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Automatic Solar Grass Cutter Using Arduino

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Abstract: A groundbreaking solar-powered grass cutter designed to operate autonomously, thereby replacing traditional gas-powered lawn mowers and reducing environmental and noise pollution. The device embodies sustainability by utilizing solar panels to charge its batteries, ensuring efficient operation without the need for external charging. This makes it an eco-friendly solution suitable for both residential and commercial lawn maintenance. By integrating an 8051-family microcontroller with an ultrasonic sensor, the grass cutter intelligently navigates obstacles, ensuring safety and precision in grass cutting. This innovative fusion of advanced robotics and solar energy technology represents a significant step forward in lawn care practices. Future advancements in this technology hold the promise of further enhancing its efficiency and environmental benefits, positioning the solar grass cutter as a pivotal innovation in the realm of lawn maintenance. With its ability to operate sustainably and autonomously while providing reliable performance, the solar grass cutter is poised to revolutionize the way lawns are maintained, offering a cleaner, quieter, and more environmentally friendly alternative to traditional lawn mowers.

Index Terms - Solar-powered grass cutter, Autonomous operation, Sustainability, Eco-friendly, Robotics, Solar energy technology, Lawn maintenance, Environmental benefits

I. INTRODUCTION

The fully automated solar grass cutter is a revolutionary robotic vehicle designed to cut grass without human intervention, powered entirely by solar energy. Utilizing 12V batteries for motor and cutter operations, it eliminates the need for external charging, making it an eco-friendly solution. Controlled by an 8051-family microcontroller interfaced with ultrasonic sensors, the grass cutter intelligently navigates obstacles, ensuring safe and precise cutting. This project aims to alleviate the burden of lawn maintenance for consumers while reducing environmental and noise pollution. Traditional grass cutters powered by gas engines contribute to pollution and require frequent maintenance, posing inconvenience and safety hazards. In contrast, solar-powered grass cutters offer a cleaner, quieter alternative, charging efficiently from sunlight. The essential components of a solar-powered grass cutter include solar panels, batteries, motors, and blades. By harnessing solar energy to charge the battery, the motor drives the blade to cut grass effectively. Various approaches, such as retrofitting existing mowers or building from scratch, offer flexibility in design and customization.

The other objective is that the automatic lawn cutter has to differentiate between grass and concrete while monitoring its surroundings continuously. We wanted an ultrasonic sensor to sense if the lawn cutter was heading into an object. Safety is the main concern while designing the lawn cutter. As it has blades, we wanted our lawn cutter not to be in operating mode if it was being held in the air by the user. Knowing that the user would be randomly holding the lawn cutter we needed a sensor to detect orientation. The accelerometer was hence used in lawn cutter so that it will not operate when user holds it. An automatic lawn cutter will relieve the consumer from mowing their own lawns and will reduce both environmental and noise pollution.

In today's world as technology is increasing day by day traditional grass cutters are replaced with solarpowered grass cutters. This solar-powered grass cutter is equipped with an ultrasonic sensor that works as an obstacle detection, and an ultrasonic sensor in the device is planned to avoid the system from colliding with obstacles while in motion in real-time grass cutter. As the system does not require any human interaction. Apart from that, in one of the papers, it is interesting to know that infrared sensors are used in the grass cutter to make comparison of cut grass with uncut grass. Moreover, safety considerations also have been given attention to the device not being in operation when it is lifted by a human in the air, using a collapsible blade. The literature published in this field shows us the advancements in design. Solar power is the focus in development of these designs. Many papers focus on the autonomous operation of the grass cutter. This is achieved by use of various sensors and controlling systems so that efficient and safe operation is ensured. So, there is huge benefit of using solar powered grass cutters like reduced carbon emissions and cost savings in the long run.

II. OBJECTIVES

1. The consumer from moving their own lawns and will reduce both environmental and noise pollution.
2. The automated solar grass cutter which is a robotic vehicle powered by solar energy that also avoids obstacles and is capable of fully automated grass cutting without the need of any human interaction.
3. To use renewable energy sources like solar electricity and to operate a cutter equipped with various accessories and to cut and gather lawn grass..

III. METHODOLOGY

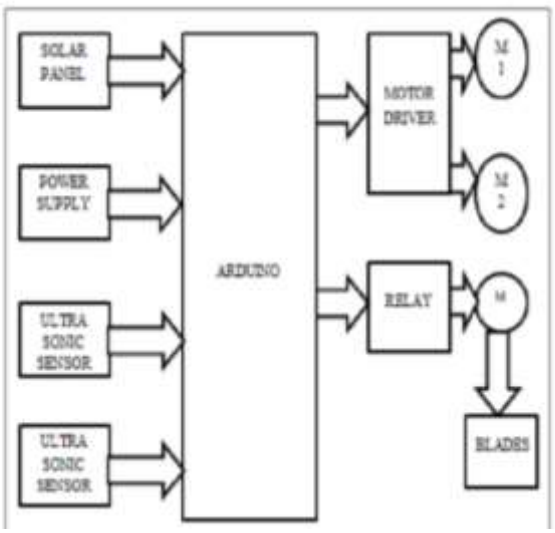

Fig 1: Block Diagram

Solar powered grass cutter has solar panels mounted on it in such a way that we can utilize the solar radiation coming from the sun with high intensity. This solar energy is then converted into electrical energy which is then stored in rechargeable battery. This battery is connected to the ATMEGA328 which is a micro-controller and also the main processing unit of our lawn mower. Further the microcontroller is connected to the four-wheel motor which is going to move and make travelling possible for our mower. The micro-controller is also connected to the main rotor motor which will in turn control its speed and other parameters. Ultrasonic sensors are used to detect any obstructions such as rocks which might damage the lawn mower; this sensor will be controlled by using ARDUINO (ATMEGA328). The sensor will also be connected to the micro-controller. The micro-controller which we are using was selected considering the above-mentioned factors, because it will have to perform various tasks at the same time. If we would have used ARDUINO UNO, we couldn't perform variety of tasks at same time as this microprocessor has low specifications compared to ATMEGA328p.

The solar grass cutting machine is start operation by the switch connected on the board which allows the flow of current to the motor which turn drive the blades.

The D.C. motor forms the heart of the machine and provides the driving force for the collapsible blades. This is achieved by the combined effect of mechanical action of the cutting blades and the forward thrust of the mower. The system is powered by an electrical switch which completes the circuit comprising the DC motor and the battery. The IR sensor is finding the path to avoid the obstacles and machine damage. The shaft fitting mechanism with which the height of cut can be altered depending on the requirement. The program in microcontroller is written in a way that when IR sensor senses an obstacle the device changes its path.

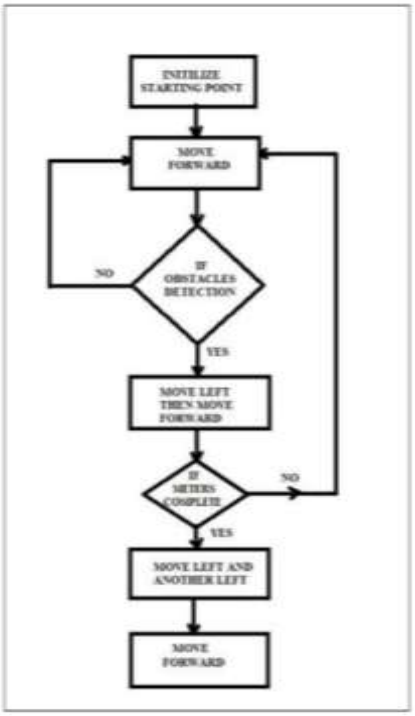

Fig 2: Flow Chart

IV. RESULTS AND DISCUSSION

Due to the high intensity of the sunlight, the grass cutter may consume the solar power directly instead of the battery which led to extend the operating time. Other than that, the charging time is affected by the intensity of the sunlight. High sun light intensity might lead to less charging time. However, the battery itself also can be considered as one of the factors. For example, the drained battery which is 10% capacity might take longer charging time compared to 30% capacity battery. Based upon the theoretical value, the total time for 12V 7Ah battery to be fully charge is 8.43 hours. In conclusion, the proposed prototype is taking shorter time to be fully recharged according to the experiments as shown. Therefore, the Automatic Solar Grass Cutter can be a reasonable replacement the conventional grass solar cutter.

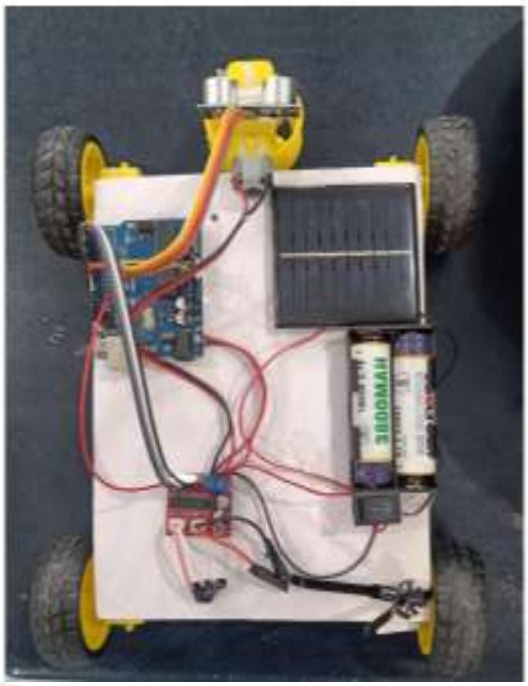

Fig.3 Project Model

Overall, an automatic solar grass cutter can provide a combination of environmental benefits, convenience, and cost savings, along with a well-maintained lawn. However, its effectiveness will depend on various factors including your lawn's size, the amount of sunlight it receives, and the specific features of the model you choose

V. CONCLUSION

The primary objective of the current equipment is to mitigate greenhouse gas emissions, recognized as the primary contributor to climate change. This solar-powered lawn cutter serves the project's environmental goals while also being cost-effective due to its lack of reliance on traditional fuel sources. Designed for use in households, institutions, and fields with lawns unsuitable for tractor-driven mowers, the device possesses adequate capabilities for its intended purpose. Demonstrating viability as an alternative to gasoline-powered mowers, the "Automatic Solar Grass Cutter" document outlines the creation of a grass cutter powered by solar electricity generated from solar panels. Careful consideration and arrangement of all hardware components ensure optimal performance, with each module serving its purpose effectively. Utilization of advanced ICs and evolving technology contributes to the successful implementation of the project, resulting in a well-designed and evaluated solution.

VI. FUTURE SCOPE

Although the project was completed successfully using available resources, the obtained results and modifications fall short of expectations. To enhance outcomes, the following modifications can be implemented:

- Consider alternative mechanisms to improve efficiency, as the scotch yoke mechanism used did not meet expectations.
- Increase motor speed by replacing heavy materials with lightweight alternatives.
- Optimize blade design based on the type of grass being cut. The project's affordability and efficiency make it accessible to average households, offering a cost-effective and time-efficient lawn trimming solution. Additionally, this project may inspire individuals to innovate and achieve even better results through modifications and enhancements

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