

Design and Fabrication of Automated Smart Solar grass cutter using GPS Technology

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ABSTRACT: Due to the continuous increase in the cost of fuel and the effect of emission of gases from the burnt fuel into the atmosphere, this necessarily indicate the use of the abundant solar energy from the sun as a source of power to drive a lawn mower. A solar powered lawn mower was designed and developed, based on the general principle of mowing. The designed solar powered lawnmower 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.

keywords—Emission, Abundant, Lawn mower, stainless-steel and controller.

1 INTRODUCTION

- Nowadays there are lots of development work has been pending but there is still some labour power which requires lots of income distribution for a small work.
 - This require that some work should have done as some other alternative so that the labour power wastage can be avoided.
 - In our project we are trying to make a daily purpose cutter which is able to cut the grasses in lawn. The project work will be done according to the proper application-based fabrication.
 - The system will have some automation work for guidance and other obstacle detection. The system will have a power source that is battery and a solar panel will be attached on the top of the robot. It will be charged from sun by using solar panels.
 - Moving the mower with a standard-cutters is an inconvenience, and no one takes pleasure in it. Cutting grass cannot be easily accomplished by elderly or perhaps even the younger people often sometimes.
 - The traditional grass cutters moving with engine creates noise pollution with much unwanted sounds due to the loud engine and local air pollution due to the combustion in the engine.
- A motor-powered engine requires periodic maintenance such as changing the engine oil. Even though electric solar grass cutter are eco-friendly, but in case if it is corded, mowing could prove to be problematic and dangerous.
 - Different designs have been made; each to suit a ease of electricity to power lawnmower. However, most particular need or convenience.
 - The solar powered mowers are based on the use of small but powerful engine lawnmower is an improvement on cordless electric lawn that provides enough torque to spin a very sharp horizontal mower. The sun provides sustainable amount of the energy blade that cuts the grass upon contact. The blade is located used for various purposes on earth for atmospheric system. in the deck that prevents grass from flying all over the place.

The first lawn mower was invented by Edwin Budding in 1830 in Thru, just outside Stroud, in Gloucestershire, England. Budding's mower was designed primarily to cut the grass on sports grounds and extensive gardens, as a superior alternative to the scythe, and was granted a British patent on August 31, 1830. [1]in 1995, the first fully solar powered robotic mower became available. The mower can find its charging station via radio frequency emissions, by following a boundary wire, or by following an optional guide wire.

This can eliminate wear patterns in the lawn caused by the mower only being able to follow one wire back to the station. A robotic lawn mower is an autonomous robot used to cut lawn grass. A typical robotic lawn mower requires the user to set up a border wire around the lawn that defines the area to be mowed. The robot uses this wire to locate the boundary of the area to be trimmed and in some cases to locate a recharging dock. Robotic mowers are capable of maintaining up to 20,000 m² (220,000 sq-ft) of grass.

Automated solar grass cutter are increasingly sophisticated, are self-docking and some contain rain sensors if necessary, nearly eliminating human interaction. Robotic lawn mowers represented the second largest category of domestic robots used by the end of 2000. Possibly the first commercial robotic lawn mower was the MowBot, introduced and patented in 1969 and already showing many features of today's most popular products. In 2012, the growth of robotic lawn mower sales was 15 times that of the traditional styles. With the emergence of smart phones some robotic mowers have integrated features within custom apps to adjust settings or scheduled mowing times and frequency, as well as manually control the mower with a digital joy-stick.

2 LITERATURE REVIEWS

1. At first author had enhanced a new lawn cutting - equipment. The system consists of a solar-powered revival release reaper that uses suitable power to work itself. This robot is provided with 34 solar -cells established on top of the frameworks scheme and has the ability of processing possessions up to 13, 500sq-ft. The device works at the same rule as the Lawn Ranger exclude it employs a cable under the surface of a person's lawn. The mower utilizes this cable along with its sensors to permit the robot to shunt around while conservation the system on the path. The mower will keep to run as long as the mower has capacity, from the sun. The robot is provided with elastic absorber that when stimulated backs the mower up and keeps the robot on a several tracks.

2. Authors have automated instrument for clipping the grass. The machine comprises of linear blade which is worked with the aid of the motor which is using battery as power supply. Power supply and battery can be used for charging the battery. Infra-red sensor is used for sensing any obstacles in the track. If there is any changing in the track, then the instrument employing free trend sensor and discover the fresh way to departure. The main advantage of this device the damage of this device is avoided.

3. Authors presented a review of researches done on the subject of automated tractor. An autonomous tractor is a car that can work with least possible human monitoring, self-propelled and controlled automatically along a required route. The advantages from such a device are benefit for

agriculture industry by decreasing the time and work cost, as well as enhancing output efficiency.

4. Author has illustrated how an automatic lawn cutter can aid the employer to clip the grass in their lawn with minimal labours. Distinct sensors are used, they will discover and evade targets and humans while clipping. The major goal of this automatic lawn cutter is that the employer can assign the region that is to be clipped and also the height of grass.

5. Author developed an autonomous lawn mower that will permit the employers to clip their grass with less time and labour. Dissimilar other robotic lawn mowers in the shop, this scheme needs no circumference wires to keep the robot within the lawn. Through an array of sensors, this robot will not only remain within the lawn, but it will also evade and discover targets and humans. This scheme is yet in the prototype period due to financial and time reconstructions.

6. Author invented grass clipping tool with rotary blades by utilizing solar energy. The solar energy is trapped in the photovoltaic cell to produce electricity. The cells may be gathered in the shape of plates or arrays. Solar panel is designed such that to absorb high intensity from the sun. The major job of solar charger is raised current during batteries after that solar is charging and releasing when they are totally charged.

3 PROBLEM FORMULATION

A solar grass cutter is a machine that uses a revolving-blades to cut a lawn at an even height. Lawn mowers employing a blade that rotates about a vertical axis are known as rotary mowers, while those employing a blade assembly that rotates about a horizontal axis are known as cylinder or reel mowers. Many designs have been made, each suited to a particular purpose. The smallest types, pushed by a human, are suitable for small residential lawns and gardens, while larger, self-contained, ride-on mowers are suitable for wide lawns, and the largest multi-gang mowers pulled behind a tractor, are designed for large expanses of grass such as golf courses and municipal parks.

THE PROBLEMS WITH AVAILABLE GRASS CUTTER ARE:

1. **Power consumption:** the available grass cutter are petrochemical powered or electrical powered which will consume large amount of conventional energy source.
2. **Human effort & safety:** the mowing work always needs to get control with a worker for the proper mowing with foremost safety.

3. **Time consumption:** for mowing the land in different patterns and design it takes larger time and much human effort.

Disadvantages are high maintenance and low life-span for high intensity uses. Maintenance involves regularly replacing the carbon brushes and springs which carry the electric current, as well as cleaning or replacing the commutator. components are necessary for transferring electrical power from outside the motor to the spinning wire windings of the rotor inside the motor. Brushes consist of conductors.

4 MATERIALS AND COMPONENTS USED

4.1 Charging Station

In practice, the maximum voltage is in the range of 0.6 volt and this occurs in open circuit, when no power is produced. The maximum power of a silicon cell occurs at an output voltage of approximately 0.45 volts when there is bright sunlight, the current from a commercial cell is then roughly 270 amperes per sq.-m of exposed surface. The power is thus about $0.45 \times 270 = 120$ watts. The rate at which solar energy reaches the top of the atmosphere is 1.353kW/sq.-m (Kalyan, 2013). Part of this energy is reflected back to the space and an electric switch is connected to the circuit to control the flow of current.

4.2 Battery

Batteries are available in various volts and ampere hour range. To determine the one to use, consideration was given to the voltage and the ampere hour rating. Since the motor is 1.5hp, then a 12V battery was selected. The ampere hour measures the length of time the battery will discharge while in use and is not charging. A 17-ampere hour battery will give a 17 amp of current for one hour and the current required by the motor is less than that.

4.3 Arduino

Arduino is brain of overall system. Arduino is single-board microcontroller intended to make building interactive objects or environments more accessible. Introduced in 2005, the Arduino's designers sought to provide an inexpensive and easy way for hobbyists, students, and professionals to create devices that interact with their environment using and actuators.

4.4 DC Motor

A DC motor relies on the fact that like magnet poles repel and unlike magnetic poles attract each other. A coil of wire with a current running through it generates an electromagnetic field aligned with the centre of the coil. By switching the current on or off in a coil its magnetic field can be switched on or off or by switching the direction of the current in the coil the direction of the generated magnetic field can be switched 180°. A simple DC motor typically has a stationary set of magnets in the stator and an armature with a series of two or more windings of wire wrapped in insulated stack slots around iron pole pieces (called stack teeth) with the ends of the wires terminating on a commutator. Advantages of a brushed DC motor include low initial cost, high reliability, and simple control of motor speed.

4.5 IR Sensors

A Sensor converts the physical parameter (for example: temperature, blood pressure, humidity, speed, etc.) into a signal which can be measured electrically. Sensors are sophisticated devices that are frequently used to detect and respond to electrical or optical signals to detect and avoid the object to reduce the chances of failure of blade.

5 RESEARCH METHODOLOGY

- The Solar grass robot is made up of an induction motor, a battery, an alternator, three collapsible blades, and a link mechanism.
- The power and charging system comprises of an alternator which charges the battery while in operation. 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 induction motor and the battery.
- The Ultra sonic sensor is finding the path to avoid the obstacles, machine damage and rotation. The shaft fitting mechanism tasks with which the height of cut is altered.

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 until some delay and senses again and same procedure works if no detection occurs to ultra-sonic 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 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. Then 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 runs directly by 12v rechargeable battery. The DPDT switches are used for movement of bot and cutting blade separately.

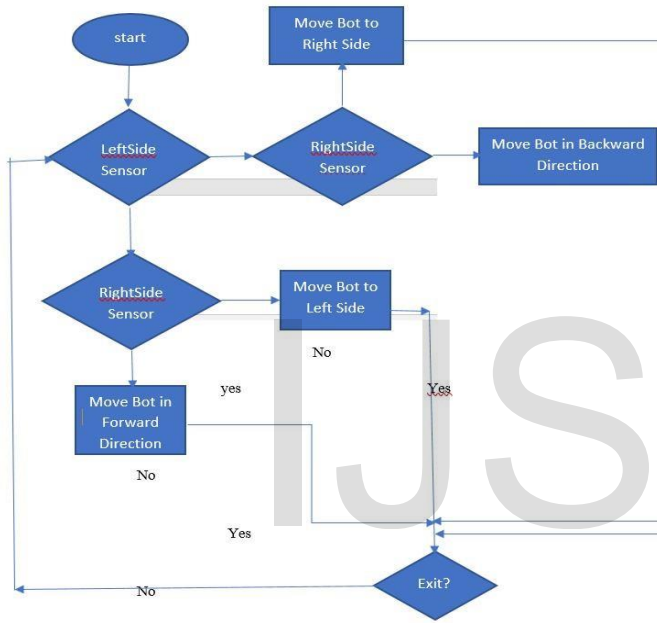


Fig 4.1: Grass cutter Algorithm

6 MODEL-ILLUSTRATION

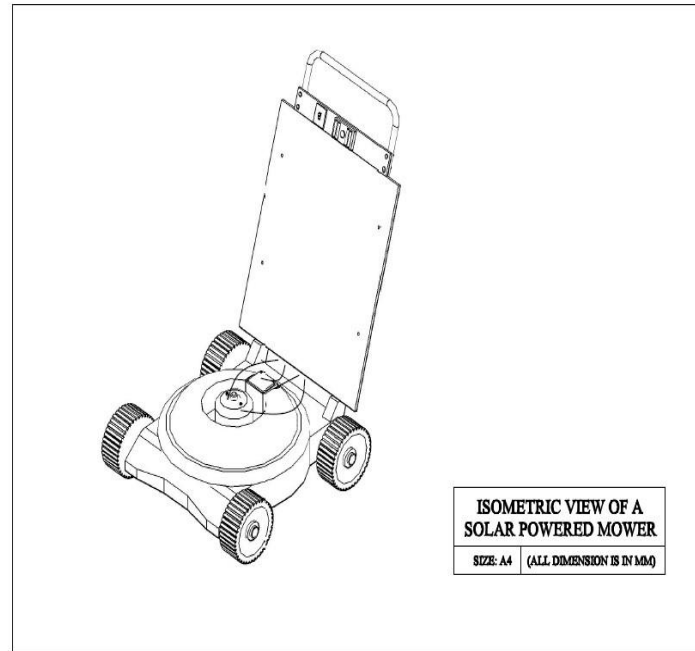


Figure 6.1: Solar Powered Lawn Mower

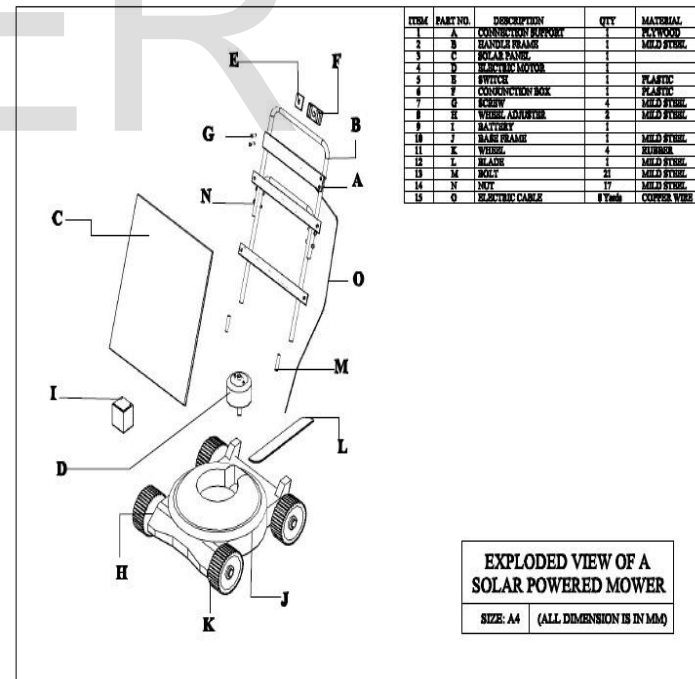


Figure 6.2: Exploded View of Solar Powered Lawn Mower

7 DESIGN PARAMETERS

8.1 Selection of electric motor

- A) 30 RPM DC motor SPEED = 30
- B) RPM VOLTAGE = 12 VOLT
- C) WATTS = 18 WATT

8.2 Torque of the motor

- A) Torque = $(P \times 60) / (2 \times 3.14 \times N)$
- B) Torque = $(18 \times 60) / (2 \times 3.14 \times 30)$
- C) Torque = 5.72 Nm Torque = 5.72×10^3 N-m
- D) The shaft is made of MS and its allowable shear stress = 42 M-Pa
- E) Torque = $3.14 \times fs \times d^3 / 16$ $5.72 \times 10^3 = 3.14 \times 42 \times d^3 / 16$ $D = 8.85$ mm
- F) The nearest standard size is $d = 9$ mm.

8.3 Electrical (electric) power equation

- A) Power $P = I \times V$ Where $V = 12$ $W = 18$ $I = 18/12 = 1.5$
- B) A H.P = .02414

8.4 Solar panel calculation

- A) VOLT = 12 V
- B) WATT = 5 W
- C) $W = V \times I$ $5 = 12 \times I$ $I = 5/12$ $I = 420$ ma

8.5 Battery calculation

- A) BAH / CI = 8 ah/420ma = 19 hrs
- B) To find the Current Watt = 18 w
- C) Volt = 12v Current =? $P = V \times I$ $18 = 12 \times I$ $I = 18/12 = 1.5$
- D) AMPS battery usage with 1.5 AMPS BAH / I 8/1.5 = 5.3 hrs.

8 RESULTS AND DISCUSSION

Sample plot	Average height of the grass before mowing (mm)	Average height of the grass after mowing (mm)	Expected height of the grass after mowing (mm)
Elephant grass	224	90	100
Stubborn grass	234	92	100
Spare grass	111	70	80
Carpet grass	70.5	56.5	50

Table 8.1: Average height of grass for each sample plot

Integrating features of all the hardware components used have

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. Thusly the project has been successfully designed and tested. This lawn mower will meet the challenge of environmental production and low cost of operation since there is no cost for fuel-filling. A lawn mower has been developed for the use of residences and establishments that have lawns where tractor driven mowers could not be used.

9 SCOPES OF PROJECT

To allow for greater flexibility in the design, a custom-built platform will be used. Much experience has already been gained with the other sensors working on the first two generations of autonomous lawn mowers. This is the key system that will enable the mower to recognize objects, avoid them, and can move also in a pattern. We completed our project successfully with the available sources. But the results and modifications are not up to the expectations. This can be further improved by incorporating the following modifications to obtain better results. The efficiency can be increased by using some other mechanism. and speed of motor is reduced 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.

10 CONCLUSIONS

Main Drawback of the Subsisting System is it need a separate person to operate the Robot, so to overcome this drawback a system was implemented for fully automated battery powered grass cutter. As the technology is getting advanced, features of grass cutters are also enhanced. The designed Model is highly efficient and accurate as it detects the objects and stops the movement. Thus, the Design and implementation of the project has been successful. Since there is no cost of fuel and any kind of pollution as the present system uses battery as a power source, the designed Robot will meet the Challenge of low cost of operation and a renewable energy.

11 APPLICATIONS

For cricket ground.
All gardens and playgrounds.

12 ADVANTAGES

1. Compact size and portable.
2. Easy to move from one place to another place.
3. Operating principle is simple.
4. Non-skilled person also can operate this machine.

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