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Design and Fabrication of Automated Grass Cutting Machine by Using Solar Energy

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Abstract:
Rapid growth of various high-tech tools and equipments makes our jobs done comfortable and sophisticated. The project aims at fabricating a grass cutting machine system which makes the grass cutter based motor running through solar energy. Power plays a great role wherever man lives and works. The living standard and prosperity of a nation vary directly with the increase in the use of power. The electricity requirement of the world is increasing at an alarming rate due to industrial growth, increased and extensive use of electrical gadgets. The best alternative source is solar energy.

Key Words:
Solar Panel, Relay, DC motor, Blades, Comparator, Temperature sensor, Battery.

I. INTRODUCTION:

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 machines 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 18000 rpm and it is connected to the electric supply by the use of a roll of wire. The motor rpm increased by the help of gears. Motor controlled by an electric switch for easy operation. The tempered blades are attached in this machine.

The raw materials mainly used are GI sheet, motor, switch, wheel, wire, aluminium sheet, square pipe, paint, insulating material and other standard item like nuts, bolts and reverts. The machines required for manufacturing includes welding machine, grinding machine etc. Working principle of the grass cutter is providing a high speed rotation to the blade, which helps to cut the grass. 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. Now-a-days, there are plenty of options starting from the simplest push along mower to the most advanced electric grass cutting machine. 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.

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The cells, each of which is about the size of an adult's palm, are usually octagonal and colored 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. They are sometimes called photovoltaic cells because they use sunlight ("photo" comes from the Greek word for light) to make electricity (the word "voltaic" is a reference to electricity pioneer Alessandro Volta). As small engines became more powerful, a new type of lawn mower that could cut larger and longer swaths of grass became more popular. Instead of cutting grass like scissors cut paper as a reel mower does, the rotary mower spins a horizontal blade around fast enough to cut the grass as it hits it. The blade sits within a casing called a deck, which keeps the grass and other objects from flying in all directions when struck. Typically, the deck rides on four wheels, with a motor sitting on top of it and a bag attached to it to collect the cut grass. The basic version of a rotary mower has a handlebar attached to it that the operator stands behind and pushes to make it move forward. Self-propelled versions have a transmission that turns the wheels using the power of the motor.

Figure- 1.Image of Solar panel

II. RELATED WORK:

Intelligent information appliance is the main direction of development in the appliance control at irrigation fields. We designed a broad and commendable range of Super Mini Electric Grass Cutter along with solar panel. As the energy conversation is very important in the current scenario and should be done to a maximum extent where ever it is possible.

Still, these mowers grass cutting machineries all need the same things to work right -- a motor, a rotating blade, a means of getting around and a way to get rid of the grass clippings.

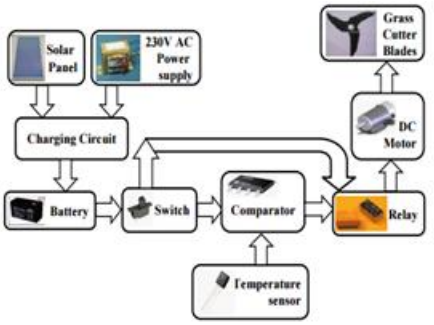

Figure- 2.Image of Block Diagram of Proposed model

The controlling device of the whole system is provided using LM358 Comparator which takes the input from the user through switch and switches ON the DC motor interfaced with grass cutting blades. The entire model consists of two sections one controlling section and another designing section of the model. The controlling section consists of Rechargeable battery, LM358 comparator, Relays switches, temperature sensor, and Solar panel. The system depending on the charging circuit the motor can be controlled using relay switch. The solar power stores the energy to a battery and then runs the motor through the relay switch. The system also includes comparator circuit for checking the temperature of the motor and when it goes beyond the limit the motor gets switched off automatically using relay switch.

Advantages:

•They have no moving parts and hence require little maintenance and work quite satisfactorily without any focusing device.

•It does not cause any environmental pollution like the fossil fuels and nuclear power.

•Solar cells last a longer time and have low running costs.

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•Low power consumption. •Conservation of energy.

•Utilization of free available source of energy from sun

•Storage of energy into rechargeable battery.

•Stored energy is used for grass cutter.

•Motor automation.

•High efficiency can be achieved with relay switch.

•By using this project we can save more power. That is we can reduce the wastage of power.

•Here no need of man. The circuit itself checks the presence of vehicle and also checks weather it is day or night time. Once we switch on the circuit it automatically performs all this actions without manual operation.

•At night time also whenever vehicle comes at that time only light brightness increases after few seconds it will come to normal position that is decreases light brightness.

•It is the most advantage of this project. For these all reasons in future this project may be used in all streets to save power.

WORKIND MODEL OF AUTOMATED GRASS CUTTING AFTER ASSEMBLING ALL THE COMPONENTS

III. PROPOSED METHODLOGY:

The portable Electric Grass cutter machine with solar power is used To fulfil the objectives of the proposed idea we need to understand the basic elements of few electronics like LM358 comparator, relay, solar panel, charging circuit, rechargeable battery, temperature sensor, geared DC motor, cutting blades etc.

a. LM358 comparator:

In the proposed fabricated model we use comparator for controlling the relay switch of the motor when the user switches the supply unit. Also it compares the temperature of the motor and when it exceeds beyond the threshold limit it switches off the motor and protects from over heat in its continuous usage. The LM358 comparator is a great, easy-to-use dual-channel opamp. Opamps have many applications include transducer amplifiers, DC gain blocks and all the conventional opamp circuits. It can handle a supply of 3-32VDC and source up to 20mA per channel. This opamp is great to operate two individual opamps from a single power supply. Comes in an 8-pin DIP package.

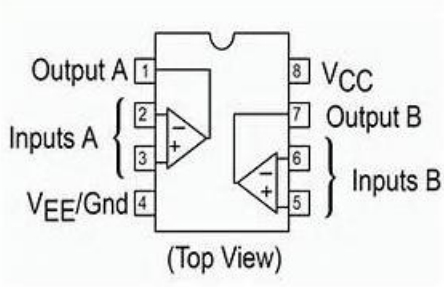

Fig.3 Image of LM358 comparator

b. Rechargeable Battery:

Solar power can be stored in the rechargeable battery and can be further used for the grass cutting machine to run. A rechargeable battery, storage battery, or accumulator is a type of electrical battery. It comprises of one or more electrochemical cells, and is a type of energy accumulator. It is known as a secondary cell because its electrochemical reactions are electrically reversible.

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Rechargeable batteries come in many different shapes and sizes, ranging from button cells to megawatt systems connected to stabilize an electrical distribution network. Several different combinations of chemicals are commonly used, including: lead–acid, nickel cadmium (NiCd), nickel metal hydride (NiMH), lithium ion (Li-ion), and lithium ion polymer (Li-ion polymer).

Fig 4. Rechargeable battery

c. Relay:

A relay is an electrically operated switch. We use it in the grass cutting machine model for controlling the motor connected to blades as a switch. Many relays use an electromagnet to operate a switching mechanism, but other operating principles are also used. Relays find applications where it is necessary to control a circuit by a low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another. Relays found extensive use in telephone exchanges and early computers to perform logical operations. A type of relay that can handle the high power required to directly drive an electric motor is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device triggered by light to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called “protection relays”.

d. Temperature Sensor:

The device solar grass cutting machine uses temperature sensor for providing the safe guard for the motor. Due to continuous usage of the model the motor may gets heated and damage so the sensor senses the temperature of the motor continuously and when it crosses beyond the threshold limit it sends the signal to the comparator and controls the motor. The LM35 sensor series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. To detect the heat produced during fire occurrence we use temperature sensor. The Temperature Sensor LM35 sensor series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.

Fig.5. Temperature Sensor

e. DC motor:

In the presented idea for grass cutter model we used Johnson 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). Johson motor has many novel linear and rotary motors and at least one self-powering magnetic rotary device Johnson 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 exchange forces, which are known to momentarily produce bursts of very strong force fields.

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In short, the motor used to produce precisely located and directed sudden magnetic forces, using self-initiated nonlinear magnetic phenomena.

IV. CALCULATION

Square DC motor specification:
Speed N = 30 RPM
Voltage V = 12 Volt
Current I = 0.3 A (loading condition)
Current I = 0.06 A (No Load Condition)
Power P =V x I=12x0.3 = 3.6 WATT
P= 0.0048 HP

Motor Efficiency = 36% Electrical power of the motor is defined by the following formula:
Pin = I * V

Where, Pin – input power, measured in watts (W)
I – current, measured in amperes (A)
V – applied voltage, measured in volts (V)
Motors supposed to do some work and two important values define how powerful the motor is. It is motor speed and torque – the turning force of the motor. Output mechanical power of the motor could be calculated by using the following formula
Pout = T * ω

Where, Pout – output power, measured in watts (W)
τ – Torque, measured in Newton meters (Nm)
ω – Angular speed, measured in radians per second (rad/s).
Calculate angular speed if you know rotational speed of the motor in rpm:
ω = N * 2π / 60

Where, ω – Angular speed, measured in radians per second (rad/s);
Rpm – rotational speed in revolutions per minute
; π – Mathematical constant pi (3.14). 60 – Number of seconds in a minute.
Efficiency of the motor is calculated as mechanical output power divided by electrical input power
E = Pout / Pin

Therefore Pout = Pin * E
After substitution we get
T * ω = I * V * E T * N * 2π / 60 = I * V * E

Connect the motor to the load. Using the motor from generator kit is the best way to do it. Why do you need to connect the motor to the load? Well, if there is no load – there is no torque. Measure current, voltage and rpm. Now you can calculate the torque for this load at this speed assuming that you know efficiency of the motor. Motor torque changes with the speed. At no load you have maximum speed and zero torque. Load adds mechanical resistance. The motor starts to consume more current to overcome this resistance and the speed decreases. If you increase the load at some point motor stops (this is called stall). When it occurs the torque is at maximum and it is called stall torque. While it is hard to measure stall torque without special tools you can find this value by plotting speed-torque graph. You need to take at least two measurements with different loads to find the stall torque.

TORQUE OF THE MOTOR:

And the formula for calculating torque will be
T = (I * V * E *60) / (N * 2π) = (0.3x12x0.36x60)/30x2π
Torque = 0.412 Nm
Torque (T) = 4.2kgcm .

V. GRASS CUTTER BLADE ANALYSIS IN ANSYS:

A static structural analysis determines the displacements, stresses, strains, and forces in structures or components caused by loads that do not induce significant inertia and damping effects. Steady loading and response conditions are assumed; that is, the loads and the structure's response are assumed to vary slowly with respect to time. The types of loading that can be applied in a static analysis include Externally applied forces and pressures Steady-state inertial forces (such as gravity or acceleration) Imposed (nonzero) displacements
Temperatures (for thermal strain)

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VI. RESULTS FOR GRASS CUTTER BLADE IN STRUCTURAL ANALYSIS

Analysis of grass cutting blade is done in ANSYS software, fromthese analyses following maximum and minimum equivalent elastic strain, equivalent elastic stress and total deformation

Table 6.3: Analysis report

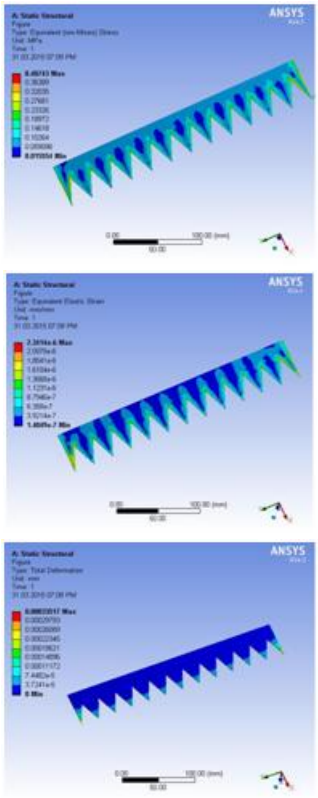

Fig. 2 Results (a) Total deformation (b) Equivalent strain (c) Equivalent stress (d) Result tabulation

S.No	Analysis	Minimum value	Maximum value
1.	Equivalent elastic strain(mm/mm)	1.485e-7	$2.414e^{-6}$
2.	Equivalent elastic stress(MPa)	0.0155	0.407
3.	Total deformation (mm)	0	$3.3517e^{-4}$

VII CONCLUSION:

In the presented paper provides the fabricated information about the "Fabrication of automated Solar grass Cutting Machine" which was designed such that the solar plate generates solar energy and utilizing this energy for running the grass cutter motor. Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested. The idea can be extended by adding more features like displaying the solar voltage generated on LCD display unit, also alerting when the battery voltage level goes low below threshold limit. We can add an interfacing of automatic power bank to charge the battery instantly. It can also be extended using driver circuits for controlling intensities, speed levels of the motor. Extensions using Wireless remote controls like RF, zigbee, Wi-Fi networks through which the grass cutter model can be operated from a distance by the user.

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