Project Report
on

Solar Powered Grass Cutter

Submitted in the partial fulfillment for the requirements
For the award of the degree of

Bachelor of Engineering
in
Electronics and Telecommunication Engineering

By

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Under the Supervision of
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Academic Year 2023-24

MCT
MANJARA CHARITABLE TRUST
RAJIV GANDHI INSTITUTE OF TECHNOLOGY, MUMBAI
(Permanently Affiliated to University of Mumbai)

Department of Electronics and Telecommunication Engineering

CERTIFICATE

This is to certify that the project entitled **“Solar Powered Grass Cutter”** is a bonafide work of **Swaraj Ahire (B-801), Govinda Garje (B-811), Vrushabh Sawant (B-834) and Satyam Tiwari (B-841)** under the supervision of **Prof. Sanjna Repal** submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of **Bachelor of Engineering in Electronics and Telecommunication Engineering.**

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REPORT APPROVAL FOR B.E.

This project report entitled **"Solar Powered Grass Cutter"** by **Swaraj Ahire, Govinda Garje , Vrushabh Sawant** and **Satyam Tiwari** is approved for the degree of Bachelor of Engineering in Electronics and Telecommunication Engineering from University of Mumbai, in academic year 2023-24.

Examiners:

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Place: Mumbai

Acknowledgments

It is indeed a matter of great pleasure and proud privilege to be able to present this project on **" Solar Powered Grass Cutter".** We would like to express our regards and gratitude to the Principal **Dr. Sanjay U. Bokade** and Head of Department **Dr. Sanjay. D. Deshmukh**. The completion of this project work is a milestone in student life and its execution is inevitable in the hands of a guide. We are highly indebted to the project guide **Prof. Sanjna Repal** for her invaluable guidance and appreciation for giving from and substance to this report. It is due to her enduring efforts, patience and enthusiasm, which has given a sense of direction and purposefulness to this project and ultimately made it a success. We would also like to tender our sincere thanks to the staff members for their cooperation.

Abstract

*I*n the field of sustainable landscape management, the need to reduce environmental impact while improving efficiency is crucial. This research provides an innovative approach to addressing these issues through the development of the Solar Powered Grass Cutter. Our goal, based on the fusion of renewable energy technology and creative design, is to transform standard lawn maintenance techniques by offering a comprehensive system that uses solar power to trim grass efficiently and responsibly.

At its core, the Solar Powered Grass Cutter represents the integration of modern engineering with environmental concern. This device provides a disruptive solution by combining solar panels with precision cutting mechanisms, reducing reliance on fossil fuels and the carbon emissions associated with traditional lawn care equipment.

Key features of the Solar Powered Grass Cutter include:

Renewable energy integration: Through the utilization of solar power, the system operates efficiently and sustainably, reducing environmental impact and promoting eco-conscious practices.

Precision grass cutting: Equipped with advanced cutting mechanisms, the Solar Grass Cutter ensures precise and effective grass trimming, optimizing resource utilization and minimizing waste.

User-friendly design: Designed with user convenience in mind, the Solar Grass Cutter offers intuitive operation and seamless functionality, making it accessible to a wide range of users.

In essence, the Solar Powered Grass Cutter represents an evolutionary jump in lawn maintenance, bringing technological innovation together with environmental responsibility. It represents a dedication to sustainable behaviors as well as a vision for a greener future in which human creativity and environmental consciousness combine to improve our planet's health.

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Chapter 1

Introduction

Due to the continuous increase in the cost of fuel and the effect of emission of gases from the burnt fuel into the atmosphere, this necessitated the use of the abundant solar energy from the sun as a source of power to drive a lawn Grass cutter. Based on the main idea of mowing, a solar powered lawn mower was created and built. The solar powered lawnmower is constructed with a D.C motor, a rechargeable battery, a solar panel, a stainless-steel blade, and a control switch. The D.C motor provides the necessary torque to operate the stainless-steel blade, which is directly linked to the shaft of the D.C motor.

The solar lawnmower is controlled by a switch on the board that closes the circuit and permits electricity to pass to the motor, which drives the mowing blade. The solar charging controller recharges the battery. The created machine's performance was evaluated using several types of grasses. The sun provides sustainable amount of the energy used for various purposes on earth for atmospheric system. The difference is just the application of the energy source. It is assumed that Grass cutter using solar as the energy source will address a number of issues that the standard internal combustion engine and electric motors lawn grass cutter do not. A lawnmower with solar energy will be easier to use, it eliminates down time by frequent trips to the gas station for fill-ups and danger associated with gasoline spillage.

The dangerous emissions generated by the gasoline spillage and that of the internal combustion engine into the atmosphere are eliminated. The solar powered lawnmower will help to reduce air pollution. Thus, solar grass cutter is used.

Chapter 2

Literature Survey

A literature review of Solar Powered Grass Cutter would typically involve summarizing and analyzing key research papers, articles, and publications in the field. Here's a brief overview of some key points that such a review might cover:

2.1 Paper 1: "The Efficiency of Solar PV system “Year of Publish: 2019 Author: Adeel saleem,Faizan Rashid, Kashif Mehmood.

Finding/Outcomes:Maintenance is crucial for PV systems due to their higher maintenance requirements compared to other power generation systems. Improving solar cell efficiency is key to making solar power the largest source of energy generation. Battery discharge should be limited to 50Higher amperage batteries are necessary to meet power demands effectively. Enhancing solar system efficiency improves overall power system stability. Although initially expensive, this method is more cost-effective and reliable in the long run compared to traditional practices.

2.2 Paper 2: "IoT based real-time solar power remote monitoring system" Year of Publish: 2021 Author: Sheikh Hasib Cheragee, Nazmul Hassan

Finding/Outcomes: Successful development of the system, integrating various components. Remote data collection and real-time monitoring of power production and environmental conditions. Use of IoT for continuous data recording and analysis. Improved efficiency through simplified network management and reduced maintenance. Optimization of solar radiation usage for enhanced power generation. Detection of faults for timely response and maintenance.

2.3 Paper 3: "Solar Automated Grass Cutter." Year of Publish : 2021 Author: Prasanna Titarmare, Shital Yende, Priyanka Gaurkhede, Ankit Salunke

Finding/Outcomes: Explanation of a design scheme for an Android mobile application system to control a pattern design grass cutting robot powered by solar energy and based on Arduino. Implementation of touch arrow buttons and voice recognition for controlling the grass cutting robot. Presentation of three operational modes for controlling the robot: touch arrow buttons, voice recognition, and pattern designing through the Android mobile application. The grass cutting robot responds to user inputs (button presses or voice commands) by executing corresponding actions, such as movement in the specified direction.

2.4 Paper 4: "Solar energy technology and its roles in sustainable development." Year of Publish : 2022 Author: Ali O.M.Maka and Jamal M.alabid

Finding/Outcomes: It emphasizes the significant role of solar energy in sustainable development, highlighting its environmental friendliness, abundant supply, and contribution to renewable energy goals. It underscores ongoing technological advancements in both concentrated solar power and solar photovoltaic to meet energy needs efficiently. Moreover, it emphasizes the employment opportunities generated by the solar energy sector, supporting economic development. The paper provides insights into the sustainability of solar energy, examining its environmental and economic impacts. Overall, it portrays solar energy as a key player in shaping the future of the energy sector, offering both environmental benefits and economic opportunities.

Chapter 3

Problem Statement

The problem at hand is the time-consuming and unsustainable nature of conventional lawn maintenance techniques, like hand-cut grass and hand-weeding. These techniques frequently include the use of gasoline-powered machinery, which adds to air and noise pollution and necessitates a large amount of labor. Additionally uneven, and inconsistent grass cutting might give the image of an unmaintained lawn.

Our project seeks to address these challenges by developing an innovative solar-powered grass cutter, designed for residential and small-scale commercial use. The goal is to create an autonomous, eco- friendly, and efficient solution that not only reduces the carbon footprint associated with lawn maintenance but also provides users with a consistently well-maintained lawn.

Chapter 4

Objective

Reduce Manual Labor: The objective of reducing dependency on manual labor for grass cutting in agricultural or landscaping operations aims to streamline tasks by implementing technology and automation. By minimizing reliance on human workers for physically demanding tasks like mowing, organizations can improve efficiency, reduce costs, and enhance productivity. Automated solutions offer consistent results, improve safety, and contribute to environmental sustainability. Overall, embracing technology-driven approaches enables operations to achieve higher levels of efficiency, quality, and competitiveness while creating safer and more sustainable work environments.

Promote Sustainability: An additional objective could be promoting sustainability through the transition from fossil fuel-powered to solar-powered machinery in grass cutting operations. This shift aims to reduce greenhouse gas emissions and minimize environmental impact. By embracing solar energy, organizations can decrease reliance on non-renewable resources, mitigate pollution, and contribute to a greener future. This initiative aligns with global efforts to combat climate change and fosters a more environmentally responsible approach to agricultural and landscaping practices.

Increase Efficiency: To increase efficiency in grass cutting operations, implementing an autonomous or semi-autonomous solar grass cutter can be pivotal. These machines can operate continuously without breaks, significantly reducing downtime and enhancing overall productivity. By harnessing solar power, they also minimize reliance on fossil fuels, contributing to sustainability efforts. This approach streamlines workflow, optimizes resource utilization, and ultimately improves the effectiveness of grass cutting endeavors, aligning with the goal of achieving greater operational efficiency.

Enhance Precision: To enhance precision in grass cutting, transitioning to modern methods allows for more accurate and uniform results compared to traditional approaches. By utilizing advanced technologies such as robotic mowers or GPS-guided machinery, operators can achieve consistent grass height and patterns, enhancing the overall aesthetics and health of the land. This precision ensures that grass is cut at optimal levels, promoting healthier growth and creating visually appealing landscapes. Embracing these modern methods facilitates greater control over cutting parameters, leading to improved land aesthetics and environmental sustainability.

Adaptability: To ensure adaptability, the solar grass cutter should be designed to seamlessly navigate diverse terrains and handle different types of grass or vegetation. Incorporating features such as adjustable cutting heights, terrain-sensing technology, and versatile cutting mechanisms enables the machine to efficiently tackle various landscapes and grass varieties. This adaptability enhances the machine's versatility, allowing it to perform effectively across different agricultural or landscaping environments without compromising cutting quality or efficiency. By prioritizing adaptability in design, the solar grass cutter can effectively meet the diverse needs of users while maximizing its utility and effectiveness in grass cutting operations.

Chapter 5

Block Diagram

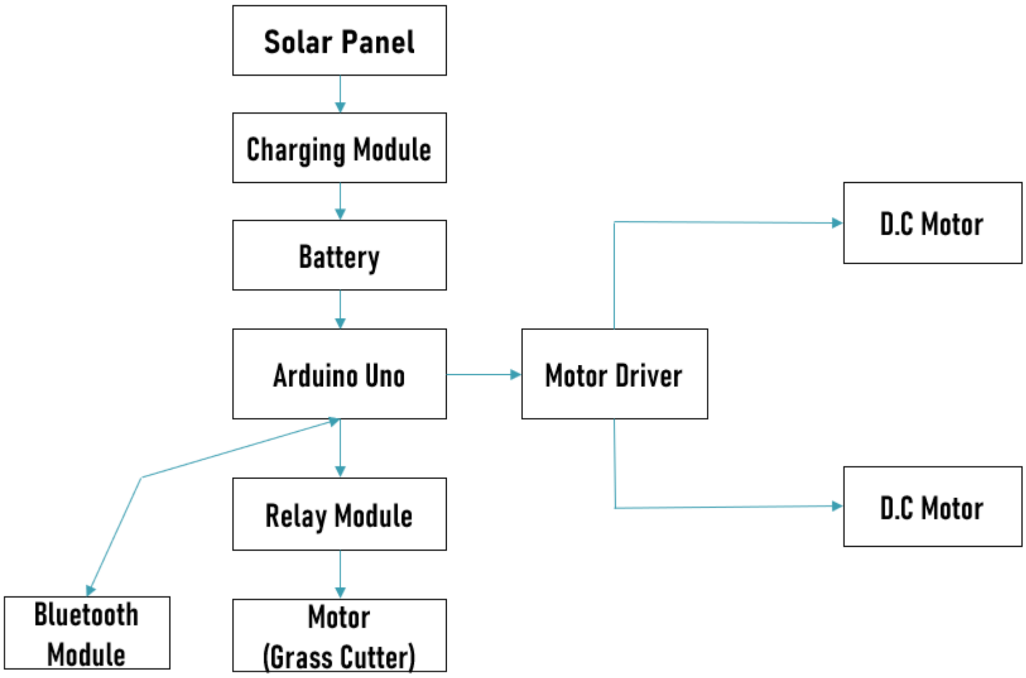


Figure 5.1: BLOCK DIAGRAM

The system uses a solar panel to generate electricity, which is then stored in a battery. An Arduino Uno microcontroller controls the system and communicates with a Bluetooth module. Here's a breakdown of the components:

Solar panel: Converts sunlight into electricity to power the system.

Charging module: Regulates the voltage from the solar panel to safely charge the battery.

Battery: Stores the electricity generated by the solar panel.

Arduino Uno: A microcontroller that controls the entire system. It receives signals from the Bluetooth module and controls the motor driver and relay module.

Motor driver: Drives the DC motors based on the signals received from the Arduino Uno.

Relay module: An electronic switch that can turn on or off the DC motors based on the signal from the Arduino Uno.

Bluetooth module: Enables wireless communication between a smartphone or other Bluetooth device and the Arduino Uno.

DC motors: Two DC motors that drive the wheels of the grass cutter.

Chapter 6

Methodology

6.0.1 System Design: -

1. User Input and Control Interface:

- Utilize a smartphone application or remote control device via HC05 Bluetooth module for sending commands.

- Commands include forward, backward, left, and right for grass cutter movement.

2. Motor Control:

- Arduino Uno and motor driver regulate motor speed and direction based on Bluetooth commands.

- Ensure precise control of grass cutter movement.

3. Grass Cutter Activation:

- Relay module manages activation/deactivation of grass cutter motor in response to start/stop commands from the user interface.

4. Solar Panel Integration:

- Introduce solar panel to charge the grass cutter's battery.

- Solar charge controller regulates charging process, ensuring optimal battery health.

5. Battery Management:

- Monitor battery voltage to determine charging status.

- Solar charge controller stops output voltage when battery nears discharge voltage, prioritizing battery charging.

6.Efficiency and Sustainability:

- Enhance system sustainability by integrating solar power, reducing reliance on external power sources.

- Maximize efficiency by ensuring continuous battery charging while maintaining grass cutter functionality.

6.0.2 Design Considerations:

1. Functionality: The functionality of the solar mower hinges on two crucial aspects: a properly designed front grass cutter for effective mowing and a well-designed and mounted wheel motor holder on the chassis. This ensures the mower operates efficiently.

2. Reliability: Reliability is paramount for any machine, and the solar grass cutter is no exception. To achieve this, all components must be meticulously designed with the loads and forces encountered during operation in mind. This includes factors like:

- Motor and Gear Strength: The motor and gears need to be robust enough to handle the cutting force of the grass and efficiently propel the mower across uneven terrain.

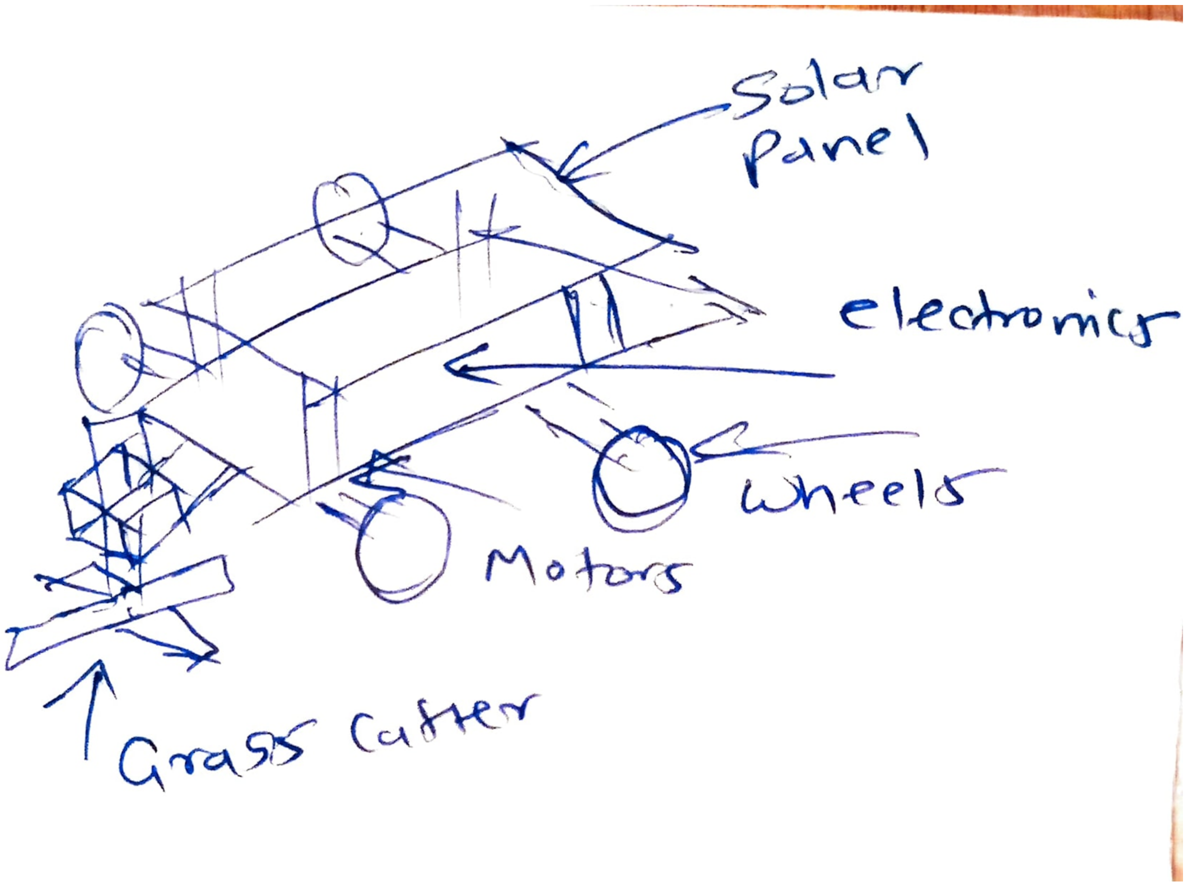
- Chassis Durability: The chassis, which forms the main body of the grass cutter, must be constructed from strong, lightweight materials that can withstand bumps, vibrations, and potential impacts.

- Component Quality: Using high-quality materials throughout the design minimizes the risk of breakdowns and ensures long-lasting performance.

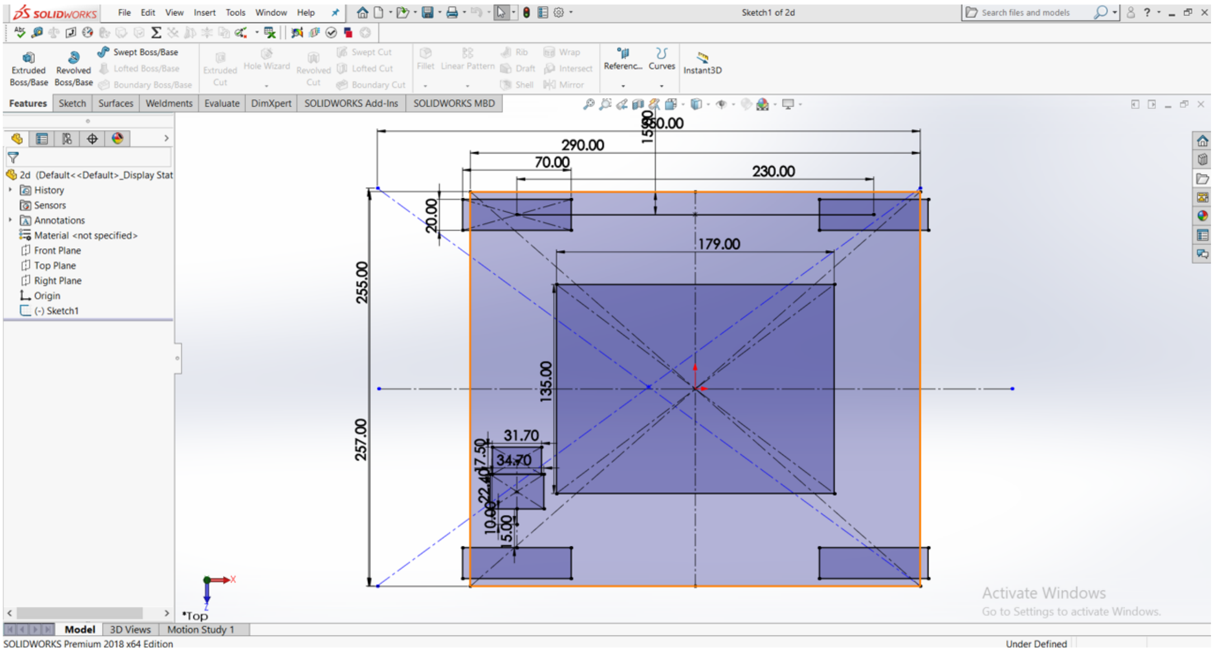
3. Aesthetic: While functionality and reliability are crucial for a solar grass cutter, a touch of aesthetic appeal shouldn't be forgotten. A mower with a sleek, modern design can enhance your outdoor space and make mowing a more enjoyable experience. Imagine a mower that complements your landscaping, not detracts from it. This doesn't necessarily mean sacrificing practicality, but rather achieving a balance between function and form.

6.0.3 Steps of Designing:

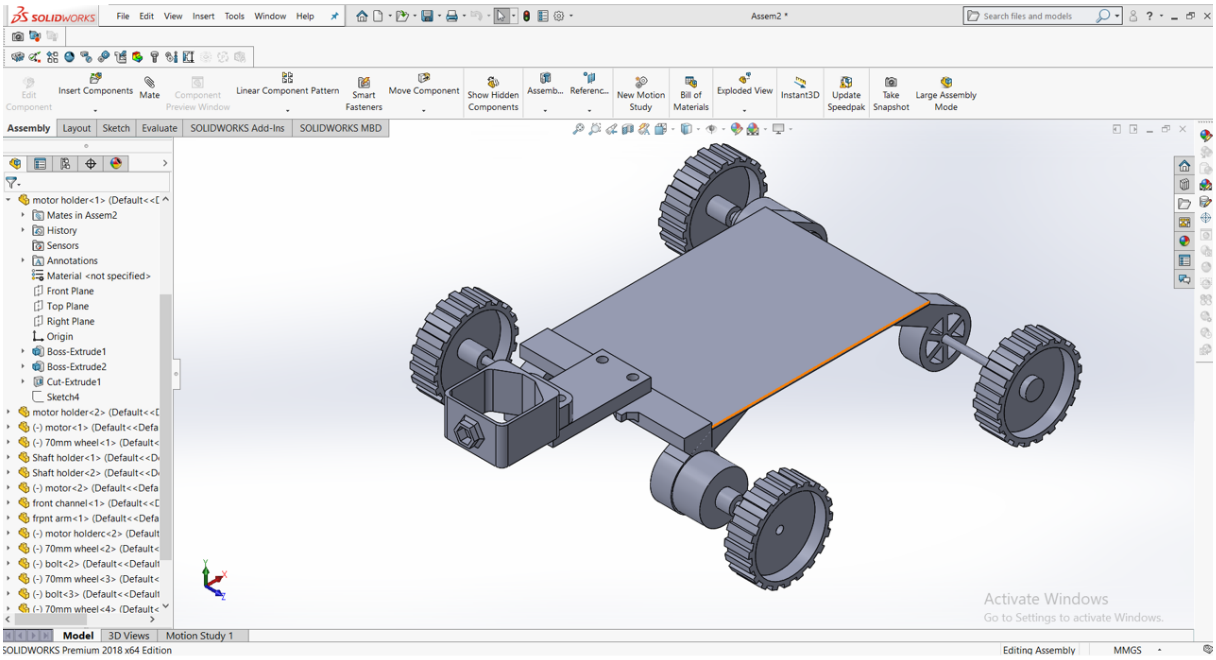
1. Rough sketch: Initially the rough sketch of the vehicle is done which consist the location of grass cutter, Wheels and motors, electronics and solar panel.



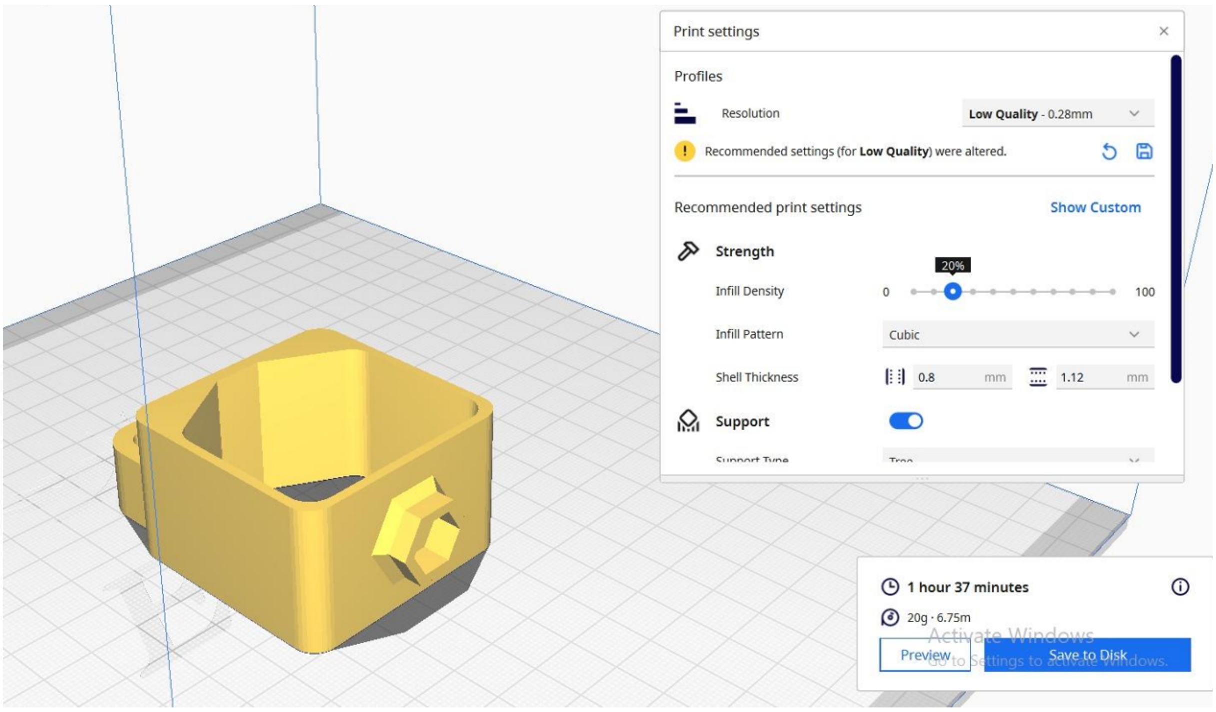
2. 2D sketch with dimensions: By referring the rough sketch and measuring the dimensions of individual parts the 2D sketch is created which will helps to create a final 3d modelling.



3. 3D modelling and assembly: In solidworks software the 3D modelling of parts are done by referring the 2D sketch and assembly of all this parts are done within the software.



4. 3D Slicing: Slicing is done for the 3D printing procedure. In this procedure we have to import the 3d model in .stl extension and after entering the parameters of 3d printers we have to just slice the model. After this slicing operation we get to know about the 3d printing time of parts. This operation is done on the Cura software.



Chapter 7

Calculations

7.0.1 Power Consumption -

1. Two Motors Consuming 150 mA Each:

- Total current drawn by the two motors = 2 * 150 mA = 300 mA

2. Large Motor Consuming 1 A:

- Current drawn by the large motor = 1 A

3. Solar Panel Output:

- Voltage output = 18 V

- Current output = 100 mA

4. Charging the 12 V, 2000 mAh Battery:

- Battery capacity = 2000 mAh

- Voltage = 12 V

Power for each component

1. Two Motors:

- Power consumed by the two motors = Total current * Voltage

- Power = 300 mA * 12 V = 3.6 W

2. Large Motors:

- Power consumed by the large motor = Current * Voltage

- Power = 1 A * 12 V = 12 W

3. Solar Panel:

- Power generated by the solar panel = Current * Voltage

- Power = 100 mA * 18 V = 1.8 W

4. Charging the Battery:

- Power used to charge the battery = Current * Voltage

- Power = 100 mA * 12 V = 1.2 W

Total Power Consumption

- To calculate the total power consumption, we sum up the power consumed by each component:

- Total Power Consumption = Power consumed by Two Motors + Power consumed by Large Motor

- Total Power Consumption = (3.6 W) + (12 W) = 15.6 W

So, the total power consumption of your project is 15.6 watts.

7.0.2 Motor Selection Based on weight Calculation -

1	Solar Panel	1.1 Kg
2	775 DC Motor	0.35 Kg
3	Wheel Motor (0.04Kg x 2)	1.1 Kg
4	Battery: 0.05 x 4	0.2Kg
5	Body and Circuit	0.5 Kg
	Total Weight	2.5Kg

To calculate the torque required for the motors,use the formula:

Torque= Force × Wheel Radius/Gear Ratio

Where:

- Force = Weight of the car (2.5 kg) times Acceleration (assume 1 m/s² for simplicity)

- Wheel Radius = 70 mm/2 = 0.035 m (since diameter is given)

- Gear Ratio = 1 (assuming no gear reduction for simplicity, you may adjust this based on the actual setup)

Let's plug in the values:

Torque=(2.5kg×1m/s2) × 0.035m/1

Torque= 0.0875 Nm / 1

Torque= 0.0875 Nm

So, each motor should provide at least 0.0875 Nm of torque to move the car with a total weight of 2.5 kg, assuming a gear ratio of 1 and an acceleration of 1 m/s².

To convert the torque value from Nm to kg-cm:

1 Nm = 10.1971621298 kg-cm

So, the torque value of 0.0875 Nm is approximately:

$0.0875\text{Nm} \times 10.1971621298\text{kg-cm/Nm}$

$= 0.892\text{kg-cm}$

Each motor should provide at least 0.892 kg-cm of torque to move the car with a total weight of 2.5 kg, assuming a gear ratio of 1 and an acceleration of 1 m/s^2.

7.0.3 Time Required to charge a battery -

- To calculate the time required to charge the battery,use the formula:

1. Convert Battery Capacity: The battery capacity is given in milli-ampere-hours (mAh). Convert it to ampere-hours (Ah) by dividing by 1000.

Battery Capacity (in Ah)=2200mAh / 1000 = 2.2Ah

2. Calculate Charging Current: Use the formula Charging Current = Power (in Watts)/Voltage (in Volts) to find the charging current produced by the solar panel.

Charging Current= 12V/10W = 0.83A

3. Calculate Charging Time: Finally, use the formula Charging Time= Battery Capacity (in Ah)/Charging Current (in Amps) to determine the time required to charge the battery.

Charging Time= 2.2Ah/0.83A = 2.65 hrs

So, it would take approximately 2.65 hours to charge the battery. Actual charging time may vary due to factors such as sunlight intensity, efficiency losses, and the condition of the battery.

7.0.4 Runtime of Solar Powered Grass Cutter -

To calculate the runtime of the solar powered grass cutter, consider the power consumption of the motors and the capacity of the battery.

Given:

Battery Capacity: 2.2 Ah

Total Power Consumption: 15.6 W

We need to convert the battery capacity to ampere-hours (Ah) and then use the formula:

Runtime (in hours)= Battery Capacity (in Ah)/ Total Power Consumption (in Amps)

Runtime (in hours)= 2.2Ah/ (15.6W/12V)

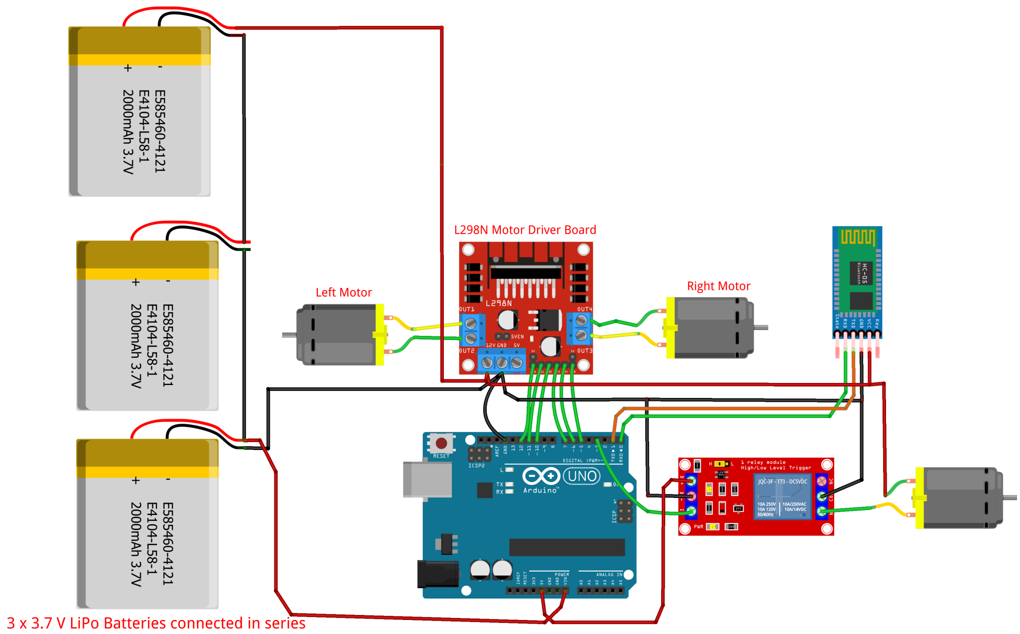
Runtime (in hours)= 2.2Ah / 1.3A

Runtime (in hours)= 1.69hrs

So, the estimated runtime of the solar powered grass cutter, given the provided battery capacity and total power consumption of the motors, is approximately 1.69 hours. Keep in mind that this is an approximation, and actual runtime may vary based on factors such as efficiency losses and variations in motor power consumption during operation.

Chapter 8

Working Principle



The system operates by harnessing solar energy through a solar panel, which converts sunlight into electrical energy. This electrical energy is then fed into a charging module responsible for regulating and controlling the charging process of the battery using the power generated by the solar panel. The battery serves as the primary energy storage unit, supplying power to the various components of the system when needed, ensuring continuous operation even during periods of low or no sunlight.

At the heart of the system is the Arduino Uno microcontroller board, acting as the central control unit, managing the operations of the entire setup. The Arduino Uno interfaces with motor drive circuits or modules, which provide the necessary power and control signals to drive separate DC motors. The DC motor is specifically dedicated to operating a grass cutter mechanism, used for lawn mowing.

In addition to controlling the motor drives, the Arduino Uno also governs a relay module, which contains relays (electrically operated switches) that can turn the grass cutter motor on or off based on commands from the microcontroller. This allows for precise control and operation of the grass cutter mechanism according to predetermined conditions or user input. Furthermore, the system incorporates a Bluetooth module connected to the Arduino Uno, enabling wireless communication and remote-control capabilities. This feature enables users to send commands or monitor the system's status from a mobile device or computer via a Bluetooth connection, providing a convenient and flexible interface for managing the system's operations.

The system is designed to be powered primarily by the solar panel and battery combination, making it a self-sustaining and environmentally friendly setup.The solar panel generates electrical energy from sunlight, which is used to charge the battery through the charging module, ensuring a reliable and renewable power source for the entire system. This approach not only reduces the reliance on traditional energy sources but also contributes to a more sustainable and eco-friendly operation.

Chapter 9

Hardware Specification

9.1 ARDUINO UNO:

The Arduino UNO is a low-cost, adaptable, and user-friendly open-source microcontroller board that may be used in a wide range of electronics applications. This board is compatible with other Arduino boards, Arduino shields, and Raspberry Pi boards. It can control relays, LEDs, servos, and motors as output. The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc and initially released in 2010. Arduino Uno is a microcontroller board that controls the whole system. It has 14 digital input/output pins and all the sensors and motors are connected through these pins. Arduino Uno operates at a voltage of 5 volts. The absolute maximum input voltage for the Arduino Uno is 20 volts. Exceeding this voltage may damage the board. Each digital I/O pin on the Arduino Uno can source or sink up to 20 mA of current.

Figure 9.1: ARDUINO UNO

9.2 SOLAR PANEL (12V 10W)

Solar panels are devices that convert sunlight directly into electricity through the photovoltaic effect. They consist of multiple interconnected photovoltaic cells, typically made from silicon semiconductors, enclosed between protective glass and a backing material. When exposed to sunlight, the solar cells generate an electric current proportional to the intensity of the incident light.

Figure 9.2: SOLAR PANEL

9.3 18650 RECHARGEABLE BATTERY

18650 rechargeable batteries are a popular type of lithium-ion cell, named after their cylindrical form factor of 18mm diameter and 65mm length. They employ a lithium-based cathode and a carbon-based anode, with a non-aqueous electrolyte in between. Key specifications include nominal voltage of 3.6-3.7V, typical capacities ranging from 2000-3500mAh, and energy densities around 200-300Wh/L. 18650 cells can be configured in series or parallel to meet desired voltage and capacity requirements.

Figure 9.3: 18650 RECHARGEABLE BATTERY

9.4 SOLAR CHARGE CONTROLLER

A solar charge controller is an essential component in photovoltaic systems that regulates the charging of batteries from the variable output of solar panels. Its primary functions are to prevent overcharging of the batteries by limiting the voltage and current from the solar array once the batteries are fully charged, and to prevent reverse current flow from the batteries to the panels at night or during low light conditions. Most solar charge controllers typically require a minimum input voltage from the solar panels to start functioning. This voltage threshold is usually around 5 to 6 volts for most controllers.

Figure 9.4: SOLAR CHARGE CONTROLLER

9.5 L298N MOTOR DRIVER

The L298N is a high-voltage, high-current dual full-bridge driver integrated circuit designed to control inductive loads such as DC motors, stepper motors, and other actuators. It features two H-bridge driver circuits with an output current rating of 2A per bridge and peak output current capability of 3A. The L298N operates from a wide supply voltage range of 5V to 35V, making it suitable for a variety of applications.

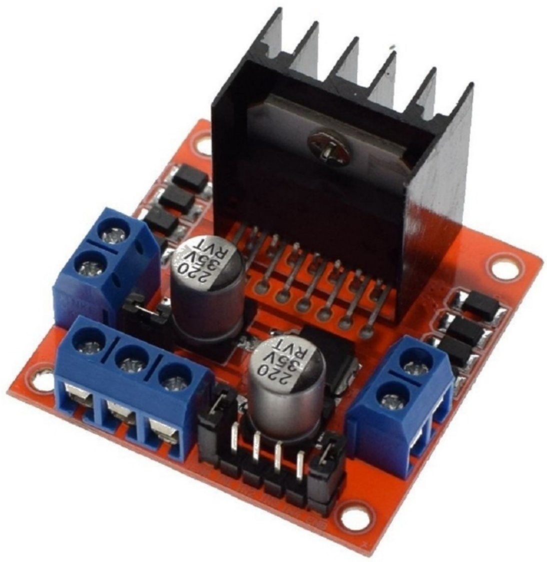


Figure 9.5: L298N MOTOR DRIVER

9.6 2-CHANNEL RELAY MODULE

A 2-channel relay module is an electronic device that allows a low-power control signal, such as a microcontroller output, to switch higher-voltage or higher-current electrical circuits on and off. It consists of two independent electromechanical relays integrated onto a single board. Each relay acts as an electrically operated switch controlled by an input signal, typically at logic levels from 3.3V to 5V. When activated, the relay contacts change state to make or break a connection, enabling the module to control external circuits or loads up to the relay's rated voltage and current capacities.

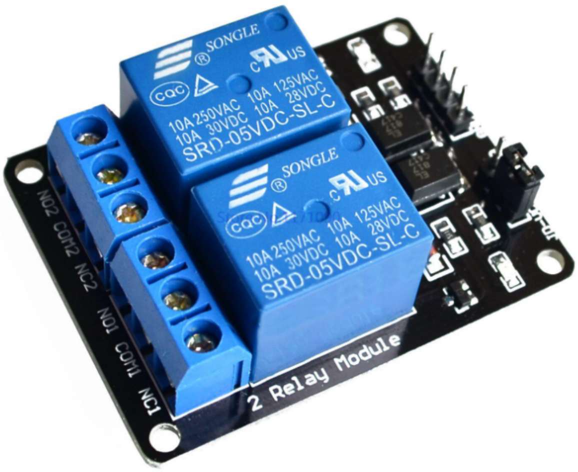


Figure 9.6: 2-CHANNEL RELAY MODULE

9.7 BLUETOOTH MODULE HC-05

The HC-05 is a widely used Bluetooth serial port module designed for transparent wireless serial communication. It is based on the BC417 Bluetooth-to-serial chip. The module operates in the unlicensed 2.4GHz ISM band with a range up to 10 meters. It supports master and slave modes, enabling it to connect to other Bluetooth devices or act as a wireless serial link to a microcontroller or computer.

Figure 9.7: BLUETOOTH MODULE HC-05

9.8 775 DC MOTOR(FOR GRASS CUTTING)

The 775 DC motor is a small, affordable, and versatile permanent magnet direct current (DC) motor commonly used in hobby electronics, robotics, and low-power applications. It is a 12V motor typically found in sizes ranging from 25mm to 50mm diameter. The 775 motor contains a stator with permanently magnetized fields and a slotted rotor assembly with windings that generate an electromagnetic field when energized. When DC power is applied, the interaction between the two fields causes the rotor to spin continuously. Key specifications include the rated voltage (typically 12V), no-load speed (around 3000-9000 RPM), stall torque, and power output (usually under 10W). Higher voltages lead to faster speeds, while the torque drops with increasing RPM.

Figure 9.8: 775 DC MOTOR(FOR GRASS CUTTING)

9.9 18650 LITHIUM BATTERY PROTECTION BOARD

The 18650 Lithium Battery Protection Board is a crucial component in safeguarding the performance and longevity of lithium-ion batteries. Designed specifically for use with 18650 cylindrical cells, this protection board offers comprehensive protection against overcharging, over-discharging, short circuits, and overcurrent conditions. It features a compact form factor and integrates a range of protection mechanisms including overvoltage protection, undervoltage protection, and temperature monitoring.

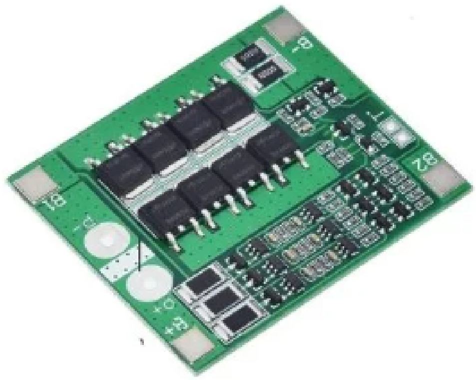


Figure 9.9: 18650 LITHIUM BATTERY PROTECTION BOARD

9.10 12V 500 RPM DC GEARED MOTOR

A 12V 500 RPM DC geared motor is a type of electric motor that operates on a 12V direct current supply and incorporates a gearbox to reduce the output speed while increasing the torque. It consists of a small 12V DC motor, typically a permanent magnet brushed or brushless design, coupled to a compact gearbox assembly. The integrated gearbox contains a gear train that steps down the high revolutions per minute (RPM) of the motor to a lower output speed of approximately 500 RPM. This reduction in speed results in a corresponding increase in output torque, making the motor suitable for applications requiring higher torque at lower speeds, such as driving mechanisms, robotics, actuators, and automation systems.

Figure 9.10: 12V 500 RPM DC GEARED MOTOR

Chapter 10

Circuit Diagram

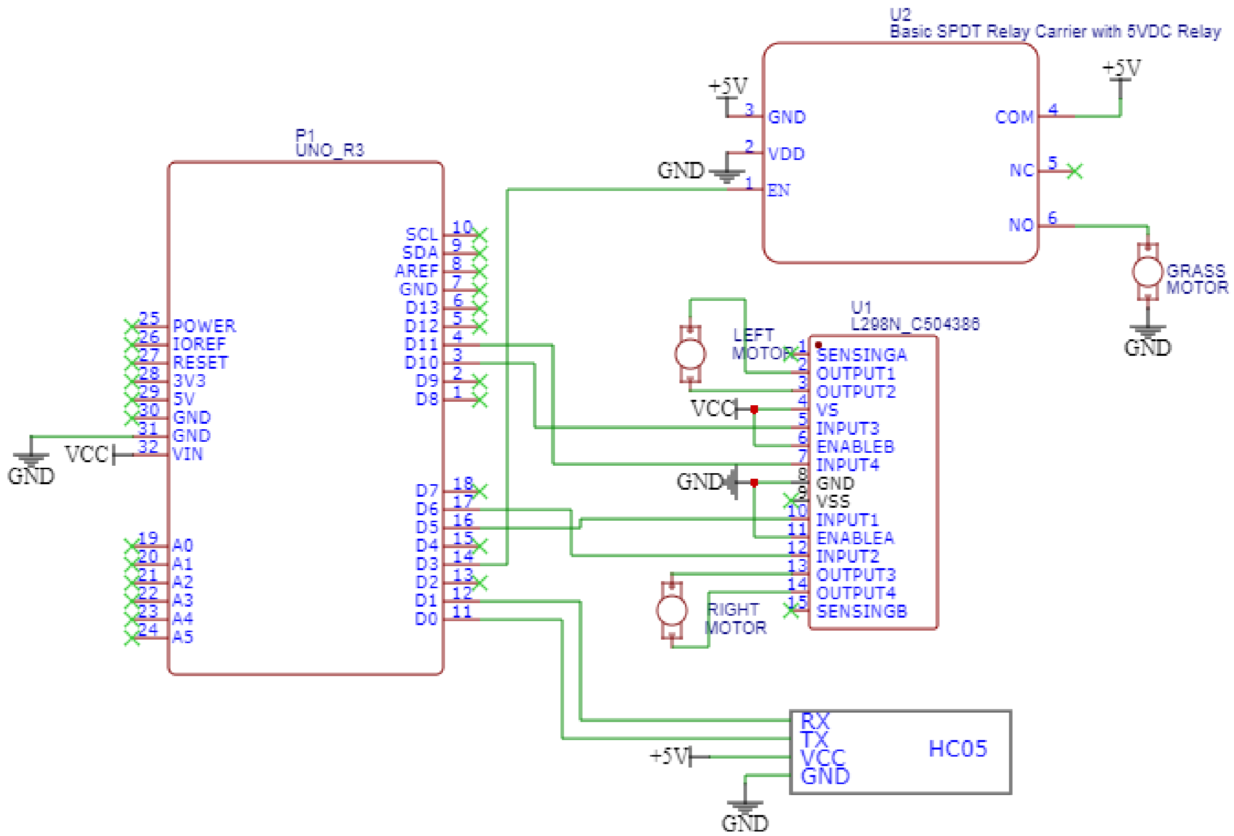


Figure 10.1: CIRCUIT DIAGRAM

Chapter 11

Cost Estimation

Table 11.1: HARDWARE COMPONENTS COST

Sr. No	**Hardware Components**	**Cost (in Rupees)**
1	Arduino UNO	500
2	Solar Panel	1000
3	Solar Charge Controller	900
4	18650 Rechargeable Battery	660
5	L298N Motor Driver	200
6	2-Channel Relay Module	150
7	Bluetooth Module HC-05	400
8	775 DC Motor (For Grass Cutting)	300
9	Lithium Battery Protection	150
10	12V 500 RPM DC Geared Motor	440
11	Chassis	1100
Total		**5800**

Chapter 12

Future Scope

1. Wi-Fi Enabled: The device is equipped with Wi-Fi connectivity, which allows it to communicate with a smartphone app or a cloud-based platform. This feature enables remote control, monitoring, and configuration of the device.

2. Camera-Enabled Views Direct on App: The device likely has one or more cameras that capture live video or still images of the lawn area. These visuals can be streamed or transmitted directly to a companion mobile app, allowing users to monitor the device's progress and the condition of the lawn remotely.

3. Progress Tracking: The device is capable of tracking its progress while mowing or performing other lawn care tasks. This feature could involve GPS tracking, lawn coverage mapping, or other techniques to provide users with real-time updates on the task's completion.

4. Fixed Lawn Boundaries: The device can be programmed or configured to recognize and respect fixed lawn boundaries, ensuring that it operates only within the designated areas and avoids damaging or encroaching on non-lawn areas.

Chapter 13

Results

13.0.1 Model Images

Figure 13.1: SOLAR GRASS CUTTER VEHICLE

Figure 13.2: CUTTING BLADE

Chapter 14

Conclusion

In conclusion, the creation of a solar-powered grass cutter is a possible alternative to standard gas-powered lawn mowers. This unique design eliminates the need for fossil fuels by harvesting solar energy using photovoltaic panels, reducing greenhouse gas emissions and noise pollution. One of the key advantages of the solar grass cutter is its environmentally friendly operation. With no direct carbon emissions during use, it aligns with sustainability goals and the transition towards renewable energy sources.

Despite some current limitations in battery life and cutting capacity for larger areas, continued research and development can address these challenges. Overall, the solar-powered grass cutter represents a step towards more sustainable landscaping practices and a reduced environmental footprint for residential and commercial grounds keeping operations.

Chapter 15

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SOLAR GRASS CUTTER: HARNESSING RENEWABLE ENERGY FOR SUSTAINABLE LAWN MAINTENANCE

Swaraj Ahire, Govinda Garje, Vrushabh Sawant, Satyam Tiwari, Prof. Sanjna Repal

Electronics and Telecommunications & Manjara Charitable Trust's Rajiv Gandhi Institute of Technology

---***---

Abstract - In the realm of sustainable landscape management, the imperative to reduce environmental impact while enhancing efficiency is paramount. This paper presents a pioneering approach to address these challenges through the development of the Solar Grass Cutter. Grounded in the fusion of renewable energy technology and innovative design, our objective is to revolutionize traditional lawn maintenance practices by introducing a comprehensive system that harnesses solar power to trim grass effectively and sustainably.

At its core, the Solar Grass Cutter represents the convergence of modern engineering with environmental concern. This device provides a disruptive solution by combining solar panels with precision cutting mechanisms, reducing reliance on fossil fuels and the carbon emissions associated with traditional lawn care equipment.

Key features of the Solar Grass Cutter include:

1.Renewable energy utilization: Leveraging solar power, the system operates autonomously, reducing dependence on non-renewable energy sources and mitigating environmental impact.

2.Efficient grass cutting: Through innovative design and engineering, the Solar Grass Cutter ensures precise and efficient grass trimming, optimizing resource utilization and minimizing waste.

3.Environmental stewardship: By adopting sustainable practices, the Solar Grass Cutter promotes environmental stewardship, contributing to the preservation of ecosystems and biodiversity.

In essence, the Solar Grass Cutter represents an evolutionary leap in lawn maintenance, bringing technological innovation together with environmental responsibility. It represents a dedication to sustainable behaviours as well as a vision for a greener future in which human inventiveness and environmental consciousness combine to improve our planet's health.

Key Words: Solar Grass Cutter, Renewable Energy, Sustainable Lawn Maintenance, Precision Cutting, Environmental Stewardship, Technological Innovation.

1.INTRODUCTION

Due to the continuous increase in the cost of fuel and the effect of emission of gases from the burnt fuel into the atmosphere, this necessitated the use of the abundant solar energy from the sun as a source of power to drive a lawn Grass cutter. Based on the main idea of mowing, a solar powered lawn mower was created and built. The solar powered lawnmower is constructed with a D.C motor, a rechargeable battery, a solar panel, a stainless-steel blade, and a control switch. The D.C motor provides the necessary torque to operate the stainless-steel blade, which is directly linked to the shaft of the D.C motor. The solar lawnmower is controlled by a switch on the board that closes the circuit and permits electricity to pass to the motor, which drives the mowing blade. The solar charging controller recharges the battery. The created machine's performance was evaluated using several types of grasses. The sun provides sustainable energy for several functions on Earth, including the atmosphere. The only difference is the application of the energy source. It is assumed that Grass cutter using solar as the energy source will address several issues that the standard internal combustion engine and electric motors lawn grass cutter do not. A solar-powered lawnmower is easier to use since it avoids downtime caused by repeated trips to the gas station for refills and the dangers connected with fuel spillage. This eliminates harmful pollutants from gasoline spills and internal combustion engines. The solar powered lawnmower will help to reduce air pollution. Thus, solar grass cutter is used.

2. COMPONENTS USED

1.ARDUINO UNO

Figure 1: Arduino UNO

The Arduino UNO is a low-cost, adaptable, and user-friendly open-source microcontroller board that may be used in a wide range of electronics applications. This board is compatible with other Arduino boards, Arduino shields, and Raspberry Pi boards. It can control relays, LEDs, servos, and motors as output. The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc and initially released in 2010. Arduino Uno is a microcontroller board that controls the whole system. It has 14 digital input/output pins and all the sensors and motors are connected through these pins.

2. SOLAR PANEL

Figure 2: Solar Panel

Solar panels are devices that convert sunlight directly into electricity through the photovoltaic effect. They consist of multiple interconnected photovoltaic cells, typically made from silicon semiconductors, enclosed between protective glass and a backing material. When exposed to sunlight, the solar cells generate an electric current proportional to the intensity of the incident light.

3. 18650 RECHARGEABLE BATTERY

Figure 3: 18650 Rechargeable Battery

18650 rechargeable batteries are a popular type of lithium-ion cell, named after their cylindrical form factor of 18mm diameter and 65mm length. They employ a lithium-based cathode and a carbon-based anode, with a non-aqueous electrolyte in between. Key specifications include nominal voltage of 3.6-3.7V, typical capacities ranging from 2000-3500mAh, and energy densities around 200-300Wh/L. 18650 cells can be configured in series or parallel to meet desired voltage and capacity requirements.

4. SOLAR CHARGE CONTROLLER

Figure 4: Solar Charge Controller

A solar charge controller is an essential component in photovoltaic systems that regulates the charging of batteries from the variable output of solar panels. Its primary functions are to prevent overcharging of the batteries by limiting the voltage and current from the solar array once the batteries are fully charged, and to prevent reverse current flow from the batteries to the panels at night or during low light conditions.

5. L298N MOTOR DRIVER

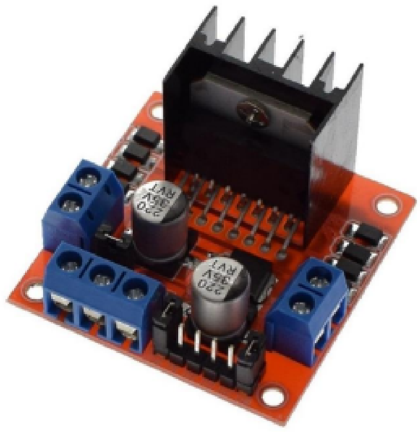


Figure 5: L298N Motor Driver

The L298N is a high-voltage, high-current dual full-bridge driver integrated circuit designed to control inductive loads such as DC motors, stepper motors, and other actuators. It features two H-bridge driver circuits with an output current rating of 2A per bridge and peak output current capability of 3A. The L298N operates from a wide supply voltage range of 5V to 35V, making it suitable for a variety of applications.

6. 2-CHANNEL RELAY MODULE

Figure 6: 2-Channel Relay Module

A 2-channel relay module is an electronic device that allows a low-power control signal, such as a microcontroller output, to switch higher-voltage or higher-current electrical circuits on and off. It consists of two independent electromechanical relays integrated onto a single board. Each relay acts as an electrically operated switch controlled by an input signal, typically at logic levels from 3.3V to 5V. When activated, the relay contacts change state to make or break a connection, enabling the module to control external circuits or loads up to the relay's rated voltage and current capacities.

7. BLUETOOTH MODULE HC-05

Figure 7: Bluetooth Module HC-05

The HC-05 is a widely used Bluetooth serial port module designed for transparent wireless serial communication. It is based on the BC417 Bluetooth-to-serial chip. The module operates in the unlicensed 2.4GHz ISM band with a range up to 10 meters. It supports master and slave modes, enabling it to connect to other Bluetooth devices or act as a wireless serial link to a microcontroller or computer.

8. 775 DC MOTOR (FOR GRASS CUTTING)

Figure 8: 775 DC Motor (For Grass Cutting)

The 775 DC motor is a small, affordable, and versatile permanent magnet direct current (DC) motor commonly used in hobby electronics, robotics, and low-power applications. It is a 12V motor typically found in sizes ranging from 25mm to 50mm diameter. The 775 motor contains a stator with permanently magnetized fields and a slotted rotor assembly with windings that generate an electromagnetic field when energized. When DC power is applied, the interaction between the two fields causes the rotor to spin continuously.
Key specifications include the rated voltage (typically 12V), no-load speed (around 3000-9000 RPM), stall torque, and power output (usually under 10W). Higher voltages lead to faster speeds, while the torque drops with increasing RPM.

9. DUAL SHAFT DC GEARED MOTOR (FOR WHEELS)

Figure 9: Dual Shaft DC Geared Motor (For Wheels)

A dual shaft geared DC motor is a type of electric motor that incorporates an integrated gearbox and has two parallel output shafts rotating in opposite directions. It combines the characteristics of a traditional geared DC motor with an additional coaxial shaft.
The motor consists of a small DC motor, typically brushed or brushless, coupled to a compact gearbox assembly. The gearbox contains a system of gears or planetary gear trains that reduce the high-speed rotation of the motor to a lower output speed while increasing the torque.

10. JUMPER WIRES

Figure 10: Jumper Wires

Jumper wires are simple electrical cables used to transfer signals or make temporary connections between components on a breadboard, circuit board, or other prototyping systems. They typically consist of a strand of flexible insulated wire with connector pins, often male-to-male or male-to-female, at each end.
The wires come in various colors to facilitate organization and tracing of connections. Common conductive materials used for the internal wire include solid or stranded copper, tinned copper, or copper alloy. The insulation is usually PVC, though silicone and other materials are also used.

11. CONNECTING WIRES

Figure 11: Connecting Wires

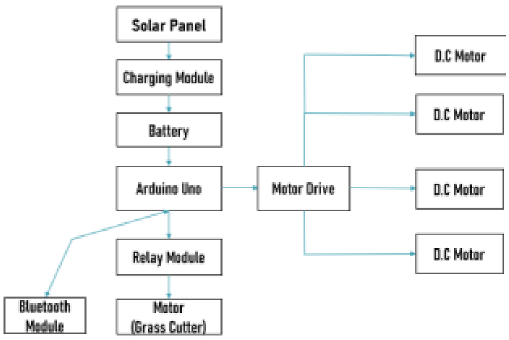
Connecting wires are insulated electrical conductors used to create temporary or permanent point-to-point connections between components in an electronic circuit or system. They serve as the electrical pathways for transferring signals, power, and ground references.
These wires consist of a solid or stranded conductive core, typically made of copper or copper alloy, surrounded by an insulating jacket made of materials like PVC, PTFE (Teflon), silicone rubber, etc. The insulation prevents short circuits and provides protection against environmental factors.

12. 18650 LITHIUM BATTERY PROTECTION BOARD

Figure 12: 18650 Lithium Battery Protection Board

The 18650 Lithium Battery Protection Board is a crucial component in safeguarding the performance and longevity of lithium-ion batteries. Designed specifically for use with 18650 cylindrical cells, this protection board offers comprehensive protection against overcharging, over-discharging, short circuits, and overcurrent conditions. It features a compact form factor and integrates a range of protection mechanisms including overvoltage protection, undervoltage protection, and temperature monitoring.

3. BLOCK DIAGRAM OF SOLAR GRASS CUTTER



The system operates by harnessing solar energy through a solar panel, which converts sunlight into electrical energy. This electrical energy is then fed into a charging module responsible for regulating and controlling the charging process of the battery using the power generated by the solar panel. The battery serves as the primary energy storage unit, supplying power to the various components of the system when needed, ensuring continuous operation even during periods of low or no sunlight.

At the heart of the system is the Arduino Uno microcontroller board, acting as the central control unit, managing the operations of the entire setup. The Arduino Uno interfaces with motor drive circuits or modules, which provide the necessary power and control signals to drive separate DC motors. The DC motor is specifically dedicated to operating a grass cutter mechanism, used for lawn mowing.

In addition to controlling the motor drives, the Arduino Uno also governs a relay module, which contains relays (electrically operated switches) that can turn the grass cutter motor on or off based on commands from the microcontroller. This allows for precise control and operation of the grass cutter mechanism according to predetermined conditions or user input.

Furthermore, the system incorporates a Bluetooth module connected to the Arduino Uno, enabling wireless communication and remote-control capabilities. This feature enables users to send commands or monitor the system's status from a mobile device or computer via a Bluetooth connection, providing a convenient and flexible interface for managing the system's operations.

The system is designed to be powered primarily by the solar panel and battery combination, making it a self-sustaining and environmentally friendly setup. The solar panel generates electrical energy from sunlight, which is used to charge the battery through the charging module, ensuring a reliable and renewable power source for the entire system. This approach not only reduces the reliance on traditional energy sources but also contributes to a more sustainable and eco-friendly operation.

4. CODE

//This program is used to control a robot using a app that communicates with Arduino through a bluetooth module.

```
#define in1 5 //L298n Motor Driver pins.
#define in2 6
#define in3 10
#define in4 11
#define LED 4
#define RelayPin 3;
int command; //Int to store app command state.
int Speed = 255; // 0 - 255.
int Speedsec;
int buttonState = 0;
int lastButtonState = 0;
int Turnradius = 0; //Set the radius of a turn, 0 - 255 Note:the robot will malfunction if this is higher than int Speed.
int brakeTime = 45;
int brkonoff = 1; //1 for the electronic braking system, 0 for normal.
void setup() {
  pinMode(in1, OUTPUT);
  pinMode(in2, OUTPUT);
  pinMode(in3, OUTPUT);
  pinMode(in4, OUTPUT);
  pinMode(LED, OUTPUT); //Set the LED pin.
  pinMode(RelayPin, OUTPUT);
  Serial.begin(9600);  //Set the baud rate to your Bluetooth module.
}

void loop() {
  if (Serial.available() > 0) {
    command = Serial.read();
    Stop(); //Initialize with motors stoped.
    switch (command) {
      case 'X':
        grass();
      case 'Z':
        nograss();
      case 'F':
        forward();
        break;
      case 'B':
        back();
        break;
      case 'L':
        left();
        break;
      case 'R':
        right();
        break;
      case 'G':
        forwardleft();
```

5. CONCLUSIONS

In conclusion, the creation of a solar-powered grass cutter is a possible alternative to standard gas-powered lawn mowers. This unique design eliminates the need for fossil fuels by harvesting solar energy using photovoltaic panels, reducing greenhouse gas emissions and noise pollution.

One of the key advantages of the solar grass cutter is its environmentally friendly operation. With no direct carbon emissions during use, it aligns with sustainability goals and the transition towards renewable energy sources.

Despite some current limitations in battery life and cutting capacity for larger areas, continued research and development can address these challenges. Overall, the solar-powered grass cutter represents a step towards more sustainable landscaping practices and a reduced environmental footprint for residential and commercial groundskeeping operations.

6. REFERENCES

1. P. Titarmare, S. Yende, P. Gaurkhede, A. Salunke, and H. Turkar, "Research paper on solar automated grass cutter," International Journal of Advance Research, Ideas and Innovations in Energy, vol. 7, no. 3, pp. 7, 2021.

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Poster


Rajiv Gandhi Institute of Technology,
Juhu Versova Link Road, Andheri (W), Mumbai - 400053
Department of Electronics and Telecommunication
"Solar Powered Grass Cutter"
Presented by - Mr.Swaraj Ahire, Mr.Govinda Garje, Mr.Vrushabh Sawant, Mr.Satyam Tiwari
Guided by - Prof. Sanjna Repal
Session 2023-2024
ABSTRACT:- Maintaining lawns and grasslands by frequent mowing is a routine activity that has traditionally been accomplished with gas-powered or electric lawn mowers. However, these traditional mowers contribute to air and noise pollution and incur constant operational costs. The paper suggests using a solar-powered grass cutter as an environmentally beneficial and sustainable option. Key features include a lightweight frame, high-efficiency brushless motors, and charge controllers for optimized energy capture and usage. With no direct emissions and much lower operating costs compared to gas mowers, the solar grass cutter promotes greener landscaping practices.
INTRODUCTION:- Maintaining grassy areas requires regular mowing, but traditional gas and electric lawnmowers are polluting, noisy and unsustainable. This poster depicts a revolutionary solar-powered lawn cutter that uses renewable energy to provide an environmentally responsible and quiet solution for gardening needs. The self-contained device stores an onboard battery pack using photovoltaic cells, which then power high-efficiency electric motors that spin the cutting blades. The solar grass cutter promotes better lawn care methods by eliminating direct emissions, significantly lowering running costs, and producing excessive noise. Key benefits of this technology include emissions-free operation, low noise output, sustainable energy usage, lower operating costs compared to gas mowers, and zero reliance on fossil fuels.
CIRCUIT DIAGRAM:-
RESULT:-
FUTURE SCOPE:- Wi-Fi Enabled: The device is equipped with Wi-Fi connectivity, which allows it to communicate with a smartphone app or a cloud-based platform. This feature enables remote control, monitoring, and configuration of the device. Camera-Enabled Views Direct on App: The device likely has one or more cameras that capture live video or still images of the lawn area. These visuals can be streamed or transmitted directly to a companion mobile app, allowing users to monitor the device's progress. Progress Tracking: The device is capable of tracking its progress while mowing or performing other lawn care tasks. This feature could involve GPS tracking, lawn coverage mapping, or other techniques to provide users with real-time updates on the task's completion. Fixed Lawn Boundaries: The device can be programmed or configured to recognize and respect fixed lawn boundaries, ensuring that it operates only within the designated areas and avoids damaging or encroaching on non-lawn areas.
CONCLUSION:- In conclusion, the creation of a solar-powered grass cutter is a possible alternative to standard gas-powered lawn mowers. This unique design eliminates the need for fossil fuels by harvesting solar energy using photovoltaic panels, reducing greenhouse gas emissions and noise pollution. One of the key advantages of the solar grass cutter is its environmentally friendly operation. With no direct carbon emissions during use, it aligns with sustainability goals and the transition towards renewable energy sources. Despite some current limitations in battery life and cutting capacity for larger areas, continued research and development can address these challenges. Overall, the solar-powered grass cutter represents a step towards more sustainable landscaping practices and a reduced environmental footprint for residential and commercial groundskeeping operations.
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Chapter 16

Annexure

16.1 Overall Project Code

```
#define in1 5 //L298n Motor Driver pins.
#define in2 6
#define in3 10
#define in4 11
#define LED 4
#define RelayPin 3
int command; //Int to store app command state.
int Speed = 255; // 0 - 255.
int Speedsec;
int buttonState = 0;
int lastButtonState = 0;
int Turnradius = 0;
int brakeTime = 45;
int brkonoff = 1;
void setup() {
 pinMode(in1, OUTPUT);
 pinMode(in2, OUTPUT);
 pinMode(in3, OUTPUT);
 pinMode(in4, OUTPUT);
 pinMode(LED, OUTPUT);
 pinMode(RelayPin, OUTPUT);
 Serial.begin(9600);
 digitalWrite(RelayPin, HIGH);
}

void loop() {
 if (Serial.available() > 0) {
  command = Serial.read();
  Stop(); //Initialize with motors stoped.
```

```
switch (command) {
 case 'X':
 digitalWrite(RelayPin, HIGH); // Turn ON the relay
 Serial.println("Relay turned ON");
 break;
 case 'Z':
 digitalWrite(RelayPin, LOW); // Turn OFF the relay
 Serial.println("Relay turned OFF");
 break;
 case 'F':
 forward();
 break;
 case 'B':
 back();
 break;
 case 'L':
 left();
 break;
 case 'R':
 right();
 break;
 case 'G':
 forwardleft();
 break;
 case 'I':
 forwardright();
 break;
 case 'H':
 backleft();
 break;
 case 'J':
 backright();
 break;
 case '0':
 Speed = 200;
 break;
 case '1':
 Speed = 200;
 break;
 case '2':
 Speed = 200;
 break;
 case '3':
 Speed = 200;
 break;
 case '4':
```

```
   Speed = 200;
   break;
   case '5':
   Speed = 200;
   break;
   case '6':
   Speed = 200;
   break;
   case '7':
   Speed = 200;
   break;
   case '8':
   Speed = 200;
   break;
   case '9':
   Speed = 200;
   break;
   case 'q':
   Speed = 200;
   break;
  }
  Speedsec = Turnradius;
  if (brkonoff == 1) {
   brakeOn();
  } else {
   brakeOff();
  }
 }
}

void forward() {
 analogWrite(in1, Speed);
 analogWrite(in3, Speed);
}

void back() {
 analogWrite(in2, Speed);
 analogWrite(in4, Speed);
}

void left() {
 analogWrite(in3, Speed);
 analogWrite(in2, Speed);
}

void right() {
```

```
 analogWrite(in4, Speed);
 analogWrite(in1, Speed);
}
void forwardleft() {
 analogWrite(in1, Speedsec);
 analogWrite(in3, Speed);
}
void forwardright() {
 analogWrite(in1, Speed);
 analogWrite(in3, Speedsec);
}
void backright() {
 analogWrite(in2, Speed);
 analogWrite(in4, Speedsec);
}
void backleft() {
 analogWrite(in2, Speedsec);
 analogWrite(in4, Speed);
}

void Stop() {
 analogWrite(in1, 0);
 analogWrite(in2, 0);
 analogWrite(in3, 0);
 analogWrite(in4, 0);
}


void brakeOn() {
 //Here's the future use: an electronic braking system!
 // read the pushbutton input pin:
 buttonState = command;
 // compare the buttonState to its previous state
 if (buttonState != lastButtonState) {
  // if the state has changed, increment the counter
  if (buttonState == 'S') {
   if (lastButtonState != buttonState) {
    digitalWrite(in1, HIGH);
    digitalWrite(in2, HIGH);
    digitalWrite(in3, HIGH);
    digitalWrite(in4, HIGH);
    delay(brakeTime);
    Stop();
   }
  }
  // save the current state as the last state,
```

```
  //for next time through the loop
  lastButtonState = buttonState;
 }
}
void brakeOff() {

}
```