International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 03 Issue: 01 January 2025
Page No: 88-92
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2025.0011

Smart Solar Powered Grass Trimmer and Liquids Spraying Vehicle Using Arduino UNO

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Abstract
The Arduino based Solar Grass Trimmer and Liquids Spraying Vehicle is an eco-friendly, automated system designed to simplify lawn maintenance and irrigation. Powered by solar energy, the system integrates an Arduino microcontroller and IOT technology to enable efficient grass cutting, trimming and water, pesticides and any fluid spraying with minimal human intervention. The grass cutter features sharp blades, while the liquids spraying module optimizes irrigation using water pump. Users can control and monitor the system remotely via a mobile app or web interface, ensuring convenience and flexibility. The use of solar power promotes sustainability and reduces operational costs, making the system suitable for residential, commercial, public, and agricultural applications. This work aims to reduce labor, conserve resources, and promote renewable energy utilization, providing a modern, automated solution for smart landscaping and irrigation.

Keywords: *Arduino Uno, Solar Panel, Water pump, Cutting machine.*

1. Introduction
The Arduino UNO-based solar grass cutter and water spraying vehicle is a groundbreaking innovation designed to address modern challenges in gardening, landscaping, and small-scale agricultural maintenance [1]. As the world increasingly shifts towards sustainable and energy-efficient solutions, this project leverages the power of renewable solar energy and the versatility of Arduino technology to create a fully automated system capable of performing two essential tasks [2]: cutting grass and spraying water. At its core, the system features solar panels that harness sunlight to charge the onboard batteries, ensuring that the vehicle operates [3] efficiently without relying on non-renewable energy sources. This makes it an eco-friendly alternative to conventional grass-cutting machines and water sprinklers that consume electricity or fossil fuels. [4] The Arduino UNO microcontroller acts as the brain of the system, controlling the movement of the vehicle, the operation of the cutting blades, and the water spraying mechanism with precision and adaptability. [5] Sensors integrated into the design allow the vehicle to navigate autonomously, detect obstacles, and perform tasks in a targeted and efficient manner. [6] The project highlights several advantages, including reduced energy consumption, minimized manual labour, and the potential to operate in remote or off-grid areas. [7] Its compact and versatile design makes it ideal for use in urban gardens, public parks, sports fields, and small agricultural lands. Furthermore, the automation of grass cutting and water spraying ensures uniformity, consistency, and time savings for users, making it a practical tool for both personal and commercial use.

2. Method
The Arduino-Based Solar Grass Cutter and Water Spraying Vehicle focuses on the integration of various sensors and real-time communication technologies to enhance effective and efficient cutting and irrigation of grass. The solar optimized

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vehicle ensures the optimal power to be provided.

2.1 Step 1: Power System Working

Tables and Figures are presented center, as shown below and cited in the manuscript.

- Solar Energy Harvesting: The solar panel mounted on the vehicle captures sunlight and converts it into electrical energy.
- Energy Storage: The energy is stored in a rechargeable battery, ensuring a continuous power supply even during low sunlight conditions. A charge controller regulates the flow of energy to prevent overcharging.
- Power-Distribution: The stored energy powers the Arduino UNO, motors, water pump, and sensors through a regulated voltage system.

2.2 Step 2: Movement and Navigation

- DC Motor Control: The Arduino UNO sends signals to the motor driver module to control the DC motors responsible for vehicle movement (forward, backward, left, right).
- Bluetooth Controls: The HC-05 Bluetooth module allows the Arduino UNO to receive commands wirelessly from a smartphone or other Bluetooth-enabled device. Users can control the vehicle’s movement (forward, backward, left, right) and the operation of grass-cutting or water-spraying mechanisms through a mobile application or paired device. This ensures convenient and remote operation of the vehicle, enhancing its usability and efficiency for various tasks in lawn maintenance and irrigation.

2.3 Step 3: Grass Cutting Mechanism

- Cutter Operation: The grass cutter is powered by the DC motor controlled via the LD29 motor driver, which is connected to the Arduino UNO. The cutter efficiently trims the grass based on its programmed motion and direction.
- Safety Mechanisms: Sensors integrated with the Arduino UNO ensure that the cutter operates only in safe conditions, preventing accidental damage or injuries.

2.4 Step 4: Water Spraying Mechanism

- Pump Control: The water spraying mechanism consists of a pump motor activated by the Arduino UNO through a relay. This enables controlled water flow based on the user's instructions or automated settings.
- Spray Adjustment: The pump pressure and spray pattern can be modified for irrigation needs, ensuring precise water delivery to targeted areas.

2.5 Step 5: Sensor Integration for Smart Functionality

- Obstacle Detection: Ultrasonic sensors or infrared sensors can be used to detect obstacles in the vehicle's path, allowing the Arduino UNO to adjust its direction and prevent collisions automatically.
- Soil Moisture Monitoring: An optional soil moisture sensor can be integrated to monitor soil conditions and activate the water spraying mechanism only when necessary, improving irrigation efficiency.

2.6 Step 6: Real-Time Monitoring and Control

- Wireless Monitoring: Using the HC-05 Bluetooth module, users can monitor the vehicle’s performance and status, such as battery level, motor operation, and sensor readings, in real time via a smartphone application.
- Remote Commands: Additional commands for initiating or stopping operations, such as cutting or irrigation, can be transmitted wirelessly, offering complete control over the vehicle's functionality.

2.7 Step 7: Overall System Integration and Operation:

- Synchronization: The Arduino UNO integrates inputs from the sensors, the Bluetooth module, and user commands to synchronize the movement, cutting, and irrigation mechanisms seamlessly.

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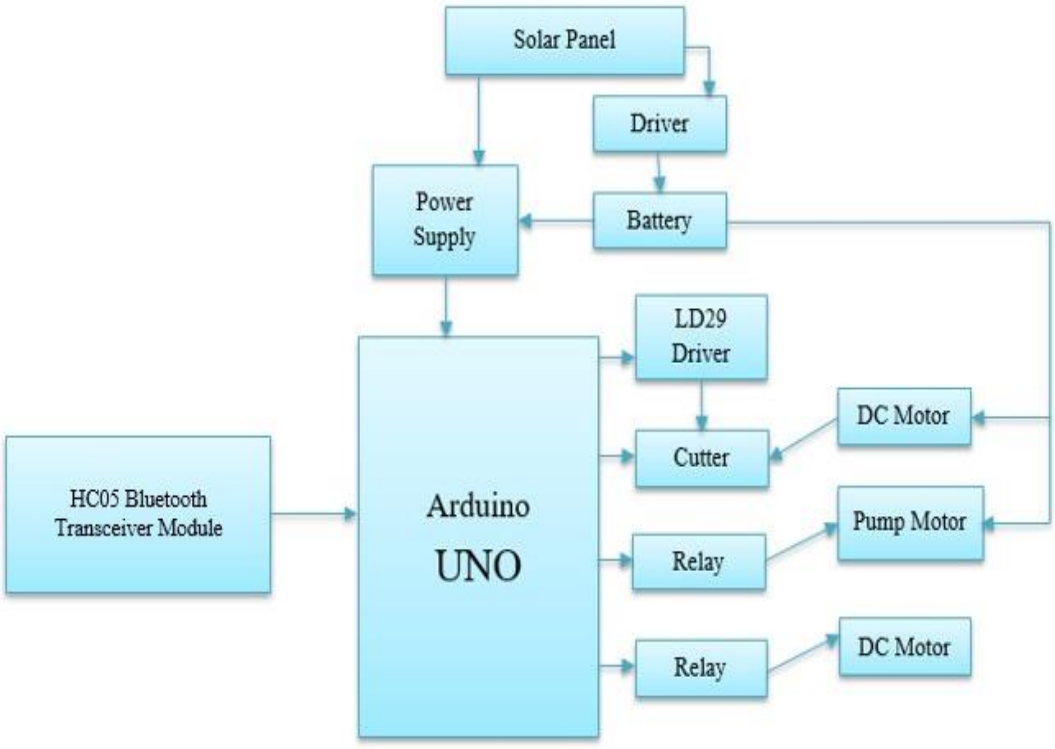

Figure 1 Block Diagram

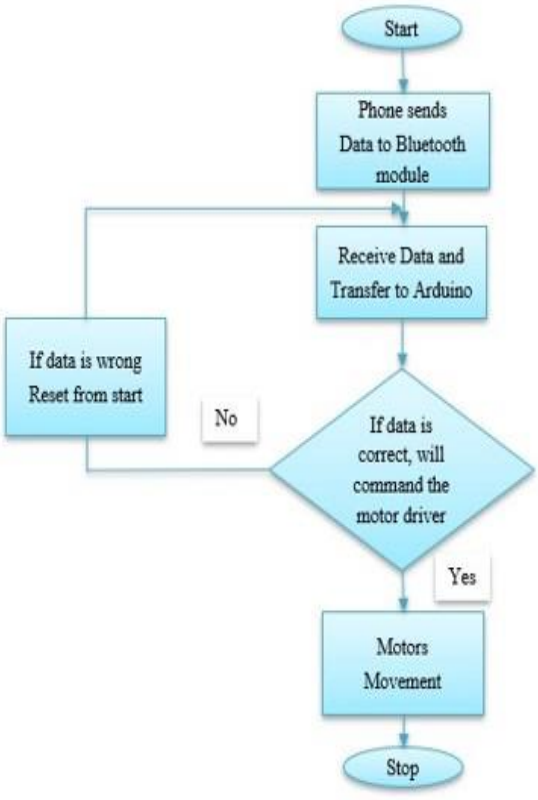

Figure 2 Flow Chart

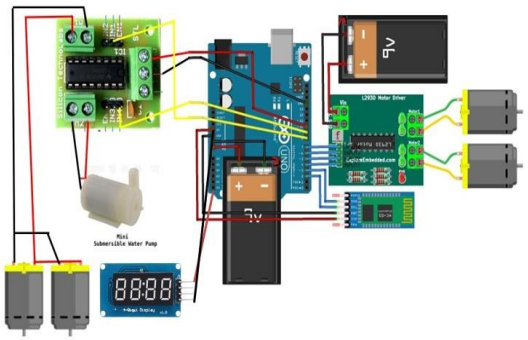

Figure 3 Functional Diagram

3. Results and Discussion

The experiment showcases the development and functionality of an innovative solar-powered, Arduino UNO-based automated vehicle designed for grass cutting and water spraying. This system represents a forward-thinking approach to eco-friendly lawn maintenance and irrigation, combining renewable energy sources with cutting-edge automation technology. At its core, the system is powered by a solar panel that harnesses sunlight to generate renewable energy. This energy is stored in

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a rechargeable battery, providing a sustainable and uninterrupted power source for the vehicle. The inclusion of a power supply management module ensures that the energy generated by the solar panel is efficiently regulated and stored, optimizing the performance of the entire system. The Arduino UNO microcontroller serves as the brain of the vehicle, enabling seamless integration and operation of all connected components. It processes commands received via the HC-05 Bluetooth transceiver module, which allows for wireless communication with an external control device, such as a smartphone. This wireless connectivity facilitates real-time, remote control of the vehicle's operations, enhancing convenience and user interaction. The vehicle is equipped with various hardware modules to perform its dual functions of grass cutting and water spraying. A dedicated LD29 motor driver is responsible for the precise control of multiple motors, including DC motors for the vehicle's mobility and movement. These DC motors enable the vehicle to navigate the lawn and maneuver around obstacles with accuracy. A separate pump motor is integrated into the system to manage water spraying, effectively irrigating the lawn as the vehicle moves. For grass-cutting tasks, the system features a cutter mechanism, driven by a motor and designed to handle grass trimming with efficiency. Relays are strategically utilized to control and switch the power supply to different components, ensuring smooth transitions between various operations and improving overall reliability. The relays also enable the system to execute multiple tasks in parallel without overloading any part of the circuitry. Figure 1 shows Block Diagram, Figure 2 shows Flow Chart, Figure 3 shows Functional Diagram, Figure 4 shows Model Out-View, Figure 5 shows Water Spraying Process, Figure 6 shows Solar Input Voltage Digit Counter, Figure 7 shows Solar Water Sprayer. Figure 8 shows Grass Cutting Process. The grass cutter is powered by the DC motor controlled via the LD29 motor driver, which is connected to the Arduino UNO. The cutter efficiently trims the grass based on its programmed motion and direction. enhancing its usability and efficiency for various tasks in lawn maintenance and irrigation.

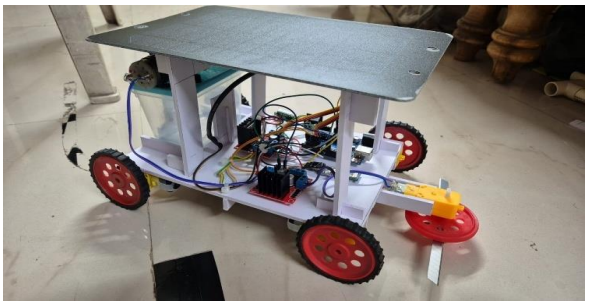

Figure 4 Model Out-View

Figure 5 Water Spraying Process

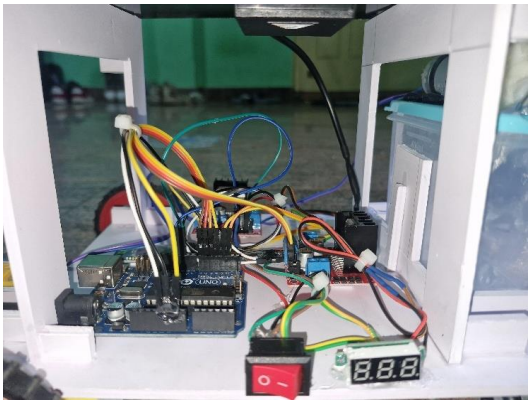

Figure 6 Solar Input Voltage Digit Counter

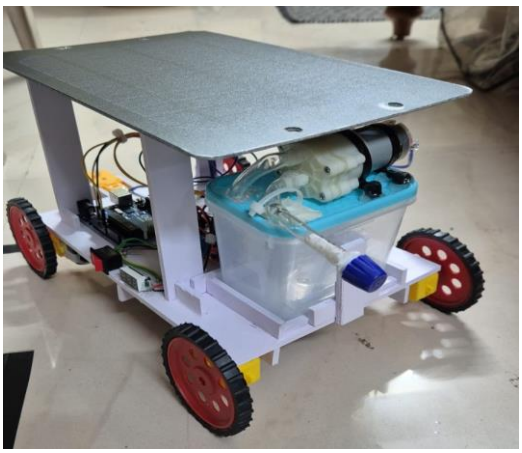

Figure 7 Solar Water Sprayer

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Figure 8 Grass Cutting Process

Conclusion

In conclusion, the Arduino UNO Based Solar Grass Cutter and Water Spraying Vehicle provides a highly eco-friendly solution by utilizing solar energy, significantly reducing reliance on non-renewable resources, and promoting environmental conservation. With the integration of Arduino for precise control and customization, the system efficiently optimizes energy and water usage, with the solar panels lowering operational costs and the smart water spraying system minimizing wastage through moisture sensors. This innovative vehicle not only contributes to more sustainable landscaping practices but also lays the groundwork for future advancements in automated lawn care. Furthermore, the potential for future enhancements, such as AI integration, advanced navigation systems, and predictive maintenance, ensures that the vehicle will continue to improve in performance, scalability, and adaptability, making it a versatile solution for broader adoption in various applications.

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