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Solar Grass Cutter

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Abstract
This paper presents the development of an autonomous Solar Grass Cutter, incorporating both an ADXL accelerometer and ultrasonic sensors for enhanced navigation, safety, and efficiency. The system operates entirely on solar power, contributing to eco-friendly and sustainable lawn maintenance. The ADXL accelerometer is used for monitoring the mower's orientation and detecting tilting, while the ultrasonic sensors are employed for obstacle detection and distance measurement. These sensors enable the grass cutter to autonomously navigate around obstacles, avoid collisions, and ensure smooth operation across varying terrains. The integration of the ultrasonic sensors provides real-time data on the proximity of objects in the mower's path, allowing it to adjust its movement accordingly and prevent damage. The microcontroller processes inputs from both the ADXL and ultrasonic sensors to control the mower's motors and optimize energy usage. Additionally, the solar panel efficiently charges the system, ensuring continuous operation without the need for external power sources. Experimental results demonstrate that the system is capable of efficient lawn care with effective obstacle avoidance, precise path planning, and safe operation. This solar-powered, sensor-driven grass cutter offers a promising solution for environmentally conscious, autonomous landscaping.

Keywords: *Solar-powered automation, Obstacle detection, Autonomous lawn care.*

1. Introduction
An innovative and eco-friendly method of automated lawn care is a solar-power grass cutter with adxl and ultrasonic sensors attached. As a cost -effective and environmentally friendly alternative to traditional grass cutting techniques, this technique uses solar energy. Its performance and safety in dynamic situations are improved by the invocation of sophisticated sensors. For the grass cutter to remain stable and run smoothly, even on Uneven Surfaces, The Adxl Sensor is Essential for Sensing Tilt and Motion. However, the system can proceed independently and prevent accidents to estimate the distance of ultrasonic sensors and to identify obstructions. This grass cutter provides an extremely effective, safe and environmentally responsible way to manage lawns in homes, businesses and other places by fusing solar energy with smart sensor technologies [1].

2. Methodology
Traditional grass-cutting methods require significant manual effort or rely on fuel-powered machines, which are costly, polluting, and inefficient for large areas. To overcome these challenges, this project proposes a solar-powered automated grass cutter that operates with minimal human intervention. The system utilizes solar energy for power, ultrasonic sensors for obstacle detection, and an accelerometer sensor (ADXL) for stability and balance, ensuring safe and efficient operation. An Arduino UNO microcontroller controls the overall system, making

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it an intelligent and autonomous solution for lawn maintenance [2].

2.1 Solar Panel

A small-scale power system uses a small photovoltaic module that includes a 5-watt, 12V solar panel. It produces roughly nothing.42A of contemporary technology with a 5W energy rating and a nominal 12V output in the best sunshine. Typical applications for those panels include microcontrollers such as Arduino, small battery charging, and low-energy Internet of Things devices. This solar panel is efficient, lightweight, and portable for renewable electricity applications such as distant sensors, weather tracking structures, and yard lighting. It uses sunlight to create DC electricity, which is then stored in a 12V battery for later use.

2.2 Buck Convert

The voltage provided by the 24V, 20Ah battery is regulated by this system using a buck converter. The greater voltage of the battery is effectively lowered by this step-down converter to a lower, steady voltage needed for the robot's electrical components. The buck converter improves the overall performance and dependability of the autonomous service robot by precisely regulating voltage to provide a continuous power supply to sensitive electronics like the Raspberry Pi 4, Arduino Nano, and others.

2.3 Battery

A rechargeable energy storage unit, 12V 5AH battery provides strength to many system components. It can deliver one hour for five hours or 5A for 1A before it requires charging because it has a nominal production of 12 V and a capacity of 5Ah. Usually, this battery is a lithium-ion (LIFPO4), sealing acid (SLA) or AGM type, which is known for their addiction and efficiency. This 12V provides strength to Arduino Uno, motor drivers, relay modules and sensors, and stores energy from 12V 5-Watt solar panel. To guarantee safe operation of connected electronics, a deer checking the converter voltage. Even with low sunlight, the battery can be continuously charged using an external charger or solar panel. It is used in large -scale robotics and initiative for renewable energy

2.4 ADXL Sensor

A movement-sensitive unit called ADXL sensor (accelerometer) is used to identify vibration and orientation changes in the system. Usually, a 3-Xis MEMS-accelerometer can measure acceleration with X, Y and Z-axis, such as ADXL335, ADXL345 or ADXL377. It provides digital (ADXL345-I2C/SPI) or analog output based on the model. It can be used for movement detection, balance and navigation as it measures acceleration in M/S G or G-forces and operates between 3.3 V and 5 V. By providing real-time movement data, Arduino-based solutions come in favor of robots, car systems and Play applications. When involved in autonomous systems, it helps with the improvement of movement and recognition of obstacles, improves the general stability and control of the system [3].

2.5 Module of Relays

Relay modules are electrically operated switches that allow excessive-electricity additives, such the cutter motor inside the sun grass cutter device, to be controlled by a low-energy microcontroller, such as the Arduino UNO. It guarantees protection and continues the Arduino secure via isolating the manage circuit from the high-energy circuit. The relay completes the circuit and powers the cutter motor when the Arduino gives you a sign. This module presents efficiency and dependability for managing high-contemporary loads. By ensuring the cutter motor most effective runs when vital, it lowers power intake and improves gadget performance.

2.6 Motor Driver

Arduino UNO and Motors are intervened through a motor driver, which allows the sunback cutter to be transferred to control. This provides nice directional control by controlling the power flow in the left and right motor in response to the Arduino command. The driver is activated by contributing speed, which also changes torque and speed as needed. By handling the current load carefully, it guards against microcontroller damage. For these types of applications, H-Bergen engineers, which provide spontaneous navigation. This section is necessary for the automation process, as it ensures stable and efficient mobility, which increases the efficiency and autonomy of the sunbeam [4].

2.7 Ultrasonic Sensor

An ultrasonic sensor is used by the sunbathing system

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to identify obstacles and navigation. After measuring an object, high-appearance sound waves are released, and it takes some time for a resonance to return. The Arduino Uno processes this data in order to determine the distance between obstacles and to correctly switch the cutter. By resolving the dispute, this renders the system semi-plate or autonomous. Ultrasound sensors are very dependable in outdoor environments since they function well in a range of illumination conditions. Their combination ensures continuous, steady movement of grass cutters and increases efficiency, safety, and accuracy over the widest possible area. Figure 1 shows System Architecture.

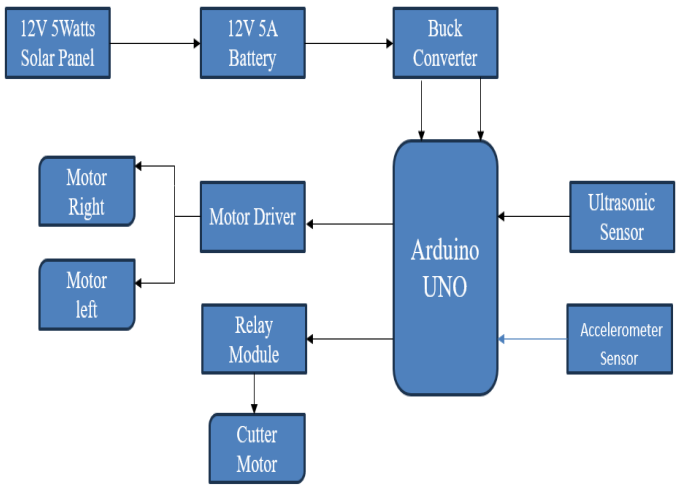

Figure 1 System Architecture

3. Design

Figure 2 & 3 shows Front view, Top view, Bottom view, Side view

Figure 2 Front view, Top view

Figure 3 Bottom View, Side View

4. Results and Discussion

The implementation of the solar -driven grassy system shows effectively and autonomous maintenance of the lawn using renewable energy. The 12. The solar panels and batteries ensure successful stability and operate the system. The motor driver effectively controls the left and right motor and allows smooth navigation. The relay module effectively turns the cutter motor turned on and on and causes adaptation of energy consumption. Ultrasound sensor detects accurate obstacles to preventing collision, while the accelerometer maintains the sensor stability. Arduino Uno integrates and controls all components with success, and ensures spontaneous operations. The system works effectively under external conditions, covers an important area with minimal manual intervention [5][6].

Conclusions

The solar lawn cutter system is an inventive and environmentally beneficial method of autonomous lawn care. The gadget is inexpensive and relies less on conventional power sources thanks to its 12V solar panel and battery combo, which guarantees sustainable power use. The Arduino UNO, the top processing unit, effectively controls several components, such as the motor driver for motion, the relay module for cutter motor operation, and the accelerometer and ultrasonic sensors for obstacle detection and balance. The ultrasonic sensor enhances protection by preventing collisions, while the accelerometer ensures smooth navigation. Because it combines automation and renewable

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energy to create an efficient, low-protection, and grass-reducing strategy, this gadget is ideal for both household and business applications.

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