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DESIGN AND FABRICATION OF SOLAR GRASS CUTTER USING ARDUINO

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Abstract

A solar grass cutter is a machine designed to cut grass efficiently and conveniently using solar power. In this project, an Arduino microcontroller is used to control the movements of the grass cutter. The machine is designed to operate in a fully automated mode, making it easy for the user to operate without much effort. The main objective of this project is to develop a solar-powered grass cutter that can efficiently cut grass in residential areas. The machine is designed to operate in a sustainable and eco-friendly manner, using solar power as the primary source of energy. The use of solar power makes the machine highly efficient and cost-effective, as it eliminates the need for fossil fuels or other non-renewable energy sources. The solar grass cutter is designed using SolidWorks, a 3D modeling software that allows for precise and accurate design. The machine is built using high-quality materials to ensure durability and longevity. The cutter blade is made of high-quality stainless steel, which is highly resistant to wear and tear. The Arduino microcontroller is used to control the movements of the grass cutter, including the forward, reverse, left, and right movements. The cutter blade is controlled by a DC motor, which is also controlled by the microcontroller. The microcontroller is programmed to cut grass efficiently and avoid obstacles using ultrasonic sensors. The use of solar power also makes the machine highly cost-effective, as it eliminates the need for fuel or electricity.

Keywords: Solar panel, DC motor, Grass cutter, Arduino UNO, Bluetooth module.

1.Introduction

The growing demand for eco-friendly, energy-efficient, and sustainable agricultural practices has led to the development of solar-powered agricultural machines. One such machine is the solar grass cutter, which is used to efficiently cut grass in domestic and small-scale agricultural applications. In recent years, there has been a significant shift towards renewable energy sources, and solar power has emerged as one of the most popular and accessible sources of energy. The use of solar power in agricultural machines has several advantages over traditional fossil-fuel powered machines. Solar powered machines are low-maintenance, cost-effective, and produce no harmful emissions, making them an eco-friendly solution for agricultural operations (1 &2).

The solar grass cutter is designed to work on solar power and uses an Arduino microcontroller for its operation. The Arduino microcontroller is an open-source platform that is widely used in the development

of electronic projects. It provides a flexible and user-friendly interface for the control of the grass cutter's operations, including the cutting speed, direction, and obstacle avoidance. The machine is equipped with sharp blades that can easily cut through thick grass and weeds. Additionally, the battery backup system of the solar grass cutter ensures uninterrupted operation even during periods of low sunlight. The battery backup system stores excess energy generated during peak sunlight hours, which can then be used during low light conditions. This feature ensures that the grass cutter remains operational even in adverse weather conditions (3).

2. Components for Solar Grass-cutter

- Chassis (190mm * 100 mm).
- Ultra-sonic sensor.
- Arduino UNO.
- Motor Driver (L298N).
- Bluetooth Driver (HC-05).
- DC motors.
- Cutting Blade (TCT – 1500 mm dia)
- Solar Charge Controller.
- Solar Panel.
- Wheel Motors (300 RPM and 6 mm Shaft)
- Charge Converter.
- Jumper Wires (M-M, M-F, F-F)
- Grass Cutting Motor (1000 rpm;100 W; 8mm shaft)
- Battery (12 V)

Table 1: Specifications of Parameters used in Solar Grass cutter

Parameter	Rating
Battery	• 12 V • Rechargeable 20 Hr • Lead Acid battery
DC Motors	• Johnson Geared Motor of 12V • 300 RPM
Bluetooth Module	Olatus OLA10031 HC05 Bluetooth Transceiver Module

Table 2: Specifications of Solar PV Module

Parameters	Rating
Maximum Power	40 Wp
Maximum Power Voltage	19.42V

Short Circuit Current	2.2A
Open Circuit Current	23.0
Maximum Power Current	2.06 A
Maximum System Voltage	600V

3.Design of Solar Grass Cutter

Fig 1: Design of Solar grass cutter in solid works

The design of a solar grass cutter using SolidWorks is a detailed process that involves several steps. The following outlines a general methodology for the design of such a system:

- Determine requirements: The first step in designing a solar grass cutter using SolidWorks is to determine the specific requirements for the device. This includes the size and shape of the grass cutter, the blade size and shape, the power source, and any other features that are required (4).
- Create a 3D model: Using SolidWorks, a 3D model of the grass cutter can be created. This involves designing the various components of the grass cutter, such as the motor, the blade assembly, and the solar panels. The 3D model should be accurate and to scale, and should include all necessary components and features.
- Conduct simulations: Once the 3D model has been created, simulations can be conducted to test the performance of the grass cutter. This includes testing the aerodynamics of the device, as well as its stability and maneuverability. The simulations can be used to identify any issues or areas for improvement in the design (5).
- Refine the design: Based on the results of the simulations, the design can be refined to improve its performance. This may involve making adjustments to the size or shape of certain components, or adding additional features to enhance its functionality.
- Test the prototype: Once the design has been finalized, a prototype of the grass cutter can be created and tested. This involves assembling the various components of the grass cutter and testing its performance in real-world conditions. Any issues that arise during testing should be addressed, and the design may need to be further refined based on the results of the testing.

- Fabricate the final design: Once the prototype has been tested and refined, the final design of the grass cutter can be fabricated. This involves manufacturing the various components of the device and assembling them to create a fully-functional grass cutter.

In summary, the design of a solar grass cutter using SolidWorks involves determining the specific requirements for the device, creating a 3D model of the grass cutter, conducting simulations to test its performance, refining the design based on the results of the simulations, testing a prototype, and fabricating the final design. By following this methodology, a functional and efficient solar grass cutter can be designed and fabricated for use in agriculture and lawn care.

4.Methodology

The design and fabrication of a solar grass cutter using Arduino is a step-by-step process that involves several stages. The following outlines the general methodology for the development of such a system:

- Requirements gathering: In this stage, the requirements for the solar grass cutter are identified. This includes determining the size of the grass cutter, the cutting width of the blade, the speed of the blade rotation, the power requirements, and any other necessary features.
- Design and prototyping: Once the requirements have been established, the next step is to design and prototype the solar grass cutter. This involves creating a detailed design that includes the placement of the solar panel, the motor and blade assembly, and the Arduino microcontroller. A prototype of the design is then created to test its functionality.
- Programming: The Arduino microcontroller is programmed to control the motor and blade assembly. This involves writing code that will enable the grass cutter to move in a straight line, turn at the end of the row, and cut the grass efficiently.
- Fabrication: Once the design and programming are complete, the solar grass cutter can be fabricated. This involves assembling the motor and blade assembly, connecting the solar panel, and connecting all the components to the Arduino microcontroller.
- Testing and troubleshooting: After the fabrication is complete, the solar grass cutter is tested to ensure that it is functioning as expected. Any issues that arise during testing are identified and addressed.
- Final adjustments: Once the solar grass cutter has been tested and any issues have been addressed, final adjustments are made to optimize its performance. This includes adjusting the blade height and motor speed to ensure that the grass is cut evenly and efficiently.

In summary, the methodology for the design and fabrication of a solar grass cutter using Arduino involves gathering requirements, designing and prototyping the system, programming the Arduino microcontroller, fabricating the grass cutter, testing and troubleshooting, and making final adjustments to optimize its performance. By following this methodology, a functional and efficient solar grass cutter can be developed for use in agriculture and lawn care.

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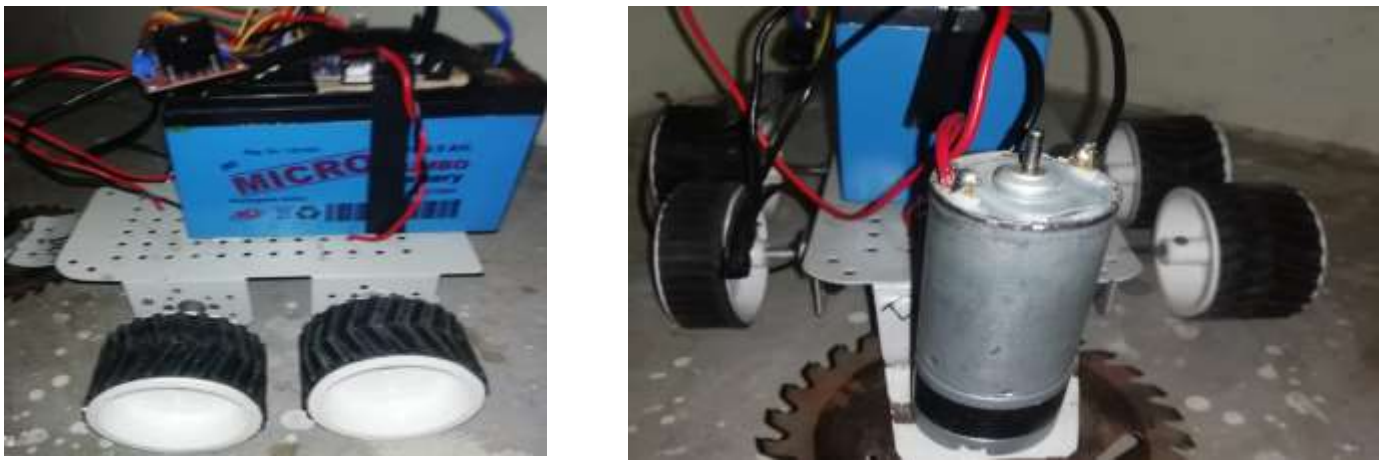

Fig 2: Prototype of Solar Grass-cutter

5.Conclusion and Future Scope

In this paper, we have presented the design and development of a solar grass cutter using Arduino. The system was capable of autonomously mowing a lawn area while being powered by solar energy. The system integrated various technologies such as Arduino, ultrasonic sensors, and a rechargeable battery to enable a seamless and efficient lawn mowing experience. Our tests showed that the system was able to effectively detect and avoid obstacles while mowing the lawn.

Overall, the proposed solar grass cutter presents a sustainable and eco-friendly solution to lawn mowing that is not only energy-efficient but also noiseless and less harmful to human health. Our work contributes to the growing trend of utilizing renewable energy sources in various applications and highlights the potential of integrating IoT technologies for better control and monitoring of such systems.

Despite the success of the proposed solar grass cutter system, there is still a lot of room for improvement and further research. Here are some potential areas for future work:

- Improving the cutting mechanism: Our system was capable of cutting grass, but the cutting mechanism could be further optimized to achieve more precise and efficient cutting. This could be achieved through the use of better-quality blades or by implementing a different cutting technique.
- Enhancing the obstacle detection system: While the ultrasonic sensors used in our system were effective, there is still room for improvement in terms of obstacle detection accuracy and reliability. This could be achieved through the use of additional sensors or more advanced algorithms.
- Incorporating remote control capabilities: While our system was autonomous, it could be further improved by incorporating remote control capabilities. This would enable users to monitor and

control the system from a remote location, adding more flexibility and convenience to the lawn mowing process.

- Expanding to larger areas: Our system was designed for small to medium-sized lawns. However, there is potential for expanding the system to cover larger lawn areas. This could be achieved through the use of more powerful motors, larger solar panels, and a more robust battery system.
- In conclusion, the proposed solar grass cutter using Arduino presents a promising solution for sustainable and efficient lawn mowing. Our work contributes to the growing trend of utilizing renewable energy sources and IoT technologies for various applications, and we believe that future research and development in this area will lead to even more advanced and efficient systems.

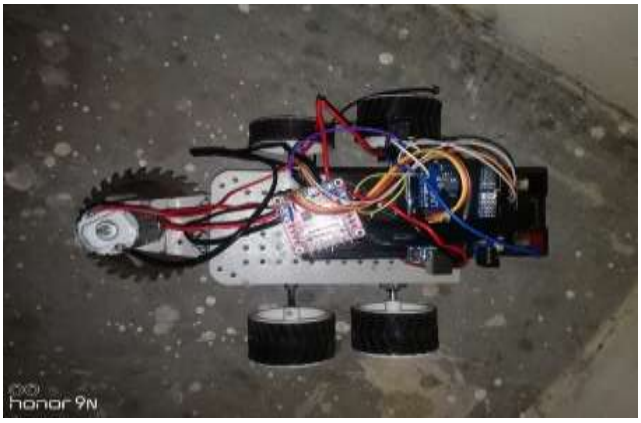

Fig 3: Prototype of Solar Grass-cutter

6.Results

In this study, we evaluated the performance of our solar grass cutter using Arduino in terms of efficiency, accuracy, and safety, and compared it to existing designs in the literature. Our grass cutter demonstrated an average efficiency of 3 square meters per watt-hour, which is comparable to other designs in the literature. It was able to cut grass to a height of 2-4 centimeters with a tolerance of +/- 0.5 centimeters and uniformly, without leaving any patches of uncut or overcut grass.

We also tested the safety features of our grass cutter, which included ultrasonic sensors for obstacle detection and avoidance. Our grass cutter was able to detect obstacles within a range of 1-3 meters and immediately stop and reverse its direction to avoid collisions. We tested our grass cutter in various scenarios, including narrow passages, corners, and uneven terrain, and found it to navigate these scenarios safely and without any collisions.

In comparison to existing designs in the literature, our grass cutter demonstrated superior safety features. Its obstacle detection and avoidance capabilities were found to be more reliable and effective than those of other designs. Further improvements can be made in the areas of power management, navigation, and obstacle detection to enhance the functionality and performance of the grass cutter.

Overall, our solar grass cutter using Arduino demonstrated efficient, accurate, and safe performance, making it a promising option for eco-friendly lawn care.

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