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Smart Car Parking System

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ABSTRACT
Reducing traffic congestion on highways, in multi-story buildings, and in shopping centers is the main goal of the Internet of Things-based Smart Car Parking System Project. This project displays any empty slots that are available in relation to the user's location. Our proposal's objective is to efficiently use parking spaces. We monitor available spaces in the parking slot and assign them to users. The smart parking system outlined earlier can deliver a precise, reliable, safe, and efficient management solution. The idea of a smart city now appears to be feasible. Road safety, parking space shortages, and traffic congestion are among the problems that IOT is tackling. The suggested smart parking system's IOT module is installed on the property, where it tracks and displays the status of each individual parking place. In addition, a smartphone application is offered so that consumers can confirm parking availability. At the conclusion of the study, a use case that describes how the system operates is provided in order to confirm the veracity of the suggested model.
Keywords*: IOT, Smart Parking System, Traffic Congestion, Mobile Application, Real-time Tracking.*

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I. INTRODUCTION

The project for the smart parking system will enable users to control every parking facility. It is wonderful that even the average middle-class individual can now purchase a car due to the market's low pricing and the economy has experienced recent growth. Even if there is space finding the right parking spot often wastes time, increasing fuel consumption and harming the environment. Car ownership does have some disadvantages, though, such as pollution, heavy traffic, a lack of roads, and insufficient parking spaces hinder the parking it is also the main concerns that accounting needs to take into consideration. It will be very helpful for the cars and the environment if we can figure out a way for the parking structure to inform us the precise location of a free place. We utilize a direct current motor to simulate the motors used to open gates and infrared sensors to determine whether parking spaces are occupied in order to demonstrate the concept. They are currently able to communicate online thanks to a Wi-Fi modem, and the system is managed by a microcontroller. To determine the parking slots' occupancy status, we offer a mobile app. The number of parking spaces that are either occupied or available is retrieved by the system. A flawless parking experience is ensured by users' quick online access to real-time parking availability information from any location. Our paper aims to explore the technical structure, theoretical underpinnings, and practical implementations of the IoT Smart Parking System built on Arduino. Consequently, the system provides consumers with a simplified parking management system and effectively addresses the issue of parking in metropolitan areas. These systems strive to address the problems related to urban parking through resource allocation, intelligent monitoring, and enhanced user experiences. They do this by combining the power of Arduino microcontrollers with the ubiquitous connection of the Internet of Things. Driver displeasure and activity disruption might result from inadequate car parking spaces.

II. MATERIAL AND METHODS

2.1 Materials

- Arduino UNO
- ESP8266 Wi-Fi Chip
- IR Sensor
- Ultrasonic Sensor
- Servo motor
- LCD
- Arduino IDE

- ❖ MQTT Dashboard Client

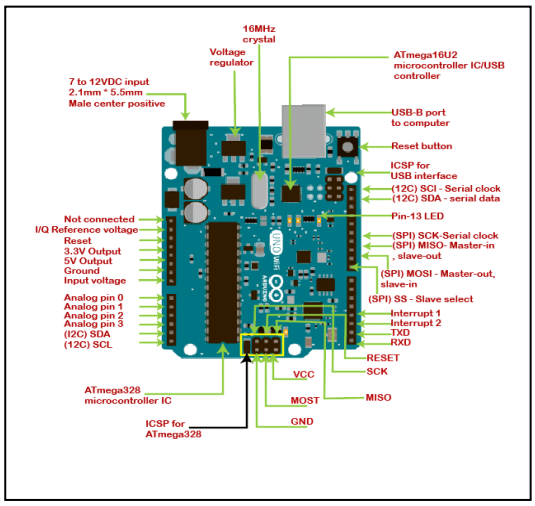
2.2 Methodology

The project consists of two main components: hardware architecture and software details. A prototype for the project was created, and the circuit design was incorporated into the hardware architecture. All of the prototype's control during the software development phase came from programming code.

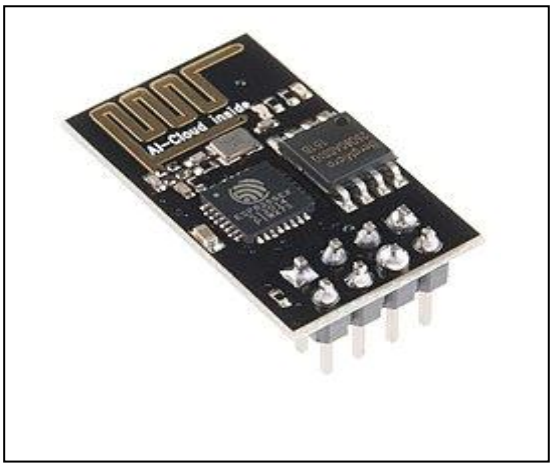
2.2.1 System Architecture

1. Hardware Specifications:

I. Arduino Uno: The well-known open-source Arduino Uno microcontroller board has the ATmega328P CPU. It can be powered by an external power source (7–20V), features six analog inputs, 14 digital I/O ports (6 with PWM output), and a clock speed of 16 MHz. There is also a reset button on the board, a USB interface, and an ICSP header for incircuit serial programming. It is a great option for both novice and expert builders who want to construct a range of electronic projects because of its simplicity, adaptability, and robust community support.

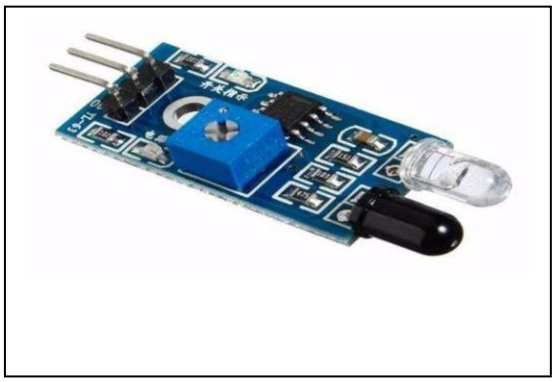


II. ESP8266 Wi-Fi Chip: Espressif Systems developed the ESP8266, a low-cost Wi-Fi microprocessor with microcontroller and complete TCP/IP stack capabilities. Because of its low cost, low power consumption, and simplicity of integration, it is commonly utilized in Internet of Things applications to enable wireless connectivity to devices. ADC, I2C, PWM, GPIO, and STA pins enable flexible interface with sensors and peripherals, and the chip supports Wi-Fi Direct, STA, and AP modes. Programmable with languages such as C and Lua.



III. IR Sensor: Optoelectronic devices that detect and react to light with infrared wavelengths between 780 nm and 50 µm are called infrared sensors, or IR sensors for short. Infrared sensors are increasingly commonly used in motion detectors in modern applications. Building services employ these detectors to turn on lighting systems, and alarm systems use them to find trespassers. The

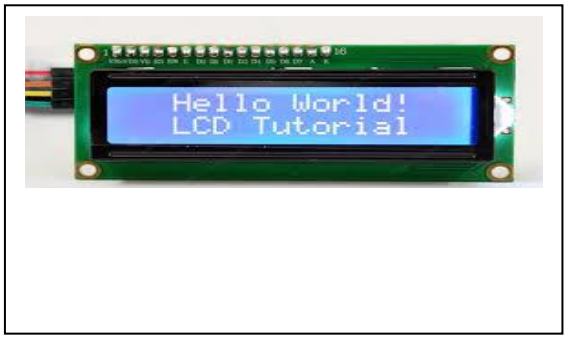
sensor's components measure changes in heat radiation—more precisely, infrared radiation—caused by humans moving within a predetermined range of angles, both in space and time. Such infrared sensors are cheap, mass-produced goods that only need to meet a few simple requirements.



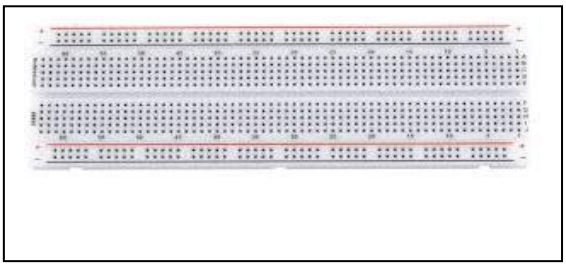
IV. Ultrasonic Sensor: A device known as an ultrasonic sensor uses sound waves to determine distance. Ultrasonic waves, which are sound waves with a frequency higher than what the human ear can detect, are produced by it. When these waves hit an object, they return to the sensor. The distance from the item is determined by the sensor using the time it takes for the waves to return. They are frequently employed in procedures like as industrial distance measurement and robot obstacle identification.

V. Servo Motor: An extremely accurate motor that can rotate at predetermined angles or distances is called a servo motor. Strong rotational force can be produced in small, light units by the device's gear system, which can be powered by either an alternating current (AC) or direct current (DC) power source. Numerous devices and systems, including as toy cars, RC helicopters, planes, and robotics, use these motors. The entry and exit gates of the system are powered by two servo motors that rotate on their own from 45° to 140° when an IR sensor detects the presence of an automobile. The motor returns to its initial position after some time. Servo motors fall into many classifications based on how their gears are arranged and how they operate.

VI. LCD: Using liquid crystal, an LCD is a type of electrical display module that produces a visible image. In do-it yourself circuits and projects, the 16x2 LCD display is one of the most basic components. A 16x2 display is one that has 16 characters on each of the two lines. On this LCD, each character is displayed as a 5 by 7 pixel matrix. The 16*2 screen shows the number of spilled and vacant spots. Additionally, the LCD display is refreshed when a car parks or unparks.



VII. Breadboard: In order to accommodate small transistor and integrated circuit (IC) pins, component wires, and connecting wires, a breadboard is a plastic block with electrical sockets. It facilitates part removal and replacement, demonstrating their operation and permitting repurposing in other circuits.



VIII. Jumper wires: In order to make temporary connections between two sites without the necessity for soldering, jumper wires are crucial parts of electronics. They are made up of a flexible wire with clips or connector pins on either end. For electronic applications, jumper wires can be used for connections between males and females, males and females, or males and females. They are available in a range of hues and lengths to satisfy different needs.

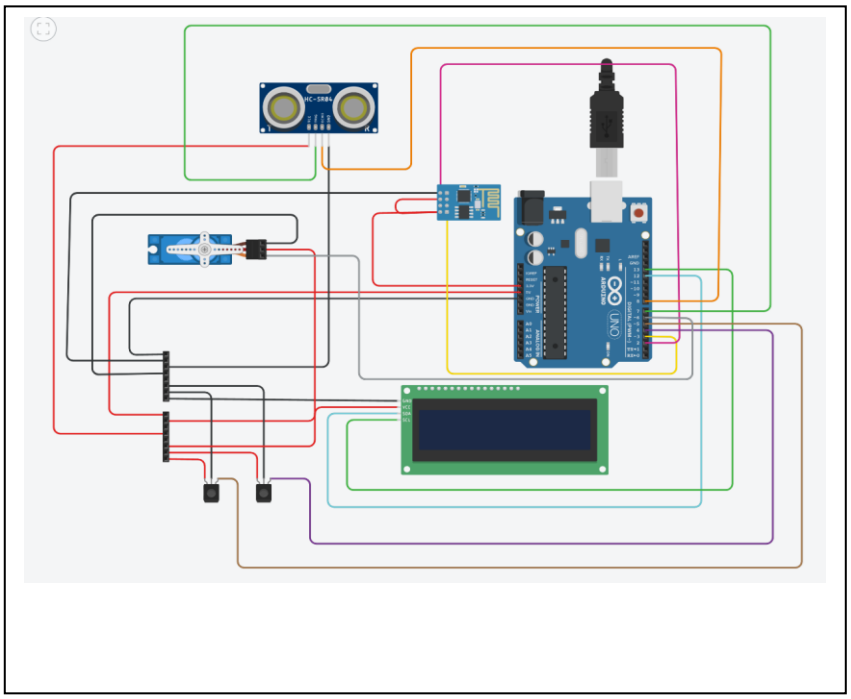
2. Software Specifications:
   I. Arduino IDE: Writing and compiling code for The Arduino IDE is a free software application used to create Arduino modules. It is compatible with Linux, Windows, and Mac OS X. Running on the Java Platform, the application comes with capabilities for code editing,

debugging, and compilation. There are four types of Arduino modules: the Uno, Mega, Leonardo, and Micro. Programming languages available include C and C++. by the text editor and compiler that are part of the IDE environment. It makes it possible for beginners to learn and improve their Arduino skills.

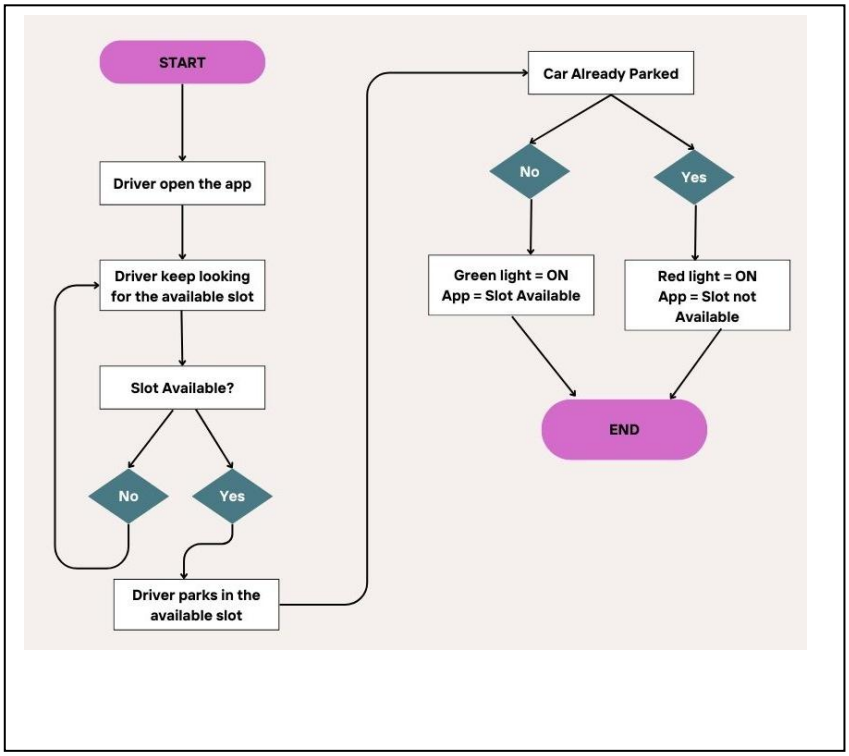
II. MQTT Dashboard Client: Doikov Evgenii created the MQTT Dashboard Client, a free Android app. Users can program and operate a wide range of devices, including microcontrollers (MCU), sensors, computers, pumps, thermostats, Sonoff, Electro dragon, IoT, M2M, Smart Home, esp8266, Arduino, Raspberry Pi, and more.

2.3 Design

The plan shows how inputs and outputs flow during the project's operation. For example, the infrared (IR) sensor sends a signal to the Arduino and Node MCU when a car is about to park, and those two devices then send a signal to the servo motor. In addition, the output gate's infrared sensor starts to function. To find out if a car is parked in a secure place, more infrared sensors are employed. The results are then displayed on a mobile application called MQTT Dashboard client. The hardware components of the project are connected in the following schematic, which serves as a connection for programming. The scheme illustrates how each sensor and other component is connected to its appropriate port.



The computer code's operational procedure is depicted in the diagram, where the first IR sensors detect whether a car is present at the input gate and decide whether or not the parking area is full. The entrance gate closes and the park is indicated as full in the application if it fills to capacity.



2.4 RESULT

This section introduces the system's hardware level based on the design schematic.

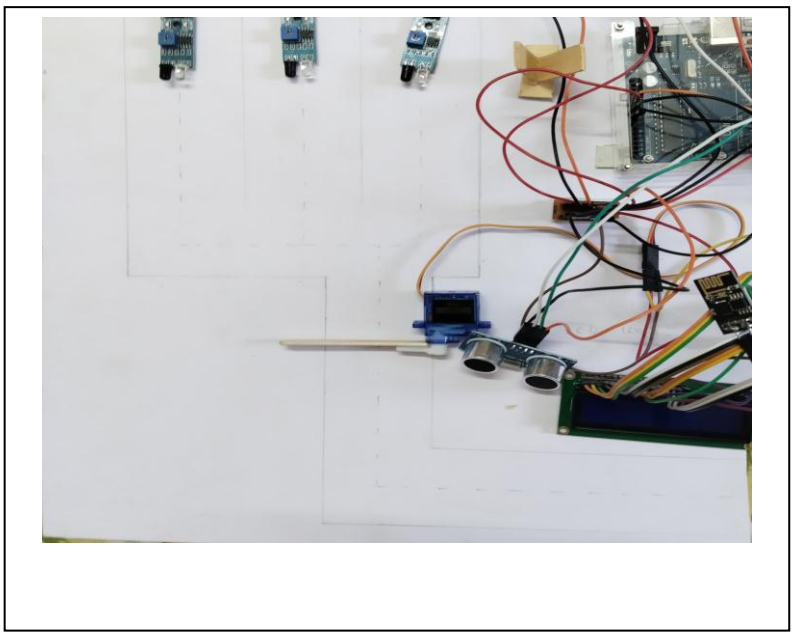
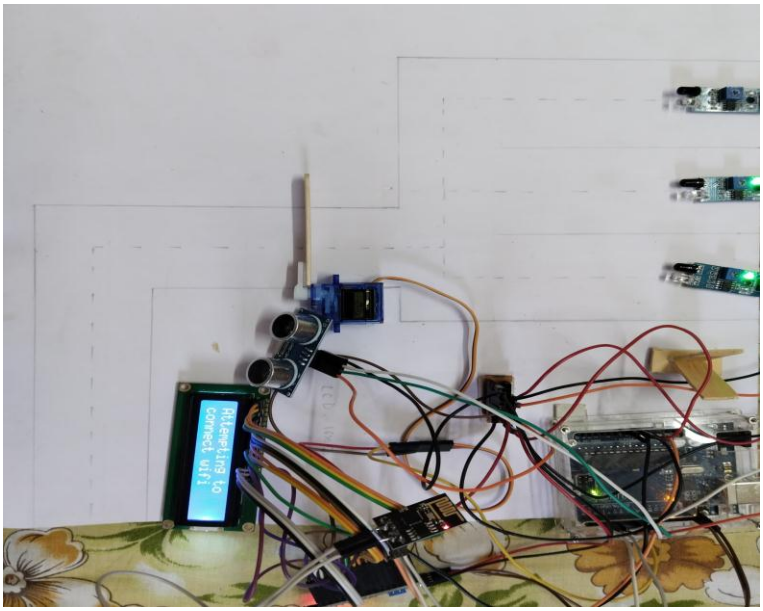
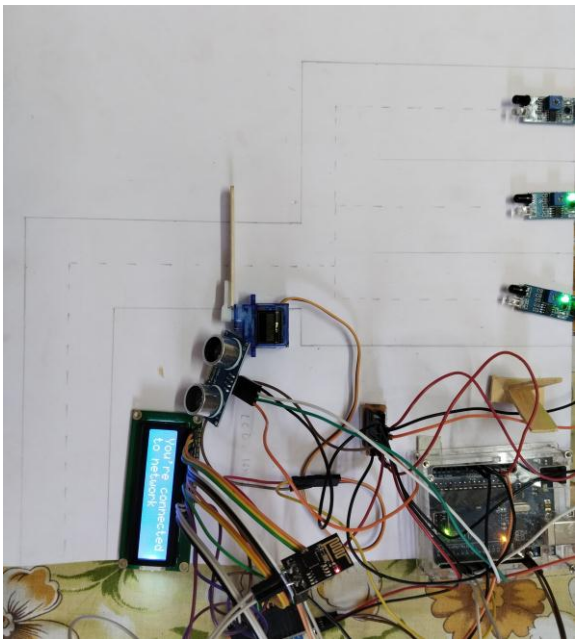
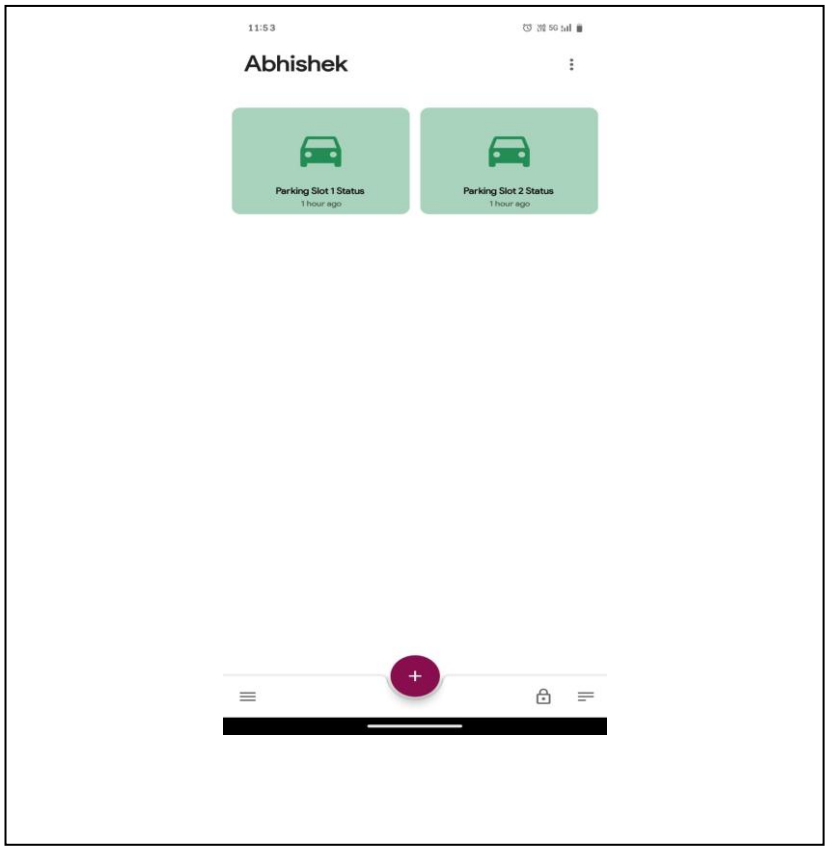


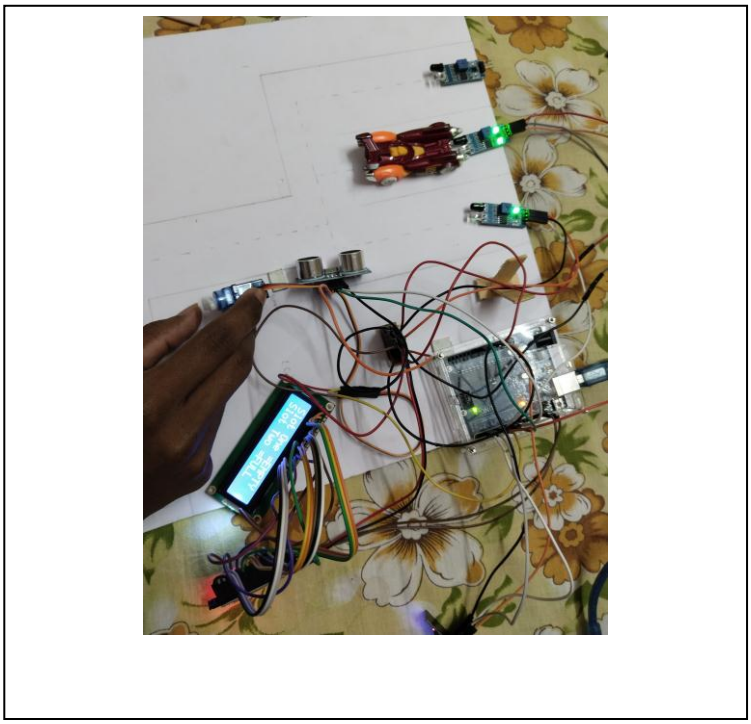
Figure 11 provides a graphic representation of the Internet of Things (IoT) at the outset of the project. Based on the number of parked automobiles, it may be inferred that there are none at the address.


Attempting to
connect wifi

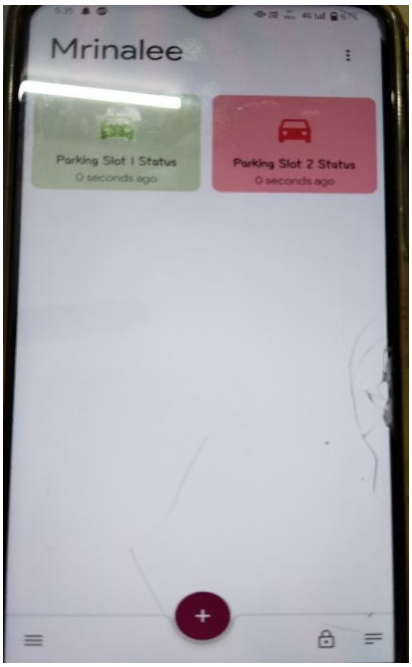

You're connected
to network



A graphic representation of an abandoned parking lot and how app's interface is shown in Figure 12, 13 and 14. The car parked counter in Figure 15 will increase by 1 when a vehicle enters the park due to the sensor's activation. The entry gate will also be operated by a servo motor. The vehicle then approaches a vacant parking space, such the first one that becomes available. As seen in Figure 13, the infrared sensor allows data to be transferred to the Internet of Things (IoT) platform regarding the length of time a vehicle is parked and the moment it leaves a particular parking area.



When the park fills up, as it does in Figure 15, the website will report that one car is parked as you can show in Figure 15, and all of the sensors will keep working, sending the appropriate entry timings to the website, as seen in Figure 16.



III. DISCUSSION AND CONCLUSION

3.1 Discussion

In order to alleviate the problems associated with urban parking, smart auto parking systems make use of IoT technology. They provide real-time updates on parking availability, ease traffic, and improveuser convenience1. These systems improve the whole parking experience by providing precise and dependable data via sensors, microcontrollers, and cloud platforms. Predictive analytics and artificial intelligence (AI) include analyzing enormous volumes of data using sophisticated algorithms and machine learning methods. Based on real-time inputs and historical data, these technologies can forecast parking demand predicting future requirements and allocating parking places optimally, this improves decision-making. AI can, for instance, recommend different parking lots during rush hours, which would ease traffic. Better urban planning and a more seamless parking experience are ensured by predictive analytics, which aids in resource management.

3.2 Conclusion

In many retail centers and metropolitan regions, the issue of parking is a major concern. We have developed a proposal for an (IoT) enabled intelligent parking system that makes use of an Arduino microcontroller, a WIFI module, and a Node MCU in order to address this problem. The parking system is run by the cloud. Urban communities are currently seeing a lot of congestion in their parking lots. We will use an Internet of Things (IoT) parking system in an attempt to simplify the process. The goal is to find a city where parking is a problem and park the car there before we start this endeavour. By putting this mechanism in place, this idea makes parking a car in any parking lot easier. Regardless matter where they are, users can easily access and track the availability of parking spaces via an online portal, guaranteeing a smooth parking experience. As a result, the system uses Internet of Things (IoT) technology to efficiently tackle the parking issue in urban areas and offers clients a simplified parking management system. The addition of an RFID card system for vehicle access is one potential improvement. It is also possible to install a camera to record the car as it enters. putting the payment and reservation features online into operation.

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