Faculty of Electronic and Computer Technology and Engineering

DEVELOPMENT OF SOLAR POWER GRASS CUTTER USING ARDUINO FOR LAWN MAINTENANCE

RIESHIKESAN A/L MURALEE

Bachelor of Computer Engineering Technology (Computer System) with Honours

2024

DEVELOPMENT OF SOLAR POWER GRASS CUTTER USING ARDUINO FOR LAWN MAINTENANCE

RIESHIKESAN A/L MURALEE

A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Computer Engineering Technology (Computer Systems) with Honours

Faculty of Electronic and Computer Technology and Engineering

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DEDICATION

With profound appreciation and sincere gratitude, would like to thank my family who's support have made this academic journey more meaningful. I extend my deepest thanks to my Final Year Project Supervisor TS.DR.HASRUL 'NISHAM BIN ROSLY for the guidance, expertise, and invaluable insights throughtout this journey. Beyond thankful to everyone who was with me this far to complete this thesis,

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ABSTRACT

Rising worries regarding climate change and pollution require the development of environmentally friendly and sustainable technologies. This project entails the development and enhancement of a solar-powered grass cutter, which is operated by an Arduino microcontroller. The objective is to encourage more environmentally friendly methods of maintaining lawns. The main goals consist of developing a solar-powered system, programming an Arduino microcontroller for self-directed movement and operation, and evaluating the effectiveness of solar energy in operating the grass cutter. The process involves a methodical approach, starting with the development of a flowchart for the system, and subsequently programming the Arduino microcontroller. The core of the development process is in the selection and assembly of components for constructing the circuit. The grass cutter utilizes solar energy, effectively converting it to power the device, which consists of a blade cutter for trimming grass and an ultrasonic sensor for detecting and avoiding obstacles. The key findings indicate that the solar panel efficiently replenishes the battery, guaranteeing continuous functionality. The ultrasonic sensor effectively identifies and avoids obstructions, while the blade cutter efficiently trims the grass, showcasing the system's operational efficiency. The initiative highlights substantial environmental advantages, particularly in the reduction of air and noise pollution and its contribution to climate change mitigation. The creation of this solar-powered grass cutter signifies a significant progression in environmentally friendly technology, providing a sustainable substitute for conventional lawn care techniques.

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ABSTRAK

Kekhawatiran yang semakin meningkat mengenai perubahan iklim dan pencemaran memerlukan pembangunan teknologi yang mesra alam sekitar dan berkelanjutan. Projek ini melibatkan pembangunan dan peningkatan pemotong rumput bertenaga solar, yang dikendalikan oleh mikrokontroler Arduino. Tujuan ialah untuk menggalakkan kaedah yang lebih mesra alam sekitar untuk mengekalkan rumput. Matlamat utama terdiri daripada membangunkan sistem bertenaga solar, merancang mikrokontroler Arduino untuk pergerakan dan operasi sendiri, dan menilai keberkesanan tenaga solar dalam mengendalikan pemotong rumput. Proses ini melibatkan pendekatan metodikal, bermula dengan pembangunan carta aliran untuk sistem, dan kemudiannya pemrograman mikrokontroler Arduino. Inti proses pembangunan terletak dalam pemilihan dan perhimpunan komponen untuk membina rangkaian. Pemotong rumput menggunakan tenaga solar, secara berkesan menukarkannya untuk memberi kuasa kepada peranti, yang terdiri daripada pemotong pisau untuk pemotongan rumput dan sensor ultrasonik untuk mengesan dan mengelakkan halangan. Temuan utama menunjukkan bahawa panel solar secara berkesan mengisi semula bateri, menjamin fungsi berterusan. Sensor ultrasonik secara berkesan mengenal pasti dan mengelakkan halangan, manakala pemotong pisau secara cekap memotong rumput, menunjukkan kecekapan operasi sistem. Inisiatif ini menyoroti faedah alam sekitar yang ketara, terutamanya dalam pengurangan pencemaran udara dan kebisingan dan sumbangan kepada pengurangan perubahan iklim. Penciptaan pemotong rumput bertenaga solar ini bermakna kemajuan yang signifikan dalam teknologi ramah alam sekitar, menyediakan pengganti yang berkelanjutan untuk teknik penjagaan rumput konvensional.

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CHAPTER 1

INTRODUCTION

1.1 Project Background

Arduino will serve as the control system for the solar-powered grass cutter for lawn maintenance that this project seeks to create. Traditional grass cutters frequently utilize engines powered by gasoline, resulting in environmental degradation and dependence on non-renewable resources. Using solar energy and an Arduino-based control system, the project seeks to develop a sustainable and environmentally friendly solution for lawn care.

Solar energy is a pure and renewable energy source that can be utilized to power the grass cutter. Using solar panels, the system will convert sunlight into electricity, supplying the lawn cutter with the necessary power to operate. This contributes to a greener and more sustainable approach to lawn care by reducing reliance on fossil fuels and greenhouse gas emissions.

The Arduino microcontroller will serve as the system's brain, regulating the grass cutter's various components and functions. It will monitor and regulate the power supply, manage the overall operation of the machine, and control the cutting blades. Arduino will be used to construct the required control logic and algorithms for efficient and effective grass cutting.

The design and integration of solar panels, a power management system, motor control mechanisms, and safety features will be required for the development of a solar powered grass trimmer. In addition to implementing safety measures to protect users and prevent accidents, the system will be optimized to guarantee sufficient power supply for the grass cutter's operation.

The initiative will also concentrate on the design and engineering of the grass cutter, taking consideration on manoeuvrability, cutting efficiency, and usability. It will include prototyping, testing, and iterative enhancements to ensure a functional and user-friendly lawn maintenance solution.

By creating a solar-powered grass cutter with Arduino, this project hopes to promote sustainable lawn care practices, reduce environmental impact, and offer an alternative to traditional grass cutting machines. The system's reliance on renewable energy and its efficient operation will contribute to a greener and more sustainable future, addressing increasing concerns about climate change and resource depletion.

1.2 Problem Statement

Traditional grass cutters require a lot of energy from the person using it, so they require a lot of hard work. This makes people tired, slows them down, makes them hard to get to, and puts their safety at risk. Larger areas may be hard for operators to cover in a fair amount of time, which could slow down progress and make the quality of the grass cutting less consistent. Also, people with limited physical strength or mobility problems may not be able to take part in lawn care activities because of the physical demands. This makes it harder for everyone to get involved and participate. Besides that, the high amount of energy needed from the operator makes it more likely that something will go wrong, or someone will get hurt while cutting grass, because the operator may get tired and lose control of the machine.

Moreover, traditional grass cutter uses gasoline, which pollutes the environment and creates noise. Gasoline burning results in air pollution and greenhouse gas emissions, which have an impact on climate change. Additionally, gasoline-powered grass cutter machines make a lot of noise, disturbing people in their homes and in public areas. For a sustainable future, it is essential to address these concerns.

Furthermore, the use of battery-powered grass cutters without solar panels should be fix because even though the machines that run on batteries have some benefits over ones that run on gasoline, there are still some problems with using it. Grass cutters that run on batteries but can't be charged by the solar usually have a short battery life. This limits how long the machine can be used before the battery needs to be charged or replaced. This slows down the process of cutting grass and makes it less efficient. Battery-powered grass cutters can't be charged using solar energy, so they must use electricity to recharge. This reliance on outside power sources can be inconvenient, especially in remote areas or when the power goes off, making grass-cutting activities less available.

Traditional grass cutters result in a lack of energy, decreased productivity, and safety risks, excluding those with mobility impairments. Both gasoline and battery powered grass cutters contribute to air pollution, noise pollution, and limited battery life. It is essential to address these issues in order to develop solutions that are efficient, environmentally favourable, and accessible.

1.3 Project Objective

The aim of this project is to develop an Arduino-powered solar-powered grass cutter for efficient and sustainable lawn maintenance. The project aims to achieve the following specific objectives:

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i. To design and develop a solar powered grass cutter system.
ii. To program an Arduino microcontroller to manage the grass cutter system movement, sensors and cutting operation.
iii. To analyse the use of solar energy in a grass cutter system.

1.4 Scope of Project

The project's overall objective would be developing an Arduino-powered solar powered grass cutter for efficient and sustainable lawn maintenance. The scope of this project are as follows:

i. Designing a grass cutter machine powered by solar energy.

ii. Integrating an Arduino-based control system for operation.

iii. Programming an Arduino microcontroller for managing the grass cutter’s operation.

iv. Incorporating safety features and user-friendly controls.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Maintaining grass and other green areas in good shape is an important part of making places look nice and well-kept. Traditional grass cutters have been used for a long time to take care of lawns, but they often require a lot of human energy or gasoline, which makes them less efficient, bad for the environment, and hard to obtain towards. In recent years, there has been a greater interest in finding ways to take care of lawns that are both environmentally friendly and cost-effective. Arduino is an open-source electronics tool that can be used to make control systems that can be programmed. This could be used to make a solar-powered grass cutter. Solar-powered grass cutters have many benefits over traditional ones because they use the power of the sun and have more advanced control technologies. This review will specifically look at the problems with traditional grass cutters, the advantages of using solar power to take care of lawns, and the ways in which Arduino-based control systems can improve efficiency and usefulness. The review will look at how long grass affects fields, like how it looks, how it attracts weeds, pests, and venomous animals, and how it cuts down on air flow. It will also look at the problems with standard grass cutters, like how hard they are to use, how they hurt the environment, how hard they are to get to, and how much it costs to keep them running. Also, the literature study will focus on the benefits of solar power for cutting grass, including how it is renewable and sustainable, how cheap it is, and how little of an impact it has on the environment. When solar energy is used to power grass cutters, gasoline is no longer needed. This cuts down on greenhouse gas emissions and air pollution. This review will also look at how Arduino technology can be used in solar-powered grass mowers.

Arduino-based control systems offer exact control over cutting mechanisms, efficient energy management, safety features, and the ability to be automated and customised. This review aims to give useful information about the development of solar-powered grass cutters that use Arduino for efficient and environmentally friendly lawn care by analysing the current literature and research. The results of this review will help us understand the possible benefits, challenges, and opportunities of this new way of doing things. They will also lay the groundwork for future study and development in the field.

2.2 Past Related Project Research

Several articles state that the authors effectively illustrated their framework in the research. Several studies and initiatives on the Development of a Solar Power Grass Cutter with Arduino for Lawn Maintenance have been reported as follows:

1. Arduino Based Solar Operated Grass Cutter[1].
2. Development of Microcontroller Based on Solar Grass Cutter[2].
3. Structure of a Smart Grass Cutter Based on Solar Power[5].
4. Design of remote monitored solar powered grasscutter robot with obstacle avoidance using IoT[7].

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2.2.1 An Autonomous Grass Cutting Revolution with Arduino Technology

The use of solar energy as an alternative energy source has existed for a very long time but has been utilised for fewer applications due to the prevalence of other energy sources. Solar energy is the process of capturing the sun's radiant light and heat using a variety of technologies that are constantly evolving, such as solar thermal energy and photovoltaics. Depending on how the energy is converted to solar power, these technologies are broadly classified as either passive solar or active solar. Due to the efficacy of these technologies, solar energy has become a significant source of renewable energy, allowing for the expansion of its wide range of applications. Today, the world's power consumption is shifting from conventional energy sources such as fossil fuels and biomass fuels to solar energy. Awareness of fossil fuel pollution and its contribution to global warming, as well as the fact that fuel energy is non-renewable and unsustainable, led to a shift in energy consumption patterns[12]. The depletion of conventional energy sources has also increased the significance of nonconventional energy sources. Fossil fuel has been the primary source of non-renewable energy in all developing countries. When we import fuel, there is always a tendency for the price of fuel to rise. This hinders the development of the nation and causes economic instability. Lawn maintenance is the art and profession of maintaining a healthy, clean, secure, and aesthetically pleasing lawn, typically in a garden, park, or estate.

The project details a solar-powered and microcontroller-operated field cutter. This initiative primarily reduces labour and energy consumption. Extreme power point monitoring is utilised to improve the efficiency of solar panels. The DC will DC buck boost converters increase the DC voltage produced by the photovoltaic panel and store it in a battery. It's an automated system designed for grass mowing. Using photovoltaic panels, the source is derived from the sun's energy[3]. The DC-DC converter is utilised to convert low-level DC voltage to high-level DC voltage. High DC voltage is required for the operation of the entire apparatus. Sensors and microcontrollers are employed to accomplish automation. Using dc motors, wheels and cutting operations are operated[6]. The system is powered and operates in reserve mode using a DC battery. The developed prototype can be operated in two modes: automatic mode and remote mode[4]. In manual mode, the cutter is controlled with a Bluetooth-connected remote controller[9].

2.2.2 Smart Solutions for Lawn Maintenance

This paper, entitled Solar-Powered Grass Cutter, occupied less space and weigh less because it is powered by a non-conventional energy source, resulting in zero operating costs. It has the ability to charge the battery while the lawn cutter is in operation. The price of a solar-powered lawn cutter will be less than that of a conventional grass cutter. In order to maintain a neat and uniform lawn in schools, gardens, and playgrounds, grass cutters are utilised. The Arduino Nano microcontroller is the system's brain and controls all functions[18]. The system is operated using solar energy[19]. The solar panel converts the sun's energy into a charge for the connected battery[2]. The microcontroller controls the robotic lawn cutter cart[11]. It has two modes of operation. One of it is auto mode and another is remote mode[13]. The cart contains three motors, one for rotating a cutter blade and the other two for propelling the cart. The cart can travel forward, backward, to the left or to the right. A switch is available to select between these modes. In automatic mode, the operation of the field cutter is automated entirely automatic. It is controlled by the microcontroller's stored programme. As soon as this mode is selected, the cart advances forward and the grass cutter motor is activated. The microcontroller is connected to the ultrasonic sensor HCSR04 for obstacle detection[1][16]. The obstruction detection distance is 35cm, which means that when an obstacle is 35cm away, the cart automatically stops moving forward and rotates to the right. Thus, the cart cuts the vegetation throughout the entire area. No manual intervention is necessary. A PIR sensor (HC-SR501) is also connected to the microcontroller in order to detect nearby humans and animals. When a person or animal is detected, the microcontroller turns off the motor, preventing any damage or accident. After a delay, the microcontroller resumes normal operation by turning on the cutter motor. A driver IC L293D connects the DC motors that propel the vehicle to one another. Since the microcontroller cannot provide the necessary current to operate the motor, these drivers are utilised to increase the driving current[10]. The name of the project and the detected distance of obstacles are both displayed on an LCD screen. In addition, it displays the mode of operation, such as automatic or remote. The motor of the cutter is controlled by an electromagnetic relay[20]. This relay is controlled by BC547 transistor via microcontroller. In remote mode, the trolley is moved manually using a mobile device. Downloading the app Arduino RC from the play store on a mobile device enables remote control of the cart. After installing the app, a remote with multiple buttons appears on the mobile screen and can be used by linking it to the

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microcontroller's programme. The microcontroller is connected to the mobile device via Bluetooth device HC-05. Thus, using various controls on the mobile device, we can manually move the cart and turn the motor on or off.

2.2.3 The Architecture of an Intelligent Grass Cutter

The world is experiencing an increase in air and noise pollution[14][17]. The traditional fuel-powered grass trimmer discharges petrol, causing air pollution and increasing costs[15]. A solar-powered grass cutter has been introduced to combat this issue[8]. This device converts solar energy into electrical energy, allowing the blades to rotate and the lawn to be moved. Solar energy is a renewable energy source, and the project's objective is to construct and operate the equipment. The solar panel will be mounted on an appropriate machine structure, and it will provide the electrical supply. A switch will be installed to govern the operation. Other components include a motor, switch, wheel, wire, aluminium sheet, square tubing, and insulating material. The frame will be constructed from GI sheet. Utilising standard materials such as grinding and welding machinery, manufacturing is performed. The principle of operation of the grass trimmer is the rapid rotation of the blade. The electric grass cutter is a more convenient option for lawns, gardens, and fields because it permits timely grass trimming. 80% of all energy is generated by conventional fossil fuels, with oil, natural gas, and coal accounting for 36%, 21%, and 23%, respectively[5]. To maintain a strategic distance from impending energy shortages, solar power is a viable alternative to these sources. An easier-to-operate solar panel with a rectangular and wide body and a solar powered hanger will reduce the environmental impact of inward ignition movers. The solar-powered grass cutter is an advancement in the electric grass cutter industry because different designs have been created to accommodate various requirements and conveniences.

The structure is equipped with a microcontroller, sensor, and solar charging system. Assembling these components yields the proposed system architecture. The sensors are the system's eyes, used only a colour sensor to obtain the green colour for cutting the grass, and the blades will not rotate on the path where there is no grass. The apparatus was powered by the battery, which was charged by the solar panel. The battery supplies the energy necessary for the components and motor to move in response to commands. Additionally, it will store the grasses cut by the grass-cutting equipment. Our design is effective because it is emery-intensive, as the sensor will halt the machine upon detecting grassless areas. Additionally, this machine will eliminate any obstacles in its path. The proposed system eliminates the need for human intervention in machine operation. Once the machine is initiated, it will operate automatically.

2.2.4 Design A Grass Cutter with Remote Control and IoT Features

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Historically, vegetation was cut with a cutlass, which was inefficient and inaccurate. Technology has advanced to the point where a single or multiple blades are used to cut vegetation surfaces uniformly, reducing the amount of time and effort required by humans. There are numerous varieties of grass cutters, with fuel, electricity, and propane as essential power sources. Grass cutters powered by petrol have a four stroke internal combustion engine that requires manual cranking to initiate. Compared to gasoline-powered grass cutters, electric-powered grass cutters, such as corded and cordless electric grass cutters, produce an average of less than 75 decibels[7]. However, corded grass cutters can be dangerous and costly, whereas cordless grass cutters utilise rechargeable batteries. To address these issues, new technical domain-based Grasscutters are being developed, such as solar-powered grass cutters that interface with IoT technology to control their operation and movement. This paper proposes a new method for cutting grass with solar-powered grass cutters, which requires minimal human intervention and enables increased services for connected objects. The proposed model seeks to design and develop a prototype that is adaptable, resilient, comfortable, potent, and obstacle-avoidant. In the proposed model, the Arduino UNO ATmega328 controller acts as the brain, controlling the complete operation of the device that is intended to make the construction of interactive environments easier. The battery, which is rechargeable and charged by the solar panel, supplies the model with power. Two DC motors are connected to the device's wheel via the motor driver circuitry, which simultaneously regulates the speed and direction of both motors. Using the host control interface, the Bluetooth module manages the wireless communication between the device and the user's end. A front-mounted ultrasonic sensor prevents the device from colliding with obstructions.

2.3 Comparison between Previous Research and this Project

There are some researches have been conducted from the past researches, journals and articles to gather the knowledge and information regarding the developed product, technologies used and methodologies. There are four studies which contain some advantages and disadvantages as Table 2.1:

Table 2.1: Comparison between Past Research with this Project

Project	Advantages	Disadvantages	References
1	• Use PIR sensor to detect human present. • Can operate auto mode and remote mode.	• Use Arduino Nano which have limitation of I/O pins. • The battery's health life will drop quickly.	[1]
2	• Suitable while cutting grass at the corners. • Can control the speed of motor.	• The motor in a cordless hedge trimmer is typically less efficient. • Does not use Ultrasonic sensors to detect obstacles.	[2]

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3	• Able to clean the grass once the grass is cut off. • Used colour sensor (green colour) to detect the grass.	• Used colour sensor. If there is green colour objects detected by the prototype may cause damages or accident. • Does not use Ultrasonic sensor to detect obstacles.	[5]
4	• Can control the movement of prototype manually.	• Does not use LCD display lead to lack of real-time feedback.	[7]

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2.4 Summary

Researchers have recognised that the growth of long grass in lawns poses maintenance challenges in terms of efficiency and effectiveness. Long grass can affect the look of outdoor spaces, increase the risk of fire, sheltered pests and allergens, and prevent the development of desirable plants. The development of a solar-powered, Arduino-controlled lawnmower seeks to address these issues by providing an automated, eco-friendly solution. Solar energy provides a renewable source of energy, reducing reliance on gasoline and minimising carbon emissions. This is in line with global efforts to combat climate change, one of the most urgent global issues.

CHAPTER 3

METHDOLOGY

3.1 Introduction

This chapter focuses on the development of a solar-powered grass cutter using Arduino for lawn maintenance. The initial step involved Gantt Chart, flowchart, selecting components, constructing circuit and programming. This methodology aimed to develop a solar-powered grass cutter using Arduino that efficiently maintains lawns.

3.2 Project Planning

Project planning is the process of defining and organizing the tasks, resources, and timeline required to successfully complete a project. It involves determining the project's objectives, scope, deliverables, and milestones, as well as identifying the necessary activities, dependencies, and resources needed to achieve those goals. In Appendix B shows present Gantt Chart for BDP 1 and planned Gantt Chart for BDP 2.

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3.3 Functional modules of the system

A flowchart is used to construct and describe the system's procedure. It is extensively utilised in engineering and hardware development. It describes how to follow a sequence of actions. Using them determines the operation's stage and method of execution. This subsection describes the project and component processes. This chapter will elucidate the entire procedure before moving on to the next chapter, which will apply the determining and evaluating.

3.3.1 The Flowchart of the System

According to Figure 3.1, the flowchart demonstrates an advanced operational method for an automated system, a type of robotic technology. This sequence begins by simultaneously moving the machine forward and initiating a cutting mechanism, as seen by the engagement of a blade motor. The key attribute of this system is its ongoing surveillance for any obstacles in its path. When an obstacle is detected within 20 cm distane, the procedure requires an immediate stop of the blade motor, indicating a stoppage in the cutting operation. The system subsequently adjusts its direction by performing a right turn, a deliberate operation intended to bypass the identified impediment.

When there are no obstacles in its way, the device continues moving forward, keeping the blade motor running to ensure uninterrupted completion of the task. This operational flow showcases the machine's innate capacity to effortlessly combine movement and task completion, while also being able to quickly adjust to changes in the surroundings. The flowchart not only demonstrates the technical architecture of automated replies but also emphasises the significance of incorporating sensory inputs to enable instantaneous decision-making. These characteristics are crucial in automated systems, especially those that need to function in settings with fluctuating and uncertain factors. The complex interactions that occur in modern robotics between mechanical action, sensor-based detection, and adaptive response systems are demonstrated by this flowchart.

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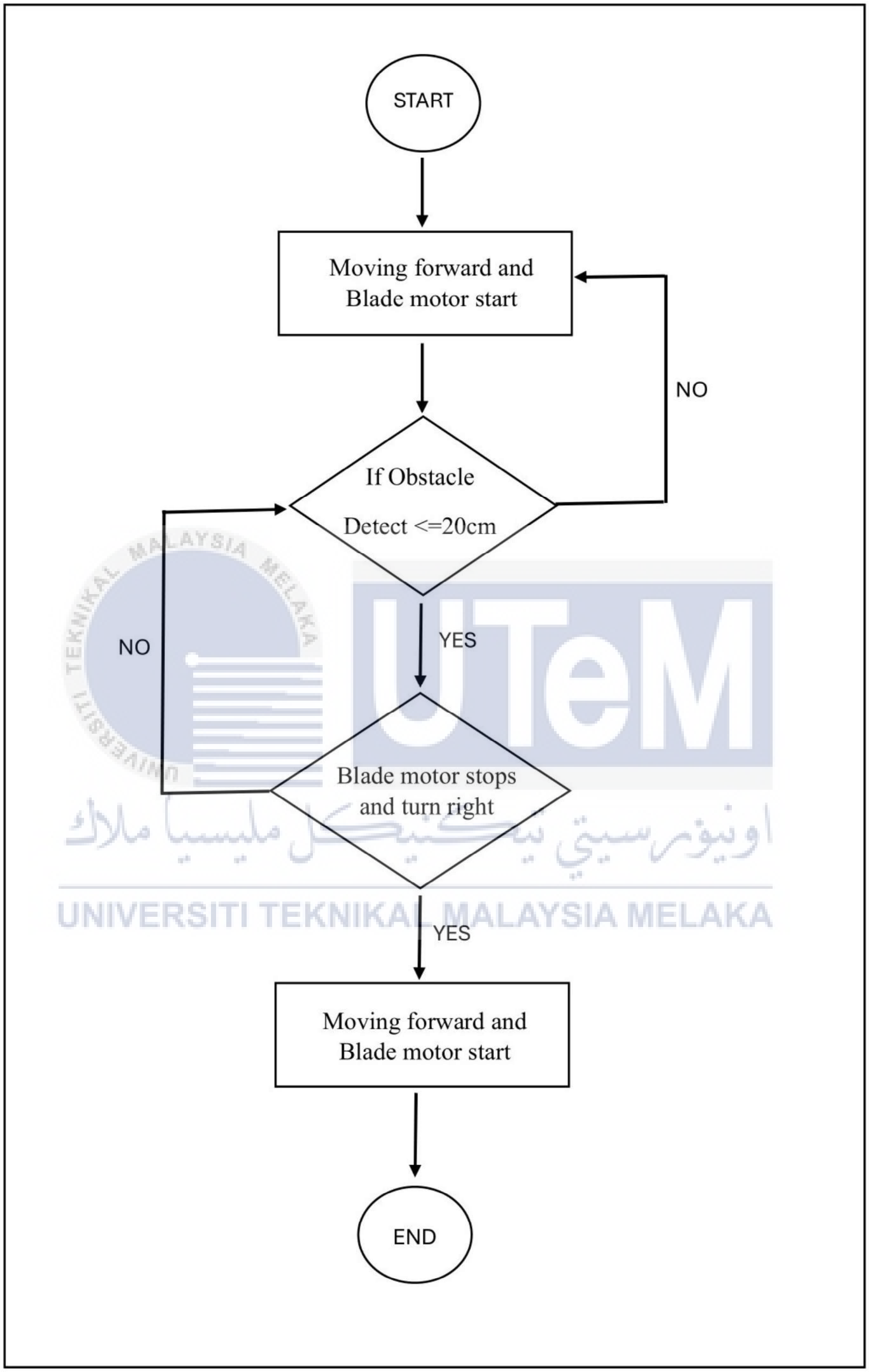

Figure 3.1: The Flowchart of the System

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3.4 Block Diagram of The System

The Figure 3.2, presents an in-depth picture of an autonomous grass cutting robot that operates on solar power, including renewable energy sources and advanced sensory input to carry out its tasks. The input components of the system consist of a solar panel, which serves as the main energy source by capturing solar electricity to power the machine. The lithium battery serves as a way of storing solar energy, therefore guaranteeing the machine's functionality even in the absence of direct sunlight.

The ultrasonic sensor is a crucial component of the robot's navigation system, utilising sound waves to identify impediments in its path and enabling the robot to move around them. The power switch serves as a manual interface for the user to initiate or terminate the system.

The microcontroller serves as the central component responsible for making decisions and controlling the system's functionality. It receives input signals and controls the outputs accordingly. The outputs are well illustrated, with an LCD display offering a user interface that probably shows obstacle detect status and the distance of obstacles. The relay module, under the supervision of the microcontroller, functions as an intermediary device that may securely enable or disable the DC blade cutter.

The motor driver is an essential component that allows the microcontroller to manage the speed and direction of the motors. The grass cutter DC motor has been developed for the purpose of cutting grass, contrasting it from the regular DC motor which is more likely responsible for the robot's overall movement capabilities.

This diagram represents an advanced concept that combines energy economy and automation to provide an autonomous robotic lawn mower capable of independently maintaining grass areas without the use of fossil fuels or manual intervention.

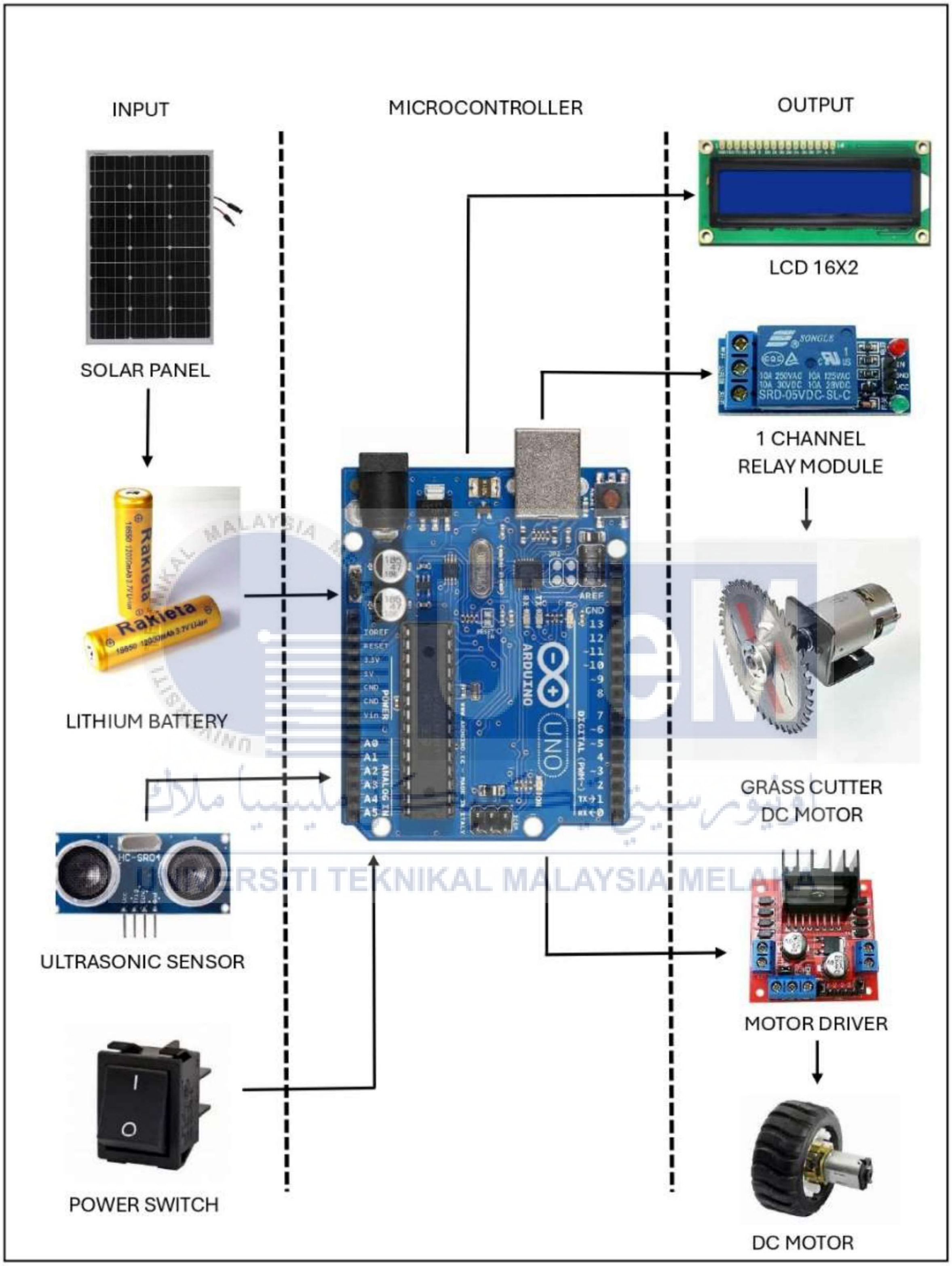

Figure 3.2: Block Diagram of the System

3.5 System Requirements

A system requirement consists of two parts: the hardware component and the software component.

3.5.1 Hardware Components

This project requires hardware components to build the prototype. Each component serves a specific function and contributes to the overall functionally of the system.

3.5.1.1 Arduino UNO

In Figure 3.3 shows Arduino UNO. Arduino is an open-source microcontroller board based on the ATmega328P microcontroller from microchip and developed by Arduino.cc. The panel contains digital and analogue input or output ports that can interface with multiple expansion boards and other circuitry. A microcontroller is supplied the embedded C programme to control the movement of the prototype.

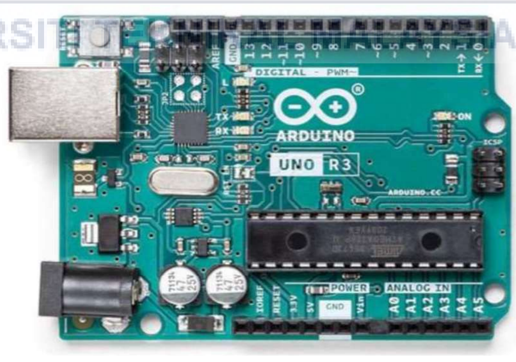

Figure 3.3: Arduino UNO

Based on the Table 3.1, each microcontroller has its own set of advantages and disadvantages. The Arduino UNO is chosen for this project because its bigger size, compared to other Arduino boards like the NANO, allows for more development space, making it easier to connect and test many components or use breadboards. The Arduino UNO has a track record of reliability and durability, ensuring continuous performance for long-term projects or applications requiring continuous operation. Arduino UNO would be the ideal microcontroller for the system because it offers more benefits.

Table 3.1: Arduino NANO vs Arduino UNO

Arduino	Advantages	Disadvantages
Nano	Smaller size makes it appropriate for tasks with limited space.	Fewer than eight analog input pins.
	A breadboard-friendly design factor with 0.1" pin spacing as a minimum.	Certain interfaces may require additional connectors or adapters.
	Less expensive than Uno.	Fewer GPIO ports than the Uno.
Uno	Size expansion provides greater space for prototyping and connecting peripherals.	Larger dimensions may not be suitable for small-scale endeavours.
	Greater accessibility and familiarity as a result of being one of the first Arduino boards.	Slightly more expensive than Nano.
	Robust and dependable, with an extended track record.	Not as compatible with breadboards as Nano.

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3.5.1.2 Power Switch

The primary function of a power switch is to control the flow of electrical power. When the switch is in the "on" position, it completes the circuit, allowing electricity to flow and power the device. When in the "off" position, the circuit is broken, and electricity is prevented from flowing. The power switch is connected between motor driver 5V output pin and Vin pin in Arduino Uno. The power switch is represented in Figure 3.4.

Figure 3.4: Power Rocker Switch

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3.5.1.3 Ultrasonic Sensor

In Figure 3.5 represents the ultrasonic sensor diagram. The primary function of the ultrasonic sensor is to detect obstacles or objects in the prototype vicinity. It emits ultrasonic waves, which bounce off nearby objects and return to the sensor. By measuring the time, it takes for the waves to return, the sensor can calculate the distance to the obstacle. The ultrasonic sensor is connected to the microcontroller.

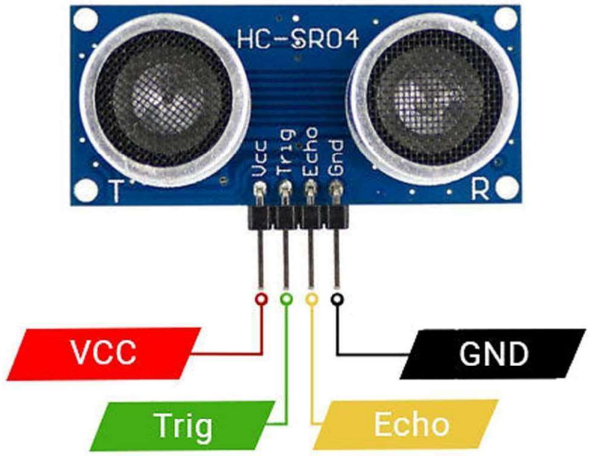

Figure 3.5: Ultrasonic Sensor

3.5.1.4 Liquid Crystal Display (LCD)

The LCD diagram is represented in Figure 3.6. A Liquid Crystal Display (LCD) is a thin, flat display device composed of any number of colour or black-and-white pixels arranged in a grid in front of a source of light or reflector. Each pixel is composed of a column of liquid crystal molecules suspended between two transparent electrodes, as well as two polarising filters with perpendicular polarity axes. If liquid crystals weren't present between them, light passing through one would be blocked by the other. The liquid crystal inverts the polarisation of light to allow it to pass through the other filter. Numerous microcontroller devices use intelligent LCD displays to emit visual data. LCD display module manufactured by Hitachi is LCD HD44780. These are inexpensive, user-friendly, and even capable of producing a readout using the 880 pixels of the display.

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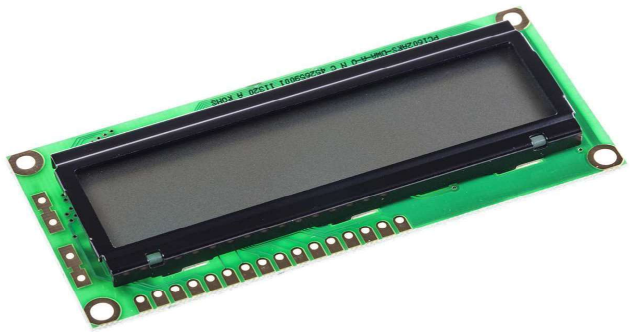

Figure 3.6: Liquid Crystal Display (LCD)

3.5.1.5 Solar Panel

A solar panel is designed to absorb solar rays, which provides a source of energy for electrical generation. The operational premise when photovoltaic cells absorb solar radiation, the photovoltaic effect causes the production of electromotive force at the extremities of the cells, which produces electricity. This type of electricity is known as direct current (DC). Diagram of a solar panel is represented in Figure 3.7.

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Figure 3.7: Solar Panel

3.5.1.6 Motor Driver

Figure 3.8 represents the diagram of a motor driver. The L298D is a versatile and reliable motor driver IC for controlling DC motors or stepper motors. It features bidirectional control, H-bridge configuration, voltage and current handling, control signals, heat dissipation, and built-in protection features. It can handle a wide range of motor supply voltages and has built-in flyback diodes for protection. The L298D requires a microcontroller or other control circuit for operation, and features overcurrent and thermal shutdown protection to prevent potential damage.

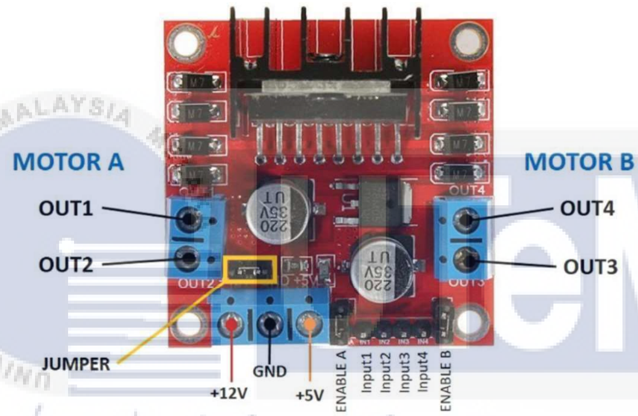

Figure 3.8: Motor Driver

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3.5.1.7 DC Gear Motor

Figure 3.9 represents the diagram of a DC gear motor. Wheel rotation is typically accomplished by a DC motor with a gearbox. Assists the wheel in rotating gently so that it can encompass the grass to be cut. Utilised two DC gear motors for four axles. The shaft of a 5mm DC motor is drilled with a 3mm opening, and then the shaft is inserted into chassis holes and secured with threads. Designed the shafts to withstand the weight of the chassis. Figure 3.9 represents the diagram of a DC gear motor.

Figure 3.9: DC Gear Motor

3.5.1.8 Relay

The relay diagram is represented in Figure 3.10. Relay is a valve that is electromagnetically operated. It connects or disconnects only one contact is required for operation. It has a total of four terminals, including the coil terminals. The SPST relay can control a single circuit of electricity or electronics. It typically provides the same toggling or on/off functionality as an electrical switch, with the exception that it is controlled by an electrical or electronic signal. When a voltage is applied to the relay coil, its contacts close, and when the voltage is removed, they open. By employing a low voltage or low current power supply, relays are typically designed to control a high voltage and high current circuit.

Figure 3.10: Relay

3.5.1.9 Rechargeable Battery

The rechargeable battery diagram is represented in Figure 3.11. Rechargeable batteries are designed to be reused multiple times. They can be recharged by applying an electric current that reverses the chemical reactions within the battery, restoring its energy storage capacity. The rechargeable battery acts as the main power supply for the system. It provides the necessary electrical energy to drive the dc gear motors, blades cutter motor, sensors, and other components.

Figure 3.11: Rechargeable Battery

3.5.1.10 Battery Charger Controller

In Figure 3.12 show battery charge controller. A battery charge controller is an essential component of a power system that charges a battery, as it ensures the battery's long-term safety. In principle, a charge controller is an electronic device that regulates the passage of energy from the battery charger to the battery. The charge is automatically reduced, stopped, or redirected when the battery is entirely charged. Battery charge controllers can also be used to preserve battery life by preventing the battery from being deeply drained.

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Figure 3.12: Battery Charge Controller

3.5.1.11 Jumper Wire

In Figure 3.13 shows the jumper wire. Jumper wires are crucial components in electronic circuits, enabling temporary connections between components on breadboards or other prototyping platforms. Made of flexible, insulated copper wire, they have connectors for easy insertion and protection against short circuits. Available in various lengths and colours, they are flexible, reusable, and easy to remove and reposition. They are commonly used in prototyping and experimentation scenarios, allowing for quick modifications and iterative testing of circuit designs. Jumper wires are also breadboard compatible, ensuring reliable connections between various electronic components.

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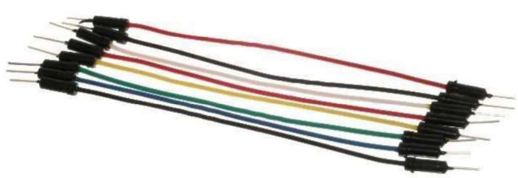

Figure 3.13: Jumper Wire

3.5.1.12 DC Motor Cutter

Figure 3.14 represents the DC motor cutter. The cutter's DC motor is in centre of the prototype so that the vegetation can be cut efficiently. The cutter must revolve. For this application, DC motor is selected to operate at very high speed. The battery provides electricity to the DC motor.

Figure 3.14: DC Motor Cutter

3.5.2 Software Components

The software application is essential to the completion of specified activities associated with the execution of a task or project. This project requires two kinds of software: schematic and layout circuit software and programming software.

3.5.2.1 Proteus

Figure 3.15 shows the Proteus Logo. Proteus is a potent CAD programme for designing electronic circuit diagrams and PCB layouts. This software is only Windows compatible. In this project, it is used to create the schematic diagram illustrating the relationship between each component. Before constructing a PCB layout, the primary reason for adopting this CAD programme is that we can

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convert to layout design, allowing us to determine the correct pinhole location and board layout size.

Figure 3.15: Proteus Logo

3.5.2.2 Arduino IDE 2.1.0

The Figure 3.16 shows Arduino IDE 2.1.0. The Arduino IDE is a software application for writing, compiling, and uploading code to Arduino boards. It offers a user-friendly interface, features like a code editor, library manager, serial monitor, board manager, example sketches, code compilation and upload, and integrated documentation.

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Figure 3.16: Arduino IDE 2.1.0

3.6 Cost and Budget

Table 3.2 shows a comprehensive overview of the costs associated with the purchase of materials and components on Shopee, including the specific prices for each item. The overall sum of expenses for all things given in the table is RM334.02, which signifies the total spend for necessary resources in the project.

Table 3.2: Cost and Budget for the System

No.	Items	Quantity	Expected Price (RM)
1.	Arduino Uno	1	26.00
2.	Arduino Uno Transparent Case	1	5.90
3.	Powe Rocker Switch	1	2.00
4.	Ultrasonic Sensor	1	3.20
5.	Ultrasonic Sensor Case	1	9.74
6.	Liquid Crystal Display (LCD)	1	8.40
7.	Solar Panel	1	52.72
8.	Motor Driver	1	5.40
9.	DC Gear Motor	4	50.00
10.	DC Gear Motor Hex Coupling	4	22.78
11.	Tyres	4	21.89
12.	Relay	1	4.80
13.	Lithium Battery 3.7V	3	15.50
14.	Battery Holder 3 Slots	1	5.00
15.	Battery Charge Controller	1	14.50
16.	Jumper Wire	40	3.20
17.	DC Motor Cutter	1	2.57
18.	3.17mm Axle Motor Shaft	1	4.69
19.	Cutter Blade !0 Inch	1	11.93
20.	Mild Steel Plate	2	45.00
21.	Waterproof Enclosure Box	1	14.90
22.	Breadboard	1	3.90
Total			334.02

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3.7 Summary

The methodology on development of solar power grass cutter using Arduino for lawn maintenance project involves several key steps. It starts with project planning to define objectives and requirements. Hardware components, such as gear motors, sensors, batteries, and cutting mechanisms, are selected based on objective and requirements. Software development involves programming the microcontroller to control motor operation, obstacle detection, and cutting mechanism activation. The method's ultimate goal is not to achieve the maximum level of accuracy, but to achieve efficiency, and the ability to develop a solar powered grass cutter using Arduino.

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CHAPTER 4

RESULT & ANALYSIS

4.1 Introduction

The outcomes of the conducted testing related to this topic are discussed in this part. The creation of an Arduino-powered solar grass cutter arises from several project concepts. The innovation is achieved through the synthesis of several concepts and ideas, resulting in an innovative idea for this project. The circuit is designed with the many features of the solar power grass cutter. This chapter will describe and demonstrate the outcome of the output current and voltage. In addition, this chapter offers a comprehensive explanation of the project's functioning, along with an analysis, and discussion.

4.2 Results and Analysis

Figure 4.1 shows the circuit simulation of the project carried out using in Proteus 8 Professional. Simulating circuits before the hardware implement provides major cost benefits by enabling early detection and resolution of possible problems, hence reducing the requirement for costly replacements or modifications in the latter phases of the design process. Furthermore, circuit simulation reduces the potential hazards linked to hardware implementation. Early identification of problems mitigates component degradation and minimizes the risk of expensive delays or the need for substantial redesigns.

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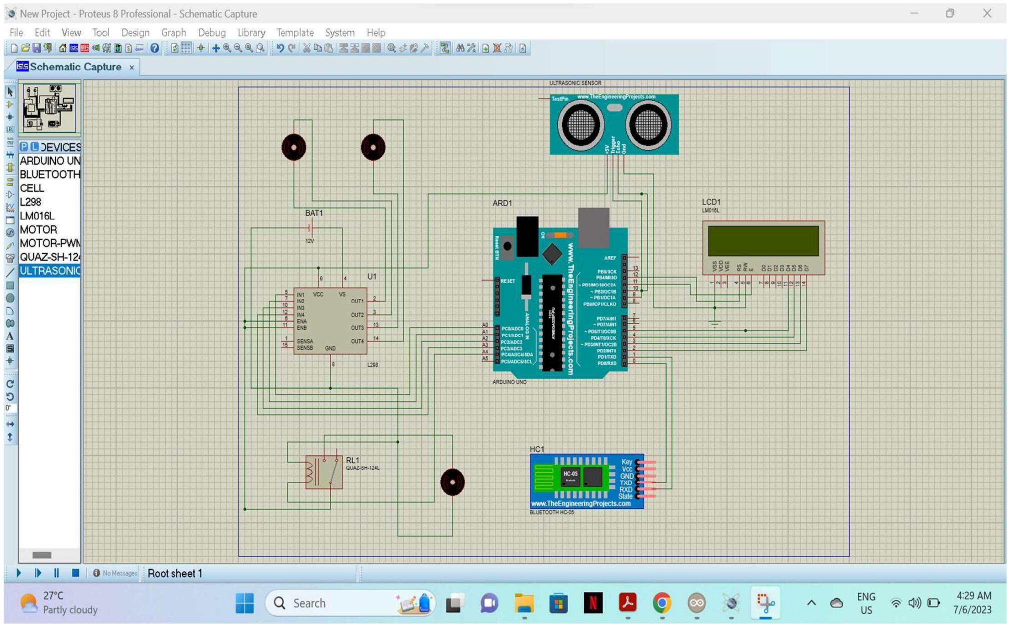

Figure 4.1 : Circuit Simulation

4.2.1 Hardware

Figure 4.2 represents the physical connection of the hardware circuit. This connection was established following the circuit simulation done in Proteus 8 Professional. One modification was made to the hardware circuit connection, where the power switch was substituted with a Bluetooth module.

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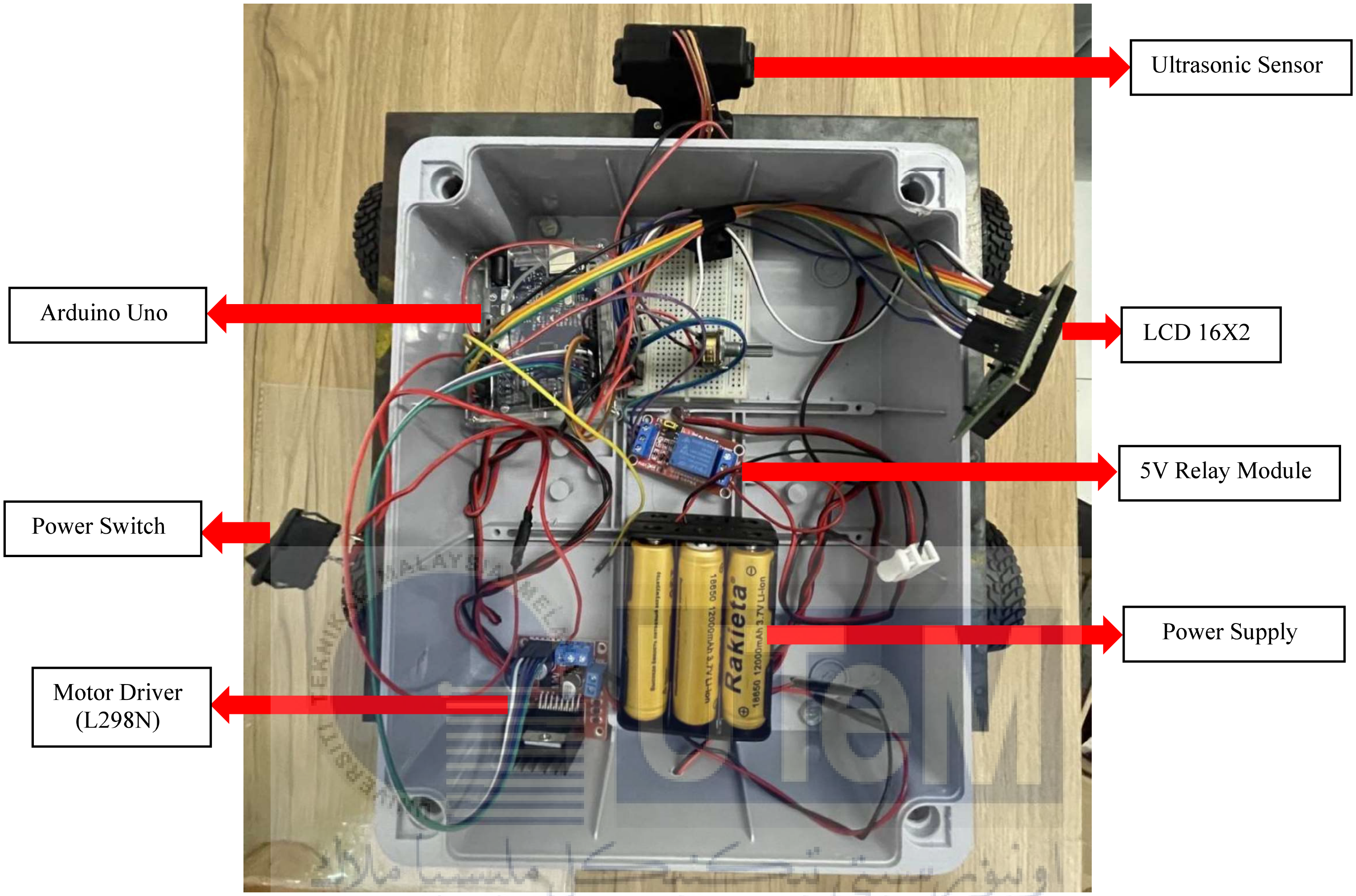

Figure 4.2: Hardware circuit

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4.2.2 Prototype

Top view of Prototype:

Figure 4.3 : Top view of Prototype

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Front view of Prototype:

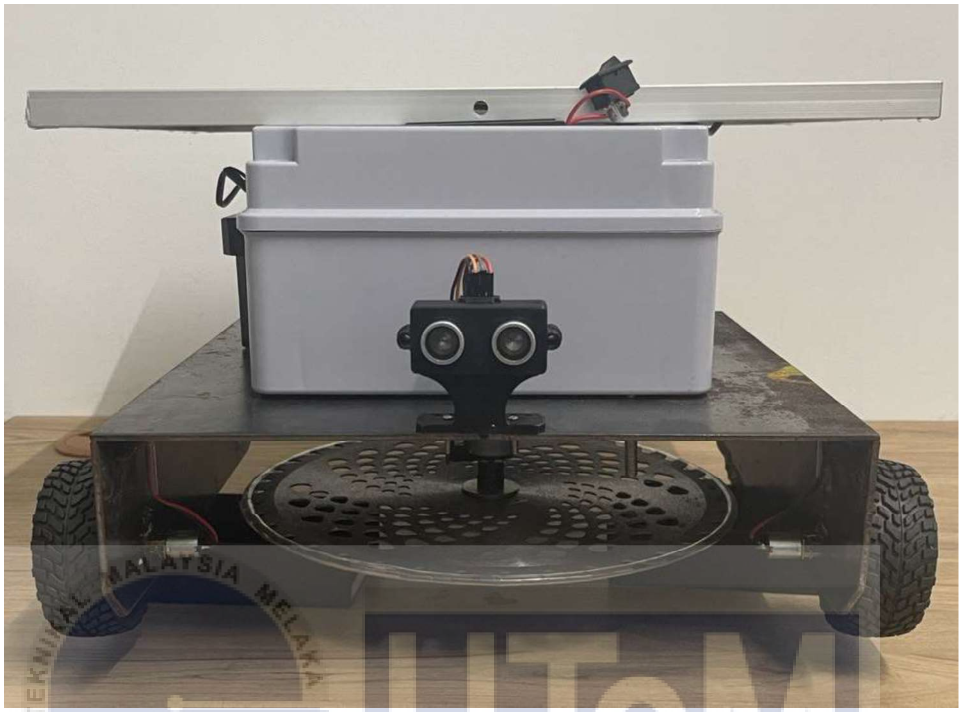

Figure 4.4 : Front view of Prototype

Left view of Prototype:

Figure 4.5 : Left view of Prototype

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Right view of Prototype:

Figure 4.6 : Right view of Prototype

Back view of Prototype:

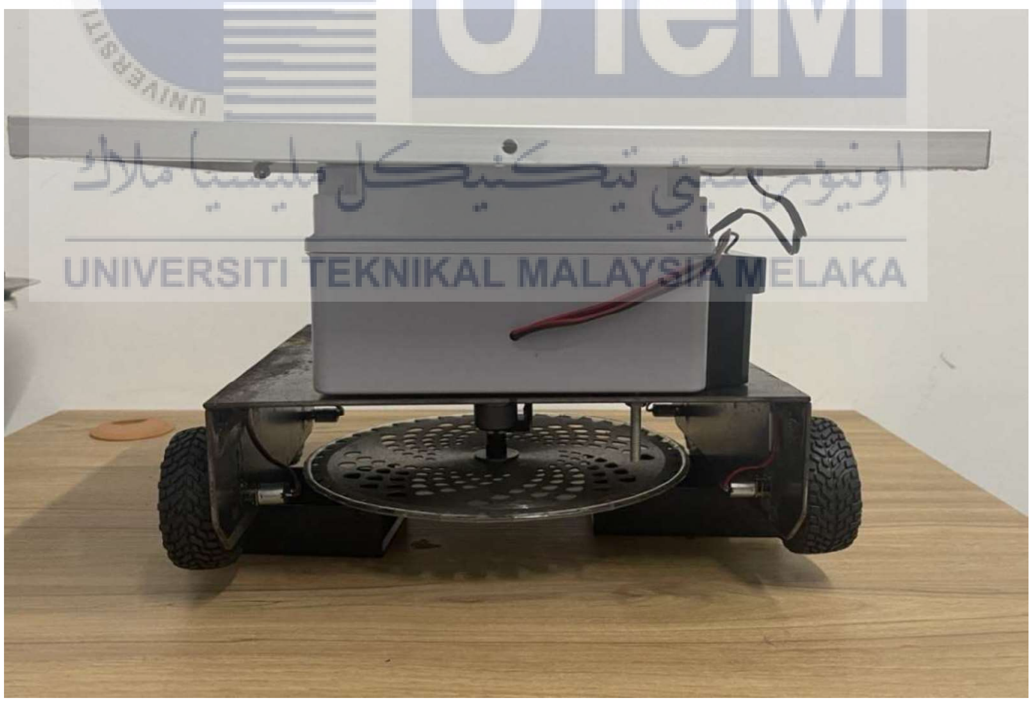

Figure 4.7 : Back view of Prototype

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Bottom view of Prototype:

Figure 4.8 : Bottom view of Prototype

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4.2.3 Data for Voltage (V) and Current (A) without Load

Figure 4.9 shows the measurement of Voltage (V) without any load. In order to measure the voltage without any load, it is important to ensure that the prototype tires do not make contact with the ground. Setup the multimeter to the DCV setting in order to obtain the Voltage (V) reading of the circuit.

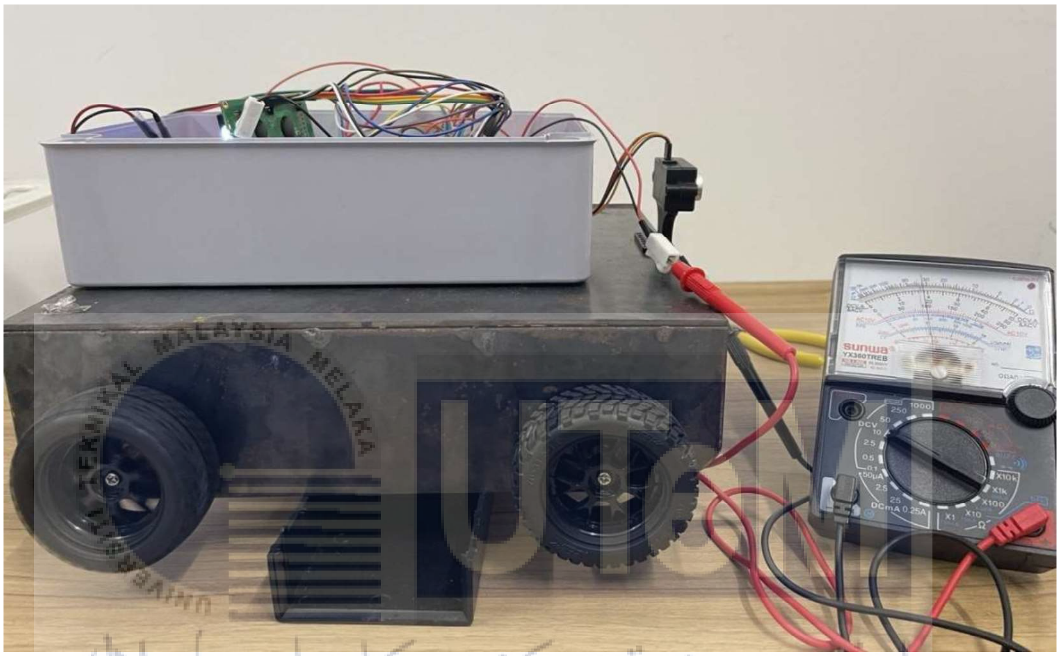

Figure 4.9 : Measure the Voltage (V) without Load

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Figure 4.10 represents the relationship between voltage (V) and time (s). The voltage, measured in volts, is recorded at various time intervals, measured in seconds, during a duration of 3 minutes. The dataset provides a consistent voltage level of 4 volts that remains constant across the recorded time intervals, indicating a steady electrical production over this timeframe.

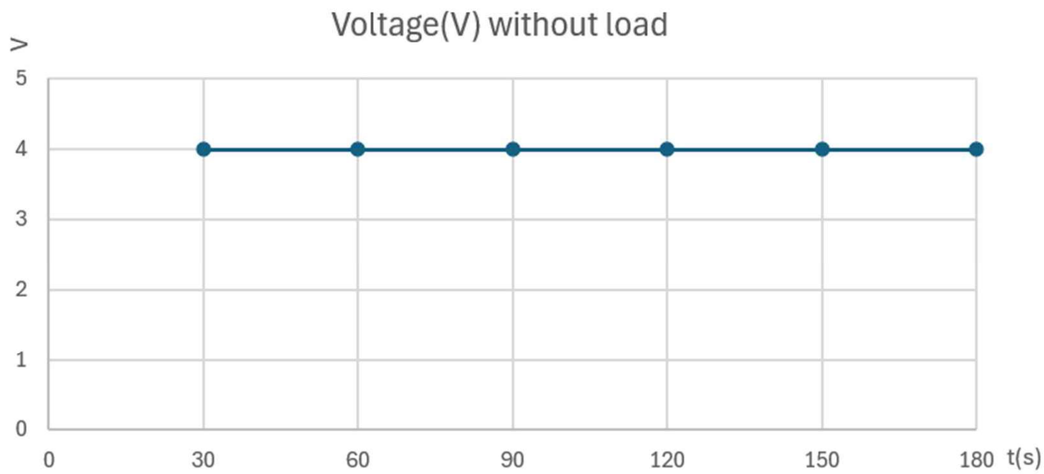

Figure 4.10 : Voltage (V) vs. time (s) without Load

Figure 4.11 shows the measurement of current (A) without any load. In order to measure the current without any load, it is important to ensure that the prototype tires do not make contact with the ground. Setup the multimeter to the DCmA setting in order to obtain the Current (A) reading of the circuit.

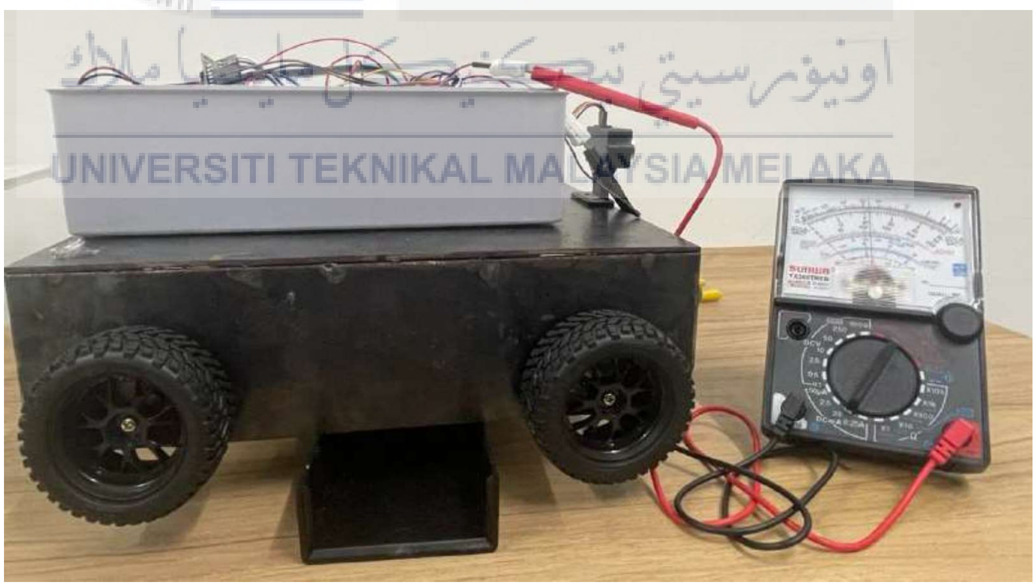

Figure 4.11 : Measure the Current (A) without Load

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Figure 4.12 represents the relationship between electric current (measured in amperes) and time (measured in seconds). The current is measured in milliamperes (mA) at various time intervals (in seconds) throughout a period of 3 minutes. The dataset shows a constant current level of 795 mA that remains unchanged throughout the recorded time intervals, indicating a stable and uninterrupted supply of electricity during this timeframe.

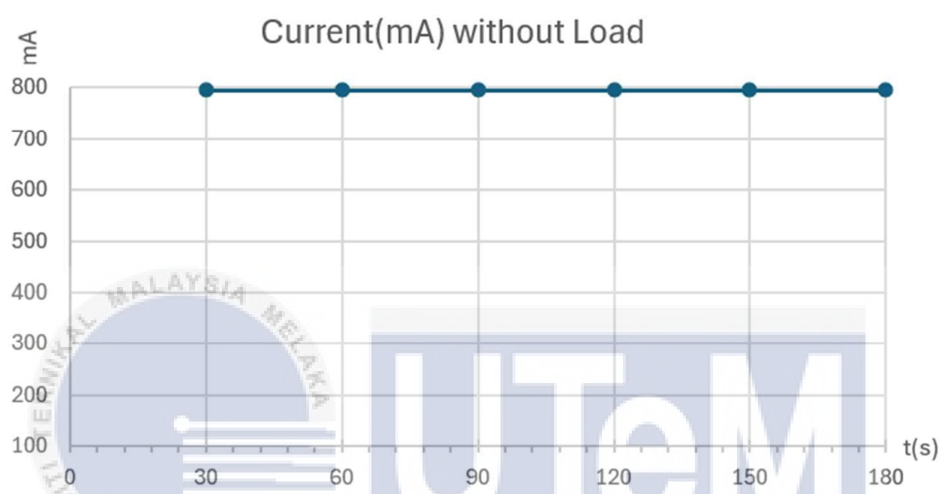

Figure 4.12 : Current (A) vs. time (s) without Load

4.2.4 Data for Voltage (V) and Current (A) with Load

Figure 4.13 shows the measurement of Voltage (V) under load conditions. To accurately measure the voltage under load, ensure that the tires are in contact with the ground. Setup the multimeter to the DCV mode to collect the Voltage (V) measurement of the circuit.

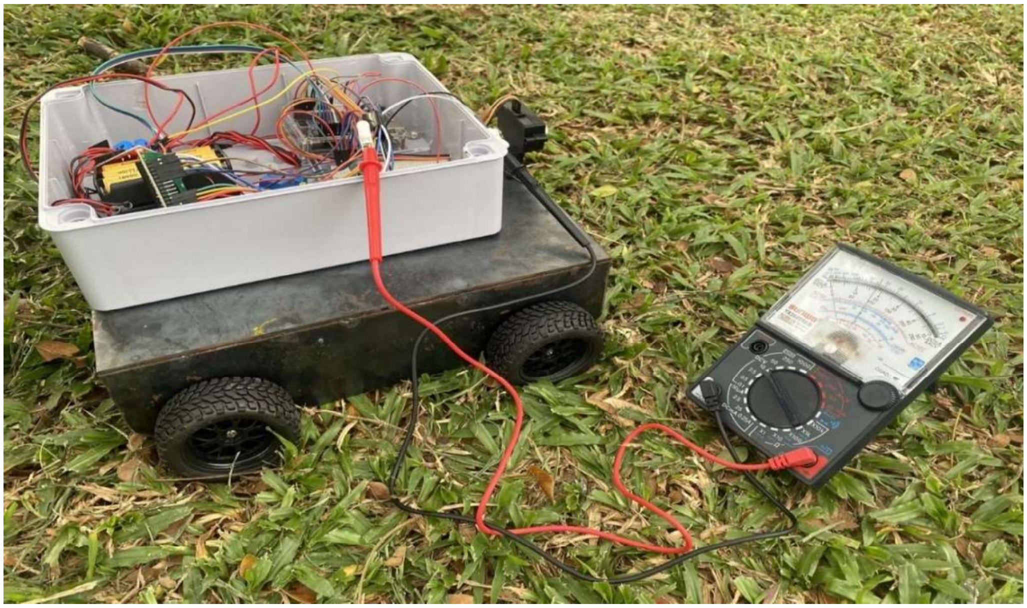

Figure 4.13 : Measure the Voltage (V) with Load

.Figure 4.14 represents the relationship between voltage (V) and time (s). The voltage, measured in volts, is recorded at various time intervals, measured in seconds, during a duration of 3 minutes. The dataset provides a consistent voltage level of 3.8 volts that remains constant across the recorded time intervals, indicating a steady electrical production over this timeframe

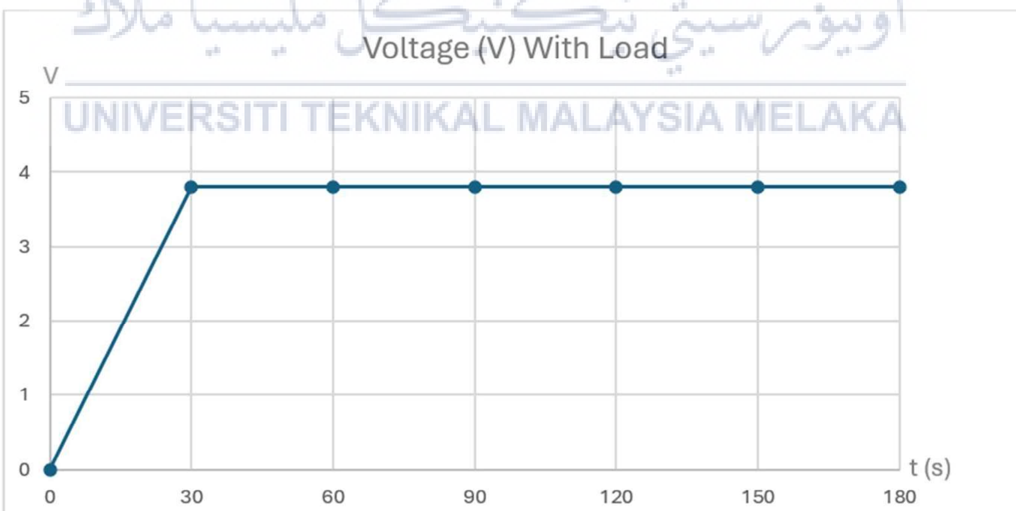

Figure 4.14 : Voltage (V) vs. time (s) with Load

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Figure 4.15 shows the measurement of Current (A) under load conditions. To accurately measure the Current (A) under load, ensure that the tires are in contact with the ground. Setup the multimeter to the DCmA mode to collect the Current (A) measurement of the circuit.

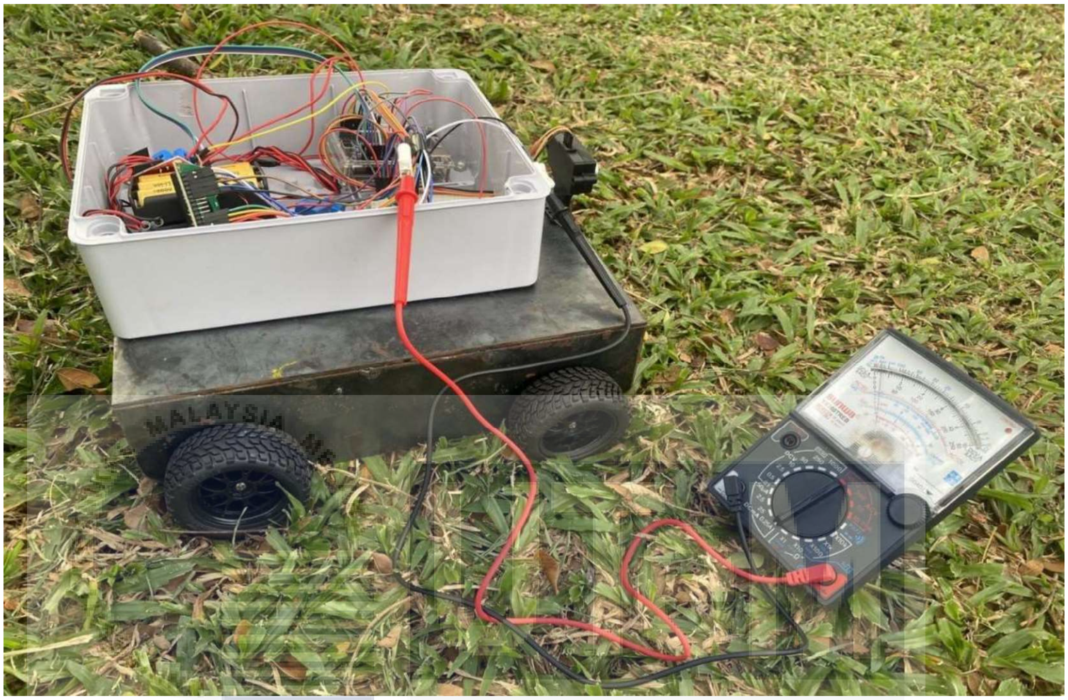

Figure 4.15 : Measure the Current (A) with Load

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Figure 4.16 represents the relationship between electric current (measured in milliamperes) and time (measured in seconds). The current is measured in milliamperes (mA) at various time intervals (in seconds) throughout a period of 3 minutes. The dataset shows a constant current level of 742 mA that remains unchanged throughout the recorded time intervals, indicating a stable and uninterrupted supply of electricity during this timeframe.

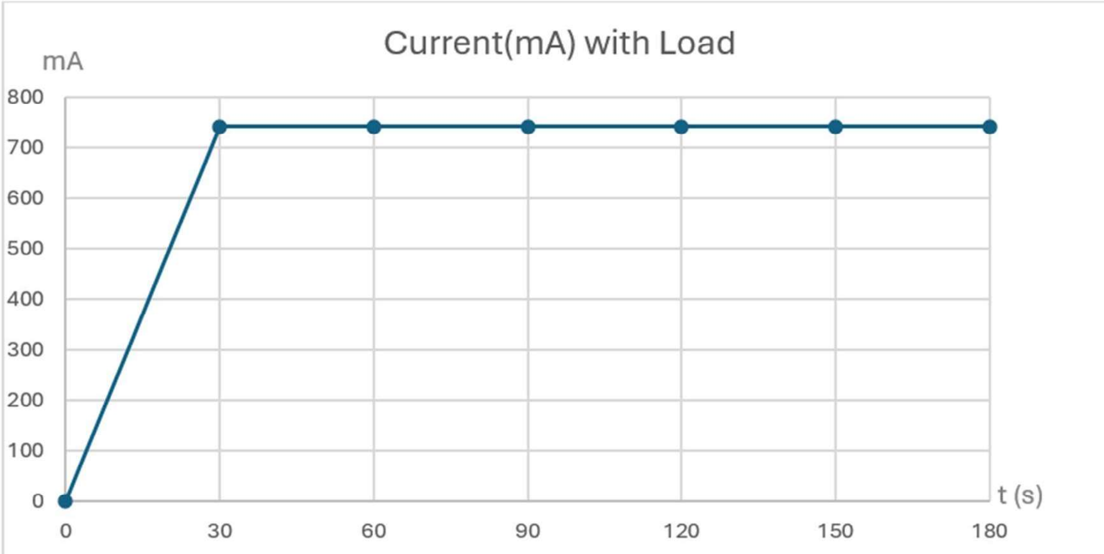

Figure 4.16 : Current (A) vs. time (s) with Load

4.2.5 Solar Panel Data for Output Current (A)

Figure 4.17 represents the measurement of the current (A) generated by the solar panel. The solar panel used for this project has a maximum output current of 3100 mA. The output current (A) of a solar panel is directly affected by the intensity of sunlight or solar irradiance, which reaches its maximum value when the sun is at its highest position in the sky, also known as solar noon. Set the multimeter to the DCmA mode in order to measure the current (A) output of the solar panel.

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Figure 4.17 : Measure the solar panel output Current (A)

Figure 4.18 shows the relationship between current (A) and time (s). The current is measured in milliamperes (mA) at various time intervals (in seconds). The solar panel's electric energy is highly affected by environmental factors, and changes in current forecast in accordance with changes in the sun conditions.

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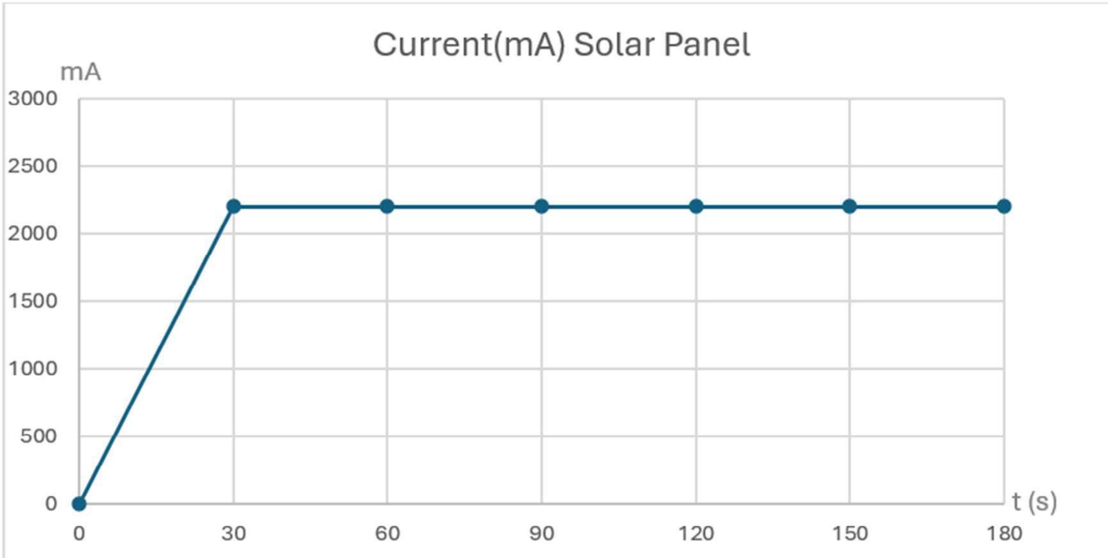

Figure 4.18 : Current (A) output of the Solar Panel

4.2.6 Data Estimate For Battery Runtime

The estimation of battery life following solar panel charging entails factoring in the battery capacity and the rate of energy use. The battery's estimated duration (in hours) can be determined using the following formula:

$$\text{Battery Life (hours)} = \frac{Battery\ Total\ Capacity\ (mAh)}{Current\ (mA)}$$

As analysing the battery system, with a total capacity of 36,000 milliampere-hours (mAh) and an estimated current with load of 742 milliamperes (mA), the battery life formula was applied to calculate an approximate operating duration of 48.5 hours.

4.2.7 Data Estimate Charge Time for Solar Panel Charge the Battery

During the test of the solar charging system, the solar panel generates an output current of 2200 milliamperes (mA), while the associated battery has a total capacity of 36000 milliampere-hours (mAh). Based on these values, the estimated charging time 0% to 100% is roughly 16.36 hours**.** The estimate is obtained by applying the formula :

$$\text{Charging Time (hours)} = \frac{Battery\ Total\ Capacity\ (mAh)}{Solar\ Panel\ Current\ (mA)}$$

The current generated by a solar panel is dependent upon the amount of sunlight it receives. An increase in sunlight results in a corresponding increase in electricity production by the solar panel. Shading caused by clouds or obstructions may reduce the amount of sunlight and affect the flow of electric current. The solar panel's electricity generation can be affected by the angle of sunlight and the weather.

4.2.8 Functioning of the Prototype

Figure 4.19 shows the LCD display a welcome message. When the power switch is on in initialize state, the LCD will display welcome message "SOLAR CUTTER, BY RIESHIKESAN" for 3 seconds. Then, if there is no obstacle detect by the ultrasonic sensor the prototype will start move forward at the same time the DC motor blade cutter will start cut the grass. The LCD also will display the "Distance:" of object and "No object Detect". In figure 4.20, shows the output of LCD display the "Distance:" and "No Object Detect". If the ultrasonic sensor detects the object below 20cm distance the prototype will stops for 3 seconds the blade cutter also will stops, the LCD will display the distance obstacle detect and "Object Detected". In figure 4.21, shows the output of LCD display "Distance:" of obstacle detects by sensor and "Object Detected". Then the prototype will turn right to continue cut the grass. When turn right the ultrasonic sensor detect the obstacle again, the prototype will turn right again until there is no obstacle detect by the ultrasonic sensor. Then only the prototype will move forward, and blade cutter will cut the grass.

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Figure 4.19 : Display welcome message on LCD

Figure 4.20 : LCD display the “distance” and “No Object Detect”

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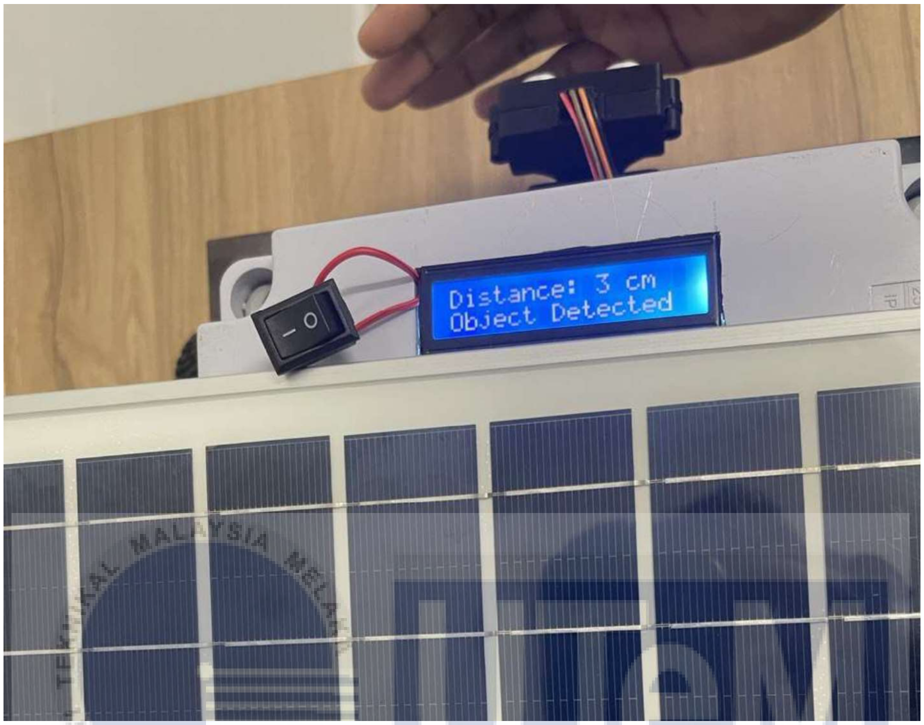

Figure 4.21 : LCD display the “distance” and “ Object Detected”

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CHAPTER 5

CONCLUSION

5.1 Conclusion

In conclusion, the development of a solar-powered grass cutter using Arduino for lawn maintenance addresses both local and global issues. Locally, the initiative provides a sustainable and independent solution for lawn maintenance. By utilising solar energy, the system reduces its reliance on conventional fossil fuel-powered equipment, resulting in decreased carbon emissions and a smaller ecological legacy. Arduino microcontroller's autonomous capabilities enable efficient grass mowing, reducing the need for manual labour and freeing up time for other tasks. The initiative is consistent with the global objective of transitioning to renewable energy sources and reducing the effects of climate change. By utilising solar energy, the grass cutter reduces the greenhouse gas emissions produced by conventional lawn maintenance equipment. In addition, the use of an Arduino-based control system permits energy efficient operation, thereby optimising resource utilisation and promoting sustainability. In addition, the project highlights the potential for technological innovation to address environmental issues. By integrating solar power, automation, and intelligent control systems, the solar-powered grass cutter demonstrates how technological advancements can be utilised to address global problems such as climate change, resource conservation, and sustainable development. In conclusion, the development of a solar powered grass cutter using Arduino for lawn maintenance not only provides a practical and efficient solution for local lawn maintenance, but also contributes to the larger global goal of promoting sustainability and reducing environmental impact.

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5.2 Potential for Commercialization

The development of solar power grass cutter using Arduino for lawn maintenance offers efficient, convenient, cost-effective, environmentally friendly, and customizable solutions for lawn maintenance. To eliminate fossil fuels, reduce labour costs, and relate to the rising demand for environmentally responsible solutions. With advancements in robotics, sensors, and artificial intelligence, the development of solar power grass cutter using Arduino for lawn maintenance can continue to enhance their functionality. Enhanced obstacle detection, and cutting mechanisms give lawn maintenance a competitive edge. Maintenance and support are essential to the commercialization process, while market research and analysis serve to identify potential customers. The sustainability and efficacy of a product are determined by its design and consumer engagement.

5.3 Future Works

The future development of solar power grass cutter using Arduino for lawn maintenance can involve several exciting areas of improvement and innovation. Here are some potential future works that can enhance the capabilities and performance of this system:

i. Incorporate advanced navigation systems, such as GPS and mapping technologies, to enable the system to create a digital map of the lawn.
ii. Develop more advanced energy storage and managements systems to maximize the utilization of solar power.
iii. Implement automated charging and docking systems that allow the system to autonomously locate and dock with a charging station when the battery level is low.
iv. Enhance the obstacle detection and avoidance capabilities of the robot by integrating advanced sensors, such as 3D cameras or LiDAR (Light Detection and Ranging).

v. Integrate the solar grass cutter system with smart home systems and voice assistants. This allows users to control and monitor the prototype operation through voice commands or via smart home automation platforms.

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APPENDICES

APPENDIX A – SOURCE CODE

sketch_r.ino

```
#include <LiquidCrystal.h>


#define L298N_ENA 2
#define L298N_IN1 3
#define L298N_IN2 4
#define L298N_IN3 5
#define L298N_IN4 6


#define TRIG_PIN 7
#define ECHO_PIN 8


#define MOTOR_PIN 9


#define MIN_DISTANCE 20


LiquidCrystal lcd(A0, A1, A2, A3, A4, A5);

void setup() {
  // Initialize L298N motor driver pins as outputs
  pinMode(L298N_ENA, OUTPUT);
```

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sketch_r.ino

```
  pinMode(L298N_IN1, OUTPUT);
  pinMode(L298N_IN2, OUTPUT);
  pinMode(L298N_IN3, OUTPUT);
  pinMode(L298N_IN4, OUTPUT);

  // Initialize ultrasonic sensor pins
  pinMode(TRIG_PIN, OUTPUT);
  pinMode(ECHO_PIN, INPUT);


  pinMode(MOTOR_PIN, OUTPUT);


  lcd.begin(16, 2);

  // Print a welcome message on the LCD
  lcd.print("SOLAR CUTTER");
  lcd.setCursor(0, 1);
  lcd.print("BY RIESHIKESAN");
  delay(3000); // Display the message for 3 seconds
  lcd.clear();  // Clear the LCD screen

  Serial.begin(9600);
}

```

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sketch_r.ino

```
void loop() {
  // Get distance from the ultrasonic sensor
  int distance = getDistance();

  Serial.print("Distance: ");
  Serial.println(distance);

  // Display the distance on the LCD
  lcd.setCursor(0, 0);
  lcd.print("Distance: ");
  lcd.print(distance);
  lcd.print(" cm");

  // Update LCD with object status
  lcd.setCursor(0, 1);
  if (distance < MIN_DISTANCE) {
    lcd.print("Object Detected ");


    // Stop both the robot and the blade motor cutter
    stopMotors();
    delay(3000);
    turnLeft();
    stopBladeMotor();
  } else {
```

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sketch_r.ino

```
      lcd.print("No Object Detected");


      // Move forward if no obstacles
      moveForward();
      // Start or continue running the blade motor cutter
      startBladeMotor();
    }
      delay(1000);
      lcd.clear();


  }

  int getDistance() {
    // Trigger the ultrasonic sensor to send a pulse
    digitalWrite(TRIG_PIN, LOW);
    delayMicroseconds(2);
    digitalWrite(TRIG_PIN, HIGH);
    delayMicroseconds(10);
    digitalWrite(TRIG_PIN, LOW);

    // Measure the time it takes for the pulse to return
    long duration = pulseIn(ECHO_PIN, HIGH);

```

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sketch_r.ino

```
  // Calculate distance in centimeters
  int distance = duration * 0.034 / 2;

  return distance;
}

void moveForward() {
  // Control all four motors using L298N driver
  analogWrite(L298N_ENA, 255);
  digitalWrite(L298N_IN1, HIGH);
  digitalWrite(L298N_IN2, LOW);
  digitalWrite(L298N_IN3, HIGH);
  digitalWrite(L298N_IN4, LOW);
}

void stopMotors() {
  // Stop all four motors using L298N driver
  analogWrite(L298N_ENA, 0);
  digitalWrite(L298N_IN1, LOW);
  digitalWrite(L298N_IN2, LOW);
  digitalWrite(L298N_IN3, LOW);
  digitalWrite(L298N_IN4, LOW);
}

void turnLeft() {
```

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```
  
  digitalWrite(L298N_IN3, LOW);
  digitalWrite(L298N_IN4, LOW);
  digitalWrite(L298N_IN1, LOW);
  digitalWrite(L298N_IN2, HIGH);
  analogWrite(L298N_ENA, 255);
}


void startBladeMotor() {
  // Start running the blade motor cutter
  digitalWrite(MOTOR_PIN, HIGH);
}

void stopBladeMotor() {
  // Stop the blade motor cutter
  digitalWrite(MOTOR_PIN, LOW);
}

```

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APPENDIX B

BDP 1 – GANTT CHART

TASK/WEEK	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
Briefing with JK PSM FTKEE														
Title Selection and Registration														
Finding Research Paper														
Planning on Circuit Design														
Coding														
Progress Work 1 Evaluation														
Chapter 1 : Introduction														
Chapter 2 : Literature Review														
Briefing with JK PSM FTKEE														
Chapter 3 : Methodology														
Chapter 4 : Preliminary Result														
Testing on Circuit Design														
Chapter 5 : Conclusion														
Checking Final Report														
Progress Work 2 Evaluation														
Compile and Turnitin														
Slide presentation														
BDP 1 Presentation														

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BDP 2 – GANTT CHART

TASK/WEEK	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
Coding														
Construct Circuit														
Purchase Component and Material														
Drafting Measurement for Chasis														
Cut the Metal Sheet for Welding														
Welding the Chasis														
Assemble all components on chasis														
Hardware Testing														
Whole System Testing														
Result & Analysis														
Update Report														
Presentation BDP 2														