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Automatic Car Park System Using RFID and Android Application

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Abstract: Nowadays, the number of vehicles on the rise and parking becoming a big burden in urban and semi-urban places. There is a need to create a parking system with updated technologies that would eliminate manual input as well as the problem of vehicles parking on roadways. The challenges related with parking are normal to most of us such as we always struggle to find a safe parking place with a minimal time taken. This research seeks to examine internationally adopted parking management techniques that employ various technology. This research also intends to investigate the shift in focus of current parking management techniques by evaluating a range of parking management solutions from across the world.

Keywords: Android Application, Automate Car Park, Radio Frequency Identification (RFID), Sensor

1. Introduction

The chapter focuses on the underlying idea that is driving the implementation of this project. It highlights the importance of keeping devices updated with the latest technological advancements in order to enhance the user experience. The chapter specifically delves into the topic of the Internet of Things (IoT) and how it relates to the project at hand. It explains in detail the process and method of controlling the project through IoT, making it a key aspect of the project. Furthermore, the chapter emphasizes the need for a clear understanding of the problem statement, objectives, and project scope. This is essential in order to have a comprehensive and holistic view of the project, allowing for effective planning and execution. Without a clear understanding of these elements, it would be difficult to fully understand the project and its goals, making it difficult to achieve success.

1.1 Background Study

Parking space is a need to every place in the whole world. This is because car users around the world are rapidly increasing day by day and the rapid development in every corner of the city is making

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car parking spaces decreasing drastically. Thus, the time taken for the user to find a parking spaces for their cars. According to Dr. Jean-Paul Rodrigue of Hofstra University's Department of Global Studies and Geography, more than 10% of car users in the large cities spend 20 minutes for them to find a parking spot [2]. There are several types of parking space that has been provided for the road users such as single level parking lot, multi-story parking lot, underground parking lot and many more. In large cities, there are automatic parking lots equipped with automated entrance and exit barrier to ensure the parking lot users paid their parking fees. Even the parking lot equipped with automatic barrier. The user still cannot know whether the parking lot are fully occupied or vice versa. Thus, it will take time for the user to find unoccupied parking lot. Data shows that 3.6 hours of time and 6.4 billion of petrol were wasted just to find a perfect spot to park [3].

1.2 Problem Statement

Nowadays, most people need to move from one place to another in a very short time of period. Thus, they need to park their vehicle faster. In Malaysia, most of the current car park system is not user friendly [4]. User often face difficulties to find out if the parking lot is still unoccupied. Furthermore, a lot of time is consumed by the user to search for a parking space especially during the peak session such as lunch hour and weekend [5]. Lastly, user is also unable to make parking reservations if they are having important affairs such as to attend a meeting, talk, conference and many more. So, this will affect users time consumption and schedule that may be very important to the user.

1.3 Project Objectives

The objective in constructing this project as follows:

i. To develop an automatic parking system using mobile application.
ii. To integrate the system with RFID, cloud database and online payment
iii. To analyze the booking system's effectiveness.

1.4 Project Scopes

The scope of this project will be executed within the several points that is being stated:

i. System used will determine a total number of 5 cars entering and leaving the car park. In addition, the developed application will show parking spaces that are still empty.
ii. The microcontroller used to control the system is Arduino and NodeMCU ESP32.
iii. Infrared sensor is used to detect the presence of vehicle.
iv. NodeMCU ESP32 integrated with Firebase Database is used for booking system.

2. Materials and Methods

This section gives a comprehensive summary of the project's methodology and materials. The data will cover all components of the work operations for each step, such as the block diagram, software and hardware used, and an overview of the system flowchart.

2.1 Materials

This project's design was built on its operation as an automated parking garage. As a result, the real parking places are created on a compact design. However, the functioning is identical to the genuine figure. A servomotor is utilized as a gate to make an entrance and an exit. The use of an infrared sensor allows the system to run considerably more smoothly [6]. An NFC scanner is used to confirm that the

user may access the parking place. To access or depart the parking spot, the user must produce an RFID or NFC card at the gate. The list of components and software used for this project are listed below:

- Arduino UNO
- Arduino NANO
- NodeMCU ESP32
- NFC Tag
- Servomotor
- Infrared Sensor
- MIT App Inventor
- I2C LCD
- Fritzing
- Arduino IDE
- Light Emitter Diode

Figure 1 below portrays the block diagram of this project. This figure is the design of the Automatic Car Park System Using RFID and Android Application. This design is to get a clear view on the element connected and could operate the system. The power source will power up the Node MCU, Arduino UNO and Arduino NANO simultaneously. After all of the microcontroller has been given supply, input for Arduino UNO which is NFC tag and ESP32 will start to give any input to the Arduino UNO. When Arduino UNO already get the data, the data will be sent to Arduino NANO to trigger LCD display. After all components are ready, this will enable Node MCU to send the occupancy data through Android application. That would complete the process of the system.

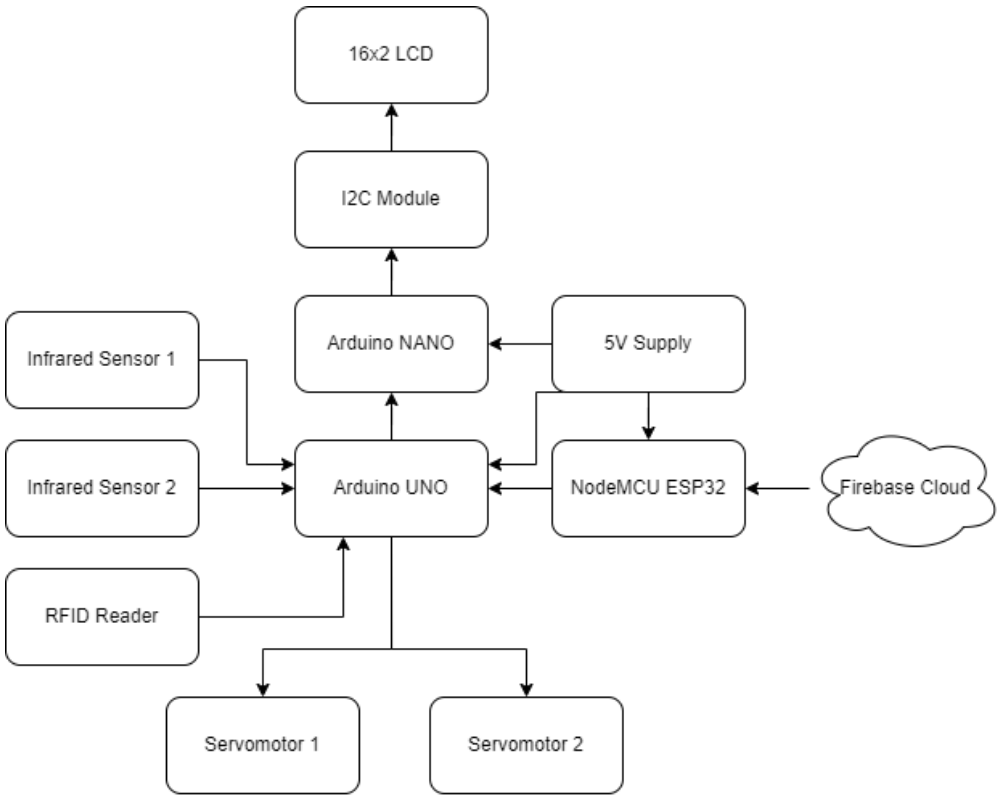

Figure 1: Block Diagram of the system

2.2 Methods

The RFID system, database information collection, and android application are the three major functionalities of this system. Figure 2 depicts an overview of how the system works. The system begins by requiring the user to register or log in to the built Android application. Following that, the user must select their preferred parking spot and time slot on the android application, which will be transmitted to the database. Each button on the parking selection and time slot screens corresponds to a single parking space. Once the user has completed their booking, the "Booking Successful" screen will appear. For example, if the "CHECK AVAILABILITY" button in parking 1 is clicked, the screen will take the user to the parking 1-time slot screen, and so on for each parking spot. When a user successfully books parking, the information is transferred to a database and stored there until the user exits the parking lot. If a user taps their RFID card but does not have a reservation, the entrance gate will be closed. The Infrared sensor will control the servomotor's movement. After the servomotor opens, it will wait for the Infrared sensor data before closing it. Figure 2 below illustrates an explanation of how the system functions.

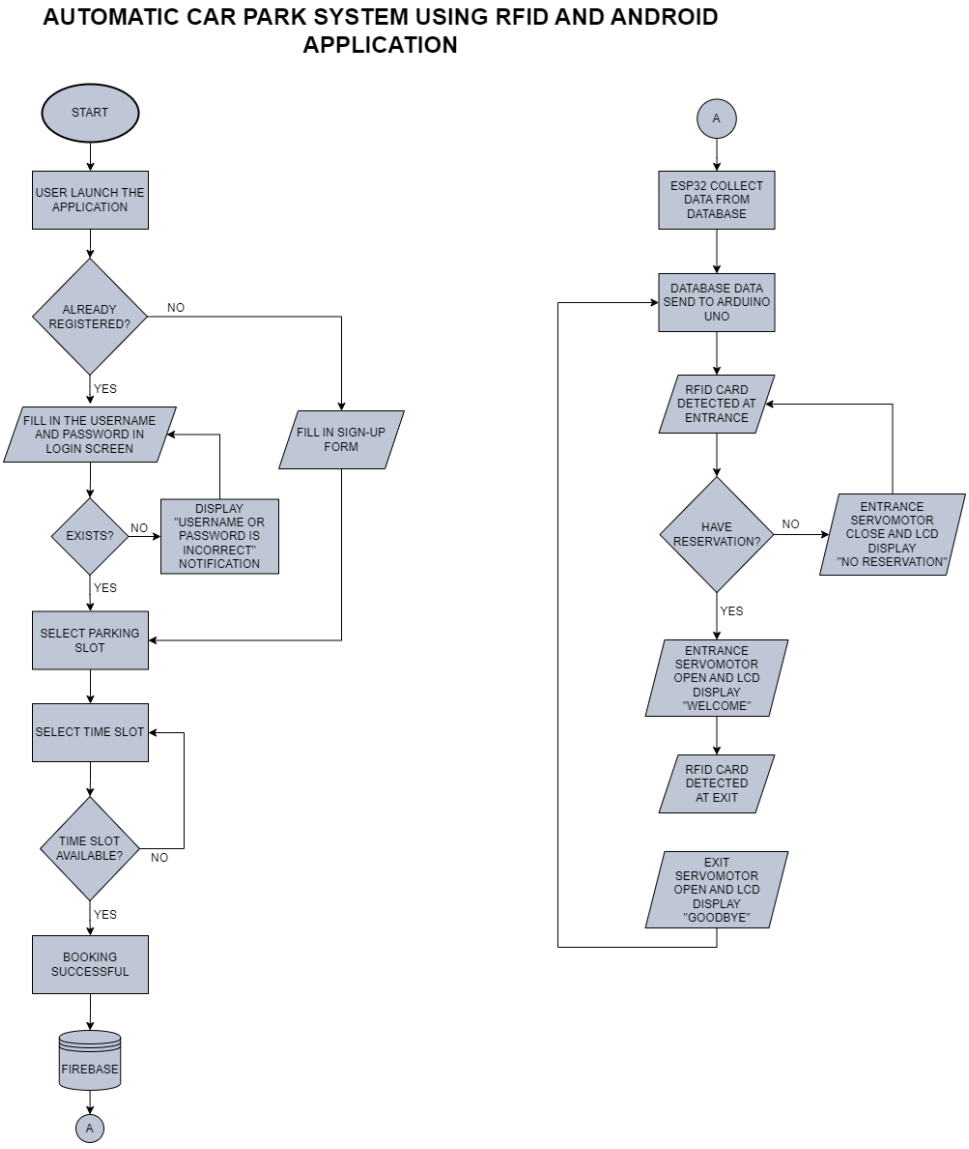

Figure 2: Block Diagram of the System

3. Results and Discussion

This part focuses on the analysis and discussion of gathered results and conclusions from many experiments undertaken in relation to the project's goals. To recap, the project's goals are to develop a system that allows users to book parking spaces even if they are not close to the premises. The next step is to use the Radio Frequency Identification technology to interact with the microcontroller and database in order to determine the RFID card's booking status. The investigation focused on the prototype's usability, durability, and accessibility. By comparing data obtained from the tests, the performance of the Automatic Car Park System Using RFID and Android Application was investigated and debated. For ease of viewing, the results are presented in a tables, graphs, and charts.

3.1 Project Layout and Application

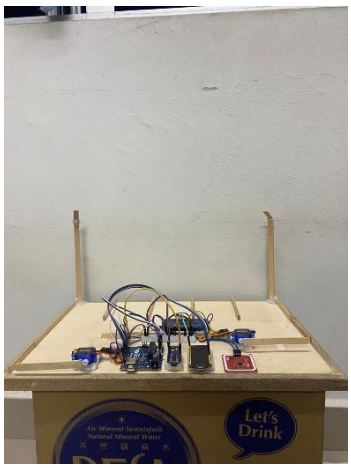

Figure 3: Front View of the Prototype

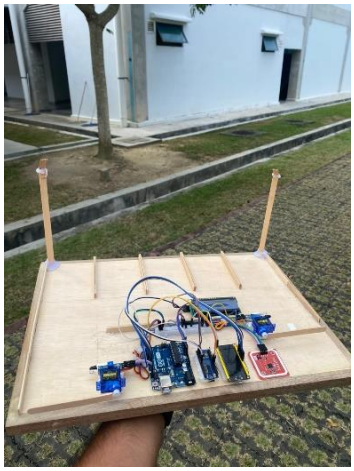

Figure 4: 3D View of the Prototype

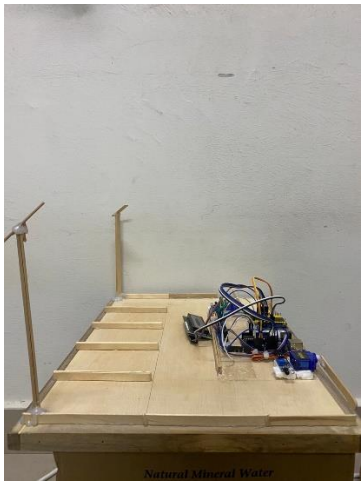

Figure 5: Side View of the Prototype

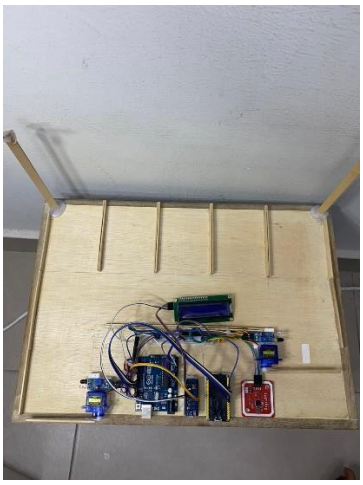

Figure 6: Top View of the Prototype

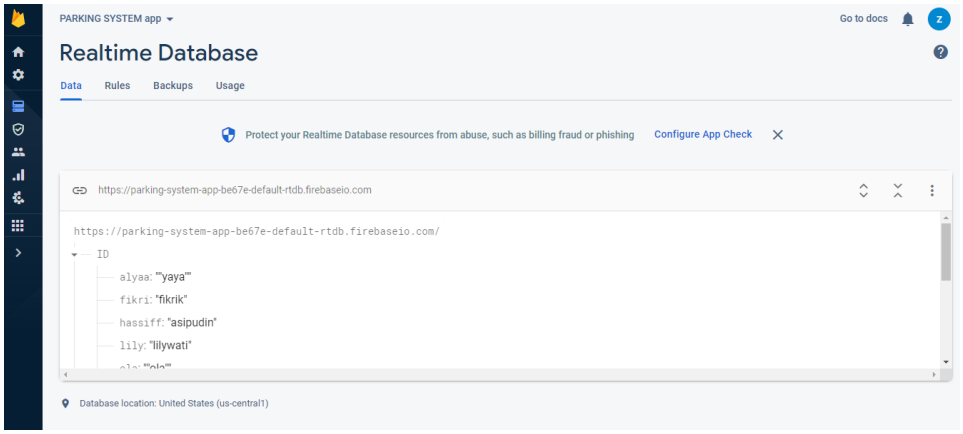

Figure 7: Database interface

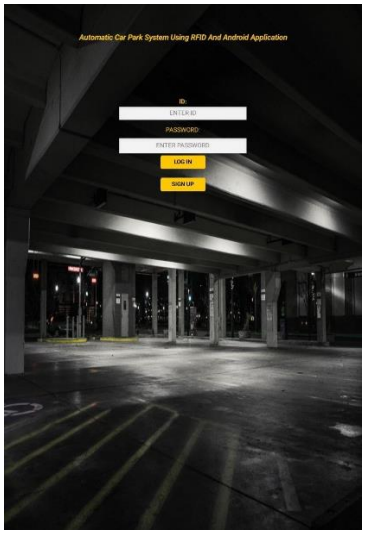

Figure 8: Application Home screen

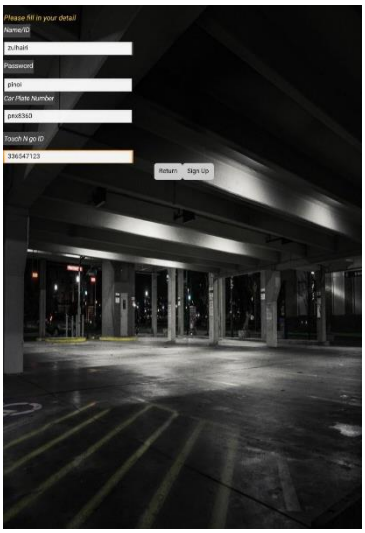

Figure 9: Sign Up Form Screen

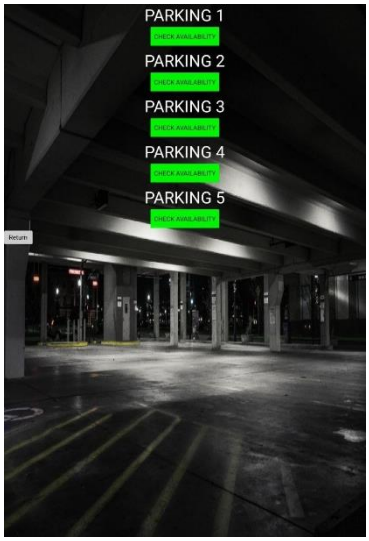

Figure 10: Parking Selection Screen

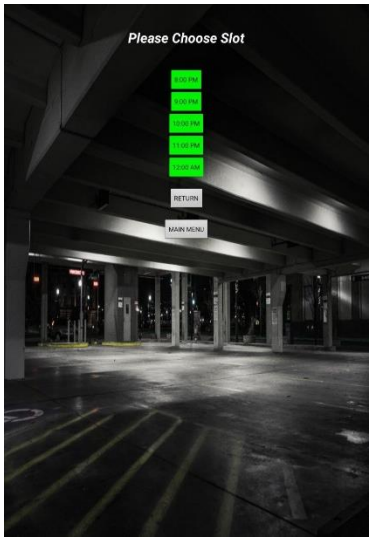

Figure 11: Time Slot Screen

Figure above shows the layout of this project. Figure 3, figure 4, figure 5 and figure 6 shows the overall view of the prototype. All of the project's information is stored in the database as shown in figure 7. Lastly, figure 8, figure 9, figure 10 and figure 11 shows the application screen for every process in the android application.

3.2 Android Application Codeblock

MIT App Inventor is used to build the android application. This software use codeblock as its main coding at the back end of the system. On the website, we can build an application with drag and drop method. Figure 12 shows the main screen of the application builder in the MIT App Inventor website. From the page, the developer can configure the user interface setup, layout, connectivity and many more. It also can directly monitor the smartphone display at the centre tab of the screen. Button, slider, notifier and textbox are also can be insert in this screen. In blocks section, the developer can set up the codeblock for each of the application screen. This replaces the coding used on other websites and software which really helps the user to understand better about the process. Figure 13 shows the process on every button is pressed by the user. When button 1 is pressed which is the "LOG IN" button, the data will be send to database to check whether the username and the password is correct and already in the database or not. If the username and the password are correct, the application will be directed to parking selection screen. If the data is not correct, notification will be popped out at the screen that will show "USERNAME OR PASSWORD IS INCORRECT". In this main screen, the user also can press the "SIGN UP" button which will redirect the user to sign up form screen.

Figure 12: Android application homescreen

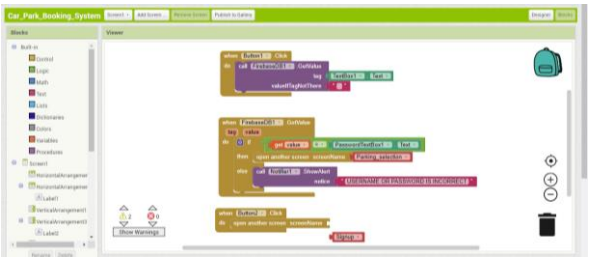

Figure 13: Home screen codeblock

Figure 14: Sign up codeblock

Figure 15: Parking selection codeblock

When the application is redirect to the sign-up form screen, the user needs to fill in all of the information asked which is username, password, car plate number and card identification number. To store the data in the database, the user needs to press the "SIGN UP" button which is button 1 referred to the codeblock shown in the figure 14. Once the user data successfully sent to database, the application will show the parking selection screen. As this screen is only a slot chooser, there will be no data that need to be sent to database. As shown in the figure 15, it has 5 "CHECK AVAILABILITY" button to determine the availability of the parking slot. If the parking 1 slot is chosen, the screen will go to the parking 1 time slot screen, if the parking 2 slot is chosen, the screen will go to the parking 2 time slot screen and so on.

Figure 16: Time slot codeblock

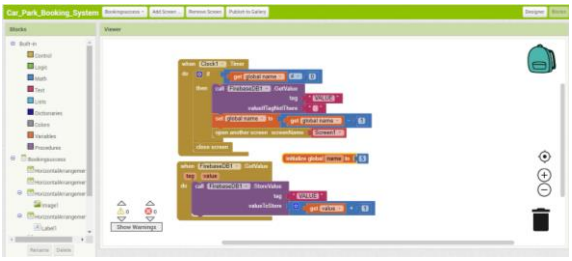

Figure 17: Booking success codeblock

When the user is on the time slot screen, user needs to choose one of the time slots as shown in the figure 16. It has 5-time slot which is 8:00PM, 9:00PM, 10:00PM, 11:00PM and 12:00PM slot. If the chosen time slot available, the system will send the data to database and the screen will be redirected to booking successful screen. If the time slot is already taken or unavailable, notification will be popped out on the screen showing "SLOT NOT AVAILABLE" message. If the booking is successful, the application will show booking successful screen to the user to indicate user the booking is complete. The screen will show in one second as shown in figure 17 and will redirect the user to application main screen.

4. Conclusion

In short, a car park system using RFID and an Android app was developed with some limitations. The system is made up of microcontrollers NodeMCU ESP32, Arduino UNO, and Arduino NANO, and uses C language and Arduino IDE to operate, analyze, and transfer data from sensors. The system mainly uses RFID and Android apps for input and the Firebase database for output, but it has a limitation where the user must manually reset the system if they have used the parking slot once and the admin must manually change the booking in the database. This is due to a lack of pinout on the Arduino UNO to send information to the NodeMCU ESP32 when the user leaves the parking space. For the effectiveness of the booking system, this built system is very helpful for users to get parking earlier and more conveniently. This is because this system will tell users whether there is still an empty parking space or not in the parking space.

For future references and comments, this project might be enhanced to incorporate other inputs such as car registration number display on the LCD and parking lot indication. The information might be utilised to make it easier for the user to access the parking place. Next, the use of a microcontroller that has more pinouts is very helpful to ensure that the system can be reset automatically based on the information sent by RFID after the user exits the parking space. In the future, the mechanical system may be improved from a wood basis as the primary material for this project to a much more lasting material such as hard plastic or a 3D-Modeling structure. The addition of parking space is an excellent upgrade for this project. Furthermore, to encourage green energy, it is recommended that the system be combined with a solar panel, which may help reduce power costs and be utilised in an emergency.

Acknowledgement

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