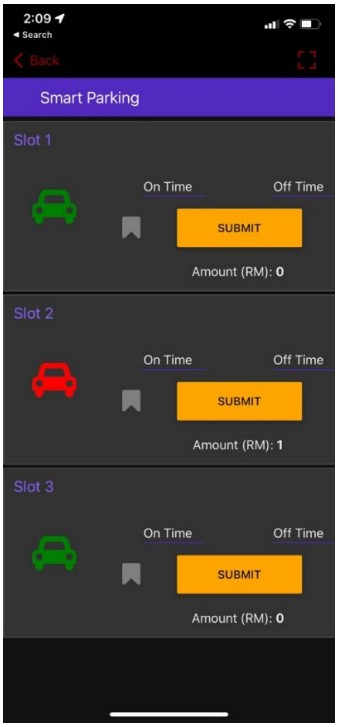

Figure 6: Red Slot

Result 1 demonstrates how this system operates normally. The ultrasonic sensor will detect the presence of the car, the red LED lights will turn on, and the green LED lights will turn off, as shown in Figure 5. While if there is no presence of the car, the red LED lights will turn off, and green LED lights will turn on. Figure 6 shows the state of the website dashboard if there is the presence of a car where the slot 2 picture will turn from green to red. Also, the total payment also will become 1 in the Amount section to show the amount that the user needs to pay.

Figure 7: Orange LED Light

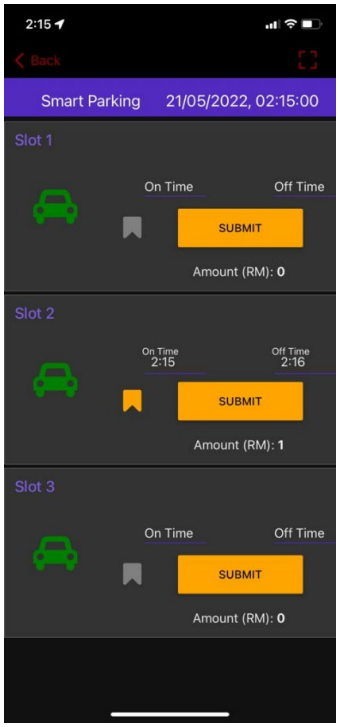

Figure 8: Booking Section

Result 2 demonstrates the booking feature which is available in this project system. In Figure 8, the user can type in the time that they want to book for them to use the parking service. Once the user has done key in the time and pressed the submit button, the orange mark will display on that slot to indicate that the user has made the booking, and also, the orange LED light will turn on, as shown in Figure 7. Then, the system will count the payment if the time of booking has approached real-time, even if there is no card detected. if the user inserts the invalid information in the booking time section by displaying 'error time not set.' So, the user needs to insert the correct time format when keying in the booking time.

4.0 DISCUSSION

As explained before, this chapter demonstrates how this project functions with its result. It has a little bit issue during the linking process of the ultrasonic sensor with the microcontroller where the sensing distance cannot be changed, and this issue can be overcome with some programming in the function node. With this project, the user can use this project to monitor the availability of parking spots just through the smartphone. They also can save up much time just by priorly booking the desired parking spot on the website dashboard.

But the fourth objective, which is to make software where the user can make the payment online, cannot be achieved. That is because there are very few sources about online payment in Node-Red software. Furthermore, there is no available bank in Malaysia that can integrate with the Node-Red ecosystem. There is one developer that can integrate the payment system using Node-Red software, which is Line Pay from Line apps. But they are only used in certain country, which is Japan, Taiwan, and Thailand only, and not available in Malaysia.

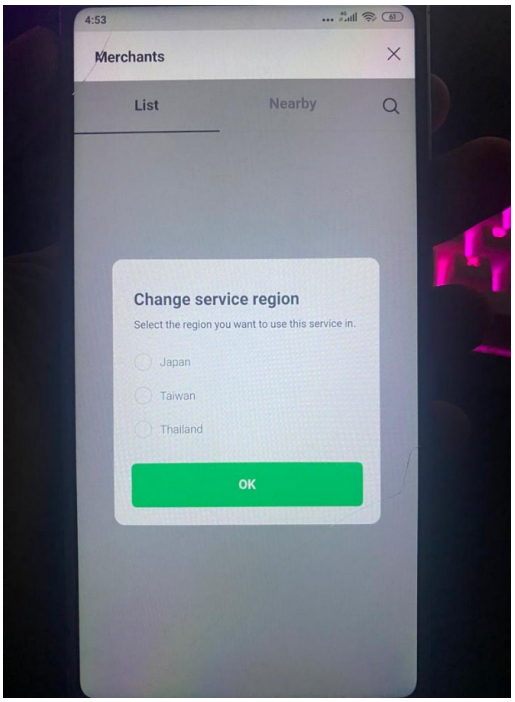

Figure 9: Line Pay

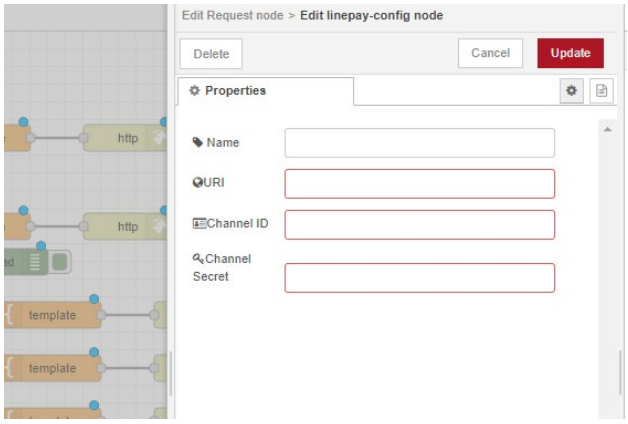

Figure 10: Merchant ID Required

First of all, the merchant needs to register as a merchant by registering the store information and uploading the required documents to the Line developer. The documents need to be included in the application, like the store certificate and the certificate of all history items or current items. It will take a few weeks to get the confirmation of the store examination. Then, after successful registration, the merchants need to create new passwords to get the Link Key. There are 2 Link Keys that are important and required for authentication for Lina Pay linking, which are Channel ID and Channel Secret Key, as shown in Figure 10. And there are a lot of other things that really need a deeper and longer time to study, like payment APIs authentication, that involve a lot of algorithm and coding and need someone with higher programming skill and knowledge to design and use that code.

5.0 CONCLUSION

In conclusion, the Smart Parking System Using IoT is able to automatically detect the presence of a car by using an ultrasonic sensor. Then the user can see the availability of parking spots either on hardware, which is LED lights or wirelessly monitored through software in the website dashboard. This project is very suitable for a place that has an enclosed public parking place like a shopping mall or government centre. This project is the improvement of the current parking system that only uses hardware LED lights and only uses two colours which are red and green. This project also eases the user by booking the desired parking slot without having any issues with the search effort.

Overall, the first objective, which is to investigate the characteristics of Ultrasonic Sensors in this system, is achieved because this system can detect the presence of a car up to 3cm. The second objective, which is to design the smart parking system with a monitoring system in the software application, is achieved because this system can there are the prototype of smart parking that has been built and a website dashboard to monitor the status available of parking. The third objective is to create a system where the user can book the parking spot that they desire is also achieved because the user can book the parking via mobile application. And the last objective, which is to make a software where the user can make the payment online, is not achieved because of the complexity of the program coding for the payment system that is very high.

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