

Smart Parking System using ESP8266 Wi-Fi Module

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Abstract: This paper examines the issues with conventional parking lots. Additionally, it covers the effects and inconveniences brought on by the inefficiency of conventional parking places. The authors of this work propose and develop a smart parking system that makes use of IoT technology and enables users to locate open parking spaces in a certain location. Additionally, it prevents unnecessary movement through already crowded parking lots. The authors of this study introduce a revolutionary parking system with an IoT over WiFi module. The authors propose a mobile-based Internet of Things (IoT) solution to the problem. ESP8266, SG90 servo motor, and IR sensors are important parts. Users may quickly search for neighboring parking lots and view real-time availability in each parking lot with the aid of the solution. Through the app, they may even reserve the desired parking space before heading to the lot. Through the mobile application, the user may also make the payment. Additionally, the administrator may offer a free parking spot.

Keywords: IoT (Internet of Things), IR Sensors, Smart Parking, Traffic Congestion, Android Application, SG90 Servo Motor

I. INTRODUCTION

In recent times, finding a parking slot on a narrow road or in heavy traffic is difficult. Also, it consumes more time for searching a vacant place to park a vehicle in crowded places. [1] It opened the door for traffic congestion, which has developed into a grave issue on a global scale. It has also been discovered that it has resulted in the combustion of over a million tonnes of oil worldwide. People find it challenging when their car is towed after they park it in a small space or a no-parking zone. According to a report[1], the Smart Parking system could benefit by saving 2,20,000 gallons of gas by 2030 and 3,00,000 gallons of gas by 2050, if it is executed perfectly. Numerous smart parking facilities were developed to help with this situation, however, they did not succeed in providing relief for everyone. They could only provide parking information, but they didn't show that they were "smart" enough. People find it challenging when their car is towed after they park it in a small space or a no-parking zone. For example, if they were able to advertise open parking places, numerous drivers would hurry to fill them. So, in this work, we have attempted to address these difficulties. Here, we put up a concept for a Smart Parking structure that would allow for Internet of Things (IoT)-based reservations. The miracle of the Internet of Things is the ability for devices to communicate with one another by using the Internet, allowing server farms to compile data and view and manage anything. "Internet" and "Things" are the two amazing words in the IoT. The Internet is a massive worldwide network of interconnected servers, computers, tablets, and mobile devices that uses protocols and connecting methods that are accepted around the world. The resulting machine-to-machine (M2M) data is quite diverse. For the better comprehension of Internet of Things, we state it as,

Real Objects + Internet + Sensors and Controllers = Internet of Things

Smart Cities are made possible by the Internet of Things. The development of smart cities is primarily influenced by comfortable parking spaces and effective management and transit systems [2]. We assert that applications can be developed using the Internet of Things due to developments in sensor technology and the low-cost properties of embedded systems. The International Parking Institute's most recent study [3] states that numerous creative parking concepts have been created. They were successful in getting the word out about the empty parking lots. These systems deployed active data processing units in addition to using efficient sensors in the parking spaces and tracking data from multiple sources.

This project was created to establish a prototype for a mobile-based car parking system that would enable users to view vacant parking spaces nearby and allow administrators to create spaces for car parking. Firebase Database is used for storing the data such as admin while specifying the location and providing the number of slots.

II. LITERATURE REVIEW

IOT-based smart parking systems have been implemented in many different places. Some experiments used Arduino, ultrasonic sensors, and cloud servers to deploy an IOT-based parking system. This research has used a system that can be accessed through a mobile application to find open slots and receive real-time parking spot updates. The program stated that four slots would be reviewed in real-time for availability, and the webpage would turn green if a slot was available and red if all of the slots were taken [4], [5], and [6]. In the paper [7], a radio-frequency identification (RFID)-based and wireless sensor network-based parking IoT solution is proposed. But a large-scale parking lot is not a topic that is covered in the paper [7]. A parking system based on the ZigBee network has been suggested in the Paper [8]. Here, data regarding the parking space is gathered through a web service. At each point specified in a time-driven sequence, mixed-integer linear programming (MILP) is used, according to one study [6]. In order to address the problem, a different strategy was used in this study, which transformed parking planning into a linear problem. Studies that demonstrated IoT modules and the usage of mobile applications for customers also included a feature of wallet-based payment [3] and [9]. Our strategy is based on the ESP8266 Wi-Fi Module, a 32-bit microprocessor. The Arduino IDE application, which needs to be loaded on the machine, runs the Wi-Fi Module. Simple embedded C code is written and then directly uploaded to the ESP8266 system using a microcontroller. As a result, the code-based system keeps track of how many vehicles have entered the parking area. The goal slots' availability will be checked using IR sensors, which will then transmit the information to the ESP8266, which will then send it to the Firebase Database and notify the user via the mobile application.

III. PROBLEM STATEMENT

Recent studies in large cities have shown that there are various perspectives from which to approach the issue of parking management. Roads with a high vehicle density. This makes it incredibly challenging for cars to find parking spaces, which is an inconvenient problem. The majority of the time, driver's waste time and energy looking for parking spaces and wind up parking their cars on the street. In the worst situation, customers are unable to find a parking space, particularly during busy times and holiday seasons.

IV. OBJECTIVES

The goal of this project is to give clients an easy-to-use web platform where they can look for nearby parking options and reserve the closest spots for their cars before they arrive. Additionally, it will continuously update users on parking spots that are available when using the program. The administrator can use a mobile application to create a free spot for parking a vehicle. Finally, through our project, we have tried to offer a flexible 24/7 booking facility

V. RESEARCH METHODOLOGY

The development of our system is divided into parts, as explained by the following flowcharts:

5.1 Entry Process Flowchart

The unique procedures that each user or client must adhere to in order to access our online parking service are shown in Figure [1]. Users using mobile applications can look up local locations to park their cars, look up parking lots in those locations, and then authenticate as a user after those searches are complete. The mobile application now verifies the user's status as a registered user or not before allowing them access to the service. If so, they can move on to the booking procedure. If not, they must create an account on the mobile application using the New User Register page and a working email address. The user can access this service only after successfully registering on the application.

After completing the online registration, the user will look for a parking spot nearby. The user can check the availability of slots after choosing a venue and then make a reservation for a certain slot. The user must first set the time for parking

their car there before setting the time and paying for the parking space. The IR sensor will identify the automobile as it approaches the gate when it enters the parking area, and it will then transmit a signal to the servo motor to open the gate. The user must then proceed to the assigned parking space, park their automobile there, and enter by being detected. car parked in that slot via IR sensors, with a mobile device updating the status to indicate that the slot is occupied

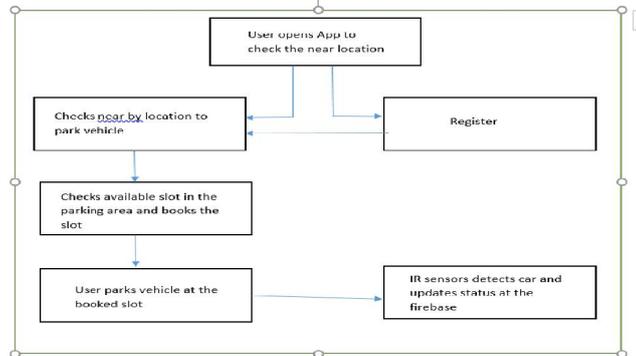


Figure 1: Entry Process Flowchart

5.2 Exit Process Flowchart

The exit procedure is shown in Figure [2], which will begin when the user takes their car out of the parking space. The IR sensor will be deactivated and its status (i.e., this spot is not available for booking) will be updated on the mobile application/server as soon as the car is removed from the designated parking space. This will make it easier for the new user to access the application and look for a position. As soon as the prior vehicle has been removed, he or she can reserve the time slot. This fast process will aid the owner in preventing income loss due to slowness. The car will approach the gate as it exits the parking space, and the ir sensor will detect it and send a signal to the servo motor to open the gate.

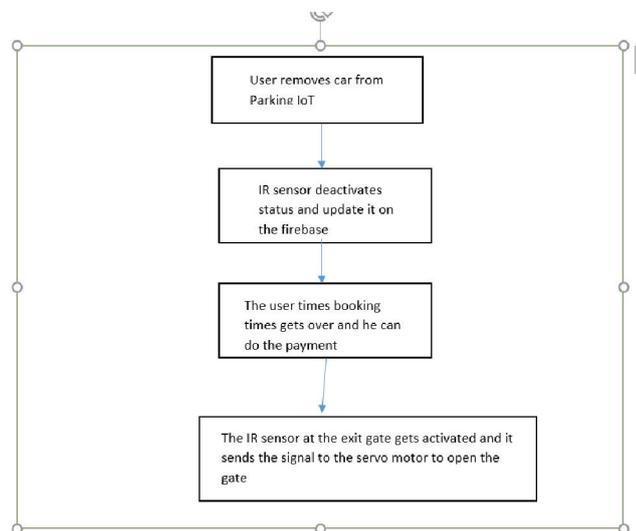


Figure 2: Exit Process Flowchart

5.3 Admin Specifying Parking Space

Figure [3] depicts how to admin will provide his empty space as a parking space. If the admin has not registered himself/herself on the mobile application then he/she has to register first through a valid email address. Then after successful registration, he will redirect to the login page. After Login the admin will go to the dashboard where he can see add location link after clicking it the admin has to insert the data for parking space and also the upi id for receiving payment.

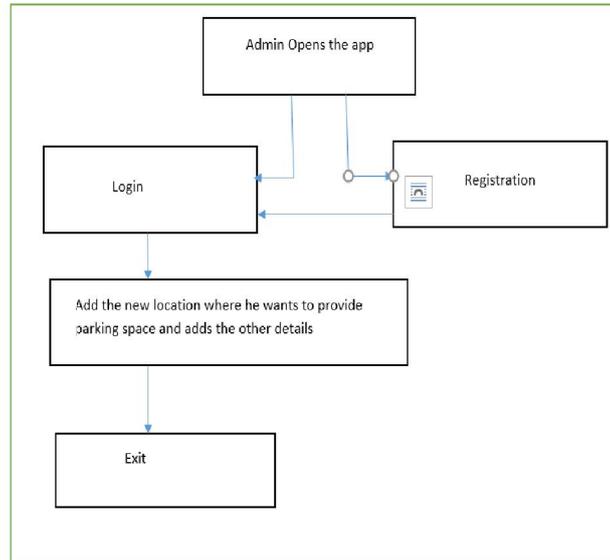


Figure 3: Admin process Flowchart

Details of the Components:

ESP8266

ESP8266 is a wifi SOC (system on a chip) produced by Espressif Systems . It is a tightly integrated chip meant to deliver complete internet access in a compact form factor. The ESP8266 can be used as an external WiFi module by attaching it to any microcontroller through the serial UART and using the standard AT Command set Firmware, or it can directly function as a Wifi-enabled micro controller by writing new firmware using the available SDK. The GPIO pins support PWM, SPI, I2C, analogue and digital IO, among other things.[W2]



Figure 4: ESP8266 Wi-fi Module

IR Sensors

An electrical device that monitors and detects infrared radiation in its environment is called an infrared (IR) sensor. William Herchel, an astronomer, made the unintentional discovery of infrared radiation in 1800. He saw that the temperature was highest just beyond the red light as he measured the temperatures of each colour of light (separated by a prism). Despite being on the same electromagnetic spectrum as visible light, IR has a longer wavelength than visible light, making it invisible to the human eye. Infrared radiation is produced by everything that emits heat (i.e., everything with a temperature higher than about five degrees Kelvin).[W3]

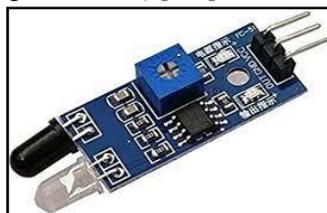


Figure 5: IR Sensors

Servo Motor:

A rotary actuator known as a servo motor (or servo) enables precise control of angular position, velocity, and acceleration. Servos are a common component in toys, home electronics, automobiles, and aircraft. Servos are also found in the background of many of the gadgets we use every day. Servos are used by electronic equipment like DVD players to extend or retract the disc trays.[W4]

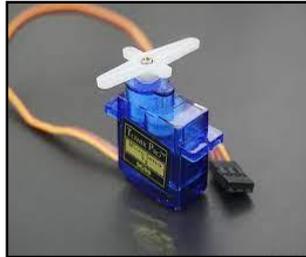


Figure 6: SG90 Servo Motor

VI. RESULTS

6.1 Hardware

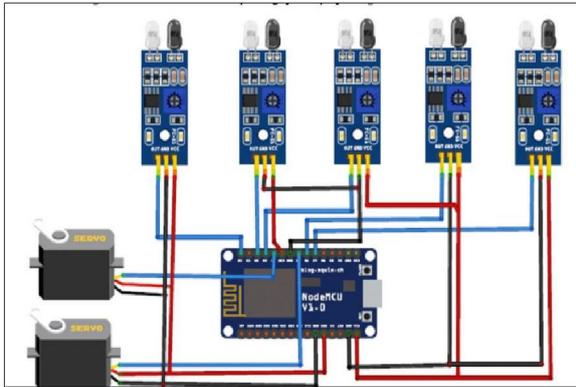


Figure 7 : Circuit Diagram

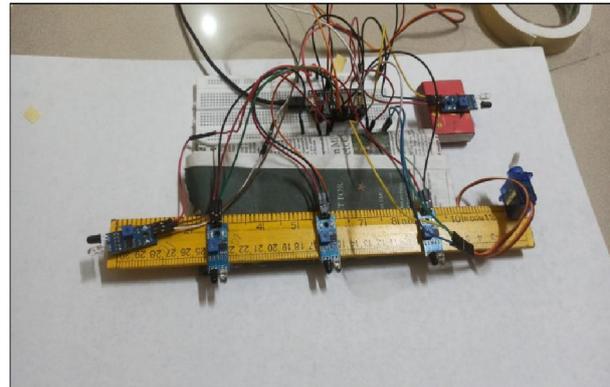


Figure 8: Hardware Development Backend

Figure [7] & [8] depicts the backend connections for the driver barrier's two SG90 servo motors, one ESP8266 WiFi module, and five IR sensors. The parking space can be reserved in advance using an Android app, as shown in picture [9]. After successfully reserving the time slot, the user will arrive at the parking lot within a certain amount of time. The entrance gate will open when the IR sensor at the location detects the vehicle and sends a signal to the servo motor to open the gate for a specific period of time. The IoT module and Wifi module are linked. Further, the IR sensor connected to the WiFi module will activate when the car is parked at its designated space, turning on the LED and updating the firebase to show that the spot is occupied.

The IR sensor will once more identify the vehicle at the exit point, and it will then trigger the servo motor to open the gate for a certain period of time. The IR sensor LED will turn green when the car pulls out of the parking space, and the status will now read "available on firebase."

6.2 Mobile Application Development

1. User Side

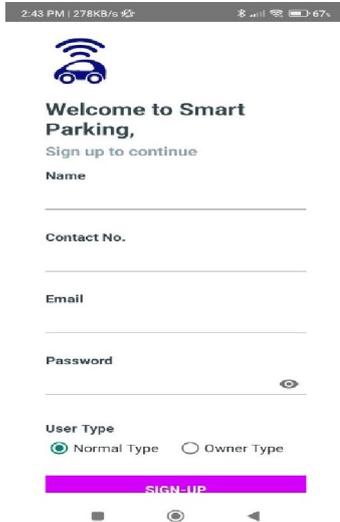


Figure 9: Registration Page

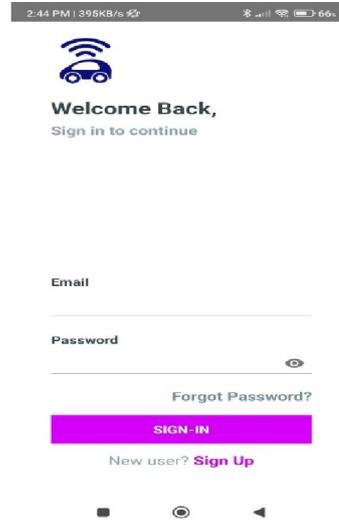


Figure 10: Login Page

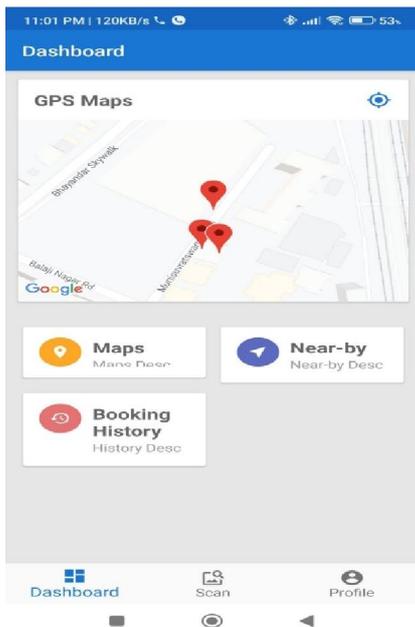


Figure 11: User Dashboard

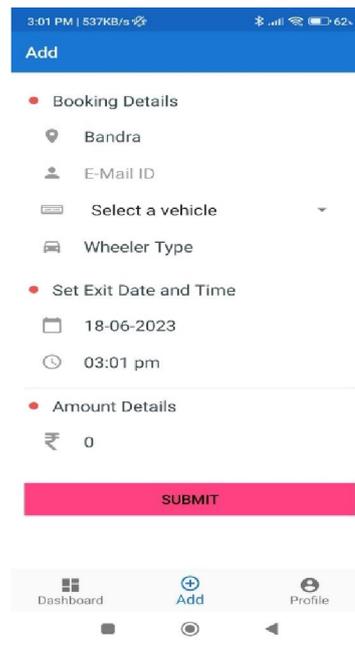


Figure 12: Slot Booking

This project offers the user an application that allows pre-booking, or the ability to reserve parking spaces before arriving at the parking facility.

Figure [9] depicts the signup page for a new user created using the mobile application. The user must enter their name, phone number, email address, and password in order to access the service. Existing users of the application can also log in using a screen that includes a password recovery option. The user is prompted to select the local location and parking slots after successfully signing up or logging in. The application will display both reserved and open parking spaces. Figure [10], [11], [12] shows the Login page, user dashboard and slot booking images.

6.3 Admin Side

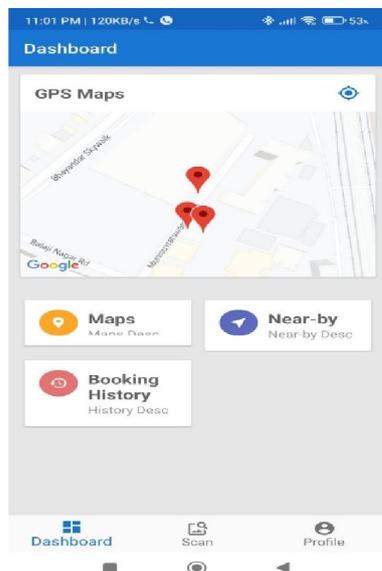


Figure 13: Admin Dashboard

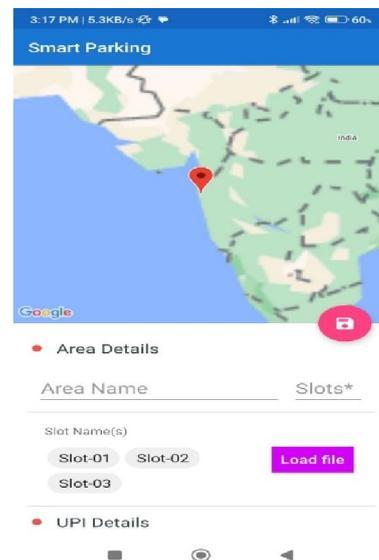


Figure 14: Providing Parking Slots

The figure [13] & [14] depicts the page for the admin, who must first complete out the sign-up and login forms before he can access the program. The administrator can now provide a free parking spot as well as the location of the parking area after a successful login.

VII. CONCLUSION

This paper showcases a Smart Parking System using the Internet of Things on ESP8266 Wifi module and firebase/mobile application. The project is broadly divided into two parts, such as mobile application for pre-booking and payment system and another the deployment of IoT module at parking slots and also at entry and exit gate. This project's unique features will help people overcome their parking difficulties and manage their time too. The owner can also provide his/her empty space for parking space through the mobile application. Also the owner can enjoy profits at every booking. This project's motivation is to make a parking system with no human intervention and digitize the conventional parking space. The advantage of this project includes ease of locating a parking space as instead of looking around and searching, parking lots are tagged on the mobile app, real-time availability of parking space can be checked online to save time and resources of manually travel and look for the same. Moreover, Parking slots can be booked in advance, reducing the uncertainty and ambiguity of not getting vacant parking slots on arrival to the parking lot. Payments are made automatic reducing time, congestion, and scope of human error giving the easy setting and cost-effective solution.

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