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Design and Fabrication of Solar Grass Cutter

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Abstract: *The objective of this project is to design and fabricate a solar-powered grass cutter to address the challenges faced in agricultural fields, houses, and nurseries when it comes to grass removal. The traditional method of manually removing grass requires a significant amount of human effort and time, which is not efficient in today's fast-paced world. The solution to this problem is to develop a grass cutter machine that is powered by solar energy. By incorporating a solar panel into the design, the grass cutter can utilize clean and renewable energy to operate efficiently. This eliminates the need for fuel or electricity, making it cost-effective and environmentally friendly. The solar grass cutter will be designed to effectively cut and remove grass from various surfaces, including agricultural fields, houses, and nurseries. It will be equipped with sharp blades and a durable cutting mechanism to ensure efficient grass cutting. The use of solar energy in this machine reduces the operational costs and minimizes environmental impact. It also provides the flexibility of using the grass cutter in remote areas or places with limited access to electricity.*

Keywords: solar-powered grass cutter.

I. INTRODUCTION

In today's world, pollution has become a significant global concern that affects all of us. Pollution, which is caused by human activities, can even be found within our own homes. For instance, the use of gas-powered lawnmowers contributes to pollution due to the emissions of gases. Moreover, the rising cost of fuel makes them inefficient. To address this issue, solar-powered lawn cutters have been introduced. These lawn mowers utilize solar energy to power an electric motor, which in turn drives a blade responsible for cutting the grass on a lawn. Solar energy is the renewable energy. Using a regular motor-powered lawn mower for grass cutting or lawn mowing can be quite bothersome, and it's not something that brings joy to anyone. It's not an easy task for elderly, younger, or disabled individuals to accomplish. Both push lawnmowers and riding lawnmowers with motor-powered engines tend to create noise pollution because of their loud engines, as well as local air pollution due to the combustion happening within the engine. Additionally, motor powered engines require regular maintenance, such as oil changes, to keep them running smoothly. Even though electric lawn mowers are environmentally friendly, they too can be an inconvenience. Electric lawn mowers are also hazardous and cannot be easily used by all. Also, if the electric lawn mower is corded, mowing could prove to be problematic and dangerous. The self-propelled electric lawn mower with remote control capability is a cutting-edge prototype that combines robotic technology with user-friendly features. Not only is it cost-efficient and safe to use, but it also offers high efficiency and environmental friendliness. By reducing the need for manual labour, it presents significant savings in terms of labour costs. While electric solar grass cutters are known for their environmental friendliness, they can sometimes be inconvenient. Additionally, motor-powered grass cutters can pose hazards and may not be easily accessible to everyone. However, this research paper aims to address those challenges by introducing an autonomous solar grass cutter. This innovative device will enable users to effortlessly maintain their lawns with minimal effort.

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Fig. 1. Hand driven Solar grass Cutter

II. WORKING COMPONENTS

The main components of the solar powered grass cutter are

(a) Solar panels
(b) Brush less DC motor
(c) Solar charger
(d) Linked Mechanism
(e) Circuit breaker
(f) Blades
(g) Batteries

The lawn mower or grass cutter consists of several components including an induction motor, a battery, an alternator, three collapsible blades, and a link mechanism. The power and charging system includes an alternator that charges the battery during operation. At the core of the machine is a D.C. motor, which generates the driving force to operate the collapsible blades. The functionality is achieved through the coordinated action of the cutting blades and the forward movement of the mower. The system is driven by an electrical switch that connects the induction motor and the battery, completing the circuit. To prevent obstacles and potential damage, an IR sensor is utilized to detect the path. Additionally, the height of cut can be adjusted using a shaft fitting mechanism. Solar grass cutters operate by utilizing a compact yet powerful engine that generates sufficient torque to rotate a sharp horizontal blade, effectively trimming the grass upon contact. The blade is housed within a deck, which ensures that the cut grass remains contained and doesn't scatter. Typically, the motor is positioned on top of the deck and is supported by four wheels for easy manoeuvrability. The solar grass cutter harnesses energy from a photovoltaic panel to power its operations. By utilizing solar energy as the primary power source, this mower aims to overcome various challenges that conventional mowers with internal combustion engines or electric motors face. With a solar-powered mower, users can enjoy a more user-friendly experience, eliminating the need for frequent trips to the gas station for refuelling and avoiding the potential hazards of gasoline spillage and that of the internal combustion engine into the atmosphere are eliminated. The solar powered lawnmower will help to reduce air pollution as well as noise pollution produced by other types of lawnmowers. In addition, it will help to reduce the running cost of using and maintaining a lawnmower.

III. WORKING PRINCIPLE

The solar grass cutter operates on the principle of utilizing solar panels arranged in a specific configuration to efficiently capture intense solar radiation from the sun. These solar panels then convert the solar energy into electrical energy. To ensure continuous power supply, a solar charger is used to store the electrical energy in batteries, allowing the mower to operate even when sunlight is not available. The primary purpose of the solar charger is to amplify the current from the solar panels during the charging process of batteries. Additionally, it has the ability to disconnect the solar panels from the batteries once they are fully charged, as well as reconnect them when the battery charge is low. The motor is connected to the batteries through connecting wires. Between these two mechanical circuit breaker switch is provided. It starts and

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stops the working of the motor. From this motor, the power transmits to the mechanism and this makes the blade to slide on the fixed blade and this makes to cut the grass.

Fig. 2. Fixation of Blade to Solar grass Cutter

The solar powered lawnmower is composed of several components, including a direct current (D.C) motor, a rechargeable battery, a solar panel, a stainless steel blade, and a control switch. The primary function of the D.C motor is to generate the necessary torque for driving the stainless steel blade, which is directly connected to the motor's shaft. The rechargeable battery is responsible for storing the solar energy captured by the solar panel, which powers the D.C motor during the mowing process. The control switch allows for the operation and control of the lawnmower. To operate the solar powered lawnmower, the circuit is closed by using the switch on the control board, enabling the flow of current to the motor. This current then drives the blade, which is responsible for the mowing action. The rechargeable battery of the lawnmower is replenished through the solar charging controller, which harnesses solar energy to charge the battery. To assess the effectiveness of the lawnmower, a performance evaluation was conducted using various types of grass. This evaluation aimed to test the machine's efficiency and capability to effectively mow different grasses.

IV. ASSEMBLING OF COMPONENTS

In the first phase it is considered about the mechanical arrangements, which is responsible for rotating the dynamo. The mechanical arrangement consisting of

- External framework
- Solar frame
- Shaft with free-wheeling bearing
- Wheels with DC motor
- Secondary spring with breaking arrangement
- Blades
- Battery
- External framework

The external frame work is having 20/15 inches .There are four pairs of cylindrical hollow pipes are welded as pillars, which will give the support for the surface of the platform. At the bottom of the platform we have attached a lever. Hence when a pressure is applied on the surface of the platform the platform compresses softly with the help of springs which is attached between the platform and the hollow cylindrical iron pipes and the suspension for the platform will be given by the spring .the spring will compress for the average weight of 55 to 70 kg. The spring's compression is tested for average weight using the spring balance.

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Fig. 3. Platform with lever arrangement.

4.1 Solar frame

The solar frame having the iron cylindrical hollow pipes are welded in square shape which is used to carry the solar panel. The solar panel is 12watts which is connected to the battery.

Fig. 4. Solar Frame

4.2 Shaft with Free wheel Bearing

The shaft is clamped between the iron frame work and the freewheeling type bearings are attached on the shaft. The free-wheel bearing rotates only in one direction which resembles the cycle. Hence the pressure applied is perfectly delivered to the shaft. In this Shaft we have connected a spring which gets straightened when the load is applied and it gets to compress when it is removed hence it pull the shaft which will give additional rotation for the pulley.

Fig. 5. Free Wheel Bearing

4.3 Wheels with DC Motor

The wheels are connected to the dc motor which is used to cut the grass very fast and smooth. Due to this wheel with dc motor it moves fast. This dc motors are arranged both the side of solar grass cutter .Each wheel is attached to a dc motor. This dc motors are with 100rpm with hydraulic gearing system. Wheel radius is 1.5 inches

Fig. 6. Wheels connected with DC motor

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4.4 Secondary Spring with Braking Arrangement

There is a secondary spring arrangement which consists of a spring and a brake system. This arrangement is used to produce additional rotation time to the generator. When the setup is compressed continuously, this spring gets wound on the shaft slowly. The reverse rotation of the shaft under the tension of the spring is prevented by the brake system and second freewheel bearing that is fitted to the shaft until the spring attains its maximum tension. By the time the spring attains its maximum tension, the break releases and the freewheel bearing rotates the shaft on the opposite side. This rotates the large pulley which in turn rotates the small pulley and the dynamo. This increases the time period of the rotations of the generator.

Fig. 7. Wheels with secondary brake

4.5 Blades

The blades are mounted according to the need. After the blade mount was finished being fabricated it is inserted on to the shaft. Then to make sure the mount was supported vertically drilled a small hole completely through the mount and shaft. This allowed to insert a bolt as an added safety measure. It is easy to cut the grass and the moving of blades will be freely. This blades rotates with the help of a dc motor which is connected with this blades. Due this dc motor the blades rotates very fast which uses to cut the grass. This dc motors are 1000 rpm with hydraulic gear motors 12 watts. There are two blades one in arranged front of the solar grass cutter and another blade is arranged at the back side of the grass cutter.

Fig. 8. Blades

V. WORKING OF SOLAR GRASS CUTTER

The working principle of solar grass cutter is it has panels mounted in a particular arrangement at an in such a way that it can receive solar radiation with high intensity easily from the sun. These solar panels convert solar energy into electrical energy. This electrical energy is stored in batteries by using a solar charger. The main function of the solar charger is to increase the current from the panels while batteries are charging, it also disconnects the solar panels from the batteries when they are fully charged and also connects to the panels when the charging in batteries is low. The motor is connected to the batteries through connecting wires .Between these two mechanical circuit breaker switch is provided. It starts and stops the working of the motor. From this motor, the power transmits to the mechanism and this makes the blade to slide on the fixed blade and this makes to cut the grass. The designed solar powered lawn mower comprises of direct current (D.C) motor, a rechargeable battery, solar panel, a stainless steel blade and control switch. Mowing is achieved by the D.C motor which provides the required torque needed to drive the stainless steel blade which is directly coupled to the shaft of the D.C motor. The solar powered lawnmower is operated by the switch on the board which closes the circuit and allows the flow of current to the motor which in turn drive the blade used for mowing. The battery recharges through the solar charging controller. Performance evaluation of the developed machine was carried out with different types of grasses.

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VI. RESULTS

Manufacturing of solar powered grass cutter is successfully completed and the results obtained are satisfactory. It will be easier for the people who are going to take the project for the further modifications. This project is more suitable for a common man as it is having much more advantages i.e, no fuel cost, no pollution and no fuel residue, less wear and tear because of less number of moving components and this can be operated by using solar energy. This will give
much more physical exercise to the people and can be easily handled. This system is having facility of charging the batteries while the solar powered grass cutter is in motion. So it is much more suitable for grass cutting also. The same thing can be operated in night time also, as there is a facility to charge these batteries in day light.

VII. CONCLUSION

The mechanism which we used ie scotch yoke mechanism does not given excepted efficiency. This efficiency can be increased by using some other mechanism and speed of motor is reduce because we have used heavy material and this material can be replaced by using light weight material .and design of blades should be done based on types of grass is used to cut. The project which we have done surly reaches the average families because the grass can be trimmed with minimum cost and with minimum time

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