Automatic Grass Cutter and Garden Cleaner

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Abstract: *Nowadays, the use of grass cutters and garden cleaners has become essential for maintaining tidy and healthy outdoor spaces. This paper aims to fabricate a grass cutting machine that also cleans the lawn using a vacuum cleaner. These tools enhance efficiency, allowing homeowners and landscapers to quickly manage overgrown lawns and remove debris. This results in a simple, cost effective and making it an excellent feature for future smart robotic operations. This paper focuses on developing an automated grass cutting robot capable of independently cutting grass with high efficiency and minimal human oversight and automatically cleaning outdoor grassy areas by collecting debris, such as leaves and other waste, without requiring manual intervention. This entire mechanism is placed within a suitable machine structure. The grass-cutting machine operates in two modes automatic mode and manual mode. The vacuum device is at the back of the vehicle will automatically clean the cut grass pieces. The hardware is equipped with a combination of ultrasonic sensors, a powerful suction mechanism and robust wheels.*

Keywords: *Arduino UNO, Solar Panel, Bluetooth Module, Grass Cutter, Vacuum Cleaner, Lawn maintenance.*

1. Introduction

Maintaining gardens and lawns is an essential aspect of creating a clean and pleasant environment, but traditional methods often come with challenges. Gas-powered grass cutters and manual tools require significant effort, emit harmful pollutants, and generate noise pollution. Similarly, maintaining cleanliness in outdoor spaces using conventional methods or electric vacuums can be labor-intensive and energy-consuming. These traditional approaches are not only inefficient but also contribute to environmental degradation and inconvenience, especially for elderly or physically limited individuals. To address these challenges, innovative solutions like automatic grass cutters and garden cleaners powered by renewable solar energy have been introduced. These devices utilize photovoltaic panels to harness clean energy, making them efficient, eco-friendly, and cost effective. The automatic grass cutter ensures uniform lawn maintenance with minimal effort, while the solar-powered garden cleaner provides an efficient way to keep outdoor spaces tidy. Together, these technologies combine convenience, sustainability, and environmental conservation, making them ideal for modern lawn and garden care.

Mallikarjun Mudda (2018) Presented a study on the concept of an Automatic Solar Grass Cutter. In the present generation, grass cutter machines are becoming increasingly popular. Pollution, which is manmade, is evident in our daily lives. In older models of grass cutters, IC engines were used, which had a significant environmental impact and contributed to rising pollution levels. [1]

Dr. A. Krishnamurthy (2022) explained a grass-cutting machine system controlled by an Android application via a Bluetooth module, powered by solar energy. Traditional grass cutters rely on fue. In contrast, this system uses a solar panel to charge the battery, eliminating the need for external charging. Solar energy is cost-effective, easy to use, and environmentally friendly. The machine operates in automatic or manual mode, with movement and direction controlled through an Android app. The entire system is programmed in Embedded C to enable efficient grass-cutting operations. [2]

Gopala Reddy (2024) Presented a study on the concept of an Android App Operated Solar Powered Grass Cutter with Vacuum Cleaner. The grass cutter includes features like ultrasonic sensors to detect and avoid obstacles, preventing damage to the blades. Additionally, a built-in vacuum cleaner collects waste, maintaining the cleanliness of lawns and gardens. In today's world, automation is transforming lawn care by integrating technology like the Blynk cloud platform, enabling remote control of grass cutters via smartphones. This device combines cutting and cleaning functions, making it ideal for maintaining relaxing spaces like gardens [3].

This paper presents a solar-powered automatic grass cutter and garden cleaner that operates in both manual and autonomous modes. It integrates ultrasonic sensors, Bluetooth control, and a vacuum system for efficient grass cutting and debris collection. Powered by a 12V battery charged via a solar panel, the vehicle ensures energy efficiency, safety, and remote control. The system promotes sustainable, low-maintenance lawn care while reducing manual effort and environmental impact.

2. Block Diagram

The block diagram for Automatic Grass Cutter and Garden Cleaner is shown in the Fig 1.

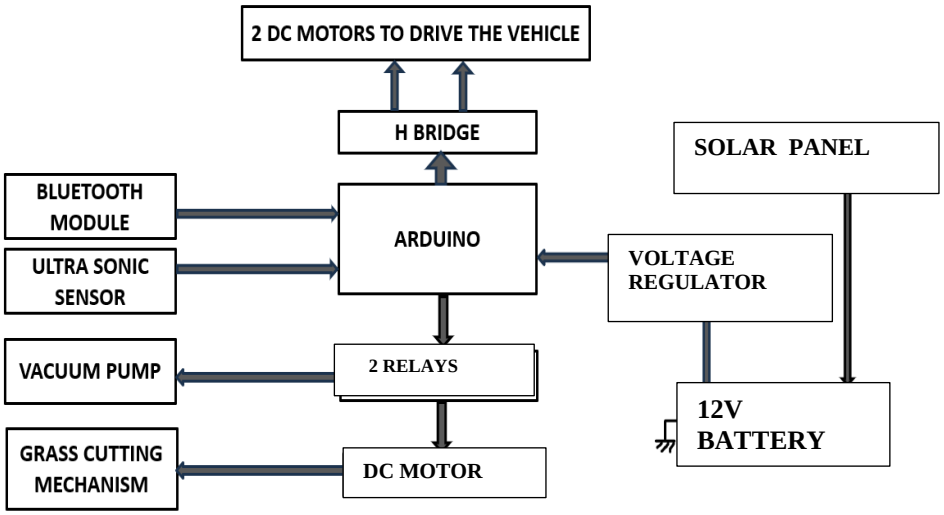

Fig. 1 Block Diagram

A solar panel serves as the primary power source, converting sunlight into electrical energy to charge a 12V battery, which acts as the main energy storage unit. A voltage regulator ensures that the power supplied to the components is stable and matches their operational requirements. At the core of the system is the Arduino, which processes inputs from various sensors and executes programmed instructions to control the actuators. A Bluetooth module enables wireless communication, allowing users to remotely operate the vehicle via a smartphone. The ultrasonic sensor detects obstacles by measuring distances, ensuring safe navigation and

collision avoidance. Mobility is achieved through two DC Motors, controlled by the H-Bridge motor driver, enabling the vehicle to move forward, backward, right, and left as needed. The relay module acts as a switch, allowing the Arduino to control high-power components such as the grass-cutting mechanism, powered by DC Motor, and an optional vacuum cleaner, which enhances the system by cleaning debris and grass clippings. The system integrates these components to create an efficient, sustainable, and user-friendly solution for garden maintenance.

3. Hardware Module

The hardware module constructed for Automatic Grass Cutter and Garden Cleaner is shown in the Fig 2 and Fig 3.

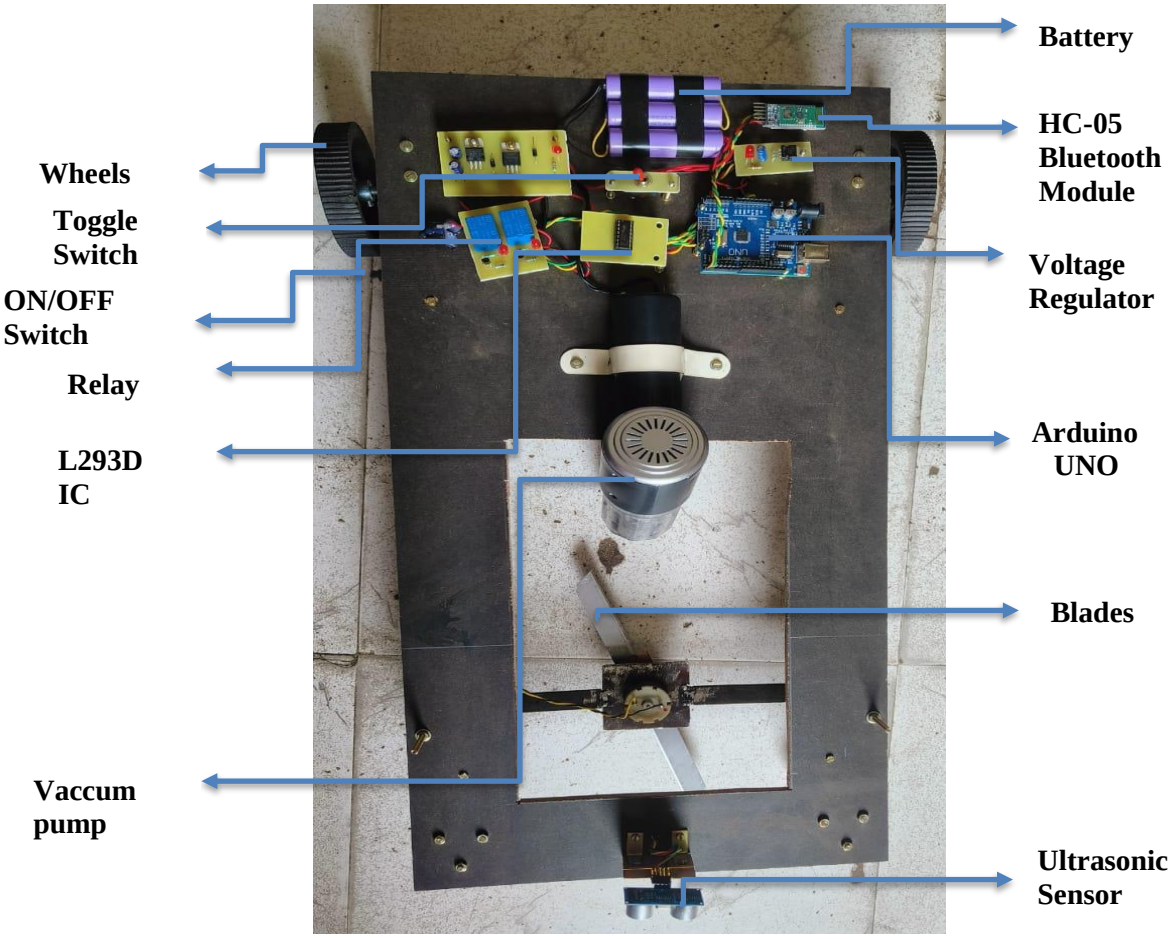

Fig. 2 Hardware Module without a Solar Panel

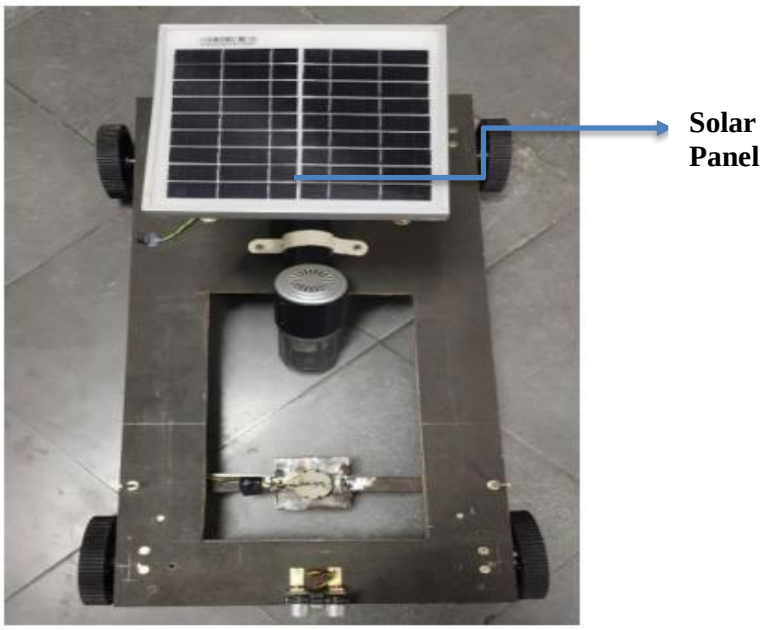

Fig. 3 Hardware Module with a Solar Panel

The automated grass cutter is an intelligent system designed to simplify lawn maintenance through autonomous operation. At the heart of the system is the Arduino Uno microcontroller, which acts as the brain, processing inputs from various sensors and coordinating the operation of all components. To ensure safe navigation, an ultrasonic sensor is used to detect obstacles by measuring the distance to nearby objects using sound waves, effectively preventing collisions. The movement of the grass cutter is controlled by DC motors attached to the wheels, allowing it to travel smoothly across different terrains, including uneven surfaces. A motor driver circuit, specifically the L293D IC, acts as the interface between the Arduino and the motors, enabling precise control of motor speed and direction. The relay module is used to safely control high-power components like motors and a vacuum pump, protecting the Arduino from voltage overload. A Bluetooth module (HC-05) allows the system to be remotely controlled via a smartphone, offering users added convenience and flexibility. The cutting blade is powered by a separate DC motor, ensuring consistent and efficient grass cutting performance. All components draw power from a rechargeable battery pack, regulated by a voltage regulator to maintain safe and stable voltage levels. Essential electronic components are mounted on supporting circuit boards, which ensure the reliability and stability of the entire system. A toggle switch is included for manual control, allowing the user to power the system on or off as needed. Together, these components create a fully functional, efficient, and user-friendly smart grass-cutting machine.

4. Testing and Results

The hardware was tested for different cases to observe its operation.

Case 1: Forward and Backward Movements

The Hardware module was thoroughly tested for reliable performance in both automatic and manual modes. In automatic mode, the ultrasonic sensor detects obstacles in real time and directs the vehicle to move forward or reverse to avoid collisions, ensuring smooth navigation. In manual mode, the Hardware module responds to Bluetooth commands from the user, allowing accurate control of forward and backward movement. Testing involved placing obstacles in different positions to assess the effectiveness of automatic avoidance and manual control. The Fig. 4 shows the grass cutter movement in forward movement and the Fig. 5 shows the grass cutter movement in backward movement. The 'F' command is used to move the vehicle forward, while the 'B' command is used to move it backward.

Fig. 4 Forward movement

Fig. 5 Backward movement

Case 2: Right and Left Movements

The vehicle was tested for efficient handling of right and left turns in both automatic and manual modes. In automatic mode, the ultrasonic sensor detects obstacles and initiates right or left turns to prevent collisions. In manual mode, the user can control the turns via Bluetooth commands for responsive maneuvering. Testing confirmed the system's ability to perform timely directional changes and accurately execute commands in various obstacle scenarios. The 'R' command is used to move the vehicle Right Direction, while the 'L' command is used to move it Left Direction. The Fig. 6 shows the grass cutter movement in right direction and the Fig. 7 shows the grass cutter movement in left direction.

Fig. 6 Right movement

Fig. 7 Left movement

Case 3: Cutter Operation

The cutter of the hardware module was tested for effective operation in both automatic and manual modes. In automatic mode, the cutter automatically turns ON when the hardware module begins grass-cutting operations and turns OFF when an obstacle is detected or when the cutting task is completed, ensuring safety and efficiency. In manual mode, the user can control the ON and OFF states of the cutter blades through Bluetooth commands, allowing for convenient and precise operation as needed. During testing, the automatic mode was evaluated by initiating the cutting process. In manual mode, Bluetooth-enabled devices were used to send commands to the cutter, confirming accurate and reliable blade control. The Fig. 8 shows the grass cutter movement in ON condition and the Fig. 9 shows the grass cutter in OFF condition. This dual-mode functionality enhances the system's flexibility, safety and user convenience. The '1' command is used to ON the Cutter, while the '2' command is used to OFF the Cutter.

Fig. 8 ON condition of Cutter

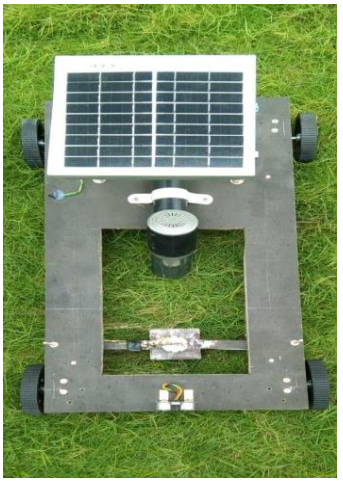

Fig. 9 OFF condition of cutter

Case 4: Vacuum Cleaner Operation

The garden vacuum cleaner was tested for efficient performance in both automatic and Bluetooth control modes. In automatic mode, sensors detect garden debris and automatically activate the vacuum cleaner to begin the cleaning process, ensuring hands-free and timely operation. In Bluetooth mode, users can manually control the vacuum cleaner ON and OFF functions through a mobile app, allowing for precise and convenient operation as needed. The Fig. 10 shows the Vacuum cleaner in ON condition and the Fig. 11 shows the Vacuum cleaner in OFF condition. This dual-mode functionality offers a balance of automation and user control, ensuring reliable and efficient garden cleaning in different scenarios**.** The '3' command is used to ON the Vacuum cleaner, while the '4' command is used to OFF the Vacuum cleaner.

Fig. 10 ON condition of Vacuum cleaner

Fig. 11 OFF condition of Vacuum cleaner

Results

Table 4.1

The Table 4.1 shows the command-based operations of the Automatic Grass Cutter and Garden Cleaner in Bluetooth mode.

SNO	Commands	Operations	Cutter	Vacuum	Motor A	Motor B	Motor C
1	F	Forward Direction	OFF	OFF	ON	ON	OFF
2	B	Backward Direction	OFF	OFF	ON	ON	OFF
3	R	Right Direction	OFF	OFF	ON	ON	OFF
4	L	Left Direction	OFF	OFF	ON	ON	OFF
5	1	ON Condition of Cutter	ON	OFF	OFF	OFF	ON
6	2	OFF Condition of Cutter	OFF	OFF	OFF	OFF	OFF
7	3	ON Condition of Vacuum cleaner	OFF	ON	OFF	OFF	OFF
8	4	OFF Condition of Vacuum cleaner	OFF	OFF	OFF	OFF	OFF

Motor A and Motor B are the two DC motors used for the movement of hardware module. Motor C is DC motor used for grass cutter. Commands like "F" (Forward), "B" (Backward), "R" (Right), and "L" (Left) activate both Motor A and Motor B for movement. Motor A controls the right side, while Motor B controls the left. Motor C operates the cutter. Command "1" turns the cutter ON and "2" turns it OFF. Command "3" activates the vacuum cleaner and "4" deactivates it.

5. Conclusion

The automatic grass cutter and garden cleaner project provides an innovative and efficient solution to the labor intensive task of lawn maintenance. It combines ultrasonic sensors, DC motors, Bluetooth control, and solar power to enable autonomous navigation, obstacle detection, and precise grass cutting. The system significantly reduces manual labor while enhancing user convenience through Bluetooth-based remote control. The ultrasonic sensor improves safety by detecting obstacles and preventing collisions, while solar power in-creases energy efficiency and reduces operational costs.

A key feature of this project is the integration of a vacuum cleaner with the grass cutting system. While the grass cutter trims the grass tips, the vacuum cleaner collects the clip-pings and debris. The system has been thoroughly tested in four Movements forward, backward, left, and right. It also supports flexible control of the cutter and vacuum under different operating conditions. The entire system was tested and operated in our college garden, demonstrating its effectiveness in a real world environment. With both automatic and manual modes, the system adapts to various garden layouts, offering a sustain-able, user-friendly, and versatile approach to modern garden maintenance.

6. Acknowledgment

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