Research Paper on Solar Based Automated Grass Cutter Robot

Ayush kottalwar, Nikhil Nakshane, Akash Kadukar, Himansh Wasnik

Assistant Professor Dr. Mrs. A.R. Kondelwar Department of
Electronics and Telecommunications engineering. Priyadarshini college of Engineering,Nagpur, India

B.tech Student, Department of Electronics and Telecommunication Engineering.
Priyadarshini college of engineering , Nagpur, India

ABSTRACT

This research presents the development of an solar based automated Grass Cutter robot utilizing Arduino Uno, aimed at enhancing lawn maintenance through automation, safety, and efficiency. The system integrates an ultrasonic sensor for obstacle detection, a servo motor for steering, and a stopper switch as a critical safety mechanism. By continuously monitoring sensor inputs, the Arduino Uno controls movement and cutting functions, ensuring precise operation while minimizing risks. The autonomous grass cutter adapts to environmental conditions, avoiding obstacles and preventing unintended operation in hazardous situations. Experimental validation demonstrates the system's effectiveness in providing a safe and efficient grass-cutting solution. This research contributes to the advancement of autonomous lawn maintenance technology, with potential for further enhancements through additional sensors and AI-based navigation. Future developments in automation and safety features can further optimize performance, making autonomous grass-cutting solutions more adaptable and sustainable for various applications.

Keywords: *Lawn, Automation, Solar Grass Cutter, Microcontroller, Motor, Solar Panel, Battery.*

1.INTRODUCTION

Solar energy is an inexhaustible wellspring of energy. Its sources are partitioned into two kinds they are inactive solar source and dynamic solar source. These sources are totally relying on how the solar energy is caught and it is disseminated and furthermore on how it is changed over to the solar force. As we probably are aware the solar energy is free energy and it very well may be used without any problem. By utilizing this solar energy, we work solar grass cutter. In the market there are a wide range of grass cutters are accessible, for example, gas based grass cutter, electrical energy-based grass cutter. The electrical grass cutter relies on power and the gas based grass cutter expects fuel to work. The consuming of fuel in gas grass cutter reason air contamination just as commotion contamination. For the cutter machine huge link wire is needed for cutting the grass of enormous region and the heaviness of motor is additionally hefty [3]. Along these lines, as the innovation is improving, we additionally need to supplant the customary traditional grass cutter to the new computerized solar based grass cutter.

In this way, from the above challenges, attempted to make a computerized solar based grass cutter which having battery of 12V and a solar board which used to store the solar energy in the battery [4]. There are complete 5 DC motors are utilized in the gadget from which 4 are utilized for moving gadget starting with one spot then onto the next and one major motor is utilized for cutting of the grass. These motors are associated with the motor driver and took care of by Arduino UNO. For the hindrance discovery reason ultrasonic sensor is utilized. There is on need of wire and fuel to work gadget. Thus, the gadget is contamination less and eco-accommodating. The gadget has given with two modes to work inside they are programmed and furthermore one can work the gadget with telephone by interfacing the gadget with Bluetooth as Bluetooth module is given in the gadget.

This venture gives the planning steps to mechanized solar grass cutter, whose point is to cut the grass of the predetermined region which is indicated to the gadget with no human collaboration. The yield is accomplished by utilizing the sensors and different parts. A definitive objective of this gadget is to make a comparative gadget as conventional grass cutter with better proficiency and of minimal expense.

METHODALOGY

The gadget comprises of Arduino UNO microcontroller, Ultrasonic sensor, Bluetooth Module and a Solar fueled framework. Associating these components in required organization we get our ideal framework structure [7]. The Ultrasonic sensors functions as the eyes of the gadget, To give the necessary capacity to the gadget we utilize the battery and to charge the battery we mount solar board at the highest point of the gadget, The battery supplies the energy to the segments and as indicated by the orders the motor moves. Furthermore, this machine will likewise eliminate the obstacles coming. The framework doesn't need any human association for the activity of the framework. When the information is given it will all work without anyone else and as the space is covered it will stop by its own.

BLOCK DIAGRAM

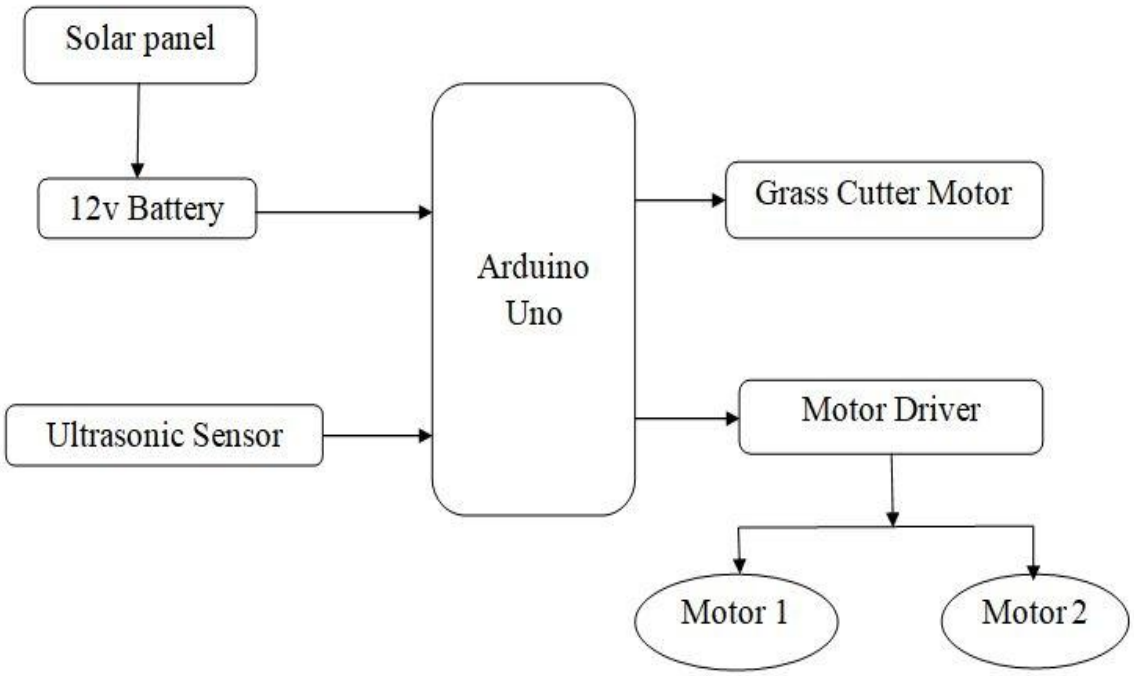

Fig. 3.1 Block Diagram

COMPONENTS

Component	Component Specification
Arduino Uno	ATmega328P microcontroller, 16MHz clock speed
Ultrasonic Sensor (HC-SR04)	Detection range: 2cm–400cm, Accuracy: ±3mm
Servo Motor (SG90 or MG995)	Operating voltage: 4.8V–6V, Torque: 2.5–12 kg·cm

DC Motor (Blade Motor)	12V, 3000–5000 RPM (as per requirement)
Motor Driver (L298N)	Dual H-Bridge, Operating voltage: 5V–35V
Wheels & Chassis	Custom-designed or pre-built frame
Stopper Switch (Emergency Kill Switch)	Normally open (NO) or Normally closed (NC)
Battery (Li-ion or Lead Acid)	12V, 5Ah (or as required)
Relay Module	5V, Single-channel or Dual-channel

FLOW CHART

B. Flow Chart

Figure 2: Flow Chart of Grass Cutter

Before all else, the Android portable application gives three modes (contact button, voice acknowledgment, and example plan) of controlling grass cutter, as delineated in Figure 5. Initially, interface the Android versatile application with Arduino by the Bluetooth module, when the client

presses any contacted button or talks some keyword in voice acknowledgment in the application, it will subsequently move the information to Arduino that is put on grass cutter by means of Bluetooth module. In the wake of getting the information. Arduino will quantify these with predefined Keywords.

Arduino Uno will check if the client talks or press "Forward" contact button, it's anything but a forward sign to the motor safeguard. On the off chance that Arduino establishes that client press the regressive or talks a retrogressive keyword, it's anything but a back message to the motor safeguard. Essentially, if the client squeezed the right bolt or speak Right, Arduino will convey a Right message to the motor safeguard. Moreover, if keywords are perceived as left move if client press left bolt or talks left, Arduino will convey a

Left message to motor safeguard, and if client press stop button or talks stop, Arduino will convey a stop message to the motor safeguard. Hence, subsequent to acquiring the sign, the motor module will check and control the grass cutter's development [6]. Likewise, If Arduino found that client talks or press the ON/OFF touch button, it's anything but a sign to the hand-off module to turn ON or OFF cutter.

Moreover, It Arduino establishes that the client squeezed any examples button; it's anything but a sign to the motor module to move in relating examples and hand-off module to turn on the cutter.

At first, the grass cutter robot won't move and remained still when it doesn't get any sign from an android application. At whatever point the client squeezed or talks the keyword, the sign will be estimated of that bearing by an Arduino and order will ship off the motor safeguard to turn on comparing motors and the grass cutter robot will begin moving in the like the keyword.

CIRCUIT DIAGRAM

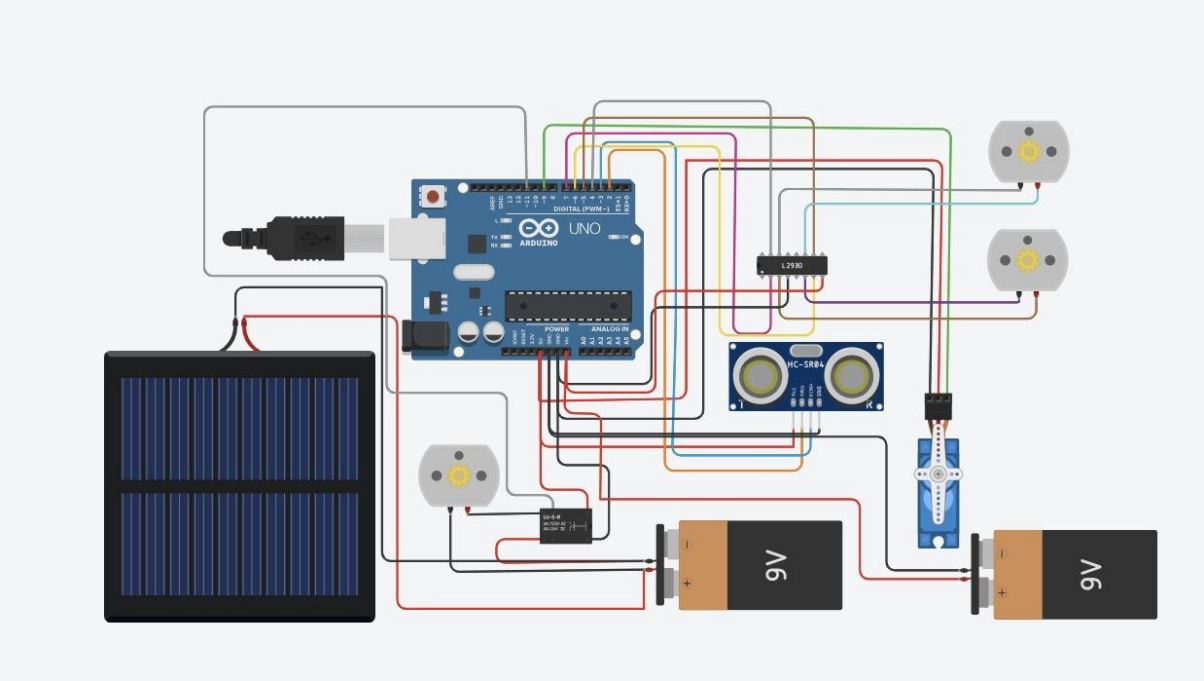

Fig. 6 Circuit Diagram

DESIGN PARAMATERS

1. Power Supply: The system is powered by a 12V DC rechargeable battery, providing sufficient energy for extended operation.
2. Microcontroller Unit: The Arduino Uno (ATmega328P, 16MHz clock speed) processes sensor inputs and controls motor functions.
3. Obstacle Detection: An ultrasonic sensor (HC-SR04) detects objects in real time and prevents collisions by adjusting the movement.
4. Steering Mechanism: A servo motor is used to control the direction of the grass cutter for autonomous navigation.
5. Cutting Mechanism: A high-speed DC motor-driven rotating blade ensures efficient grass cutting.
6. Motor Control System: The L298N motor driver regulates the power supply to both the blade motor and wheel motors.
7. Safety Features:
   - A stopper switch (emergency stop button) immediately halts the blade motor for safety.
   - The system ensures automatic shutdown in case of power fluctuations or malfunctions.
8. Navigation and Movement: The system operates autonomously, using sensor-based obstacle detection to adjust its direction.
9. Chassis and Structural Design:
   - The body is constructed from lightweight yet durable metal or plastic for easy maneuverability.
   - The design maintains a low center of gravity for stability during operation.
10. Wheel System:

- Uses rubber or plastic wheels with adequate traction for smooth movement on grass surfaces.
- The drive system provides sufficient torque for movement across uneven terrain.

11. Control Algorithm: The Arduino-based program is designed for efficient movement, obstacle avoidance, and cutting operations.
12. Operating Mode: The device functions in a fully autonomous mode, requiring no human intervention during operation.
13. Battery Capacity and Efficiency:
- A 12V, 5Ah (or as required) battery supplies power to all system components.
- Energy-efficient components ensure optimal power consumption.
14. Voltage Regulation: A voltage regulator (LM7805 or LM2596) ensures a stable power supply to all electronic components.

WORKING

The autonomous grass cutter operates using an Arduino Uno microcontroller, ultrasonic sensors, and motorized components to perform grass-cutting tasks efficiently and safely. The system is powered by a 12V rechargeable battery, which supplies energy to the Arduino, motors, and sensors..The ultrasonic sensor detects obstacles in the path, and the Arduino processes this data to control the servo motor for steering. The L298N motor driver regulates the movement of DC motors, allowing the grass cutter to navigate autonomously. A high-speed DC motor rotates the cutting blade, ensuring effective grass trimming.

For safety, an emergency stopper switch instantly halts the blade motor when pressed. The system continuously monitors its surroundings and adjusts movement accordingly. Once the task is complete or the battery runs low, the system can be manually or automatically turned off.

This fully autonomous grass cutter minimizes human effort by integrating sensor-based obstacle detection, motorized cutting, and self-navigation for efficient lawn maintenance.

ADVANTAGES

- Fully autonomous operation reduces human effort.
- Efficient grass cutting with minimal supervision.
- Obstacle detection prevents collisions and ensures smooth navigation.
- Safety features like an emergency stop switch enhance user protection.
- Battery-powered system ensures portability and eco-friendliness.
- Cost-effective alternative to commercial robotic lawn mowers.
- Suitable for various terrains with adjustable blade height.
- Reduces labor costs and time required for lawn maintenance.
- Energy-efficient design optimizes power consumption.
- Easy to modify and upgrade with additional features.

RESULT

The solar based automated grass cutter robot successfully performs **automatic grass cutting with obstacle detection and safety mechanisms**. The integration of **Arduino Uno, ultrasonic sensors, and motorized components** ensures efficient and reliable operation. The system effectively detects obstacles, adjusts direction, and continues cutting without manual intervention.

The **cutting mechanism operates smoothly**, trimming grass at an optimal height while ensuring **safe and controlled movement**. The **emergency stop switch functions as expected**, providing an immediate halt to the

blade motor when activated. The battery-powered system ensures **portability and energy efficiency**, making it suitable for small to medium-sized lawns.

Overall, the project demonstrates a **functional, safe, and efficient autonomous grass-cutting system**, reducing human effort and enhancing lawn maintenance automation.

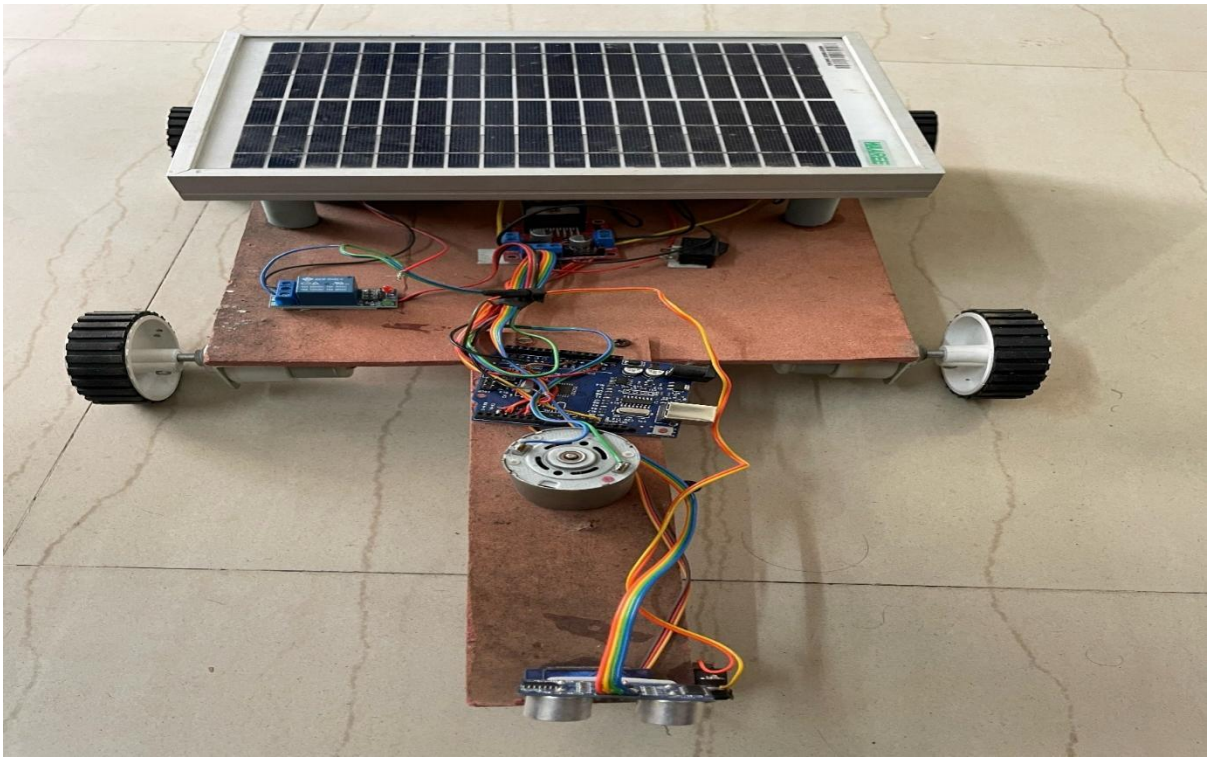

FIG . AUTOMETED GRASS CUTTER

CONCLUSION

The autonomous grass cutter successfully demonstrates an efficient, safe, and fully automated approach to grass cutting. By integrating an Arduino Uno, ultrasonic sensors, a servo motor, and a high-speed cutting blade, the system effectively detects obstacles, navigates autonomously, and trims grass with minimal human intervention. The project highlights the importance of automation in lawn maintenance, offering a cost-effective, energy-efficient, and user-friendly solution. The incorporation of safety features, such as the emergency stop switch, ensures reliable and accident-free operation. With further modifications, such as solar charging or AI-based path optimization, this system can be improved for enhanced performance and wider applications. Overall, the project successfully achieves its objective of automating the grass-cutting process, making it a valuable innovation for smart gardening and lawn care.

REFERENCES

- Arduino. (n.d.). **Arduino Uno Datasheet**. Retrieved from https://www.arduino.cc
- HC-SR04 Ultrasonic Sensor Datasheet. (n.d.). Retrieved from https://www.micropik.com/PDF/HCSR04.pdf
- L298N Motor Driver Module Datasheet. (n.d.). Retrieved from https://www.st.com/en/motor-drivers/l298.html
- DC Motor Working Principle and Applications. (n.d.). Retrieved from https://www.electronics-tutorials.ws/dc/dcmotors.html
- Servo Motor Basics and Applications. (n.d.). Retrieved from https://www.engineersgarage.com/servo-motor/
- Autonomous Lawn Mowers: A Review on Technology and Future Trends. (2020). Retrieved from IEEE Xplore: https://ieeexplore.ieee.org
- Smart Grass Cutting Machine Using IoT. (2021). International Journal of Engineering Research. Retrieved from https://www.ijera.com
- Battery Management for Autonomous Robots. (n.d.). Retrieved from https://www.sciencedirect.com