

# Automated Solar Lawn Mower Using MATLAB

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**Abstract**— Rapid growth of various high-tech tools and equipment's makes our jobs comfortable and easy. So, automation plays a vital role in the agricultural field which is helpful for the farmers as well as gardeners. In the earlier days, the grass cutters used were manually handheld devices which was a time consuming and tiring activity. Also 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 necessitated the use of the abundant solar energy from the sun as a green source of power to drive a grass cutter. This project aims at fabricating a grass cutter-based motor running through solar energy which is automatically driven through MATLAB. A solar powered grass cutter is designed and developed, based on the general principle of mowing. This project deals with design of solar powered grass cutter comprises of direct current (D.C) motor, Arduino Unos, RF Transmission, a rechargeable battery, ultra-sonic sensor, solar panel, a stainless-steel blade and control switch and MATLAB software.

**Keywords:** Solar energy, grass cutter, Arduino Uno, RF Transmission, Ultrasonic Sensor, MATLAB

## I. INTRODUCTION

Energy has been defined as the ability to do work. This definition encompasses energy in its various forms as it is measured in terms of work done. The various energy forms be it mechanical, electrical or chemical are changing our day to day lives. The renewable source of energy which is a clean source of energy is a better solution for our environment such as solar energy, wind energy, hydro energy, geothermal energy etc.

The word 'solar' literary means connected with the sun. Hence solar energy is energy from the sun which can be in form of light for illuminating the earth and for photosynthesis or in form of heat (radiation) for heating up the earth, drying clothes and for preservation of some food crops. As we know, electrical energy readily puts all other forms of energy into consideration in terms of their quick conversion and usage. Electrical energy is therefore a hub for other forms of energy since it is easily stored and readily available. Solar power therefore simply means solar energy for electricity or the sun for electricity therefore puts the vast energy of the sun into use. Therefore, solar powered lawn mower is better than that powered by internal combustion engines as it is pollution free. It is easy to use, less noisy and environmentally friendly. It does not require a gasoline engine mechanic. The solar mower with a charge station running on battery is an improvement of the electric cord lawn mower because it can be used in rural areas where there is no electricity. The extra stored energy can also be used for lighting up homes.

Due to increased availability of system on chips, the lawn mower can be automated very easily and also the reduced size and cost of DC motors causes the system to be

independent of fossil fuels to be able to tap into renewable energies. The presence of Ultrasonic sensors in a smaller and cheaper packaging cause to be more aware of its surroundings. The Ultra-sonic sensor which is programmed using MATLAB acts as an eye for the grass cutting robot. The programming is done so as to avoid obstacle in the range of 50 cm and automatically makes a 90° turn to the right as soon as obstacle is detected. Traditional design of Grass Cutter had motored powered engines which required regular maintenance such as engine oil and greasing. In the cold and harsh environment, the fossil fuel powered motors tend to freeze and not run. These problems are solved by using electric motors. They are also much greener because they use solar panel.

## II. LITERATURE REVIEW

### A. Review of Research Papers

#### 1) S.Arivoli (2017) [1]

This paper describes the working of grass cutter work in two modes that is automatic and manual. All hardware and software operations are controlled by ATmega microcontroller. In manual mode the wireless communication between remote and robot is performed by the RF modules which covers a range of 50m. For obstacle detection the robot is developed with IR sensor. 4 motors are used, one for grass cutting and 2 for wheels. Driver IC L293D used to drive the motors. The entire circuitry is connected with 12v battery. By using keypad, the expected task is performed in the manual mode to operate the robot. For transmission and reception of the information between remote and robot, RF module is used and to display the fetched information related to the detection of hurdle, 16x2 LCD module is used.

#### 2) Darwin Ramos, Jessie Lucero (2009) [2]

The study of this research paper is necessary to know the basic design of the robot. It discusses about the design of the robot which consist a microcontroller, multiple sensors and a solar charging system. Robot due to the presence of different sensors was able to detect its surrounding. It used ADXL335 accelerometer, RB-PIX-75 IR sensor, LV- Maxsonar-EZ1 Ultrasonic sensor, HHH-4000 Humidity sensor. It used NiMH battery which was best about 10 years ago due to low charging current that would not overcharge. For path to be followed it used PWM technique for the automatic motion of the bot. The PWM controlled the speed of each motor. Higher the voltage given to robot the faster the motor moved. The top PWM signal moved the motors slower than the lower PWM signal.

#### 3) Srishti Jain et al., (2015) [3]

This paper proposes a solar powered vision based robotic lawn mower which is an autonomous lawn mower allowed the user the ability to cut the grass with minimum effort. This design requires no perimeter wires to maintain the robot within the lawn and also with less human effort in the manual

mode operation. Through an array of sensors safety takes major consideration in the device, this robot stayed on the lawn, and avoided and detected objects and humans. The robot was having a 12v 310mA solar panel which efficiently synthesized the sunlight. There were 24 solar cells on the solar panel, each contributing to 0.5v each. To detect the obstacles, it used IR sensors which has 1m 555 IC. The IR sensor allowed the robot to judge the surrounding by continuously emitting IR waves.

4) *Ashish Kumar Choudhry et al., (2016) [4]*

This paper was useful in understanding the regulation pattern of solar energy. Solar plates were placed above the grass cutter so as to collect maximum solar energy and use this energy for the working of grass cutter. Driver circuit consist of ATmega microcontroller for controlling the speed of the motor as per the requirement. However, there was no automation in the robot and all the operations were needed manual assistance. For preventing the battery from overcharging and the over-discharging regulator was placed into the system and it was placed in series. Further there was a LCD display unit which displayed voltage generated during solar rays trapping. Due to seasonal conditions if the battery was not charged it can be provided by the power bank to charge the battery instantly.

5) *Gordon Carlson (1961) [5]*

This was the first ever idea of an automated lawn mower. It used most simple technology. With no microchip it was based on electromagnetic induction. A length of ordinary plastic covered hookup wire is buried about 1 inch under the lawn in the pattern the grass is to be cut. It had two pickup coils about 6 inches apart and 2 inch above the lawn. Small alternative current was passed through the buried wire which set electromagnetic field. Further, it drove the mower due to electromagnetism. The amplitude of these voltages increases as the coil move nearer the wire. If the coils were equally distant from wire, the induced voltages were equal. That laid the foundation of modern automated lawn mowers, hence was the first step towards the future.

6) *G K Balaji et al., (2019) [6]*

This paper describes the design and fabrication of the solar-powered grass cutter. The unique aspect of this project is the use of technology to make the frame. The frame design was made using AutoCAD and it provided as base to fabricate and assemble other components and 3D assembly model design was done using Creo2.0. The robot could be controlled through an application in the smartphone which could configure itself with the Arduino board. The Bluetooth transceiver transmitted the incoming RF waves to the configured device so that the setup is moved and simultaneously grass is cut down. The DC Motor controller was used which integrated the motors situated on the four corners of the wheel and makes it work together while running the setup. The main aim was to control within a specific range. Hence it assured that this equipment can be used to cut grasses on plain fields such as cricket and football grounds.

7) *P.Amrutesh et al., (2014) [7]*

Scotch Yoke technique was used in this project by which the solar powered grass cutter cut the grass. It had panels mounted in a particular arrangement at an angle of 45 degrees in such a way that it could receive solar radiation with high

intensity easily from the sun. The Scotch yoke (also known as slotted link mechanism) is a reciprocating motion mechanism, converting the linear motion of a slider into rotational motion or vice versa. The piston or other reciprocating part is directly coupled to a sliding yoke with a slot that engages a pin on the rotating part. When the power was transmitted to the mechanism, made the blade to slide on the fixed blade and then that made the machine to cut the grass.

8) *Ms. Lanka Priyanka et al., (2015) [8]*

This project mainly focused on the maximum extent to which the solar energy could be converted to electrical energy. The controlling device of the whole system was provided using LM358 comparator. It took the inputs from the user itself through switch and switched ON the DC motor interfaced with grass cutting blades. It consisted of two sections, one is the controlling and other is designing. The controlling section consisted of battery, LM358 comparator, Relay switches, temperature sensor and solar panel. Relay switches were used in two ways: - for checking the overcharging of the battery and regulating the temperature of the robot. If it exceeded the threshold temperature the relay automatically switched it off.

9) *Er. Vikrant Tomar, Shewta Sengar (2016) [9]*

This paper described about the Semi-Autonomous car having the function of detecting the lanes of the road and keep itself in the lane, also having the feature of detecting obstacles and presence of human that help it to drive slow or fast or brake. It was important to know about how MATLAB would be used for any vehicle to move it autonomously. The live video is capturing with help of the camera and then this video is transmitted to MATLAB Software through Camera-MATLAB interface. After which various sub programs were applied on this signal, such as: Hough Transform, Local Maxima Finder, Colour Space Converter, etc. than that signal was displayed through Video Out function of MATLAB Software and also the resultant action on the basis of these sub programs are sent to the Arduino for controlling and further processing.

10) *Akshay Haria, Dhaval Dethaliya (2017) [10]*

The solar panel here used was not polycrystalline or any thin film. The new technology used here was Monocrystalline panel which is more efficient. Monocrystalline panels are generally constructed from high quality silicon cell. In this project, solar panel which was used was in between ratio of 12V and 240mA. This solar panel was connected with the 12V battery through the solar battery charger. The feature that stands out in their model is the use of an LCD screen and keypad system to allow user to provide input regarding the area to be cut in terms of X and Y axis. This allowed for customizing the cutting patterns, for instances cutting the lawn area in shapes of letters or words. The technological microcontroller here used was ATmega8 microcontroller. It has a low-power Atmel 8-bit AVR RISC-based microcontroller which combines 8KB of programmable flash memory, 1KB of SRAM, 512B EEPROM, and a 6 to 8 channel 10bit A/D converter. The device supports throughput of 16MIPS at 16-MHz and operate between 4.5-5.5 volts. In this controller 23 I/O programmable lines are available. Hence it matched all the criteria for the processor used to run the robot.

11) *V.Kubendran et al., (2018) [11]*

This paper discussed about new development in boundary detection made by the robot. It used ultrasonic sensor for the object detection and LDR's for boundary detection. The whole procedure can be understood by studying the laser pattern. The laser beam A, when detected, causes the start event and the robot moves forward until it detects laser beam B. When laser beam B is detected the robot stops for the time period of two seconds and then takes a right angle turn and moves forward by 8 inches and takes another right angle turn and starts moving forward. This step is repeated until the laser beam C detected along with laser beam A. When laser Beam A and C are detected triggers the stop event. The ultrasonic sensor was placed at an angle of 15 degrees and set to minimum detection range of two feet to the common axis. The LDRs were placed at perpendicular to each other. This is how the robot would detect the boundary and cut the grass in the desired area.

12) *Shyam Lal Sharma (2019) [12]*

This project designed an automated grass cutter which used solar energy. The basic component used are solar panels, batteries, DC motors, ATMEGA8 microcontroller, solar charger and ultrasonic sensor. It used 12v rechargeable battery of 7Ah which used Lead Acid based technology. Atmega 8-bit AVR RISC based microcontroller used C++ as programming language. Solar charger can charge lead acid battery banks up to 48V and hundreds of ampere-hours capacity.

13) *Prof. Rohini P. Onkare et al., (2018) [13]*

The alternative regarding the technology in mode of motion used is described in this project. This system used four wheels, two wheels on right side and two left side with 45 rpm, 6v DC geared motors. The motor was controlled by the signal coming from the microcontroller. The robot used IR sensor to detect any obstacle in front of it. However, it gave it a disadvantage over accuracy and resolution. It had H-bridge circuit using IC L293D which was used as driver circuit for the four motors. The microcontroller gave signal to four motors depending upon signal coming from IR remote control. In manual mode commands were given through IR remote controller by the user. It used UART (Universal Asynchronous Receiver-Transmitter) for communication between microcontroller and IR decoder. In this type of communication, the data is transmitted asynchronously. This means there is no clock or other timing signal involved between the sender and receiver.

14) *Vicky Jain (2016) [14]*

This system was designed considering the language used to configure the robot. As traditional grass cutter it consisted of Atmel 32-bit AVR microcontroller, RF transmission, L293D motor driver, DC motor and a rechargeable battery. This robot was powered by solar energy for recharging the battery. It used Priority encoder, RF encoder, RF decoder for encoding and decoding respectively. That meant it was not autonomous, it had to be controlled by an RF remote controller. This robot is configured using MikroC IDE which takes C code. Since it used "C" language it was easier to configure and execute.

15) *Sanjana Arunesh et al., (2016) [15]*

This proposed paper used RF technology for transmission of signals. The corresponding frequency ranged from 30khz to

300Ghz. This robot used AVR microcontroller (Alf and Vegard's RISC). An RF transmitter transmitted serial data and it wirelessly used RF waves through its antenna. The transmission occurred at the rate of 1Kbps-10Kbps. The transmitted data was received by an RF receiver operating at the same frequency as that of the transmitter. The RF module was used along with a pair of encoder/decoder; the encoder was used for encoding parallel data for transmission feed, while reception was decoded by a decoder. It used an IDE for developing and debugging AVR microcontroller which was written in C/C++. Solar panel is the basic source for recharging the battery and for navigation it used ultrasonic sensor.

### III. CONCLUSION

Many researchers have contributed for development of an Automated Solar Lawn Mower using different technologies based on solar panels, battery, sensors used or languages used to configure the robot. In the world today, all machines are designed with the aim of reducing or eliminating greenhouse gas emission which is the major causes of climate change. The development of solar powered lawn mower will meet the challenge of environmental production and low cost of operation since there is no cost of operation since there is no cost for fuel. A solar powered lawn mower can be developed for the use of residence and establishments that have lawns where tractor driver mowers could not be used.

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