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Development and Implementation of Remote-Controlled Grass Cutter

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Abstract - This research paper presents the design, development, and implementation of a Remote-Controlled Grass Cutter intended for efficient lawn maintenance. In an era where automation and smart solutions dominate, this project addresses the need for a user-friendly, cost-effective, and eco-friendly grass cutting device. The prototype utilizes a combination of electronic components such as motors, relays,buck converter, a battery source, and a wireless controller to achieve remote operation. With the integration of safety features, ergonomic control, and sustainable power, this project stands out as a viable alternative to manual grass cutting equipment. Performance testing shows satisfactory results in terms of maneuverability, efficiency, and battery endurance, making it suitable for both residential and small-scale commercial applications.

***Key Words*:** Remote-controlled grass cutter, automation, lawn maintenance, renewable energy, smart agriculture, DC motor.

1. INTRODUCTION

Traditionally and even now in many places like an institution, sports ground, organization, restaurants, companies, hotels, public places etc, cutting of grasses was done with a chopper or machete. This method is very time-consuming, it requires more man power and also less accuracy level of cutting is observed. In advance technology, cutting of grass done with single or more blades to cut the grass surface to a uniform height and in less time as compared to manual method. Normally, the height of the grass cutting will be adjusted or fixed from the operator end either by lever or nut adjusted to the machine wheels. Based on the requirement several types of Grasscutters are available to assist one in having the best Grasscutter. Even the power source for the grass cutter plays a very important role while designing the best tool for the user end. Technology oriented cutting down the grass has been implemented adopting modern energy sources such as petrol, electricity, propane etc. Petrol-powered Grasscutter pushes the rotary mowers powered by an internal combustion engine of four-stroke used for maximum torque and cleaner combustion [1] . The power consumption generally ranges from 4-7 hp (horsepower) equipped with a single-cylinder having a carburettor, so the engine needs to be started in manual pull crank method even though few models provided with an electric starter. Electric-powered Grasscutter is available with two types such as corded and cordless electric Grasscutter both producing an average of fewer than 75 decibels compared to more than 95 decibels of petrol-powered Grasscutter. Corded Grasscutter limits its range depending on the cable wire availability and also may lead to being hazardous when Grasscutter accidentally moves over the cable wire, which leads to a chance of high risk of receiving electric shock to the user [02,03]. Cordless Grass- cutter uses rechargeable batteries to deliver power to the Grasscutter, more number of batteries leads to more run time of Grasscutter. But these are more expensive and disposal of worn-out batteries is problematic. Compared to petrol-powered Grasscutter even the performance is less considering the parameter of the same weight. To overcome all this issues leads to a rise of new technical domain-based Grasscutter such as Solar powered Grasscutter that interfaced with IoT (Internet of Things) technology to control its operation and movement . In this paper, a new approach is proposed for cutting grass based on Solar-powered Grasscutter, with minimal intervention of human involvement adopting IoT technology. IoT technology is the connection of physical things that are embedded with electronics components and software to enable greater services for the connected things with applying computation and analysis [04] . Here our proposed model aims at designing and developing a prototype to operate with highly versatile, much durable, highly comfortable, powerful and avoiding obstacles in the path.

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2. OBJECTIVES

- To design a remote-controlled grass cutter that reduces manual labor.
- To implement a system powered by DC motors and rechargeable batteries.
- To ensure user-friendly operation with a robust control interface.
- To evaluate performance parameters such as speed, area coverage, and battery life.
- To create an economical prototype suitable for residential or small-scale commercial lawns.

3. WORKING PRINCIPLE

The working principle of the remote-controlled grass cutter is based on simple electric drive and remote navigation logic. The system consists of a wireless remote-control transmitter, a receiver unit mounted on the grass cutter, and a microcontroller that processes directional commands. When a user presses a button on the remote control, a corresponding signal is transmitted via RF or Bluetooth to the onboard receiver module.

Upon receiving the signal, the microcontroller interprets the command and sends signals to the motor driver circuit, which in turn powers the appropriate DC motors. The grass cutter is equipped with two drive motors for differential steering—allowing the unit to move forward, backward, left, or right based on the relative rotation of the motors. A separate high-speed motor powers the cutting blade, which spins at sufficient RPM to trim grass evenly.

Power is supplied from a 12V rechargeable battery, which is connected to both the control circuit and the motors. The cutter's blade motor can be turned on or off via a specific remote command, allowing the user to control cutting operations independently from movement.

The device operates efficiently on flat to slightly uneven terrain and can be maneuvered remotely up to a distance of approximately 20 meters. The adjustable blade height mechanism enables the user to control the grass cutting height as needed. Safety is ensured through an emergency stop switch and blade shielding to prevent accidental contact.

4. PROPOSED METHODOLOGY

In the proposed model, the Arduino UNO ATmega328 controller acts as a brain as it controls the entire working of the device that is intended to make building interactive environments more accessible. The power supply is applied to the model through the battery, which are rechargeable batteries that charge through the DC 12V adaptor. DC motors are connected to the wheel of the device through the motor driver circuitry, which controls the speed and direction of two motors simultaneously. Bluetooth module manages the communication between the device and user end wirelessly with the help of the host control interface [5]. Fig. 1 shows the Block Diagram of the proposed model.

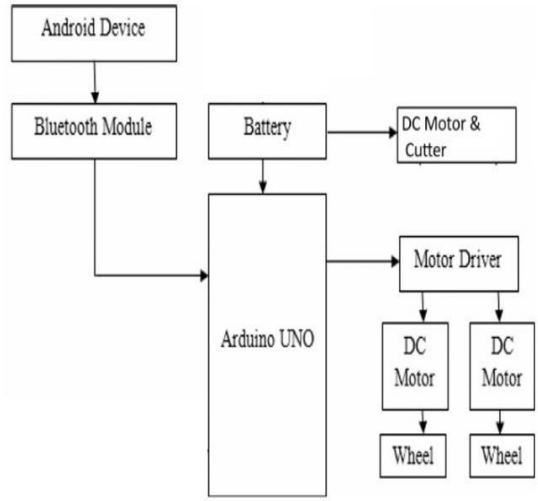

Fig 1. Block Diagram of the proposed model

The proposed model contains the following component as follows:

1.Arduino Uno R3 :- Arduino UNO is a microcontroller board based on the **ATmega328P**. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

Advantages: - The ATmega328P also features 1kb of EEPROM, a memory which is not erased when powered off.
The Arduino UNO features a barrel plug connector, that works great with a standard 9V battery.

2. Motor Drive Shield L293D :-

The L293D motor driver shield is a popular interface for controlling DC motors and stepper motors with an Arduino. It can drive two DC motors bidirectionally and handle up to 600 mA per channel, with a peak current of 1.2 A. The shield features built-in diodes for flyback protection, which safeguard the circuit from voltage spikes when the motors are turned off. It is equipped with control pins that connect to the Arduino, allowing for speed and direction control via PWM signals.

3. HC-05 Bluetooth Module :-

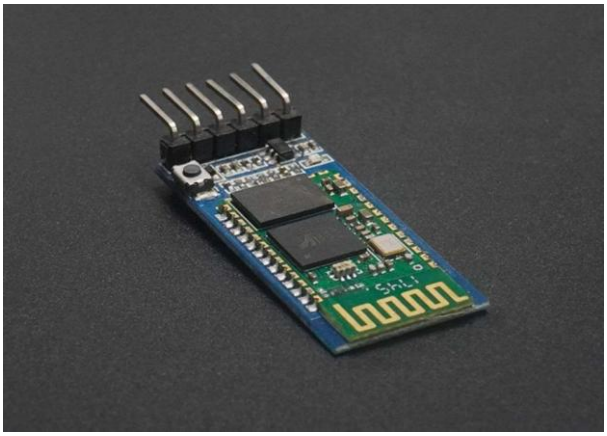

Fig.2 HC-05 is a Bluetooth module

- HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration. It is used for many applications like wireless headset, game controllers, wireless mouse, wireless keyboard, and many more consumer applications.
- It has range up to <100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions.
- It is IEEE 802.15.1 standardized protocol, through which one can build wireless Personal Area Network (PAN). It uses frequency-hopping spread spectrum (FHSS) radio technology to send data over air.
- It uses serial communication to communicate with devices. It communicates with microcontroller using serial port (USART).

4. DC Gear motor :

The **DC Gear Motor** is an essential component used to drive the wheels of the solar grass cutter, providing high torque at low speeds for effective movement over grass and uneven terrain. Operating typically at 6–12V and 100–200 RPM, it combines a DC motor with a gear reduction system to enhance torque while maintaining power efficiency. Its sturdy build allows it to handle the load of the chassis, battery, and mounted components with ease. Controlled through an L298N motor driver, it ensures smooth forward, reverse, and turning motions as directed by the remote system. Its compact size, low power consumption, and mechanical strength make it ideal for autonomous and semi-autonomous robotic vehicles.

Fig.3 DC Gear motor (12V, 45-100 RPM)

5. DC Motor:

This motor is used for the rotating the blade and when the blade is rotated the grass is cut. The motor is rotated at 2000 RPM.

Specification:

Operating Voltage: 12V
No-load Current: 0.6A
Maximum Current: 2A
Speed: The speed can vary depending on the load and the applied voltage. Some DC motors also have adjustable speed control.
When selecting a DC motor for a particular application, it's crucial to consider factors such as the required speed, torque, power supply, and any specific environmental or operational requirements.

6. Battery (12V, 15Ah):

A 12V, 15Ah battery is a rechargeable battery with a voltage of 12 volts and an Ampere-hour (Ah) rating of 15. This means it can deliver 15 Amps of current for one

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hour, or 15 Amps for a longer period with a reduced discharge rate.
Key Characteristics:
Voltage: 12V.
Capacity: 15Ah.
Battery Type: Can be lead-acid (AGM), lithium-ion (Li-ion), or LiFePO4.

7. PVC pipe:- Size of PVC pipe is 1 inch and 20 feet long.

5.PROTOTYPE

The proposed grass cutter with water is an efficient proto-vehicle. It has many advantages over the conventional grass cutters. This project is more suitable for a common man as it is having much more advantages i.e., no fuel cost, no pollution and no fuel residue, less wear and tear because of a smaller number of moving components. The proposed solution has presented progress towards achieving a future precision autonomous farming system. This system is designed to help farmers in reducing their time and energy spent for weed cutting. It can be operated on +12V rechargeable battery. Based upon the theoretical value, the total time for 12V 15Ah battery to be fully charge is 4.0 hours. This system will reduce labor problem in future. The time requirement is shown in table 1.

Working Process-The user operates a wireless remote which sends commands to the receiver on the cutter. The microcontroller interprets these signals and drives the motors accordingly. The blades are powered independently and engage when the system is activated. The system can move forward, backward, and turn left or right based on motor direction control.

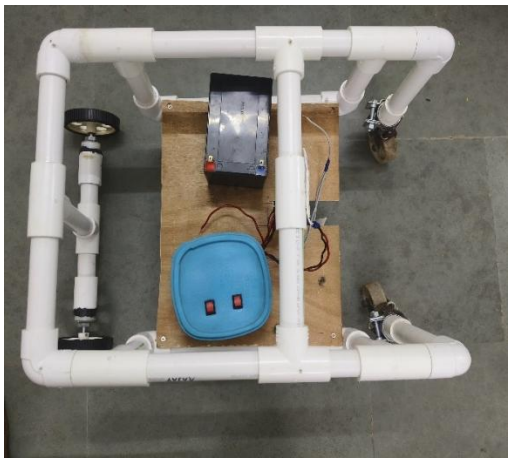

Fig.4 Proposed Prototype(Top view)

Fig.5 Proposed Prototype (Front view)

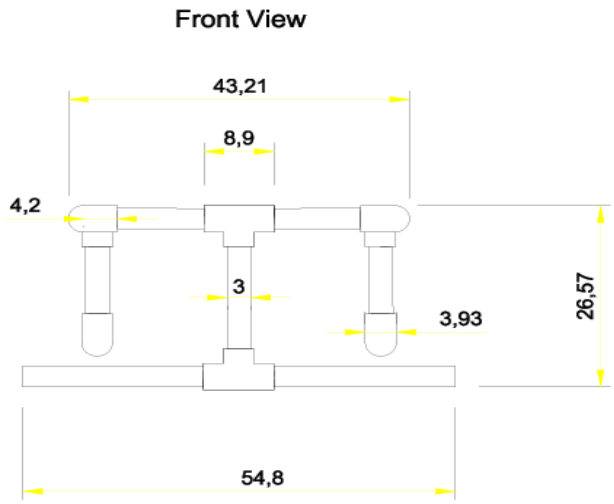

Fig.6 .PVC structure with dimensions (Front view)

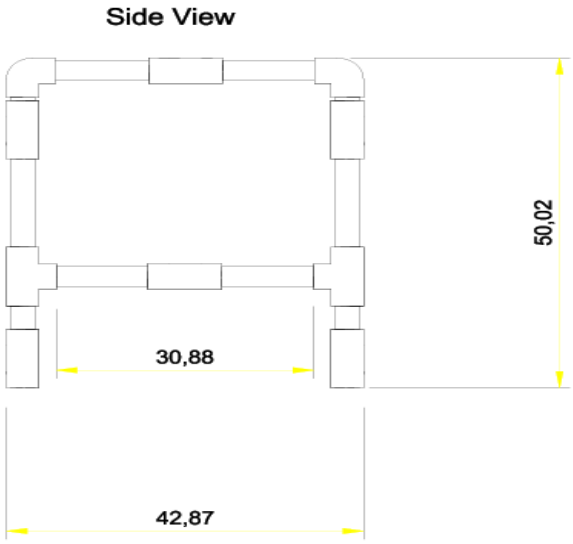

Fig.7 PVC structure with dimensions (Side view)

The grass cutter is designed using the following components:

- **Mechanical Framework**: Metal chassis fitted with wheels for mobility.
- **DC Motors**: Two 12V motors for driving the wheels and one high-torque motor for operating the cutting blades.
- **Battery**: A 12V DC rechargeable battery providing power to the motors and control system.
- **Remote Control Module**: RF or Bluetooth controller interfaced with a receiver circuit on the device.
- **Cutting Mechanism**: Rotating blades attached to a motor shaft.

Testing:- The prototype was developed and tested under varied lawn conditions:

- **Test Area**: 25 m² lawn with medium-density grass.
- **Operation Time**: 45 minutes per full battery cycle.
- **Speed**: Approximately 0.6 m/s.
- **Blade Efficiency**: Cut height adjustable between 2–5 cm.
- **Range**: Remote operational range up to 20 meters.

Test results indicated satisfactory performance with minimal lag in control response. The cutting efficiency remained consistent across uneven surfaces. Battery life met expectations with scope for solar panel integration in future versions.

Table 1 Experimental Results

Operation	No. of operators required	Area covered (in sq. ft)	Time required (in min)
Cutting grass	1	1000	42

Table 2 Operating Hours with Fully Charged Battery and Charging Time

Experimental result test	Test 1	Test 2
Full charge (in hours)	4	4.3
Total Operational time (Hours)	2.3	2.5

6.MERITS OF THE SYSTEM.

The remote-controlled grass cutter offers numerous advantages that make it an appealing choice for modern lawn maintenance. One of its primary benefits is enhanced safety, as users can operate the device from a distance, reducing the risk of injury from the cutting blades. This convenience also saves significant time and physical effort, especially for those with large lawns or mobility challenges. The precise remote control allows for careful navigation around obstacles such as trees and flower beds, ensuring a neat and damage-free cut. Environmentally, the battery-powered operation produces no direct emissions and operates quietly, minimizing noise pollution—a significant improvement over traditional petrol mowers. Additionally, the lower running costs and reduced maintenance needs make it an economical option in the long term. Features like adjustable cutting height add versatility to accommodate various lawn conditions, while the modular design allows for future upgrades. Overall, the device not only simplifies lawn care but also promotes technological literacy by engaging users with robotics and electronics.

Environmental Impact Assessment

The environmental benefits of the remote-controlled grass cutter are noteworthy, particularly when compared to traditional petrol-powered mowers. By using a rechargeable battery-based system instead of an internal combustion engine, the device reduces air pollution and eliminates the emission of greenhouse gases during operation. Each session with a gas-powered mower contributes significantly to carbon emissions, while this battery-powered alternative ensures a cleaner operation without exhaust fumes.

Furthermore, electric operation minimizes noise pollution, with sound levels under 65 dB, making it ideal for use in noise-sensitive residential environments. Although the current model is not powered by solar

energy, it still reduces the environmental footprint by avoiding fossil fuel dependency and supporting cleaner energy practices. Future iterations may consider incorporating renewable energy charging methods, but even in its present form, the cutter promotes eco-conscious behaviour.

The compact and modular design encourages maintenance and component reuse, which supports long-term sustainability and waste reduction. Materials used in the cutter are selected for durability and efficiency, aiding in reducing the frequency of part replacements and thereby limiting environmental impact from manufacturing and disposal. Thus, while not solar-powered or equipped with water sprinklers, the remote-controlled grass cutter still significantly advances sustainable landscaping practices.

7.RISK ASSESSMENT AND SAFETY GUIDELINES

Operating the remote-controlled grass cutter presents certain risks that must be carefully managed to ensure safe and effective use. One of the main concerns is the rotating blade, which can pose serious injury if handled improperly. It is essential to disconnect the battery before performing any maintenance and to keep hands and feet away from the blade area during operation. The machine should only be used on dry, even ground to avoid electrical hazards and tipping risks. Electrical safety is also critical—users must avoid operating the cutter in wet conditions and ensure that the battery is charged using approved equipment in well-ventilated areas.

Additionally, safety guidelines recommend using protective gear such as gloves and sturdy footwear while operating the machine. Users should inspect the cutter for loose components or damaged wiring before each use and ensure the remote control is functioning properly. Children and pets should be kept at a safe distance during operation. The inclusion of an emergency stop switch provides an added layer of protection in case of unexpected malfunctions. Adhering to these precautions will help prevent accidents and support the reliable performance of the system.

8.CONCLUSION

The remote-controlled grass cutter successfully demonstrates a simple yet effective solution for lawn maintenance. It serves as a bridge between manual labor and fully autonomous systems. By incorporating remote control, efficient battery use, and modular design, this model showcases a practical and scalable approach to smart gardening. With further enhancements, it can evolve into a multifunctional lawn care assistant suitable for a variety of users and environments. Its affordability and ease of use make it a strong candidate for wide-scale adoption.

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