
## Faculty of Electrical Technology and Engineering

# SMART MULTILEVEL CAR PARKING SYSTEM WITH AUTOMATED MANAGEMENT

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**Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours**

**2024**

# SMART MULTILEVEL CAR PARKING SYSTEM WITH AUTOMATED MANAGEMENT

**MOHD DANISH AZIZI BIN MOHD YUSOFF**

**A project report submitted**
**in partial fulfillment of the requirements for the degree of**
**Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics)**
**with Honours**



**Faculty of Electrical Technology and Engineering**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**2024**

**DEDICATION**

*This project is dedicated to my beloved family, whose unwavering support, sacrifices, and encouragement have been my constant source of strength and inspiration throughout this academic journey.*

*To my parents, for their endless love, guidance, and belief in my abilities. Their faith in me has been the foundation of all my achievements.*

*To my friends and peers, for their companionship and for motivating me to strive for excellence.*

*And finally, to my dedicated supervisors and mentors, whose expertise, patience, and constructive feedback have guided me to complete this project successfully.*

*This work stands as a testament to the collective efforts, support, and motivation of everyone who believed in me*

## ABSTRACT

In recent years, the number of vehicles has continued to rise, and parking space has become a major issue in urban and semi-urban areas, which requires the design of a parking system that will reduce physical labour while also addressing the problem of cars parking on streets. In todays world of modern, it is crucial to minimise unused space in large companies and apartments. Smart Multilevel Automatic Car Parking System with Automated Management enables the parking of vehicles floor after floor and reducing the space used. To enhance this project, the combination of microcontroller and mechanical parts is used in this project. The RFID card RFID reader is utilized with Arduino to indicate the empty slot. By utilized the use of RFID card and RFID reader, the drivers are able to find the empty slot in parking slot to park the car and help the driver to find the slot easily and reduce the searching time.

## *ABSTRAK*

Dalam beberapa tahun kebelakangan ini, bilangan kenderaan terus meningkat, dan ruang letak kereta telah menjadi isu utama di kawasan bandar dan separa bandar, yang memerlukan reka bentuk sistem tempat letak kereta yang akan mengurangkan tenaga kerja fizikal di samping menangani masalah tempat letak kereta. di jalanan. Dalam dunia moden hari ini, adalah penting untuk meminimumkan ruang yang tidak digunakan di syarikat besar dan pangsapuri. Sistem Tempat Letak Kereta Automatik Berbilang Aras Pintar dengan Pengurusan Automatik membolehkan tempat letak kenderaan lantai demi lantai dan mengurangkan ruang yang digunakan. Untuk meningkatkan projek ini, gabungan mikropengawal dan bahagian mekanikal digunakan dalam projek ini. Pembaca RFID kad RFID digunakan dengan Arduino untuk menunjukkan slot kosong. Dengan memanfaatkan penggunaan kad RFID dan pembaca RFID, pemandu dapat mencari slot kosong di slot parkir untuk meletakkan kereta dan membantu pemandu mencari slot dengan mudah dan mengurangkan masa pencarian.

**ACKNOWLEDGEMENTS**

First and foremost, I would like to express my gratitude to Allah S.W.T for the guidance, blessings and strength, which make me always calm and doing smooth.

I am very thankful to my supervisor, TS MOHD RAZALI BIN MOHAMAD SAPIEE, for his precious guidance, words of wisdom and patient throughout this project.

I am also indebted to Universiti Teknikal Malaysia Melaka (UTeM) and my family for the financial support through this semester which enables me to accomplish the project. Not forgetting all my lecturers from semester 1 until now for the willingness of sharing their thoughts and ideas regarding the project.

My highest appreciation goes to my parents and family members for their love and prayer during the period of my study. An honourable mention also goes to all my friends for all the motivation and understanding, thank you for the laughter, financial support and idea sharing during the challenging times

Finally, I would like to thank all the individuals, fellow colleagues and classmates, the Faculty members, as well as other individuals who are not listed here for being co-operative and helpful.

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**LIST OF SYMBOLS**

## LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| $V$ | - | Voltage |
| IDE | - | Integrated development environtment |
| SDG | - | Sustainable Development Goals |
| RFID | - | Radio Frequency Identification |

## LIST OF APPENDICES

# CHAPTER 1

# INTRODUCTION

## 1.1 Background

The range of motor vehicles available at affordable rates has increased, leading to an alarming rise in the number of cars on the road. The use of automobiles for transportation is growing daily in tandem with the expansion of the world economy. There's no denying that transport networks have a big daily impact on people and society as more and more people choose to own personal vehicles. Drivers in Kuala Lumpur, Malaysia, could have to wait up to 25 minutes each day to find a parking space that is free. Drivers in the world's least developed nations are frequently loud and combative when attempting to park. Such incidents frequently result in traffic at the entrance to the parking lot, which backs up into the road. When people park their automobiles on the road, it exacerbates the issue by causing traffic congestion. Taking into account all the information, an automatic multilevel smart parking system will assist in parking a big number of cars in a smaller space. Automating this will also reduce the need for manual intervention, which will minimise issues. The current methods are expanded upon to guarantee optimal space utilisation. The system is an automated parking system.

## 1.2 Problem Statement

As cities become more crowded, finding efficient car parking solutions is crucial. Multilevel car parking facilities help by stacking cars vertically to save space, but they

often face problems like congestion, inefficient use of spaces, difficult navigation, and long search times for available spots. Traditional systems don't provide real-time information or optimize space use, leading to frustration and more traffic.

To solve these issues, a Smart Multilevel Car Parking with Automated Management System that improve efficiency, user experience, and sustainability. This system will monitor parking space availability in real-time using Blynk application, allow drivers to reserve spots in advance. The system will be easy to use, ensuring accessibility for all, and provide tools for facility managers to efficiently run the parking facility.

The expected benefits include less time searching for parking, better use of spaces, higher user satisfaction, reduced congestion, and a lower environmental impact. This solution supports the United Nations Sustainable Development Goals, particularly those for sustainable cities and climate action, benefiting city planners, parking operators, drivers, local businesses, and environmental advocates.



## 1.3 Project Objective

1. To design a smart multilevel car parking system for vertical space utilization and maximize the use of available parking spaces.
2. To develop a parking system that reduced time spent searching for parking spaces.
3. To create scalable system, accommodating parking facilities of various sizes and capacities.

## 1.4 Scope of Project

1. Designing the car parking system that includes electronic components, microcontrollers, and mechanical parts.
2. Create a flexibility system with ability to integrate with existing parking infrastructure.
3. Testing the initial deployment in a pilot location and refine the system.
4. Conducting a comprehensive budget covering all aspects of development, deployment, and maintenance.
5. Providing a report on the development of the process, challenges faced, and recommendations for future improvements and real-world implementation.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

In today modern society, car parking is a crucial aspect of urban infrastructure, facilitating the temporary storage of vehicles in designated areas known as parking lots or car parks. These spaces are integral to the functionality and organization of cities, towns, and other populated areas. Car parking solutions vary widely, ranging from simple surface lots to complex multi-level parking structures, each designed to address different needs and constraints.

Parking lots are typically located near commercial centers, residential areas, workplaces, and public facilities, ensuring that people have convenient access to their destinations. It plays a vital role in traffic management by preventing congestion on streets and providing orderly parking spaces. Additionally, car parking facilities enhance safety by reducing the likelihood of accidents and offering secure places for vehicles.

## 2.2 Sustainable Development Goals (SDG) and understanding current issue of multilevel car parking


**Figure 2.1: List of SDG**

In the modern era, the increasing of the vehicle and lack of space require innovative technologies to reduce their impacts. Smart Multilevel Car Parking System with automated management represent a significant advancement in space management, playing a crucial role in achieving several United Nations Sustainable Development Goals (SDGs). These systems support SDG 11, which focuses on sustainable cities and communities by utilizing vertical space to help preserve valuable land for other purposes, such as parks or green spaces, contributing to the creation of more sustainable and livable cities. The system also align with SDG 9, innovation in infrastructure development, incorporating advanced technologies and design concepts to maximize space utilization and enhance environmental sustainability. Furthermore, SDG 13 on climate action is advanced as these systems efforts by reducing the need for expansive surface parking lots, which can contribute to urban heat island effects and increase greenhouse gas emissions associated with vehicle travel. In addition, SDG 7 emphasizes affordable and clean energy that can integrate renewable energy sources, such as solar panels, to generate clean energy for lighting, ventilation, and

other operational needs. By harnessing renewable energy, these facilities can reduce reliance on fossil fuels and contribute to the transition to a more sustainable energy system.

These technologies also contribute to SDG 12 responsible consumption and production to supports responsible consumption and production by optimizing space efficiency and minimizing the environmental footprint of parking facilities. By encouraging more efficient use of land and resources, multilevel car parks contribute to sustainable patterns of consumption and production in urban areas. Overall, the system aligns with several SDGs by promoting sustainable urban development, enhancing infrastructure resilience, mitigating climate change impacts, and supporting responsible resource management..

## 2.3 Studies Related to Multilevel Car Parking Systems with Automated Management.



Car Parking Systems has become a crucial aspect of urban infrastructure research due to its potential to increase community development . Many studies have explored various aspects of implementing the systems, highlighting the advancements, challenges, and future development directions in this field. A study by Kumar et al. (2005) This author discusses GIS-based advanced passenger information, which can also be used to quickly locate parking spots that are accessible, entry-exit time records, and bus routes, hospitals, bus stops, and hotels that a traveller may require. It also makes it easier to find parking near the market during busy periods. And the driver can easily find a place to park. The GIS system gives data about all of the

necessary facilities available in Hyderabad City because it was developed and used in Hyderabad City only.[1]

Richard Arnott and John Rowse (2000) created a model of curve side parking and traffic congestion in a downtown region. Curve side parking is more expensive, but it also reduces social opportunity costs and provides a solution to traffic congestion by clearing the market for curve side parking places. This author briefly discusses traffic congestion, garage parking, and curve side parking [2]. Additionally, the research conducted in 2012 by Duardo Barata, Luis Cruz, and João-Pedro Ferreira provides information regarding the importance of integrated parking management policies that clarify parking space usage and accessibility. It also provides information on how to generate income from parking facilities, which aids in making the most profitable use of government-owned land and boosts economic growth. [3].



Paul A. Barter (2013) This article provides a quick overview of foreign comparisons with regard to off-street parking policies for non-residential buildings. Parking management must to be appropriate and focused on the market. Describe a few parking management strategies. parking spot with a focus on the market that uses suitable parking method [4]. Ruan, Jin-Mei (2019) along with the traffic management plan, transit plan, and travel demand management initiatives, the author also describes the codes, guidelines, and programming for an event-based transportation management plan. These arrangements are crucial for motivating guests to choose public transit as their main means of mobility, especially during a major event like the Olympic Games [5].

The author, Ankit Gupta (2019), detailed the application of the idea of a microcontroller-based vehicle parking system that receives data on the presence and motion of cars, determines the availability of space, permits parking, and displays all of the procedure on an LCD panel. An RFID module provides security so that authorised users can exchange their RFID cards for entrance; otherwise, nothing special will happen. [6] In Geneva, where the vendor's multilevel parking system is based on a basic sprocket chain mechanism, Vipul More (2018) introduced wheel mechanisms. A multilevel parking system allows you to park more cars in less area and makes it easy to identify available spots as well as any problems a user may have when parking. [7] The lift mechanism notion that was implemented has been identified, anticipated, or explored by G. Narone (2017). There will be an explanation of the two lift options: traction lift and hydraulic lift. A hydraulic lift is appropriate for moderate heights, but as height grows, it becomes quite expensive. Cost-prohibitive traction lifts use a pallet as its primary component, which is developed utilising a chain mechanism technique to impart pulling force to the pallet management system based on the vehicle's weight. [8]



The lift mechanism notion that was implemented has been identified, anticipated, or explored by G. Narone (2017). There will be an explanation of the two lift options: traction lift and hydraulic lift. A hydraulic lift is appropriate for moderate heights, but as height grows, it becomes quite expensive. Cost-prohibitive traction lifts use a pallet as its primary component, which is developed utilising a chain mechanism technique to impart pulling force to the pallet management system based on the vehicle's weight. [9]. According to Saifullah Kamarul Azlan's estimate from 2021, the

project's goal is to make parking lots available in metropolitan areas and prevent the shortage of parking spaces. The implementation of a fully automated IoT multilevel parking system that is tailored to Malaysia's parking system capabilities, together with community constraints, is possible with the Smart Multilevel Parking system. [10]

Correa Alejandro (2021) discusses the design of a smart parking system for autonomous cars within Vehicular Sensor Networks (VSNs), utilizing a cooperative vehicular positioning network to guide autonomous cars to the best parking place and maximize the accessibility rate. [11] In 2017, Sabiya Sultana unveiled a smart parking system that uses an IOT module deployed on-site to track and indicate the availability of individual parking spaces. The author also presents a coordinated framework based on IOT for a quick and straightforward method of parking cars by determining slot availability. One of the IOT modules in the Smart Parking framework is used to monitor and indicate the accessibility of a single parking space. [12]



According to Hemant Chaudhary (2017), the car parking system's architecture and design are based on Arduino. The fundamental rule for parking a car in a parking space is the drivers or users authorization. An authorization card including the vehicle number or other information will be provided to each user. When the parking gate opens and there is room in the lot for the user to park their car, they are permitted to do so otherwise, even if they are an authorised user, they are not. A smartphone notification regarding parking will be sent to the user if their automobile is permitted to park. It not only fixes the problem of parking in cities but also protects a car from intruders.[13]

In 2019, Shruthi Mudaliar created a car parking system that effectively mitigates traffic congestion. This work has been expanded to include a fully automated system that uses the multilayer parking approach and a smart car parking system with an automated invoicing system. safety features including driver face recognition and car number tracking. Additionally, by giving each person a unique OTP and making sure they park in the designated slot, precautions have been taken to ensure that there is no malfunction or incorrect vehicle entering the allocated space [14]. The RFID tag that serves as a rechargeable parking credit card is also used to pay for the parking fee management system that Tahmidul Kabir established. In [15] Al Mamun Mizan made use of the Intelligent Parking System project, which uses a mobile application to integrate features including automated parking, parking management, position monitoring, real-time invoice creation, and a payment system. The system is extremely inexpensive to build and may function offline, allowing the owner of a parking spot to make money while helping the general public who regularly deal with a shortage of parking spaces. [16]



The automated multi-level parking garage designed by V. Padiachy demonstrates a revolutionary parking innovation technique. According to the author, parking is becoming more problematic in Fijian or urban settings because there is a shortage of suitable land. When it comes to implementing the best parking solution, a multilevel parking lot offers the greatest versatility. Though this prototype could actually be put into practice with the addition of a stronger motor for faster movement, limit switches for accuracy, bearings and appropriate materials for reduced friction, a more rigid structure for increased stability, a closed system to reduce noise pollution, and a display system to provide parking availability. [17]

M. M. Charde focused on developing a fully automated parking structure using electromagnets. Various models and algorithms are presented to address parking challenges in metropolitan areas. There is a need for improved parking systems for both two-wheelers and four-wheelers. Wire rope technology is discussed for load distribution. The project emphasizes the importance of efficient parking systems in improving traffic conditions, road safety, and the local economy. [18]. The project was examined by MD Shahnauze Ahsan, who covered the specifics of the circuit utilised in the project as well as an overview of the Automated Car Parking system's hardware. Lead screws translate rotational action into linear motion by utilising the thread's helix angle. This unique screw raising technique uses the actuator's shaft. [19]

An RFID-enabled intelligent multilevel car parking system was demonstrated by Pradeep Kumar. RFID is the most cutting-edge technology available for tracking, monitoring, and data transfer due of its tiny size, rapid data transfer rate, and combination of reed sensors, which increase system efficiency. The author also mentioned that the car parking system uses microcontrollers 89s52 and PIC16F877, both of which have been merged into a single system to reduce the number of circuits. [20]

## 2.4 The Concepts of Smart Multilevel Car Parking System with Automated Management.

A smart parking system that does away with traditional parking systems' significant space usage is a smart multilevel car park system. In addition to being totally automated, it offers extra advantages including flexibility, security, little inside

space, and less damage to vehicles. Users can halt rotation by using the Blynk iot app, which corresponds to the trolley that is assigned to the app. To drive the vehicle storage slot, the motor has a gear and chain. The system consists of a control circuit, software, and mechanical model. Because the mechanical parking system is built vertically to preserve land consumption, Nanang Ismail demonstrated that the Rotary Car Parking System is one of the efficient parking models utilised in the metropolitan area. The author talked about how the RCPS tiny control system uses fuzzy logic in conjunction with the Sugeno Inference Model. [21]

The systems come with risks such as mechanical failures, power outages, and safety hazards from potential malfunctions. It requires high maintenance and has significant initial investment costs. There are limitations on vehicle size and weight, and user errors can cause issues. Additionally, emergency access can be challenging, and the system may struggle to handle peak usage efficiently. Moreover, the height and the base of the structures played big role to maintain the structure durability. However, to maintain the durability of the system involves regular inspections and preventive maintenance, including lubricating parts, tightening bolts, and replacing worn components. Using high-quality replacement parts, keeping software updated, and providing comprehensive training for operators are essential.



## 2.5 Implementation of the Earlier Projects

### 2.5.1 Components

Assessments by Rohan Mithari centred on the PLC-based Automatic Multistoried Car Parking System. There is a single primary monitor on the bottom floor that functions as a

counter and shows the total number of cars on each story. Every slot has an infrared sensor that detects if a parking spot is available or not. An elevator is available for moving cars up and down. Lift movement is motor-controlled. LEDs are available at ground level to show the lift's position. When a car enters the parking system, the controller determines if a spot is available. For instance, the lift will park the car on a priority basis if every spot is available. When a car enters the parking system, the controller checks for an available spot. If spots are available, the lift parks the car based on priority. After the car is parked and its slot number is shown on the display, the lift returns to its starting position and the controller updates the display. To retrieve the car, the driver enters the slot number on the ground-level keyboard. The controller then signals the lift, which moves to the specified slot and retrieves the car. [22]

Qoytaba Darawshi focuses on utilizing underground spaces for parking solutions. Our research centers on implementing an automated crane mechanism within the underground parking system, optimizing space utilization and streamlining parking processes. By addressing challenges through microcontroller programming and mechanical principles, the author successfully integrated smart control algorithms and sensors to ensure safe and accurate parking procedures. This project highlights the practical application of knowledge in microcontroller technology and mechanics to enhance urban parking efficiency.[23]

### 2.5.2 Equipment

The equipment used in smart multilevel car parking systems includes various sensors, motor and mechanical component. Sensors like IR sensors, which allows one to detect an object's distance, are commonly used due to their accuracy and reliability. In the smart multilevel car parking systems, ultrasonic sensors were utilized to detect the vehicle passing by the barrier

gate for car park, while giving rfid card to the user.[24] This setup will ensure the user get their parking spot without wasting their time.

RFID stands for Radio Frequency Identification. It consists of a reader and one or more tags (transponders). RFID systems have advanced from barcodes to help automatically identify and track items and people. In the RACPS, each user gets a unique ID for their specific trolley, making it easy to identify and move. [25] The Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (6 can be used for PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, and a reset button. It has everything needed to run the microcontroller; just connect it to a computer with a USB cable or power it with an adapter or battery to start.

The linear control system manages the relay, which directly controls the motor. The trolley moves based on the motor shaft's movement, which can rotate clockwise or counterclockwise, depending on what the user needs. The system also uses RFID to manage user details and sensors. Infrared sensors are used to check if the trolleys are occupied or not.



### 2.5.3 Microcontroller

Microcontrollers are the most important component in Smart Multilevel Car Parking system, as they process the data collected from sensors and execute necessary actions, such as the movement of the trolley. Common microcontrollers include Raspberry Pi, Arduino, and ESP8266, each offering distinct functionalities and supporting various communication protocols. For example, Raspberry Pi is often used for its robust processing power and ability to handle complex algorithms and data processing tasks, as demonstrated in the study, where it was used to manage data from rfid reader and ir sensor. [25]

Arduino, known for its simplicity and ease of use, is frequently employed in projects requiring straight forward data processing and control. In the car parking system, Arduino microcontrollers were used to process data from IR sensor and trigger the stepper motor module, highlighting their role in ensuring responsive and reliable system performance. Similarly, Ankit Gupta (2019) used the ATmega328P in his project with an RFID module to provide security. Authorized users can swipe their RFID cards to gain entry [6]. These microcontrollers are essential for the effective functioning of car parking systems, as they provide the power needed to analyze sensor data in real-time and make informed decisions to ensure the safety of the car. Their ability to integrate with various sensors and communication modules makes them ideal for creating scalable and adaptable automated car parking management solutions.

## 2.6 Technology Used

The systems used in car parking systems are critical for processing sensor data and generating output based on rfid card. Each card has been programmed a fixed coding to coordinated each trolley. In her 2015 project on Rotary Automated Car Parking Systems, Chandni Patel used a standard power supply circuit to power different components. The power is distributed mainly in two ways: one part goes to the main unit, another to the relay, and another to the RFID system. This method ensures power is evenly and adequately distributed where needed. The power supply system has several stages, each performing a different task. The transformer adjusts the input line voltage and isolates the power supply from the power line. The rectifier converts the AC input signal to a pulsating DC signal. The smoothing block removes any unwanted spikes or harmonics from the signal. Finally, the regulator maintains a

constant output voltage regardless of changes in input voltage or load conditions, keeping the power supply output stable. [26].

In another study [19], an automated car parking system used a leadscrew with a helical thread to convert rotary motion to linear motion, lifting the car via the actuator shaft. Additionally, Shruthi Mudaliar designed an IoT-based smart car parking system using a combination of ultrasonic sensors, an Ethernet shield, and microcontroller technology. The Ethernet shield connects the Arduino to the internet, allowing the system to exchange data globally.

## 2.7 Comparison of Article Papers

**Table 2.1: Article comparison**

| REF No. | Technology Used | Applications | Key features | Future Works |
|---|---|---|---|---|
| [1] | Infrared Sensor (IR), LCD Display, Arduino UNO. | GIS-based advanced traveler information | This system will help in the space utilization of the parking lots and help in saving the time | This system could be handy in managing smart cities, especially for folks with jam-packed schedules. |
| [2] | Mathematical method, The equilibrium values of travel time (T) and cruising time (C) | Curve side parking | To free up space in the market for curbside parking spots. | The stability of various equilibria |
| [3] | Yellow Pipe Barrier, Touch Screen Display, Photo - Electric Sensor, RE-PARK Logic, | Multilevel car parking | Optimization of space, comfort for drivers, and reduced traffic congestion. | Add more options in the car parking system like priority based parking |

| | | | | |
|---|---|---|---|---|
| | Safety Lock, Anti - Corrosive Platform | | | according to park time. |
| [4] | Typology Method (analysis or classification based on types or categories) | Off-street parking policy in Asian cities | To developed a typology of parking policy approaches, which includes conventional, parking manage ment, and market-oriented categories. | More research is needed into the effects of parking regulations in practice |
| [5] | Hybrid Artificial Bee Colony algorithm (ABC) | A Sustainable Road Network Design Problem with Land Use Transportation Interaction over Time | To solving transit network design problems. To solve proposed BI-level problem, where ABC is used to solve the upper level problem | One can incorporate into the proposed bi-level framework in future studies |
| [6] | LCD, 89S52 microcontroller, dc motors, Infra-red sensor, RFID card and RFID card reader | Automatic Multilevel Car Parking | To enables the parking of vehicles and thus reduces the time taken to check the space to be used by displaying the spot where the space for parking is available on an LCD display by using IR sensors at the entrance. | Adding vertical parking space can reduce the parking space and increase the amount parking slot. |
| [7] | Arduino Mega 2560, LCD, IR sensors, RFID card and RFID card reader. | Automatic Car Parking system using RFID | To efficiently utilize space and improve parking security and payment processes. | By using GSM technology, the system is integrated with GSM module so that when a user requests for the details related to the available slots, the system will send a SMS text message to the user |
| [8] | Control System, PLC, Sensor Rotary Encoder. | Low Vertical Car Parking Automatic Control System Using Programmable Logic Control | To lead to the reduction of the effective carriageway from four to three lanes. | More options in the car parking system like priority based parking according to park time |

| | | | | |
|---|---|---|---|---|
| [9] | Structural designing, Analysis, Seismic, STADD Pro Programming tools, Auto Cad | Multi Storey Sleeve Car Parking With Stadd Pro. | To provide safe and easily accessible area for parking. To minimize the traffic load due to parking of vehicle in no parking zone. | Give a technical solution for the traffic congestion problem and proper plan and design of multi storey parking |

# CHAPTER 3

# METHODOLOGY

## 3.1 Introduction

The methodology of this section consists of three major steps to implement the project starting from planning, implementing and testing. The description of the hardware and details of the circuits used in this project are provided. This innovative system aims to enhance the safety of the user vehicle and security by utilizing the vertical parking space. The methodology are designed to address the specific requirements of multilevel car parking, focusing on the combination of various electronic components and mechanical parts. Each step of the process are planned with much detail and executed to ensure the reliability, safety and efficiency of the system. By detailing the technical and procedure aspects of the project, this section provides an overview of the method used to achieve the project's objectives and demonstrates the practical applications on real life.

### 3.2 Block diagram/ System architecture

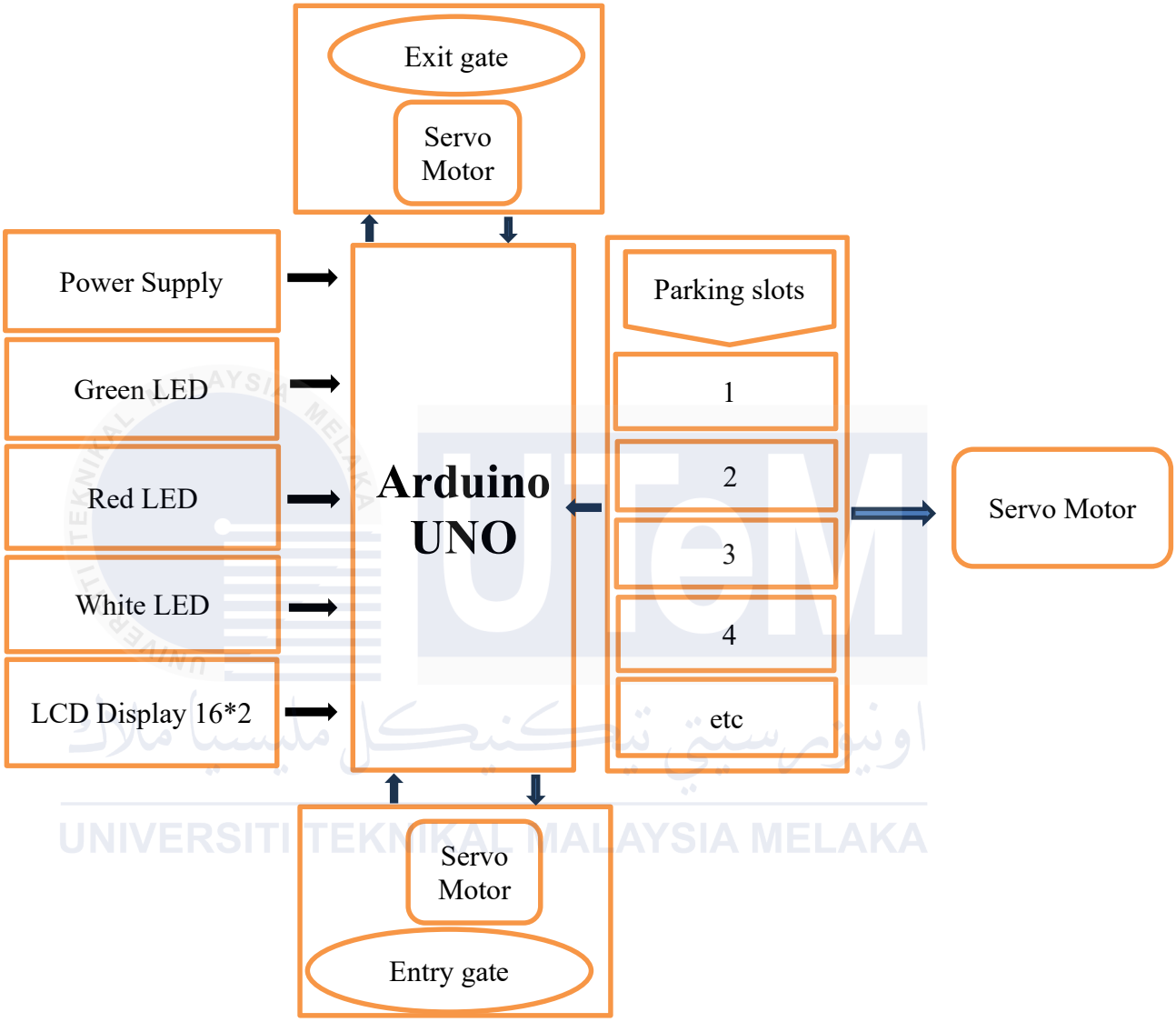


**Figure 3.1: System block diagram**

**Figure 3.2: System architecture**

## 3.3 System Flowchart

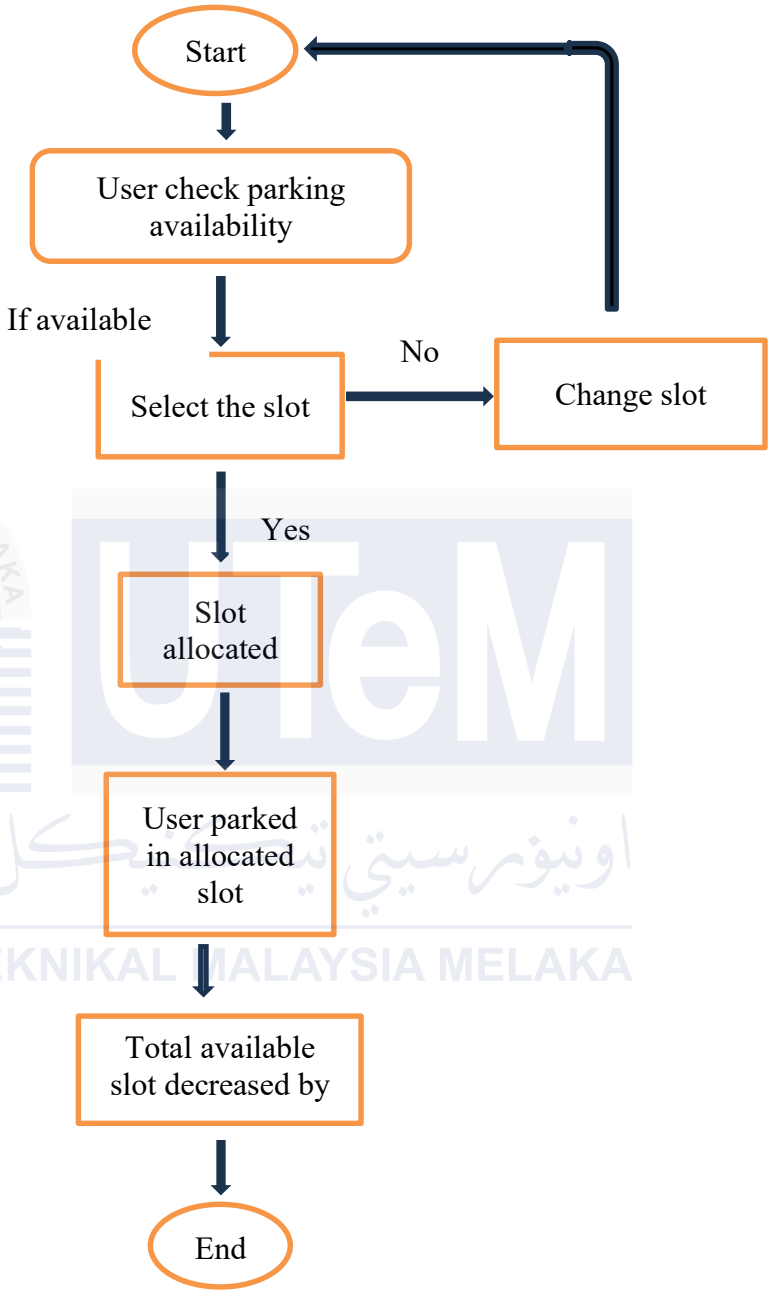


**Figure 3.3: System flowchart**

## 3.4 Hardware setup

### 3.4.1 Servo Motor

The system initiates by setting up the Blynk IoT app, IR sensor, LCD and servo motor, with the IR sensor constantly scanning for the presence of an object, such as a vehicle or person. When user use the app, then the signal transmitted to the Arduino. If the slot is available and the IR sensor detects the presence of an object, the Arduino instructs the servo motor to move the platform, performing an action such as opening a gate or parking slot. This dual-validation mechanism ensures that the servo motor only activates when specific requirements are met, preventing unauthorised accessed and ensuring that the gate only operates when needed. Figure 3.5 shows the sequence of the systems.



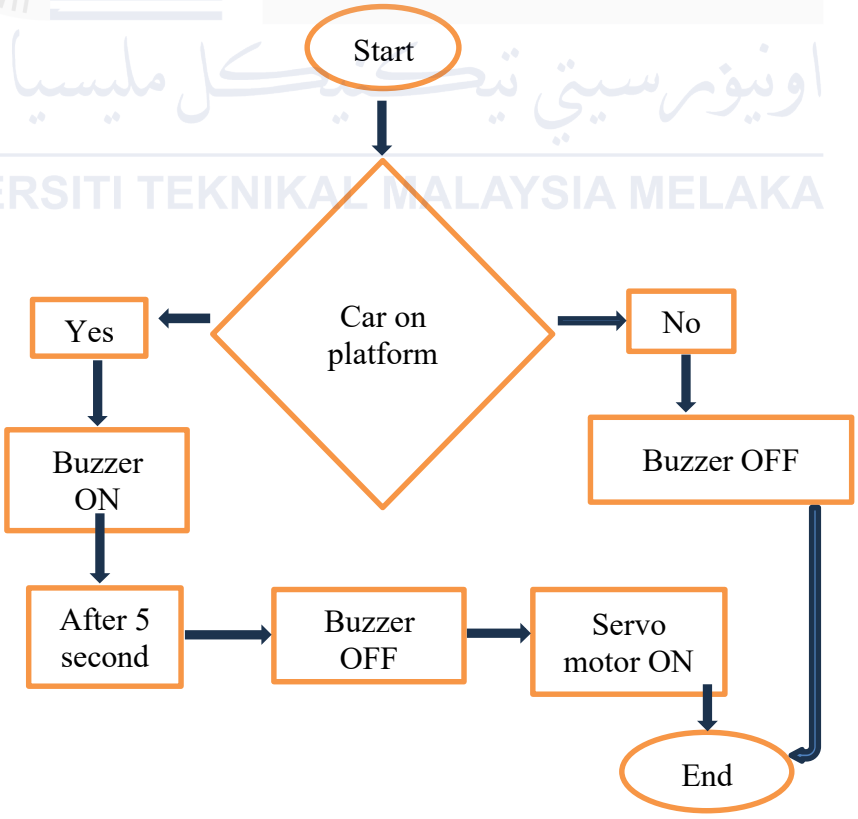


**Figure 3.4: Servo motor flow chart**

## 3.5 Software setup

### 3.5.1 Arduino IDE

The Arduino IDE plays an important role in developing and operating a smart multilevel car parking system that utilises Blynk IoT, RFID, IR sensors, and servo motors, considering that it offers a user-friendly platform for coding, compiling, and uploading programmes to the Arduino board. It simplifies integration by providing libraries for Blynk IoT app, infrared sensors, and servo motors, as well as real-time debugging and testing via the Serial Monitor. This allows developers to create, customise, and deploy integrated systems for vehicle identification, presence detection, and gate control. The IDE flexibility and ease of use enable quick modifications and maintenance, ensuring that the system remains reliable and adaptable to specific requirements.


**Figure 3.5: Arduino coding page**

### 3.5.2 Proteus 8

Proteus, as a simulation software, works alongside the Arduino IDE to develop and test complex systems such as multilevel car parking. Engineers and developers can design and simulate the entire system virtually before deploying it in the real world. Proteus allows users to describe the actions of electronic components, simulate interactions between hardware modules, and debug system functionality in a virtual environment. This capability improves the development process by allowing for rapid prototyping, troubleshooting, and efficiency of the parking system's operation. Furthermore, Proteus supports collaboration among team members by providing a platform for sharing and reviewing designs. Using Proteus and the Arduino IDE together allows users to streamline the development process, reduce errors, and ensure the reliability and efficiency of the final result.

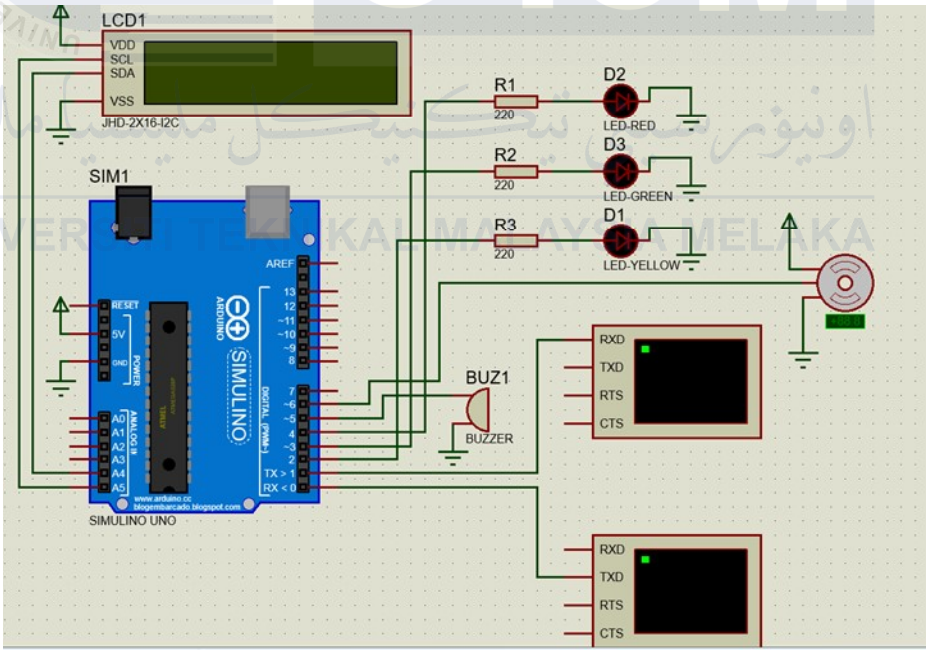


**Figure 3.6: Proteus simulation with RFID, servo motor and other electronic component**

# CHAPTER 4

# RESULTS AND DISCUSSIONS

## 4.1 Introduction

This section presents the initial findings from our smart multilevel car parking system, which improve the efficiency of managing parking spaces. Our system connected to Arduino boards to enable the systems operate smoothly. These motors were individually tested to ensure accuracy and reliability. The collected data was then recorded in the table for system analysis.

Through initial testing and simulation, we have successfully demonstrated the core functionalities of the parking system. These include RFID tag detection for vehicle identification, and servo motor control for the slot available. The attainment of these fundamental functionalities in the simulated environment signifies a promising start to the project, laying a solid groundwork for further development and optimization. This introduction to the results highlights the achievement of key objectives and sets the stage for more comprehensive testing and refinement in subsequent phases of the project.

## 4.2 Results and Analysis

**Table 4.1: Result of the simulation in Proteus software**

| Case | RFID Tag | RFID Reader | Servo Motor |
|---|---|---|---|
| 1 (ABC123) | ABC123 | PASS | ON |
| | DEF456 | INVALID | No respond |
| | GHI789 | INVALID | No respond |
| 2 (DEF456) | ABC123 | INVALID | No respond |
| | DEF456 | PASS | ON |
| | GHI789 | INVALID | No respond |
| 3 (GHI789) | ABC123 | INVALID | No respond |
| | DEF456 | INVALID | No respond |
| | GHI789 | PASS | ON |



1. Technical Analysis

- System Design for Layout, dimensions, and levels of the parking structure.

**Table 4.2: Physical Analysis**

| | |
|---|---|
| **Dimensions** | The dimension increased vertically which affected the height only. The length and width of the base remain same. |
| **Levels** | The building levels affected by the number of parking slot. |

- Power Source and Energy requirements.

  Energy requirement to operate the project are low. 5VDC are enough to operate 4 servo motor.

- Maintenance

  Chain lube.

2. Environmental Impact

- Space Efficiency

  Traditional parking need more land usage than this project which only require 3 slot for 9 car park.

- Energy Consumption:

  Low energy consumption.

- Carbon Footprint

  Emission reductions due to optimized traffic flow and reduced idling

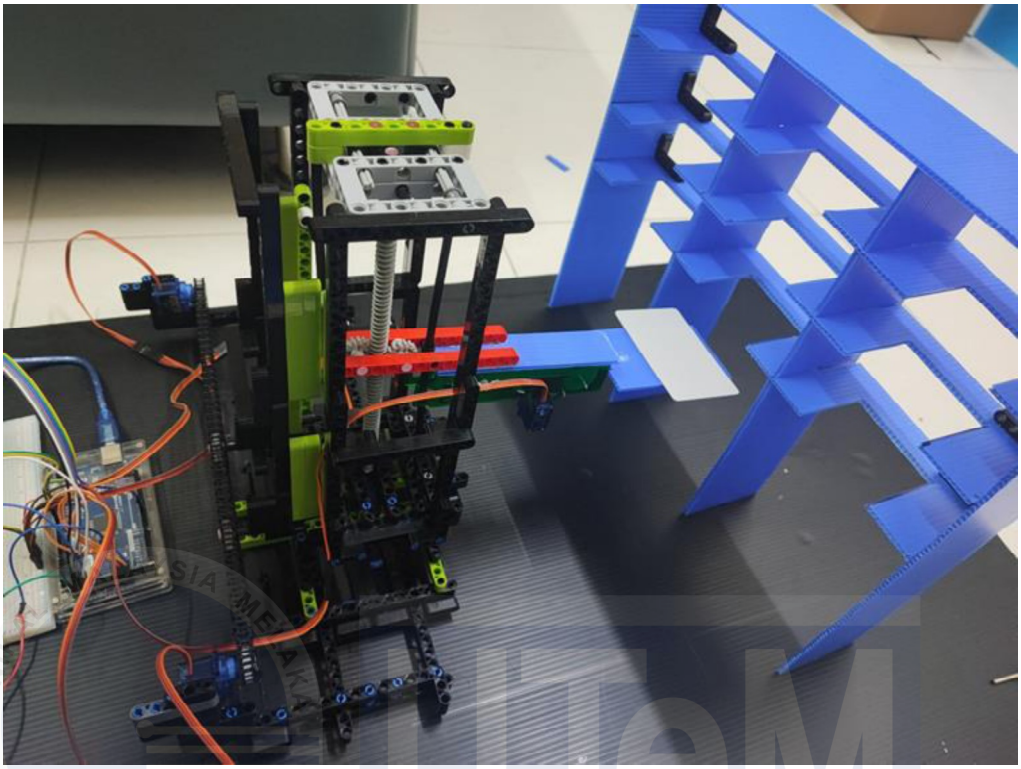

**Figure 4.1: The car at the bottom waiting for RFID to be scan**

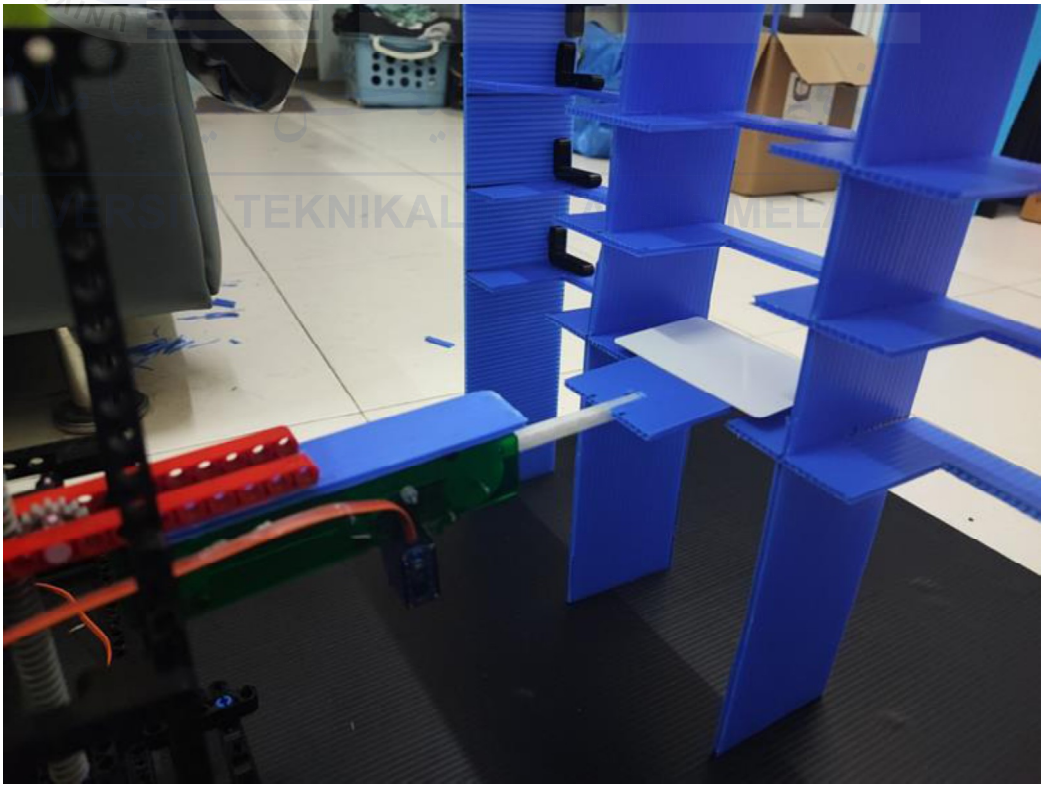

**Figure 4.2: The arm extend to the parking slot**

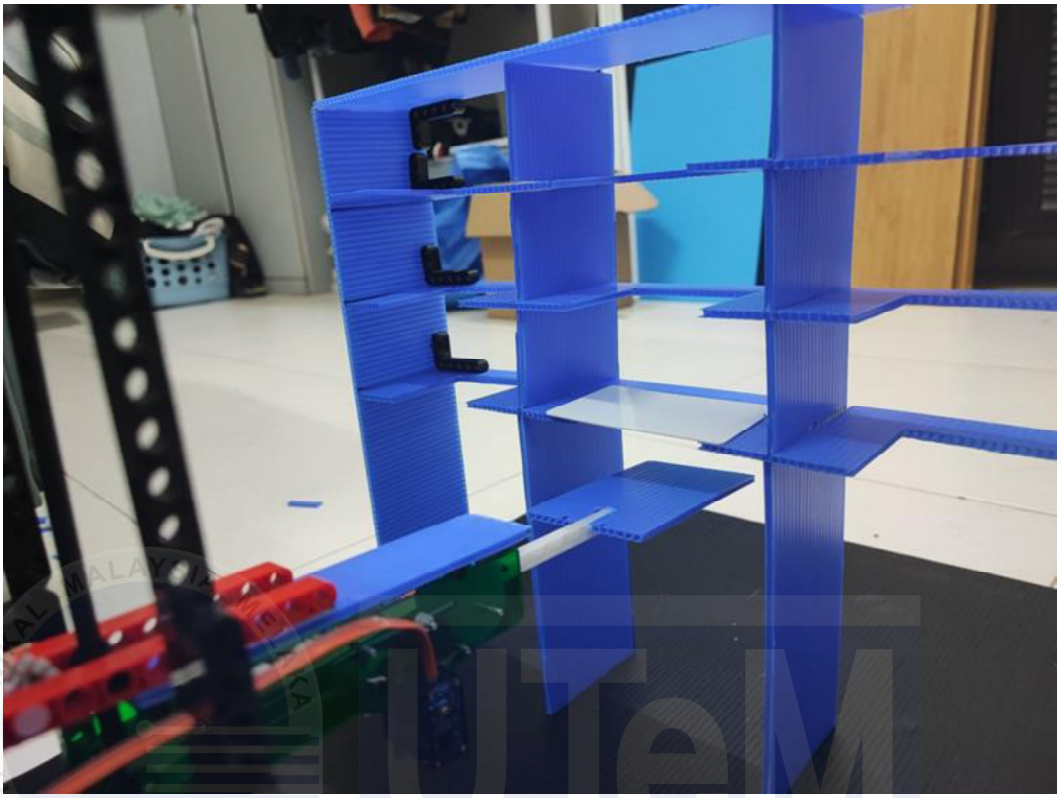

**Figure 4.3: The car successfully land on the parking slot**

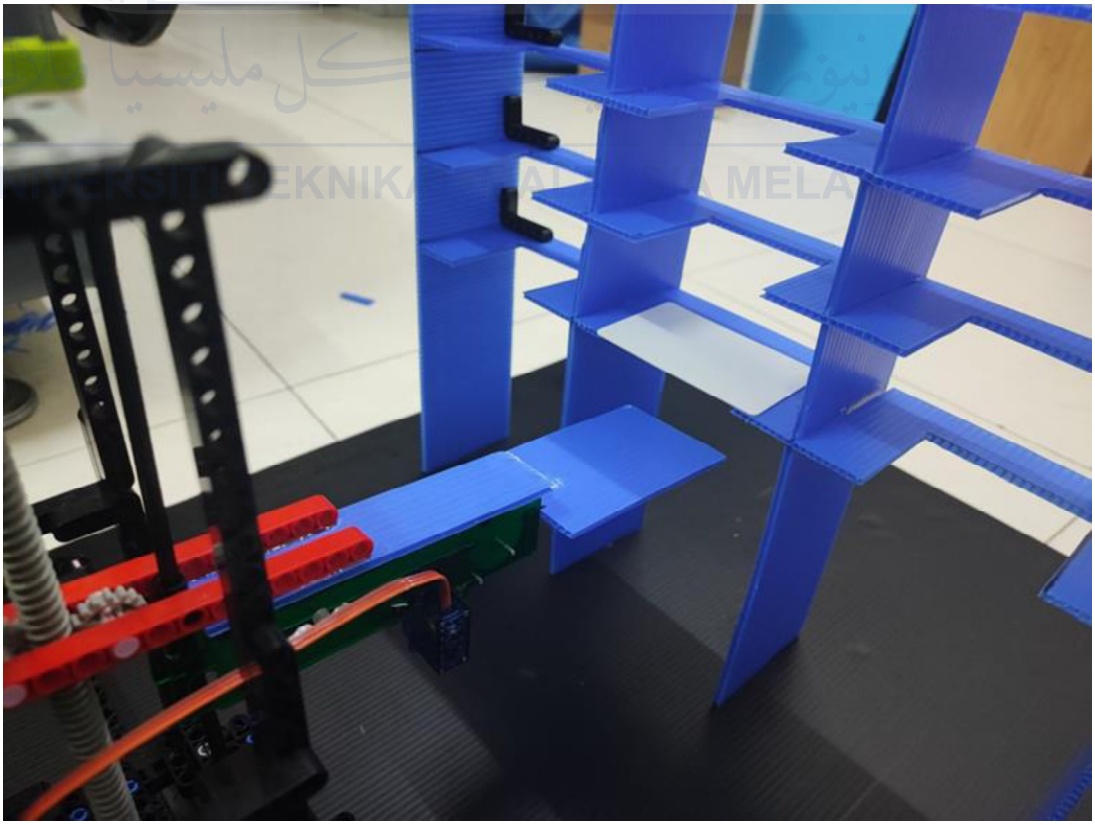

**Figure 4.4: The arm retract back to initial position**

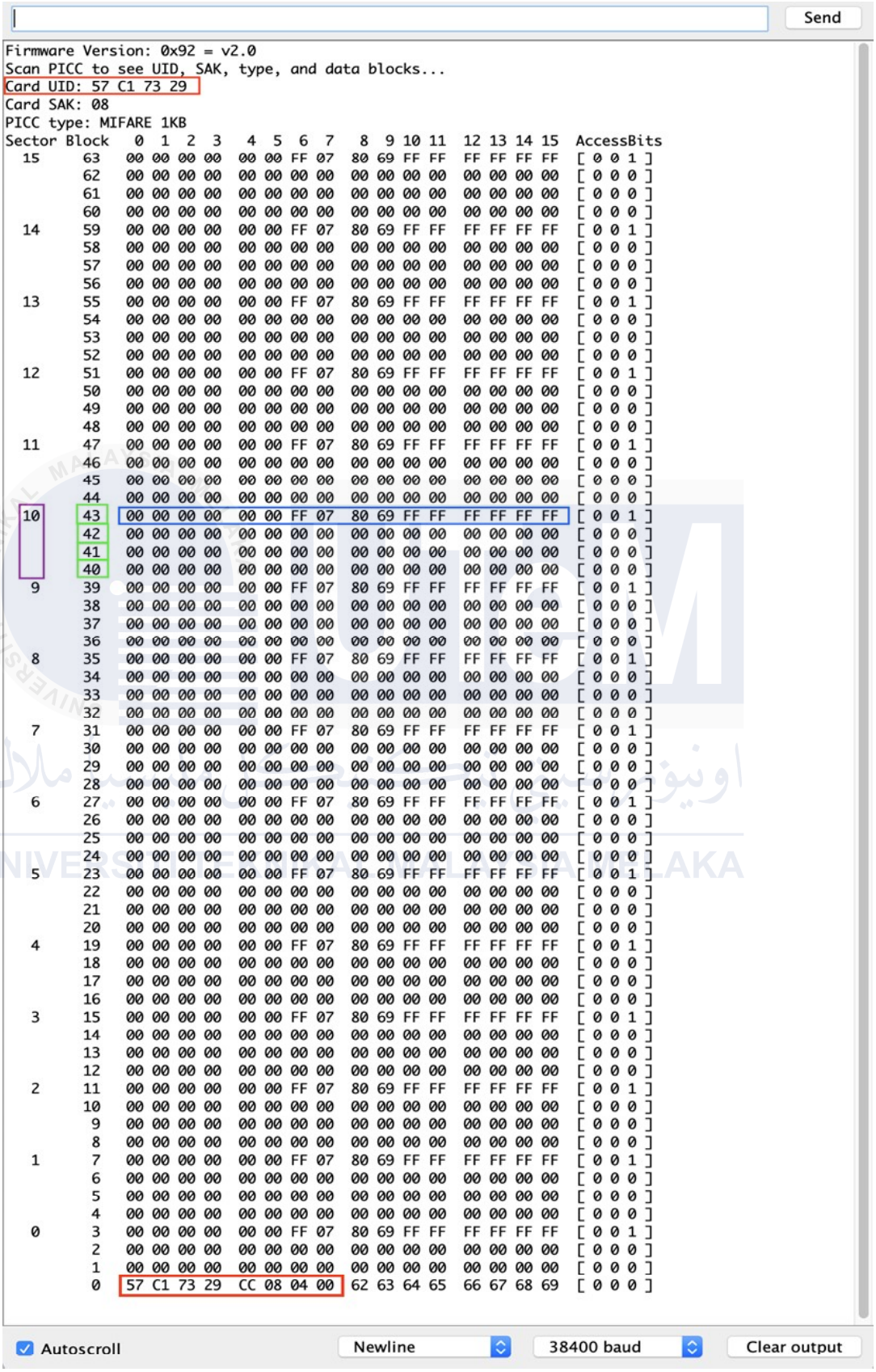


**Figure 4.5: RFID UID**

## 4.3 Circuit Diagram

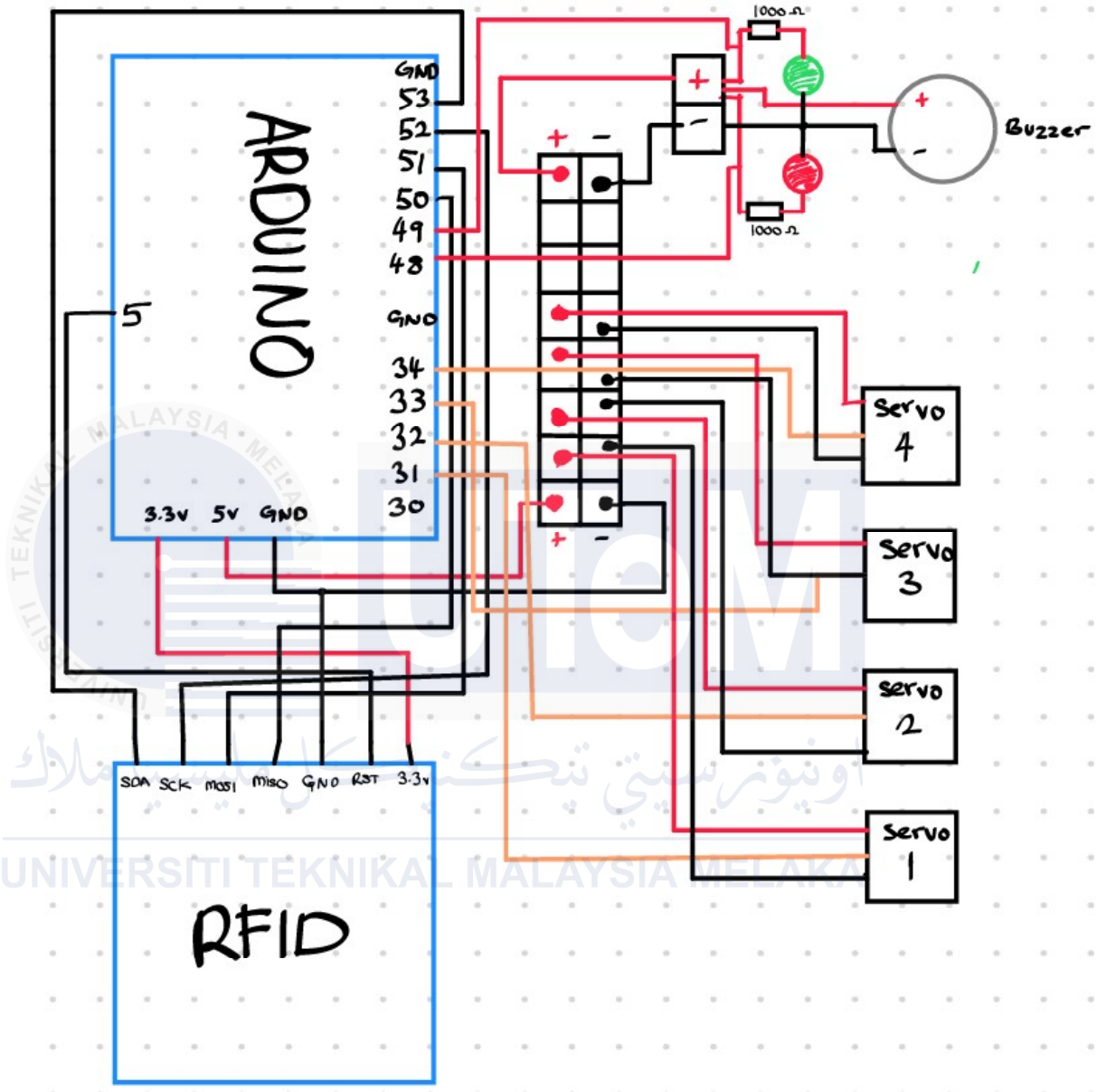


**Figure 4.6: Completed circuit**

## 4.4 Summary.

The results of the smart multilevel car parking system show promising developments in achieving core functionalities. Through testing and simulation, the system successfully detects RFID tags for vehicle identification. Additionally, servo motors are successfully controlled to manage gate mechanisms using validated inputs. These results provide a solid foundation for the project's future development and optimisation. Moving forward, more testing and refinement will be done to improve the systems reliability and efficiency in future. Overall, the results support the integrated systems feasibility and effectiveness in automating access control and optimising space utilisation in multilevel parking systems.

# CHAPTER 5

# CONCLUSION

## 5.1 Conclusion

In conclusion, the development of a multilevel car parking system involving electronic component, microprocessor and mechanical part demonstrates great promise in achieving the results. The results of our project indicate successful integration and functionality of key components such as RFID tag detection and servo motor control mechanisms. These results validate the systems feasibility and potential to improve parking management in urban areas. Furthermore, additional testing, optimisation, and real-world implementation will be required to ensure the systems reliability and scalability. With additional improvements, the multilevel car parking system has the potential to transform parking infrastructure by providing a streamlined and convenient solution for drivers while maximising space utilisation and improving security.

Overall, the Proteus software developed in this project offers a structured approach for path planning and execution on smart multilevel car parking system, contributing to enhanced automation and precision in the processes. The successful implementation of this workflow signifies a step towards the future. The attainment of these fundamental functionalities in the simulated environment signifies a promising start to the project, laying a solid groundwork for further development and optimization. This preliminary results highlights the achievement of key objectives

and sets the stage for more comprehensive testing and refinement in subsequent phases of the project.

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# APPENDICES

## Appendix A : Arduino IDE Full Coding

```
#include <SPI.h>
#include <MFRC522.h>
#include <Servo.h>
#include <Adafruit_PWMServoDriver.h>

#define SS_PIN 53
#define RST_PIN 5
#define LED_G 49 //define green LED pin
#define LED_R 48 //define red LED
#define BUZZER 30 //buzzer pin
MFRC522 mfrc522(SS_PIN, RST_PIN);   // Create MFRC522 instance.
Servo Servo1;
Servo Servo2;
Servo Servo3;
Servo Servo4; //define servo name

void setup()
{
  Serial.begin(9600);   // Initiate a serial communication
  SPI.begin();      // Initiate  SPI bus
  mfrc522.PCD_Init();   // Initiate MFRC522
  Servo1.attach(31);
  Servo2.attach(32);
  Servo3.attach(33);
  Servo4.attach(34); //servo pin
  Servo1.write(90);
  Servo2.write(90);
  Servo3.write(90);
  Servo4.write(90); //servo start position
  pinMode(LED_G, OUTPUT);
  pinMode(LED_R, OUTPUT);
  pinMode(BUZZER, OUTPUT);
  noTone(BUZZER);
  Serial.println("Put your card to the reader...");
  Serial.println();

}
void loop()
{
  // Look for new cards
  if ( ! mfrc522.PICC_IsNewCardPresent())
```

```
  {
    return;
  }
  // Select one of the cards
  if ( ! mfrc522.PICC_ReadCardSerial())
  {
    return;
  }
  //Show UID on serial monitor
  Serial.print("UID tag :");
  String content= "";
  byte letter;
  for (byte i = 0; i < mfrc522.uid.size; i++)
  {
     Serial.print(mfrc522.uid.uidByte[i] < 0x10 ? " 0" : " ");
     Serial.print(mfrc522.uid.uidByte[i], HEX);
     content.concat(String(mfrc522.uid.uidByte[i] < 0x10 ? " 0" : " "));
     content.concat(String(mfrc522.uid.uidByte[i], HEX));
  }
  Serial.println();
  Serial.print("Message : ");
  content.toUpperCase();
  if (content.substring(1) == "33 E0 26 AD") //change here the UID of the
card that want to give access
  {
    Serial.println("Authorized access");
    Serial.println();
    delay(500);
    digitalWrite(LED_G, HIGH);
    tone(BUZZER, 500);
    delay(300);
    noTone(BUZZER);

    Servo3.write(0); // 1. up
    delay(10000);
    Servo3.write(90); //stop
    delay(1000);

    Servo1.write(150); // 2. kanan
    Servo2.write(150); //    bergerak sekali
    delay(1500);
    Servo1.write(90); // stop serentak dengan servo2
    Servo2.write(90);
    delay(1000);

    Servo4.write(150); // 3. depan belakang?? nanti ubah balik 150 atau 0
    delay(28000);
```

```
    Servo4.write(90); // stop
    delay(1000);

    Servo3.write(150); // 4. down
    delay(4000);
    Servo3.write(90); // stop
    delay(1000);

    Servo4.write(0); // 5. depan belakang?? nanti ubah balik 150 atau 0
    delay(28000);
    Servo4.write(90); // stop
    delay(1000);

    Servo1.write(0); // 6. kiri
    Servo2.write(0); //    bergerak sekali
    delay(1500);
    Servo1.write(90); // stop serentak dengan servo2
    Servo2.write(90);
    delay(1000);

    Servo3.write(150); // 7. down pergi ke initial place
    delay(6000);
    Servo3.write(90); // stop
    delay(1000);

    //Servo2.write(90); // servo?? mesti ada stop ni
    //delay(3000); // dan delay ni

    digitalWrite(LED_G, LOW);
  }

 else   {
    Serial.println(" Access denied");
    digitalWrite(LED_R, HIGH);
    tone(BUZZER, 300);
    delay(1000);
    digitalWrite(LED_R, LOW);
    noTone(BUZZER);
  }
}
```