International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

FABRICATION OF SOLAR GRASS CUTTER CUM FLOOR CLEANER

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Abstract
The solar grass cutter and floor cleaner is a mechanical device used for cutting grass and cleaning the floor with the help of solar energy instead of electrical energy. First of all its body made with help of UPVC (Unplasticized Polyvinyl Chloride) pipes, then tri-cycle wheel is placed below the body of bar. Then inclined fibre plate is kept on a body, then on inclined fibre plate solar panel is kept. Which collects solar energy & then solar energy is converted into electrical energy & electrical energy is converted into mechanical energy. This electrical energy is transmitted to electric motor. On the shaft of the electric motor a blade is connected having cutting edge which cuts the grass. (OR) On the shaft of electric motor a polishing pad is connected to clean the floor.

Introduction

In the time where technology is merging with environmental awareness, consumers are looking for ways to contribute to the relief of their own carbon footprints. Pollution is manmade and can be seen in our own daily lives, more specifically in our own homes. Gas powered lawn mower are in 90% of U.S. home and they create 5% of the total U.S. pollution. And also for electrically powered mowers it consumes large amount of energy for the working. Green technology initiatives are being support by both the government and cooperates business. Our new design for an old and outdated habit will help both the consumer and the environment. This grass cutting cum floor cleaner device is solar powered which gets charged its battery while moves on the lawn or floor from sunlight and also we can charge it manually from main supply.

Grass cutter machines have become very popular today. Most common machines are used for soft grass furnishing. In our project Grass cutter machine we are aimed to develop for operation and construction. The main parts of the Grass cutting cum floor cleaner are DC motor of .75HP capacity, relay switch for controlling motor, Battery for charging it through solar panel. It is placed in a suitable machine structure. The motor have 6000 rpm and it is connected to the electric supply by the use of a roll

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of wire. Motor controlled by an electric switch for easy operation. The tempered blades or buffing pad are attached in this machine. The raw materials mainly used are motor, switch, wheel, wire, solar panel, battery, CPVC pipe, paint, and other standard item like nuts, bolts and reverts. The machines required for manufacturing includes portable drilling machine and grinding machine.

Working principle of the grass cutter cum floor cleaner is providing a proper speed of rotation to the blade, which helps to cut the grass or cleaning the floor. The blade will get kinetic energy while increasing the rpm. The cutting edges are very smooth and accurate. Also Electric Grass Cutting Machines are much easier to be used in garden, lawn and grass fields. In order to enhance the beauty of home-lawns and gardens, Grass cutting machines are the best available option in the industry. With the help of a lawn mower which is a machine with revolving blades to help us cutting lawns at even length, people can easily maintain and beautify their lawns and gardens without any hassle. The buffing pad will get rotating motion from blades at suitable rpm. Also electric floor cleaning machines are much easier to be used for cleaning compared to a person cleaning the floor with mop.

Now-a-days, there are plenty of options starting from the simplest push along machines to the most advanced machines. According to world energy report, we get around 80% of our energy from conventional fossil fuels like oil (36%), natural gas(21%) and coal (23%). It is well known that the time is not so far when all these sources will be completely exhausted. So, alternative sources should be used to avoid energy crisis in the nearby future.

So introduce solar energy for the machine process to work. A solar panel is a large flat rectangle, typically somewhere between the size of a radiator and the size of a door, made up of many individual solar energy collectors called solar cells covered with a protective sheet of glass. The cells, each of which is about the size of an adult's palm, are usually octagonal and coloured bluish black. Just like the cells in a battery, the cells in a solar panel are designed to generate electricity; but where a battery's cells make electricity from chemicals, a solar panel's cells generate power by capturing sunlight instead.

1.2 What Is Grass Cutting Machine?

A grass cutting machine is a type of machine that uses one or more than one blades for cutting a grass surface to a uniform height. The height of the cut grass is fixed by the design of this machine but mostly it can be adjusted by the operator either by a single master lever or by a lever or nut including the bolt-on every machine wheels.

The first grass cutter was invented by Edwin Budding in 1830 in Thrupp, just outside Stroud, in Gloucestershire, England. Budding's mower was designed primarily to cut the grass on sports grounds and extensive

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gardens, as a superior alternative to the scythe, and granted a British patent on August 31,1830.

Figure 1.1: Grass Cutting Machine

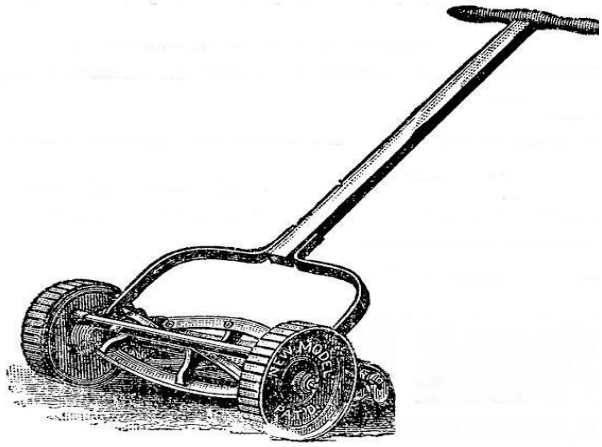

Figure 1.2: First Lawn Mower

1.3 What Is Floor Cleaning Machine?

A floor scrubber is a floor cleaning device. It can be a simple tool such as a floor mop or floor brush, or in the form of a walk-behind or a ride-on machine to clean larger areas by injecting water with cleaning solution, scrubbing, and lifting the residue off the floor. With advancements in robotics, autonomous floor-scrubbing robots are available as well.

When floor scrubbing machines became more available to many types of facilities, there was a need to cover a different type of flooring. Floor buffers or rotary floor machines were invented to scrub and polish the floor with linoleum surface. The machines use rotary brushes with soft material to clean and make the floor shine. For marble and wood floors, floor polishers may be used to apply protective coating to floor.

Figure 1.3: Floor Cleaning Machine

1.4 Solar Energy

Solar energy is very large, inexhaustible source of energy. The power from the sun interrupted by earth is approximately 1.8/10MW, which are many thousands of times larger than the present consumption rate on the earth of all energy sources. The quantum of energy India's land area receive from sun is equivalent to15,000 time sits consumption requirement (500 billion kWh) as projected for 2004. In addition to its size, solar energy has two other factors in its

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favour. Firstly, unlike fossil fuels and nuclear power, it is an environmentally clean source of energy. Secondly, it is free and available in adequate quantities in almost all parts of the world people live. But there are some problems associated with its. The real challenge in utilizing solar energy is of and economic concern. One has to strive for the development of cheaper methods of collection and storage so that large initial investments required at present in most applications are reduced, solar energy in India.

A large amount of solar radiation fall on India and for most of the country very few days are without sunshine. India lies within the latitude of 7 N to and 37 N with annual average intensity of solar radiation as 500 to 600cal/cm/day with more such insulations available in arid and semi-arid regions. Average solar radiation falling on India in arid and semiarid regions is 7.5 Kwh/m/day. Solar energy 5× 10 K w h/year potential to meet basic energy needs of teeming millions who live in rural India. Solar energy is an important, clean, cheap and abundantly available renewable energy. The sun radiates heat and light. The heat, light received from the sun supports the environment on the earth through the following well known natural effects.

- Temperature balance on the earth
- Photo-synthesis by biological plants production of oxygen and organic materials, production of organic chemicals and bio-mass
- Wind due to unequal heating of water, land surfaces
- Heating of ocean water: ocean thermal energy(OTEC)
- Waves in ocean: ocean wave energy
- Tides in ocean: ocean tidal energy (due to gravitational forces)

The sun produces enormous amount of energy of heat and light through sustained nuclear fusion reactions. The solar energy received on the earth in the form of radiation is used for heating and producing an electrical energy.

Among the non-conventional sources of energy solar energy is the most promising. Hence our project is based on the solar energy conversion to mechanical energy to run a normal grass cutter blade or floor cleaning mop.

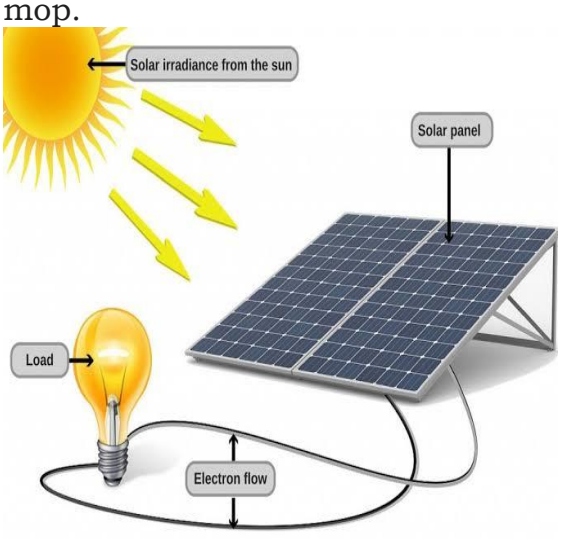

Figure 1.4 Solar Energy System

1.5 What is Solar Grass Cutter?

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A Solar grass cutter is a machine that uses rotating blades to cut a lawn at even length. Even more sophisticated devices are there in every field. Power consumption becomes essential for the future. The solar grass cutter consists of the photovoltaic cell for the efficient power from solar panel. The DC to DC buck boost converter helps to setup the DC voltage from the photovoltaic panel and store the DC voltage in a battery. It is an automated system for the purpose of grass cutting.

1.6 What is Solar Floor Cleaner?

A Solar floor cleaner is a machine that uses rotating mop to clean the floor. Even more sophisticated devices are there in every field. Power consumption becomes essential for the future. The solar floor cleaner consists of the photovoltaic cell for the efficient power from solar panel. The DC to DC buck boost converter helps to setup the DC voltage from the photovoltaic panel and store the DC voltage in a battery. It is an automated system for the purpose of floor cleaning.

1.7 Advantages of Solar grass cutter cum floor cleaner

- Easy to move from one place to another place
- Operating principle is simple
- Compact size and portable
- Long life
- Low maintenance
- Non-skilled person can also operate this machine
- High efficiency
- No environmental pollution
- As there are no reciprocating parts present, wear and tear will be less
- As the battery is used for backup it can be used in the absence of sunlight also.

1.8 Objectives of project

- To design a grass cutter cum floor cleaner operating on solar energy
- To reduce operating cost
- To avoid any damage to operator and the machine itself
- To keep the environment clean and healthy
- To reduce human effort
- To be able to perform both grass cutting and floor cleaning operations.

The current technology available in the market are too expensive, they can't be used in domestic applications, so the end product need to be economic in price for it to be used on a large scale.

Methodology

Procedure

- Select the material for structure of machine
- Fabricate the structure of machine
- Calculate the required power of motor for desired operation
- Select the required solar panel with suitable power output
- Determine the capacity of battery

For the fabrication of a solar powered grass cutter cum floor cleaner we referred to various literature and papers. Different ideas were gathered and evaluated before designing and fabricating the grass cutter. Several rural areas were visited to

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find out the challenges in terms of access to electricity and gasoline. Based on these challenges, the idea of designing solar powered grass cutter cum floor cleaner came about to address this problem. The electricity is produced when sun light falls on the solar cells causing the electrons move around them. The action of electrons starts an electric current. The convection of sun light into electricity takes place instantly. There are no mechanical parts to wear out. The rays coming from sun are made to fall on the solar panel. The solar panel is kept at an angle perpendicular to sun rays such that maximum rays are falls on the panel, energy receiving from sun used to produce electricity and stored in a battery. Electrical energy of the battery is converted to mechanical energy through a set of blades designed to achieve cutting operation. The electric circuit ensures power transfer from the battery to run the D.C. motor, while the solar panel power to continuously recharge the battery while in operation. The cutting blades or polishing pad gets power from the D.C motor. When the power switch is on, the electrical energy from the battery powers the motor which in turn actuates the blades or polishing pad . The solar panel generates current to recharge the battery, thereby compensating for the battery discharge. The rotating blades continuously cut the grass as the mower is propelled forward and the cut grass or the polishing pads continuously cleans the floor as the mower is propelled forward.

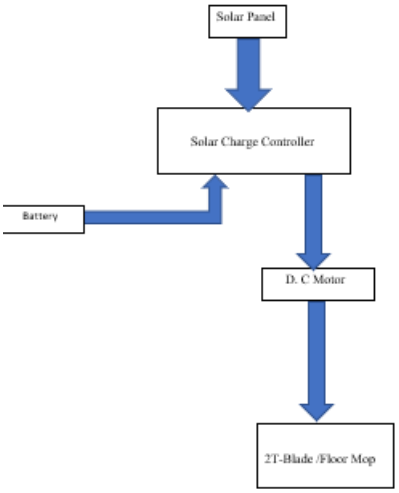

Figure 3.1 Block Diagram of Solar Grass Cutter cum Floor Cleaner

COMPONENTS DESCRIPTION

The main components used for the Solar grass cutter cum floor cleaner are

1. Solar Panel
2. Battery
3. D. C Motor
4. Solar Charge Controller
5. Blades
6. Floor Mop
7. UPVC Pipes with Tees and Elbows
8. D. C motor speed regulator

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4.1 Solar Panel

4.1.1 Photovoltaic Principles

The photo- voltaic effect can be observed in nature in a variety of materials that have shown that the best performance in sunlight is the semiconductors as stated above. When photons from the sun are absorbed in a semiconductor, that create free electrons with higher energies than the created there must be an electric field to induce these higher energy electrons to flow out the of semi-conductor to do useful work. A junction of materials, which have different electrical properties, provides the electric field in most solar cells for the photon interaction in a semiconductor. A solar cell consists of

1. Semi-Conductor in which electron hole pairs are created by the absorption of incident solar radiation
2. Region containing a drift field for charge separation
3. Charge controlling front and back electrodes.

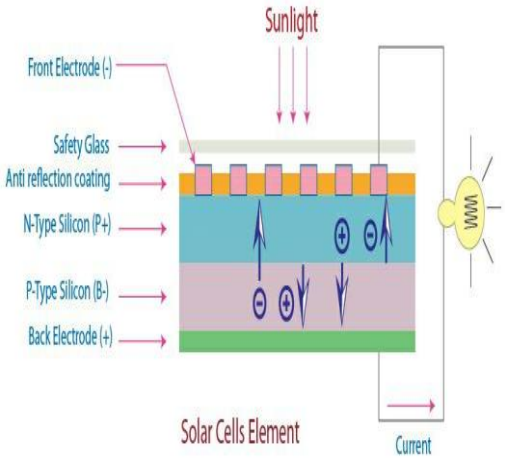

Figure 4.1 Photovoltaic Principle

4.1.2 Photovoltaic Effect

The photo-voltaic effect can be described easily for p-n junction in a semi-conductor. In an intrinsic semi-conductor such as silicon, each one of the four valence electrons of the material atom is tied in a chemical bond, and there are no free electrons at absolute zero. If a piece of such a material is doped on one side by a five valance electron material, such as arsenic or phosphorus, there will be an excess of electrons in that side, becoming an n-type semi-conductor.

The excess electrons will be practically free to move in the semi-conductor lattice. When a

three valance electron material, such as boron dopes the other side of the same piece, there will be deficiency of electrons leading to a p-type semi-conductor. This deficiency is expressed in terms of excess of holes free to move in the lattice. Such a piece of semi-conductor with one side of the p-type and the other, of the n-type is called p-n junction. In this junction after the protons are absorbed, the free electrons of the n-side will tends to flow to the p-side, and the holes of the p-side will tend to flow to the n-region to compensate for their respective deficiencies. This diffusion will create an electric field from the n-region to the p-region. This field will increase until it reaches equilibrium for voltage, the sum of the diffusion potentials for holes and electrons. If electrical contacts the connected through an external electrical conductor, the free electrons will flow from the n-type material through the conductor to the p-type material as shown in the figure. Here the free electron swill enter the holes and become bound electrons thus both free electrons and holes will be removed. The flow of electrons through the external conductor constitutes an electric current, which will continue as long as move free electrons and holes are being formed by the solar radiation. This is the basis of photo-voltaic conversion that is the conversion of solar energy into electrical energy. The combination of n-type and p-type semiconductors thus constitutes a photo-voltaic cell or solar cell. All such cells some rate direct current that can be converted into alternating current it desired. The photo-voltaic effect can be observed in almost any junction of material that have different electrical characteristics, but the best performance to date has been from cells using semiconductor material especially all of the solar cells used for both space and terrestrial applications have been made of the semiconductor silicon. Future cells may use such materials as the semiconductors like Gallium arsenate, copper

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sulphated sulphide etc. The device used to utilize the photovoltaic effect is solar cell.

4.1.3 Specification

Array size : 66.5 cm ×43 cm

Maximum power : 50 Watts

Maximum voltage : 20 volts

Maximum current : 2.52 amp

Short circuit current : 2.65 amp

Open circuit voltage : 22.5 volts

Maximum system voltage: 600 volts

Type : Mono-crystalline

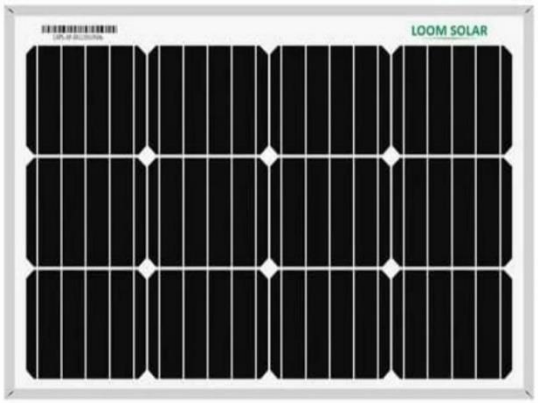

Figure 4.2 Solar Panel

4.2 Battery

The batteries are used as a storage device for solar energy which can be further converted into electrical energy. The only exceptions are isolated sunshine load such as irrigation pumps or drinking water supplies for storage, for small units with output less than one kilowatt. Batteries seem to be the only technically and economically available storage means. Since both the photo- voltaic system and batteries are high in capital costs, it is necessary that the overall

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system be optimized with respect to available energy and local demand pattern. To be economically attractive the storage of solar electricity requires a battery with following particular combination of properties:

- Low cost
- Long life
- High reliability
- High overall efficiency

4.2.1 Specification

Voltage : 12 volts

Power : 4 Ah

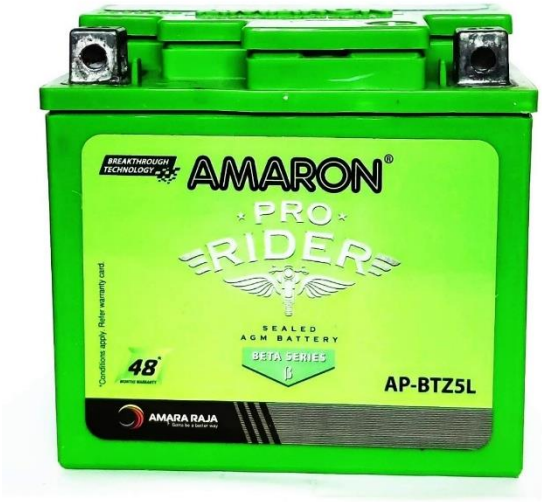

Figure 4.3 Battery

4.3 D. C Motor

In the presented idea for grass cutter model we used DC motor interfaced with blades for cutting grass when operated. A dc motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors. The input of a DC motor is current/voltage and its output is torque (speed).

DC motor has many novel linear and rotary motors and at least one self-powering magnetic rotary device in motor uses a bidirectional “two particle” theory of magnetic flux showing the internal bidirectional energy flows in all potentials and fields. The motor utilizes controlled spin-waves and self-initiated precise ex-change forces, which are known to momentarily produce bursts of very strong force fields. In short the motor used to produce precisely located and directed sudden magnetic forces, using self-

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initiated non-linear magnetic phenomena.

4.3.1 Specification

Model : 775 D. C motor

Voltage : 12 volts -24 volts

RPM : 3500 to 9000

Figure 4.4 D. C Motor

4.4 Solar Charge Controller

The power charge regulator is also known as charge controller, voltage regulator, charge-discharge controller or charge-discharge and load controller. The regulator sits between the array of panels, the batteries, and the equipment or loads.

By monitoring the voltage of battery, the regulator prevents overcharging or over discharging. Regulators used in solar applications should be connected in series: they disconnect the array of panels from the battery to avoid overcharging, and they disconnect the battery from the load to avoid over discharging. The connection and disconnection is done by means of switches which can be of two types: electromechanical (relays) or solid-state (bipolar transistor).

Solar chargers should never be connected in parallel. In order to protect the battery from gasification, the switch opens the charging circuit when the voltage in the battery reaches its high voltage disconnects (HVD) or cut-off set point. The low voltage disconnects (LVD)prevents the battery from over discharging by

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disconnecting the load. The most modern regulators are also able to automatically disconnect the panels during the night to avoid discharging of the battery. They can also periodically overcharge the battery to improve their life, and they may use a mechanism known as pulse width modulation (PWM). Solar charger has three light indicators. The first light blinks when the batteries are charging by using solar energy. The second light glows when the charging in the batteries is very low. The third light glows when the batteries are fully charged and an extra load (charging) is applied on the batteries.

4.4.1 Specification

Model : PWM (Pulse Width Modulation)

Capacity : 10 Amp

Figure 4.5 Solar Charge Controller

4.5 Blades

A stainless steel 2T blade is used a cutting tool to perform grass cutting. As the blade is connected to motor shaft which rotates at rated rpm, with the help of cutting edges provided the grass cutting will be done.

4.5.1 Specification

Material : Stainless steel

Length : 30 cm

Type : 2T

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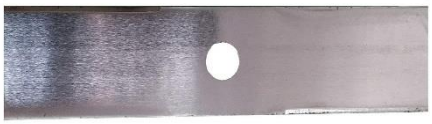

Figure 4.6 Cutting Blade

4.6 Floor Mop

Floor mop is circular shaped disc type brush covered with wool or sponge material for floor cleaning.

Figure 4.7 Floor Mop

4.7 UPVC pipes with tees and elbows

By using the UPVC (Unplasticized Polyvinyl Chloride)pipes of certain dimensions with suitable tees and elbows the structure of the machine is fabricated.

Figure 4.8 UPVC Pipes

4.8 D. C Motor Speed Regulator

D. C motor speed regulator is a electronic device used to control of speed of motor.

Figure 4.9 D. C Motor Speed Regulator

Working

5.1 Working Principle

The working principle of solar grass cutter cum floor cleaner is “It has panels mounted

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in a particular arrangement in such a way that it can receive solar energy with high intensity easily from the sun". These solar panels convert solar energy into electrical energy. This electrical energy is transmitted to electric motor then motor converts electrical energy into mechanical motion (desired work).

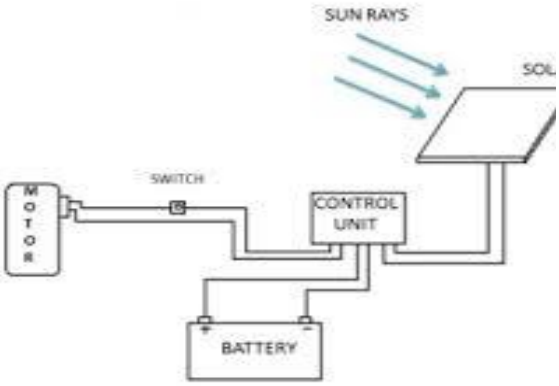

Figure 5.1 Working Principle of Solar Grass Cutter Cum Floor Cleaner

5.2 Working

Coming to the working of solar powered grass cutter cum floor cleaner, it has panels mounted in a particular arrangement at an angle of 45 degrees 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 as studied earlier. Now 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 blade cut the grass or to the floor mop to clean the floor.

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The solar grass cutter cum floor cleaner 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 or drives the floor mop for cleaning. The battery recharges through the solar charging controller.

Calculations

6.1 Solar Panel Tilt Angle

Solar panel tilt angle
= Latitude × 0.87

(If latitude is less than 25°)

Solar panel tilt angle
= (Latitude ×0.87) +3.1°

(If latitude is more than 25°)

Latitude of surampalem
= 17.3188° N

Therefore,

Solar panel tilt angle
= Latitude ×0.87

= 17.3188 ×0.87

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Solar panel tilt angle = 15°

6.2 Output of Solar Panel

Solar panel wattage (W) =50 watts

Average hours of sunlight(T) = 7.8 hours

All variables we are going over = 0.75

Daily watt-hours = W×T×0.75

=50 ×7.8×0.75

=292.5 watt-hours

6.3 Time Required for Battery Charging

Constants:

For PWM charge controller, Efficiency =0.75

For lead batteries, Battery efficiency =0.85

Battery voltage =12 volts

Battery amp-hours =4 Ah

1. Divide solar panel wattage by battery voltage to estimate maximum charge current output by solar charge controller:

50/12 = 4.1667 amp

2. Multiply current by rule-of-thumb system losses (20%) and charge controller efficiency (PWM: 75%; MPPT: 95%):

4.1667 × (1-0.15) ×0.75 = 2.656 amp

3. Multiply battery capacity by 1 divided by rule-of-thumb battery charge efficiency (lead acid: 85%; lithium: 95%):

4 × (1/0.85) =5.882 Ah

4. Divide battery capacity by current to estimate how long it'd take to charge the entire battery:

5.882/2.656 = 2.2 hrs

S. No.	Components	Price (Rs)
1.	UPVC pipes with Tees and Elbows	2500 /-
2.	Solar Panel	3050 /-
3.	Battery	1100 /-
4.	D. C Motor	450 /-
5.	Solar Charge Controller	450 /-
6.	Stainless Steel Blade	50 /-
7.	Floor Mop	700 /-
8.	D. C Motor Speed Regulator	250 /-
9.	Wire	100 /-
10.	Switch	30 /-
	Total cost	8680 /-

Table 2. Final Costing of components

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Conclusion

Our project entitled Fabrication of solar powered grass cutter cum floor cleaner 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.

In the presented paper provides the fabricated information about the "Fabrication of Solar grass Cutter" Which was designed such that the solar plate generates solar energy and utilizing this energy for running the grass cutter motor. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Thus, the project has been successfully designed and tested.

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