Mediterranean Journal of Basic and Applied Sciences (MJBAS)
Volume 7, Issue 2, Pages 41-47, April-June 2023

Smart Solar Agriculture Grass Cutting Robot

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DOI: https://doi.org/10.46382/MJBAS.2023.7206

Article Received: 19 March 2023 *Article Accepted: 27 April 2023* *Article Published: 19 May 2023*

ABSTRACT

The agricultural industry has benefited from increased automation, especially in the field of automation. In the past, people cut their own lawn by hand with grass cutters. Because the use of petroleum and diesel engines causes pollutants and degradation of energy. Therefore, automated cutters should be used in place of the conventional ones, with batteries acting as the system's power source and allowing it to operate as directed. This research suggests a smart solar agriculture grass cutting robot that is IoT based. A Bluetooth module, Arduino Uno microcontroller, Node MCU, battery, solar panel, and other components are used to do this. Rechargeable batteries can be charged using a power source or a solar panel. The DC motor's rotational speed and direction are controlled by the motor driver, and Node MCU monitors the DC motor as the system's brain. The Bluetooth module keeps track of the grass cutter robot's movements. This paper is entirely powered by automation and clean energy sources.

Keywords: IoT; Arduino Uno microcontroller; Node MCU; DC motor; Solar panel.

1. Introduction

Green is the color of natural beauty. The same is true of the grasses. However, by properly trimming and modifying their length, their beauty can be enhanced. Many technological devices are developed to carry out this function. The grass cutter produces its own solar power, which is used to operate the machine. Further using the driver circuit to regulate the motor's speed as needed [1]. The incorporation of a regulator into the system is imperative, as it must be connected in series with the battery to prevent instances of overcharging and over-discharging [2]. When comparing an automatic solar grass cutter to a traditional grass cutter, it can be observed that the former necessitates lower levels of maintenance and human intervention. In recent times, there has been a surge in the prevalence of problems such as air pollution, noise pollution, power outages, and other related issues [3].

The adoption of an independent solar-powered grass cutting device, which poses a reduced environmental impact, could potentially supplant a traditional counterpart as a viable solution to these concerns. In recent times, electric lawn mowers have superseded gasoline lawn mowers due to their eco-friendliness, albeit at the cost of manual operation and the need for charging at a designated station [4]. These electrical lawn mowers employ lead acid batteries, which have a reduced depth of discharge (DoD) and higher round-trip effectiveness. Automated cutters should take the place of conventional cutters. Using a battery as power, the automated cutters will operate in accordance with instructions. The Node MCU, a motor that drives for the robot's wheels, and a linear blade for cutting the grass into different designs based on the user's instructions, are the brains of the system [5].

The old lawn mowers must be replaced with automated models that use batteries as their power source for obstacle detection and navigation. The robot's top will have a solar panel affixed to it, which will power the batteries. A fully automated solar lawn cutting machine is one that mows the grass on its own. This gadget lessens noise and environmental pollutants. It is a robotic mower that uses solar power to trim the lawn [6]. The robot's top will have

a solar panel connected, which will help with the issue of increased power usage. Everyday robots that employ a variety of technologies and can cut the grass on a lawn while spotting obstacles using IR sensors, ultrasonic sensors, etc. The proposed solar lawnmower comprises several components, including a direct current (DC) motor, rechargeable battery, solar panel, stainless steel blades, and control switch [7]. The circuit-disrupting switch on the board regulates the flow of current to the motor that propels the mowing blade of the solar-powered lawnmower. The solar-powered lawn cutting device is an autonomous robotic platform that utilises solar energy to perform both manual and automated grass cutting operations, while also exhibiting obstacle avoidance capabilities. The 12-volt battery in the system provides power to both the vehicle movement motor and the grass cutter motor. The photovoltaic panel facilitates the charging of the battery, thereby obviating the necessity of an external charging mechanism [8]. Both the elderly and younger individuals encounter challenges when it comes to mowing the lawn. The operation of lawn mowers in motion generates noise pollution due to the high decibel levels of their engines and the emission of air pollutants resulting from the combustion process. A novel electric grass cutter has been developed with the aim of reducing power consumption. In this paper, a smart, solar powered agricultural grass cutter robot is proposed. The list that follows shows how the paper is set up: The recent research is discussed in Section 2. Detailing the proposed work in Section 3. Section 4 of the paper contains the outcomes. A conclusion is provided in Section 5.

2. Recent Works

Khemnar et al. [9] have proposed an IoT-based solar lawn mower. IoT is a network of connected digital machines, mechanical parts, and human beings who use data effectively. Controls for an IOT-based solar cutter are built using smartphones, which are now used by everyone. All programming for this gadget is done using the Arduino software. When an issue is discovered by an ultrasonic sensor, a DC motor can be used to provide an upward or downward motion. Solar energy from solar panels serves as a source of power for the system. This renewable energy source is used all year round, not just in the summer. Selvaraj et al. [10] have presented a solar grass cutter, a device that uses blades to cut grass in gardens, school fields, and other locations. Today's power consumption is crucial for the future. Therefore, a solar grass cutter is a very practical tool for cutting grass. To make its application simpler with the least amount of risk to its cost, many adjustments have been made to the prior machine, which is likewise solar-powered. Even those without technical understanding can use it with ease and keep the lawn's very fine and consistent surface appearance. The solar-powered grass cutter has several uses.

Prashant et al. [11] have reveals that India's entire economy greatly depends on agriculture, which is the country's largest and most diverse economic sector by demographics. Mechanization is essential for the expansion of the Indian economy. Mechanization in agriculture is primarily used to increase output and productivity overall. The system is powered and operated in standby mode by a DC battery. The battery serves as the source of the entire supply, and the battery charger circuit is employed to provide charging for the battery. Additionally, the second application involves using a water pump equipped with a spreading nozzle to disperse the pesticide.

Daniyan et al. [12] have presented the automated lawn cutter, a solar powered robotic vehicle that can cut grass with little assistance from a person. It can also avoid obstacles. The vehicle and lawn cutter motors are controlled

by an Atmega 328 microcontroller, which serves as the central processing unit. An IR sensor is utilised as an interface for object detection. This enhances the efficiency of the device for lawn mowing and mitigates the challenges related to grass cutting. Sherly Stalin et al. [13] have suggests the goal of technology to create a cost-efficient and environmentally friendly grass cutting machine. The purpose is to evaluate the many advancements made in lawn cutter machines as well as their functionality. There are several restrictions on the height at which grass can be mowed with commercially available grass cutters [14]. Try to develop a new, creative idea that can be used specifically in the agricultural sector. Tend to be approaching to modify the grass cutting machine for the employment of agricultural field, to chop the crops within the field but on cut the grass in any stadiums or utilized in traditional agriculture.

3. Proposed Work

In this paper, an Arduino UNO microcontroller serves as the device's brain by managing every aspect of operation. Rechargeable batteries that are charged by a solar panel are used as the power source to power the model. The Bluetooth Module is used to track the movements of the robotic grass mower. It keeps an eye on the motor all the time and feeds data to a blink application for remote monitoring through a Wi-Fi module. A DC motor is observed using Node MCU. The motor driver regulates the DC motor's rotational speed and direction. Figure 1descibes the proposed system block diagram.

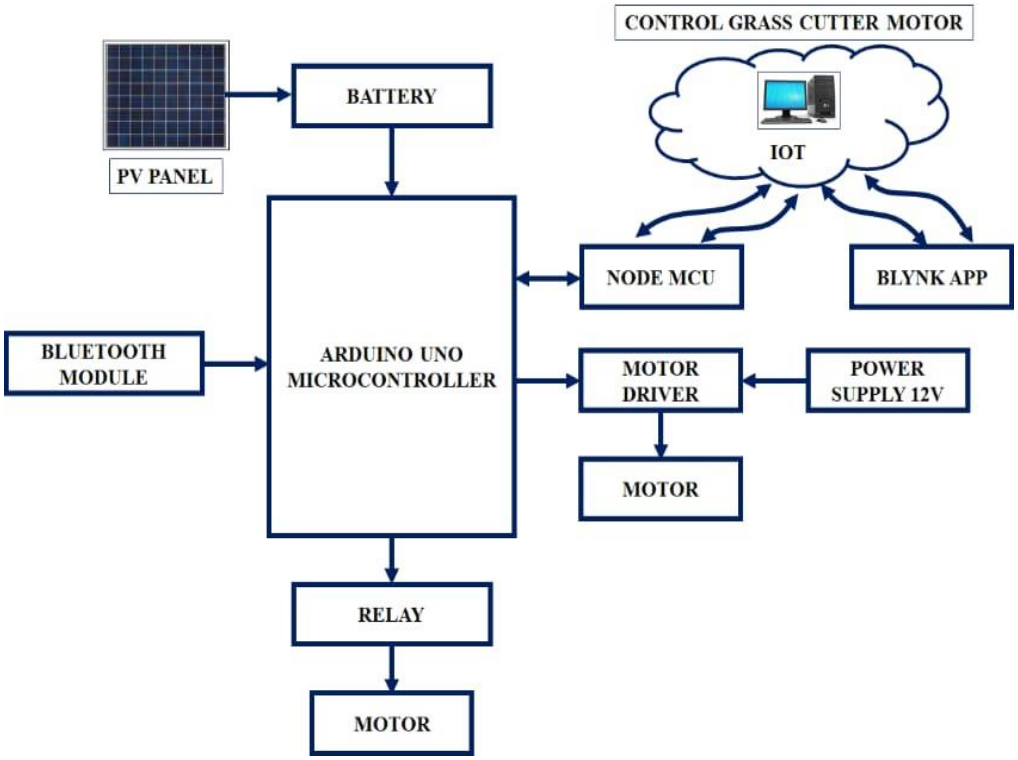

Figure 1. Block Diagram of Proposed System

3.1. Arduino UNO

The Arduino UNO is a microcontroller platform that is furnished with a multitude of input/output pins for both analogue and digital operations, in addition to having a restricted memory storage capacity. The Arduino UNO is a

representative example of the Arduino series. The Arduino UNO is equipped with a USB port that serves the dual purpose of facilitating power supply connection and programme uploading. Electrical circuits can be established through the utilisation of either battery cells or mains power.

3.2. NODEMCU ESP8266

The ESP8266 is a cost-effective System-on-a-Chip (SoC) that serves as the foundation for the Node MCU (Node Micro Controller Unit), an open-source software and hardware design environment. In various operating modes, wireless network technology uses the 2.4 GHz band to improve WLAN performance. This module can withstand temperatures of up to 125C. GPIO pins enable the integration of various sensors.

3.3. Solar Panel

The photovoltaic effect is used by solar cells, also known as PV cells, to capture solar energy and generate current between two layers with opposing charges. A solar panel is comprised of many solar cells. Even though each solar cell produces just a slight quantity of power, a big number of solar cells placed closely together can produce enough energy.

3.4. Relay Module & Motor Driver

A relay is a switch that is activated by an operational mechanism, enabling the control of the flow of current through it by turning it on or off. The regulation of this switch can be achieved through the application of low voltages. Depending on the polarity of the voltage when it applies, a motor rotates either forward or backwards. The voltage directly affects how fast the rotation spins. It is composed of a commutator, a brush, a coil-equipped rotor, and a permanent magnet stator. Motor drives for all electric motors are not readily available. For types of combustion engines, certain manufacturers generate motor drivers particularly.

3.5. Bluetooth Module

The technology finds application in various consumer products such as wireless headsets, game controllers, wireless mice, wireless keyboards, and several others. The range of transmission can vary up to approximately 100 metres, contingent upon factors such as the transmitter and receiver utilised, atmospheric conditions, geographical location, and urban environment.

3.6. BLYNK App

Blynk is an IoT platform that enables remote management of Arduino, Raspberry Pi, and Node MCU through iOS and Android mobile devices. This programme is utilised to generate a graphical user interface (GUI) or human machine interface (HMI) by compiling and providing the appropriate address on any available widgets. The Blynk library enables direct control of Arduino or ESP32 pins from a phone without the need for programming. It is also possible to share with friends or clients, giving them access to the linked devices but not the ability to change them.

4. Results and Discussions

Robotic grass cutter driven by solar energy and using Arduino. However, in general, a solar-powered grass-cutting robot powered by Arduino would most likely combine solar panels for power generation, an Arduino board for

controlling the robot's movements and cutting mechanisms, and sensors for detecting obstructions and ensuring the robot stays within the specified cutting area. The performance would be influenced by several elements, such as the caliber of the materials used, the Arduino board's programming, and the effectiveness of the solar panels. The cutting area's size and complexity as well as the kind of grass or plants being removed could potentially influence how well the robot performs. Overall, a well-thought-out and properly implemented Arduino-powered solar grass-cutting robot might be able to offer a practical and effective replacement for conventional lawn care techniques.

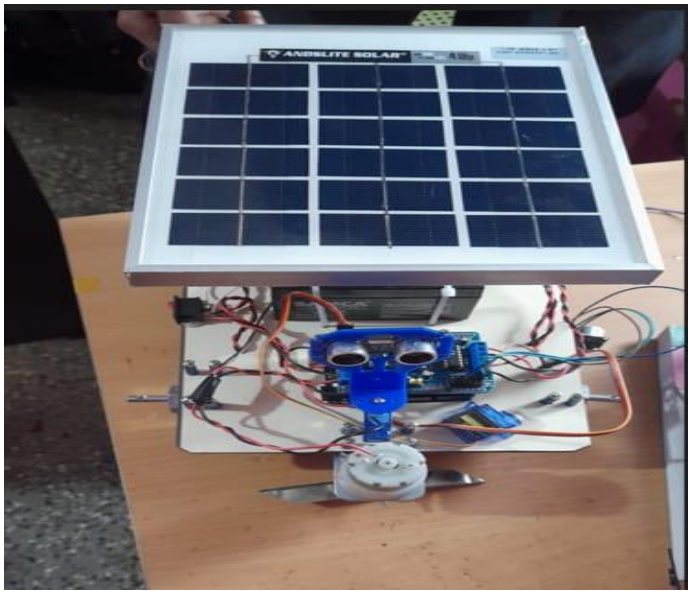

Figure 2. Hardware Image

5. Conclusions

Contemporary machinery is designed with the objective of reducing or eradicating the discharge of greenhouse gases, which are among the primary causative agents of alterations in the climate. The utilisation of solar power in the operation of the grass cutter presents a viable solution to the issues of eco-friendly production and reduced operational expenses, owing to the absence of fuel-related expenses. The present study involves the development of an intelligent robot for mowing grass in solar farms. The model's power source is a battery that can be recharged and is charged by a solar panel. The Bluetooth Module keeps track of the grass cutter robot's movements. A blink application receives information from a Wi-Fi module that continuously monitors the motor and delivers it for remote monitoring. The Node MCU keeps an eye on the DC motor. The motor driver has complete control over the direction, rotation, and speed of the DC motor.

Declarations

Source of Funding

This study did not receive any grant from funding agencies in the public or not-for-profit sectors.

Competing Interests Statement

Authors have declared no competing interests.

Consent for Publication

The authors declare that they consented to the publication of this study.

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