Solar Based Grass Cutting Machine

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***Abstract* — Grass cutting is a time- consuming and labor-intensive process. The technology that is available in the present-day for grass cutting operation is mostly the manually handled Diesel operated cutter. These types of equipment operating under non-conventional sources of energy emit green- house gases and pollute the environment and also responsible for climate change. These grass cutters are also a source of noise pollution that adversely affects the health of the cutter and the surrounding people. The cost of diesel is another matter for consideration. To mitigate the problems of the conventional cutter, a solar-powered automatic grass cutter is designed. Solar energy is chosen because it is free of cost, pollution-free and renewable form of energy. The automation is done to reduce the need for labor. The design consists of a solar panel of rated power 20 W, Solar charge controller of voltage 12 V and current 10 A, sealed Lead Acid battery of 7Ah, 24 V high speed DC motor and cutter blades. Various sensors like ultrasonic and temperature sensors and microcontrollers are used for the automatic function of the machine. The paper summarizes all the design parameters, the working principle, design calculations on the basis of the solar radiation data of Guwahati city and also the cost analysis of the designed system.**

Keywords: solar power, microcontroller, solar energy, ultrasonic sensors, motors

I. INTRODUCTION

Nowadays scarcity of fossil fuels induces the usage and necessity of alternate fuels. So, researchers are busy in evaluating the source's, solar powered projects are given more importance; many fields are depended on solar energy now. The sun, an average star, is a fusion reactor that has been burning over 4 billion years. It provides enough energy in one minute to supply the world's energy needs for one year. The natural environment which modern man abide, is usually covered with vegetation which includes forest trees or grass land. Grass cutter machines are operated by fuel and electrical energy which are costly and requires high maintenance. Most of the grass cutter available in today's market is of IC engine type and runs on fuel. This consumes about 250 g fuel generally petrol. Use of IC engine cutter release huge amount of carbon in the environment. Pollution is a major issue for whole world. It is manmade and can be seen in own homes. The name solar powered grass cutter provides the information that the usage of solar energy to power an electric motor which in turn actuates the rotor blade and that cut the lawn. Grass cutter machines have become very essential to our daily living in maintaining the yards. Furthermore, environmental awareness on usage of grass cutting machines has caught a great interest among consumers. energy consumption is becoming an increasingly important topic. In today's climate of growing energy needs and increasing environmental concerns, alternatives to the use of non-renewable and polluting fossil fuels must be investigated. One such alternative is solar energy.

A solar-powered grass cutter uses sliding blades to cut grass at an even length. Its construction is very simple. It consists of a DC motor, a switch for controlling the motor and a battery for charging it through a solar panel. The first grass cutter developed by Edwin Budding in1830 in Thrupp Engine-powered machines increase air pollution and noise and require maintenance. Moving standard motor-powered grass cutters require hard work and are difficult for. Cutting grass cannot be easily accomplished by the elderly and children. The advantage of powering a grass cutter by solar energy rather than by fuel is mainly ecological. With reference to current literature availability, there

are different types of grass cutter that are exist in the markets, which may not fulfil the performance and operational cost criteria. The main concentration of this paper is to design and fabricate a solar powered grass cutter which is cost effective, easy to maintain, operated in rural areas, and easy to use.

II. OBJECTIVES

1) The main project objective is to minimize overall weight so we can move this easily.

2) Ac motor create more vibrations and have more noisy therefore to remove vibrations and noise we use DC motor which have a less weight and create a less noise.

3) Ac motor need more power and long wire to provide power for working of machine, we remove this disadvantage by using battery and solar panel. Solar panel is secondary source to charge battery.

4) Machines available in market have less space for storing of trimmed grass; we eliminate this disadvantage by providing big tray on the top of chassis.

III. LITERATURE REVIEW

Srishti Jain, et al [1] this paper describes a solar powered robotic lawn mower that is autonomous and allows the user to cut grass with minimum effort. The sensors used in the robotic mower helps it to stay on the lawn and to detect and avoid any obstacles in its way. A 12v 310mA solar panel is used to provide the required power to the components and also to the battery. A 12v 1.2Ah rechargeable lead acid battery is also used as a backup, and won't be over charged due to the small output of solar panel. The battery charges in 5 hours when under direct sunlight and the power is delivered to the components via voltage regulators. To detect the obstacles, they have used IR sensors which has 1m 555 IC. There are two sensors, one on each side. This is because in case the obstacle is on the left then it will move in right direction and if the right sensor detects the obstacle then it goes towards the left. However the main disadvantage is that sometimes response of the system is too slow so in real time high end DSP processors is recommended that can process much faster.

Ashish Kumar, et al [2] in this paper describes an experimental study of solar powered Grass Cutter Robot. The author explains about the energy generated due to the Solar panel and how the system uses this energy to function. A battery is also used and to prevent it from over charging or discharging, a voltage regulator or a charge controller is placed into the system in series. It also specifies some extensions like using the driver circuit for controlling the speed of the motor as required and the use of LCD screens for status and energy monitoring, provisions of power banks to charge the system instantly when there is a scarcity in solar energy.

Mallikarjun Mudda, et al [3] in this paper it described about the automated solar grass cutter. In this it is explained about the grass cutting robotic vehicle powered by solar energy that also avoids the obstacles and that cuts the grass without any human interaction. Here they have used two 12v batteries one is for entire circuit and another is for cutting blade. The 10w solar panel is used to charge the batteries, solar panel gives the maximum of 18v and 580mA current. The charging circuit has been used in between the solar panel and batteries and this charging circuit consist of the voltage regulator. The microcontroller 8051 is used take input from ultrasonic sensors which is used for the obstacle detection. Is this work the motors used was of 9v but the microcontroller provides 5v so they have used the motor drivers which intakes 5v and provides 12v by this way the motors are made to run. This model can also can be used in the night time because the use of rechargeable batteries. The main drawback of this model was it was more basic and until the obstacle is recognised the bot will not take the direction.

Debangsu Kashyap, et al [4] is this research it is explained about the fully automated solar grass cutter for campus cleaning. The solar panel is placed at the angle of 45° south to get the maximum intensity of solar radiation. The charge controller is used to connect the battery and the panel to protects the battery from overcharging. The microcontroller is connected with the ultrasonic sensor and the temperature sensor. The new thing in this research is 'temperature sensor', which is used to detect the temperature of the motor if the motor crossed the threshold temperature range, microcontroller controls the speed limit.

IV. METHODOLOGY

In this project, the solar panel is mounted on the grass cutter machine receives the solar power from the sun. This solar power stored in the battery. The battery provides power supply by using the solar charge controller. The main function of the solar charge controller is to increase the current from panels while batteries are charging. It also disconnect the solar panels
from the batteries when they are fully charged and also connects to the panels when the charging in the batteries is low. The solar grass cutting machine is start operation by the switch connected on the board which allows the flow of current to the motor which turn drive the blades used for moving.

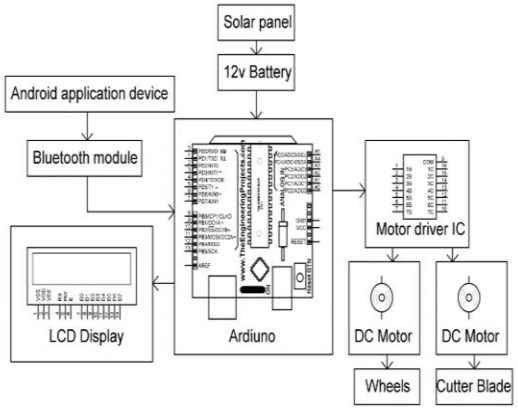

Fig. 1 Block Diagram of the Proposed system

In the solar grass cutting machine the four dc 12v motors are connected to the both sides of the machine, per side two motors are connected in parallel connection so they works as a single unit on both sides. Other additional motors are connected at the front of the frame; these motors have connected the blades on the motor shaft so that the grass is cut by turn on this motor.

These motors are operated by the microcontroller; it gives the forward moving command to the motors during the operation of this grass cutter if the obstacle comes in front of the machine the microcontroller gives the command to the ultrasonic sensor and the sensor detects that obstacles and avoid them and change the direction of grass cutter machine. The component used in this project are 12v, 10w solar panel, 18v battery, voltage regulator, micro controller, IR sensor, Dc motors, Blades.

V. WORKING

The lawn mower or grass cutter is made up of two in built reduction gear mechanism motors for driving the vehicle, one high RPM DC motor For grass cutting to which a fan with sharp blades is connected, a Rechargeable battery, solar panel, a control unit with microcontroller, drivers for the motors and a link mechanism. The power and charging system comprises of a solar panel which charges the battery while exposed to sunlight. The D.C. motor forms the heart of the machine and provides the driving force for the collapsible blades. This is achieved by the combined effect of mechanical action of the cutting blades and the forward thrust of the mower. The system is powered by an electrical switch which completes the circuit comprising the DC motor and the battery. The IR sensor is finding the path to avoid the obstacles and machine damage. The shaft fitting mechanism with which the height of cut can be altered depending on the requirement. The program in microcontroller is written in a way that when IR sensor senses an obstacle the device changes its path.

VI. COMPONENTS

6.1 Cylindrical Blades

Cylinder lawn mowers have cylindrical blades that rotate vertically at the front of the mower. They cut against a fixed blade at the bottom. The cylinder should have multiple blades – three or more is best.

Fig. 3 Cylindrical Blades

Cylinder lawnmowers are best for flat lawns that you want to keep short and well-manicured. They can be electric, petrol-powered and push mowers.

6.2 DC Motor

A DC motor is any of a class of rotary electrical motor that converts direct current electrical energy into mechanical energy.

Fig. 4 DC Motor

The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current in part of the motor.

6.3 Solar Panel

The term solar panel is used colloquially for a photo-voltaic (PV) module. A PV module is an assembly of photo-voltaic cells mounted in a frame work for installation. Photo-voltaic cells use sunlight as a source of energy and generate direct current electricity.

Fig. 5 Solar Panel

A collection of PV modules is called a PV Panel, and a system of Panels is an Array. Arrays of a photovoltaic system supply solar electricity to electrical equipments.

6.4 Battery

Fig. 6 Battery

A battery is a device consisting of one or more electrochemical cells with external connections for powering electrical devices such as flashlights, mobile phones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal.

When a battery is connected to an external electric load, a redox reaction converts high-energy reactants to lower-energy products, and the free-energy difference is delivered to the external circuit as electrical energy. Historically the term "battery" specifically referred to a device composed of multiple cells, however the usage has evolved to include devices composed of a single cell.

VII. SOFTWARE REQUIREMENT

The Arduino IDE is an open-source software, which is used to write and upload code to the NodeMCU board. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. The Arduino IDE is an open-source software, which is used to write and upload code to the NodeMCU board.

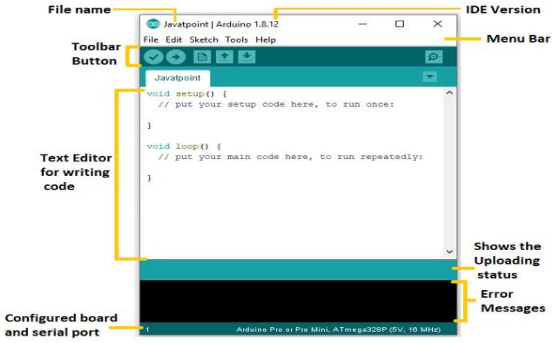

Fig. 7 Software Test

The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment. The program or code written in the Arduino IDE is often called as sketching. We need to connect the NodeMCU board with the IDE to upload the sketch written in the Arduino IDE software. The sketch is saved with the extension ‘ ino.' The Upload button compiles and runs our code written on the screen. It further uploads the code to the connected

board. Before uploading the sketch, we need to make sure that the correct board and ports are selected. We also need a USB connection to connect the board and the computer. Once all the above measures are done, click on the Upload button present on the toolbar. The latest Arduino boards can be reset automatically before beginning with Upload. In the older boards, we need to press the Reset button present on it. As soon as the uploading is done successfully, we can notice the blink of the Tx and Rx LED. If the uploading is failed, it will display the message in the error window. We do not require any additional hardware to upload our sketch using the Arduino Bootloader. A Bootloader is defined as a small program, which is loaded in the microcontroller present on the board. The LED will blink on PIN 13. The serial monitor button is present on the right corner of the toolbar. It opens the serial monitor. When we connect the serial monitor, the board will reset on the operating system Windows, Linux, and Mac OS X. If we want to process the control characters in our sketch, we need to use an external terminal program.

VIII. RESULT AND DISCUSSION

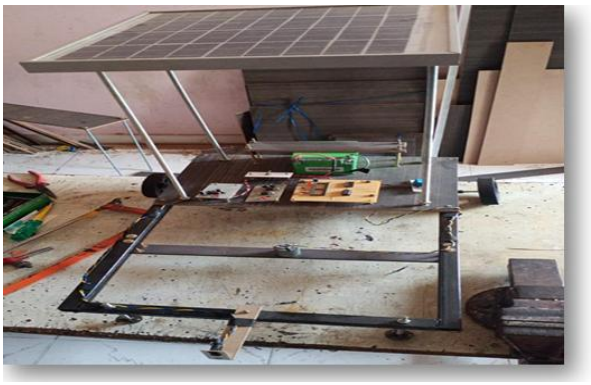

Fig. 8 Solar Grass Cutter

The 10 watts solar panel is used to charge the batteries which are rechargeable. the solar panel gives maximum 18v and 580mA current. we need charging circuit between solar panel and batteries .The charging circuit has voltage regulator which regulates voltage to 15v and one transistor to amplify the maximum current to circuit and diode is used .we use 12 voltage battery for entire circuit and another 12v volts for cutting blade.

The microcontroller 8051 takes the input from the ultrasonic sensors, when any interrupt or obstacle occurs the ultrasonic sensor senses the obstacle and gives feedback to microcontroller then according to the program which was given to microcontroller its turns left or right.

It waits up to some delay and senses again and same procedure works if no detection occurs to ultrasonic range then it moves forward until it finds some detection. B The movement of bot is done by using the two DC motors of 100 rpm. The motors are driven by using motor driver (L293D). It is also known as H-Bridge. The main purpose of using motor driver is because that DC motors require the minimum voltage as 9v as input. But the microcontroller gives output as only 5v so we require 9v to 12v for driving the motors. So, we use motor driver which takes 5v as input and gives the 12v for motors. The L293D motor driver drives only two motors which can move in both directions. And the cutting blade is used to cut the grass to cut any type grass we need high rpm motor, so we used 1400 rpm motor for cutting blade. The motors run directly by 12v rechargeable battery. The DPDT switches are used for movement of bot and cutting blade separately.

IX. ADVANTAGES

• It uses solar energy, a clean form of energy and hence does not create any air pollution.

• It has compact size and light in weight, so it can be easily moved from place to place.

• It produces less noise pollution than the conventional grass cutter which uses gasoline/diesel as its fuel.

• Wear and Tear is negligible.

• Operation of the solar powered grass cutter is user friendly so non skilled person can easily operate it.

• There is no fuel cost as it uses only solar energy.

• Operation cost is decreased and hence it is economical.

X. FUTURE SCOPE

Man is always trying to develop more and more techniques with increasing aesthetic look considerations. Hence there is more and more scope. Whatever he might have created of course after experience of presently manufacturing the things. We completed our project with the minimum available resources but the results and modifications are not up

to expectations. This can be further improved by the following modifications to obtain better results.

- The efficiency can be improved by increasing the battery capacity.
- By using light weight material for the frame and handle the weight of the assembly can be reduced.
- By using the cutter blade with high strength and increasing power it can be used for many applications in agricultural sector like shrub cutting, maize cutting, cane cutting.
- Currently the project is manually operated. It can be automated to reduce human fatigue.
- Also using modified blade designs it will be more beneficial to farmers.

XI. CONCLUSION

The solar grass cutter is mainly designed for the campus cleaning in a sustainable and efficient way. Grass cutting or mowing is one of the main operation that is carried out in the campus for cleanliness. It is a time consuming, fuel consuming and labour intensive process. The conventional grass cutter that are used in the campus is costly. Therefore, the capital investment and operating cost both is very high. As the cutter burns diesel it creates air pollution to the campus. The noise pollution is also very disturbing for all the residents present in the campus. To rectify all the problems mentioned above the automated grass cutter that we discussed in the paper may be a good solution. The cutter can be used in both day and night time if properly charged. In rainy season due to less sunshine hours, it will take much time for full charging which is a drawback for the users. The cost of the machine is also very low as compared to the presently used cutters. The fuel i.e. solar energy is free of cost. Therefore, the operation cost is almost negligible in this case. The self-life for the solar panel is almost twenty years. Therefore, the machine will remain intact for many years. Our design implies a pollution free environment to the campus. In the conclusion, we can say that the designed model can be an economic alternative for the users inside as well as for the other users outside the campus.

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