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IOT Based Automatic Parking Management System

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This project has been submitted to the Department of the Computer Science & Engineering at Sonargaon University in the degree of Bachelor of Science in Computer Science and Engineering.

May, 2019

DECLARATION

The project has been submitted to the Department of the Computer Science & Engineering, Sonargaon University in the partial fulfillment of the requirement for the degree of Bachelor of Science in CSE performed by us under supervision of **Bakir Hossain, Lecturer, Department of CSE** at Soanrgaon University. We hereby, declare that this project has not been submitted elsewhere for the requirement of any degree or diploma or any other purposes.

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Letter of Acceptance

This Project entitled **"IOT Based Automatic Parking Management System"** submitted By Md. Rayhan Ali ID: CSE1503006031, Md. Soroar Zahan ID: CSE1503006013, Md. Khalid Mahbub ID: CSE1503006035, Mani Bala ID: CSE1503006044 to the Department of Computer Science and Engineering, Sonargaon University, Dhaka, Bangladesh has been accepted as satisfactory for the partial fulfillment of the requirement for the degree of Bachelor of Science in Computer Science & Engineering and approved as to its style and contents.

Board of Examiners

Examiner 1

Examiner 2

Examiner 3

Examiner 4

ABSTRACT

Internet of things (IoT) is most recent and an important topic of the modern technology that plays an important role in our daily lives. IoT reduces human labor, human effort, human time and errors due to human negligence. In the current area, we are facing a new problem of parking of car. This is major issue in cities of today. This has led to the need for efficient parking management systems. In this report, an IoT based smart car parking management system has been describe that allows for efficient parking space utilization by using IoT technology, by using IoT, we can access information using internet. The system is used for minimizing manpower.

Power system had eight sensors such as TCRT5000 sensor and IR sensor. They connected to arduino Uno microcontroller. The TCRT5000 sensor were detection of the position of car and gave data which lots were occupied or not and the laser light for IR sensor were obstacle detecting of the position of the car before entering and exiting. Two servo motors also connected to arduino Uno. Servo motor opened or closed the gate when IR sensor detects the car. A database and an android application were connected to this system to store the data and apps will help the user to identifying and booking the parking space. The system had also a LCD monitor that was connected to arduino Uno which was displayed the empty space of parking slots. The system hat a GSM module which was building up online communication.

From the system, any drives can register and login with his/her appropriate name and mobile number to find the nearest parking space availability to park their car in that respective parking area by using our android apps that is the main objective of our system. And it mainly focuses on reducing the time to find out the parking slots and it avoids the unnecessary travelling and it also provides facility to pay fee online. The system reduces the global air pollution by unnecessary burns fuel. Thus it reduces carbon footprints in an atmosphere.

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

Title   **Page No.**

List of Figures:

List of Table:

Chapter 01

Introduction

1.1 Introduction

Internet of things (IoT) is a most recent and an important topic of the modern technology that plays an important role in our daily lives. The internet of things is a system of inter-related computing devices, mechanical and digital machines, objects, peoples that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. IoT reduces human labor, human effort, human time and errors due to human negligence.

In the current period, car parking is a major problem in modern congested cities of today. Car parking is not only just a major problem in Bangladesh but also all over the world. Simply there are too many cars on the road and not enough parking spaces. This has led to the need for efficient parking management systems. That's why we designed the arduino Uno based automatic car parking management system that allows for efficient parking space utilization by using IoT technology. A smart car parking management system helps in synchronized parking and saves the user's time.

In our project, IoT objects are connected to each other and exchange information through the internet. Our IoT based smart parking system organized parking lot. To design the project at first we have used laser light sensors or IR sensors for sensing car occupancy along with a DC motor to simulate as gate opener or closer. We also used a GSM module for connecting android apps and arduino Uno as a microcontroller to operate the system. The system reads the number of parking slots and updates data. The microcontroller reads the collected data and sends the data to system server over internet. A LCD displayed the empty spaces. Microcontroller was programmed used embedded 'C' language.

1.2: Justification of Study

Now-a-days more than half of the world's people are living in the cities. So the cities have reached full of its occupancy. As people uses cars for transportation so there is large number of cars exists for people convenience. Most of the time people spend their precise time to searching parking slots to park their cars. Thus congestion occurs in the traffic it leads to a hectic job to find the parking space to park their car. The most traffic and the most road accident occurs only cause of car congestion in the urban areas. On the other hand, we know that this search burns about one million barrels of the world's oil every day (Aniket et al. 2017). These problems will get worse as the global population continues to urbanize without

a well-planned, convenience-driven retreat from the car. That's why it is highly required to develop an automated smart car parking management system that would help the driver to find out some suitable parking space for his/her very quickly.

In recent era, the concept of smart cities has gained grate popularity. The ideal of creating a smart city is now becoming possible with the emergence of the Internet of Things. In this project, we have proposed an idea and designed an automated smart car parking management system. This system can be change the cities peoples lifestyle and reduce the driver's waste time, traffic congestion and also reduce the global air pollution by unnecessary burns fuel. According to a report smart parking could result in saving 2,20000 gallons of fuels till 2030 and approx. 3,00,000 gallons of fuels by 2050(Aniket et al. 2017).The smart parking system also enables better and real time monitoring and managing of available parking space which results in a significant revenue generation.

1.3: Scope of Study

The smart parking management system can be broadly applied in many fields. The basic role of parking management system of cars it can be also applied for ship and airplane. This system can be modified into ship and airplane with very few equipment changes and almost the same software just replacing the interface.

For domestic and residential parking system the device can be interfaced with home automation system which can control the various home appliances by sensing whether the user is arriving or exiting from the parking space.

For commercial parking system the device can be interfaced with a module which can sense the arrival of employee and can switch on his computer and accordingly switch off the appliances when the employee exits.

1.4: Application

The application to adopt this automatic smart car parking management system to find the availability of spaces could be displayed on a web site or a smart phone application so that drivers will always aware of whether there are free spaces or not. This project can be provides flexibility, on time update and online process to control all parking spaces effectively and manage all traffic within a reasonable time.

Chapter 02

Literature Review

2.1: Background Study

Internet of things was first introduced in 1999 at auto-ID center and first used by Kevin ashton. As evolving this latest burning technology, it promises to connect all our surrounding things to a network and communicating with each other with less human involvement. Still internet of things is in beginning stage and there is no common architecture exists till today (Basavaraju 2015).

Transportation is an essential need for many people to go to their work, school, and home. Particularly, the main common method inside many cities is to drive the car. Driving a car can be an easy task to reach the destination and load all stuff in a reasonable time. However, deciding to find a parking lot for a car can take a long time using the traditional system that can issue a paper ticket for every driver. As a result, this project focuses on providing an IoT based online smart car parking system in order to save time, budget and space (Amjaad & Liyakathunsia 2017).

There are many approaches to implement a smart parking system and in this project, we reviewed some ideas and those related techniques. In particular, each technique can maintain similar methodologies such as finding parking lots to the driver, amending parking status, paying the parking fee, and saving the whole data. However the main difference between those systems is the type of technology and mechanism.

According to Souissi, the smart parking system can be achieved using wireless network. In fact, he supported his solution by suggesting thatusing sensor for each parking slot. For example, if one slot becomes available, it will directly update its status and pass the information (Amjaad & Liyakathunsia 2017).

Hartono and Hutabarat proposed another solution by implementing smart parking system using E-commerce Solutions to Parking Space Optimization along with Bluetooth. For instance, when the car enters parking zone, the system will scan the car's license plate image and save into the central data and link all driver's information with their cars (Amjaad & Liyakathunsia 2017).

These are some proposed solutions to apply smart parking system and in order to choose the perfect approach .we should decide the budget, system requirements, system policies and the infrastructure plan before initiating the project. Then we choose an IoT based smart car parking management system. This system would be design and develop of a low cost IoT

based parking system that can be used to determine the location of available parking slots, to reduce the traffic congestion and reduce the fuel consumption.

2.2: Related Work

Our IoT based smart car parking management system project is designed by making use of some IoT supportable hardware's such as arduino Uno, laser light or IR sensors, TCRT5000 sensors, DC motor, GSM module, LCD etc. Here we have focused on less power consumption and more performance device. So that arduino Uno is the suitable microcontroller for the implementation of our project.

Chapter 03

Requirements, Design and Development

3.1: Requirements Analysis

Requirements analysis is the first stage in the system engineering process and software development process. Requirement Analysis, also known as Requirement Engineering, is the process of defining user expectations for new software being built or modified. These features, called requirements, must be quantifiable, relevant and detailed. In software engineering, it is sometimes referred to loosely by names such as requirements gathering or requirements capturing.

This project was made by some hardware and software requirements. These are the following:

3.1.1: Hardware Requirements

In our project, we are using some hardware equipment's. These are the following:

1. Arduino Uno ATmega328 microcontroller
2. LCD
3. TCRT5000 Sensor
4. Laser light or IR sensor
5. LDR
6. Servo Motor DXW90
7. 7805 Voltage regulator
8. Resistor
9. Adaptor
10. 10K, 470Ω
11. Wire
12. PVC Sheets
13. GSM module SIM800L

3.1.2: Software Requirements

Software equipment's are

1. Arduino Compiler
2. Programming Language: C
3. An android application

3.2: Requirements Descriptions

3.2.1: Arduino Uno ATmega328 with Pin Diagram

Arduino Uno is an open-source electronics platform based on easy-to-use hardware and software. Arduino Uno consists of both a physical programmable circuit board and a piece of software or IDE (Integrated Development Environment) that runs on computer, used to write and upload computer code to the physical board. Arduino Uno microcontroller are able to read inputs - light on a sensor, a finger on a button, or an online message and turn it into an output - activating a motor, turning on an LED, publishing something online or offline. It has 14 digital I/O pins and 6 (DIP) or 8 (SMD) analog input pins.
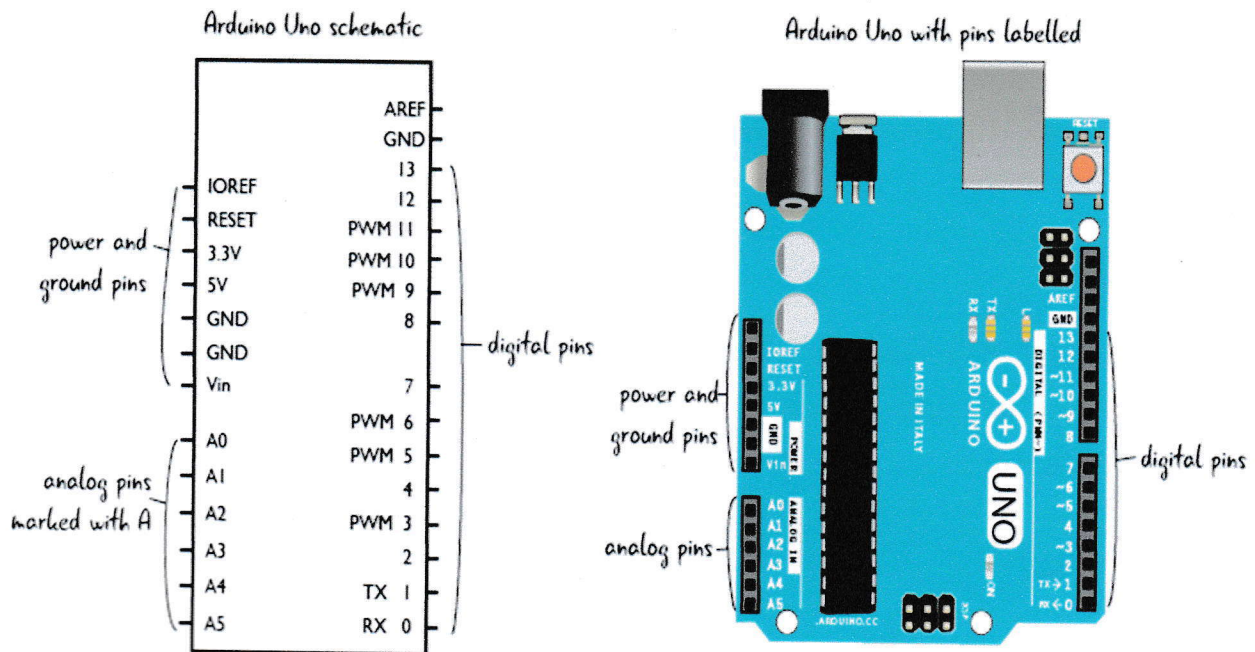

Figure 1: Arduino Uno with pin diagram

In this project, we used an ATmega328 Arduino Uno microcontroller. And also used a LCD monitor, two servo motors, two Laser Light or IR sensors, six TCRT5000 sensors, a GSM module and a Voltage regulator chip those were connected with arduino Uno microcontroller.

3.2.2: LCD Monitor

LCD (liquid crystal display) is the technology used for displays in notebook and other smaller computers. Like light-emitting diode (LED) and gas-plasma technologies, LCDs allow

displays to be much thinner than cathode ray tube (CRT) technology. LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it.
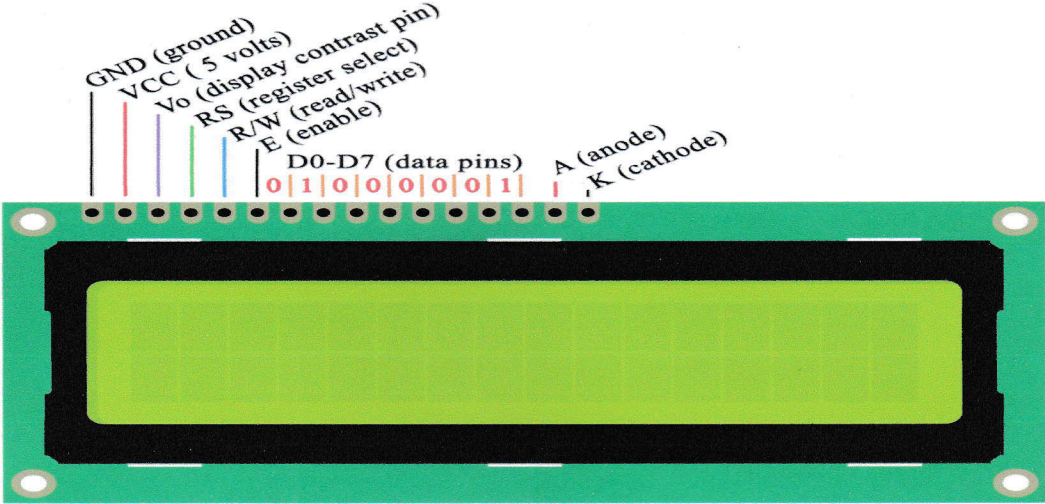
Figure 2: LCD Monitor

3.2.3: Laser Light or IR sensor and LDR

Laser is basically concentrated light source so any sensor that can detect light can detect laser as well. LDR (Light Dependent Resistor), Photo diode & photo transistors are used to detect lasers. Even LED's can be used to detect laser. LDR is the cheapest and most easily available sensor. LDR is very easy to use.
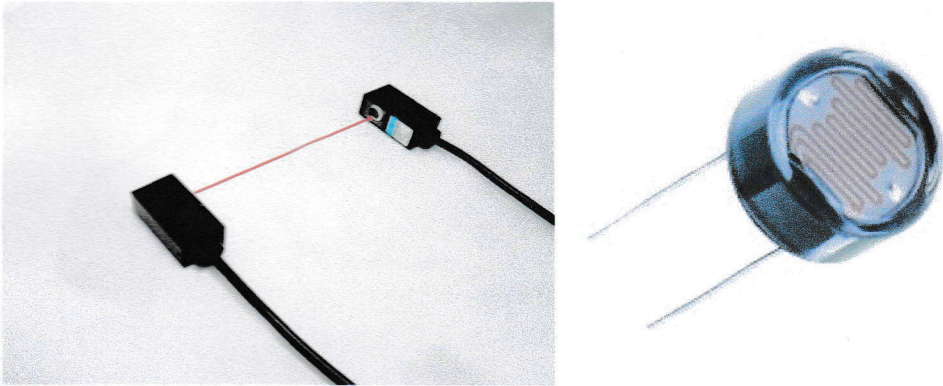

Figure 3: IR sensor and LDR

3.2.4: TCRT5000 sensor with Circuit Diagram

The TCRT5000 is the reflective sensors which include an infrared emitter and phototransistor in a leaded package which blocks visible light.
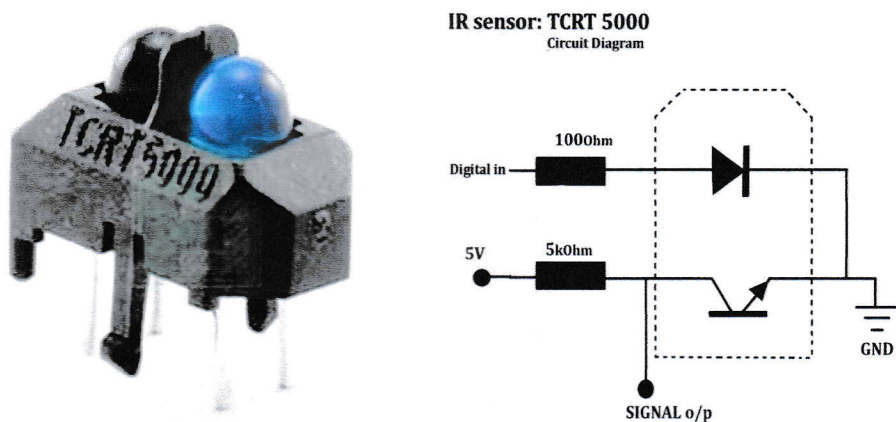

Figure 4: TCRT5000 sensor with circuit diagram

In this project, the TCRT5000 sensors were ensure the car position in parking slot.

3.2.5 Servo Motor DXW90

A servo motor is a rotary actuator or motor that allows for a precise control in terms of angular position, acceleration and velocity, capabilities that a regular motor does not have. It makes use of a regular motor and pairs it with a sensor for position feedback. The controller is the most sophisticated part of the servo motor, as it is specifically designed for the purpose.
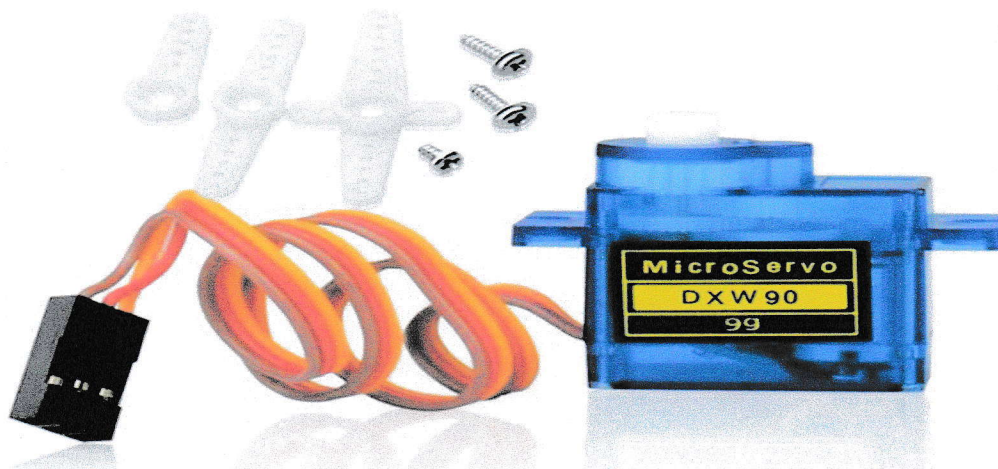

Figure 5: Servo Motor

In this project, the servo motor had used for as gate opener and gate closer.

3.2.6: 7805 Voltage Regulator

A voltage regulator IC maintains the output voltage at a constant value. 7805 IC is a member of 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). The xx in 78xx indicates the output voltage it provides. 7805 IC provides +5 volts regulated power supply with provisions to add a heat sink.

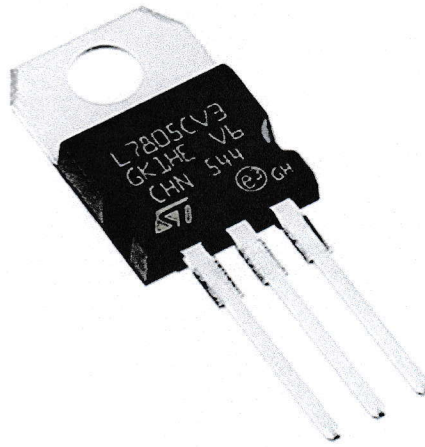*Figure 6: 7805 Voltage Regulator*

3.2.7: SIM800L GPRS/GSM Module

SIM800L is a miniature cellular module which allows for GPRS transmission, sending and receiving SMS and making and receiving voice calls.
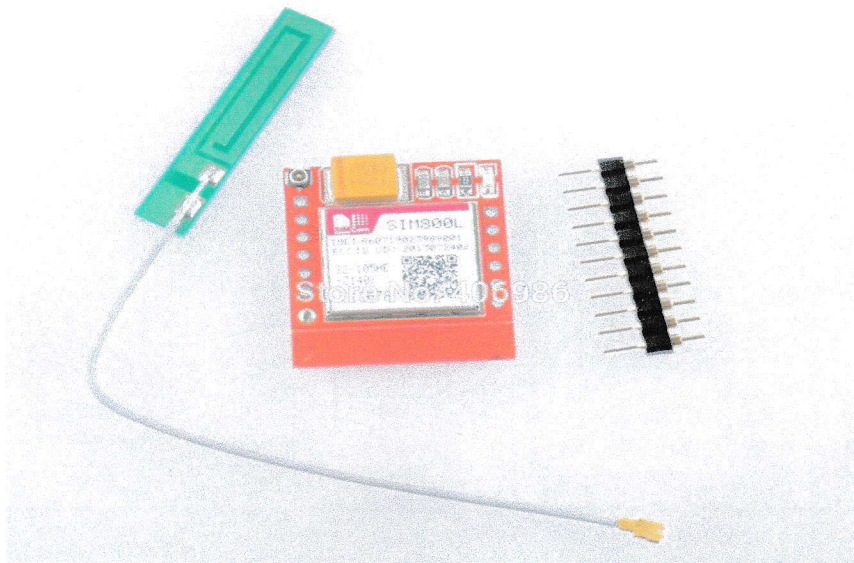

Figure 7: SIM800L GPRS/GSM Module

Low cost and small footprint and quad band frequency support make this module perfect solution for any project that require long range Connectivity. After connecting power module boots up, searches for cellular network and login automatically. On board LED displays connection state (connecting with server, updating data).

In this project, we used GSM module for internet connectivity.

3.2.8 Android Application

Android is the mobile operating system and it has own operating apps. We developed our own android apps and also we installed this apps in our mobile anyone can use this apps after the registration is completed. Users can download the android apps for booking parking slot. User booking parking slot is implemented through the android apps.
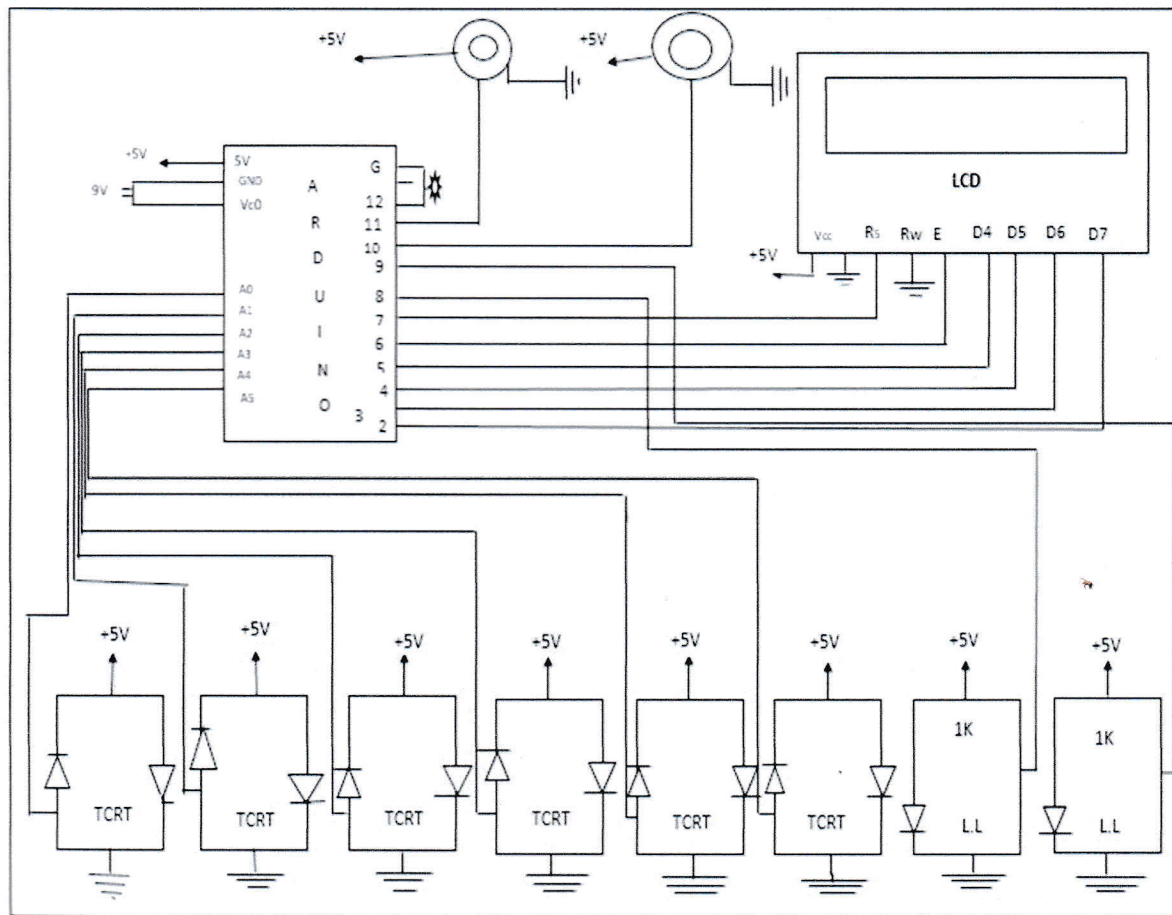
3.3 Circuit Diagram of System

Figure 8: Circuit Diagram of System

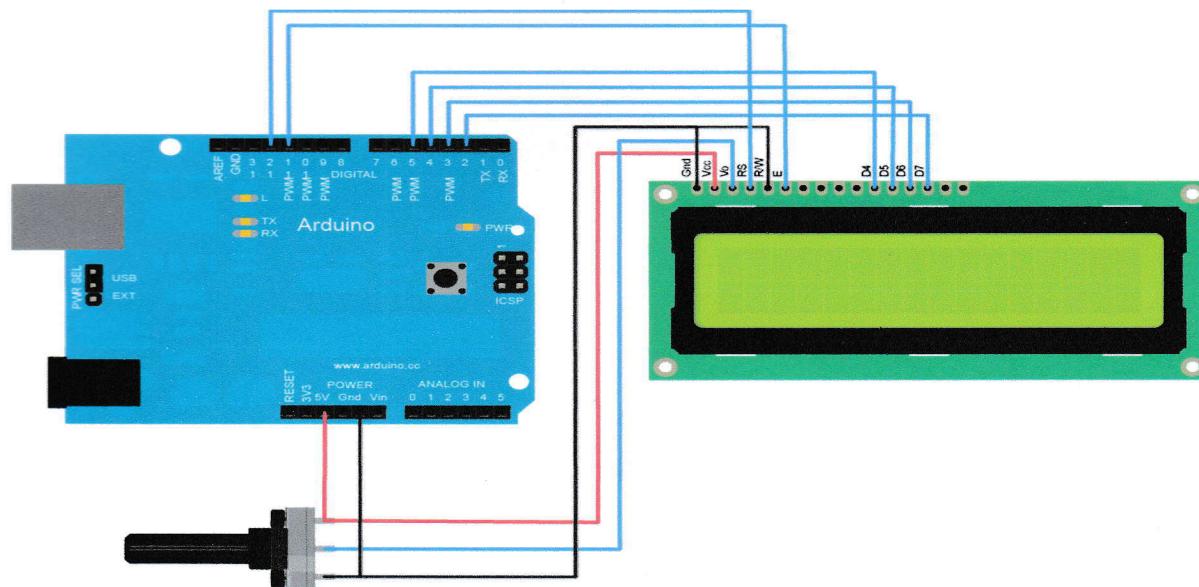### 3.3.1 Arduino Uno to LCD Monitor

Figure 9: Arduino Uno to LCD Monitor
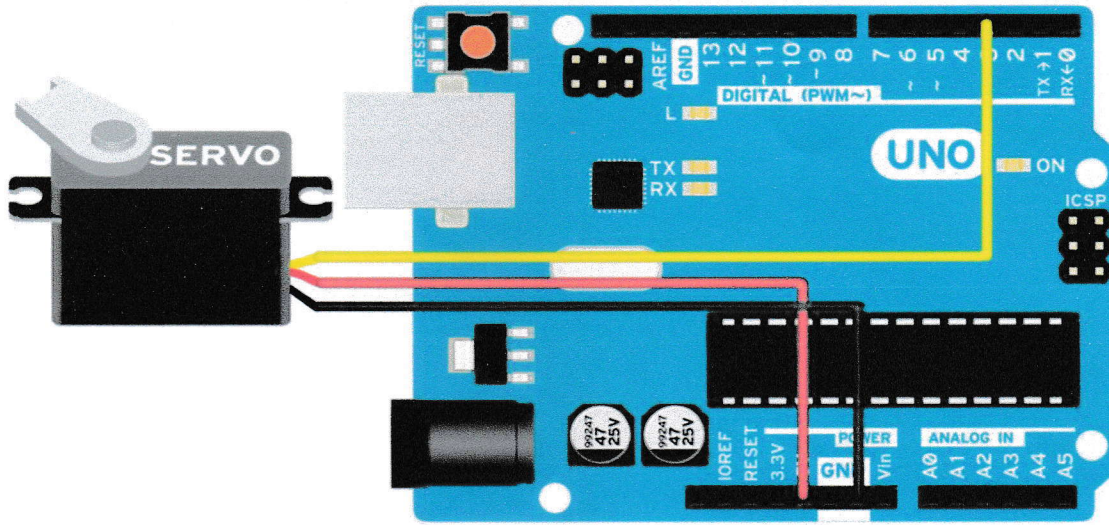
3.3.2 Arduino Uno to Servo Motor

Figure 10: Arduino Uno to Servo Motor

3.3.3 Arduino Uno to TCRT5000 Sensor
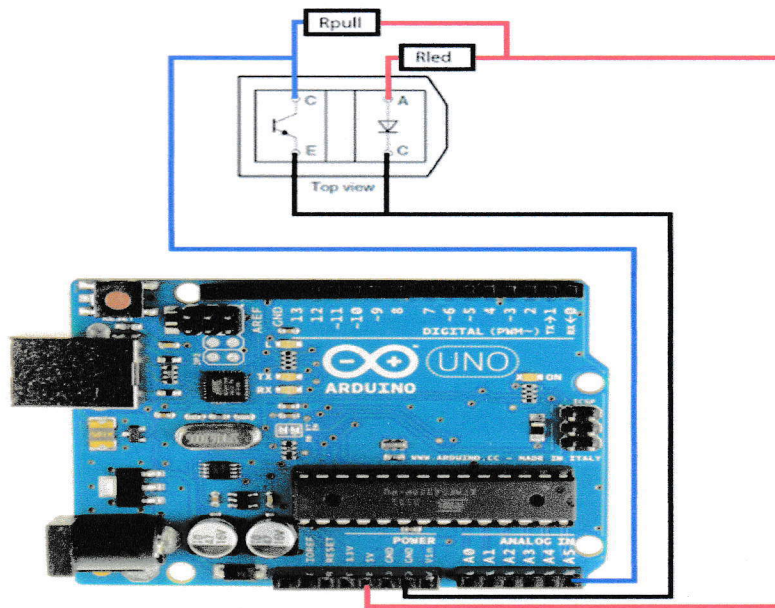
Figure 11: Arduino Uno to TCRT5000 Sensor

3.4: System Design and Development
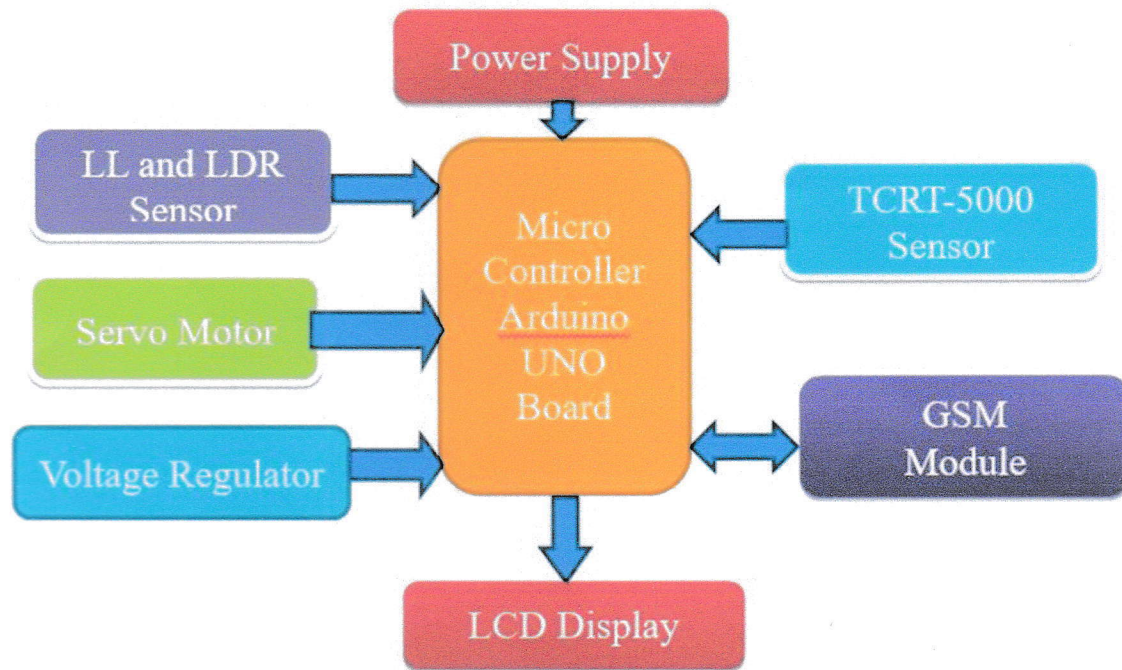
Figure 12: Block Diagram of Smart Car Parking System

Description of Block Diagram

12V power supply will be provided on Arduino UNO and then the whole system had generated by external 12V power supply. Our system had eight sensors such as TCRT5000 sensor and IR sensor. They were connected to the Arduino UNO microcontroller. The TCRT5000 sensors were detecting of the position of the car and gave data which lots were occupied or not and the laser light or IR sensors were obstacle detecting of the position of car before entering and before exiting. Two servo motors were also connected to Arduino UNO. Servo motor opened or closed the gate when IR sensor detecting the car. A database and an android application were connected to this system to store the data and apps will help the user in identifying and booking the parking space. The system had also an LCD monitor that was connected to Arduino UNO which was displayed the empty spaces of parking slots. The system had a GSM module which was built up online communication.

Chapter 04

Methodology

4.1 Methodology

A Methodology is a set of methods, rules or ideas and the system of principles for doing something, for example for teaching or for developing a project where the methods are arranged in orderly. In other words, Methodology is the systematic or theoretical analysis of the methods that are applied to a field of project or thesis. Ordinarily, it encompasses concepts such as paradigm, theoretical model, phases and quantitative or qualitative techniques.

Project Planning

Knowledge and Information Gathering

Hardware and Software Requirement Analysis

Design & Development

Testing & Debugging

Maintenance
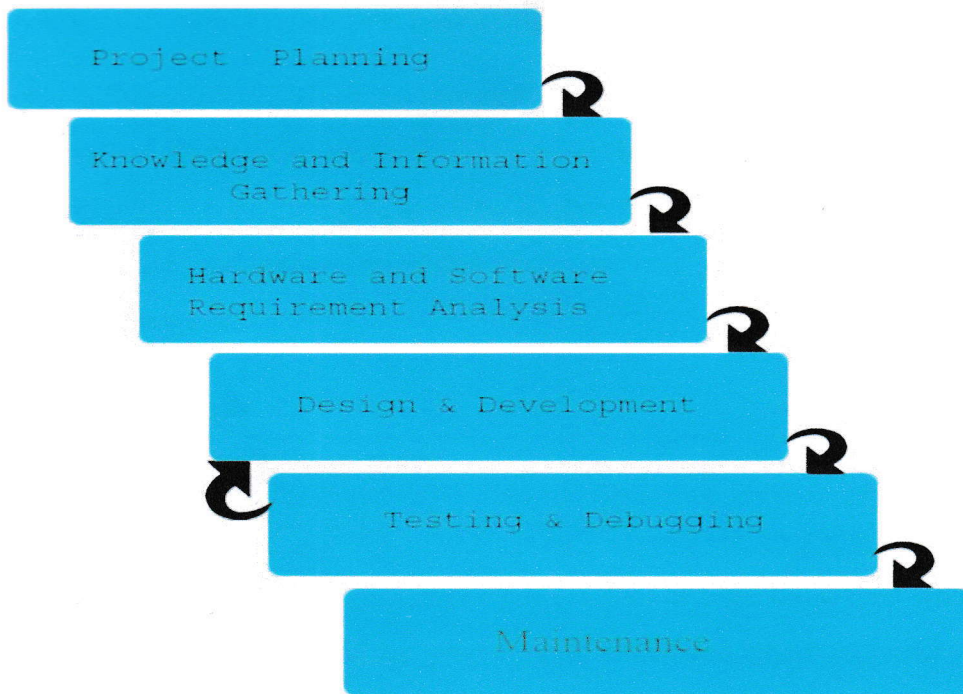
Figure 13: Workflow of the project

4.1.1 Project planning

Project planning is the heart of the project life cycle. Project planning is a disciplinary step in project management which is related to the use of schedules to plan and subsequently report progress within the project environment. It is one of the most essential parts of the systems to make a project. This is the stage of conceptual proposals where the selection of the project area is done and makes a decision which project will be constructed.

Project planning requires an in-depth analysis and structuring of the following activities:

- Setting project goals

- Identifying project deliverables
- Creating project schedules
- Creating supporting plans

In this stage we have planned in which area will be working and which project will be making. We have observed and selected of the strategy of the overall project and what is the objects of the selected project of us. Our project title is "IOT based automatic parking management system".

4.1.2 Knowledge and Information Gathering

Gathering Information describes the process of acquiring knowledge. Gathering Knowledge and information always alternative point to a problem to be identify and help ensure the relevant options are considering light of the available facts. In this part, we had searched for gather information and gather knowledge about our goal of object of our project. Some of gathered knowledge is:

- About IoT
- Cloud-based car parking system
- Smart parking system using wireless network

We reviewed some ideas according to our project goal or object and then we have collected idea for our project. The idea of our project is an automated smart cat parking management system.

4.1.3: Design & Development

The design and development process is especially challenging of a project. The process of the procedure is to outline the steps necessary to design and develop any hardware for new product or major to existing products. Development timelines affect the design, while design often sets the development timeline in the first place.

The design is collaborative one the hand Implementing includes the specifics of who, what, where, and how a program is established and run. When implementation is high quality, success is more likely.

4.1.4: Hardware and Software Analysis

Any project can be hardware-based or software-based or hardware-software based. The ultimate success of an embedded system project depends both on its software and hardware.

Requirement analysis encompasses those task that go into determine the needs or conditions to meet for new product. Requirement analysis is critical to success or failure of a systems or software project. In software engineering, it is sometimes referred to loosely by names such as requirements gathering or requirements capturing. Requirements analysis encompasses those tasks that go into determining the needs or conditions to meet for a new or altered product or project, taking account of the possibly conflicting requirements of the various stakeholders, analyzing, documenting, validating and managing software or system requirements.

In this part, we had find out our project based hardware and software requirements and then analysis the requirements to develop our project.

4.1.5: Testing & Debugging

It can be manual or automated, and it has many different kinds, like unit, integration, system/acceptance, stress, load, soak testing etc. Debugging is the process of finding and removing a specific bug from the program. It is always a manual, one-off process, as all bugs are different. Testing means verifying correct behavior. Testing can be done at all stages of module development: requirements analysis, interface design, algorithm design, implementation, and integration with other modules. In the following, attention will be directed at implementation testing. Implementation testing is not restricted to execution testing.

Debugging is a cyclic activity involving execution testing and code correction. The testing that is done during debugging has a different aim than final module testing. Final module testing aims to demonstrate correctness, whereas testing during debugging is primarily aimed at locating errors.

4.1.6: Maintenance

Hardware project Maintenance presents the full scope and understanding how the function should operate and be mange in an implementation area. Actions necessary for retaining or restoring a piece of equipment, machine, or system to the specified operable condition to

achieve its maximum useful life testing includes corrective maintenance and preventive maintenance.

4.2: Justification of Methodology

We have divided our whole work with few phases of our project. Using the workflow, we have completed our project very readily. Because it is a sequential process to solve any problem to develop any system it should arrange the whole work in the segment so that accuracy can be provided. We used the workflow in our system, because of it is six stage attributes and feedback opportunity system the characteristics of our workflow is it can return to previous steps. If we want to modify our system at any point according to equipment so we will do it depends on our requirement. In this workflow, each phase must be completed completely before the next steps may begin.

Chapter 05

Project Description and Result Analysis

5.1: Project Description

At first, we took an arduino Uno ATmega328 microcontroller. Six TCRT5000 sensors were connected to arduino Uno's six analog pins (A0-A5). And the ground pins of TCRT5000 sensors were connected to arduino Uno's ground pin. Two laser light sensors or IR sensors were connected to arduino Uno's digital I/O pin no 8 & 9. And the ground pins of L.L sensors or IR sensors were connected to arduino Uno's ground pin.

No of four digital I/O pins (2-5) of arduino Uno were connected to LCD's four pins (D4-D7). No of 6 & 7 pins were connected to LCD's E & RS pins. And the ground pins of LCD's were connected to arduino Uno's ground pin.

Two servo motors were connected to arduino Uno's 10 & 11 no pins. A 7805 voltage regulator was connected to arduino's vcc and ground pin. We used a GSM module that was connected to arduino's 12 & 13 no pins. This module was used to getting online service.

And then the hardware system was ready for given output when the arduino Uno was power up and the LCD displayed update information.

After that, we developed android apps for that user's they have booked the specific parking slot to park their car by using the apps.

5.2: Demo photo of the project

After completing the connections of all devices (LCD display, IR sensors, TCRT sensors, servo motors, GSM module and Voltage regulator) with the arduino Uno ATmega328 we had been taken a demo photo by smart phone.
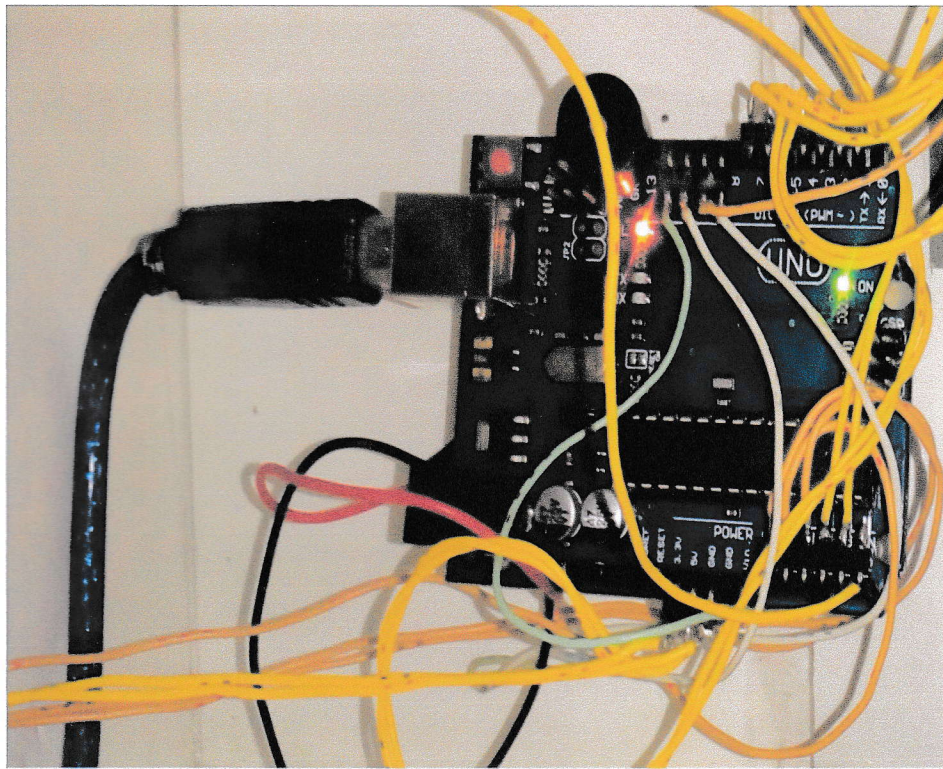
Figure 14: Demo photo of the project

5.2.1: Demo photo of our project displaying data

Figure 15: Demo photo of our project displaying data

In this demo photo we had been shown the output of empty spaces of parking zone. It will be also help to give information to the monitoring person. When any car parked in specific slot that was detected by TCRT sensors then the system will inform the monitoring person by updating data and showed on LCD display and on android apps. We had been added that information into the embedded C programming language into the arduino IDE.
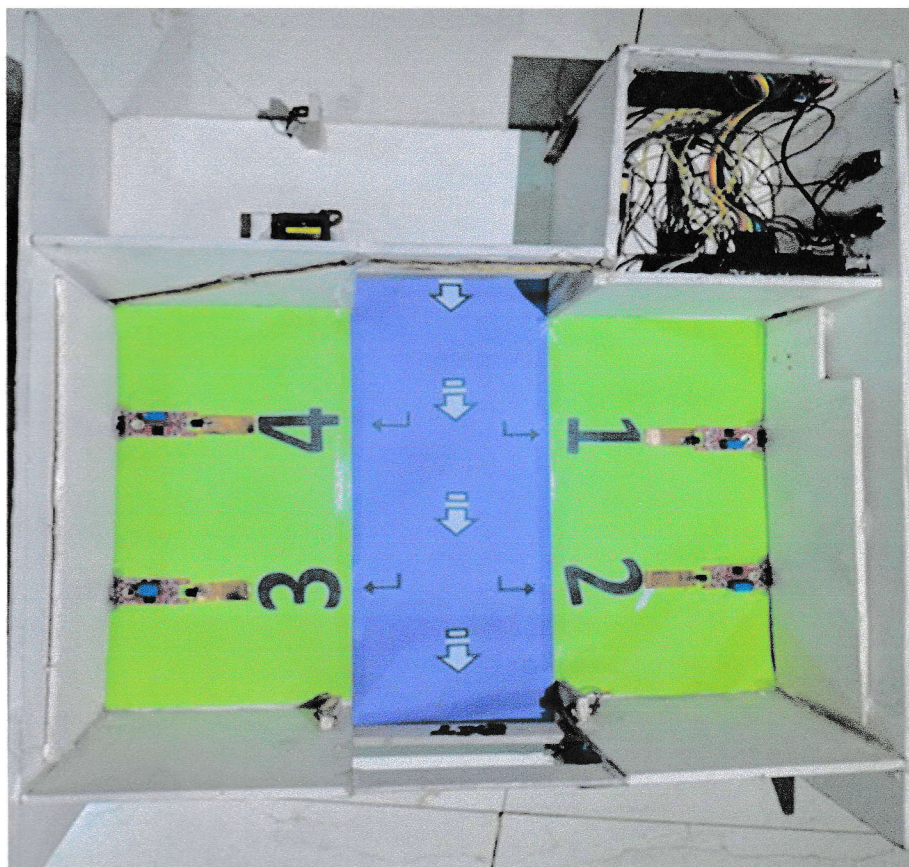
5.2.2: Demo photo of our project layout

Figure 16: Demo photo of our project layout
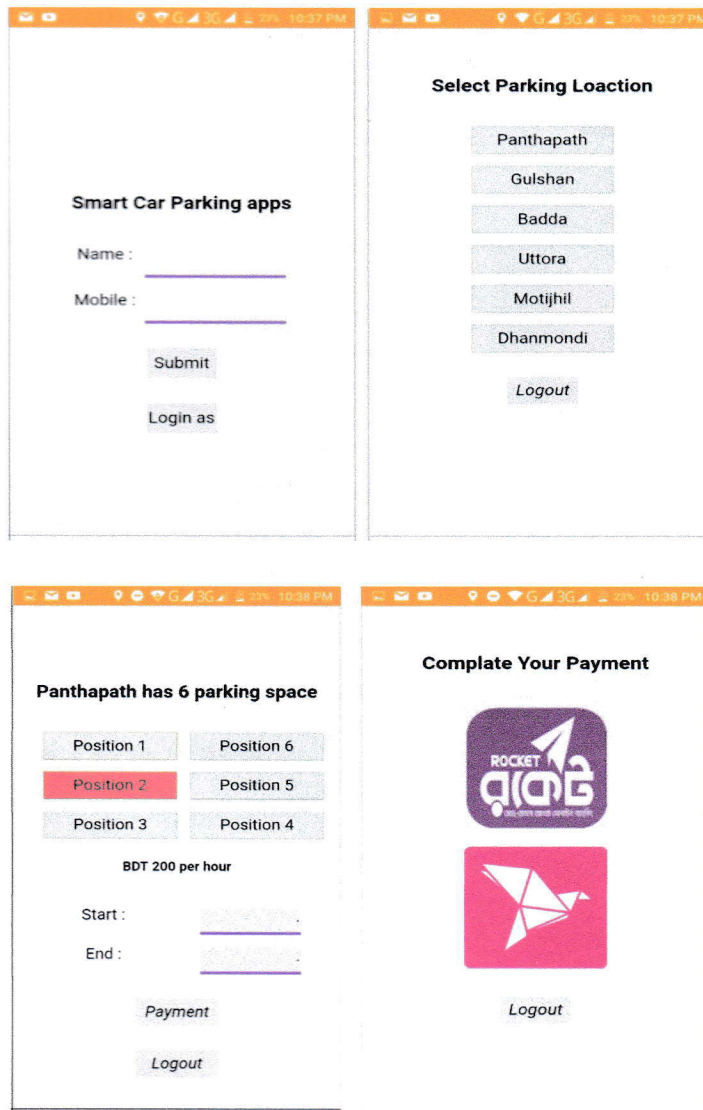
5.2.3: Demo screenshots of our apps

Figure 17: Demo screenshots of our apps

5.3: Result Analysis parking zone

Table 1: Result Analysis parking zone

Name of Test Attributes	Test Case	Success	Failed	Success Rate	Failure Rate
Car	6	5	1	83.33%	16.67%
Bike	20	17	3	85%	15%
Bus	15	13	2	86.67%	13.33%

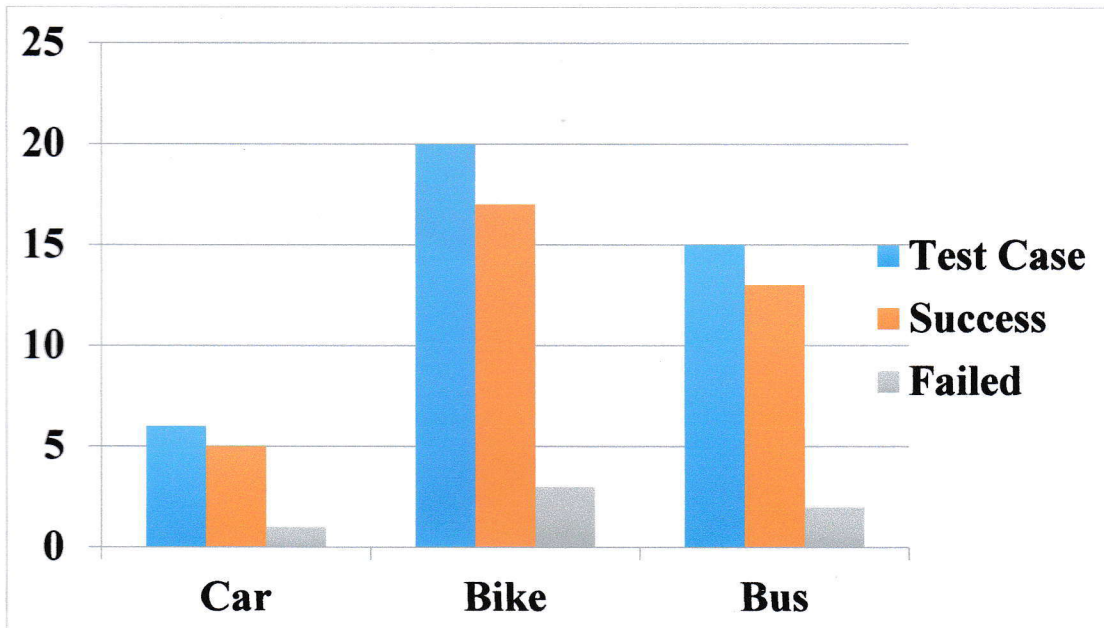### 5.3.1: Graphical View 1 of Parking Zone

Figure 18: Graphical view 1

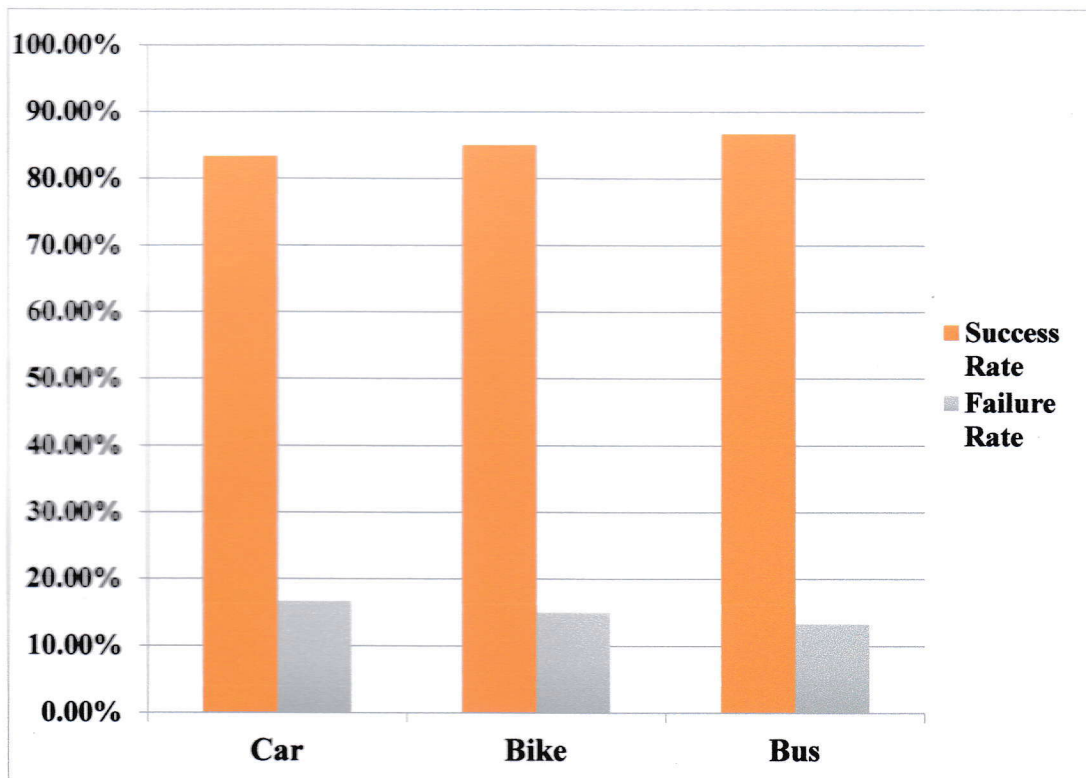### 5.3.2: Graphical View 2 of parking zone

Figure 19: Graphical view

Chapter 06

Conclusion and Limitation

6.1: Conclusion and Limitation

In this report, an IoT based smart car parking management system has been described. From the proposed system, any drivers can register and login with his/her appropriate name and mobile number and then check for space availability to park their car by using our android apps. If space is available there, he/she will be allowed to go inside the parking zone. A user can login and check for free space from anywhere which is the main objective of our proposed car parking system by using IoT. By using IoT, we can access information using internet. Now-a-days almost every person having a smart mobile phone uses internet. Hence, smart car parking system provides facility to book slot for parking and it provides facility for user to pay fee online. The system is used for minimizing manpower as well as fuel. In future simulating of this system, there are several improvements can be made in order to upgrade the fractures such as increasing the efficiency of the system. The parking accuracy of the system and improvement based on the feedback and users interaction. The proposed system can be further enhanced to the service accordingly.

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