AUTONOMOUS SOLAR LAWN MOWER WITH ROBOT

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ABSTRACT

This system was completely automated using solar energy. The grass cutter is a solar-powered vehicle that can cut grass without requiring human intervention. It can also avoid obstructions throughout the process. Both the motor of the lawnmower and the motors for vehicle movement were 12V batteries provide electricity. To do away with the requirement for external battery charging, we also employ a solar panel. An esp32 microcontroller is connected to the car and the engines of the lawnmower to regulate their operation. An ultrasonic sensor has been interfaced here to detect objects. If no obstruction is identified, the microcontroller directs the vehicle's motors to drive forward. The microprocessor halts the grass cutter motor when the ultrasonic sensor detects an obstruction, preventing any harm to the item. The motor is then the microcontroller rotated it till it clears the barrier,at which point it drives the grass cutter ahead once more.

Keyword: ESP32 microcontroller, object design ultrasonic sensor, HC-05, grass cutting

1. INTRODUCTION

These days, grass cutters have gained a lot of popularity. The most typical tools are accustomed to supply soft grass. The lawnmowers' primary components are a DC motor, a relay switch for motor control, and a battery that is charged by a solar panel. It is positioned within an appropriate machine framework. A roll of wire is used to link the motors with speeds of 100 rpm and 35 rpm to the electrical supply. This machine has linear blades connected. The grass cutter works by giving the blade a fast speed rotation, which aids in cutting the grass. As the rpm increases, The blade will acquire kinetic energy. The cutting edges are quite precise and smooth. [1] Electric lawn mowers are also considerably simpler to use in lawns, gardens, and grassy areas. Grass cutting equipment are the greatest alternative on the market for improving the aesthetics of gardens and home lawns. People can just keep their gardens and lawns looking nice. without any effort by using A lawnmower is a device that has rotating blades to assist us trim lawns at even length. There are many alternatives available today, ranging

from the most sophisticated electric lawn cutting equipment to the most basic push-along mower. Approximately Eighty percent of our energy comes from conventional fossil fuels including coal (23%), natural gas (21%), and oil (36%), according to the World Energy Report. It is commonly recognized that the day will soon come when all of these resources will be depleted. To stop an energy crisis in the near future, alternative sources should be employed. [2] In order for the machine to function, solar energy must be introduced. A huge, flat rectangle is what a solar panel looks like. Typically octagonal in shape and bluish-black in hue, the cells are roughly the size of an adult palm. A solar panel's cells are made to produce energy, just like the cells in a battery. However, instead of producing power from chemicals, the cells in a solar panel capture sunlight. Since solar lawn cutters don't have any moving components, they require minimum upkeep and function well without a focusing device. Unlike nuclear power and fossil fuels, it does not pollute the environment. Solar cells are less expensive to operate and have a longer lifespan.

1.1 OBJECTIVE

The goal of the Robot for Solar Grass Cutting is to create a completely autonomous, solar-powered lawnmower that can work without assistance from a person. With the help of solar-charged batteries, the device seeks to effectively cut grass while removing the need for external charging and lowering pollution levels. Furthermore, it has ultrasonic sensors to identify and steer clear of obstructions, guaranteeing safety by halting the blade and rerouting the robot as needed. The cutting mechanism and the robot's mobility are both controlled by an esp32 microcontroller, which oversees the whole operation.

2. METHODOLOGY

In order to charge a 12V battery that drives the motors for both mobility and lawn cutting, the technique incorporates a solar panel. A steady DC power supply is guaranteed by a regulated power supply circuit that includes a voltage regulator, filter, bridge rectifier, and step-down transformer.An HC-05 Bluetooth module is available for optional wireless control, and the esp32 microcontroller manages all aspects of the operation, including motor control and obstacle detection. With the help of DC motors managed by an L293D motor driver IC, the mobility system can move smoothly and precisely while cutting through high-speed linear blades. The microprocessor stops the blades and reroutes the robot until the road is clear when the ultrasonic sensor detects obstacles in the path. In order to ensure that the robot operates reliably, safely, and efficiently in a range of situations, thorough testing and optimization are carried out.

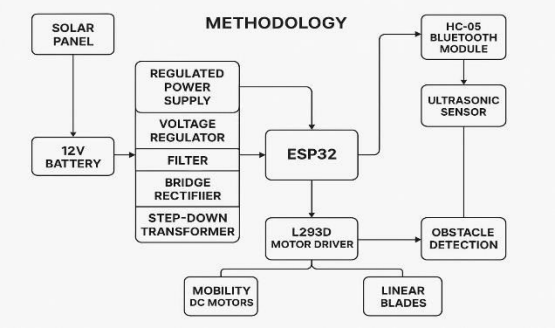

Fig.1 Methodology

3. LITRATURE SURVEY

Sivarao, Hambali, Minhat, T.J.S. Anand, and Faizul [4] reviewed the literature on automated tractors. A tractor that can drive itself and follow a predetermined route with little to no human intervention is called an autonomous tractor. The agriculture sector may profit from such a system by saving money and time on labor costs and increasing production efficiency by removing human error. The outcomes of several studies and innovations have ranged from promising and successful to others that, for various reasons, are not feasible for commercial use. Examples of such instruments include sensors, global navigation satellite systems, laser triangulation, machine vision, ultrasonic transmitters, geomagnetic controllers, actuators, and servo motors.

Prof. Sheetal Jagtap, Ashwini Bhosale, and Pratik Patil [5] spoke regarding an automated lawnmower that will allow the user to trim the grass in their yard with fewer labor. The different sensors are employed it will identify and avoid obstacles and individuals while mowing. The primary goal of this automatic lawn cutter is to allow the user to utilize the keypad to adjust the height of the grass and the area that has to be mowed. An ATmega 16 microprocessor, several This design incorporates a keypad, sensors, and an LCD display.

Hall, Ernest L. [6] The Weed Eater is an additional illustration of an automated lawn-mowing device. which was created by the corporation Weed Eater and is a self-sufficient, emission-free mower that runs on solar power. It able to manage homes up to 13,500 square feet in size size and is outfitted with 34 solar cells with iridescence embedded on top of the system platform. The Weed Eater works Similar to the Lawn Ranger's concept, but it uses a cable that is buried Under someone's grass. This cord and the mower's sensors enable the robot to move around while maintaining system stability. As long as the mower is powered by solar energy, it will keep running. When engaged, the flexible bumper on the robot backs the mower up and steers it in a new direction. Its benefit is that it can cut grass in the form of mulch, removing the requirement for raking or a grass catcher.

A review of a Gesture-controlled smart IoT-based lawnmowing machine has been provided by Sultana et al. study emphasizes how to operate the machine via hand motion. In this document, they have utilized Gesture-controlled smart IoT-based lawnmowing machine Arduino, and thus raises the cost of the system. The technique is also a little difficult to comprehend. In this case, the motor that is attached to the solar panel is powered by a battery. Its drawbacks include the system's complexity and the project's increased expense [7].

In this paper, Manimegalai and associates have presented the Integrated pesticide sprayer and automatic solar-powered grass cutter with alphabet printing. They have utilized the pesticide sprayer and alphabet printing, as well as a solar panel to charge batteries.The disadvantage of this cutter is because it is limited to printing the alphabet on grass; it cannot cover the whole grass. Although Habib and colleagues have shown a PID controller-

based automatic solar-powered lawnmower, the project's disadvantage is that it will not halt the blades' motion when an unexpected obstacle is detected, potentially endangering both humans and animals [8].

Using Bluetooth and WiFi, Paala and associates have demonstrated an Android-controlled lawnmower. This uses Bluetooth and WiFi to regulate the course of the motor, but no obstacle detection is done, Therefore, if an unforeseen obstacle arises, it won't be able to stop at its destination. The p-d algorithm was used by Zhou et al. to illustrate their research on the route planning algorithm of an intelligent mowing robot employed on a huge airport lawn; nevertheless, the system grew overly complex and the cost soared. Adeodu and associates. have demonstrated creation of a self-sufficient solar-powered lawnmowing robot with embedded obstacle avoidance and path planning for semi-structured outdoor environments. In this project, they created a lawnmower that uses route planning and obstacle detection. However, the system is difficult to manage and complex [9].

The Android -controlled, Grass cutter that runs on solar electricity robot has been represented by Jagdale et al. In this work, Bluetooth Using a Mega 328P Arduino are utilized for controlling purposes. Specifically, Bluetooth is used to regulate the direction of the motor. However, it is less accurate [7].

IoT-based solar lawn cutters have been represented by Gupta et al. This study focuses on the Internet of Things applications, specifically how to utilize an Android phone to manage a lawn mower. To do this, they connected the Android phone to the controller by Bluetooth [8]. A fully automated lawn mower that uses a solar panel has been represented by Kubendran et al.The main focus of this study is on how solar panels may be used to recharge the battery after it has been drained. However, there is reduced grass-cutting precision [9]. The creation and the layout of the smart solar grass cutter has been represented by Ismail et al. The revolutionary grass cutter technology and the clever method for precisely cutting grass are presented in this work [10].

Bluetooth-enabled solar grass cutters have been represented by Aralwad et al. In order to operate and identify obstacles, the author of this work employed an Atmega 328 and an IR sensor. They also demonstrated how to control the robot over Bluetooth [11].

4. PROPOSED SYSTEM

The lawn mower robot, often referred to as the grass-cutting robot, is a robotic machine made to autonomously mow and maintain a lawn. Th ese robots may be configured to mow the lawn according to a predetermined schedule or in re action to the grass's rate of growth. They navig ate and mow the lawn using sensors and algori thms. Other features that some grass-cutting ro bots have include protection against theft, obst acle recognition, and remote control using a s martphone app. As a means to save time and ef fort on lawn care, they have grown in popularit y in recent years [12].Typically, the robots incl ude a cutting mechanism that might be either a rotating blade or a reel of cutting blades. The r

obot may be set to mow the lawn at a particula r height, and The height at which The cutting may be changed to accommodate the length of the grass. Additionally, some robots are capabl e of mulching, which involves chopping cuttin gs of grass finely and redistributing them to th e lawn as organic fertilizer. All things consider ed, lawn care can be done effectively and conv eniently using grass-cutting robots. They may assist guarantee that the grass is maintained in good shape throughout the year and can be mo re efficient than manual lawn mowing in terms of time, energy, and effort.

5. BLOCK DIAGRAM

The lawn cutting robot's block diagram shows how several crucial parts interact to allow for autonomous operation. The microcontroller, the central processing unit that manages all inputs and outputs, is at the heart of the system. A rechargeable battery supplies power, giving the system as a whole the required voltage. For mobility, the robot has DC motors, which are controlled by a motor driver circuit that receives signals from the microcontroller. The robot can move securely and avoid collisions thanks to the use of ultrasonic sensors for obstacle identification, which transmit data in real time to the microcontroller. Remote operation using a smartphone or other Bluetooth-enabled device is made possible by a Bluetooth module, which enables wireless control and communication. A separate motor powers the grass-cutting mechanism, and the microcontroller regulates it according to its operating state. These parts work together to create an integrated system that can efficiently and precisely cut grass either manually or autonomously [13].

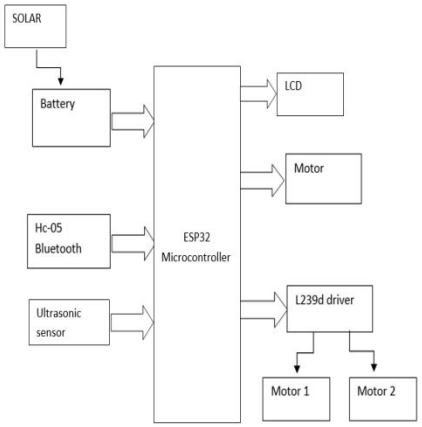

Fig.2 block diagram

6. COMPONENTS DESCRIPTION

ESP32 Espresso A System on Chip (SoC) microcontroller that is inexpensive has been produced by Systems, the firm that created the popular ESP8266 SoC. Tensilica's 32-bit Xtensa LX6 Microprocessor, which Its available in single-core and dual-core versions and includes Bluetooth and Wi-Fi integration is a replacement for the ESP8266 SoC. The ESP32 shares many of the same radio frequency components as the ESP8266, including an filters, RF balun, power amplifier, low-noise receiver amplifier, and antenna switch. due to the fact that there are so few external components are needed, building The ESP32's surrounding hardware is incredibly simple.

Bluetooth Module to communicate instructions from an Android smartphone to the system, this system makes use of an

Arduino and an HC-05 Bluetooth module. Its communication makes interacting with the controller simple. Together with a few relays, this module is installed on the system. Initially, the user connected the mobile device to this module. Once connected, the user may tell the robot to change course from a distance of 10 meters. Additionally, we may use an application to turn the system on and off. Communication across small distances is possible using this module.

DC Motor Four wheels are coupled to three DC motors with a 12V rating in this setup. The motor rotates as a result of the conversion of DC mechanical energy from electrical energy. An electric motor that is driven by direct current is known as a DC motor. Compared to other motors, it is less expensive and uses less electrical voltage.

L293d DC motor driver: This device serves as a link between the microcontroller board and the DC servo engines, allowing the shaper to use the information for various reasons. It primarily concerns with the H-Bridge concept, which allows the voltage stream to flow both clockwise and counterclockwise, turning the DC engines in one or the other bearing. Similarly, it regulates engine speed. The Arduino's working voltage is typically 5 V, but engines need higher voltages, like 6–12 V. As a result, the l293d also plays a big role in supplying voltage and current from the chip to servo engines.

BATTERY Electricity is stored in a battery for later utilize. When two different materials are used, like the electrolyte, a solution of sulfuric acid and water, is immersed in the positive and negative plates, causing a chemical reaction. is created that generates voltage. The voltage of a standard A lead-acid battery is around 2 volts per cell, for a total of 12 volts. As soon as a circuit is formed between the positive and negative terminals of the battery, electricity begins to flow. When a load that requires power is attached to the battery, this occurs. It also serves as an electrical reservoir and provides more current when the alternator is unable to meet the demand. Two Flooded Led acid batteries have been employed in this solar-powered installation.

Ultrasonic Sensor

Ultrasonic sensors determine the distance between the sensor and the target item by transforming electrical and mechanical energy. Because they are longitudinal mechanical waves, ultrasonic waves propagate through the medium in a series of compressions and rarefactions. In addition to measuring distance, they are employed in object detection, position detection, ultrasonic mice, ultrasonic material testing (to find fractures, air bubbles, and other defects in the goods), and more.

7. RESULTS AND DISCUSSION

Under a variety of testing circumstances, the produced lawn cutting robot performed dependably and effectively. With the help of its four-wheel mechanism and rotating blade system, the robot was able to successfully handle rough terrain and continuously

maintain a straight mowing route during field testing. With an average cutting speed of 0.75 m/min, it was found that the cutting efficiency for grasses of moderate height remained high. Wet or excessively dense grass, however, caused performance to slightly decline, suggesting the possible need for better blade torque or cutting height adjustment systems. Although reaction latency was occasionally seen with smaller objects, the integration of sensors allowed for efficient obstacle recognition and avoidance. Up to 90 minutes of continuous operation could be supported by a single charge, and energy consumption stayed within expected bounds. The robot's application in residential and institutional settings was supported by labor savings and increased safety as compared to manual mowing. Overall, the robot met its design goals, but future iterations should focus on increasing automation and adaptability [14].

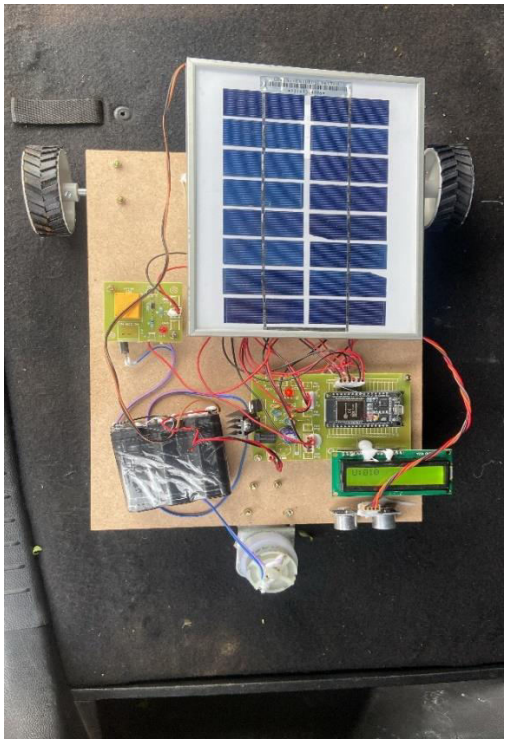

Fig.3 Results

8. CONCLUSION

We have successfully finished our project, "Making of Solar Powered Grass Cutter," and the outcomes are good. Those who will be taking on the project for the additional changes will find it easier. This undertaking is more appropriate for the average person since it has several benefits, such as no fuel expenses, no pollution or fuel residue, less wear and tear owing to fewer moving parts, and solar energy operation. People will get a lot more exercise from this, and it's manageable. While the solar-powered lawn cutter is operating, this system has the ability to charge the batteries. Therefore, it is also far more appropriate for cutting grass. Because These batteries may be charged at a facility in daylight, the same device may also be used at night. The scotch yoke mechanism, which we employed, does not provide the expected efficiency. Another mechanism can be used to boost this efficiency. and the motor's speed is decreased as we utilized heavy materials, which may be swapped out for lighter ones. The blade design have to be dependent on the kinds of grass that are being mowed.Because the grass can be mowed quickly and cheaply, the solution we completed truly touches typical families. Lastly, this initiative could serve as motivation for those who can adapt and achieve greater outcomes.

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