

Development of Automatic Solar Grass Cutter

Dakshayani M. (3BR21EE018), Deshpande Gouri Sheshgiri (3BR21EE019), Dhanush K. (3BR21EE020), Nafisa Fazal (3BR21EE058)

ABSTRACT

The development of an automatic solar grass cutter provides an eco-friendly and automated alternative to conventional grass-cutting machines. Conventional grass cutters generally depend on fossil fuels and require continuous human effort, resulting in noise, emissions, and operational expenses. The proposed system integrates solar energy, battery storage, embedded control, obstacle detection, and wireless communication to develop a sustainable robotic grass-cutting system. A solar panel charges a 12 V rechargeable battery, which supplies power to the movement motors and cutting motor. A microcontroller coordinates the operation of the motors and processes obstacle detection information to enable safer movement. Bluetooth communication provides wireless interaction with the system through an Android application. The developed prototype incorporates DC motors, a circular cutting blade, relay switching, nylon wheels, a mild-steel frame, Bluetooth module, converter, and rechargeable battery. Experimental observations indicate that the system can perform grass-cutting operations with reduced human intervention while offering low-noise and environmentally friendly operation. The proposed system is suitable for residential lawns, parks, educational institutions, sports fields, and other outdoor lawn-maintenance applications.

Keywords— Automatic grass cutter, solar energy, renewable energy, robotic vehicle, obstacle detection, Bluetooth, microcontroller, DC motor.

INTRODUCTION

Grass cutting is an essential activity for maintaining lawns, gardens, parks, agricultural areas, and other outdoor spaces. Conventional grass-cutting machines often depend on fuel-based engines and require manual operation. Such systems can contribute to environmental pollution, noise, fuel consumption, and increased maintenance requirements. The uploaded project identifies the need for an eco-friendly, cost-effective, and automated solution that minimizes human intervention while maintaining effective lawn-care operation.

The proposed automatic solar grass cutter combines renewable energy and robotic automation. A solar panel is used as the primary energy source and charges a 12 V rechargeable battery. The stored energy is subsequently supplied to the drive motors and cutting motor, allowing the system to operate without dependence on an external electrical supply during normal operation.

The system uses a microcontroller as the central control unit. It receives information from obstacle-detection sensors and controls the movement of the robotic platform. When an obstacle is detected, the controller directs the vehicle to change its movement direction, thereby reducing the possibility of collisions. Bluetooth communication is also incorporated to provide wireless interaction and remote control functionality.

The integration of renewable energy, autonomous movement, wireless communication, and grass-cutting mechanisms makes the proposed system a practical approach to sustainable lawn maintenance. The project particularly targets reduction of manual effort, fuel dependence, emissions, and noise while providing a compact robotic solution for outdoor applications.

LITERATURE SURVEY

Several researchers have investigated solar-powered and automated grass-cutting systems as alternatives to conventional fuel-based machines. Baingane *et al.* [1] presented a review of fully automated solar grass cutters, highlighting the use of solar energy to reduce environmental pollution and human effort. Bidgar *et al.* [2] developed an automatic solar grass cutter integrating solar power with an automated cutting mechanism. D'Souza *et al.* [3] also proposed an automatic solar grass cutter aimed at reducing dependence on conventional energy sources. These studies demonstrate the feasibility of combining renewable energy with automated grass-cutting mechanisms; however, issues such as energy availability, battery capacity, and autonomous operation remain important considerations.

Hariya *et al.* [4] investigated a fully automated solar grass cutter, emphasizing improved automation and reduced manual intervention. Mudda and Soumya [5] explored IoT-based energy management and control, demonstrating the potential of intelligent communication and monitoring technologies in energy-related systems. The reviewed studies indicate that solar energy can provide a sustainable power source for grass-cutting applications, while automation and wireless communication can improve usability. However, the project report identifies limitations including weather dependency, battery constraints, limited power output, terrain restrictions, and system complexity. Therefore, the proposed work integrates solar energy, battery storage, obstacle detection, microcontroller-based control, and Bluetooth communication to provide a more convenient and sustainable grass-cutting solution.

PROBLEM STATEMENT

Conventional grass-cutting machines powered by internal combustion engines contribute to environmental pollution, noise pollution, fuel consumption, and operational costs while requiring human intervention and regular maintenance..

OBJECTIVES

The two main objectives of the proposed system are:

1. To develop a solar-powered automatic grass cutter that reduces dependence on conventional fuel and minimizes environmental pollution.
2. To implement an automated robotic grass-cutting system with obstacle detection and wireless control for safe and convenient operation.

PROPOSED SYSTEM

The proposed automatic solar grass cutter consists of a solar panel, rechargeable battery, converter, microcontroller, relay circuit, DC motors, cutting blade, obstacle-detection sensors, Bluetooth module, wheels, and structural frame. The solar panel supplies electrical energy, while the rechargeable battery stores energy for operation during periods of reduced solar availability. The converter regulates the electrical energy supplied to the system and supports appropriate voltage levels for the connected components.

The microcontroller acts as the central processing and control unit. Sensor information is processed by the controller to determine the movement of the robotic platform. The drive motors provide vehicle movement, while the high-speed motor drives the cutting blade. Relays provide an interface between the low-power controller and higher-power loads. Bluetooth communication enables wireless interaction between the robotic system and a user-operated Android application.

BLOCK DIAGRA

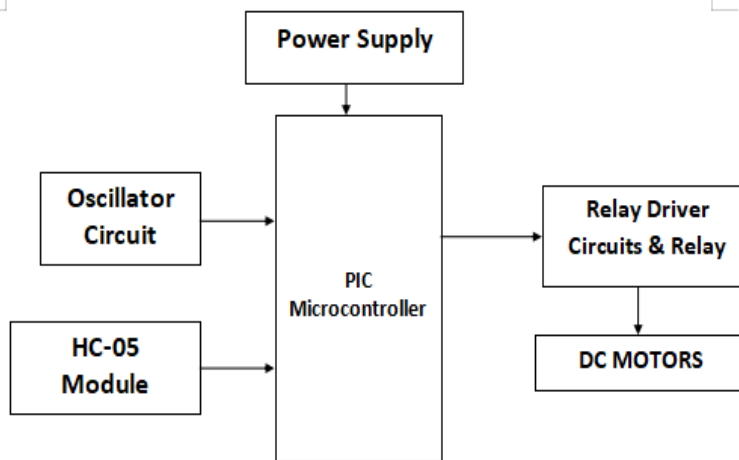


Fig 1BlockDiagram of Automatic solar grass cutter

The **Fig. 1** shows the block diagram of the PIC microcontroller-based control system, where the HC-05 Bluetooth module and oscillator circuit provide input and timing functions to the controller. The PIC microcontroller processes the received commands and operates the DC motors through the relay driver circuit and relays.

CONNECTION DIAGRAM

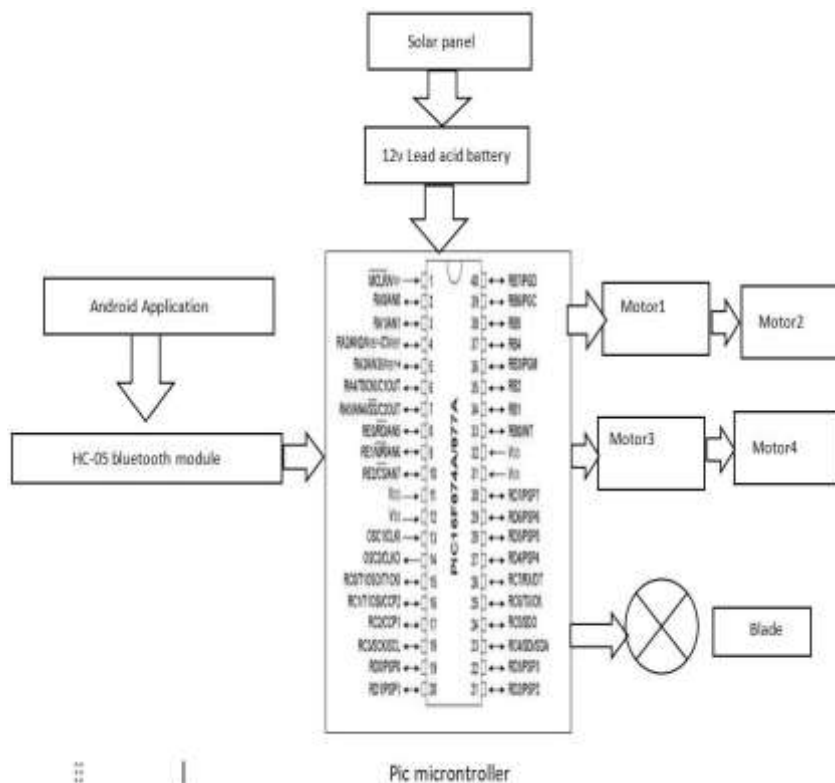


Fig 2 Connection Diagram

The **Fig. 2** shows the block diagram of the solar-powered, Bluetooth-controlled system, where the solar panel charges a 12 V lead-acid battery that supplies power to the PIC microcontroller. The HC-05 Bluetooth module receives control commands from an Android application, enabling the microcontroller to operate the four motors and blade mechanism.

METHODOLOGY

The methodology begins with identification of the lawn area, power requirements, desired cutting characteristics, obstacle-detection requirements, and autonomous movement requirements. Based on these requirements, the solar panel, battery, motors, cutting blade, controller, wheels, and frame are selected. The report specifies a 10 W solar panel with a maximum output of 12 V and 0.75 A and a 12 V rechargeable battery for supplying the system.

The mechanical assembly is constructed using an MS frame that supports the battery, solar panel, motors, wheels, and cutting mechanism. Electrical wiring connects the solar panel to the battery through suitable regulation/conversion circuitry, while the controller interfaces with the sensors, relay, motors, and communication module. The software/control methodology includes systematic movement, obstacle detection and avoidance, solar-energy management, and battery operation.

During operation, solar energy is converted into electrical energy and stored in the battery. The battery supplies power to the drive motors and cutting motor. The controller continuously receives obstacle information. When the path is clear, the vehicle moves forward and performs grass-cutting operations. When an obstacle is detected, the controller changes the direction of the vehicle, waits briefly, and scans again before continuing. The two DC Johnson motors used for movement operate at approximately 30 RPM, while the cutting motor is specified at 8000 RPM. The converter provides voltage regulation and supports efficient transfer of energy between the solar panel, battery, and load. The report also discusses MPPT functionality as a means of maximizing the available solar power under changing sunlight conditions.

RESULTS AND DISCUSSION

As shown in **Figs. 3 and 4**, the developed prototype was successfully assembled and tested as an integrated solar-powered robotic grass cutter. The experimental setup integrates the solar-energy subsystem, battery, control electronics, drive and cutting mechanisms, and wireless communication components to achieve efficient and remotely controlled grass-cutting operation.

The reported experimental observations indicate that the system can perform grass-cutting operations using solar-generated energy while reducing dependence on non-renewable energy sources. The autonomous functionality reduces the requirement for continuous human intervention. The adjustable blade arrangement provides uniform grass cutting, while the rechargeable battery supports operation when solar energy is not immediately available.

The system also provides quiet operation compared with conventional engine-driven grass cutters. The MS frame contributes to mechanical durability, while the maintenance-free battery reduces routine maintenance requirements. The prototype is intended for gardens, parks, and other lawn-maintenance environments. However, the report does not provide detailed numerical measurements such as exact cutting area per charge, charging time, energy efficiency, or obstacle-detection success percentage; therefore, these performance parameters cannot be quantitatively claimed from the source document.



Fig 3 hardware set up(top view)



Fig 4 hardware set up(side view)

CONCLUSION

The automatic solar grass cutter presented in this work combines renewable solar energy with robotic automation to provide an environmentally friendly solution for lawn maintenance. The proposed system uses a solar panel, rechargeable battery, microcontroller, DC motors, cutting blade, obstacle-detection mechanism, relay interface, and Bluetooth communication to achieve automated operation. The experimental observations reported in the project demonstrate the feasibility of integrating these subsystems into a functional grass-cutting prototype.

The system reduces manual effort and dependence on conventional fuel-powered grass cutters while offering quiet and sustainable operation. Although limitations such as weather dependency, battery capacity, terrain restrictions, and limited quantitative performance data remain, the prototype provides a foundation for further development of intelligent solar-powered lawn-maintenance robots.

REFERENCES

- [1] T. Baingane, S. Nagrale, S. Gumgaonkar, G. Langade, S. Ramteke and Prof. V. M. Dhumal, "Review on Fully Automated Solar Grass Cutter," *International Research Journal of Engineering and Technology (IRJET)*, vol. 5, no. 2, Feb. 2018.
- [2] P. D. Bidgar, N. B. Pagar, V. S. Ugale, S. Wani and Prof. Sharmila M., "Design and Implementation of Automatic Solar Grass Cutter," *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, vol. 6, no. 4, Apr. 2017.
- [3] M. D'Souza, V. B. Naik and R. V. Bicholkar, "Automatic Solar Grass Cutter," *International Journal of Science Technology & Engineering (IJSTE)*, vol. 3, no. 12, Jun. 2017.
- [4] A. Hariya, A. Kadachha, D. Dethaliya and Prof. Y. D. Tita, "Fully Automated Solar Grass Cutter," *International Journal of Science Technology & Engineering (IJSTE)*, vol. 3, no. 9, Mar. 2021.
- [5] M. Mudda and M. Soumya, "Energy Management with Disaster Intimation and Control Using IoT," *International Journal of Engineering and Applied Computer Science (IJEACS)*, vol. 2, no. 7, Jul. 2021.