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FULLY AUTOMATED SOLAR GRASS CUTTER

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Abstract: We all know that mowing the lawn is one of those never-ending chores. Push the mower under the blazing sun, deal with the noise, the fumes, and the constant back-and-forth — it's tiring, time-consuming, and not exactly eco-friendly. That's exactly why we created the Automated Solar Grass Cutter — a smart, fully autonomous robot that takes care of the grass while running completely in sunlight. The core idea is wonderfully straightforward: harness the sun's energy to do all the work. A solar panel mounted neatly on top of the machine continuously absorbs sunlight and converts it into electricity. This power is stored in a high-capacity rechargeable battery, giving the mower enough energy to run smoothly throughout the day. No plugging into the wall, no petrol cans, and zero harmful emissions — just clean, renewable energy doing its job.At the heart of this intelligent machine is the powerful ESP32 microcontroller. Think of it as the robot's brain. It constantly makes decisions — where to go, how to avoid obstacles, when to turn, and how fast to move. Working together with the L298N motor driver, it controls the DC motors with precision, allowing the mower to glide smoothly across uneven lawns, turn corners gracefully, and cover the entire area without missing spots or getting stuck. Below the chassis sits a sharp, high-speed rotating blade that delivers a clean, consistent cut every time. The height of the cut can be adjusted depending on the type of grass and your preference. The entire system is designed to operate autonomously, adapting naturally to different terrains — whether it's a flat backyard lawn, a slightly sloped garden, or a small agricultural patch. One of the best parts? You don't have to babysit it. Just place the mower in the lawn, switch it on, and let it do its magic. It can work for hours on its own while you relax indoors, play with your kids, or focus on other important tasks. And when the job is done or the battery runs low, it can be easily brought back for the next day's charge. Beyond convenience, this project means a lot more. In a world facing rising fuel costs and climate challenges, it offers a practical, affordable alternative to traditional lawn mowers. It drastically cuts down on carbon emissions, reduces noise pollution, and lowers long-term maintenance costs. For homeowners, gardeners, and even small farmers, it's a game-changer that turns a boring, exhausting job into something effortless and sustainable.

Keywords: ESP32, Solar Panel, L298N Motor Driver, Automated Grass Cutter, Renewable Energy, Embedded Systems, Sustainable Automation, Autonomous Robot, Eco-Friendly Technology.

INTRODUCTION

1.1 Introduction to Automated Solar Grass Cutter:

In today's world, we're moving incredibly fast with technology, yet we're also waking up to the urgent need to protect our environment. Automation and renewable energy are two powerful forces helping us do exactly that. One everyday task that desperately needed a smarter, cleaner solution is cutting grass. Traditionally, maintaining lawns, gardens, and fields has meant either back-breaking manual work or noisy, smoke-belching petrol mowers. Both options are tiring, expensive in the long run, and harmful to the environment. That's why we built the Automated Solar Grass Cutter — a smart, self-operating robot that cuts grass on its own, using nothing but the power of the sun. The machine uses a solar panel to capture sunlight and convert it into electricity, which is stored in a rechargeable battery. This ensures it keeps working even when the sun hides behind clouds for a while. At its core is an ESP32 microcontroller — the "brain" that controls everything from movement to cutting. An L298N motor driver smoothly handles the wheels, while a sharp, high-speed rotating blade underneath trims the grass neatly. The result is a compact, intelligent, and truly eco-friendly machine that works without constant human supervision.

1.2 Aim:

The main goal of this project is to create a fully automatic grass cutter that runs entirely on solar power — completely free from electricity bills and petrol. We wanted to build something that is not only effective but also affordable, easy to operate, and practical for real homes, colleges, and small farms. More than just cutting grass, this project aims to prove that clean energy and smart technology can work together in simple, meaningful ways. By using the ESP32, we've created a system that can think and move on its own, reducing the need for constant human control.

1.3 Applications:

What makes this solar grass cutter truly exciting is how versatile it is. Since it doesn't need a power outlet, it can be used almost anywhere — from busy cities to remote villages.
It is ideal for:

- Home lawns and backyard gardens
- Public parks, playgrounds, and community spaces
- Small agricultural fields and farms
- Smart and precision farming
- Landscaping projects
- Roadside grass maintenance
- Off-grid and rural areas with limited electricity

1.4 Problem Statement:

Even though cutting grass sounds like a simple chore, it's actually quite burdensome. Doing it manually is physically exhausting and takes up a lot of time. Petrol-powered mowers are faster but noisy, polluting, and expensive to run. Meanwhile, regular electric mowers become useless in areas where electricity supply is unreliable. None of the current solutions solve all these problems at once — they're either tiring, polluting, costly, or dependent on electricity. There is a clear need for a grass cutter that is automatic, runs on clean energy, environmentally friendly, and affordable for everyday people.

1.5 Objectives:

We set out to achieve several important goals:

- Build a fully autonomous grass cutter that works without human help
- Power the entire system using only solar energy
- Drastically reduce the time and physical effort spent on grass cutting
- Eliminate fuel costs and harmful emissions
- Create a lightweight, safe, and easy-to-use machine that works on different types of terrain
- Ensure reliable performance even on cloudy days through good battery storage
- Develop a practical, low-cost solution that people can actually build and use in real life

LITERATURE REVIEW

Over the past few years, the idea of letting technology handle everyday household chores has moved from science fiction to reality. Among the more practical and exciting developments in this space is the automation of lawn maintenance. Cutting grass has long been one of those thankless, time-consuming tasks that most people would rather skip — and now, thanks to smart technology, there's a growing body of work dedicated to making that possible.

The story of grass cutters mirrors the broader evolution of home technology. Early machines were either purely manual or powered by petrol engines. They got the job done, but at a cost — constant human supervision, noise, fuel expenses, and a steady stream of emissions. As environmental concerns began shaping consumer preferences, electric and battery-powered models gained traction.

These were undoubtedly cleaner alternatives, but they came with their own frustrations: frequent recharging, limited range, and still a heavy dependence on human input. The introduction of solar-powered grass cutters marked a meaningful shift in thinking. Rather than simply swapping one energy source for another, solar designs invited a more sustainable philosophy into the picture.

By harvesting energy directly from sunlight, these systems reduced dependence on the grid and brought down long-term running costs. That said, the earliest solar prototypes were far from perfect — inefficient panels, inadequate battery backup, and a near-total absence of intelligent features held them back from widespread adoption.

The push toward genuine automation led researchers to explore microcontrollers, with Arduino becoming an early favourite. Arduino-based designs introduced basic but valuable capabilities: motor control, simple sensor integration, and rudimentary obstacle detection. For a proof-of-concept stage, this was promising. But Arduino had clear ceilings — limited processing power and no built-in wireless connectivity made it difficult to build anything truly "smart."

That gap was largely addressed by the arrival of the ESP32 microcontroller, which has become something of a turning point for this field. Equipped with built-in Wi-Fi and Bluetooth, stronger processing capacity, and better power efficiency, the ESP32 made it realistic to design grass cutters that could be monitored and controlled remotely — through a mobile app, a web interface, or broader IoT platforms. What was once a standalone machine could now be part of a connected home ecosystem.

METHODOLOGY

Building something useful always starts with a clear and practical approach. For the Automated Solar Grass Cutter, we followed a simple yet thoughtful process: capture energy from the sun, store it efficiently, and use that power to run a smart embedded system that can cut grass completely on its own, without needing a person to push or guide it.

The process begins as soon as sunlight hits the solar panel. The panel converts the sun’s energy into electricity and sends it to a 7V rechargeable battery. This battery acts like a reliable energy bank — soaking up power when the sun is strong and supplying steady energy when the sky is cloudy or during shaded moments. From this battery, power is distributed to the two main brains of the operation: the ESP32 microcontroller and the L298N motor driver. The ESP32 is the heart and mind of the machine. It runs the programmed logic and makes real-time decisions — when to move, which direction to go, and when to activate the cutting blade. These decisions are sent to the L298N motor driver, which translates them into precise commands that control the speed and direction of the motors. The machine uses two DC motors for movement, allowing it to go forward, backward, and turn smoothly to cover the lawn. A separate motor spins the cutting blade at high speed, delivering a clean and even trim as the mower moves along.

3.1 Existing System:

To understand why this project matters, it’s important to look at how grass cutting is done today and where those methods fall short. The oldest method is pure manual labor — using hand tools, scythes, or push mowers. While it still works for very small areas, it’s extremely tiring, time-consuming, and physically demanding, especially as the lawn gets bigger. The results are often uneven, and over time it takes a real

toll on the person doing the work. Next come fuel-powered (petrol/diesel) grass cutters. These are popular because they're fast and powerful. However, they come with serious drawbacks — high fuel costs, loud noise, heavy smoke and pollution, and frequent maintenance. In residential areas, the noise and fumes make them increasingly unpopular, and the running expenses add up quickly. Electric grass cutters were introduced as a cleaner option.

3.2 Proposed System:

The Automated Solar Grass Cutter was designed to overcome all these limitations in one go. Instead of tweaking old ideas, we took a fresh approach — completely replacing fuel and grid power with solar energy, and replacing human effort with smart automation. The system starts with a solar panel that gathers free energy from the sun throughout the day. This energy is stored in a rechargeable battery so the machine can keep running even when clouds appear. This energy independence makes it perfect for outdoor use where power sockets aren't available. At the center is the ESP32 microcontroller, which acts as the robot's intelligent brain. It continuously makes decisions and sends commands to the L298N motor driver.
The result is a machine that truly solves the real problems:

- No fuel
- No electricity bill
- No constant human supervision
- Very low running cost
- Clean, quiet, and eco-friendly operation

BLOCK DIAGRAM

A block diagram is basically a simple visual story that shows how all the pieces of a system work together. In this case, it explains how sunlight turns into a neatly trimmed lawn through smart engineering. The journey starts with the solar panel. It sits on top of the machine, facing the sky, and continuously converts sunlight into electrical energy. This energy is sent straight to a 7V rechargeable battery, which acts as the system's energy storage tank. Instead of using power instantly, the battery stores it so the machine has a steady supply — even when the sun goes behind clouds for a while. From the battery, power goes to the ESP32 microcontroller — the "brain" of the entire robot. The ESP32 doesn't just use the electricity; it runs the programmed logic and makes real-time decisions about movement and cutting. These decisions are then sent to the L298N motor driver.
The system then splits into two main paths:

- One path powers the wheel motors (two DC motors), which move the machine forward, backward, and help it turn smoothly across the lawn.
- The other path powers the blade motor, which spins the cutting blade at high speed to trim the grass cleanly.

All these parts work together in coordination, allowing the machine to move and cut grass at the same time, completely on its own. The block diagram beautifully shows how a few well-chosen components come together to create something much smarter than any single part on its own.

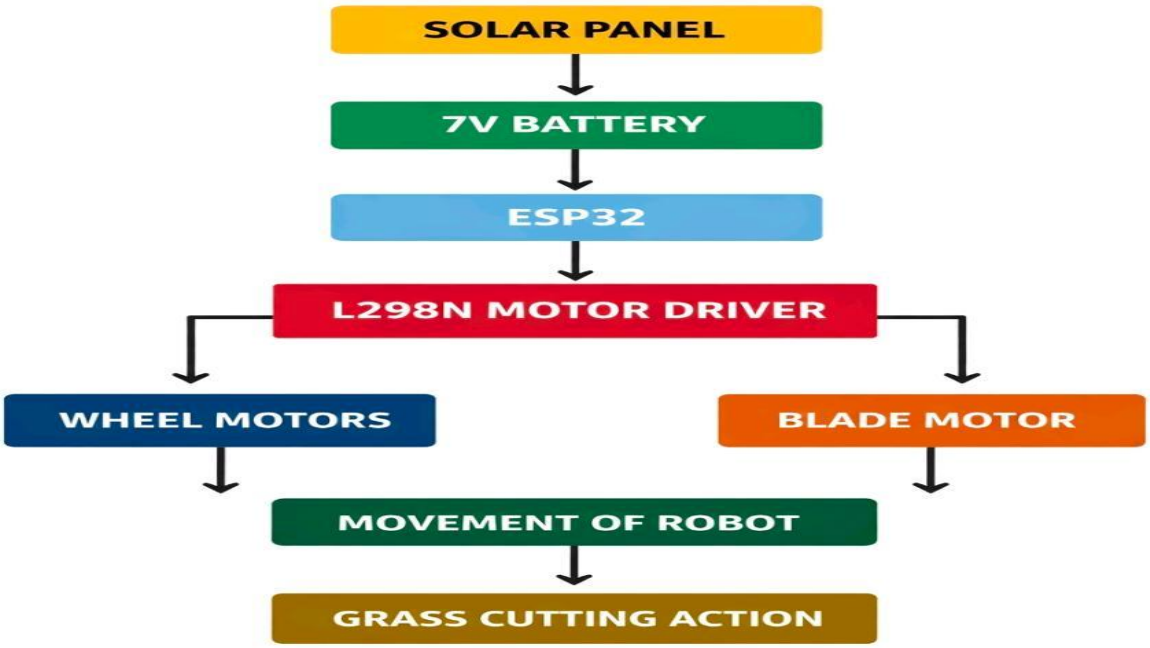

Fig.1. Block Diagram

What makes this Automated Solar Grass Cutter special is not just one big feature — it's the combination of many practical benefits that make it genuinely better than traditional mowers. No more manual labor: The machine works fully autonomously. You don't have to push it, steer it, or even stay nearby.

This is a huge relief for homeowners, elderly people, schools, colleges, and farmers who manage large areas. Completely free energy: Since it runs on solar power, there are no fuel costs and no electricity bills. Sunlight is free, available everywhere, and never runs out — a big advantage over petrol or grid-powered machines.

Eco-friendly operation: It produces zero emissions, very little noise, and no smoke. This makes it perfect for homes, parks, schools, and environmentally sensitive areas. Very low running cost: After the initial build, operating the machine costs almost nothing. No fuel, minimal maintenance, and easily available spare parts. Consistent and neat cutting: The blade spins at a constant speed and the machine follows a steady path, so you get an even trim across the entire lawn every time — unlike manual mowing, which can be uneven when you get tired.

SYSTEM DESIGN ARCHITECTURE

Building a machine that can think, move, and cut grass completely on its own is not just about collecting components and wiring them together. It requires a thoughtful design philosophy where hardware and software function as two sides of the same coin — working in perfect harmony to create an intelligent, autonomous system. In the Automated Solar Grass Cutter, every physical part has a corresponding software logic that controls and optimizes its behavior, resulting in a cohesive machine that operates efficiently without constant human intervention.

The hardware architecture forms the physical foundation of the robot. Everything begins with the solar panel, which is strategically mounted on the top of the chassis to receive maximum sunlight exposure throughout the day. It continuously converts solar radiation into electrical energy using the photovoltaic effect and feeds this power directly into the system. Since sunlight is not always consistent, a 7V rechargeable battery serves as the energy storage unit.

This battery acts as a smart reservoir — storing excess energy when the sun is bright and releasing it steadily during cloudy periods or shaded areas, ensuring uninterrupted operation. At the core of the system lies the ESP32 microcontroller, which functions as the brain. This compact yet powerful module processes all the programmed instructions, continuously monitors the system's status, and makes real-time decisions about movement, turning, and blade operation.

The ESP32 was specifically chosen not only for its fast processing capabilities and multiple input/output pins but also for its built-in Wi-Fi and Bluetooth support. This opens up exciting possibilities for future improvements, such as remote monitoring through a mobile app or wireless start/stop commands, without needing major hardware changes.

Because the ESP32 cannot supply enough current to drive motors directly, its control signals are sent to the L298N motor driver. This driver acts as a powerful translator and amplifier — boosting the weak digital signals from the ESP32 into strong, precise voltages and currents required by the motors. It also enables bidirectional control, allowing motors to rotate both forward and backward.

For movement, two DC drive motors are connected to the rear wheels. By independently controlling the speed and direction of each motor, the system can move forward, reverse, and make smooth turns with excellent maneuverability, even on slightly uneven or damp grass. A separate blade motor is dedicated solely to spinning the cutting blade at high speed. This blade is mounted beneath the chassis at an optimized height, ensuring it delivers a clean, uniform trim with every pass while consuming power efficiently.

All these components are integrated onto a strong, custom-designed chassis that provides structural stability, absorbs vibrations during operation, and maintains proper ground clearance. Four sturdy wheels are fitted to offer good traction and smooth mobility across different lawn surfaces. High-quality connecting wires ensure efficient power distribution and reliable signal transmission, minimizing losses and preventing electrical issues.

On the software side, the development was carried out using the Arduino IDE, a user-friendly platform that supports the ESP32 very well. The actual code is written in Embedded C/C++, which allows precise, low-level control over the hardware while remaining organized and maintainable. The heart of the software is the motor control logic, which defines movement patterns, controls motor speeds, manages the timing of the blade motor, and handles different operational states of the machine.

PROTOTYPE IMPLEMENTATION

Building the Automated Solar Grass Cutter from ideas to a real working machine was the most exciting part of the project. The main goal was to create a simple, functional prototype that runs on solar power and cuts grass automatically without human help.
We started by assembling a strong but lightweight chassis. All parts were carefully mounted — the solar panel on top, battery in the center, ESP32 and motor driver in easy positions, drive motors with wheels at the back, and the cutting blade motor underneath.

Next, we set up the power system by connecting the solar panel to the 7V rechargeable battery and then wiring the battery to the ESP32 and L298N motor driver. All connections were checked properly to ensure safe and efficient power flow.

Then we programmed the ESP32 using Arduino IDE. The code was written in simple Embedded C/C++ to control the movement (forward, backward, turns) and keep the blade spinning continuously while the machine was working. We tested the code using the Serial Monitor and fixed small issues.

Finally, we tested the complete prototype. First indoors to check basic movement, then outdoors on real grass. We made small adjustments to motor speed and blade height. In the end, the machine moved smoothly, cut the grass neatly, and ran reliably on solar power. This prototype successfully proved that a solar-powered automatic grass cutter is practical and works well in real conditions.

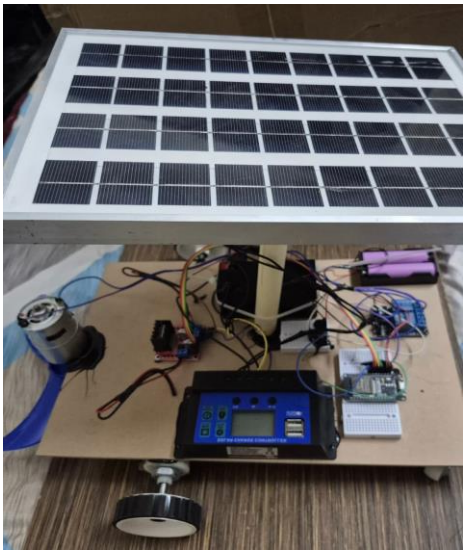

Fig.2. Fully Automated Solar Grass Cutter

RESULTS AND DISCUSSION

Testing is the moment of truth for any engineering project. For the Automated Solar Grass Cutter, the testing phase gave us clear and honest feedback on how well the machine performs in real conditions.
Overall, the prototype worked successfully. It moved autonomously across the grass, kept the cutting blade spinning steadily, and ran completely on solar power. The ESP32 microcontroller performed reliably as the brain of the system, managing both movement and cutting without major issues. All components worked together smoothly during multiple test runs.

The solar panel and 7V battery performed as expected under good sunlight. The panel charged the battery efficiently, and the stored energy was enough to run the machine for a useful duration, making it practical for small to medium lawns. However, as with any solar system, performance depends on weather. On cloudy days or in low sunlight, the battery drained faster than it charged, which reduced the operating time. Using a larger battery or a more efficient solar panel in future versions would help solve this.

The movement and navigation were among the strongest points. The lightweight chassis, wheels, and drive motors allowed the machine to move smoothly, turn easily, and maintain good traction on grass. It followed the programmed paths well and handled forward, reverse, and turning movements without slipping or stalling.

The cutting performance was good on normal grass, delivering a clean and even trim. The blade motor maintained consistent speed in regular conditions. However, when the grass was very thick or wet, the blade faced more resistance. This increased power consumption and slightly reduced the total running time. Fine-tuning the motor control through PWM adjustments helped improve efficiency and balance power usage.

FUTURE SCOPE

This is really just the beginning. The current prototype works well, but there's a lot of exciting ground left to cover.
The most natural next step is adding obstacle detection —a few ultrasonic or infrared sensors would let the mower sense what's in its path and steer around it on its own. Pair that with smarter navigation logic, and it could methodically cover an entire lawn without missing patches or doubling back unnecessarily. On the power side, a larger battery and a more efficient solar panel would keep it running longer — even on overcast days. And since the ESP32 already has Wi-Fi and Bluetooth built in, adding mobile app control or real-time status updates is more of a software task than a hardware one. Down the line, features like weather-based scheduling, low-battery alerts, or even smart home integration are all within reach. What

started as a college project has genuine potential to grow into something commercially viable — a fully autonomous, solar-powered lawn mower that's ready for the real world.

CONCLUSION

Honestly, this project turned out better than expected. The Automated Solar Grass Cutter isn't just a working prototype — it's a real demonstration that clean energy and smart technology can come together to solve an everyday problem. Powered entirely by the sun and driven by an ESP32 microcontroller, the machine cuts grass on its own without ever needing to be plugged in or fueled up.

The L298N motor driver keeps the movement smooth and the blade steady, while the lightweight frame lets it move comfortably across garden surfaces without getting stuck or struggling. More importantly, it actually works — and it works quietly, cleanly, and without any physical effort from the user. Traditional grass cutters are loud, exhausting, and not exactly kind to the environment. This project shows there's a better way — one that's affordable enough for a home garden and practical enough for school campuses or small farms. It cuts the effort, cuts the cost, and yes, cuts the grass.

REFERENCES

[1] Udhyami M. B., Afnan Shariff A., Manoj K. P., Yeshwanth Naidu M., Joel Sibi, “Solar Based Grass Cutter,” International
Journal of Creative Research Thoughts (IJCRT), vol. 12, no. 4, 2024, Paper ID: IJCRT2404623.
[2] Sachin C. S., Manasa B., Lalitha S., Sparsha T. R., “Automatic Solar Grass Cutter Using Arduino,” International Journal of Creative Research Thoughts (IJCRT), vol. 12, no. 9, 2024.
[3] Swapnil Jadhav, Tejesh Hake, Prakash Pawar, Abhishek Tondase, G. K. Inamdar, “Design and Development of an Efficient Grass Cutter for Urban Green Spaces,” International Journal of Creative Research Thoughts (IJCRT), vol. 12, no. 5, 2024, Paper ID: IJCRT2405331.
[4] I. A. Hameed, “Coverage Path Planning for Autonomous Robotic Lawn Mower Using Dubins’ Curve,” in Proc. IEEE Int. Conf. on Real-Time Computing and Robotics (RCAR), 2017, pp. 517–522.
[5] M.-H. Wu, J.-C. Yu, and Y.-C. L in, “Study of Autonomous Robotic Lawn Mower Using Multi-Sensor Fusion Based SLAM,”
in Proc. IEEE Int. Conf. on Advanced Robotics and Intelligent Systems (ARIS), 2022, pp. 1–4.