PARUL INSTITUTE OF ENGINEERING AND TECHNOLOGY

A Project report on :

Green Groom - An Automatic Solar Grass Cutter and Shaper

Submitted By :

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In fulfilment for the award of the degree of

BACHELOR OF TECHNOLOGY

In

ELECTRONICS & COMMUNICATION ENGINEERING DEPARTMENT

Under the Guidance of

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PARUL INSTITUTE OF ENGINEERING AND TECHNOLOGY

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CERTIFICATE

This is to certify that **ANNAVAJJHULA VAMSI SAI CHARAN** student of B. Tech Sem 8th (Electronics & Communication), bearing Enrolment no.**200303107010** has successfully completed his semester project report on **"Green Groom - An Automatic solar grass cutter and shaper"** as a fulfilment for the course curriculum of B. Tech 8th Semester in the acadamic year **2023-2024.**

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ABSTRACT

The main aim of our project is to maintain In the context of growing environmental concerns and the need for sustainable solutions, this abstract introduces an innovative device, the "Automatic Solar Grass Cutter." it is to maintain a sustainable solution for lawn maintenance This device represents a significant advancement in the field of lawn maintenance, offering an eco-friendly alternative to conventional lawnmowers.The Automatic Solar Grass Cutter is designed to operate autonomously, harnessing the power of solar energy to ensure efficient grass cutting without the need for fossil fuels or grid electricity. Equipped with a solar panel array and an intelligent navigation system, this device can efficiently trim grass in residential lawns, public parks, and various outdoor spaces. The Automatic Solar Grass Cutter is designed to operate autonomously, harnessing the power of solar energy to ensure efficient grass cutting without the need for fossil fuels or grid electricity. Equipped with a solar panel array and an intelligent navigation system, this device can efficiently trim grass in residential lawns, public parks, and various outdoor spaces.

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CHAPTER-1
1.1 INTRODUCTION

• The Green Groom is a mechanical device that cuts grass using solar energy rather than electricity. Unlike standard lawn mowers, which rely on electricity or fossil fuels, this innovative equipment uses solar power to efficiently and alter your lawn.

• This environmentally responsible strategy not only lowers the carbon footprint of lawn upkeep, but it also lessens our dependency on nonrenewable energy sources. Green Groom, which uses abundant and clean energy from the sun, is a sustainable and environmentally responsible option for keeping a lush and manicured lawn.

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CHAPTER-3

3.1 Methodology

This automatic solar grass cutter and shaper may be programmed to cut and shape grass in any desired shape. This cutter bot will be built without the use of basic sensors, but to be more precise and accurate, we will need various components for this project. Because of the ongoing rise in fuel prices and the impact of petrol emissions into the atmosphere, it became imperative to use the sun's abundant solar energy to power a lawn mower.

3.1.1 Existing System

The current method to lawn maintenance is primarily based on physical labour and traditional gas-powered lawnmowers. Manual mowing necessitates tremendous physical work and time, as human operators push or ride the lawnmower over the yard. Conventional lawnmowers run on fossil fuels, which pollute the environment and rely on nonrenewable energy sources. These systems lack advanced automation features, remote control capabilities, and intelligent functionality. Overall, the current system is characterised by labor-intensive activities and little technical innovation, with potential environmental consequences due to the usage of conventional energy sources.

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CHAPTER-4

4.1 HARDWARE DISCRIPTION

4.1.1 Arduino NANO

The Arduino Nano is a compact, comprehensive, and breadboard-friendly board built on the ATmega328 (Arduino Nano 3.0) or ATmega168 (Arduino Nano 2.x). It provides roughly the same capabilities as the Arduino Duemilanove, but in a different packaging. It has simply a DC power jack and uses a Mini-B USB cable rather than a conventional one. Gravitech designed and produces the Nano. Arduino Nano 3.0 (ATmega328): schematic and Eagle files. Arduino Nano 2.3 (ATmega168): Manual (pdf) and Eagle files. Note: Because the free version of Eagle cannot handle more than two levels, and this version of the Nano has four layers, it is published here unrouted so that users can open and use it in the free Eagle. Microcontroller Atmel ATmega168 or ATmega328 Operating Voltage (Logic Level) 5 V Input Voltage (Recommended) 7-12 V Input Voltage (Limits) 6-20 V Digital I/O Pins 14 (with 6 providing PWM output) Analogue Input Pins 8 DC current per I/O pin: 40 mA Flash Memory: 16 KB (ATmega168) or 32 KB (ATmega328), with the bootloader using 2 KB. SRAM: 1 KB (ATmega168) or 2 KB (ATmega328).
4.1.3 L298N DC Motor Driver Module :
If you intend to assemble your new robot friend, you should eventually learn how to control DC motors. Connecting the L298N Motor Driver to an Arduino is one of the simplest and most cost-effective ways to drive DC motors

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When utilised in conjunction with an IR transmitter and receiver, the wavelength of the receiver must match that of the transmitter. Here, the transmitter is an IR LED and the receiver is an IR photodiode. The infrared photodiode responds to infrared light emitted by an infrared LED. The photodiode's resistance and output voltage alter proportionally to the amount of infrared light collected. This is the IR sensor's essential operating concept.When the infrared transmitter emits, it gets to the item, and some of it reflects back to the infrared receiver. The sensor output can be determined by the IR receiver based on the intensity of the response.
Types of Infrared Sensor
Infrared sensors are categorised into two types: active IR sensors and passive IR sensors.
Active IR Sensor
This active infrared sensor contains both the transmitter and the receiver. In the majority of applications, light-emitting diodes are used as sources. LEDs are non-imaging infrared sensors, whereas laser diodes are imaging infrared sensors.

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CHAPTER-5

5.1 Observation and Results

5.1.1 Observation

In automatic mode the grass cutter robot will turn right first when there is an object in front of it .

In Manual mode with the help of Bluetooth connection with a smart phone we can navigate our way through objects easily.

Outdoor places on a sunny days the robot charges itself efficiently.

According to the height of the grass the blades can be adjusted properly.

5.1.2 Results

As mentioned before the robot can be operated in both automatic and manual modes.

In automatic mode robot can easily navigate itself through obstacles with ease.

In manual mode with the help of Bluetooth connectivity using a smartphone user can navigate the robot.

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CHAPTER-6

6.1 Conclusion

Based on observations, it can be determined that the system is more efficient than previous designs because it eliminates the need for human labour and is pollution-free. The method works particularly effectively on lawns with a flat surface. However, on uneven ground, the obstacle recognition stage may fail to detect nearby items.The solar grass cutter is primarily intended for campus cleaning in a sustainable and effective manner. Grass cutting is one of the key operations carried out on campus to maintain cleanliness. This is a time-consuming and labor-intensive technique. In addition, it uses a lot of fuel. The standard grass cutter that is utilised on campus is pricey. As a result, both the capital and operating costs are extremely expensive. Furthermore, one grass cutter is insufficient for campuses with huge areas such as educational institutions, playgrounds, garden areas, parks, etc. To address all of the issues raised above, the automated lawn cutter we proposed in the study could be an effective solution. If properly charged, the cutter can be used during the day or at night. Because of the shorter number of daylight hours during the rainy season, full charging takes a long time, which is a disadvantage for consumers. The machine is also far less expensive than current cutters. Solar energy, or fuel, is free. As a result, the operating costs in this scenario are almost negligible. The self-life of the solar panel is over twenty years. As a result, the machine will function properly for many years. Our design suggests a pollution-free environment.

6.2 Future scope

The ability to cut grass on uneven surfaces.

Using Image processing and Open CV the robot can cut grass in desired shape automatically

CHAPTER-1

1.1 INTRODUCTION

The Green Groom is a mechanical device that cuts grass using solar energy rather than electricity. Unlike standard lawn mowers, which rely on electricity or fossil fuels, this innovative equipment uses solar power to efficiently and alter your lawn. This environmentally responsible strategy not only lowers the carbon footprint of lawn upkeep, but it also lessens our dependency on nonrenewable energy sources. Green Groom, which uses abundant and clean energy from the sun, is a sustainable and environmentally responsible option for keeping a lush and manicured lawn. In addition to the environmental certifications, Green Groom has tackled the labor-intensive components of lawn care. It is outfitted with cutting-edge technologies and sophisticated components to ensure simplicity of use and efficiency. Homeowners no longer need to spend hours pulling lawn mowers or worrying about petrol. Green Groom automates lawn upkeep, making it easier and more efficient. Essentially, the Green Groom is a huge step forward in the way we maintain our lawns. It not only promotes a cleaner and greener environment but also lessens the strain of lawn upkeep for homeowners, making it a win-win solution for the earth and their caretakers outside. This innovative machine embodies the principles of sustainability and ethical wilderness management.

1.2 EXISTING SINARIO

Manual grass cutters use fuel, therefore a solar cutter is a suitable alternative. Because of the advancements in technology, the lawn maintenance sector need a solar grass cutter with an automated process. The automatic solar grass cutter navigates the obstacles while also cutting the grass. This autonomous process was previously carried out with the help of an ultrasonic sensor. Gas-powered lawn mowers generate noise pollution in residential areas. Traditional grass cutting methods take significant manual labour and time. Large lawns or outside areas can be time-consuming to maintain.

1.3 SCOPE

This automatic solar grass cutter and shaper will be configured to cut and shape the grass in any desired shape. This cutter bot will be constructed without the use of basic sensors, but in order to be more exact and accurate, we will employ several components for this project. Because of the constant rise in fuel prices and the effect of petrol emissions from burned fuel into the atmosphere, it became necessary to use the sun's plentiful solar energy to power a lawn mower.

1.4 AIM

“To design and implement an automatic and manual solar grass cutter and shaper robot”

CHAPTER-2

2.1 LITRATURE REVIEW

For developing a new technique to integrate the hardware and software parts of the project we have researched a total of 20 research papers and devised a new methodology .

2.1.1 Research paper presented by Md. Rawshan Habib, Koushik Ahmed, Naureen Khan, Mahbubur Rahman Kiran, Md. Ahasonul Habib, Md. Tanvir Hasan and Omar Farrok on automatic solar grass cutter titled "PID Controller Based Automatic Solar Power Driven Grass Cutting Machine" and published on International Conference on Computer, Communication, Chemical, Materials and Electronic Engineering (IC4ME2). It .Utilizes a color sensor to detect the position of grass based on a specified green color signal.Uses two-degree-of-freedom PID controllers to control the motor speed.Powered primarily by an 8W, 9V solar panel.Includes rechargeable Li-poly batteries (3.7 V) for energy storage.The research paper titled "PID Controller Based Automatic Solar Power-Driven Grass Cutting Machine" presents an innovative approach to grass cutting using solar power and PID (Proportional-Integral-Derivative) controllers. The system comprises a lightweight, portable device with motor-driven cutting blades and a color sensor for grass detection. However, the paper highlights the need to address challenges such as battery capacity, obstacle detection, maintenance, and market viability. Overall, this research offers a promising solution for eco-friendly grass cutting but underscores the importance of further development and real-world testing.

2.1.2 Research paper presented by M. Manimegalai,V. Mekala,N. Prabhuram,D. Suganthan,Department of ECE titled "Automatic Solar Powered Grass Cutter Incorporated with Alphabet Printing and Pesticide Spray" published on IEEE.When an obstacle is detected by the ultrasonic sensor, the grass cutter avoids it by turning left (first detection) and right (second detection).The system can cut grass in the shape of alphabets and spray pesticides as needed.Solar power eliminates pollution and reduces operational costs.The research paper discusses the development of an Automatic Solar-Powered Grass Cutter that incorporates features like alphabet printing and pesticide spraying. The system aims to reduce human intervention in lawn maintenance, operating on solar power to minimize pollution. I By combining grass cutting, alphabet printing, and pesticide spraying into a single machine, the research aims to reduce space, costs, and manpower required for lawn maintenance. The system utilizes ultrasonic sensors, an Arduino UNO board, and a solar panel for efficient operation. , leaving room for further development and validation.

2.1.3 Research paper presented by Prof. V. K. Thombare , Ashish Kadam ,Ranjit Pawar,Rutuja Patil

,Vaibhav Kaingade ,Suhas Kumbhoje titled "Solar Based Automatic Grass Cutting Robot" presented on IEEE .The system uses a 10W solar panel to charge the battery, reducing the need for external power.By using solar power, the project aims to reduce pollution and noise associated with gasoline-powered lawn mowers.The system can operate in both manual and automatic modes.Users can control the robot via a Bluetooth application.The research paper presents a Solar-Based Automatic Grass Cutting Robot designed to minimize human effort in lawn maintenance. This robot is powered by solar energy and incorporates various sensors, including ultrasonic and accelerometer sensors, to detect and avoid obstacles during grass cutting. It also offers both automated and manual operation through an Arduino microcontroller and Bluetooth technology. However, the paper lacks detailed technical specifications and comprehensive data, leaving room for further research and development to ensure the robot's practicality and reliability.

2.1.4 Research paper presented by Balakrishna K, Rajesh N titled "Design of remote monitored solar powered grasscutter robot with obstacle avoidance using IoT" presented on Global Transitions Proceedings 3.The robot is equipped with a Bluetooth module (HC-05), enabling wireless communication with a mobile device through the Blynk application. Users can remotely control the robot using the app. The robot can perform various control functions, including forward movement, backward movement, right movement, left movement, on/off mechanisms for the grass cutter blade, and a stop function to prevent collisions.Developing a solar-powered grasscutter robot with IoT-enabled obstacle avoidance presents a multifaceted challenge. The project encompasses power management, energy efficiency, reliable obstacle detection, IoT integration, and robust navigation algorithms. Ensuring durability, cost-efficiency, and regulatory compliance are additional hurdles. User experience, data security, and environmental impact considerations further complicate this endeavor. Successfully addressing these challenges demands a holistic approach and iterative design improvements, promising a practical and eco-friendly solution for automated grass cutting.

2.1.5 Research paper presented by Firas B. Ismail, Nizar F.O. Al-Muhsen, Fazreen A. Fuzi, A. Zukipli titled "Design and Development of Smart Solar Grass Cutter", presented on International Journal of Engineering and Advanced Technology (IJEAT). Microcontroller: An Arduino UNO board serves as the main control unit for the grass cutter.Remote Control: The grass cutter can be remotely controlled using a smartphone via a Bluetooth module (HC-05).The Smart Solar Grass Cutter is a renewable energy-powered grass-cutting device designed to reduce air pollution and improve efficiency. It features a 12V, 10W solar panel as the primary energy source and a 12V, 7Ah lithium-ion battery for energy storage. Controlled by an Arduino UNO and a smartphone via Bluetooth, the grass cutter operates for over two hours on a full charge, offering an efficiency of approximately 93.37%. Its mechanical reliability is confirmed through

stress-strain analysis, and it presents a promising eco-friendly alternative to traditional grass cutters.

2.1.6 Research paper presented by V.Kubendran, S.George Fernandez, K.Vijayakumar, K.Selvakuma, titled "A Fully Automated Lawn Mower Using Solar Panel", presented on Journal of advanced research in dynamical and control system. Arduino Nano: The brain of the robotic mower, an Arduino Nano, controls various actions, enhancing modularity and adaptability for future modifications. It operates at 5V, with a clock speed of 16 MHz, and has 8 analog input pins. Boundary Detection: Light-dependent resistors (LDRs) are used to detect the boundaries of the lawn. When laser beams (A, B, and C) are detected. The research paper titled "A Fully Automated Lawn Mower Using Solar Panel" explores the development of an innovative solar-powered automated lawn mower. This robotic vehicle is designed to autonomously cut grass without human intervention while avoiding obstacles. The mower employs light-dependent resistors (LDRs) for boundary detection and incorporates a unique algorithm that allows it to navigate in straight lines and make right-angle turns. While the paper presents an intriguing concept, it lacks detailed real-world performance data and assessment metrics, highlighting the need for further research and testing to validate its practicality.

2.1.7 Research paper presented by Kartik R. Khodke, Himanshu Kukreja, Sumit Kotekar, Nital kukade, C. J. Shende , titled "Grass Cutter Machine" presented on International Journal of Emerging Technologies in Engineering Research (IJETER).Developing grass cutting machines with smart features, such as GPS-guided mowing patterns, remote control, or smartphone app integration, could be an area of innovation.The paper titled "Literature Review of Grass Cutter Machine" provides an overview of technological developments in the field of grass cutting machines. It discusses the historical evolution of grass cutting, from manual methods to modern machines. The paper highlights the importance of efficient grass cutting in various applications, including agriculture. It mentions different types of grass cutters powered by solar, electric, and internal combustion engines available in the market. The authors aim to innovate and fabricate a grass cutting machine tailored for agricultural use, emphasizing the need for improved technology in this domain.

2.1.8 Research paper presented by Praful P. Ulhe Manish D. Inwate Fried D. Wankhede Krushnkumar S. Dhakte titled "Modification of Solar Grass Cutting Machine" presented on International Journal for Innovative Research in Science & Technology.The machine features a spiral cutting blade to efficiently cut grass.The grass cutter can operate in both manual and motor-driven modes. In the motor-driven mode, it can be remotely controlled.The machine includes a collecting box to gather and store the cut grass, preventing it from scattering on the lawn or ground.An RF (Radio Frequency) module is used for remote control operation, allowing for safer and more convenient use.The research paper discusses the

modification of a solar-powered grass cutting machine for enhanced efficiency and ease of operation. It introduces the use of spiral cutting blades and RF remote control to improve grass cutting performance. The machine utilizes solar panels to harness renewable energy, minimizing environmental impact. However, the paper lacks specific technical details and empirical data to support its claims effectively. It is crucial to address these shortcomings for a more comprehensive and informative research paper.

2.1.9 Research paper presented by Kola Snigdha, Bhavana Sai Priya, Shresta, Sindhuja, P. Hari Krishna Titled "IOT – BASED AUTOMATIC SOLAR GRASS CUTTER WITH SCALABLE PATTERNS" presented on Journal of Emerging Technologies and Innovative Research (JETIR)July 2022, Volume 9, Issue 7.The research paper presents a groundbreaking IoT-based automatic solar grass cutter, harnessing renewable energy and Bluetooth technology for remote control.This innovation significantly reduces manual labor, environmental pollution, and offers scalable grass cutting patterns, marking a pivotal advancement in automated lawn maintenance.The research paper discusses an innovative IoT-based automatic solar grass cutter designed to cut various patterns in public places like parks and gardens. Utilizing Arduino technology and powered by solar panels, the system can be remotely controlled via Bluetooth from a smartphone. The design aims to reduce the tedious manual labor involved in grass cutting while minimizing environmental impact. The paper outlines the components used, such as solar panels, rechargeable batteries, and DC motors, to achieve a sustainable and efficient grass cutting solution. Overall, the project offers an eco-friendly and scalable approach to grass maintenance in public spaces.

2.1.10 Research paper presented by Dhanaraju Athina, D Kiran Kumar, R.B.Kalyani,Kolli Vittal. Titled "Solar Grass Cutter Using Embedded Platform An Experimental Validation" . Presented on IOP Conf. Series: Materials Science and Engineering .The grass cutting robot is equipped with a set of sensors, including GPS, cameras, temperature sensors, and battery level sensors, to collect essential data for monitoring and control.The system seamlessly integrates Internet of Things (IoT) technology, allowing remote monitoring and control of solar grass cutting robots via a cloud-based platform.This research paper explores the design and development of an innovative automatic solar-powered grass cutter, aiming to address environmental concerns and enhance lawn maintenance practices. It presents a comprehensive system architecture integrating solar panels, energy storage, and autonomous navigation technology. The paper emphasizes energy efficiency, obstacle detection, and cutting precision. Field testing results showcase the machine's adaptability and reduced carbon emissions, promising a sustainable and efficient solution. However, potential challenges include optimizing energy storage, ensuring robust obstacle avoidance, and addressing scalability for broader applications.

2.1.11 Research paper presented by Sushant M. More, Ramappa K. Pujari, Shreyas S. Jadhav, Kiran R.

Kalli, Digvijay P. Mali. Titled "Fully Automatic Solar Grass Cutter".Presented on International Journal of Research in Engineering, Science and Management .The system includes a voltage regulator to manage and optimize energy consumption. This contributes to the overall energy efficiency of the grass cutter, allowing it to operate with minimal power requirements.This research project introduces a solar-powered automatic grass cutter designed to reduce human effort in lawn maintenance. The system employs solar panels to capture and convert solar energy into electrical power, stored in batteries for continuous operation. Controlled via Bluetooth through an Android application, it combines ultrasonic sensors for obstacle avoidance. While the paper lacks empirical evidence and detailed technical specifications, it presents a promising concept for eco-friendly lawn care. However, addressing security concerns, scalability, and providing cost analysis would strengthen its practicality.

2.1.12 Research paper presented by Mallikarjun Mudda, VishwaTeja, Srujan Kumar, Praveen Kumar titled "Automatic Solar Grass Cutter" , presented on International Journal for Research in Applied Science & Engineering Technology (IJRASET).The paper discusses the use of an 8051 microcontroller for controlling the grass cutter's operations and This automation ensures that the grass cutter can operate autonomously without human intervention.The research highlights the use of solar panels to harness solar energy for powering the grass cutter, eliminating the need for electricity or fossil fuels. This approach is not only cost-effective but also reduces carbon emissions.The research paper titled "Automatic Solar Grass Cutter" explores the development of a solar-powered grass cutting robot to reduce environmental impact and maintenance costs. This innovative grass cutter is equipped with an 8051 microcontroller and ultrasonic sensors for obstacle detection. It utilizes solar energy, eliminating the need for external charging. The paper highlights its fully automated operation and environmental benefits, such as reduced pollution and noise. However, it lacks specific performance data and real-world testing results.

2.1.13 Research paper presented by Varun Upasani,Kaustubh Adhyapak , Mousami Wanjale.Titled "Fully Automated Solar Grass Cutter". presented on Journal of Emerging Technologies and Innovative Research (JETIR).

The system is designed to autonomously cut grass at various lengths without human intervention. It utilizes 12V batteries to power the vehicle motors and the grass cutter motor. Additionally, it incorporates a solar panel for recharging the batteries, eliminating the need for external charging.The Fully Automated Solar Grass Cutter is a solar-powered grass-cutting system that operates without human intervention. It utilizes a 12V/7W solar panel to charge onboard batteries, powering both the vehicle motors and grass cutter motor. Equipped with an ultrasonic sensor for obstacle detection, it can navigate autonomously. Users have the flexibility to control it manually via Bluetooth or enable automatic mode. This eco-friendly solution reduces carbon emissions, offers variable grass cutting lengths, and has the potential for future

enhancements.

2.1.14 Research paper presented by Dr. J. G. Chaudhari, Akash S Ingole, Aakash Z Patel, Kunal R Bhagat, Ashwini S Gaurkhede. Titled "Smart Solar Based Grass Cutter".Presented on International Journal of Advanced Research in Science, Communication and Technology (IJARSCT).A 40W solar panel is used to charge the batteries.

Solar panel specifications include maximum power voltage (19.25 V), maximum power current (2.08 A), short circuit current (2.22 A), and open circuit voltage (22.5 V).Four DC gear motors are used for wheel movement with a speed of 30 rpm, 0.5 A load current, 12 V operating voltage, and 2.94 N.m torque.The research paper introduces a "Smart Solar Based Grass Cutter" as an eco-friendly alternative to traditional grass cutting machines. It highlights the environmental issues associated with gas-powered cutters, emphasizing the need for cleaner solutions. The smart cutter is powered by solar energy and controlled by an Arduino Uno microcontroller, making it fully automated and programmable. However, the paper lacks comprehensive testing data and comparative analysis, and it should address safety, scalability, reliability, and cost-benefit aspects for practical implementation. Future research and improvements are also briefly mentioned.

2.1.15 Research paper presented by M.HARITHA M.SRINIVASULU BELLE.SIVA,titled "SOLAR GRASS CUTTER WITH AUTOMATIC TRACKING" .Presented on International Journal of Advanced Research in Science, Communication and Technology (IJARSCT).LDR is used to sense light radiation from the sun, allowing the system to track the sun's movement for efficient solar panel orientation.IR Sensor: An IR sensor may be used for safety to detect obstacles and prevent collisions.Switch: A switch controls the electric power, enabling or disabling the DC motor.The Solar Grass Cutter with Automatic Tracking described in the document is a cost-effective and eco-friendly solution for maintaining lawns and grassy areas. It operates solely on solar energy, reducing electricity consumption and environmental impact. The system utilizes a 12V DC motor and a maintenance-free lead-acid battery for operation. It incorporates a Light Dependent Resistor (LDR) sensor to track the sun's movement and adjust the solar panel accordingly. While it offers advantages such as portability and ease of use, its limitations include longer grass-cutting times and potential manual operation requirements in some cases.

2.1.16 Research paper presented by P.Amrutesh, B.Sagar, B.Venu titled "Solar Grass Cutter With Linear Blades By Using Scotch Yoke Mechanism" . published on Int. Journal of Engineering Research and Applications .Solar panels for energy generation.Battery storage for continuous operation.Scotch yoke mechanism for grass cutting.Environmentally friendly and easy to use.Suitable for various applications, including gardens and sports fields.The provided document discusses a "Solar Grass Cutter With Linear

Blades By Using Scotch Yoke Mechanism." It presents a project where solar energy is used to power a grass cutter, making it eco-friendly and efficient. The key components include solar panels, batteries, a brush-less DC motor, a solar charger, a scotch yoke mechanism, and circuitry. The solar panels convert sunlight into electrical energy, which is stored in batteries and used to power the DC motor, which, in turn, operates the grass-cutting mechanism.

2.1.17 Research paper presented by Tanmay Bhalodi, Nikhil Bhujbal, Karan Doshi, Rahul Goregaonkar, Sheetal Jagtap .Titled "Environmental Friendly Solar Grass Cutter".published on International Journal of Research in Engineering, Science and Management .The device incorporates IR proximity sensors to detect and avoid obstacles such as objects, animals, and humans while in operation. An accelerometer ensures that the blades do not operate when the user holds the machine randomly.The machine can be controlled in both automatic and manual modes. It uses a Microcontroller ATmega 16 for its operations and can be operated via Bluetooth.The automatic solar grass cutter is an environmentally friendly solution designed to reduce air and noise pollution caused by traditional grass cutters. It operates using solar panels and can switch to a battery source when needed. Safety features such as IR proximity sensors and an accelerometer enhance its usability. While it has limitations related to sunlight dependency and initial cost, it offers a more sustainable and low-maintenance alternative for lawn maintenance.

2.1.18 Resarch paper presented by Ms. YadavRutuja A., Ms. ChavanNayana V., Ms. Patil Monika B., Mr. V. A. Mane.Titled "AUTOMATED SOLAR GRASS CUTTER". Published on International Journal of Scientific Development and Research (IJSDR).AC motor used for cutting grass.DC current from the battery is converted to AC current using an inverter.The research paper discusses the development of an Automated Solar Grass Cutter to address pollution and power shortage issues. It utilizes renewable solar energy and automation technology, featuring a solar panel connected to a battery that powers an AC motor for grass cutting. However, the paper lacks technical details, experimental results, and in-depth discussion of challenges faced during development. Additionally, the literature review is limited in scope, and the conclusion is brief. Overall, the paper could benefit from more comprehensive information and improved clarity.

2.1.19 Research paper presented by Debangsu Kashyap,Urbashi Bordoloi,Amlan Aoichoirryya Burag.Titled "DESIGN OF A FULLY AUTOMATED SOLAR GRASS CUTTER FOR CAMPUS CLEANING". published on International Journal of Creative Research Thoughts (IJCRT).The incorporation of automation features, including ultrasonic sensors, temperature sensors, and microcontrollers, enhances the efficiency of the grass cutting process. These automation features help in obstacle detection and motor control, reducing the need for manual intervention.The research paper introduces a solar-powered grass cutter designed to address the environmental and labor-intensive issues associated with

conventional grass cutting methods. The system includes a 20W solar panel, a 12V/7Ah sealed lead-acid battery, a 24V high-speed DC motor, and various sensors for obstacle detection. The paper provides design parameters, working principles, and cost analysis, highlighting the potential benefits of this automated solution for campus cleaning. However, it also raises concerns about weather dependency, battery capacity, obstacle detection, and real-world scalability that need further exploration.

2.1.20 Research paper presented by Pankaj Malviya, Nukul Patil, Raja Prajapat, Vaibhav Mandloi,Dr. Pradeep Kumar Patil, Prof. Prabodh Bhise. Titled "Fabrication of Solar Grass Cutter". presented on IJSRSET.The paper provides detailed design parameters, specifications of components used, and calculations based on solar radiation data, offering valuable insights for the practical implementation of similar systems.The document describes the fabrication of a solar-powered grass cutter, highlighting the use of solar energy to run a grass cutting machine. It emphasizes the environmental benefits of reducing pollution caused by traditional lawn mowers and the increasing demand for alternative energy sources. The key components of the system include solar panels, a battery, a DC motor, blades, and a solar charger (controller). The document provides design analysis, specifications, and calculations for various components, demonstrating the feasibility of the project. Overall, it presents a sustainable and efficient solution for grass cutting while reducing environmental impact.

CHAPTER-3

3.1 Methodology

This automatic solar grass cutter and shaper may be programmed to cut and shape grass in any desired shape. This cutter bot will be built without the use of basic sensors, but to be more precise and accurate, we will need various components for this project. Because of the ongoing rise in fuel prices and the impact of petrol emissions into the atmosphere, it became imperative to use the sun's abundant solar energy to power a lawn mower.

3.1.1 Existing System

The current method to lawn maintenance is primarily based on physical labour and traditional gas-powered lawnmowers. Manual mowing necessitates tremendous physical work and time, as human operators push or ride the lawnmower over the yard. Conventional lawnmowers run on fossil fuels, which pollute the environment and rely on nonrenewable energy sources. These systems lack advanced automation features, remote control capabilities, and intelligent functionality. Overall, the current system is characterised by labor-intensive activities and little technical innovation, with potential environmental consequences due to the usage of conventional energy sources.

3.1.2 Proposed System

The suggested technology introduces a paradigm shift in lawn maintenance by creating a solar-powered grass-cutting robot with Bluetooth connectivity. Solar panels are integrated into the architecture to capture renewable energy from the sun, decreasing the environmental effect of typical fuel-powered options. Bluetooth technology is used for wireless connection, allowing users to control and monitor the robot remotely via smartphone or a specialised control device. The robot has autonomous navigation features, which use sensors to detect obstacles and ensure effective lawn covering. AI-based cutting algorithms allow for precise and adaptable cutting patterns based on grass height and density. The system also prioritises safety with emergency stop mechanisms and obstacle avoidance, while efficient energy management makes the best use of solar power. The user-friendly interface, environmental concerns, and the possibility of future upgrades make the suggested system a more sustainable, efficient, and technologically sophisticated alternative for lawn management.

3.2 Experimental Setup

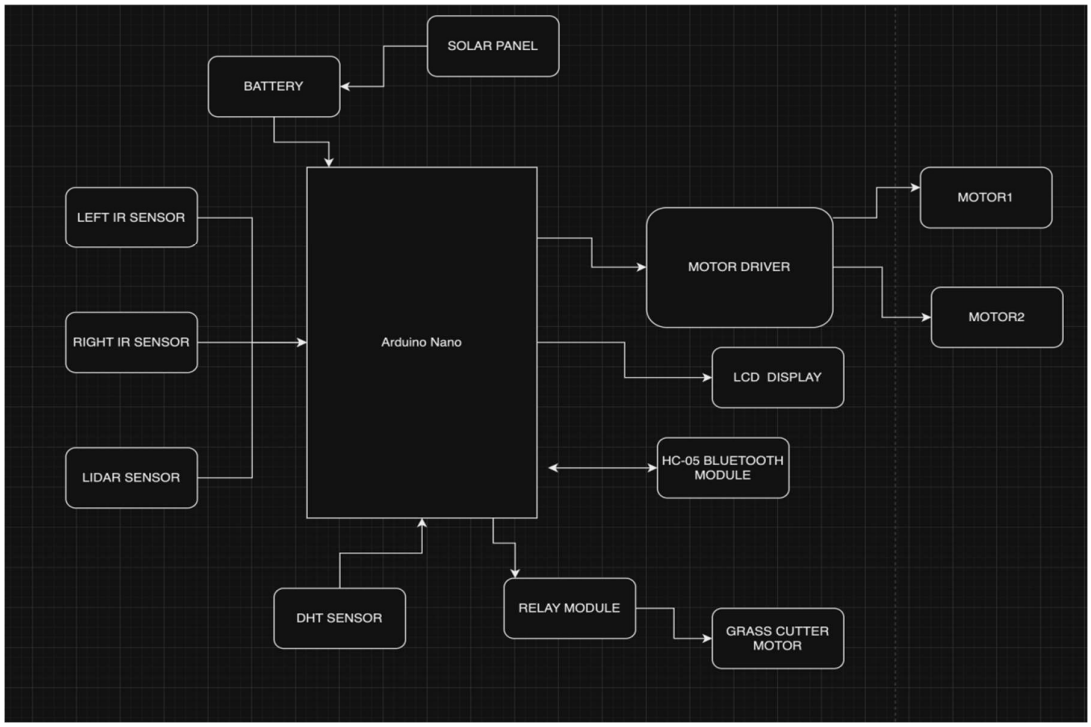


Figure 1 - Block diagram

The above block diagram represents the experimental block diagram of the grasscutter machine.

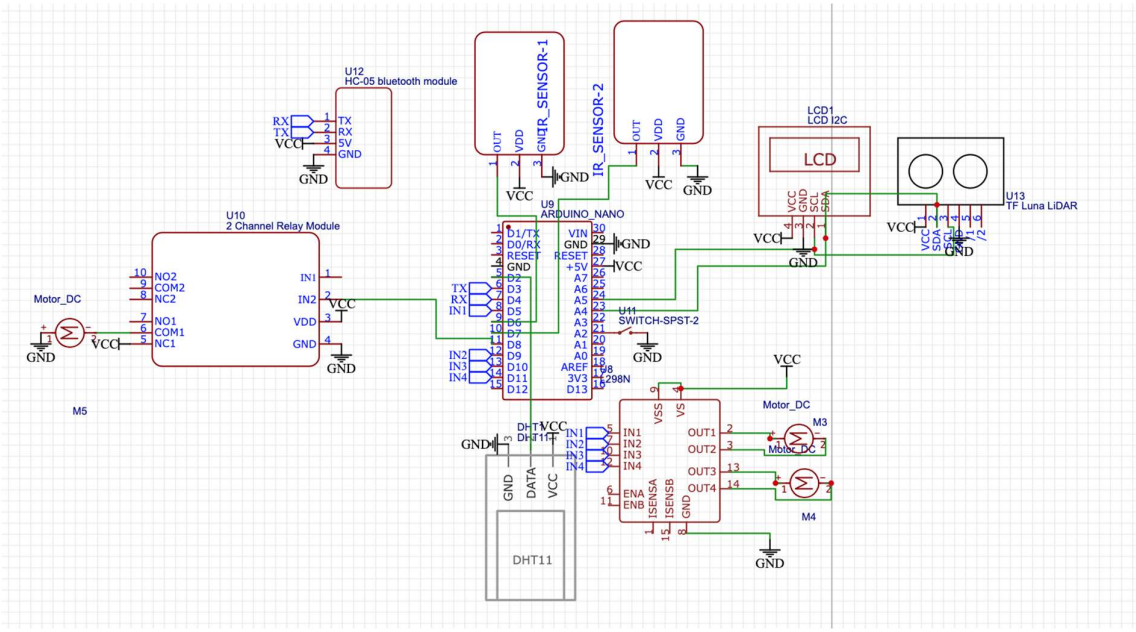


Figure 2 - Circuit Diagram

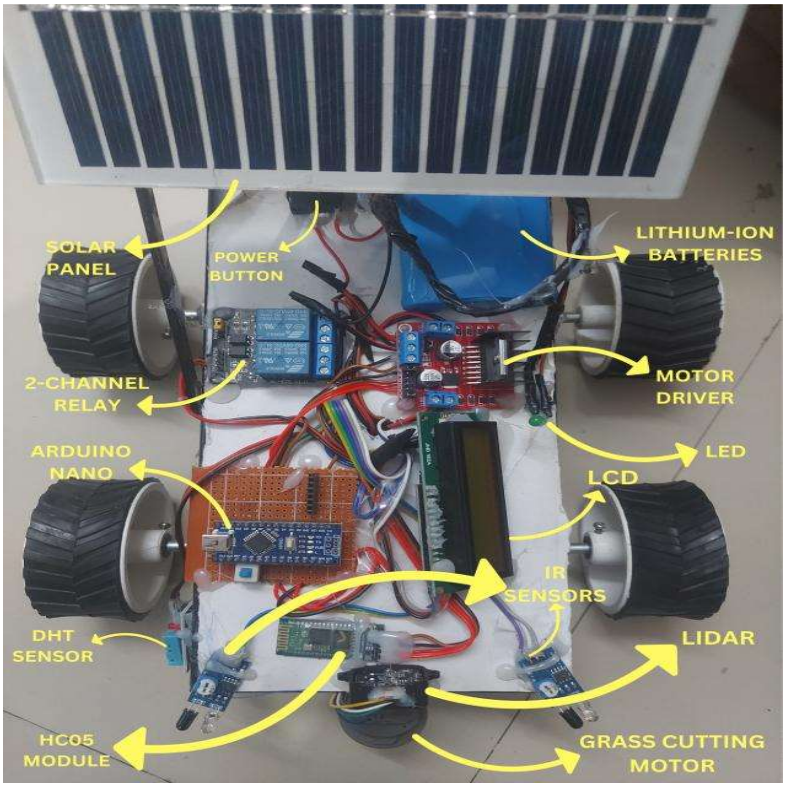


Figure 3-Experimental Setup

3.3 Automatic and Manual modes

The robot can be operated on both automatic and manual modes. With the help of a toggle button the robot can go back and forth between automatic and manual modes.

3.3.1 Automatic mode

- With the help of sensors like LIDAR and IR sensors the robot can be operated in automatic mode.

3.3.2 Manual /Bluetooth mode

- The HC-05 acts as a main communication between the robot and a smartphone.
- With HC-05 the robot can establish a Bluetooth connection.
- Using an application user can able to control the robot with ease.

3.3.2.1 Connection Establishment

Initially when we toggle for manual mode the HC-05 module will start blinking , Indicating it is ready to pair. After it is paired to the Bluetooth it will stop blinking.

3.3.2.2 Application Interface

Figure - 4-App Interface

These are the three ways to control the robot.

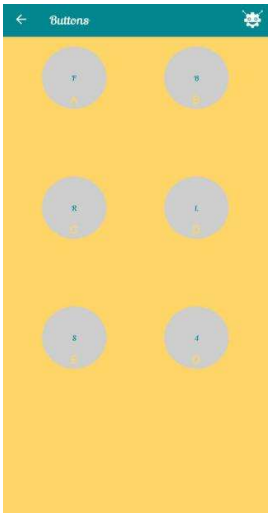


Figure 1-Buttons

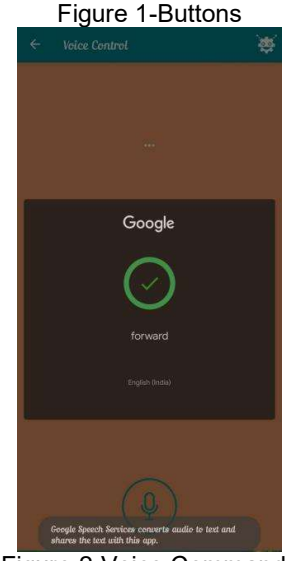


Figure 2-Voice Commands

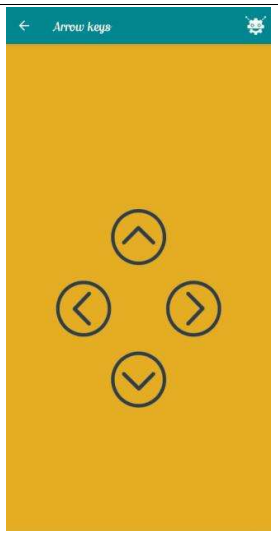


Figure 3-Arrow Keys

CHAPTER-4

4.1 HARDWARE DISCRIPTION

4.1.1 Arduino NANO

The Arduino Nano is a compact, comprehensive, and breadboard-friendly board built on the ATmega328 (Arduino Nano 3.0) or ATmega168 (Arduino Nano 2.x). It provides roughly the same capabilities as the Arduino Duemilanove, but in a different packaging. It has simply a DC power jack and uses a Mini-B USB cable rather than a conventional one. Gravitech designed and produces the Nano. Arduino Nano 3.0 (ATmega328): schematic and Eagle files. Arduino Nano 2.3 (ATmega168): Manual (pdf) and Eagle files. Note: Because the free version of Eagle cannot handle more than two levels, and this version of the Nano has four layers, it is published here unrouted so that users can open and use it in the free Eagle. Microcontroller Atmel ATmega168 or ATmega328 Operating Voltage (Logic Level) 5 V Input Voltage (Recommended) 7-12 V Input Voltage (Limits) 6-20 V Digital I/O Pins 14 (with 6 providing PWM output) Analogue Input Pins 8 DC current per I/O pin: 40 mA Flash Memory: 16 KB (ATmega168) or 32 KB (ATmega328), with the bootloader using 2 KB. SRAM: 1 KB (ATmega168) or 2 KB (ATmega328). EEPROM: 512 bytes (ATmega168) or 1 KB (ATmega328) Clock Speed: 16 MHz. Dimensions 0.73" x 1.70" The Arduino Nano can be powered by the Mini-B USB port, a 6-20V unregulated external power supply (pin 30), or a 5V regulated external power supply (pin 27).

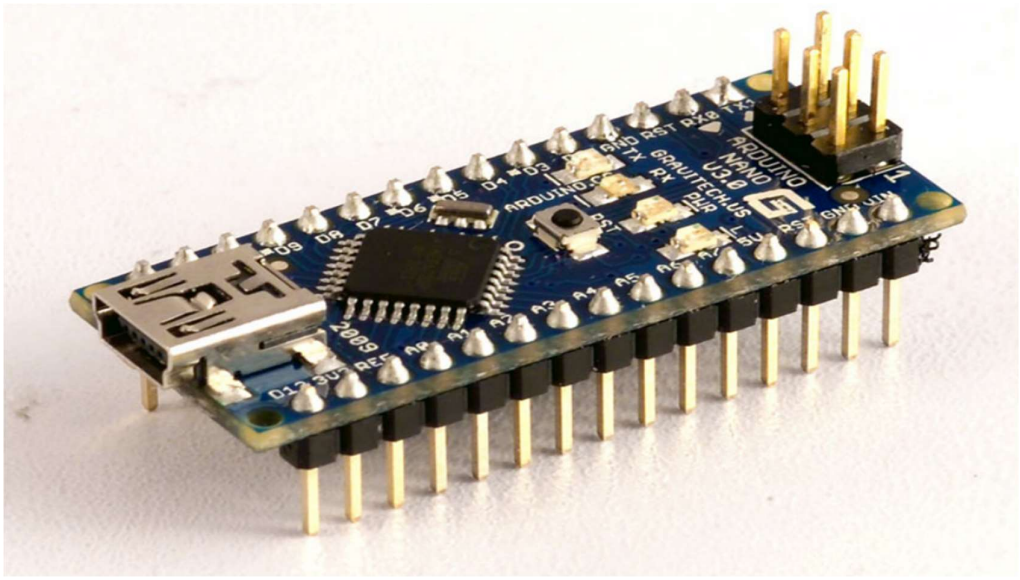


Figure 8- Arduino Nano

In addition, some pins have specialized functions:

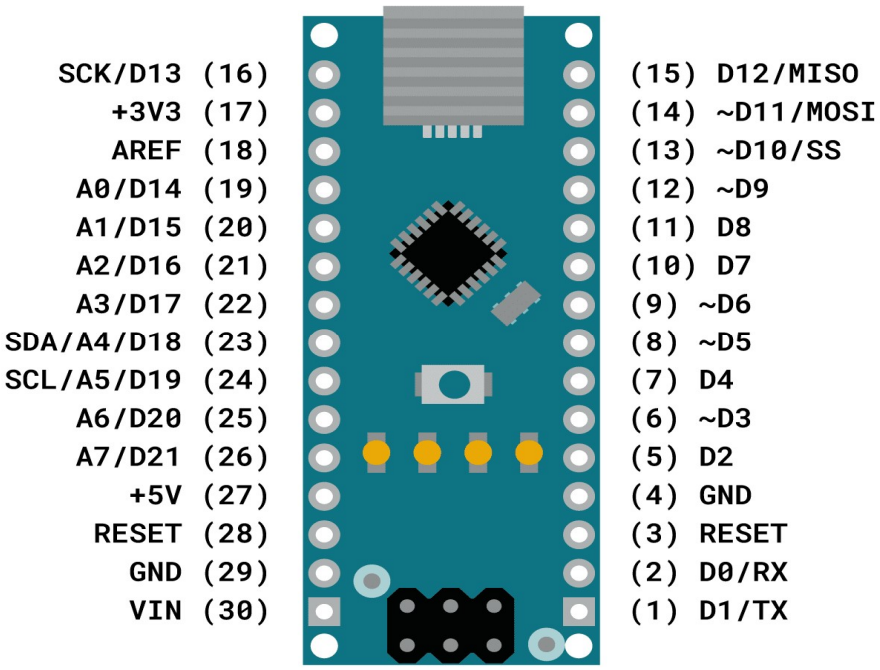


Figure 9 - Pin Layout

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the FTDI USB-to-TTL Serial chip.
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.
- LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off. The Nano has 8 analog inputs, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the analogReference() function. Additionally, some pins have specialized functionality:
- I 2 C: 4 (SDA) and 5 (SCL). Support I2 C (TWI) communication using the Wire library (documentation on the Wiring website). There are a couple of other pins on the board:

- AREF. Reference voltage for the analog inputs. Used with analogReference().
- Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board. See also the mapping between Arduino pins and ATmega168 ports.

4.1.2 Lithium-ion battery

Figure 10 - Li Ion Battery

"Lithium-ion" redirects here. For the metal element, see Lithium.

Lithium-ion battery	
 A Li-ion battery from a Nokia 3310 mobile phone.	
Specific energy	100–265 W·h/kg[1][2] (0.36–0.875 MJ/kg)
Energy density	250–693 W·h/L[3][4] (0.90–2.43 MJ/L)
Specific power	~250 – ~340 W/kg[1]
Charge/discharge efficiency	80–90%[5]

Energy/consumer-price	6.4 Wh/US$[6]
Self-discharge rate	0.35% to 2.5% per month depending on state of charge[7]
Cycle durability	400–1,200 cycles [8]
Nominal cell voltage	3.6 / 3.7 / 3.8 / 3.85 V, LiFePO4 3.2 V

Table 1

A lithium-ion battery, or Li-ion battery (abbreviated LIB), is a type of rechargeable battery. Lithium-ion batteries are widely utilised in portable gadgets and electric cars, and they are gaining favour for military and aerospace applications.

The technology was largely created by John Goodenough, Stanley Whittingham, Rachid Yazami, and Akira Yoshino in the 1970s and 1980s, before being commercialised by a Sony and Asahi Kasei team led by Yoshio Nishi in 1991.

Lithium ions in batteries flow from the negative electrode to the positive electrode via an electrolyte during discharge and back again while charging. The positive electrode of Li-ion batteries is made of an intercalated lithium compound, while the negative electrode is commonly made of graphite.

The batteries feature great energy density, no memory effect (save for LFP cells), and low self-discharge. They can, however, provide a safety risk because they contain a flammable electrolyte, which, if broken or wrongly charged, can cause explosions and flames.

Samsung was compelled to recall Galaxy Note 7 devices due to lithium-ion fires, and there have been many accidents with batteries aboard Boeing 787s.

4.1.3 L298N DC Motor Driver Module :

If you intend to assemble your new robot friend, you should eventually learn how to control DC motors.

Connecting the L298N Motor Driver to an Arduino is one of the simplest and most cost-effective ways to drive DC motors. It can control the speed and direction of two DC motors.

As an added bonus, it can also control a bipolar stepper motor such as NEMA 17.

Control stepper motor with L298N Motor Driver and Arduino.

One of the simplest and most economical ways to drive stepper motors is to connect the L298N Motor Driver to an Arduino. It can manage both speed and...

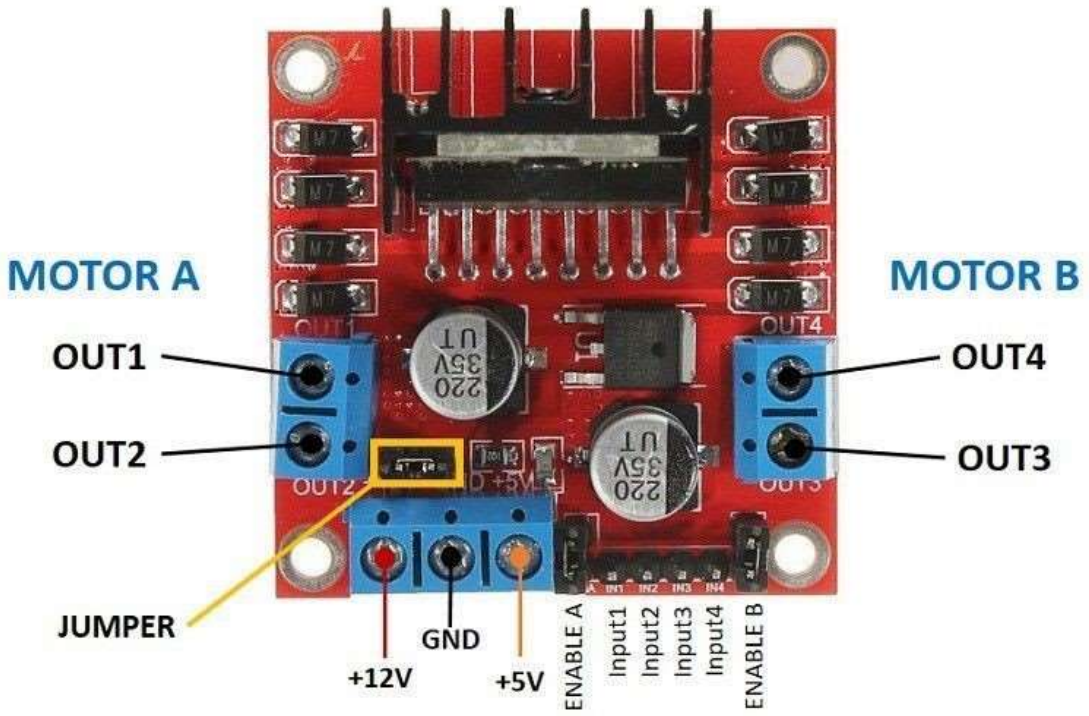


Figure 11 - Motor Driver layout

Controlling a DC Motor

To have complete control over a DC motor, we must control both its speed and rotation direction. This can be accomplished by combining the two strategies.

• PWM for managing speed.

• H-Bridge - Controls rotation direction.

PWM - To control speed.

The speed of a DC motor can be adjusted by changing its input voltage. A common approach for doing this is to utilise PWM (Pulse Width Modulation).

PWM is a technique that adjusts the average value of the input voltage using a series of ON-OFF pulses.The average voltage is related to the width of the pulses, also known as duty cycle. The average voltage applied to the dc motor (High Speed) increases as the duty cycle increases, and decreases as the duty cycle decreases.

4.1.4 Liquid Crystal Display (LCD):

Character LCD Display:

Character LCDs are intended to show characters and are widely utilised in a variety of electronic projects. The lesson specifically refers to an HD44780-based character LCD display.

The character LCD display uses a grid structure with a 5x8 pixel matrix for each character.

It offers a custom character generator tool for character design as well as demonstrations of array-based character creation.

Hardware Overview:

I2C LCD Adapter:

An I2C LCD display typically consists of an HD44780-based character LCD and an I2C LCD adaptor. The I2C adapter uses an 8-bit I/O expander chip, such as the PCF8574, to convert I2C data from the Arduino into the parallel data needed for the LCD display. The adapter also includes a trimpot for altering the display's contrast and a jumper to control the backlight intensity.

The I2C LCD adapter supports I2C address setting to prevent conflicts with other devices on the same bus.

Working Pin Description:

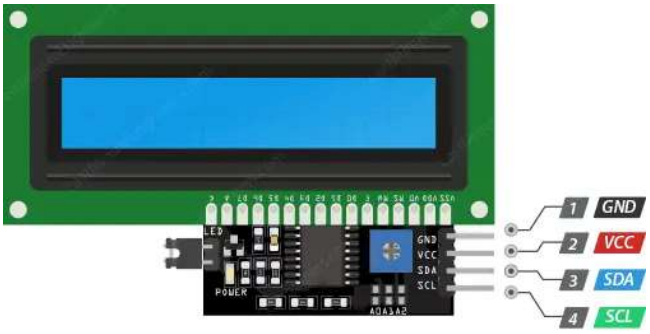


Figure 12 - LCD pin layout

I2C LCD Display Pinout:

GND (Ground): Connected to the ground pin.

VCC (Power Supply): Connected to the 5V output of the Arduino or an external 5V power supply.

SDA (I2C Data Pin): Connected to the Arduino's SDA (data line) or A4 pin.

SCL (I2C Clock Pin): Connected to the Arduino's SCL (clock line) or A5 pin.

Adjusting LCD Contrast:

The tutorial explains the process of adjusting the LCD contrast using a potentiometer on the I2C adapter.

4.1.5 Relay

A relay is an electromagnetic switch that operates on a little current but can regulate much bigger currents.

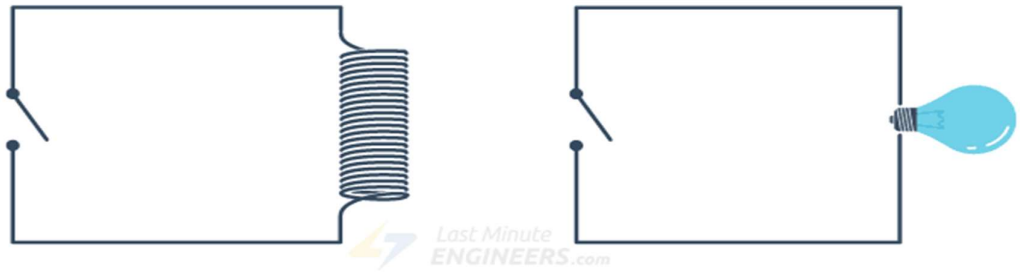


Figure 13 - Relay

Initially, the first circuit is turned off, and no current flows through it until something (a sensor or a switch closing) activates it. The second circuit is also turned off. When a modest current flows through the first circuit, it activates the electromagnet, creating a magnetic field all around it.

The energised electromagnet attracts a contact in the second circuit, causing the switch to close and allowing a considerably larger current to pass through it. When the current stops flowing, the contact returns to its original position, turning the second circuit off again.

When current runs through the coil, it charges the electromagnet, which moves the switch's internal contacts.

At that point, the normally open (NO) terminal connects to the common (COM), while the normally closed (NC) terminal is detached.

When current stops flowing through the coil, the internal contact reverts to its original condition, with the normally closed (NC) terminal connecting to the common (COM) and the normally open (NO) terminal reopening.

This is referred to as a single pole, double throw switch (SPDT).

Control Pins of one channel relay module

There are three pins: a ground pin, a VCC pin to power the module, and an IN pin to regulate the relay. The input pin is active low, which means that pulling the pin LOW activates the relay and pulling the pin HIGH deactivates it.

Control Pins:

The IN pin is used to control the relay. It is an active low pin, which means that pulling the pin LOW activates the relay and pulling the pin HIGH deactivates it.

GND represents the ground connection.

The VCC pin gives electricity to the module.

Output Terminal:

Connect the COM pin to the signal you want to switch.

By default, the NC pin is linked to the COM pin, until you transmit a signal from the Arduino to the relay module to disconnect it.

NO pin is open by default until you send a signal from the Arduino to the relay module to establish a connection.

4.1.6 DHT11

We have two variants of the DHTxx sensor series. They seem identical and have the same pinout, but have distinct properties. The DHT11 has a temperature range of 0°C to 50°C, with an accuracy of +-2 degrees. The DHT11 humidity range is from 20 to 80%, with a 5% accuracy..

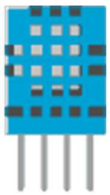
	
	DHT11
Operating Voltage	3 to 5V
Max Operating Current	2.5mA max
Humidity Range	20-80% / 5%
Temperature Range	0-50°C / ± 2°C
Sampling Rate	1 Hz (reading every second)
Body size	15.5mm x 12mm x 5.5mm
Advantage	Ultra low cost

Table 2

Humidity sensing component is used, of course to measure humidity, which has two electrodes with moisture holding substrate (usually a salt or conductive plastic polymer) sandwiched between them.

The ions are released by the substrate as water vapor is absorbed by it, which in turn increases the conductivity between the electrodes.

The change in resistance between the two electrodes is proportional to the relative humidity. Higher relative humidity decreases the resistance between the electrodes, while lower relative humidity increases the resistance between the electrodes.

4.1.7 IR Sensor

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detecting the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation.

Figure 14 - IR sensor

These types of radiation are invisible to human sight but can be detected using an infrared sensor. The emitter is a simple IR LED (Light Emitting Diode), and the detector is a simple IR photodiode that detects IR light with the same wavelength as the IR LED. When IR light strikes the photodiode, the resistances and output voltages vary in response to the magnitude of the IR light received.

An infrared sensor works similarly to an object detection sensor. This sensor combines an IR LED and an IR Photodiode, which can be used to make a photo-coupler or optocoupler. The physics laws employed in this sensor include planks radiation, Stephan Boltzmann, and Weins displacement.

IR LEDs are one type of transmitter that produces infrared radiation. This LED resembles a conventional LED, and the radiation it emits is invisible to the human eye. Infrared receivers primarily detect radiation from an infrared transmitter. These infrared receivers are available in photodiode format. IR Photodiodes differ from conventional photodiodes in that they only sense infrared energy. There are several types of infrared receivers that vary depending on the voltage, wavelength, packaging, and other factors.

When utilised in conjunction with an IR transmitter and receiver, the wavelength of the receiver must match that of the transmitter. Here, the transmitter is an IR LED and the receiver is an IR photodiode. The infrared photodiode responds to infrared light emitted by an infrared LED. The photodiode's resistance and output voltage alter proportionally to the amount of infrared light collected. This is the IR sensor's essential operating concept.When the infrared transmitter emits, it gets to the item, and some of it reflects back to the infrared receiver. The sensor output can be determined by the IR receiver based on the intensity of the response.

Types of Infrared Sensor

Infrared sensors are categorised into two types: active IR sensors and passive IR sensors.

Active IR Sensor

This active infrared sensor contains both the transmitter and the receiver. In the majority of applications, light-emitting diodes are used as sources. LEDs are non-imaging infrared sensors, whereas laser diodes are imaging infrared sensors.

Passive IR Sensor

The passive infrared sensor just has detectors; it does not have a transmitter. These sensors make use of an object such as a transmitter or an infrared source. This object emits energy and detects it using infrared receivers. After that, a signal processor is utilised to interpret the signal and extract the necessary information.

Advantages

The **advantages of IR sensor** include the following :It uses less power , The detection of motion is possible in the presence or absence of light approximately with equal reliability ,They do not need contact with the object for detection ,There is no data leakage because of the ray direction ,These sensors are not affected by oxidation & corrosion and Noise immunity is very strong

Disadvantages

The **disadvantages of IR sensor** include the following :Line of sight is required , Range is limited , These can be affected by fog, rain, dust, etc and Less data transmission rate

4.1.8 LIDAR

The working premise of a Light Detection and Ranging system is very basic. A LIDAR sensor installed on a plane or helicopter. It generates a laser pulse train that is sent to the surface/target to determine the time it takes to return to its source. To compute the distance travelled by a returning light photon to and from an object, use the formula Distance = (Speed of Light x Time of Flight)/2.

Accurate distances to ground locations are then calculated, and elevations, as well as ground surface structures, roads, and vegetation, can be recorded. These heights are integrated with digital aerial photos to create a digital elevation model of Earth.

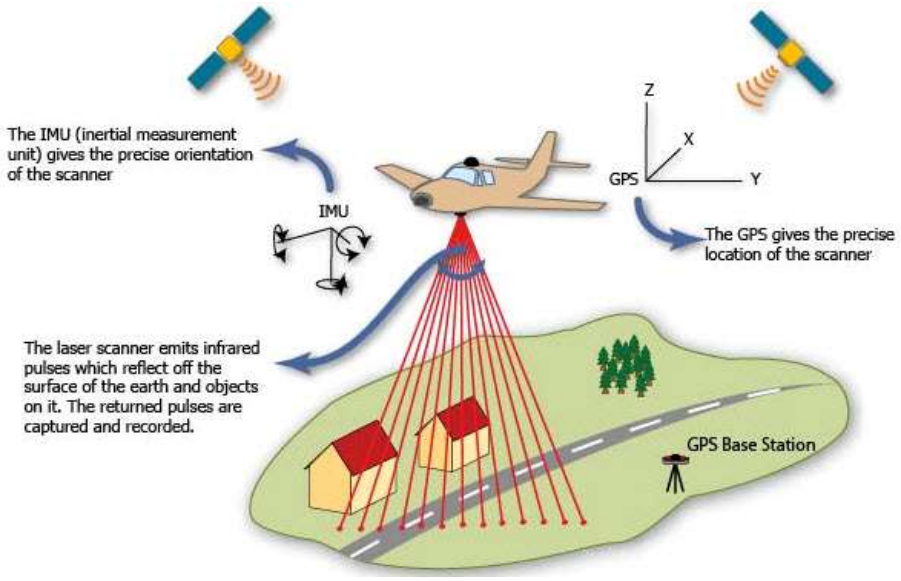


Figure 15- LIDAR flow

The laser instrument emits rapid pulses of laser light at a surface, often at speeds of up to 150,000 pulses per second. A sensor on the device measures how long it takes for each pulse to reflect back. Light moves at a consistent and known speed, allowing the LIDAR sensor to determine the distance between itself and the target with great precision. By repeating this quickly, the sensor creates a complex'map' of the surface being measured.

To ensure accuracy when using airborne Light Detection and Ranging, additional data must be acquired. Because the sensor is moving, the height, location, and orientation of the instrument must be considered when determining the position of the laser pulse at the moment of transmission and return. This extra information is critical for the data's integrity. With ground-based Light Detection and Ranging, a single GPS location can be added to each location where the instrument is installed.

LIDAR System Types

Based on the Platform

- Ground-based LIDAR
- Airborne LIDAR
- Spaceborne LIDAR

TF-Luna is a single-point ranging LiDAR that operates on the TOF concept. Its unique optical and electrical design allows for steady, accurate, and highly sensitive range measurements. The device is designed with algorithms that are optimised for different application contexts, as well as several customisable configurations and parameters, to provide good distance measuring performance in diverse application domains and scenarios.

The TF Luna is suited because to its technological qualities and ultra-compact size, which make it ideal for a variety of identifying applications. This includes applications such as level measurement, lift systems, and intrusion detection. Because of its ease of installation and integration, the LiDAR from Benewake may be used in a variety of projects.

Product characteristics:

The device is designed with algorithms that are optimised for different application contexts, as well as several customisable configurations and parameters, to provide good distance measuring performance in diverse application domains and scenarios.

Extreme Cost Performance.

Low-cost LiDAR module with a 0.2-8m operational range. TF-Luna offers an extremely reliable, accurate, and sensitive range detection system.

Slim Figure Yet Big Skill

The device is designed with algorithms that are optimised for different application contexts, as well as several customisable configurations and parameters, to provide good distance measuring performance in diverse application domains and scenarios.
The TF-Luna uses the serial communication protocol, which allows it to connect to any control board that supports serial port connection, such as Arduino or Raspberry Pi.

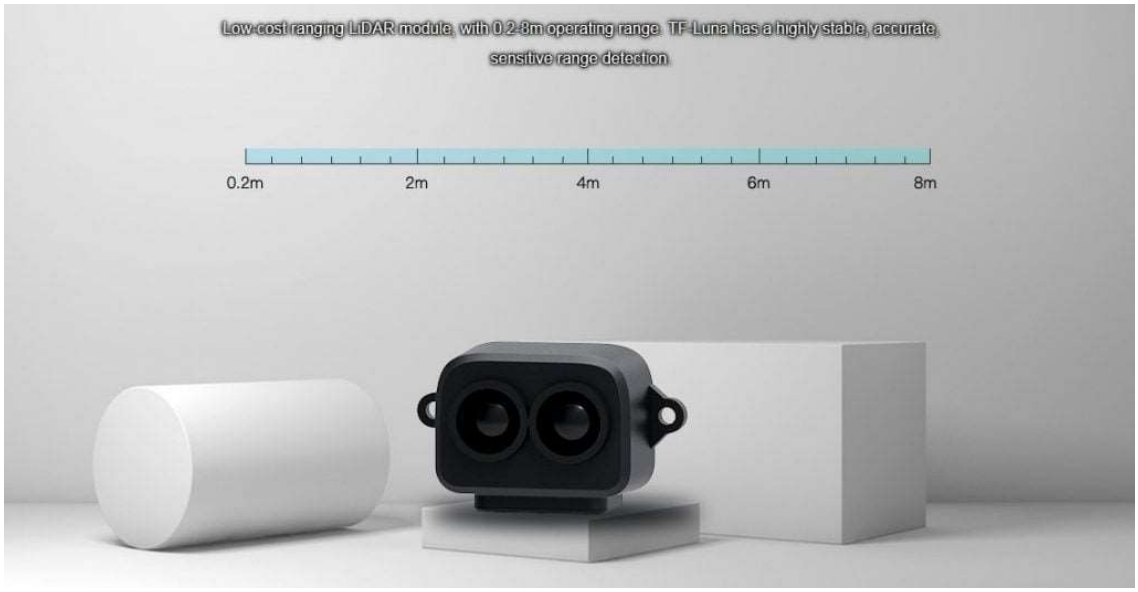


Figure 16 - LIDAR

Features:

1. The range is up to 8 meters
2. Low power consumption
3. Wide range of temperature adaptation and voltage input.
4. It has high accuracy and frequency.
5. Small size
6. Lightweight

Applications:

7. Auxiliary focus
8. Elevator projection
9. Intrusion detection
10. Level measurement
11. UAV/UAS Robots

4.1.9 Solar panel

Solar panels use the photovoltaic effect, which occurs when specific materials are exposed to sunlight and generate an electric current. The most often utilised material is silicon, which emits electrons when photons (light particles) touch its surface. Components of a solar panel: Solar cells are individual elements within a solar panel that generate power. They are typically composed of semiconductor materials such as crystalline silicon. The frame provides structural support and protection for the solar cells. The glass cover protects the solar cells from external conditions while allowing sunlight to pass through. The backsheet protects the solar cells from moisture and increases the panel's overall durability.

Working Principle:

Figure 17 - Solar Panels

Solar panels are designed to capture photons from sunshine. Photons of sufficient energy strike the semiconductor material (often silicon) in solar cells.

When photons strike a semiconductor, they transmit energy to electrons in the substance.

This energy excites the electrons, forcing them to travel and produce an electric current. The movement of electrons in solar cells provides direct current (DC) electricity.

Solar panels provide direct current (DC), whereas most domestic appliances and the grid utilise alternating current.

An inverter converts direct current (DC) electricity into alternating current (AC), making it compatible with ordinary electrical systems. The generated alternating current electricity can be used.

Key Considerations:

1. Efficiency:

A solar panel's efficiency relates to its capacity to convert sunlight into power. Higher efficiency panels are typically more expensive, but they can provide more power in less space.

2. Location and Orientation: Solar panels perform best when exposed to direct sunshine. Proper direction and tilt maximise sunshine exposure, with south-facing angles being particularly suggested in the northern hemisphere.

3. Maintenance: Solar panels require minimum maintenance, primarily cleaning to remove dirt and debris that might decrease efficiency. Regular checkups assure peak functioning.

4. Lifespan: Solar panels normally last 25-30 years or more. Manufacturers frequently give guarantees covering durability and performance.

5. Environmental Impact: Solar energy is a clean, renewable resource that emits no greenhouse gases during operation. Manufacturing procedures and end-of-life disposal are both taken into account when considering environmental impact.

4.1.10 HC-05 Bluetooth Module

HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration.

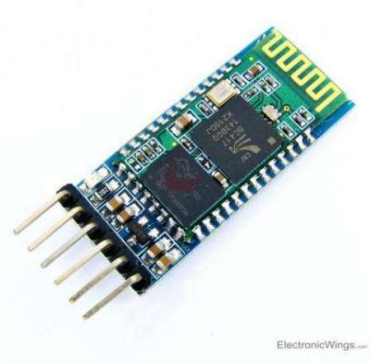


Figure 18 - HC05

HC-05 Bluetooth Module Pin Diagram

Figure 19 - HC05 Pin Layout

Bluetooth serial modules allow all serial enabled devices to communicate with each other using Bluetooth.

It has 6 pins,

1. **Key/EN:** It is used to bring Bluetooth module in AT commands mode. If Key/EN pin is set to high, then this module will work in command mode. Otherwise by default it is in data mode. The default baud rate of HC-05 in command mode is 38400bps and 9600 in data mode.

HC-05 module has two modes,

1. **Data mode:** Exchange of data between devices.

2. **Command mode:** It uses AT commands which are used to change setting of HC-05. To send these commands to module serial (USART) port is used.

2. **VCC:** Connect 5 V or 3.3 V to this Pin.

3. **GND:** Ground Pin of module.

4. **TXD:** Transmit Serial data (wirelessly received data by Bluetooth module transmitted out serially on

TXD pin)

5. **RXD:** Receive data serially (received data will be transmitted wirelessly by Bluetooth module).

6. **State:** It tells whether module is connected or not.

HC-05 module Information

HC-05 has **red LED** which indicates **connection status**, whether the Bluetooth is connected or not. Before connecting to HC-05 module this red LED blinks continuously in a periodic manner. When it gets connected to any other Bluetooth device, its blinking slows down to two seconds. This module **works on 3.3V**. We can connect 5V supply voltage as well since the module has on board 5 to 3.3 V regulator.

As HC-05 Bluetooth module has **3.3V level for RX/TX** and microcontroller can detect 3.3 V level, so, no need to shift transmit level of HC-05 module. But we need to shift the transmit voltage level from microcontroller to RX of HC-05 module. The data transfer rate of HC-05 module can vary up to **1Mbps** is in the **range of 10 meters**.

Specification of HC-05 Bluetooth Module

- Bluetooth version: 2.0 + EDR (Enhanced Data Rate)
- Frequency: 2.4 GHz ISM band
- Modulation: GFSK (Gaussian Frequency Shift Keying)
- Transmit power: Class 2 (up to 4 dBm)
- Sensitivity: -80 dBm typical
- Range: approximately 10 meters (or 33 feet) in open air
- Profiles supported: SPP (Serial Port Profile), HID (Human Interface Device) and others
- Operating voltage: 3.3V to 5V DC
- Operating current: less than 50mA
- Standby current: less than 2.5mA
- Sleep current: less than 1mA
- Interface: UART (Universal Asynchronous Receiver/Transmitter)
- Baud rates: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, and 460800
- Operating temperature: -20°C to 75°C (-4°F to 167°F)

Pair HC-05 and smartphone:

1. Search for new Bluetooth device from your phone. You will find Bluetooth device with “HC-05” name.
2. Click on connect/pair device option; default pin for HC-05 is 1234 or 0000.

After pairing two Bluetooth devices, open terminal software (e.g. Teraterm, Realterm etc.) in PC, and select the port where we have connected USB to serial module. Also select default baud rate of 9600 bps.

In smart phone, open Bluetooth terminal application and connect to paired device HC-05.

It is simple to communicate, we just have to type in the Bluetooth terminal application of smartphone. Characters will get sent wirelessly to Bluetooth module HC-05. HC-05 will automatically transmit it serially to the PC, which will appear on terminal. Same way we can send data from PC to smartphone.

Command Mode

- When we want to change settings of HC-05 Bluetooth module like change password for connection, baud rate, Bluetooth device's name etc.
- To do this, HC-05 has AT commands.
- To use HC-05 Bluetooth module in AT command mode, connect "Key" pin to High (VCC).
- Default Baud rate of HC-05 in command mode is 38400bps.

Command	**Description**	**Response**
AT	Checking communication	OK
AT+PSWD=XXXX	Set Password e.g. AT+PSWD=4567	OK
AT+NAME=XXXX	Set Bluetooth Device Name e.g. AT+NAME=MyHC-05	OK
AT+UART=Baud rate, stop bit, parity bit	Change Baud rate e.g. AT+UART=9600,1,0	OK
AT+VERSION?	Respond version no. of Bluetooth module	+Version: XX OK e.g. +Version: 2.0 20130107 OK
AT+ORGL	Send detail of setting done by manufacturer	Parameters: device type, module mode, serial parameter, passkey, etc.

Table 3

4.2 SOFTWARE DISCRIPTION

Software application is the heart of any system. In this system we will use the software's that are required by component i.e.; Arduino IDE is an open-source software program that allows users to write and upload code within a real-time work environment. Arduino Software used to write code for Arduino series board in many languages from c and c++. Also, it responsible for rate of data transfer. It connects to the Arduino hardware to upload programs and communicate with them effectively.

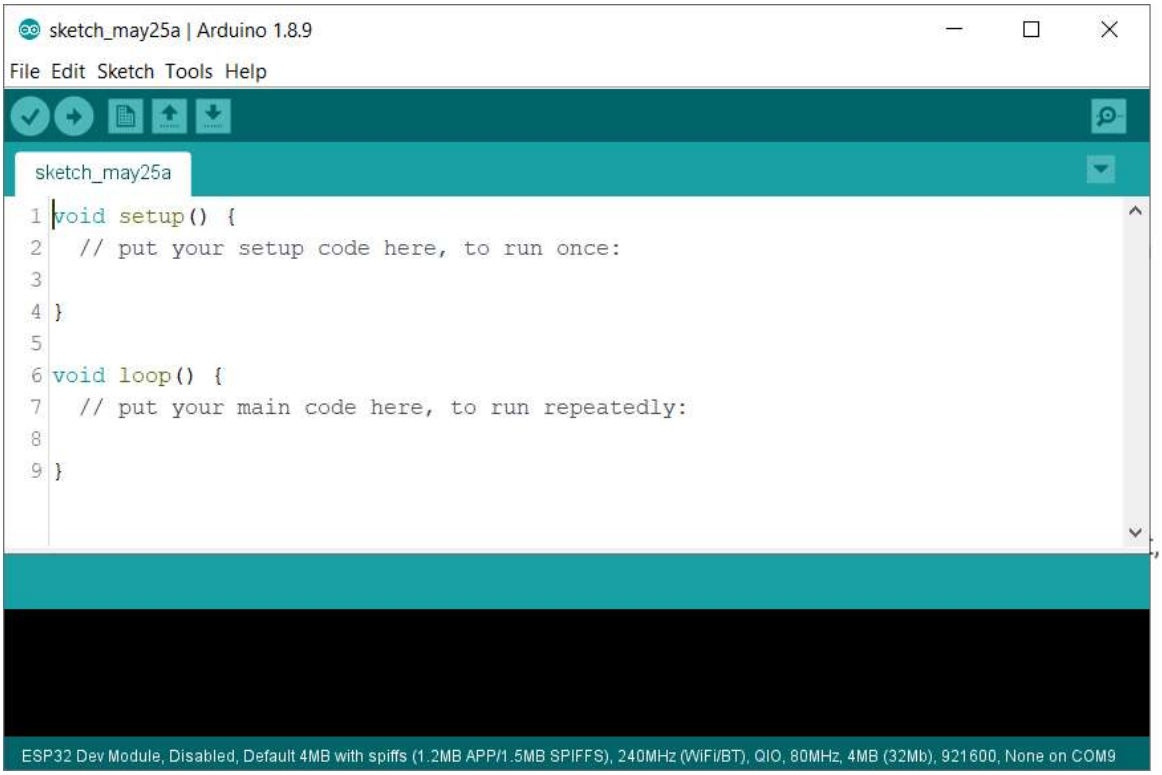


Figure-20 -Arduino IDE

4.2.1 CODE

```
#include <Arduino.h>
#include <Wire.h>
#include <TFLI2C.h>
TFLI2C tfII2C;
#include <LiquidCrystal_I2C.h>
#include "DHT.h"
#include <SoftwareSerial.h>
String value_1;
int TxD = 4;
int RxD = 3;
int lcdColumns = 16;
int lcdRows = 2;
LiquidCrystal_I2C lcd(0x27, lcdColumns, lcdRows);
int16_t tfDist; // distance in centimeters
int16_t tfAddr = TFL_DEF_ADR; // Use this default I2C address
```

```
#define DHTPIN 2
#define Left_Ir 7
#define Right_Ir 6

#define motor1 5
#define motor11 11
#define motor2 9
#define motor22 10
#define Switch_mode A2
#define Cutter_Robot 8

#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);
SoftwareSerial bluetooth(TxD, RxD);
int FLAG = 0;

void setup(){
Serial.begin(9600); // Initalize serial port
bluetooth.begin(9600);

Wire.begin(); // Initalize Wire library
lcd.init();
lcd.backlight();


lcd.setCursor(0, 0);
lcd.print("ECO GRASS CUTTER");

pinMode(Left_Ir,INPUT);
pinMode(Right_Ir,INPUT);
pinMode(Switch_mode,INPUT_PULLUP);

dht.begin();

pinMode(motor1, OUTPUT);
pinMode(motor11, OUTPUT);
pinMode(motor2, OUTPUT);
pinMode(motor22, OUTPUT);
pinMode(Cutter_Robot, OUTPUT);

digitalWrite(Cutter_Robot, HIGH);

}

void Forward(){
digitalWrite(motor1, HIGH);
digitalWrite(motor11, LOW);
digitalWrite(motor2, HIGH);
digitalWrite(motor22, LOW);
Serial.println("FORWARD");
}
void Backward(){
```

```
digitalWrite(motor1, LOW);
digitalWrite(motor11, HIGH);
digitalWrite(motor2, LOW);
digitalWrite(motor22, HIGH);
Serial.println("BACKWARD");
}
void Right(){
digitalWrite(motor1, HIGH);
digitalWrite(motor11, LOW);
digitalWrite(motor2, LOW);
digitalWrite(motor22, HIGH);
Serial.println("RIGHT");
}
void Left(){
digitalWrite(motor1, LOW);
digitalWrite(motor11, HIGH);
digitalWrite(motor2, HIGH);
digitalWrite(motor22, LOW);
Serial.println("LEFT");
}
void Stop(){
digitalWrite(motor1, LOW);
digitalWrite(motor11, LOW);
digitalWrite(motor2, LOW);
digitalWrite(motor22, LOW);
Serial.println("STOP");
}
void loop(){
int tempp = dht.readTemperature();
int hum = dht.readHumidity();

// if(tfII2C.getData(tfDist, tfAddr)){
// if((tfDist < 5) || (digitalRead(Left_Ir) == 0) || (digitalRead(Right_Ir)==0)){
// Stop();
// }
// }
lcd.setCursor(0, 1);
lcd.print("T:"+String(tempp));
lcd.setCursor(5, 1);
lcd.print("H:"+String(hum));

digitalWrite(Cutter_Robot, LOW);


if(digitalRead(Switch_mode) == 0){
if(FLAG == 1){
Stop();
FLAG = 0;
}
Serial.println("ROBOT IS IN BLUETOOTH MODE");
if(bluetooth.available() > 0){
while (bluetooth.available() > 0)
```

```
{
char inChar = (char)bluetooth.read();
value_1 += inChar; }
Serial.println(value_1);
if (value_1 == "F"){Forward();}
else if (value_1 == "B"){Backward();}
else if (value_1 == "R"){Right();}
else if (value_1 == "L"){Left();}
else if (value_1 == "S"){Stop();}
value_1 = "";
}
}

else{
FLAG =1;
Serial.println("ROBOT IS IN AUTOMATED MODE");
if(tfII2C.getData(tfDist, tfAddr))
{
if((tfDist < 5) || (digitalRead(Left_Ir) == 0) || (digitalRead(Right_Ir)==0)){
Right();
}
else{
Forward();
```

CHAPTER-5

5.1 Observation and Results

5.1.1 Observation

- In automatic mode the grass cutter robot will turn right first when there is an object in front of it .
- In Manual mode with the help of Bluetooth connection with a smart phone we can navigate our way through objects easily.
- Outdoor places on a sunny days the robot charges itself efficiently.
- According to the height of the grass the blades can be adjusted properly.

5.1.2 Results

- As mentioned before the robot can be operated in both automatic and manual modes.
- In automatic mode robot can easily navigate itself through obstacles with ease.
- In manual mode with the help of Bluetooth connectivity using a smartphone user can navigate the robot.

CHAPTER-6

6.1 Conclusion

Based on observations, it can be determined that the system is more efficient than previous designs because it eliminates the need for human labour and is pollution-free. The method works particularly effectively on lawns with a flat surface. However, on uneven ground, the obstacle recognition stage may fail to detect nearby items.The solar grass cutter is primarily intended for campus cleaning in a sustainable and effective manner. Grass cutting is one of the key operations carried out on campus to maintain cleanliness. This is a time-consuming and labor-intensive technique. In addition, it uses a lot of fuel. The standard grass cutter that is utilised on campus is pricey. As a result, both the capital and operating costs are extremely expensive. Furthermore, one grass cutter is insufficient for campuses with huge areas such as educational institutions, playgrounds, garden areas, parks, etc. To address all of the issues raised above, the automated lawn cutter we proposed in the study could be an effective solution. If properly charged, the cutter can be used during the day or at night. Because of the shorter number of daylight hours during the rainy season, full charging takes a long time, which is a disadvantage for consumers. The machine is also far less expensive than current cutters. Solar energy, or fuel, is free. As a result, the operating costs in this scenario are almost negligible. The self-life of the solar panel is over twenty years. As a result, the machine will function properly for many years. Our design suggests a pollution-free environment.

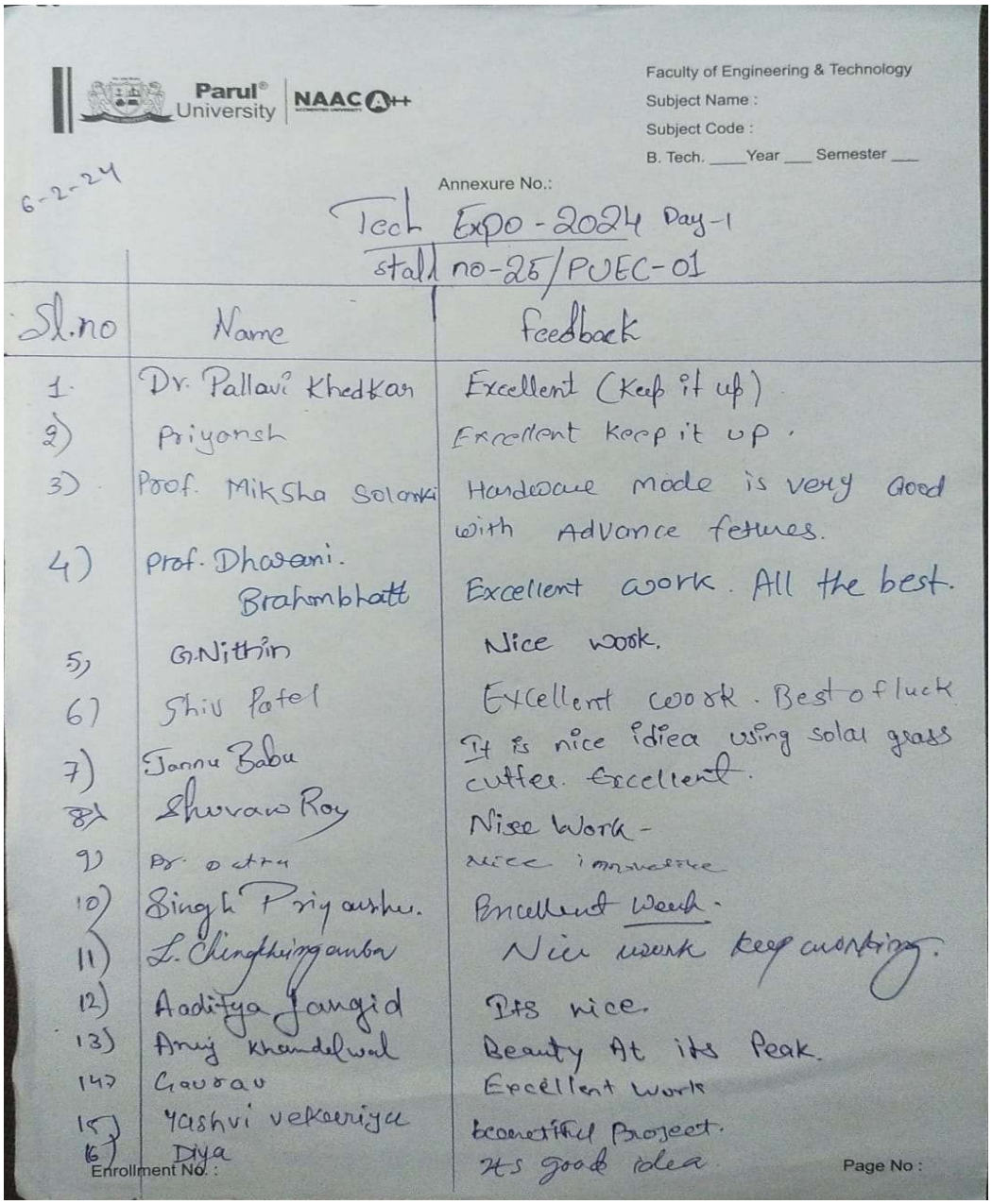
6.2 Future scope

- The ability to cut grass on uneven surfaces.
- Using Image processing and Open CV the robot can cut grass in desired shape automatically

CHAPTER-7

7.1 Tech Expo -2024

7.1.1Feedback



Parul® University | NAAC A++

Faculty of Engineering & Technology
Subject Name :
Subject Code :
B. Tech. ____Year ___ Semester ___

6-2-24

Annexure No.:

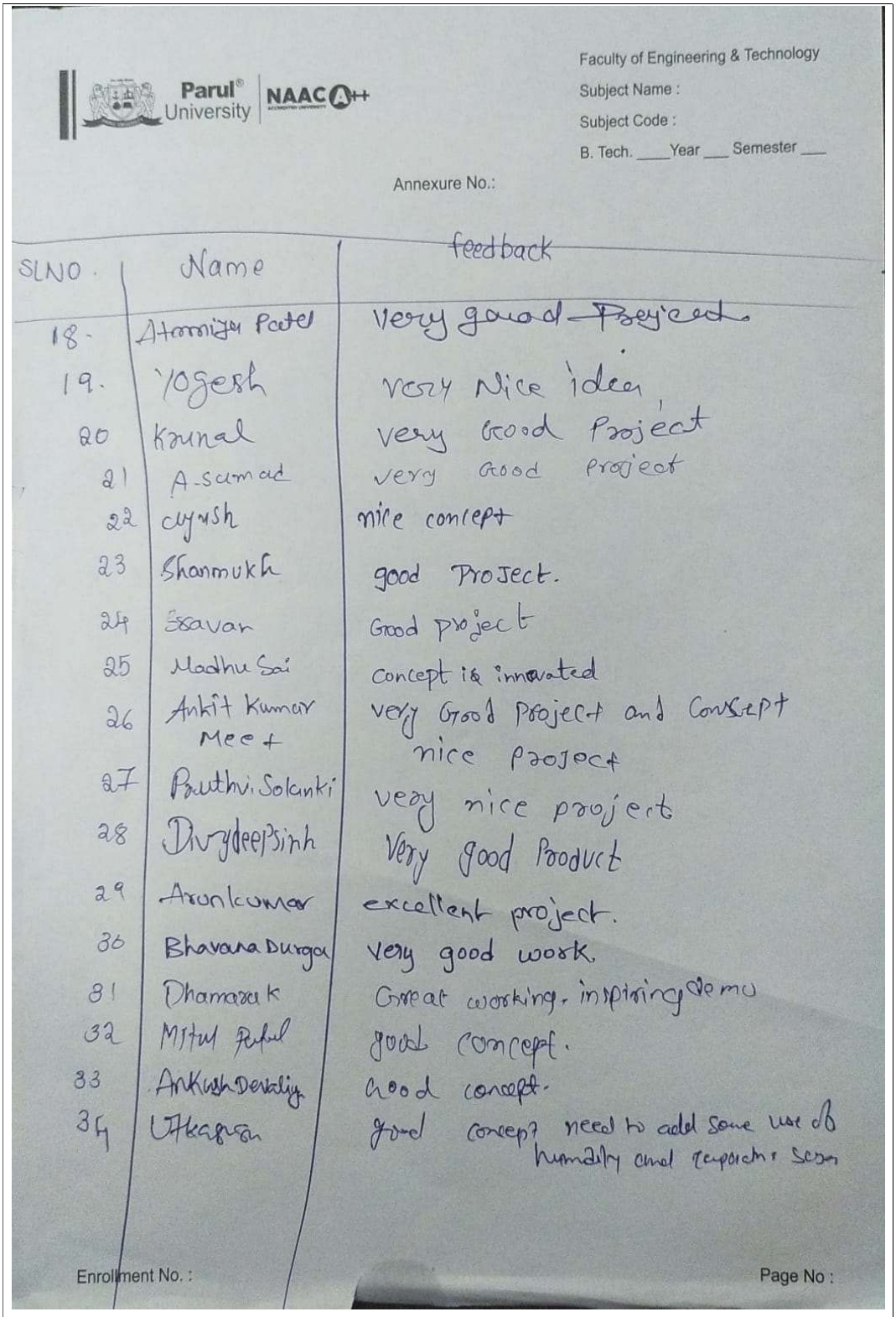
Tech Expo - 2024 Day-1
stall no-25/PUEC-01

Sl.no	Name	feedback
1.	Dr. Pallavi Khedkar	Excellent (Keep it up)
2)	Priyansh	Excellent keep it up.
3)	Prof. Miksha Solanki	Hardware mode is very Good with Advance fetures.
4)	Prof. Dharani. Brahmbhatt	Excellent work. All the best.
5)	G.Nithin	Nice work.
6)	Shiv Patel	Excellent coork. Best of luck
7)	Jannu Babu	It is nice idiea using solal grass cutter. Excellent.
8)	Shuvam Roy	Nise Work -
9)	Dr. Octra	nice innovative
10)	Singh Priyanshu.	Excellent Work.
11)	L. Chingkhingamba	Nice work keep continuing.
12)	Aaditya Jangid	Its nice.
13)	Anuj Khandelwal	Beauty At its Peak.
14)	Gaurav	Excellent Work
15)	Yashvi vekariya	beautiful Project.
16)	Diya	Its good idea

Enrollment No. :

Page No :

Figure 21 - Tech Expo Feedback I



Parul® University | NAAC A++

Faculty of Engineering & Technology

Subject Name :

Subject Code :

B. Tech. ____Year ___ Semester ___

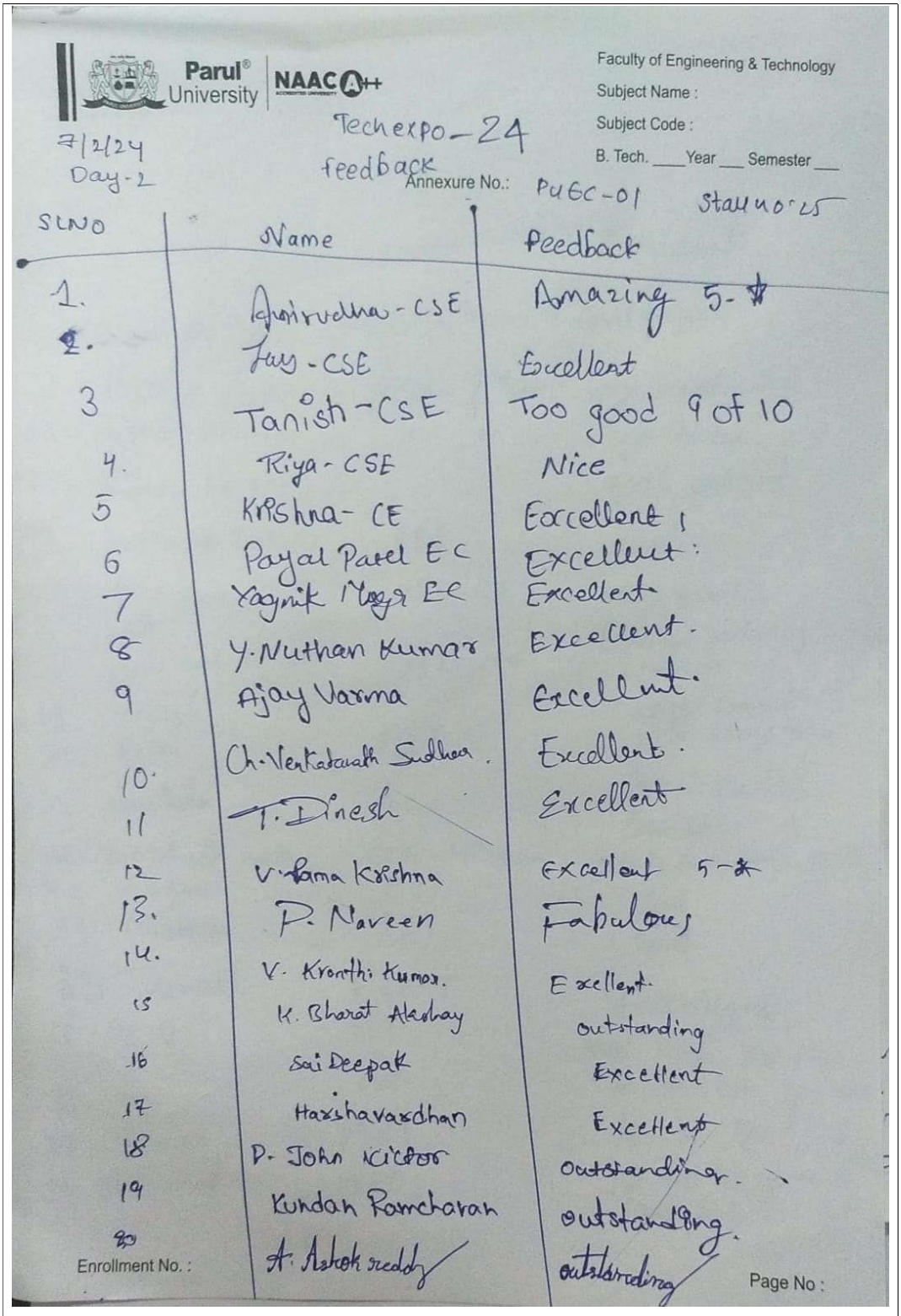
Annexure No.:

SLNO.	Name	feedback
18.	Atmmiya Patel	Very gaood ~~Peyject~~
19.	Yogesh	Very Nice idea
20	Krunal	very Good Project
21	A.samad	very Good Project
22	ayush	nice concept
23	Shanmukh	good Project.
24	Esavan	Good project
25	Madhu Sai	concept is innovated
26	Ankit Kumar Meet	very Good Project and Concept
27	Prathvi Solanki	nice project
28	Divyadeepsinh	very nice project
29	Arunkumar	Very good Product
30	Bhavana Durga	excellent project.
31	Dhamaraj k	very good work.
32	Mitul Patel	Great working. inspiring demo
33	Ankush Devaliy	good concept.
34	Utkarsh	Good concept.
		good concept need to add some use of humidity and temperature sensor

Enrollment No. :

Page No :

Figure 22 - Tech Expo Feedback II



Parul® University | NAAC A++

Faculty of Engineering & Technology
Subject Name :
Subject Code :
B. Tech. ___ Year ___ Semester ___

7/2/24
Day-2

Techexpo-24
feedback

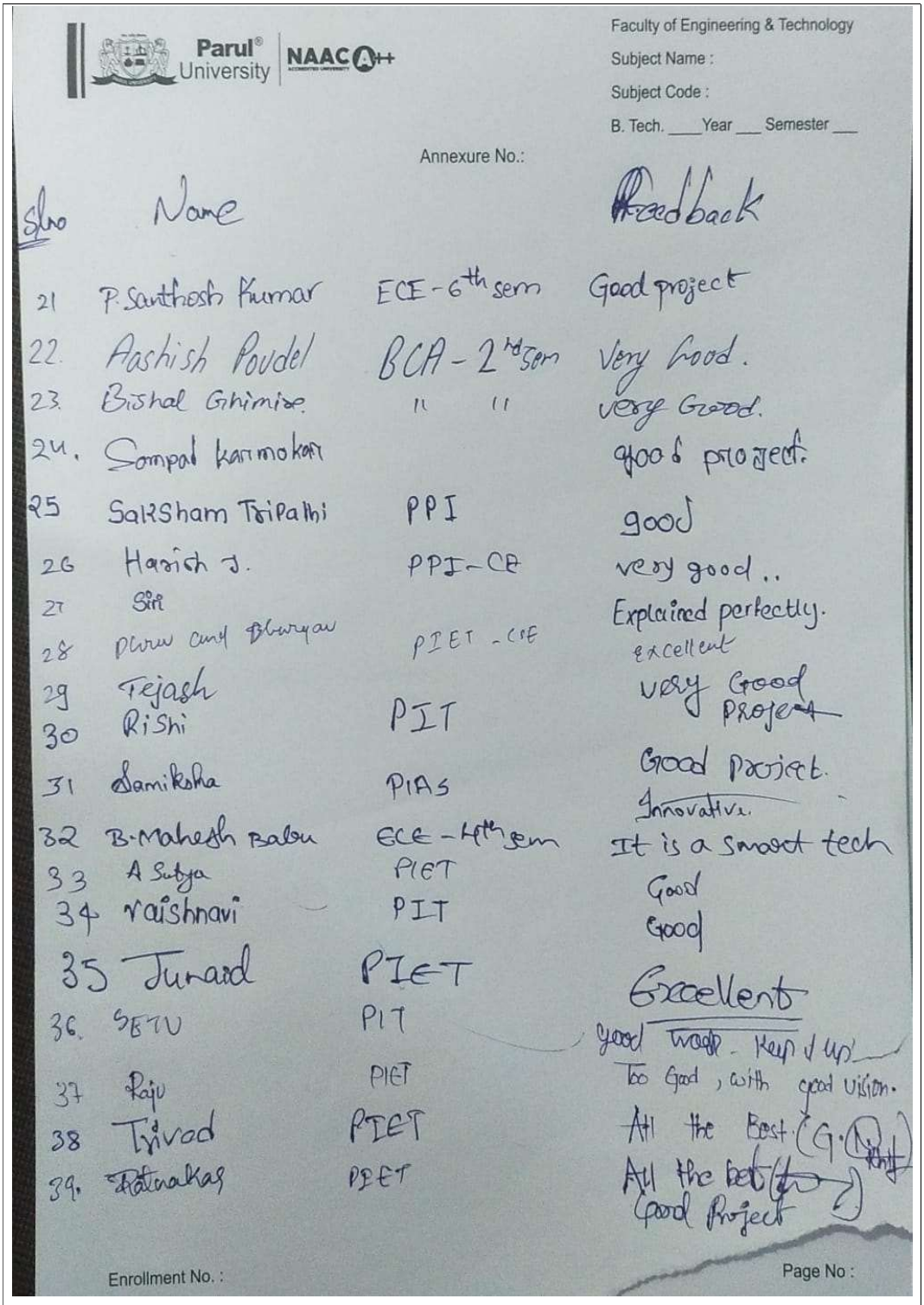
Annexure No.: PUEC-01 Staff no: 25

Sl No	Name	Feedback
1.	Ghritvedha - CSE	Amazing 5-*
2.	Jay - CSE	Excellent
3	Tanish - CSE	Too good 9 of 10
4.	Riya - CSE	Nice
5	Krishna - CE	Excellent
6	Payal Patel EC	Excellent
7	Yagnik Nagar EE	Excellent
8	Y. Nuthan Kumar	Excellent.
9	Ajay Varma	Excellent.
10.	Ch. Venkatanath Sudhea.	Excellent.
11	T. Dinesh	Excellent
12	V. Rama Krishna	Excellent 5-*
13.	P. Naveen	Fabulous
14.	V. Kranthi Kumar.	Excellent.
15	K. Bharat Akshay	outstanding
16	Sai Deepak	Excellent
17	Harisharavardhan	Excellent
18	P. John Victor	Outstanding.
19	Kundan Ramcharan	outstanding.
20	A. Ashok reddy	outstanding

Enrollment No. :

Page No :

Figure 23 - Tech Expo Feedback III



Parul® University | NAAC A++

Faculty of Engineering & Technology

Subject Name :

Subject Code :

B. Tech. ___Year ___ Semester ___

Annexure No.:

Sno	Name		Feedback
21	P. Santhosh Kumar	ECE - 6th sem	Good project
22.	Aashish Poudel	BCA - 2nd sem	Very Good.
23.	Bishal Ghimire	" "	very Good.
24.	Sampal karmakar		good project.
25	Sakisham Tripathi	PPI	good
26	Harish J.	PPI - CE	very good..
27	Sir		Explained perfectly.
28	Purw and Bhargav	PIET - CSE	excellent
29	Tejash		very Good
30	Rishi	PIT	Project
31	Samiksha	PIAS	Good Project. Innovative.
32	B. Mahesh Babu	ECE - 4th sem	It is a smart tech
33	A Satya	PIET	Good
34	vaishnavi	PIT	Good
35	Junaid	PIET	Excellent
36.	SETU	PIT	good Keep it up
37	Raju	PIET	Too Good, with good vision.
38	Trivod	PIET	All the Best. (G. [illegible])
39.	Ratnakar	PIET	All the best (to ?) Good Project

Enrollment No. :

Page No :

Figure 24 - Tech Expo Feedback IV

7.1.2 Tech Expo Banner

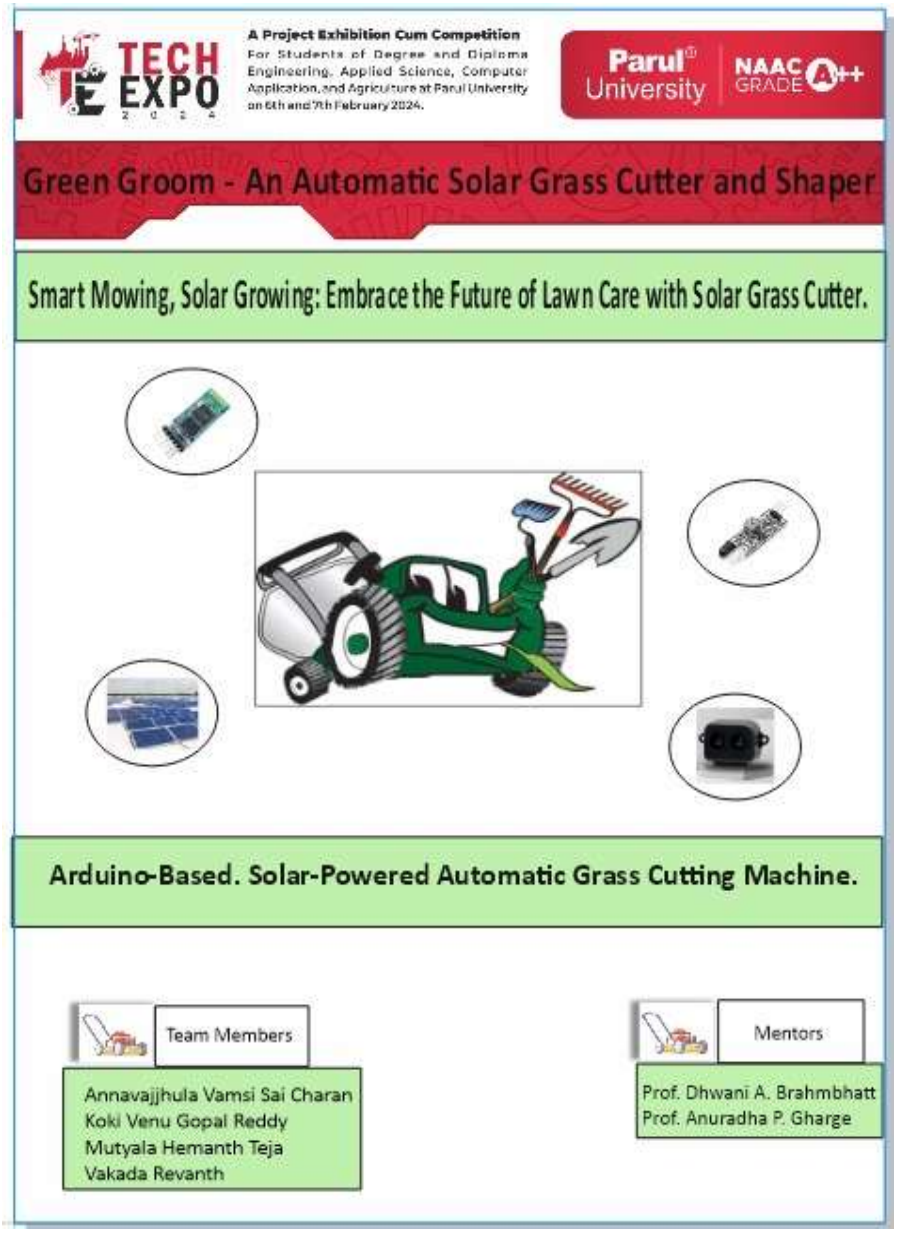


Figure 25 - Tech Expo Banner

7.1.3 English Leaflet

TECH EXPO 2024

A Project Exhibition Cum Competition
For Students of Degree and Diploma Engineering, Applied Science, Computer Application, and Agriculture at Parul University on 6th and 7th February 2024.

Parul® University | NAAC GRADE A++

Green Groom - Automatic Solar Grasscutter & Shaper

Brief Description about the Project

Our Project is Arduino NANO-based Solar powered Grasscutter designed to cut healthy grass in places like parks, hotels, public places, etc. The Grasscutter is designed through using LIDAR and solar, which is controlled remotely through Bluetooth module.

Scope

Solar panels are integrated into the design to harness renewable energy from the sun, reducing the environmental impact associated with traditional fuel-powered alternatives. The robot is equipped with automated navigation features, leveraging sensors for obstacle detection and ensuring efficient coverage of the lawn. The system also prioritizes safety with emergency stop mechanisms and obstacle avoidance, while efficient energy management optimizes the use of solar power.

Future-Prospects of the Project

The ability to cut grass in uneven surfaces , with the help of image processing and open C.V training the robot to cut the grass in desired shape.

Mentors:

Prof Dhwani A.Brahmbhatt

Prof Anuradha P.Gharge

Team Members :

- A.Vamsi Sai Charan
- K.Venu Gopal Reddy
- M.V.S.Hemanth Teja
- V.V.S.M.Revanth

Figure 26 - English Leaflet

7.1.4 Gujrathi Leaflet

TECH EXPO 2024

A Project Exhibition Cum Competition
For Students of Degree and Diploma Engineering, Applied Science, Computer Application, and Agriculture at Parul University on 6th and 7th February 2024.

Parul® University | NAAC GRADE A++

ગ્રીન ગ્રૂમ - ઓટોમેટિક સોલર ગ્રાસ કટર અને શેપર

પ્રોજેક્ટ વિશે સંક્ષિપ્ત વર્ણન

અમારો પ્રોજેક્ટ આર્ડિનો નેનો-આધારિત સૌર સંચાલિત ગ્રાસકટર છે જે ઉદ્યાનો, હોટલો, જાહેર સ્થળો વગેરેમાં તંદુરસ્ત ઘાસ કાપવા માટે રચાયેલ છે. ગ્રાસકટરને LIDAR અને સૌરનો ઉપયોગ કરીને ડિઝાઇન કરવામાં આવ્યું છે, જે બ્લૂટૂથ મોડ્યુલ દ્વારા દૂરથી નિયંત્રિત થાય છે.

અવકાશ

સૂર્યમાંથી નવીનીકરણીય ઉર્જાનો ઉપયોગ કરવા માટે સોલાર પેનલને ડિઝાઇનમાં એકીકૃત કરવામાં આવી છે, જે પરંપરાગત ઇંધણ-સંચાલિત વિકલ્પો સાથે સંકળાયેલ પર્યાવરણીય અસરને ઘટાડે છે. રોબોટ સ્વયંસંચાલિત નેવિગેશન સુવિધાઓથી સજ્જ છે, અવરોધની શોધ માટે સેન્સરનો લાભ લે છે અને લૉનનું કાર્યક્ષમ કવરેજ સુનિશ્ચિત કરે છે.

પ્રોજેક્ટની ભાવિ-ભાવનાઓ

ઇમેજ પ્રોસેસિંગ અને કોમ્પ્યુટર વિઝન ટાસ્કની મદદથી રોબોટને ઇચ્છિત આકારમાં ઘાસ કાપવાની તાલીમ આપીને અસમાન સપાટીમાં ઘાસ કાપવાની ક્ષમતા.

માર્ગદર્શકો:

પ્રો.ધ્વની એ.બ્રહ્મભટ્ટ

પ્રો. અનુરાધા પી. ગોરજે

ટુકડી સભ્યો :

- A. વંશી સાંઇ ચરણ
- K. વેણુ ગોપાલ રેડ્ડી
- M.V.S. હેમંત તેજા
- V.V.S.M. રેવન્થ

Figure 27 - Gujrathi Leaflet

7.1.5 Tech expo participation certificates

Parul® University | NAAC GRADE A++

TECH EXPO 2024

A PROJECT EXHIBITION CUM COMPETITION
FOR STUDENTS OF DEGREE AND DIPLOMA ENGINEERING, APPLIED SCIENCE,
COMPUTER APPLICATION, AND AGRICULTURE AT PARUL UNIVERSITY

CERTIFICATE
OF PARTICIPATION

This is to certify that

Mr. /Ms. A. VAMSI SAI CHARAN

of

PARUL INSTITUTE OF TECHNOLOGY

Exhibited his/her project/ poster titled

GREEN GROOM - AUTOMATIC SOLAR GRASS CUTTER AND SHARPER.

at Tech Expo 2024 held at Parul University

on 6th and 7th February 2024.

Prof. Om Prakash Shukla
Manager,
Technical Events Cell

Dr. Vipul Vekaria
Dean,
Faculty of Engineering & Technology

Figure 28

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TECH EXPO 2024

A PROJECT EXHIBITION CUM COMPETITION
FOR STUDENTS OF DEGREE AND DIPLOMA ENGINEERING, APPLIED SCIENCE,
COMPUTER APPLICATION, AND AGRICULTURE AT PARUL UNIVERSITY

CERTIFICATE
OF PARTICIPATION

This is to certify that

Mr./Ms. K. VENU GOPAL REDDY

of

PARUL INSTITUTE OF TECHNOLOGY

Exhibited his/her project/ poster titled

GREEN GROOM - AUTOMATIC SOLAR GRASS CUTTER, AND SHARPER

at Tech Expo 2024 held at Parul University

on 6th and 7th February 2024.

Prof. Om Prakash Shukla
Manager,
Technical Events Cell

Dr. Vipul Vekaria
Dean,
Faculty of Engineering & Technology

Figure 29


Parul® University
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TECH EXPO 2024
A PROJECT EXHIBITION CUM COMPETITION
FOR STUDENTS OF DEGREE AND DIPLOMA ENGINEERING, APPLIED SCIENCE,
COMPUTER APPLICATION, AND AGRICULTURE AT PARUL UNIVERSITY
CERTIFICATE
OF PARTICIPATION
This is to certify that
Mr. /Ms. M. HEMANTH TEJA
of
PARUL INSTITUTE OF TECHNOLOGY
Exhibited his/her project/ poster titled
GREEN GROOM - AUTOMATIC SOLAR GRASS CUTTER AND SHARPER.
at Tech Expo 2024 held at Parul University
on 6th and 7th February 2024.
Prof. Om Prakash Shukla
Manager,
Technical Events Cell
Dr. Vipul Vekaria
Dean,
Faculty of Engineering & Technology

Figure 30

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TECH EXPO 2024

A PROJECT EXHIBITION CUM COMPETITION
FOR STUDENTS OF DEGREE AND DIPLOMA ENGINEERING, APPLIED SCIENCE,
COMPUTER APPLICATION, AND AGRICULTURE AT PARUL UNIVERSITY

CERTIFICATE
OF PARTICIPATION

This is to certify that

Mr. /Ms. V. REVANTH

of

PARUL INSTITUTE OF TECHNOLOGY

Exhibited his/her project/ poster titled

GREEN GROOM - AUTOMATIC SOLAR GRASS CUTTER AND SHARPER

at Tech Expo 2024 held at Parul University

on 6th and 7th February 2024.

Prof. Om Prakash Shukla
Manager,
Technical Events Cell

Dr. Vipul Vekaria
Dean,
Faculty of Engineering & Technology

Figure 31

7.1.6 Tech expo 2nd prize certificates

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TECH EXPO 2024

A PROJECT EXHIBITION CUM COMPETITION
FOR STUDENTS OF DEGREE AND DIPLOMA ENGINEERING, APPLIED SCIENCE, COMPUTER APPLICATION, AND AGRICULTURE AT PARUL UNIVERSITY

CERTIFICATE
OF MERIT

This is to certify that

Mr. /Ms. A. Vamsi Sai Charan

of

Parul Institute of Engineering & Technology

Exhibited his/her project/ poster titled

Green Groom - Automatic Solar Grass Cutter & Shaper

at Tech Expo 2024 held at Parul University on 6th and 7th February 2024.

The Project/Poster secured 2nd Position.

Prof. Om Prakash Shukla
Manager,
Technical Events Cell

Dr. Vipul Vekaria
Dean,
Faculty of Engineering & Technology

Figure 32


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TECH EXPO 2024

A PROJECT EXHIBITION CUM COMPETITION
FOR STUDENTS OF DEGREE AND DIPLOMA ENGINEERING, APPLIED SCIENCE,
COMPUTER APPLICATION, AND AGRICULTURE AT PARUL UNIVERSITY

CERTIFICATE
OF MERIT

This is to certify that

Mr. /Ms. M. Hemanth Teja

of

Parul Institute of Engineering & Technology

Exhibited his/her project/ poster titled

Green Groom – Automatic Solar Grass Cutter & Shaper

at Tech Expo 2024 held at Parul University on 6th and 7th February 2024.

The Project/Poster secured 2nd Position.

Prof. Om Prakash Shukla
Manager,
Technical Events Cell

Dr. Vipul Vekaria
Dean,
Faculty of Engineering & Technology

Figure 33

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TECH EXPO 2024

A PROJECT EXHIBITION CUM COMPETITION
FOR STUDENTS OF DEGREE AND DIPLOMA ENGINEERING, APPLIED SCIENCE,
COMPUTER APPLICATION, AND AGRICULTURE AT PARUL UNIVERSITY

CERTIFICATE
OF MERIT

This is to certify that

Mr. /Ms. K. Venu Gopal Reddy

of

Parul Institute of Engineering & Technology

Exhibited his/her project/ poster titled

Green Groom – Automatic Solar Grass Cutter & Shaper

at Tech Expo 2024 held at Parul University on 6th and 7th February 2024.

The Project/Poster secured 2nd Position.

Prof. Om Prakash Shukla
Manager,
Technical Events Cell

Dr. Vipul Vekaria
Dean,
Faculty of Engineering & Technology

Figure 34

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TECH EXPO 2024

A PROJECT EXHIBITION CUM COMPETITION
FOR STUDENTS OF DEGREE AND DIPLOMA ENGINEERING, APPLIED SCIENCE, COMPUTER APPLICATION, AND AGRICULTURE AT PARUL UNIVERSITY

CERTIFICATE
OF MERIT

This is to certify that

Mr. /Ms. V. Revanth

of

Parul Institute of Engineering & Technology

Exhibited his/her project/ poster titled

Green Groom - Automatic Solar Grass Cutter & Shaper

at Tech Expo 2024 held at Parul University on 6th and 7th February 2024.

The Project/Poster secured 2nd Position.

Prof. Om Prakash Shukla
Manager,
Technical Events Cell

Dr. Vipul Vekaria
Dean,
Faculty of Engineering & Technology

Figure 35

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