

PARKING OCCUPANCY MONITORING AND ANALYZING SYSTEM

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering Degree in Electrical and Electronics Engineering

By

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SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade “A” by NAAC

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **RAM KUMAR E**
(Register No. 37140702) and **JOTHISHANKAR K R** (Register No. 37140040) who
Carried out the project entitled "**Parking occupancy monitoring and analyzing
System**" under our supervision from December 2020 to April 2021.

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DECLARATION

We **RAM KUMAR E** (Register No. 37140702) and **JOTHISHANKAR K R** (Register No. 37140040) hereby declare that the Project Report entitled “**Parking Monitoring and analyzing System**” done by us under the guidance of **Dr.M.S.SANGEETHA** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering (Full Time) degree in Electrical and Electronics Engineering.

DATE:05.04.2021

PLACE:Chennai



SIGNATURE OF THE CANDIDATES

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ABSTRACT

Car parking is a major issue in modern congested cities of today. There simply are too many vehicles on the road and not enough parking spaces. We led to the need for efficient parking management systems. This we demonstrate the use of IoT based parking management system that allows for efficient parking space utilization using IoT technology. To demonstrate the concept we use IR sensors for sensing parking slot occupancy along with a dc motor to simulate as gate opener motors. We now use a Wi-Fi modem for internet connectivity and a microcontroller for operating the system. We create a webpage for online connectivity and IoT management GUI design. The various steps involved in this operation are vehicle identification, free slot detection, and payment calculation. Vehicle identification is carried out using RFID, free slot detection is carried out using display, and payment calculation is done based on the period of parking. Automatic vehicle license plate recognition is an important component of modern intelligent transportation systems (ITS). The extracted information can be used with or without a database in many applications, such as electronic payment systems toll payment, parking fee payment, and freeway and arterial monitoring systems for traffic surveillance

TABLE OF CONTENT

CHAPTER NO	TITLE	PAGE NO
	Abstract	v
	List of figures	vi
	List of tables	viii
	List of symbols and abbreviations	ix
1	INTRODUCTION	
	1.1 General introduction	1
	1.2 Literature survey	2
2	PRESENT INVESTIGATION	
	2.1 Aim of the present investigation	9
	2.2 Scope of the present investigation	9
	2.3 Proposed methodology	9
	2.4 Proposed block diagram	10
	2.5 Demerits of existing system	11
	2.6 Merits of proposed system	11
3	HARDWARE	
	3.1 Hardware requirements	12
	3.1.1 IR sensor	12
	3.1.2 RFID reader	13
	3.1.3 LCD	14
	3.1.4 Dc motor	17

	3.1.5 Node MCU	18
	3.1.5.1 Uses of NodeMCU(ESP8266-01)	19
	3.1.5.2 ESP-12E Module	20
	3.1.5.3 ESP-12E Chip	20
4	SOFTWARE	
	4.1 Software Requirements	21
	4.1.1 ESP8266 Development platforms	21
	4.1.2 Arduino example: blink	21
	4.1.2.1 Warning	23
	4.1.3 ESP8266-01 features	25
	4.2 Program algorithm	25
	4.3 Flow chart	26
	4.4 Program to interfacing ir sensors with Node MCU	27
	4.5. Simulation results	29
5	RESULTS	
	5.1 Results of proposed prototype	31
6	CONCLUSION AND FUTURE SCOPE	40
	6.1 Conclusion	40
	6.2 Future scope	40
	Geo-tagged Photo	41

LIST OF FIGURES

FIGURE NO	FIGURE NAME	PAGE NO
2.1	Block diagram of parking occupancy and analyzing system	10
3.1	IR Sensor	12
3.2	IR Sensor Detecting method	13
3.3	RFID Reader Module	13
3.4	RFID Reader working explanation	14
3.5	16X2 LCD pinout DIAGRAM	15
3.6	DC Motor	17
3.7	Principle explanation of DC motor	18
3.8	NodeMCU	18
4.1	Module selection in Arduino software	22
4.2	Port selection in Arduino software	23
4.3	Code uploading to NodeMCU through data cable	24
4.4	When IR 1 sensor detects none	29
4.5	When IR 1 sensor detects an obstacle(car)	29
4.6	When IR 2 sensor detects none	30
4.7	When IR 2 sensor detects an obstacle(car)	30
5.1	When the user's RFID is read	31
5.2	Web page when there no car is parked	31
5.3	LCD Updation, When IR sensor 1 detects an obstacle	32

5.4	Web page Updation, When IR sensor 1 detects an obstacle	32
5.5	LCD Updation, When IR sensor 2 detects an obstacle	33
5.6	Web page Updation, When IR sensor 2 also detects an obstacle	33
5.7	LCD Updation, When IR sensor 3 detects an obstacle	34
5.8	Web page Updation, When IR sensor 3 also detects an obstacle	34
5.9	LCD Updation, When IR sensor 4 detects an obstacle	35
5.10	Web page Updation, When all 4 IR sensor detects an obstacle	35
5.11	LCD Updation, When User Exiting from the slot	36
5.12	Web page Updation, When a parking charge generated	36
5.13	Web page Updation, When the User exited from the slot	37
5.14	Car parking prototype, while no vehicles in entry/exit (Gate closed)	38
5.15	Car parking prototype, when vehicles come entry/exit (Gate opened)	39

LIST OF TABLES

TABLE NO	TITLE	PAGE NO
3.1	LCD pinout Explanation	16
3.2	NodeMCU PIN names	19

LIST OF ABBREVIATIONS

S. No	ABBREVIATIONS	EXPLANATIONS
1	IoT	Internet of Things
2	IR	Infrared
3	Wi-Fi	Wireless Fidelity
4	GUI	Graphical User Interface
5	RFID	Radio-Frequency Identification
6	ITS	Intelligent Transportation Systems
7	LCD	Liquid Crystal Display.
8	Node MCU	Node Microcontroller Unit
9	MCU	MicroController Unit
10	ESP8266	Low-cost Wi-Fi microchip
11	DC	Direct Current
12	GPIO	General-Purpose Input / Output
13	IC	Integrated Circuit
14	API	Application programming interface
15	IDE	Integrated development environment
16	ESP	Electronic stability control
17	FTDI	Future Technology Devices International
18	LM	Linear monolithic

19	TX	Transmitter
20	Rx	Receiver
21	D0, D1	Diodes
22	SW	switch
23	GND	ground
24	VCC	Voltage Common Collector
25	SOC	System on a chip
26	RISC	Reduced instruction set computer
27	RTOS.	Real-time operating system
28	XML	Extensible Markup Language
29	LDO	Low Dropout
30	Vin	Input voltage
31	Vout	Output voltage
32	ADC	Analog to digital converter
33	UART	Universal asynchronous receiver transmitter
34	PWM	Pulse width modulation
35	SPI	Serial Peripheral Interface
36	I2C	Inter integrated circuits
37	I2S	Inter IC Sound
38	RST	Reset
39	CPU	Central processing unit
40	SAR	Specific Absorption Rate
41	CTS	Clear to Send
42	SDIO	Secure Digital Input / Output
43	EN	Enable
44	SDK	Software Development Kit
45	EMR or EM	Electromagnetic radiation
46	Op-amp	Operational Amplifier
47	CRT	Cathode Ray Tube

48	AC	Alternate Current
49	ASIC	Application Specific Integrated Circuit
50	RGB	Red Green Blue
51	UV	Ultra Violet
52	JPEG	Joint Photographic Experts Group
53	CMOS	The complementary metal-oxide-semiconductor
54	USB	Universal Serial Bus
55	IEEE	Institute of Electrical and Electronics Engineers
56	UVC	Ultraviolet C
57	VoIP	Voice over Internet Protocol
58	PC	Personal Computer
59	Mac Address	Media Access Control Address
60	IDE	Integrated Development Environment
61	HTML	Hypertext Markup Language
62	Linux	Lovable Intellect Not Using XP
63	MSP	Max Signal Processing
64	AVR	Automatic Voltage Regulator
65	ATmega328	Microcontroller chip on Arduino
66	UNIX or UNICS	Uniplexed Information Computing System
67	PGI	Parking Guidance and Information
68	CPMMS	Car Parking Monitoring and Management system called
69	ITS	intelligent transportation systems
70	GPS	Global Positioning System
71	V2I	Vehicle-to-Infrastructure
72	I2V	Infrastructure-to-Vehicle
73	PC	Personal Computer
74	SPSS	Mart Parking System

CHAPTER 1

INTRODUCTION

1.1 GENERAL INTRODUCTION

Car parking is a major issue in modern congested cities of today. There simply are too many vehicles on the road and not enough parking spaces. We led to the need for efficient parking management systems. This we demonstrate the use of IoT based parking management system that allows for efficient parking space utilization using IoT technology. To demonstrate the concept we use IR sensors for sensing parking slot occupancy along with a dc motor to simulate as gate opener motors. We now use a Wi-Fi modem for internet connectivity and a microcontroller for operating the system. We create a webpage for online connectivity and IoT management GUI design. The various steps involved in this operation are vehicle identification, free slot detection, and payment calculation. Vehicle identification is carried out using RFID, free slot detection is carried out using display, and payment calculation is done based on the period of parking. Automatic vehicle license plate recognition is an important component of modern intelligent transportation systems (ITS). The extracted information can be used with or without a database in many applications, such as electronic payment systems toll payment, parking fee payment, and freeway and arterial monitoring systems for traffic surveillance.

The parking system is controlled by the cloud. Nowadays car parking is congested in cities. So we go to an easy method using the IoT parking system. In this project we are using the IR sensor to detect the slot is occupied or available and the data are sending to the microcontroller. The microcontroller is sending the data's to the cloud server (web page). Before this project, we want to park the car in any parking issue for cities. Now this project is very helpful to park the car in any parking using this system. This allows users to check for available parking spaces online from anywhere and available hassle-free parking. Thus the system solves the parking issue for cities and gets users an efficient IOT based parking management system.

1.2 LITERATURE SURVEY

A parking lot guidance system was introduced in Japan in the ancient city of Nara in 1982. This system was part of a plan to relieve congestion caused by the tourist traffic attracted by the many shrines and Buddhist temples that dot the area around Nara Park. It was a simple, small-scale system that collects information on how filled up the four parking lots around the park are and displays this information for individual parking lots on variable road signs on the road. In the six years since then, similar systems have been introduced in six cities to relieve traffic congestion exacerbating urban traffic problems brought about as a deleterious effect of motorization. But as urban traffic problems have become even more complex, the simple, small-scale systems used heretofore are no longer adequate for solving urban traffic problems caused by the lack of parking spaces as cars driven by would-be shoppers, office workers, and tourists drive around looking for an empty lot or parking spot. These problems have created a demand for highly sophisticated large-scale systems that collect and disseminate parking lot information over an entire urban area. Such large, high-function systems were introduced in 1988 in the three cities of Toyota, Kurashiki, and Takasaki. Among these, what is described here is the "Advanced Toyota Parking Guidance and Information (PGI) System" (PGIS), which collects and presents not only parking lot information but also urban area congestion.

This "age of the automobile" has also become an age of competition between cities as the area served by large stores and other commercial establishments expand in size. As a strategy to survive to the next generation, the city of Toyota is aiming to become a "civic amusement center for families to enjoy," by promoting "the business of providing comprehensive urban amenities" and by (1) becoming a model city for traffic management (with the provision of urban infrastructures such as highways and parking lots) and (2) making the city center more attractive (the concentration of urban functions by redevelopment, etc.). As part of this effort, the PGI system was planned as a support system to further enhance the urban infrastructure such as roads and parking spaces. To make a smooth transition to the "highly information-oriented society" expected to arrive in the 21st century, Toyota is following the promotional policy of the Teletopia basic plan (to create a utopian highly information-oriented society and city through

telecommunications) and making use of the new information and communications means referred to as "new media" in furthering an agreeable regional society on the theme of "Toyota, the motor city brimming with vitality and neighborliness." Here too the PGI system is proposed as a "driver information system" that broadens how automobiles can be used. Toyota's PGI system was built as a "support system" for making more effective use of parking facilities and because there are two train stations in the covered area, for the park-and drive. To make it (1) easy to find a parking spot, (2) easy to know where parking places are, and (3) easy to utilize parking lots, this PGI system aimed to increase the efficiency with which parking lots are used, which will ultimately do away with the useless traffic caused by driving around looking for a spot to park and relieve the traffic congestion and confusion caused by cars waiting for an empty spot in a parking lot.

With the growing number of vehicles, Car Parking problems at University campuses upsurge which not only results in confusion, annoyance, and wastage of time but also the information about the responsible persons for damaging (like scratches, dents, scraps, etc.) other people's cars inside a campus remain anonymous. The problem is getting more severe day by day because the number of student enrollments is increasing year by year and a huge percentage of students and faculty own cars with a limited number of parking lots. An important issue in car parking is that people while parking their cars improperly may block the other parked cars in the parking lots. Due to this, the blocked car owners cannot find the responsible persons and remain stuck and frustrated until they get the car out of the parking lot. The security guards at the parking lots are unable to help in this regard because of the lack of any monitoring and management enforcement systems and policies. Due to this, it takes much time in pursuing the responsible person which consequently results in the wastage of precious time of students as well as faculty and staff members. Another critical problem (that arises due to the reserved and limited number of car parking lots) is that students (for whom no reserved parking is available) may damage other parked cars while improper and wrong car parking. The damaged car owners remain unsuccessful in finding out the responsible persons for damaging their cars and no one can help out in this concern because there is no proper monitoring system that can keep a record of the in and out information (i.e. entrance and exit) of the vehicles and parking information (like parking location, parking duration) of vehicles.

Moreover, students, faculty, and staff members often forget where they have parked their cars in the parking lots. So, finding out a car in such a scenario without any automated management system is a difficult and time-consuming task which finally results in anger, exasperation, and wastage of time. The existing car parking management system at the university is fully manual which only allows the authorized vehicles that are registered by having the entrance sticker. The whole university area including entrance and exit gates, academic area, administrative and parking zones are all under video surveillance. But this can only serve for video capturing and storing and is not connected to any proper management and monitoring systems. To overcome the above-mentioned problems encountered while car parking in the parking area of the University campus, we propose an Automated Car Parking Monitoring and Management system called (CPMMS). Our proposed system has strong hardware and software components. This system can assist the security department to handle the parking problems more effectively such as locating the car if a person forgets its exact parking location or to locate and pursue the liable person for damaging or blocking someone's car while wrong car parking in the parking lot. A survey based on a quantitative questionnaire is also conducted to investigate the problems encountered by the students, faculty, and staff members. The survey's results confirm the above-mentioned problems that the students, faculty, and staff members are facing and thus our proposed system fulfills all the requirements that need to be addressed by providing appropriate solutions to these problems.

The realization of such a “smart parking” system relies on four main requirements. 1) Parking Space Detection: First of all, the system relies on the availability of real-time parking information, based on which it makes and upgrades allocations for drivers. As already mentioned, current sensing technologies provide several options to monitor parking spaces. Moreover, whenever the system must make an allocation, it requires location information on all vehicles with pending requests. Based on this information, it estimates the traveling time to an allocated spot and provides driving directions to it. Current vehicle tracking devices/systems provide solutions to this problem. Vehicle tracking systems combine GPS tracking technology with flexible advanced mapping and reporting software. A vehicle tracking device is installed on a vehicle, which collects and transmits tracking data via a cellular or satellite network. The system receives real-time

vehicle tracking updates, including location, direction, speed, idle time, start/stop, and so on. This technology has been widely used in bus systems. 2) V2I and I2V Communication: The second requirement involves effective two-way communication between vehicles and the allocation center (infrastructure): vehicle-to-infrastructure (V2I) and infrastructure-to-vehicle (I2V). In our “smart parking” system, V2I communication involves drivers sending their parking requests, providing driver information, and confirming reservations to the system. I2V communication includes the DRPC sending allocation results, driving directions, and payment details back to vehicles. Cellular networks (CNS) are usually applied in V2I and I2V solutions, i.e., drivers interact with the system through their mobile phones. In our implementation, we have developed a smartphone application through which drivers interact with the “smart parking” system. Using the application, drivers may log in the system with a unique ID, associated with which is a driver’s general information, such as license number, credit card number, car size, etc. The ID is registered by the driver, and the DRPC maintains a database to store the driver’s basic information. In the application, drivers also have the option to choose their destination, walking-distance preference, and parking cost tolerance. After the driver finishes all settings and sends out the request, the system will send back parking allocation results based on his parking preferences and the state of the system. There are three kinds of allocation results as follows: 1) If the system fails to find a parking space for the driver, then a notification asks the driver to wait for the next allocation time. A detailed explanation is also provided regarding the failed allocation; for example, there are no vacant parking spaces, the driver’s requirements are too strict, or the driver is too far away from his destination. The driver may then either release his parking request by changing his preferences to increase the chance to be allocated or simply do nothing but wait. 2) If a parking space is allocated to the driver but he/she is not satisfied with it, then he/she can reject the allocation and adjust his requirements. However, by doing this, he/she takes the risk that he/she may not be allocated a space at the next decision time. To prevent drivers from constantly rejecting successful allocations and adjusting requirements for better parking spots or to prevent drivers from always providing extremely strict conditions at the beginning and gradually relaxing them later, the system may charge an increased fee if the number of requests exceeds a certain threshold. 3) If the driver is satisfied This article

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with the result, then the system reserves that space for him, and the application shows the driving directions to the reserved parking space. While he/she is driving, the system may notify him of a better parking spot based on his real-time position. The driver needs to respond and tell the system whether he/she accepts it or not. When the driver arrives at the parking spot, he/she needs to confirm parking at the allocated spot. All these driver responses are simply done by pushing a button in the application. When the car leaves the parking spot, a summary of charges is sent to him. Notice that both V2I and I2V communication are implemented through a smartphone application, and data are transmitted through the CN. Drivers may reserve a parking space before a trip and interact with the system by simply pushing buttons on the smartphone, thus not causing distraction from driving.

3) Reservation Guarantee: Parking reservations are a key feature of the “smart parking” system. To implement this function, when a parking spot is reserved by the driver, the system must guarantee that this will not be taken by other vehicles. For off-street parking resources, it is relatively easy to prevent drivers with no reservation from taking the spot that has been reserved by someone else. The system can do ID checking (with RFID technology) at the gate of a garage or a parking lot. If the driver has made a reservation, then the gate opens, and a space number is provided to him. If the driver made no reservation, then he/she either may be allowed to park if there are empty unreserved spaces or is blocked from entering. For on-street parking resources, the reservation scheme is more complicated because there is no central ID checking location so that drivers may park at any space if it is vacant. One method is through wireless technology interfacing a vehicle with hardware that makes a space accessible only to the driver who has reserved it. Examples include gates, “folding barriers,” and obstacles that emerge from and retract to the ground under a parking spot; these are wirelessly activated by devices on-board vehicles, similar to mechanisms for electronic toll systems. However, this method is relatively expensive, and the hardware is not easy to install and maintain. A “softer” scheme is to use a light system placed at each parking space, where different colors indicate different parking space states. In our system, we use a GREEN light to indicate that a vacant parking spot is

available for any driver, a RED light to indicate that the spot is reserved by other drivers, a YELLOW (or blinking YELLOW for increased visibility) light to attract a driver in the vicinity who has reserved that space, and a blinking RED light to notify a driver who is parking at a space reserved by someone else. An LED light with these three colors is connected to and controlled by an IRIS sensor node (also referred to as “mote”) placed at each parking space. When a driver is approaching the parking space reserved for him, this is automatically detected by the GPS data sent from his smartphone through our “smart parking” application. (Alternatively, the driver can explicitly notify the system.) The system then sends a command to the IRIS mote, which switches the light at his reserved spot from RED to YELLOW (or blinking YELLOW). The driver should then be able to recognize his reserved spot and park there. After parking, the light goes off until the car leaves, and it returns Fig. 2. Queueing model for dynamic resource allocation. to its GREEN or RED state if the parking space is reserved. If a driver violates the rule and parks at a space reserved by someone else, then the blinking RED provides a warning, and the driver should leave. If he/she does not leave, the system knows which space is occupied and will tow the car or issue a ticket; in the meantime, the system makes a new assignment for the driver who had reserved that spot. If the second assignment is worse than the previously assigned spot, then the driver receives some compensation, which may come from the violator’s fine. 4) Optimal Allocation: One of the benefits of the “smart parking” system is that it determines the best parking space for each driver. This is done through an efficient allocation algorithm executed at the SPAC (see Fig. 1). In what follows, we will concentrate on the methodology that enables us to make optimal parking space allocations and reservations.

In the development of traffic management systems, an intelligent parking system was created to reduce the cost of hiring people and for optimal use of resources for car-park owners. Currently, the common method of finding a parking space is manual where the driver usually finds a space in the street through luck and experience. This process takes time and effort and may lead to the worst case of failing to find any parking space if the driver is driving in a city with high vehicle density. The alternative is to find a predefined car park with high capacity. However, this is not an optimal solution because the car park could usually be far away from the user’s destination. In recent years, research has used

vehicle-to-vehicle [21] and vehicle-to-infrastructure [23] interaction with the support of various wireless network technologies such as radio frequency identification (RFID), Zigbee, wireless mesh networks [22], and the Internet. This study aimed to provide information about nearby parking spaces for the driver and to make a reservation minutes earlier using supported devices such as smartphones or tablet PCs. Furthermore, the services use the ID of each vehicle in booking a parking space. However, the current intelligent parking system does not provide an overall optimal solution in finding an available parking space, does not solve the problem of load balancing, does not provide economic benefit, and does not plan for vehicle-refusal service. To resolve the aforementioned problems and take advantage of the significant development in technology, the Internet-of-Things technology (IoT) has created a revolution in many fields in life as well as in smart-parking system (SPS) technology [20]. The present study proposes and develops an effective cloud-based SPS solution based on the Internet of Things. Our system constructs each car park as an IoT network, and the data that includes the vehicle's GPS location, the distance between car parking areas, and the number of free slots in car park areas will be transferred to the data center. The data center serves as a cloud server to calculate the costs of a parking request, and these costs are frequently updated and are accessible any time by the vehicles in the network. The SPS is based on several innovative technologies and can automatically monitor and manage car parks. Furthermore, in the proposed system, each car park can function independently as a traditional car park. This research also implements a system prototype with wireless access in an open-source physical computing platform based on Arduino with RFID technology using a smartphone that provides the communication and user interface for both the control system and the vehicles to verify the feasibility of the proposed system.

CHAPTER 2

PRESENT INVESTIGATION

2.1 AIM OF THE PRESENT INVESTIGATION

To develop a Parking occupancy monitoring and analyzing system

. Car parking is a major issue in modern congested cities of today. There simply are too many vehicles on the road and not enough parking spaces. We led to the need for efficient parking management systems.

2.2 SCOPE OF THE PRESENT INVESTIGATION

- This project presents the generic concept of using cloud-based intelligent car parking services in smart cities as an important application of the Internet of Things (IoT) paradigm
- The proposed system consists of detecting the parking lot vacancy using an IR sensor.
- whenever the user leaves that slot that time for that id payable amount is generated depending upon the parking time.
- Also, we can Monitor the parking lots through the web.
- Manpower is reduced by this automation.
- Reduces cost for users by knowing the time-wise cost.
- Reduces fuel consumption and time delay.

2.3 PROPOSED METHODOLOGY

The power supply is taking from the Laptop and given to the Hardware. A web page is designed to monitor car parking. In this car parking, there are 4 slots are available to park the cars. There is a barrier gate, which works when RFID is read by an RFID scanner.

The RFID tag will work as a FASTag. When the user's RFID reads, the parking time will start. After scanning, the gate will open and the user can park the car in the available slots, which can be viewed by the web page and LCD, which is at the car parking. When the user entered the gate, the LCD will display "User Entry". Once the user parked in the parking slot then the IR sensor will detect the car as an obstacle. Then that particular slot will be Occupied, the same will be updated in both web page and LCD as slot Occupied. After completing the user's work the user will come and take the car from the parked slot. When the user came out from the parking slot, the IR sensor will detect none. So it will be updated as "slot Empty". Then the user has to read RFID to go out. When the same RFID reads again the parking timing will stop. And based on the parking time, the inbuilt program will calculate the amount for the parking. Then it can be viewed by the user. This amount will be deducted from the RFID, as it is working as a FASTag reader. Then the gate opens and the user can go out. This same operation will occur every single car, which is coming for the parking.

2.4 PROPOSED BLOCK DIAGRAM

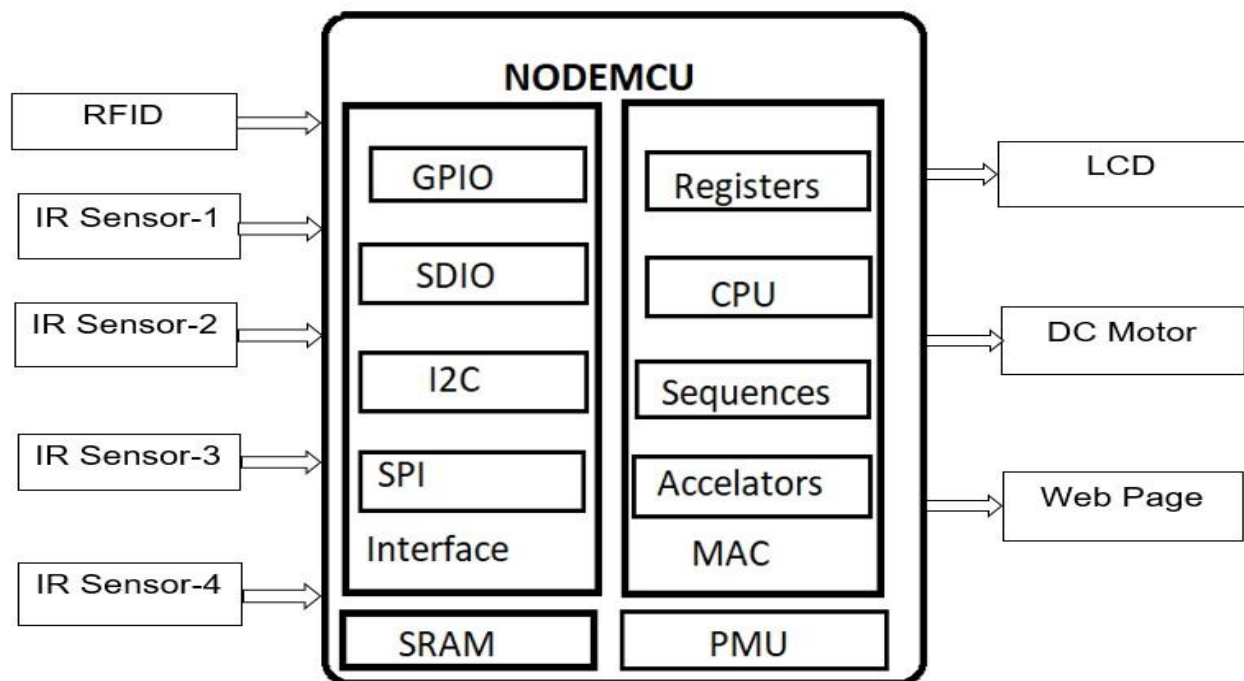


Fig:2.1: Block diagram of parking occupancy and analyzing system

2.5 DEMERITS OF EXISTING SYSTEM

- There is no automatic system to park the car in the parking slot. They were collecting the amount from the car owner. Then only they will allow parking in the parking slot.
- In the existing system, there is no full automation or RFID used for parking Lots.
- Manpower is required to maintain the car parking.
- The driver doesn't know the exact free lots available in the Parking space.
- Time delay, fuel consumption is more in manual car parking.

2.6 MERITS OF PROPOSED SYSTEM

- The proposed system consists of detecting the parking lot vacancy using an IR sensor.
- whenever the user leaves that slot that time for that id payable amount is generated depending upon the parking time.
- Also, we can Monitor the parking lots through the web.
- Manpower is reduced by this automation.
- Reduces cost for users by knowing the time-wise cost.
- Reduces fuel consumption and time delay.

CHAPTER 3

HARDWARE

3.1 HARDWARE REQUIREMENTS

3.1.1 IR Sensor

The IR sensor detecting the parking lot vacancy. Then the IR sensor is detected and whenever he leaves that slot that time for that id payable amount is generated, whenever next time that person will park his vehicle on any slot. We are using the IR sensor to detect the slot is occupied or available and the data are sending to the microcontroller.

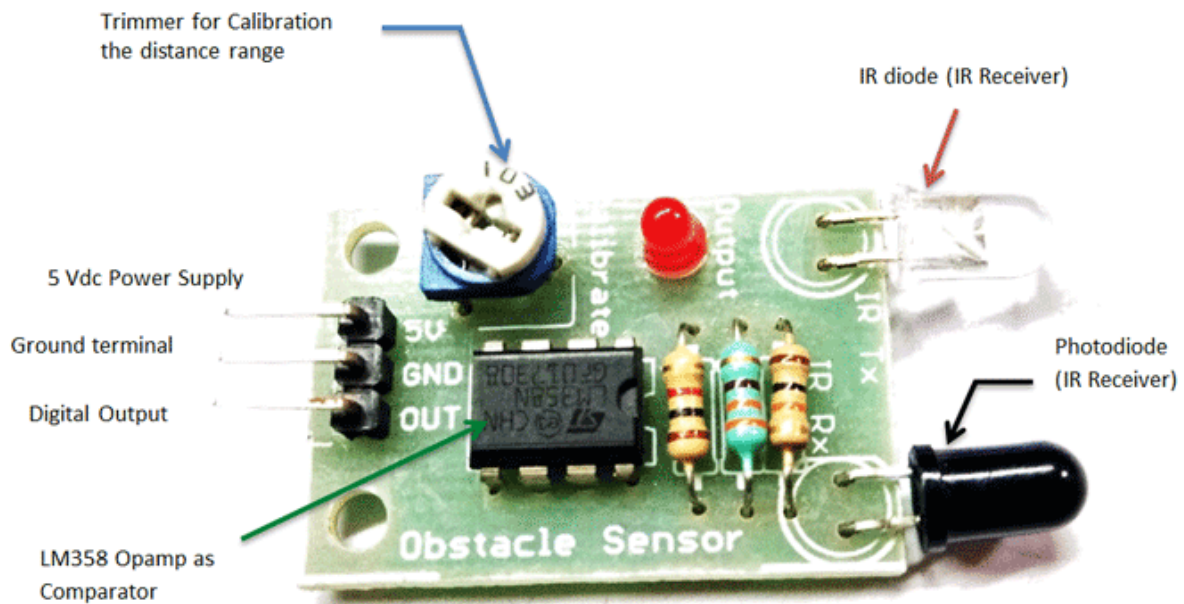


Fig:3.1: IR Sensor

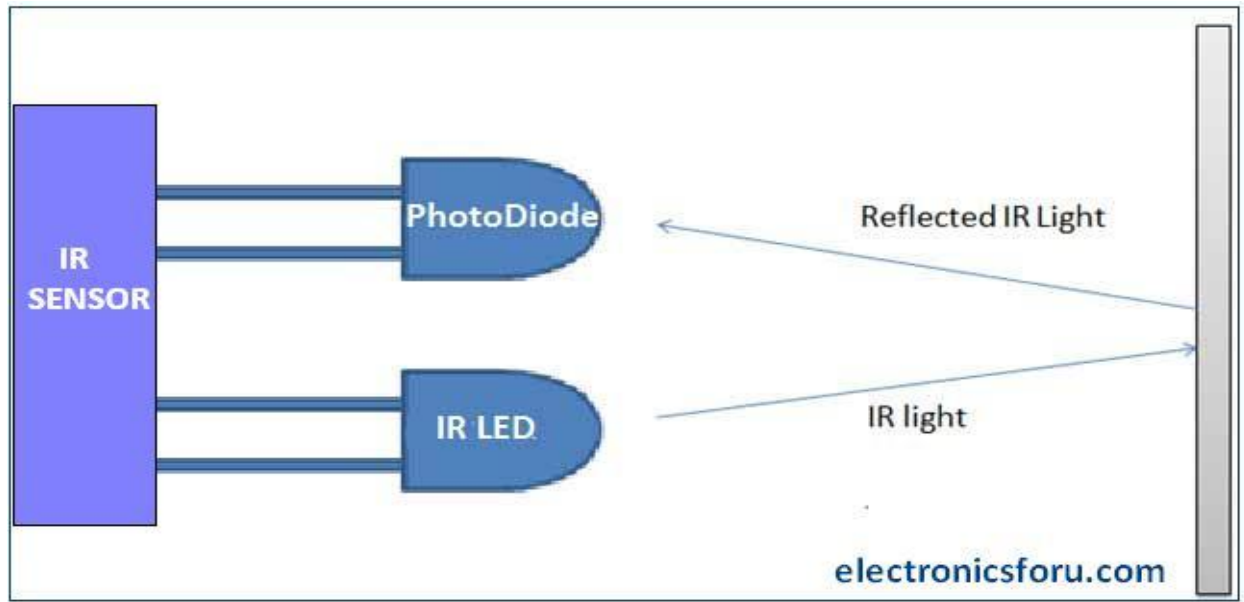


Fig:3.2: IR Sensor Detecting method

3.1.2 RFID Reader

Vehicle identification is done by RFID sensors and id is generated for that user, when a user parks his vehicle in a parking slot. When the same RFID is read by the RFID reader at that time only an amount is updated for that id.



Fig:3.3: RFID Reader Module

A radio frequency identification reader (RFID reader) is a device used to gather information from an RFID tag, which is used to track individual objects. ... RFID is a technology similar in theory to bar codes. However, the RFID tag does not have to be scanned directly, nor does it require line-of-sight to a reader

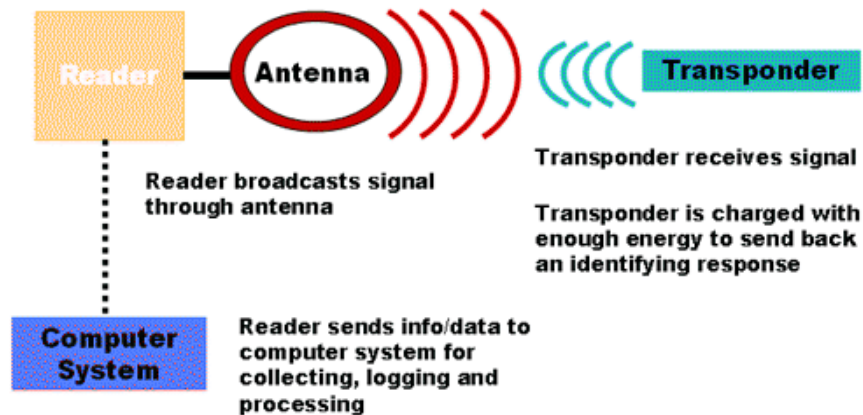


Fig:3.4: RFID Reader working explanation

RFID is a technology similar in theory to bar codes. However, the RFID tag does not have to be scanned directly, nor does it require line-of-sight to a reader. The RFID tag must be within the range of an RFID reader, which ranges from 3 to 300 feet, to be read. RFID technology allows several items to be quickly scanned and enables fast identification of a particular product, even when it is surrounded by several other items.

3.1.3 LCD

The vacancy information of the parking lot can be obtained through a webpage as well as an LCD. Also, user entry and exit status will be displayed. LCD (Liquid Crystal Display) screen is an electronic display module and finds a wide range of applications. A 16×2 LCD is a very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi-segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation

of displaying special & even custom characters (unlike in seven segments), animations, and so on.

A 16×2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in a 5×7 pixel matrix. This LCD has two registers, namely, Command and Data.

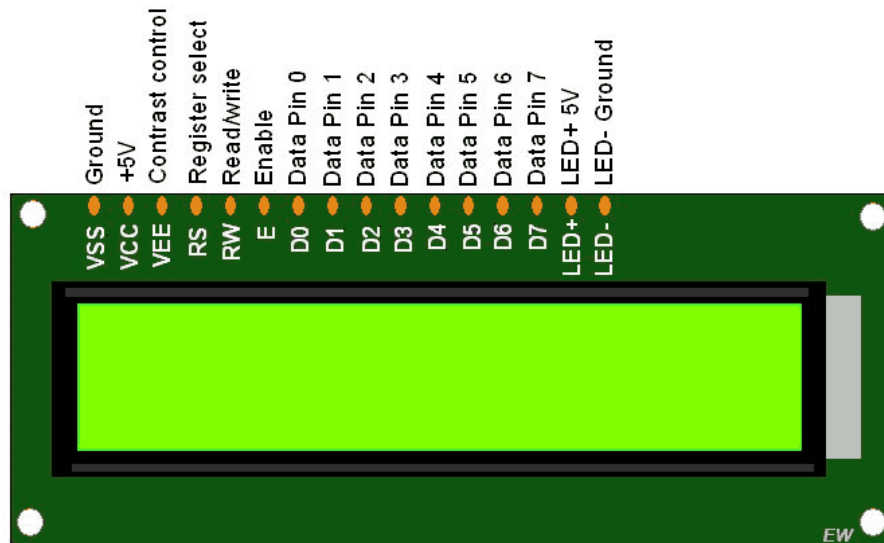


Fig:3.5: 16X2 LCD pinout *DIAGRAM*

Table:3.1: LCD pinout Explanation

Sr. No	Pin No.	Pin Name	Pin Type	Pin Description	Pin Connection
1	Pin 1	Ground	Source Pin	This is a ground pin of LCD	Connected to the ground of the MCU/ Power source
2	Pin 2	VCC	Source Pin	This is the supply voltage pin of the LCD	Connected to the supply pin of the Power source
3	Pin 3	V0/VEE	Control Pin	Adjusts the contrast of the LCD.	Connected to a variable POT that can source 0-5V
4	Pin 4	Register Select	Control Pin	Toggles between Command/Data Register	Connected to an MCU pin and gets either 0 or 1. 0 -> Command Mode 1-> Data Mode
5	Pin 5	Read/Write	Control Pin	Toggles the LCD between reading/Write Operation	Connected to an MCU pin and gets either 0 or 1. 0 -> Write Operation 1-> Read Operation
6	Pin 6	Enable	Control Pin	Must be held high to perform Read/Write Operation	Connected to MCU and always held high.

7	Pin 7-14	Data Bits (0-7)	Data/Command Pin	Pins are used to sending commands or data to the LCD.	In 4-Wire Mode Only 4 pins (0-3) is connected to MCU In 8-Wire Mode All 8 pins(0-7) are connected to MCU
8	Pin 15	LED Positive	LED Pin	Normal LED like operation to illuminate the LCD	Connected to +5V
9	Pin 16	LED Negative	LED Pin	Normal LED-like operation to illuminate the LCD connected with GND.	Connected to ground

3.1.4 DC MOTOR

The entry and exit gate of the car parking lot works automatically using a DC motor when the RFID tag is read by the RFID reader.



Fig: 3.6: DC Motor

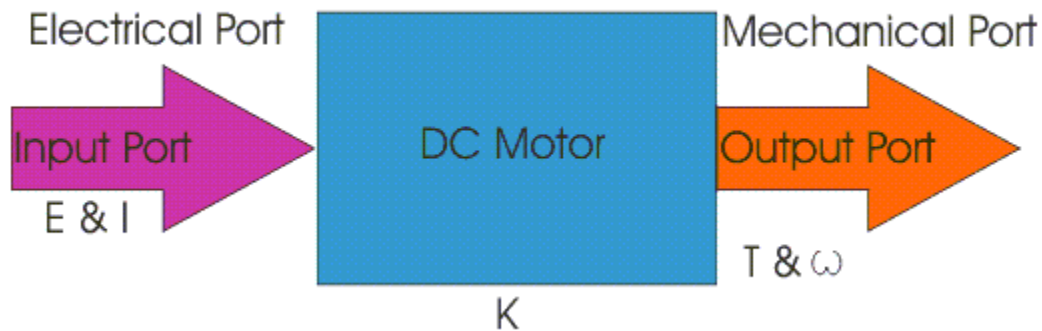


Fig:3.7: Principle explanation of DC motor

When a current-carrying conductor is placed in a magnetic field, it experiences a torque and tends to move. In other words, when a magnetic field and an electric field interact, a mechanical force is produced. The **DC motor** or **direct current motor** works on that principle. This is known as motoring action.

3.1.5 NODE MCU

In this part, acquired data is processed using Node MCU. The Wi-Fi modules esp8266 are inbuilt in the Node MCU. Here we use the C language for programming node MCU. Node MCU will make decisions based on data given in the sensor.

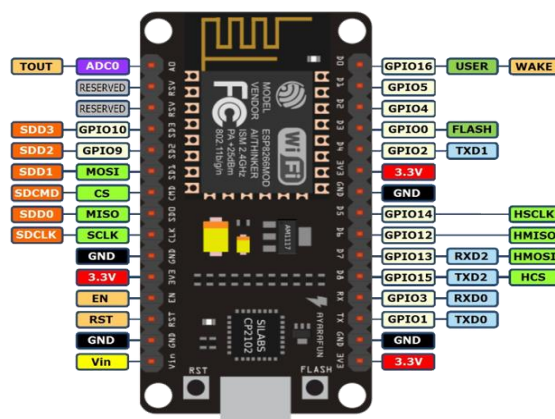


Fig:3.8: NodeMCU

General-purpose input/output (GPIO) is a pin on an IC (Integrated Circuit). It can be either input pin or output pin, whose behavior can be controlled at the run time.

3.1.5.1 Uses of NodeMCU(ESP8266-01)

The **ESP8266** is a very user-friendly and low-cost device to provide internet connectivity to the projects. The module can work both as an Access point (can create hotspot) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it to the internet making the **Internet of Things** as easy as possible. It can also fetch data from the internet using API's hence your project could access any information that is available on the internet, thus making it smarter. Another exciting feature of this module is that it can be programmed using the Arduino IDE which makes it a lot more user-friendly. However this version of the module has only 2 GPIO pins (you can hack it to use up to 4) so you have to use it along with another microcontroller like Arduino, else you can look onto the more standalone **ESP-12** or **ESP-32** versions. So if you are looking for a **module to get started with IoT** or to provide internet connectivity to your project then this module is the right choice for you.

Table:3.2: NodeMCU PIN names

Pin Names on NodeMCU Development Kit	ESP8266 Internal GPIO PIN
D0	GPIO16
D1	GPIO5
D2	GPIO4
D3	GPIO0
D4	GPIO2
D5	GPIO14
D6	GPIO12
D7	GPIO13
D8	GPIO15

Pin Names on NodeMCU Development Kit	ESP8266 Internal GPIO PIN
D9/RX	GPIO3
D10/TX	GPIO1
D11/SD2	GPIO9
D12/SD3	GPIO10

The GPIO's shown in the blue box (1, 3, 9, 10) are mostly not used for GPIO purposes on Dev Kit.ESP8266 is a system on a chip (SoC) design with components like the processor chip. The processor has around 16 GPIO lines, some of which are used internally to interface with other components of the SoC, like flash memory. Now again 2 pins out of 11 are generally reserved for RX and TX to communicate with a host PC from which compiled object code is downloaded. Hence finally, this leaves just 9 general-purpose I/O pins i.e. D0 to D8. As shown in the above figure of NodeMCU Dev Kit. We can see RX, TX, SD2, SD3 pins are not mostly used as GPIOs since they are used for another internal process. But we can try with the SD3 (D12) pin which mostly likes to respond for GPIO/PWM/interrupt-like functions. Note that D0/GPIO16 pin can be only used as GPIO read/write, no special functions are supported on it.

3.1.5.2 ESP-12E Module

The development board equips the ESP-12E module containing ESP8266 chip having **TensilicaXtensa® 32-bit LX106 RISC microprocessor** which operates at **80 to 160 MHz** adjustable clock frequency and supports **RTOS**.

3.1.5.3 ESP-12E Chip

- TensilicaXtensa® 32-bit LX106
- 80 to 160 MHz Clock Freq.
- 128kB internal RAM
- 4MB external flash
- 802.11b/g/n Wi-Fi transceiver

CHAPTER 4

SOFTWARE

4.1 SOFTWARE REQUIREMENTS

4.1.1 ESP8266 Development Platforms

Now, let's move on to the interesting stuff!

There are a variety of development platforms that can be equipped to program the ESP8266. You can go with Espruino – JavaScript SDK and firmware closely emulating Node.js, or use Mongoose OS – An operating system for IoT devices (recommended platform by Espressif Systems and Google Cloud IoT) or use a software development kit (SDK) provided by Espressif or one of the platforms listed on Wikipedia.

Fortunately, the amazing ESP8266 community took the IDE selection a step further by creating an Arduino add-on. If you're just getting started programming the ESP8266, this is the environment we recommend beginning with, and the one we'll document in this tutorial.

This ESP8266 addon for Arduino is based on the amazing work by Ivan Grokhotkov and the rest of the ESP8266 community. Check out the ESP8266 Arduino GitHub repository for more information.

4.1.2 Arduino Example: Blink

To make sure the ESP8266 Arduino core and the NodeMCU are properly set up, we'll upload the simplest sketch of all – The Blink!

We will use the onboard LED for this test. As mentioned earlier in this tutorial, the D0 pin of the board is connected to onboard Blue LED & is user-programmable. Perfect!

Before we get to uploading sketch & playing with LED, we need to make sure that the board is selected properly in Arduino IDE. Open Arduino IDE and select NodeMCU 0.9 (ESP-12 Module) option under your Arduino IDE > Tools > Board menu.

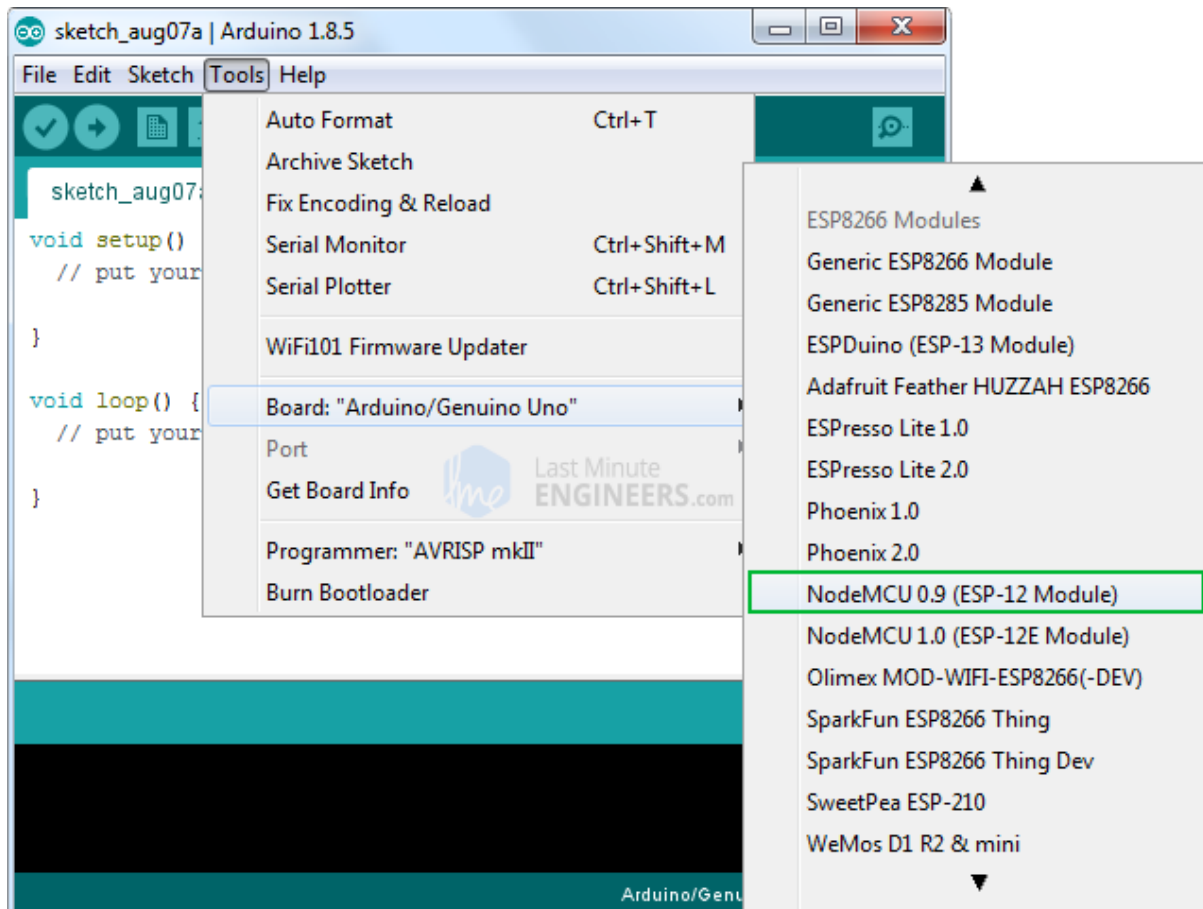


Fig: 4.1: Module selection in Arduino software

Now, plug your ESP8266 NodeMCU into your computer via micro-B USB cable. Once the board is plugged in, it should be assigned a unique COM port. On Windows machines, this will be something like COM#, and on Mac/Linux computers it will come in the form of /dev/ tty. usbserial-XXXXXX. Select this serial port under the Arduino IDE > Tools > Port menu. Also select the Upload Speed: 115200

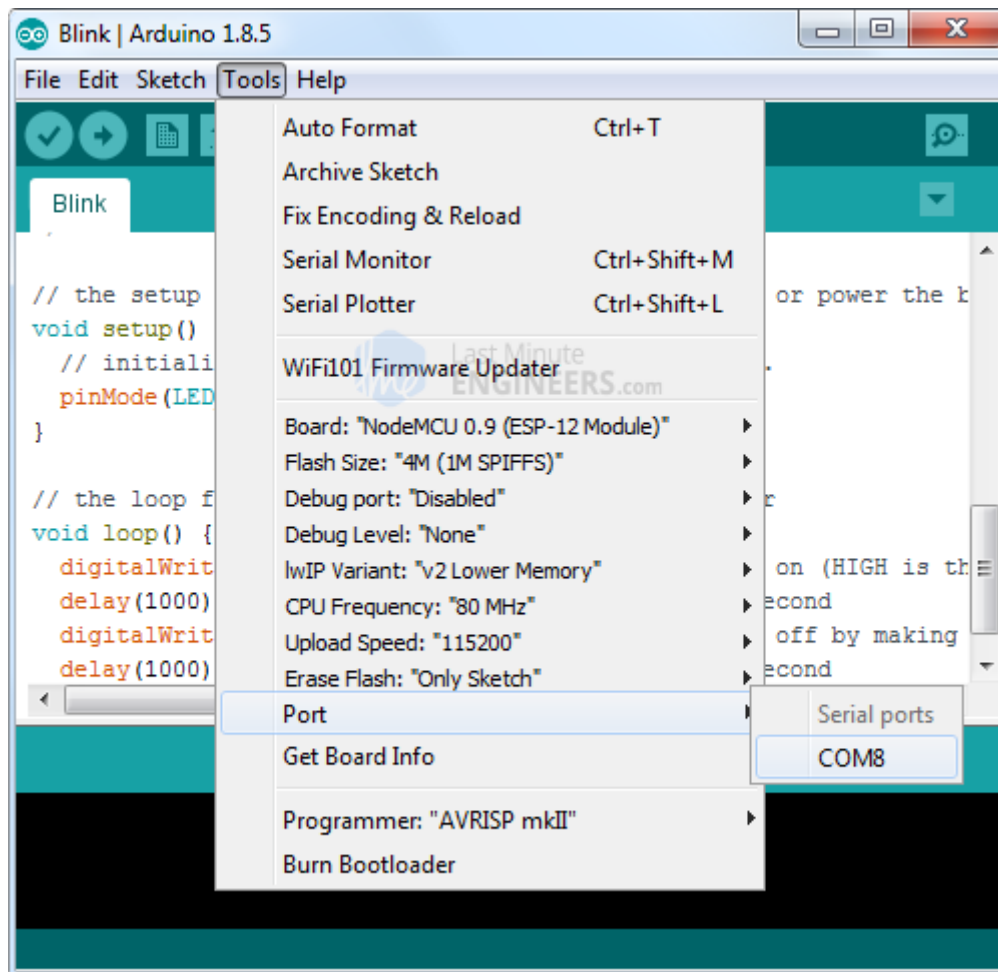


Fig:4.2:Port selection in Arduino software

4.1.2.1 WARNING

More attention needs to be given to selecting the board, choosing the COM port, and selecting Upload speed. You may get an `espcomm_upload_mem` error while uploading new sketches if failed to do so.

Once you are done, try the example sketch below.

```
void setup()
{
    pinMode(D0, OUTPUT);
```

```

}

void loop()

{

    digitalWrite(D0, HIGH);

    delay(500);

    digitalWrite(D0, LOW);

    delay(500);

}

```

Once the code is uploaded, LED will start blinking. You may need to tap the RST button to get your ESP8266 to begin running the sketch.

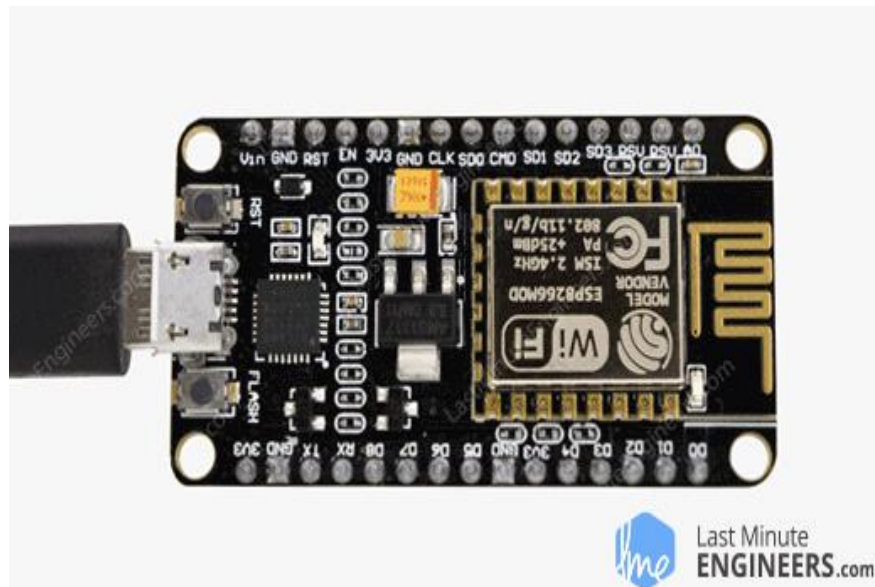


Fig:4.3:Code uploading to NodeMCU through data cable

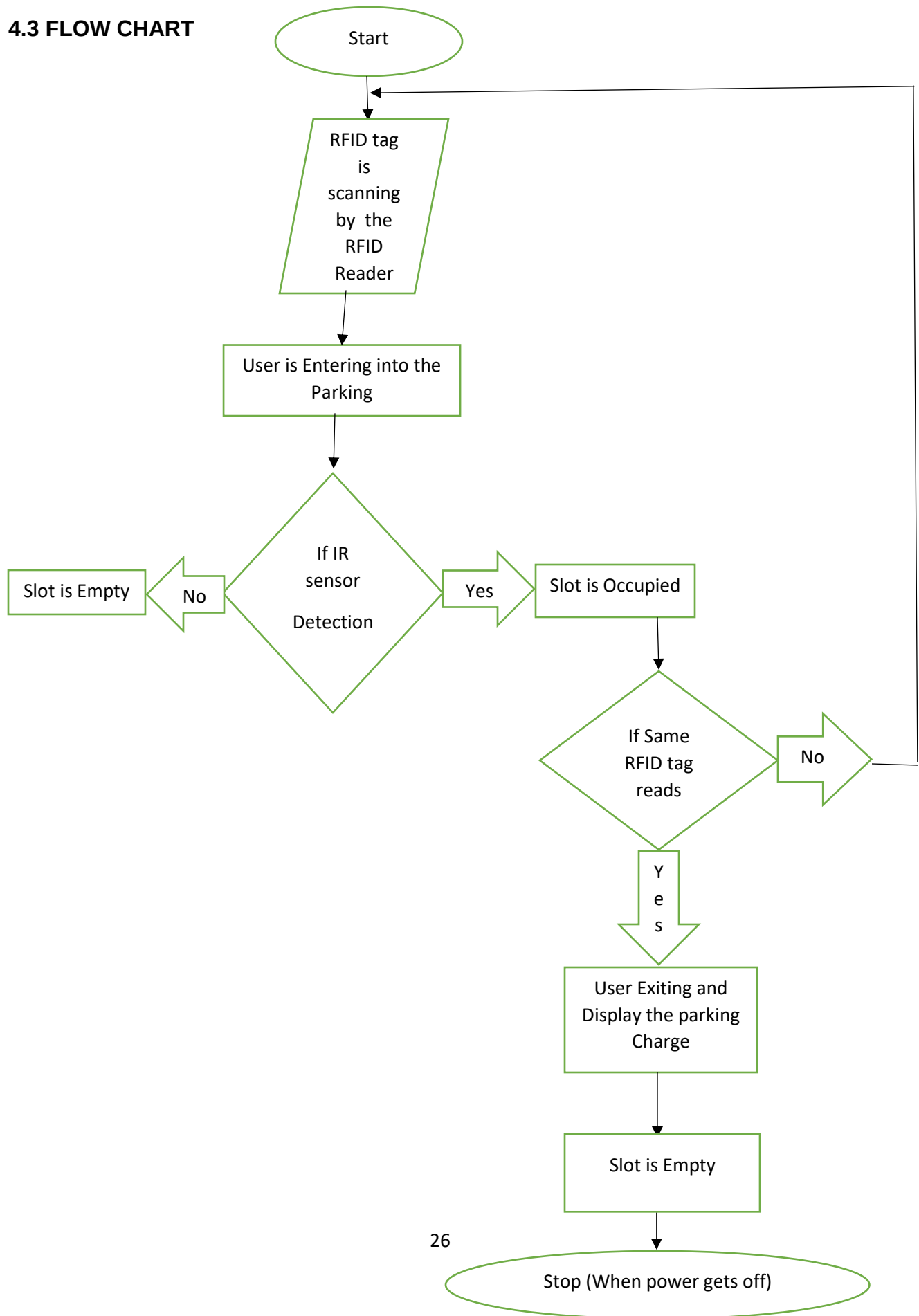
4.1.3 ESP8266-01 Features

- Low cost, compact and powerful Wi-Fi Module
- Power Supply: +3.3V only
- Current Consumption: 100mA
- I/O Voltage: 3.6V (max)
- I/O source current: 12mA (max)
- Built-in low power 32-bit MCU @ 80MHz
- 512kB Flash Memory
- Can be used as Station or Access Point or both combined
- Supports Deep sleep (<10uA)

4.2 PROGRAM ALGORITHM

- *Start the program by declaring and initializing the variables.*
- *Assigning the PINs to the declared variables.*
- *Then, starting of the loop condition to monitor the parking.*
- *The LCD starts printing all slot details denoting OCCUPIED or EMPTY.*
- *If the IR sensor detects an obstacle(car) then the LED will display OCCUPIED. If not it will show EMPTY.*
- *This same will be updated on the webpage.*
- *When the car(obstacle) leaves from the slot, the IR sensor detects none. So LCD will display as EMPTY. The same will be updated on the webpage.*
- *Then based on the period of parking, the parking charge will be calculated and the user(car) can exit from parking. The same will be updated on the webpage.*
- *This all will happen as a routine for every single car.*

4.3 FLOW CHART



4.4 PROGRAM TO INTERFECING IR SENSORS WITH NODEMCU

```
#include <LiquidCrystal.h>

const int rs = 7, en = 6, d4 = 4, d5 = 3, d6 = 2, d7 = 1;

LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

void setup() {

  pinMode(13,INPUT);

  pinMode(12,INPUT);

  lcd.begin(16,2);

  lcd.setCursor(0,0);

  lcd.print("PARKING");

  delay(200);

}

void loop() {

  lcd.clear();

  lcd.setCursor(0,0);

  lcd.print("SLOT 1");

  if(digitalRead(13) == 1){

    lcd.setCursor(0,1);

    lcd.print("FULL");

  }

  else

  {

    lcd.setCursor(0,1);
```

```
    lcd.print("EMPTY");  
}  
  
delay(200);  
  
lcd.clear();  
  
lcd.setCursor(0,0);  
  
lcd.print("SLOT 2");  
  
if(digitalRead(12) == 1){  
  
    lcd.setCursor(0,1);  
  
    lcd.print("FULL");  
  
}  
  
else{  
  
    lcd.setCursor(0,1);  
  
    lcd.print("EMPTY");  
  
}  
  
delay(200);  
}
```

4.5. SIMULATION RESULTS

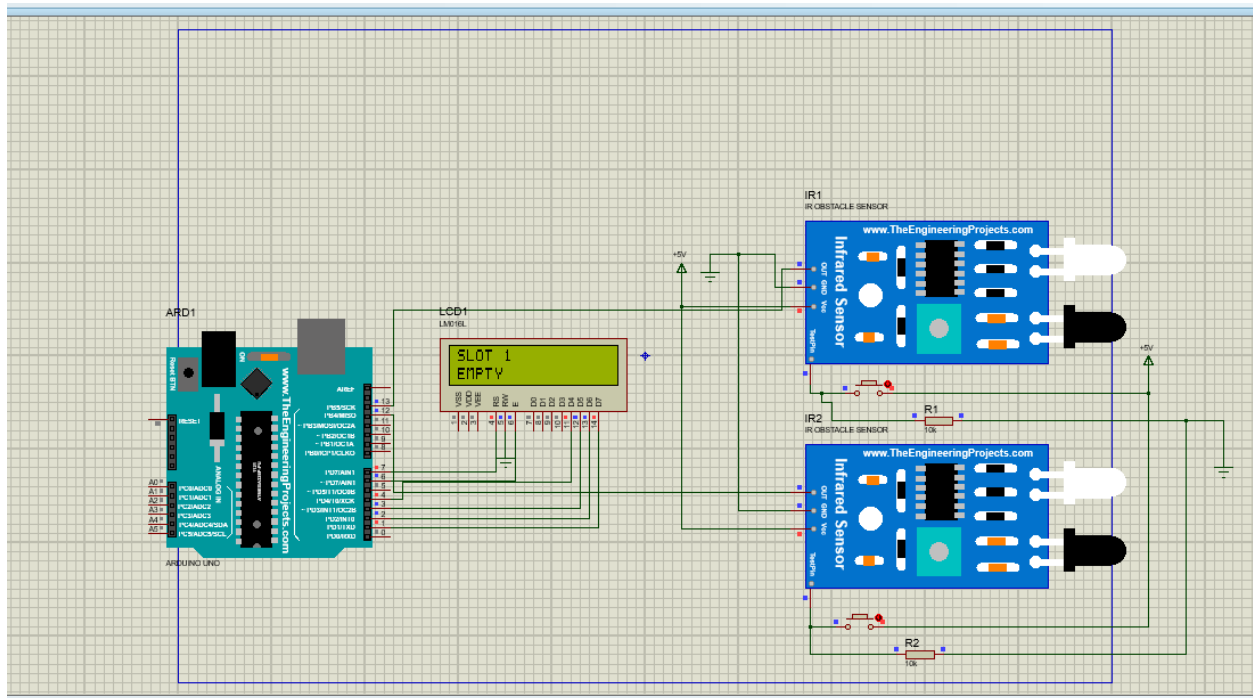


Fig:4.4: When IR 1 sensor detects none

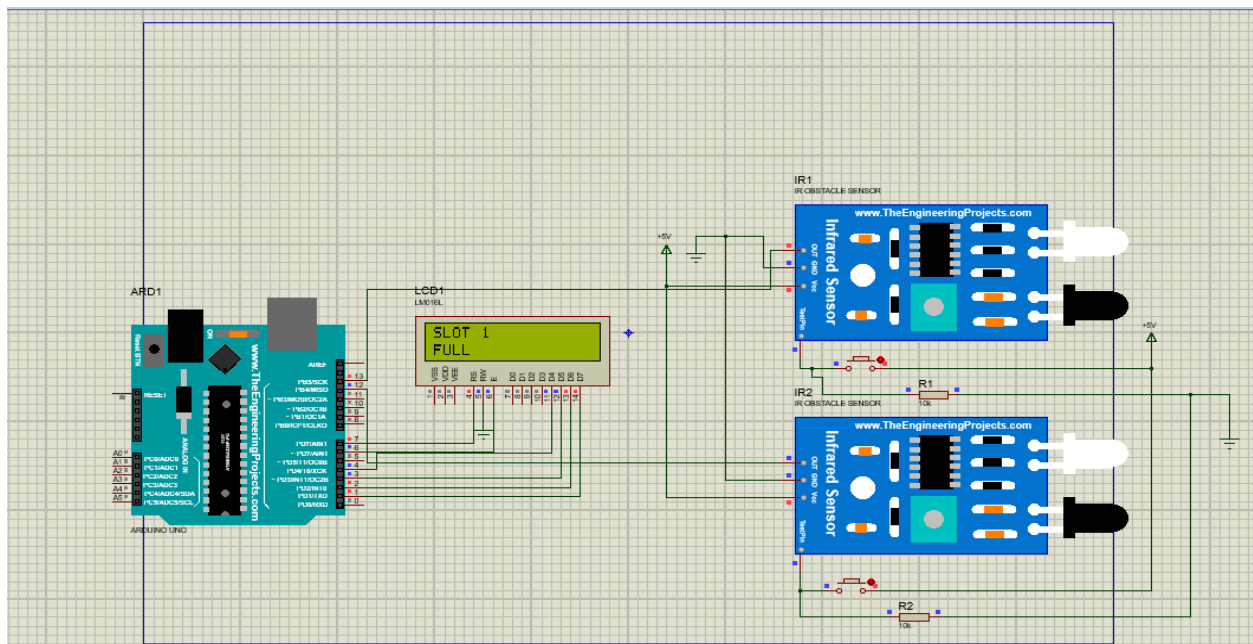


Fig:4.5: When IR 1 sensor detects an obstacle(car)

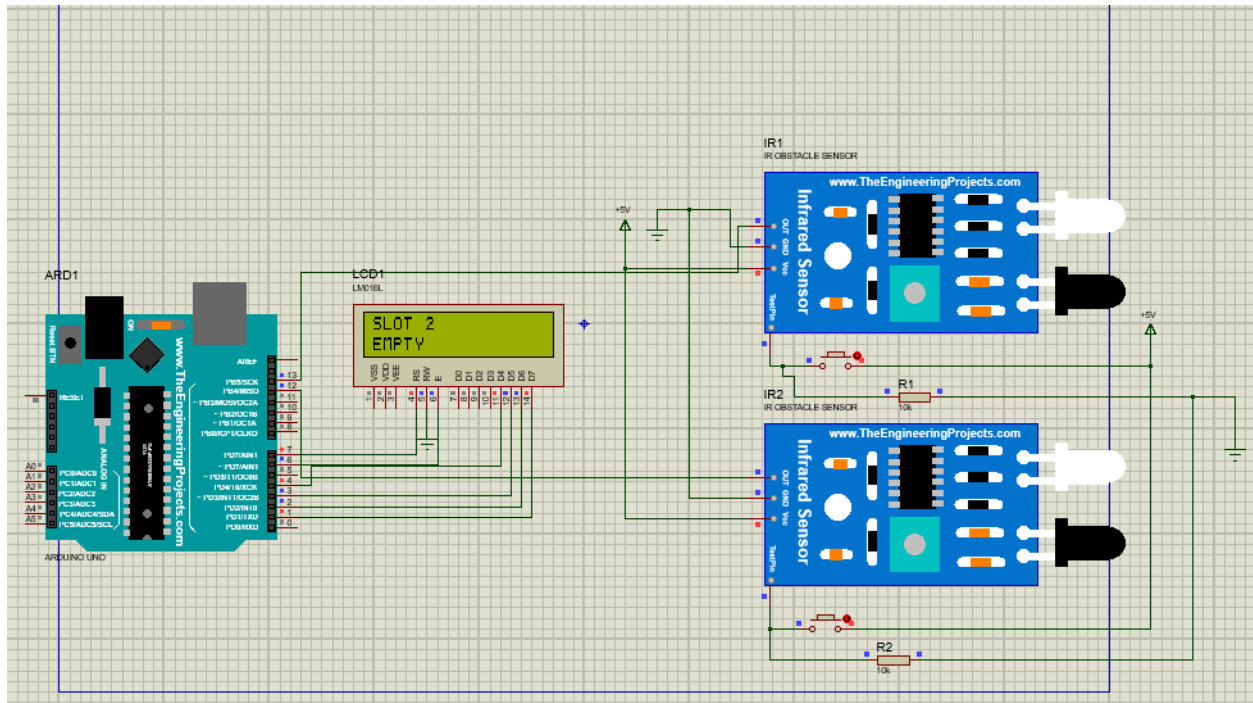


Fig:4.6: When IR 2 sensor detects none

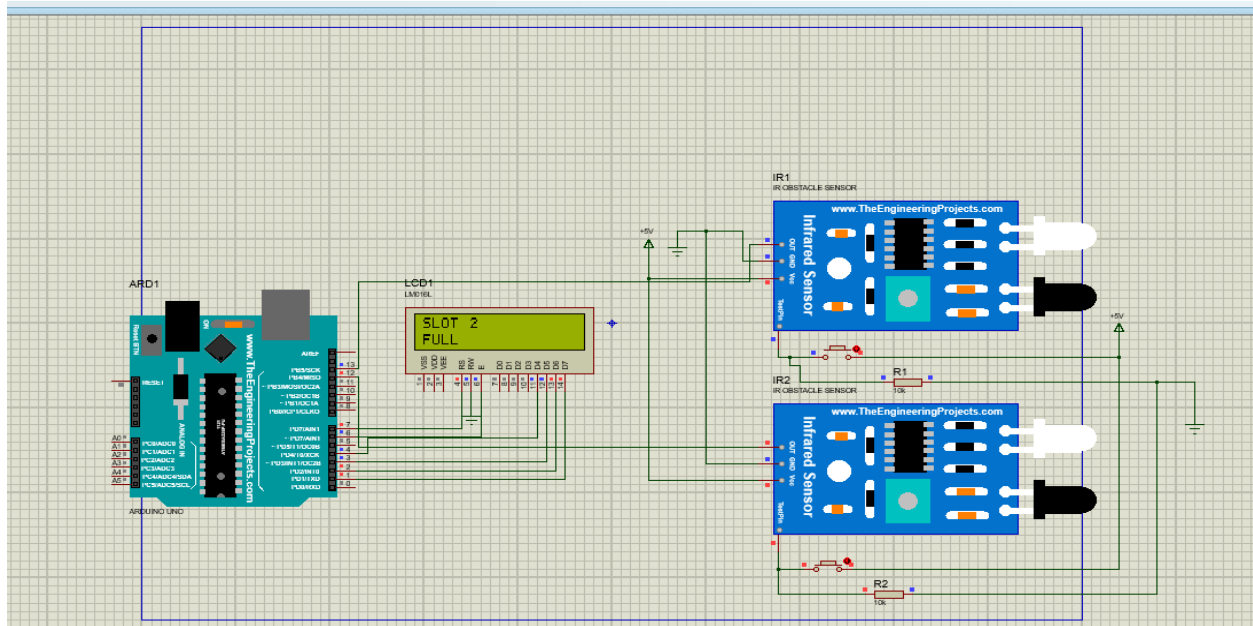


Fig:4.7: When IR 2 sensor detects an obstacle(car)

CHAPTER 5

RESULTS

5.1 RESULTS OF PROPOSED PROTOTYPE



Fig:5.1: When user's RFID is read

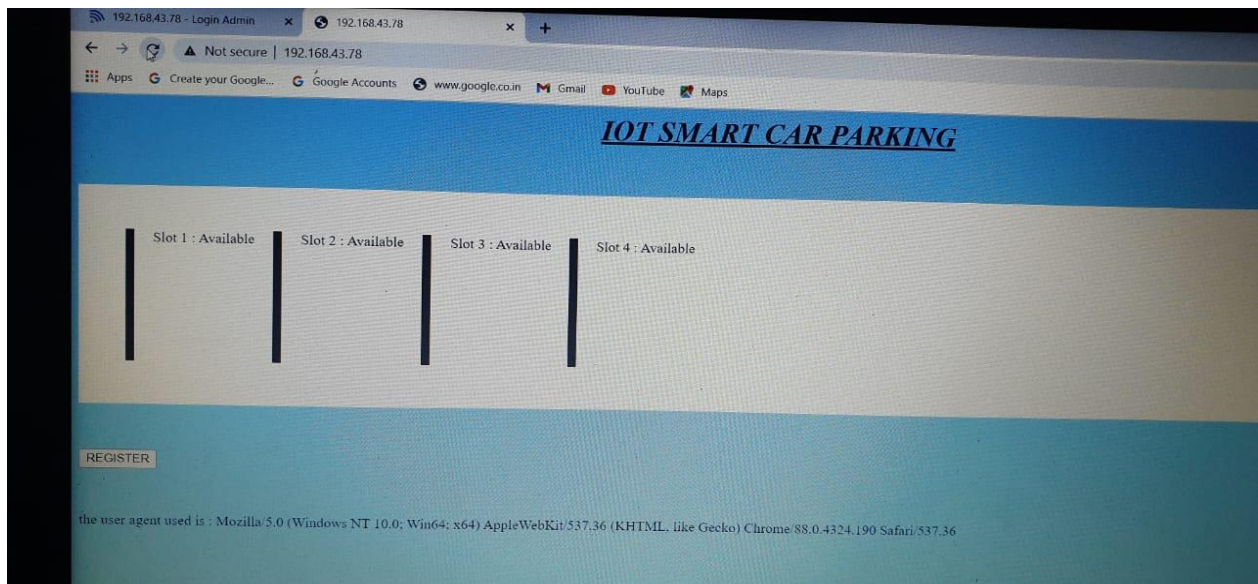


Fig:5.2: Web page when there no car is parked



Fig:5.3: LCD Updation, When IR sensor 1 detects an obstacle

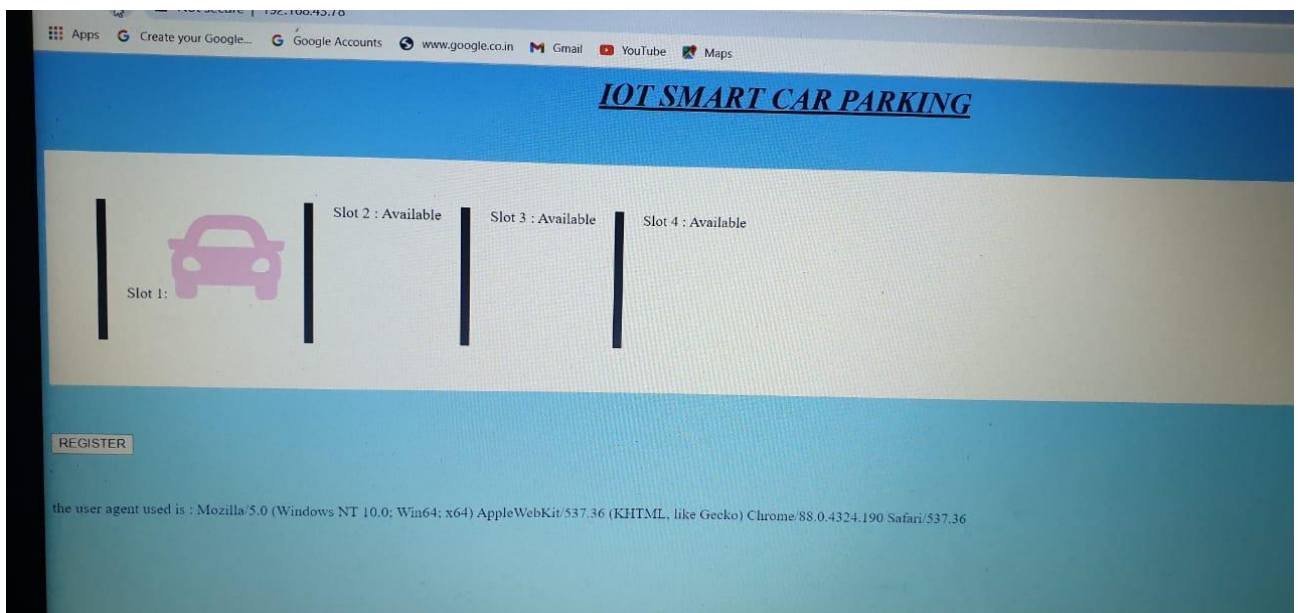


Fig:5.4:Web page Updation, When IR sensor 1 detects an obstacle



Fig:5.5: LCD Updation, When IR sensor 2 detects an obstacle

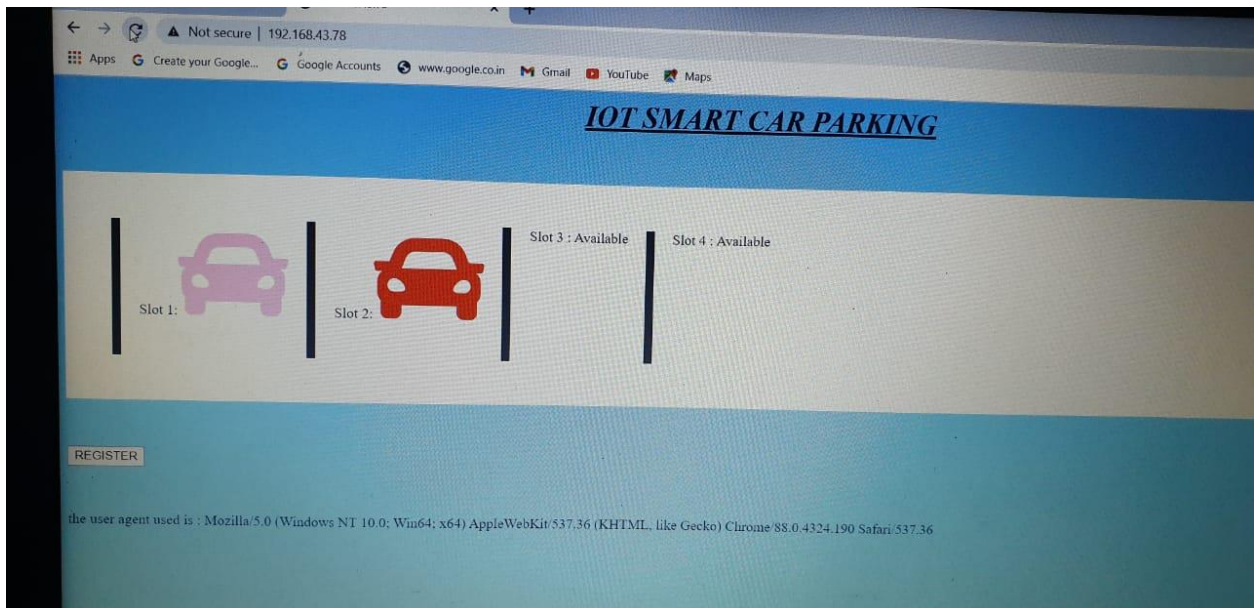


Fig:5.6:Web page Updation, When IR sensor 2 also detects an obstacle



Fig:5.7: LCD Updation, When IR sensor 3 detects an obstacle

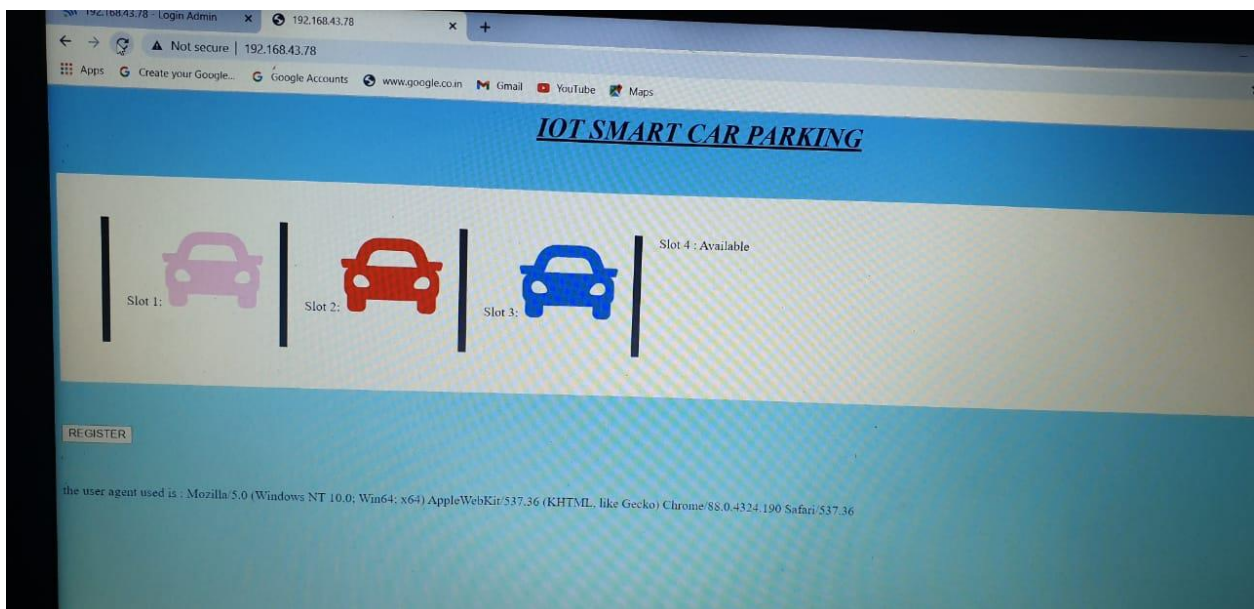


Fig:5.8:Web page Updation, When IR sensor 3 also detects an obstacle



Fig:5.9: LCD Updation, When IR sensor 4 detects an obstacle

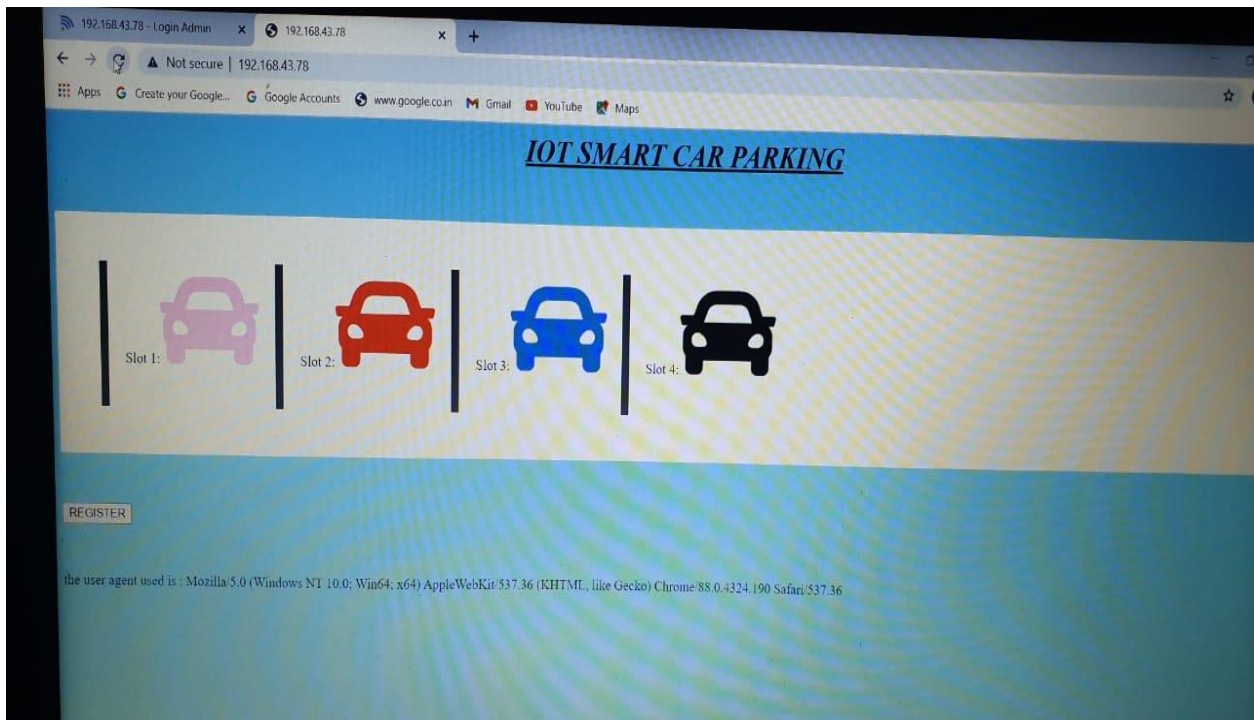


Fig:5.10:Web page Updation, When all 4 IR sensor detects an obstacle



Fig:5.11: LCD Updation, When User Exiting from the slot

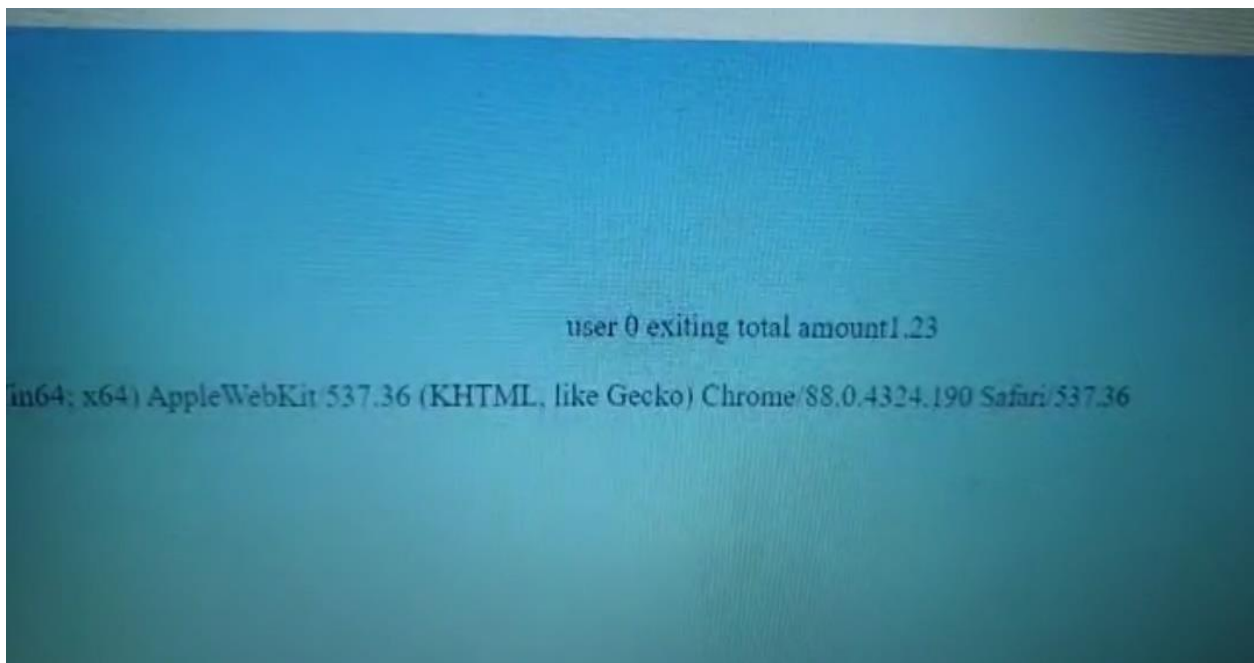


Fig:5.12:Web page Updation, When parking charge generated

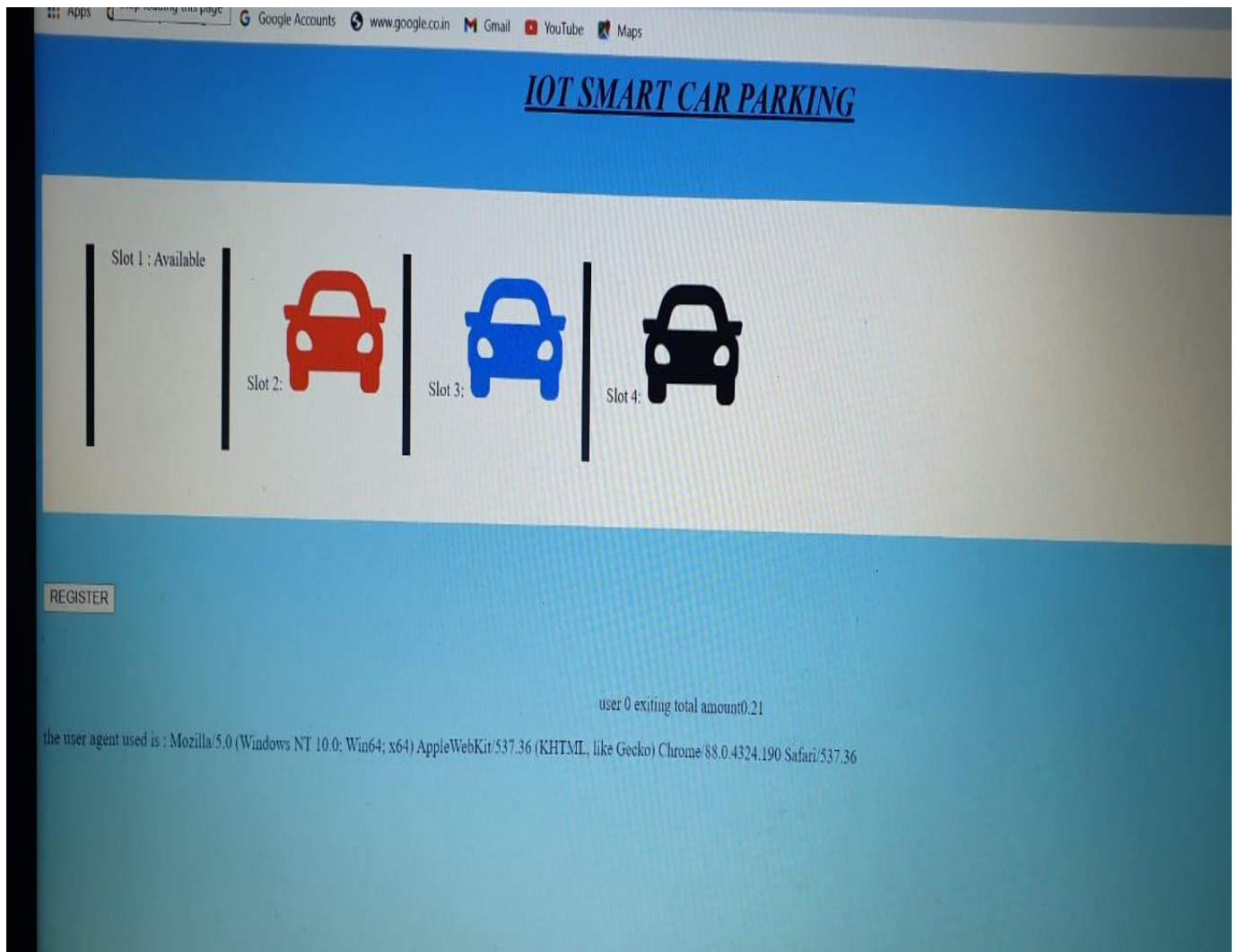


Fig:5.13:Web page Updation, When the User exited from the slot

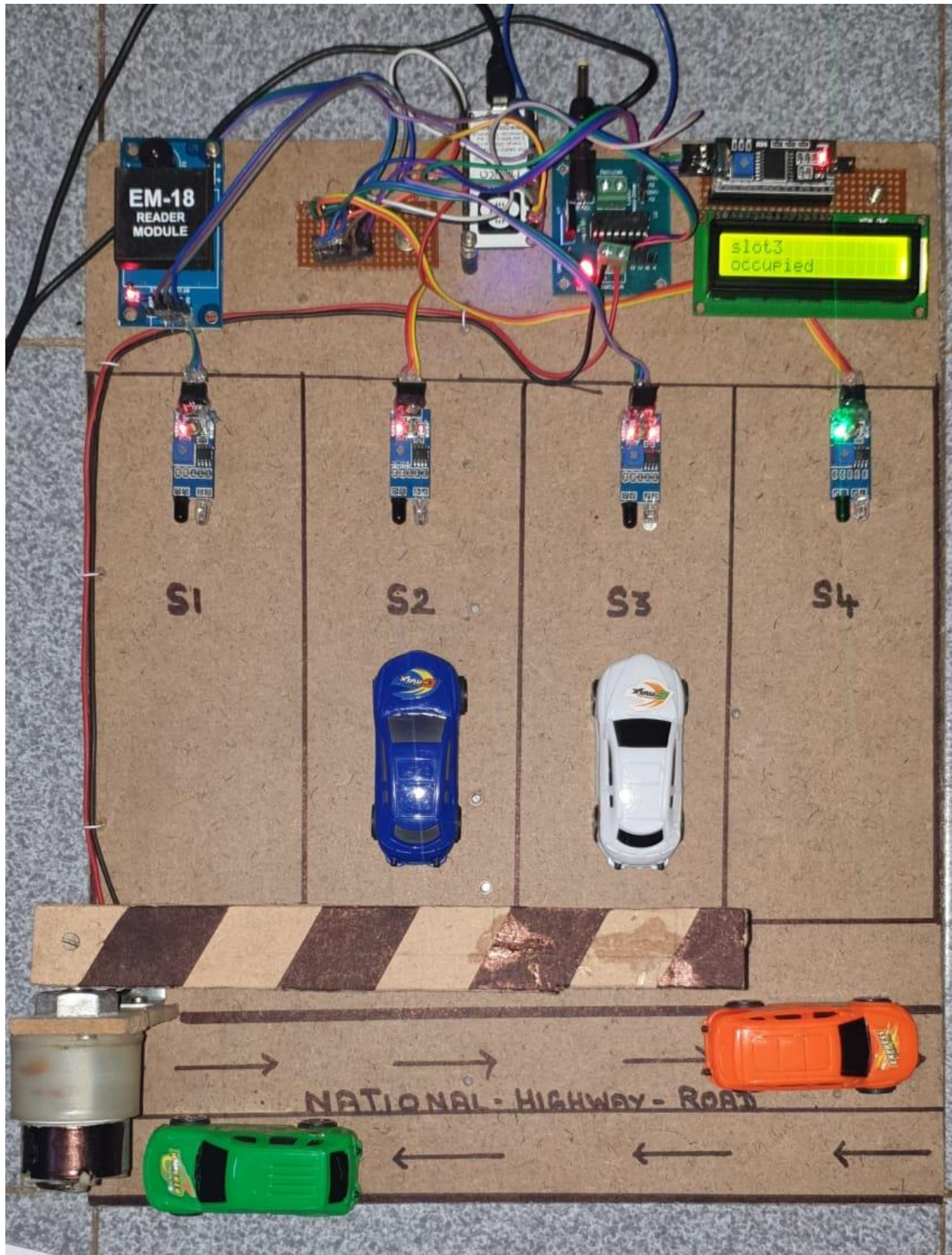


Fig:5.14:Car parking prototype, while no vehicles in entry/exit (Gate closed)

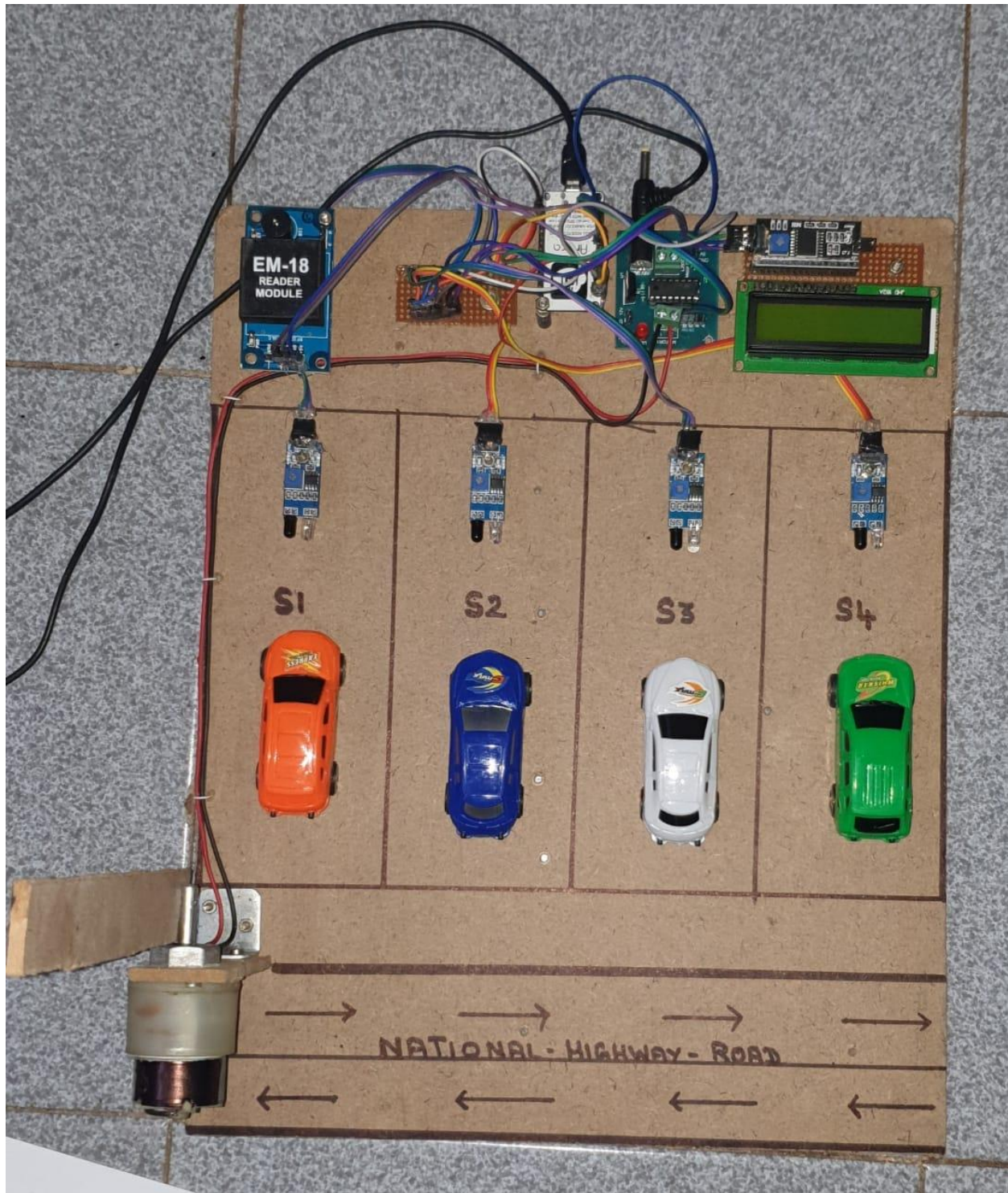


Fig:5.15:Car parking prototype, when vehicles come entry/exit (Gate opened)

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

6.1 CONCLUSION

Smart parking facilitates the problems of urban livability, transportation mobility, and environmental sustainability. Smart Parking technology is used for enhancing the productivity levels and the service levels in operations. It also benefits in terms of lowering operating costs and increases revenues and facility value. The proposed system has developed from traditional servicing channels like toll-booth and parking attendants. It involves the use of an IR sensor, ESP8266-01 Wi-Fi Module, Cloud server. The Internet of Things integrates the hardware, software, and network connectivity that enable objects to be sensed and remotely controlled across the existing network. Such integration allows users to monitor available and unavailable parking spots that lead to improved efficiency, accuracy, and economic benefit.

6.2 FUTURE SCOPE

The smart parking management system can be broadly applied for many future applications. Apart from its basic role of parking management of cars, it can also be applied for plane and ship and fleet management. With the ever-growing field of the Internet of Things, many concepts can be interfaced along with our system. Smart Parking system can be modified into fleet management of ship and plane with very few external hardware changes and almost the same software just replacing the interface fonts of cars with ship or plane for better Graphic Interface and real-world application based visual appearance.

REFERENCES

- [1] Lin T, Rivano H and Le Mouél F "A Survey of Smart Parking Solutions," in IEEE Transactions on Intelligent Transportation Systems, vol. 18, no. 12, Dec. 2017, pp. 3229-3253.
- [2] Bibi N, Majid M N, Dawood H, and Guo P, "Automatic Parking Space Detection System," 2017 2nd International Conference on Multimedia and Image Processing (ICMIP), Wuhan, 2017, pp. 11-15.
- [3] Ji Y, Guo W, Blythe P, Tang D, and Wang W, "Understanding drivers' perspective on parking guidance information," IET Intell. Transport Syst., vol. 8, no. 4, June 2014, pp. 398–406.
- [4] Guan H, Liu L, and Liao M, "Approach for the planning of parking guidance and information system," J. Highway Transport. Res. Develop., vol. 1, 2003, pp. 034.
- [5] Caicedo F, "Real-time parking information management to reduce search time, vehicle displacement and emissions," Transport. Res. D, vol. 15, no.4, 2010, pp. 228–234.
- [6] Grodi R, Rawat D B, and Rios-Gutierrez F, "Smart parking: Parking occupancy monitoring and visualization system for smart cities," SoutheastCon 2016, Norfolk, VA, 2016, pp. 1-5.
- [7] Pala, Zeydin, and Nihat Inanc. "Smart parking applications using RFID technology." RFID Eurasia, 2007 1st Annual. IEEE, 2007.
- [8] Rahman, Mohammad Shaifur, Youngil Park, and Ki-Doo Kim. "Relative location estimation of vehicles in the parking management system." Advanced Communication Technology, 2009. ICACT 2009. 11th International Conference on. Vol. 1. IEEE, 2009.
- [9] Anthony's, Robert B. "Automated vehicle parking system." U.S. Patent No. 5,414,624. 9 May 1995.

- [10] Van Deursen, Ton, and Saša Radomirović. "Algebraic attacks on RFID protocols." In Information Security Theory and Practice. Smart Devices, Pervasive Systems, and Ubiquitous Networks, pp. 38-51. Springer Berlin Heidelberg, 2009.
- [11] Arnott R, Rave T, and Schob R Alleviating Urban Traffic Congestion. Cambridge, MA, USA: MIT Press, 2005.
- [12] Atar R, Mandelbaum A, and Reiman M, "Scheduling a multi-class queue with many exponential servers: Asymptotic optimality in heavy-traffic," Ann. Appl. Probab., vol. 15, no. 4, pp. 2606–2650, 2004.
- [3] Benenson I, Martens K, and Birr S, "Parkagent: An agent-based model of parking in the city," Comput. Environ. Urban Syst., vol. 32, no. 6, pp. 431–439, Nov. 2008.
- [14] Benson J, Donovan T, Sullivan P, Roedig U, and Sreenan C, "Car-park management using wireless sensor networks," in Proc. 31st IEEE Conf. Local Comput. Netw., 2006, pp. 588–595.
- [15] K. Cheung and Varaiya P, "Traffic surveillance by wireless sensor network: Final report," Univ. California, Berkeley, CA, USA, Tech. Rep. UCB-ITS-PRR-2007-4, 2007.
- [16] Chou S, Lin S, and Li S, "Dynamic parking negotiation and guidance using an agent-based platform," Expert Syst. Appl., vol. 35, no. 3, pp. 805– 817, Oct. 2008

Geo-tagged Photo

