engineering proceedings

MDPI

Proceeding Paper

Solar Powered Grass Cutter for Domestic Utilization †

Muhammad Waqas Jabbar *, Muhammad Noman, Asad Muneer, Ali Abbas and Adnan Mazhar

Department of Electrical Engineering, University of Gujrat, Gujrat 50700, Pakistan; 18103322-041@uog.edu.pk (M.N.); asad.muneer@uog.edu.pk (A.M.); 18103322-005@uog.edu.pk (A.A.); 18813322-017@uog.edu.pk (A.M.)

* Correspondence: waqas.jabbar@uog.edu.pk

† Presented at the 1st International Conference on Energy, Power and Environment, Gujrat, Pakistan, 11–12 November 2021.

Abstract: This paper presents the fabrication and working of a smart solar grass cutter. In this work, we have developed a solar-powered lawn mower and thus saved energy by decreasing air pollution and reducing labor cost. In the old model, cutting iron was used. Due to its high environmental impact, it was the most expensive cutter used by the engine. We have utilized a microcontroller in our project to control the different lawn mower actions. Two DC gear motors (10,000 RPM, starting current 1.7 A and no load current 1.5 A) are used to move the solar grass cutter, and one DC blade motor (7000–13,000 RPM, starting current 0.7 A and no load current 0.45 A) is used to cut the grass quickly. With current technology, this new prototype is designed as a remotely controlled grass cutter using Arduino UNO. The Smart Solar tracker is controlled via Bluetooth by using a smartphone. The Smart Solar Grass Cutter can run for more than two hours when the battery is completely charged.

Keywords: solar panel; Arduino UNO; blade motor; DC gear motors; dual channel motor driver

check for updates

Citation: Jabbar, M.W.; Noman, M.; Muneer, A.; Abbas, A.; Mazhar, A. Solar Powered Grass Cutter for Domestic Utilization. *Eng. Proc.* **2022**, *12*, 105. https://doi.org/10.3390/engproc2021012105

Academic Editor: Shahid Iqbal

Published: 21 March 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

1. Introduction

The first silicon photovoltaic cell was created by Bell Labs in 1954. While solar energy has been gathered and transformed to usable energy in a few different ways, solar power became an efficient power source for long-term electricity devices only in 1954 [1,2]. In short, most of the solar panels currently available can turn sunlight into solar energy in excess of 20% efficiency, a constant figure—at a 4% efficiency, the first solar cells can convert sunlight into electricity [3].

Solar energy was used for textiles, farm goods, food storage and so on directly. We manufactured a solar system-based lawn mower. This lawn mower is shown in Figure 1. This decreases the power, labor, and pollution of human beings. This device is Bluetooth operated. Its basic block diagram is shown in Figure 2. In addition to photovoltaics, solar energy is frequently used to produce energy in thermal systems within and in liquid regions. The solar energy may be used by residential and corporate owners to install solar water heating and to design solar power [4].

The author manually processes the lawnmower. This device has direct blades and has no weather influence [5,6]. The major aim of the essay is to distribute separate grass indices as criteria for different types of production. The length of the connection might vary the cut. An untrained worker can use this device.

There are three primary solar panels: residential, business and utility [7]. The roof or floor of the home is frequently equipped with a domestic sun, normally in the range of 5 to 20 kilowatts (kW). Commercial solar power plants are generally larger than solar panels [8,9]. The solar scale has the same objective: to provide solar energy on site to enterprises and non-profit firms, but each facility's size might be different. Finally, typical big projects are used, and, with the construction of several megawatts, a considerable percentage of utility users obtain solar energy (MW).

Figure 1. Smart solar grass cutter.

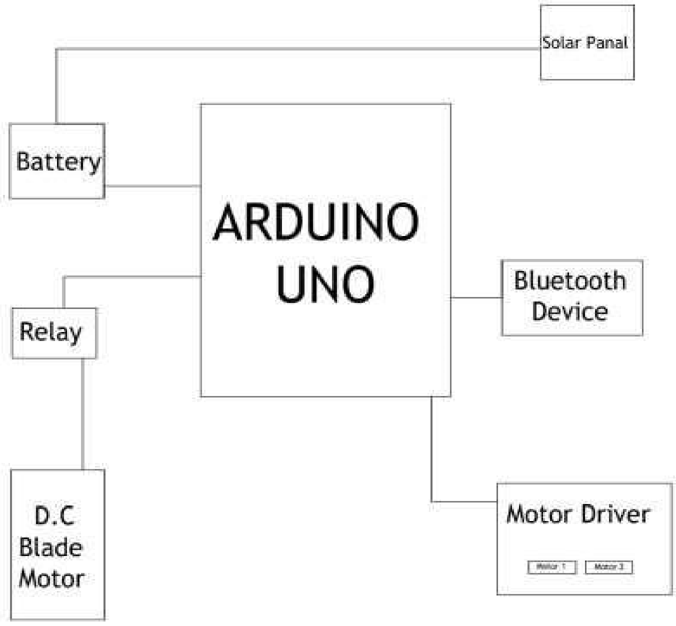

Figure 2. Block diagram.

2. Methods

Methodology will be discussed for design and fabrication of solar grass cutter control by Bluetooth. After reading different literature works, their advantages and disadvantages were identified. The advantages were adopted as much as possible, and the disadvantages were avoided as much as possible. Keeping in mind the outcomes of the project, the following methodology was adopted for the proposed grass cutter machine.

Some criteria must be taken as materials for the design of a Smart Solar Grass Cutter, such as the object position, the big body structure, design benefits and safety features. The Smart Solar Grass Cutter may be independent or autonomous. The essential thing is for it to work properly. To accomplish efficiency, utility and those things chosen, including positions, are crucial. The Smart Solar Grass Cutter is a straightforward design that utilizes construction materials. The total size of the solar panel depends on the size. The battery length of the roof height varies. A rotating rubber wheel is used for the front wheels since the direction in the back pipes automatically changes. Each back wheel has a single car. The design is expensive and meets the main objectives. The Solid Works software starts with a hand skate and consists of a prototype. Design dimensions are highly important and need to be precise to improve safety.

3. Results and Discussion

The project aims to use renewable energy sources like solar electricity and to operate a cutter equipped with various accessories and to cut and gather lawn grass. The DC motor, powered by a battery, where the charge is kept via a solar panel, has a spiral shaped grass cutting blade. This is also shown in Figure 2. In a framework of metal rolls, the complete structure is supported. The solar panel is attached to the structure and charges if the system does not run, transferring charges to the battery through the circuit. During the day and night, the solar grass cutter uses both. The grass cutter backup battery is 2 h, so, at night, we simply use a cutter. The chassis is powered by the blade engine, DC engines, solar panel, and batteries. Specifications of the components used are mentioned in Table 1.

Table 1. Components list for a smart solar grass cutter.

S. No.	Items	Quantity	Remark	Specifications
1.	Solar panel	1	Power supply for battery	12 V and 18 W
2.	Blade Motor	1	Rotating of the blade	7000 to 13,000 RPM
3.	Wheel	4	Moving of the robot	8/8″
4.	Battery	1	Power supply for circuit	12 W and 7.2 AH
5.	DC Gear Motors	2	Rotating of the wheels	10,000 RPM
6.	Dual channel motor driver	1	Control the gear motors	MOSFET IRF3205's
7.	Arduino UNO	1	Microcontroller	AT mega328

3.1. Design Analysis

The Shear power on most annual grass is typically between 9.2–11.51 N on most raspberries. The strength to shred the grass is provided by the cutting blades:

$$\text{Assume } F = 11\text{ N } F = T/R$$

where

T = Shaft torque; R = Radius of cutting blade = 11 cm; $T = F \times R$

$T = 11 \times 0.11$, $T = 1.21$ Nm

$$\text{But shaft power is given by; } P = 2\pi NT/60$$

where

P = Power developed by shaft; T = Torque required and

N = Shaft speed in Rev/min = 10,000 RPM; $P = 2 \times 3.14 \times 10{,}000 \times 1.21/60$

$P = 1266.46$ W

3.1.1. Selection of Electric Motor

Motor Speed = 10,000 RPM, Motor Voltage = 12 V

Motor Watts = 1266.46 W

3.1.2. Electrical (Electric) Power Equation

Power = $I \times V$

Where $V = 12$, $I = 1.5$

$P = 1.5 \times 12 = 18$ W, H.P = 0.02414

3.1.3. Solar Panel Calculation

Solar panel volt = 18.7 V
Solar panel watt = 30 W
W = V × I
30 = 18.7 × I = 1.6
I = 1600 mA

3.1.4. Battery Calculation

BAH/CI = 7.2 ah/1600 ma
=4.5 h
To find the current
Power = 18 W, Voltage = 12 V
Current = ?
P = V × I, 18 = 12 × I
I = 18/12 = 1.5, Battery usage with 1.5 A

4. Conclusions

One of the main objectives of this project was to make a small but efficient grass cutter in comparison to those already existing, which are bulky and heavy but are still not efficient enough. The manufactured grass cutter is only 15 kg in weight, which makes it a lot easier to transport and operate. The manufactured grass cutter is shown in Figure 1.

The cutter is moved by two DC gear motors which can make its operation completely noiseless. We only used a solar powered system so it does not have any carbon emissions or fossil fuel, so it can make a complete noise and Air pollution free friendly environment.

The main frame of the grass cutter is made of steel and is covered with wood sheets. Hence, it is hundreds of times less costly than the current market. The grass cutter is based on the solar system so we cannot use any fuel for the operation. Thus, the cost is automatically effective. The grass cutter machine is controlled by Bluetooth using a mobile app, so it can operate easily. The cost of labor is very effective. It can be used easily and be operated by a normal person, so no one needs to be hired for cutting grass.

Author Contributions: Conceptualization, M.N. and M.W.J.; methodology, M.N. and A.A.; validation, M.N., A.M. (Adnan Mazhar) and A.A.; formal analysis, M.W.J.; investigation, M.N.; data curation, A.M. (Adnan Mazhar) and A.A.; writing—original draft preparation, M.N. and M.W.J.; writing—review and editing, A.M. (Asad Muneer) and M.W.J.; supervision, M.W.J. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Khodke, K.R.; Kukreja, H.; Kotekar, S.; Shende, C.J. Literature Review of Grass Cutter Machine. *Int. J. Emerg. Technol. Eng. Res.* **2018**, *6*, 97–101.
2. Schneiderman, M. Edwin Budding and His Pepperbox: A 21st Century Update. Available online: https://americansocietyofarmscollectors.org/wp-content/uploads/2019/06/2011-B104-Edwin-Budding-and-his-Pepperbox-A-21st-C.pdf (accessed on 3 February 2021).
3. Vanishree, T.S.; Darshan, G.B.; Darshan, M.S.; Lokesh, M.J. Design and Analysis of Manual Grass Cutter. Available online: https://www.ijres.org/papers/Volume-9/Issue-7/Series-8/I09074347.pdf (accessed on 3 February 2021).
4. Shukitis, A. History of Lawn Mowers. Available online: https://digitalcommons.usf.edu/honors_et/82/ (accessed on 23 December 2020).
5. Karnes, E.; Dward, W.; David Leonard, S.; Lenorovitz, D.R. Ride-on lawnmowers warnings: Slope measurements and safety-by-separation. *Work* **2012**, *41*, 3629–3632. [CrossRef] [PubMed]

6. Kinnander, O. Rise of the Lawn-Cutting Machines. 25 October 2012. Available online: https://www.bloomberg.com/news/articles/2012-10-25/rise-of-the-lawn-cutting-machines (accessed on 1 January 2021).
7. Allen, C. ASMO: Autonomous System for Mowing Operations. Available online: https://dash.harvard.edu/handle/1/37364549 (accessed on 3 February 2021).
8. Jayson, J.; Brown, A.; Maljian, J. Lawn Buddy. 2020. Available online: https://digitalcommons.calpoly.edu/eesp/481/ (accessed on 3 February 2021).
9. Hicks, R.W., II; Hall, E.L. A Survey of robot lawn mowers. Intelligent Robots and Computer Vision XIX: Algorithms, Techniques, and Active Vision. Vol. 4197. International Society for Optics and Photonics. Available online: https://www.researchgate.net/publication/235679799_A_Survey_of_Robot_Lawn_Mowers (accessed on 3 February 2021).