Abstract:
The solar-powered grass cutter is a fully automated grass cutting machine. The main objective of this design & fabrication is to replace the conventional grass cutter that consumes more man-power. This is to construct and develop a mechanical machine to provide the best opportunities for automatic grass cutting. The working of this project depends on the non-conventional energy sources like solar power transmission. The design is simple and easy to operate since it is controlled by smartphones. This equipment is designed to minimize the human effort, to reduce the cost and to provide efficient work output as it utilizes the solar energy which powers to cut the grass.

Keywords—Automated, Conventional Grass Cutter, Non-conventional energy sources, solar power transmission and Smartphones.

1. INTRODUCTION:
Energy, the very name indicates the potent backbone behind every force, action, motion, and the list goes on without a pause. The attraction of an individual, enthusiasm of his counterparts, the livelihood of animals and dependents of creatures all stand by the energy they possess and this energy is an important phenomenon to set the ball rolling in the court of an ecosystem.

A. ENERGY RESOURCE
A water-wheel will not revolve unless there is no falling water to drive it. A railway locomotive will never move out of the station unless there is coal to burn and make steam (or) oil to burn to drive its diesel engines. Great factories full of machinery will produce nothing unless there is electricity (or) steam or some form of energy to drive the machineries.

The flamboyance of human beings will be cut down to pieces and his great dreams will be shattered if energy makes a marked absence. So, there'll be no human if there's no energy.

B. NON-CONVENTIONAL SOURCES
According to the prediction of the scientists, the conventional sources of energy at the global level, The total solar energy absorbed by Earth's atmosphere, oceans and land lots is roughly 385,000 Exa-Joules (EJ) per year. But the solar energy absorbed by the sun will last years together i.e., for many centuries. Hence, it becomes necessary to study the effective utilization of non-conventional energy and should be converted as one of the conventional sources of energy.

2. SOLAR RADIATION:
Solar energy is the non-polluting inexhaustible energy resource that can be utilized economically to supply man’s energy needs for all time. All countries in the world receive the same solar energy. This amount varies from a few hundred hours per year as in the northern countries and to four thousand hours per year in the lower part of South America. Astonishing range of radiation emitted by the sun is not only heat and light waves but also many other radiations. Each wave beam of sun-light consists of a tiny solar energy unit called “photons” and these are being fired at earth. Infrared rays that give the heat have longer wave-length and like ultraviolet rays, they are invisible to earth. In terms of energy, sunlight at earth’s surface is around 52 to 55% infrared, 42to43% visible light and 3to5% ultraviolet. This solar radiation can be converted into energy using an solar panel which converts the thermal energy produced by the sun into electrical energy which can be used for any household purpose.
3. DESIGN:

A. 2D DRAWING OF FRAME

![2D Base Frame Design](image)

Fig a. 2D Base Frame Design

B. 3D ASSEMBLY DRAWING

![Assembly Model](image)

Fig b. Assembly Model

4. MATERIAL SELECTION:

Material choice may be a step within the method of planning any object. In the context of product style, the most goal of fabric choice is to attenuate price whereas meeting product performance goals. The systematic choice of the simplest material for a given application begins with properties and prices of candidate materials.

A. PVC

PVC comes in 2 basic forms: rigid (sometimes abbreviated as RPVC) and versatile. The rigid variety of PVC is employed in construction for pipe and profile applications like doors and windows. It is also used in making bottles, non-food packaging, food-covering sheets, and cards. It is often made softer and versatile by the addition of plasticizers, which is used as phthalates. In this kind, it’s conjointly utilized in plumbing, transmission line insulation, leatherette, flooring, signage, machine records, expansive merchandise, and lots of applications wherever it replaces rubber. Pure polyvinyl chloride is a white, brittle solid. It is insoluble in alcohol however slightly soluble in tetra hydro-furan.

FLOW CHART OF DESIGN PROCESS:

1. PROBLEM STATEMENT
   - The grass cutter using human effort and consumes more electricity such that there is a need for a efficient one arises.

2. ALTERNATIVES
   - Using alternate energy sources like solar energy

3. BASIC RESEARCH
   - Studies have always shown solar as another prime form of energy that can be chosen as best among alternative sources.

4. DEVELOPMENT
   - A design is being made considering all factors in mind and properly dimensioned.

5. FABRICATION
   - A model is being constructed step by step following a methodology and finally they are assembled together.

6. RESULT ANALYSIS
   - The testing is conducted and it proves to be successful.
5. COMPONENTS USED

The following components are used in the making of solar powered grass cutter

- Solar panel
- Arduino Uno
- DC Motor Driver
- Bluetooth Transceiver
- DC Motors

A. SOLAR PANEL

Solar panel is a photovoltaic module that absorbs sunlight as a source of energy to generate electricity as shown. The Photo Voltaic (PV) module used here is a packaged, connected assembly of typically 6x10 photovoltaic solar cells made up of Monocrystalline Silicon Photovoltaic modules that constitute the photovoltaic array that generates and provides electricity in business and residential applications.

B. ARDUINO UNO

Arduino board uses a diffusion of controllers and microprocessors. The boards are equipped with sets of digital and analog input & output pins which may be interfaced with various breadboards as shown in fig d. The Arduino Uno gives continuous communications and interfaces as Universal Serial Bus (USB) on some models, that square measure used for loading programs from personal computers. The program is an open-source program that is being used for controlling the movements of the system.

C. DC MOTOR DRIVER

The Motor Controller that uses Direct Current (DC) is used to govern all motors connected to the wheels to be operated simultaneously as shown in fig e. Its main function is to run or stop all motors at the same time. It is being connected such that the polarity of individual motors does not get reversed and all runs in the same direction during forward motion and also while during turning.

D. BLUETOOTH TRANSCEIVER

The image is shown in fig f. The Radio Frequency (RF) waves emitted from the transceiver as shown. It is sensed and detected through mobile phones and that uses application software to control its movements. Initially, the Arduino is connected to the transceiver that emits RF waves when it is provided power supply from the battery that can control its movements.
E. DC MOTORS

The motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. In propulsion of electric vehicles, larger DC motors are currently used. The Helical Geared DC motor is shown in the fig, which runs at 1000 rpm is being chosen to power 4 wheels on the corners of the frame setup. Based on solving the following calculations the motor is being chosen. It works when the input voltage is about 12V with producing the required torque of about 0.2N-m for one wheel. The net torque produced by the four motors is about 0.8 N-m.

6. ASSEMBLY PROCESS:

The DC motor is fitted to the wheel that is clamped with the frame on the four corners. The solar panel is used to charge the battery that supplies the motor. The motors are interlinked with each other through a motor driver. The Arduino is linked with the motor driver through jump pins (or) connecting pins. The Bluetooth transceiver module is connected to the Arduino with the help of these pins. The power supply is given to Arduino and motor drivers. These electrical circuits are wired and placed inside a box to prevent damage and fitted to the side of the frame. The overall assembly setup is shown in fig g.

TORQUE CALCULATION FOR WHEEL MOTOR

Rating of the Battery: 12Volt, 5A

Power produced: 12X5=60W

Speed of the motor: 1000rpm

Torque of motor:

\[ P = \frac{2\pi NT}{60} \]

\[ 60 = \frac{(2\pi) \times 1000 \times T}{60} \]

For 4 wheels, \( T = 0.1433\text{Nm} \)

Hence the efficient torque is produced than the rated torque of the motor.

TORQUE CALCULATION FOR CUTTER BLADES

Rating of the battery: 12V, 5A

Power of the battery: 60W

Speed of the Motor: 500rpm

Torque produced:

\[ P = \frac{2\pi NT}{60} \]

\[ 60 = \frac{(2\pi) \times 500 \times T}{60} \]

For 4 blades, \( T = 0.285 \text{Nm} \)

Hence the efficient torque is produced than the rated torque of the motor.

FORCE PRODUCED IN CUTTER BLADES:

As we all know that,

\[
\text{Torque} = \text{Force} \times \text{Radius}
\]

\[ 0.285 = \text{Force} \times 0.01 \]

\[ \text{Force} = \frac{0.285}{0.01} = 28.5\text{N} \]

Hence a force of 28.5N is produced in the cutter blade which is sufficient enough to cut the grass.
7. WORKING:

The system uses 9V batteries to power. We use a solar panel to charge the battery that is fitted at a suitable angle of inclination. The motor driver is used to integrate all the motors connected to wheels. Its movement is completely coordinated with the help of the motor driver. The motors are interfaced to an Arduino Uno as shown in the fig d. that controls the directional movement of all the motors. The Arduino Uno is preprogrammed that transmits signals through the Bluetooth transceiver such that it can be easily detected in mobile phones. The Connecting pins are used to link the Arduino and motor controller with the Bluetooth transceiver so that the data gets transferred to the configured device.

The Bluetooth transceiver transmits the incoming RF waves to the configured device so that the setup is moved and simultaneously grass is cut down. These are all connected with connecting pins or jump pins that are used to carry information from one component to another. With the help of application software that is present on the phone, one can able to control its operations from a specific range. Since 9V batteries are used here it considerably reduces the load-carrying capacity thus thereby producing more power to run the motors.

8. CONCLUSION

The Design and Fabrication of the solar-powered grass cutter has enabled us to study how the energy is being utilized from the sun which powers the motor carrying cutter blades as well as motor carrying wheels. The frame design was made using AutoCAD and it provided as base to fabricate and assemble other components and 3D assembly model design is done using Creo 2.0 considering the following criteria.

This can be controlled through an application in the smartphone which can configure itself with the Arduino board. The Bluetooth transceiver transmits the incoming RF waves to the configured device so that the setup is moved and simultaneously grass is cut down. The DC Motor controller is used which integrates the motors situated on the four corners of the wheel and makes it work together while running the setup. The main aim was to control within a specific range. Hence we assure you that this equipment can be used to cut grasses on plain fields such as cricket and football grounds.

VOLTAGE GENERATED BY SOLAR PANELS:

Solar Panel produces different values of voltage according to the exposure of sunlight onto the panel throughout the morning/afternoon hours.

The following values were noted on different time-periods such as:

Morning (09:30am) – 12.3V
Morning (11:00am) – 12.9V
Afternoon (1:00pm) – 14.4V
Afternoon (4:30pm) - 13.2V

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REFERENCES


