

Solar Powered Joystick Controlled Grass Cutting Robot

Ishan Sharma¹,Er.Bimal Kumar²

1.Ishan Sharma ,Student, B Tech in Electrical Engineering, Amritsar Group of Colleges

2.Prof. Bimal Kumar, Department of Electrical Engineering, Amritsar Group of Colleges

Abstract

The paper gives a review about a grass cutting machine that is beneficial to cut grass and can be used anywhere.The machine is operating on solar energy which is a renewable source of energy.In project solar panels are used to charge batteries so need of fuel is eliminated.It is a 4 wheeled robot with 2 motor driven wheels and 2 castor wheels so machine requires less force to be driven and by use of joystick and other components it is possible to do speed control of front motors by pulse width modulation technique and direction control to move machine in forward and backward direction.There are generally two parts one is joystick to send signals and other is micro-controller unit for signal reception to convert it into desired outcome i.e motion of wheels.Machine is totally eco-friendly and doesn't put any harmful effects on health of human beings.

Keywords-Solar Powered Grass Cutter, Joystick controlled grass cutting robot,L298N motor driver,Arduino Uno

Introduction

A machine is a tool that can perform certain action but condition is that there is need to provide input to it in order to get desired outcome.Manual cutting of grass by laborers in farms, playgrounds and in office lawns is a time consuming and a tiresome process.The first lawn mower was invented by Edwin Beard Budding in 1830 and he was inspired from cylindrical machine which was used in cutting in the mills [11].In later stages a lot of innovations in field of lawn mowers have been made but most of them work on non renewable energy resources like coal,oil and natural gas.As a result use of these fuel cause problems like pollution and their shortage may result in hike of their prices.Moreover their operation may also be very noisy. So if renewable energy resources like solar energy,wind energy, tidal energy and geothermal energy are used then it is possible to maintain ecological balance as long as they are available.The project is focused on same idea so it uses poly-crystalline solar panel to charge a 12 V DC lithium ion 7 AH battery via solar charge controller.Moreover this machine can be operated even by unskilled laborers with less efforts as there is no requirement to pull mechanical frame by hands by use of joystick which makes the operation so easy just like playing a video game on mobile and it is even safe for children.

energy to gotten from the sun to drive a lawn mower. The designed solar powered lawn mower comprises of electric motor, a charge controller, battery (12V, 40ah), Solar Panel (100W), rotational blade and a control switch. The entire operation frame work is achieved using the electric motor which is able to provide the necessary torque needed for the rotation of the blade which is mounted to the shaft of the motor.[1]

In “A Fully Automated Lawn Cutter using Solar Panel” by Ramya. P et.al.published in International Journal of Engineering Science and Computing ,2020 tells how system uses 12V batteries to power the vehicle movement motors as well as the grass cutter motor. They use a solar panel to charge the battery. The grass cutter and Vehicle motors are interfaced to an NodeMCU that controls the working of all the motors. [2]

In “Android Controlled Solar based Grass Cutter Robot”by M/s. Snehal Popat Jagdale published in International Journal of Engineering Research & Technology (IJERT),July 2020 implements the grass cutting robot which has battery which can be charged by solar energy. This robot can be operated using android phone. This system can be created with minimum cost as compared to other existing systems. This is rugged, durable and maintenance free. This system is pollution free due to the use of solar energy to charge the battery.[3]

Literature Review

In “Design and Fabrication of a Solar Operated Lawnmower” by Aduwika Oluwatobi Akinyemi et.al.published in International Journal Of Innovative Science and Research Technology,October 2020 .This Paper focusses on the exploitation of the abundant solar

In “IOT Based Grass Cutter Using Solar Energy” by Niveditha TR et.al. published in International Journal of Innovative Research in Technology ,June 2020 proposed grasscutter totally based on IOT and robotics. The special feature of the proposed model is that it can

be controlled from any part of the world by using Cell Phone. It is also capable of fully automated grass cutting without the need of any human involvement[4].

In “Design and Development of Smart Solar Grass Cutter” by Firas B. Ismail et.al.published in International Journal of Engineering and Advanced Technology (IJEAT) ,December 2019 gives a detailed explanation on how can a grass cutter prototype is developed to reduce air pollutant and improve the current design specifically the blade position based on the previous studies. With current technology, this new prototype is designed as remotely controlled grass cutter using Arduino UNO. Smartphone is used as the remote controller[5].

In “Smart Solar Grass Cutter Machine” by Piyush Kumar Yadav et.al. published in International Research Journal of Engineering and Technology (IRJET),May 2019 explains an automated system for the purpose of grass cutting on small plants in lawns and gardens. The system control is done by the microcontroller. Wheels and cutting operations are done using dc motors. The whole supply is provided through the battery while electric motor rotates which in turn rotates a blade which does the mowing of a grass.[6]

In “Solar based Robot for Garden Grass Cutting and Watering Plants” by Gokul T S et.al.published in Global Research and Development Journal for Engineering ,May 2019 explains other type of changes made in the existing machine to make its application easier at reduced cost. Their main aim was pollution control is attained through this. Unskilled operation can operate easily and maintain the lawn very fine and uniform surface look. In their project, solar grass cutter is used to cut the different grasses for the different application.[7]

Methodology

This project known as “ Solar Powered Joystick Controlled Grass Cutting Robot” is based on principle of efficient use of renewable energy resources like solar energy in design and development of grass cutting robot whose operation is described as per the block diagram shown in Figure 1.The efficiency of solar panel can be increased by mechanism of dual axis tracking.By this method the efficiency of solar panel can increase by 60 percent[10].Moreover solar panels of high ratings are required in order to charge batteries as soon as possible.The area where sunlight is not proper under such condition solar panels need not to be adopted and one must plan to go after other renewable sources of

energy.

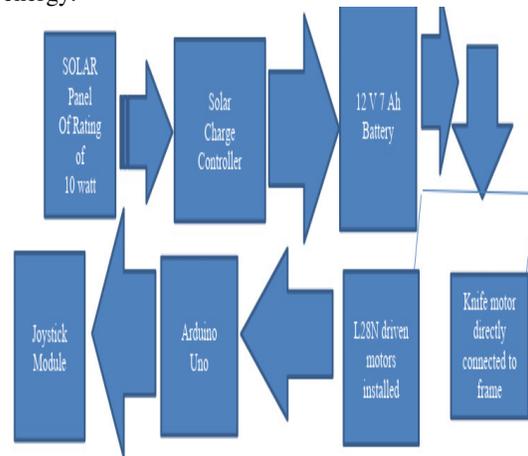


Figure 1-Block Diagram of Project

In a project known as “Solar Powered Joystick Controlled Grass Cutting Robot” a polycrystalline solar panel whose rating is 10 watt is chosen to charge a 12 V 7 Ah lithium ion battery via solar charge controller compatible for 12/24 V battery with 20 A current rating.Here 4 wheels are used.Front wheels are motor driven where 2 motors of rating of 12 V 30 rpm.The output of motors is fed to l298n motor driver module having current rating of 2 A via switch in phase wire which is capable to withstand voltage upto 46 V.From 5 V and ground terminals of motor driver Arduino uno is connected i.e 5 V pin of l298n is connected to Vin of Arduino and Gnd of l298n is connected to Gnd of Arduino uno.A specific code is burnt in Arduino Uno.A joystick’s 5 V,Gnd,Vrx and Vry pin is connected to 5V,Gnd,A0 and A1 pin of Arduino Uno respectively and the machine is ready.A seperate motor is meant for cutting purposes i.e blade motor which is connected to frame via switch in phase wire whose working is independent of microcontroller unit (consisting of L298n motor driver unit and Arduino Uno).

Problem Formulation

If a solar panel of 10 watt is used then it is capable to charge 12 Volts 7Ah battery in 8.4 hours also if solar panels are 45 percent efficient it will take up to 18 hours to charge the battery.Also the load of project is such that battery will operate it continuously for 2 full hours after that it again need charging.Above calculation doesn't taken into account the power consumed by micro-controller unit.But it is seen that voltage drop of 2 V occur across l298n motor driver as a result motor only get 10 V out of total 12 V.As a result motor is not capable to run at its full speed due to reduction in voltage.Moreover by pulse width modulation technique speed is varied by adjusting the duty cycle which further vary the value of voltage from 1 to 10 volts.Also charging done by solar panel is also dependent upon

weather conditions and intensity of sunlight falling on panel.

Components Description



Figure 2-View of Project

1.Plywood-Plywood is a material which has high mechanical strength and is widely used in various applications like furniture,home decors and in much more areas.In project made by known as grass cutter machine plywood is used as supporting material which supports various components like arduino uno,battery,solar panel and solar charge controller .

2.UPVC Pipes-A pipe is a main element by which the frame of grass cutter machine is made.The pipe of grass cutter machine has high mechanical strength along with that it is capable to withstand the weight of batteries and other components used in machine.The pipe is white in color with outside diameter of 26.67 mm.

3.Wheels-The choice of wheels greatly influence the project's performance.Here 4 wheels are used front 2 wheels are to drive motor while backward wheels are castor wheels.If diameter of front wheels are high then it will raise the level of motor rail line from ground.Moreover raising the level beyond certain instant is not possible as it may break the pipe.

4.On-Off Switches-In this project two switches are used on to turn on/off blade motor and other switch to on/off front wheels motors.

5.Battery-So depending upon cost and other factors It is preferred to use UPS Battery in this project having rating of 7Ah.While use of motor cycle battery is avoided due to its high cost, low Ah rating and no such dealer of motor cycle battery agree upon charging it by use of solar panel. So UPS battery is recommended in Solar Based Grass Cutter Project.



Figure 3-12 V 7 Ah Lead Acid Battery

6.Solar Panel-Solar Panel is considered to be a heart of project known as solar based grass cutter which is beneficial to charge the lithium ion battery. Solar panel used in project is poly crystalline with 10 watt 12 V as power and current rating.When a sunlight of particular intensity fall on solar panel then photons of sunlight together with electrons of cells produce Direct Current at output.



Figure 4-Solar Panel

7.Solar Charge Controller-A battery cannot be directly charged by solar panel because the safe charge limit of 12 V battery is 12.9 Volts[12].Beyond that limit the battery will get damaged due to inner chemical reaction or boiling of chemicals.To maintain battery voltage to safe level a device known as solar charge controller is used in this project which is compatible for 12/24 V battery with current rating of 20 Amperes.



Figure 5-Solar Charge Controller

	Indicates that Solar Panel is charging
	Indicates Battery level
	Indicates any type of fault in system

Table 1-Indications of Charge Controller

8.Blade Motor-The motor that is used to cut the grass is 12V DC with high speed and torque.The motor should be capable to run at speed of 3000 rotations per minute because if motor runs at slow speed then it will pose too much difficulty for motor to cut grass.The cost of Blade motor is less as compared to gear motors.



Figure 6-Blade Motor

9.Gear Motors-Gear Motors are type of motors working on DC supply with voltage rating of 12 volts whose main function is to drive the wheels of grass cutter machine.Such type of motors are completely different to blade motor.Here It can be seen that the cost of Gear Motor is more as compared to that of Blade Motor.In this project 2 gear motors are used whose main function is to drive 2 wheels while remaining 2 wheels are castor wheels which doesn't require any motor.Usually low speed motors are used for such purpose



Figure 7-Gear Motor

10.L298N Motor Driver-L298N motor driver is H Bridge Motor driver that can drive 2 motors at one

time[10].It has two channels of motor output.Moreover there are three terminals.One is 12 V terminal ,GND terminal and 5 V terminal.5 V terminal is used to power other circuitry like Arduino uno but for that power jumper should not be removed from place.

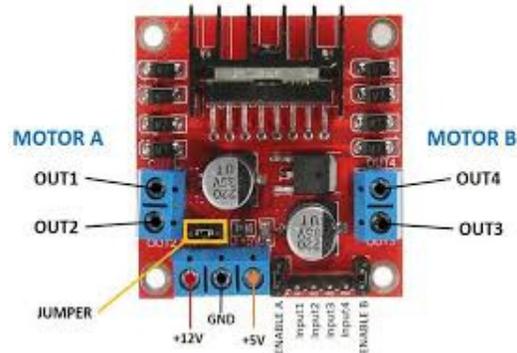


Figure 8-L298N Motor Driver

11.Arduino Uno-Arduino Uno is a brain of machine which act as interface between joystick module and motor driver module.Arduino Uno operate on voltage of 5 Volts.The point need to be noted that when jumper is in place and Arduino is getting power from motor driver then if by accident if external power supply is connected via Arduino jack or Arduino usb then it will permanently damage the Arduino board.



Figure9-Arduino Uno

Arduino Uno	L298N Connections
4	IN1
5	IN2
6	IN3
7	IN4
9	ENA
10	ENB

Table2-Arduino v/s L298N Connections

12.Joystick-Joystick is a controlling device which is used in this project to give command in order to control speed as well as direction.The joystick works on 5 volt supply and consist of two potentiometers.By use of joystick either both wheels can be rotated in clockwise

direction,both can be rotated in anticlockwise direction.Moreover rotation of a single wheel is also possible by this.



Figure 10-Joystick Module

Arduino Uno Pin	Joystick Pin
5 V	5 V
Gnd	Gnd
A0	Vrx
A1	Vry

Table 3-Arduino-Joystick Connections

Results and Discussion

As there are two switches present on panel so when switch one is ON motor connected to blade starts running at high speed of 3000 rpm.By turning on second switch motor driver and Arduino is powered indicated by their respective LED’s.When command is given command via Joystick module movement of front two wheels take place in forward and backward direction depending upon command and castor wheels are driven by front wheels resulting in running of machine in respective direction.

Conclusion -Though the use of solar panel in a grass cutter machine is a good idea but use of low wattage solar panel leads to increase in time to charge battery.Moreover if machine is in public place like school or college playground then it cannot be left alone in sunlight for charging because panel may be broken by students playing cricket on ground or accumulation of fine particles on panel can also take place which further increase charging time.Moreover use of micro-controller unit in project leads to voltage drop of 2 Volts causing motor to only get 10 volts.In-spite of this the project is fulfilling all its purpose for which it was designed.

Future Scope-There is a future potential of this idea.The use of high rating solar panel along with

efficient motor drivers can make it possible that this machine is used at mass level.More over efficiency of solar panels can also be increased by Dual Axis Solar Tracking Sun Follower systems.Moreover there is no need of expensive devices like mobiles .So it can be operated by even laborers.Though system is wired but it is flexible because wireless systems also suffer from various type of problems like high cost and fast failures etc.So system will be easily adopted due to its low cost and great reliability.

References

[1] “Design and Fabrication of a Solar Operated Lawnmower” by Adubika Oluwatobi Akinyemi and Adebayo Solomon Damilare published in International Journal of Innovative Science and Research Technology,October 2020

[2] “A Fully Automated Lawn Cutter using Solar Panel” by Ramya. P, Yogesh Sharma, Kondeti Veerendra, Shailendra Kumar, Hitesh Ritolia published in International Journal of Engineering Science and Computing ,2020

[3] “Android Controlled Solar based Grass Cutter Robot”by M/s. Snehal Popat Jagdale published in International Journal of Engineering Research & Technology (IJERT),July 2020

[4] “IOT Based Grass Cutter Using Solar Energy” by Niveditha T R, Bhuvaneshwari S M, Bhoomika N P, Likith B G, Prof. Apoorvashree H L published in International Journal of Innovative Research in Technology ,June 2020

[5] “Design and Development of Smart Solar Grass Cutter” by Firas B. Ismail, Nizar F.O. Al-Muhsen, Fazreen A. Fuzi, A. Zukipli published in International Journal of Engineering and Advanced Technology (IJEAT) ,December 2019

[6] “SMART SOLAR GRASS CUTTER MACHINE” by Piyush Kumar Yadav, Ramsewak Bind, Rakesh Kesharwani, Praveen Kumar Shah, Mr.Devashish Tiwari Published in International Research Journal of Engineering and Technology (IRJET),May 2019

[7] “Solar based Robot for Garden Grass Cutting and Watering Plants” by Gokul T S, Arunkumar C published in Global Research and Development Journal for Engineering ,May 2019

[8] “Solar Economical Grass Cutter” by Akshay A. Dhabale, Dipali B. Bachhav,Ashwini M. More, Nurmohammad R. Tadvi,Ms. Shubhangi G. Kamble published in International Research Journal of Engineering and Technology,April 2019

[9] “ Solar Based Grass Cutter” by P. V. Tambolkar, A. R. Panchal, S. P. Kshirsagar,Prof. Y. S. Ghodake in International Journal of Advance Research and Innovative Ideas in Education ,2019

[10] “Dual Axis Solar Tracker” by Ahmad Imran bin Ibrahim, Farah Diyana binti Abdul Rahman, Muazzin bin Rohaizat in International Journal of Electrical and Computer Engineering (IJECE)

[11] “History of Lawn Mowers” University of South Florida,Scholar Common ,27 April 2012

[12] <https://www.powerstream.com/SLA.html>