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Fabrication of Automatic Solar Lawn Mower

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ABSTRACT: Lawn mowing is considered to be one of the most boring and tiring routine household tasks, but mowing the lawn is a very important part of proper yard care and properly cut lawn is something that is very pleasant to behold which gives the lawn an orderly appearance. Our project aims at easing the lawn Mowing experience.

We aim on making a lawn mower which is environmental friendly as well as user friendly and automatic. The lawn mowing job with motor powered lawnmower is an inconvenience, it becomes difficult for the disabled and elderly people to cut the grass with the help of these mowers. The main focus was to design a prototype that is able to work with a little or no user interaction. Every action of the lawn mower is monitored by the PIC microcontroller with the help of the sensor. Unlike other robotic lawn mowers on the market, this design requires no perimeter wires to maintain the robot within the lawn.

KEYWORDS: Solar power, Arduino, lawn mower, Sensors

Nomenclature:

PIC	Peripheral Interface Controller.
IR	Infrared
Ω	Angular velocity
T	Torque
M	Bending moment
P	Load
R	Radius
F _c	Centrifugal force
DC motor	Direct Current motor
V	Volts
A	Amperes
W	Watts

I .INTRODUCTION

Intelligent robots are a vision, all intelligent robot mowers work precisely, using multiple degrees of co-ordinated motion and do something like a human, they mimic expected human responses, they learn from humans without making mistakes. Over the years, there have been numerous developments in lawn mower technology. But with technological advancement there also arises the need to check the impact of machines on the environment as well as on man. Pollution is the major concern with the conventional lawn mowers. Fully Automated Solar Grass Cutting device is a device which cuts the grass on its own. This device reduces both environmental and noise pollution. It is made with help of grass cutter, ultrasonic sensors, vehicle motors, robotic body and high quality crystalline panels. The system

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uses 12V battery to power the vehicle movement motors as well as the grass cutter motor. A solar panel is used to charge the battery so that there is no need of charging it externally. On obstacle detection the ultrasonic sensor monitors it and the microcontroller thus stops the grass cutter motor to avoid any damage to the object/human/animal whatever it is, the microcontroller then turns the vehicle as long as it gets clear of the object and then moves the grass cutter in forward direction again otherwise it changes the direction. We designed a foldable solar panel which comprises of cells which are made up of Silicon Alloy these cells are framed inside an Acrylic sheet and is provided with a covering with Carbon Vinyl. A motor of 100 RPM is also incorporated so that it will provide a desired height to the cutter. The mower is started with the applications which are easily available in the app store also it provides a joystick or remote type control which will permit the user to control its direction according to its requirement.

II. RELATED WORK

Sivarao, T.J.S. Anand et al,2010 presented a review of researches done on the subject of Automated tractor. An autonomous tractor is a vehicle that can operate without or with minimal human control, self-propelled and guided automatically along a desired path. The benefits from such a system are useful for agriculture industry by reducing labour cost and time, as well as improving output efficiency by eliminating human errors. Many researches and inventions have been made, with the results ranging from successful, encouraging to some that are impractical for commercial implementation for certain reasons.[1]**Pratik Patil et al,(2017)** described about an automatic lawn cutter that will help the user to cut the grass in their lawn with less efforts. The different sensors are used it will detect and avoid objects and humans while mowing. The main objective of this automatic lawn cutter is that the user can specify the area that is to be mown and also the height of grass as per their requirement by using the keypad. This design contains a microcontroller like AT mega 16, multiple sensors, LCD Display, Keypad.[2]**Ernest L. Hall,(2014)** another example of an autonomous lawn cutting system is called the Weed Eater developed by the Weed Eater Corporation. The system is a solar powered emission free mower that harnesses enough power to operate itself. The robot is equipped with 34 iridescent solar cells embedded on top of the systems platform and has the capability of handling properties up to 13,500 sq-ft. The system operates on the same principle as the Lawn Ranger except it uses a cable beneath the surface of a person's lawn. [3]**Husqvarna,(2011)** A Swedish manufacturer, has also introduced its Automatic Mower to the U. S. market (it's been sold in Austria and Germany for about three years). It works much the same as the Rob mow with a boundary wire implanted at the border of your lawn. The Husqvarna model, however, takes care of itself. Whereas the Rob mow has to be taken out and set up and watched by the owner, the Husqvarna Automatic Mower lives outside, mows when it's programmed to mow and automatically returns to its base for recharging.[4]**Srishti Jain et al,(2015)** Self-Efficient and Sustainable Solar Powered Robotic Lawn Mower. (December 2015) This paper proposes a solar powered vision based robotic lawn mower which is an autonomous lawn mower that will allow the user the ability to cut the grass with minimum effort. Unlike other robotic lawn mowers in the market, 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 will not only stay on the lawn, it will avoid and detect objects and humans. Here they used a 12v 310mA solar panel in their project. There are 24 solar cells on the solar panel, each contributing to 0.5v each. They could attach a battery but as the lead acid rechargeable battery used is rated 12v 1.2Ah, it won't be overcharged due to the small output of solar panel. To detect the obstacles, they used IR sensors which has 1m 555 IC.[5]

III. OBJECTIVE

This project is suitable for common man as it has many advantages i.e., no fuel cost, no pollution, no fuel residue, and less wear and tear. This provides less physical exercise to the people and can be easily handled. As we are nearer to Equator, the solar energy is vastly available so it's very easy to charge the battery. In a Country like India there should be more encouragement in the automation.

The objectives of this research are:

- i. To develop a prototype that reduces end user work through the utilization of an easy-to-use device.
- ii. To extend the design of currently used field mowers.

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Vol. 7, Issue 4, April 2018

- iii. To design the project so that it will be easy to use after its first mowing session as there is no user interaction required.
- iv. To detect and avoid obstacles that enables the safety of our prototype as well as the surroundings.
- v. To make the prototype environmentally friendly as the only resource needed is electricity which is stored in their battery.

IV. METHODOLOGY

The solar grass cutter has panels mounted in a arrangement at an angle in such a way that it can receive solar radiation with high intensity easily from the sun. These solar panels convert solar energy into electrical energy. This machine consists of the photovoltaic, dc to dc converter, motor, controller, linear blades, and battery. It is an automated system for the purpose of grass cutting.

Solar Grass Cutter uses solar power as an energy source that addresses a number of issues that standard internal combustion engine mowers do not. An electric grass cutter with a solar charger will be easier to use. There is no messy, dangerous gasoline to deal with, most importantly it eliminates the emissions of an internal combustion mower. The method is as follows:

- i. An Arduino Uno control board will act as a processing unit and direct the entire working of the mower as per a presented programme.
- ii. The motion of the mower is controlled by four DC motors of 200 rpm.
- iii. A height adjustment rack and pinion mechanism has been incorporated to the cutter motor to enable different heights of cutting.
- iv. A Solar panel will charge the battery and eventually power six motors, four of which are for motion of the mower and the other two are of the cutter blade and height adjustment mechanism of the cutter.
- v. IR Sensors are used to detect and avoid obstacles.

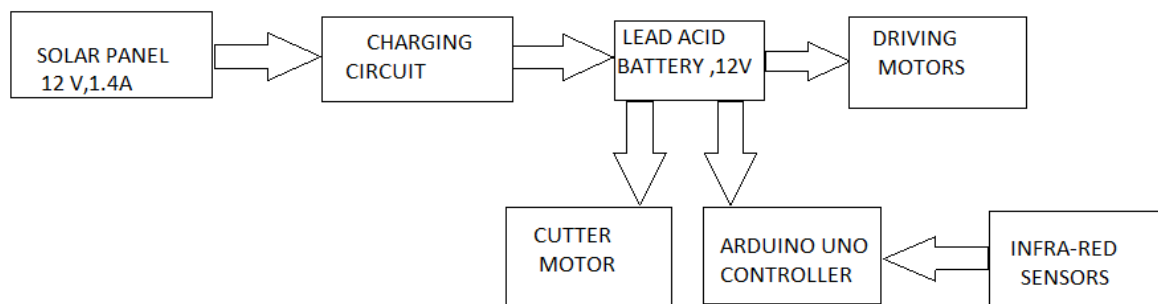


Fig.1 BLOCK DIAGRAM OF MOWER.

Fig 1 shows the block diagram of the basic working principle of the mower.

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Vol. 7, Issue 4, April 2018

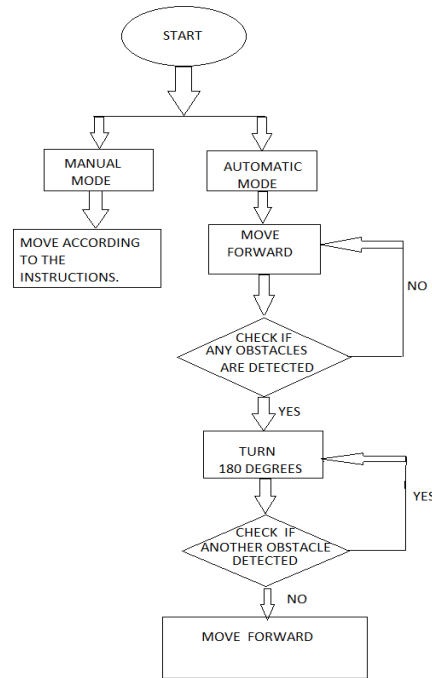


Fig 2 WORKING OF THE MOWER

Fig 2 shows the working of the mower as per the commands given to it manual or automatic.

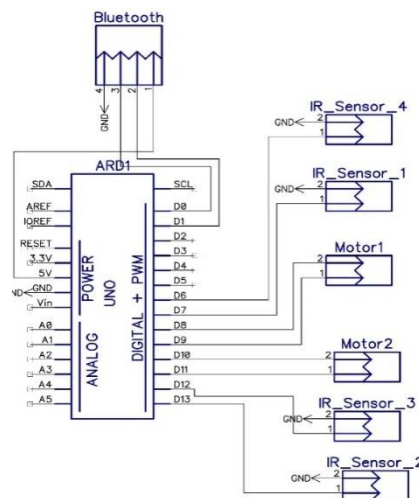


FIG 3 .CIRCUIT DIAGRAM.

Fig 3.shows the circuit diagram of the electronic circuit of the Arduino with other components of the mower.

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Vol. 7, Issue 4, April 2018

V. DESIGN CALCULATIONS

For mowing blade:

Rotary blade is being used.

Dimensions: Radius=100mm, Width=1.6mm.

Area= $100 \times 2\pi = 6283.185\text{mm}^2$

Volume= $6283.185 \times 1.6\text{mm} = 10053.096\text{mm}^3$

Mass=330g

Torque on cutting blade

Weight, $W = Mg = 330 \times 9.81 = 3.23\text{N}$.

Torque= $Wr = 323\text{Nm}$.

Power:

Angular velocity= $\omega = \pi 2N/60 = 1884.955\text{rad/s}$

Power= $T \cdot \omega = 6.088\text{Watts}$

Centrifugal force produced by blade

$F_c = m\omega^2 r = 62.20\text{N}$



FIG 4 CUTTER BLADE

Design for frame:

According to availability and cost considerations a GI sheet frame was used .

The frame is supported on 4 wheels .

The dimensions of the frame are 250×200mm and height of about 60mm.

The load to be carried is estimated to be about 5kg balanced on 4 wheels with each wheel at a distance of 300mm from other.

The bending moment= $M = PL/4$.

Load $P = 5 \times 9.81 = 49.05 = 50\text{N}$.

The load is equally shared

Therefore, $P = 50/4 = 12.5\text{N}$.

$M = 937.5\text{Nmm}$.

We have prepared the model consisting of 4 Wheels with 4 Motors of 200 RPM.

We have done the fabrication of two chassis by welding and fitted the cutter in the centre.

The Cutter is provided with motor having 18000 RPM.

The cutter motor has been provided with adjustment that is equipped with another motor of 100 RPM which provides the height adjustments along with the Rack and pinion Mechanisms

This mechanism will help the Mower for providing suitable lift to the cutter.

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Design for solar panel:

The maximum voltage output of a silicon cell used is 0.5Volts and current ratings are 1.4A per cell.

24 cells were connected in series and checked for output in bright sunlight.

The total voltage= $0.5 \times 24 = 12V$.

Checked Current=1.54A

Power= $V.I = 18W$ (approx.).

The solar panel will be connected to the battery via a solar charging controller and from battery to motor. The foldable solar panel is made using 24 silicon cells each of the dimension 156 X 26 sq.mm connected together in series

The dimensions of the solar panels are 420 X 420 sq.mm and which can be easily folded into 2 parts weighing only 350-400 grams

The cells are made up of silicon

Each cell gives 0.5V and 1.4A giving an output of 0.7W respectively

The configurations of the Panels:

P Max: 18W

Impp: 1.4 A

Vmpp: 12 W



FIG 5 FOLDABLE SOLAR PANEL.

VI. RESULTS



FIG 6 . ASSEMBLED MODEL OF THE SOLAR LAWN MOWER

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Vol. 7, Issue 4, April 2018

Working of the mower was tested on outdoor grassy area and the following observations were made:

Faster cutting rate as compared to traditional mowers.

Increased Accuracy.

Reduced human efforts.

Reliable working.

Minimized working time.

User friendly.

Removes humans from exposure to dust, pollen and allergies.

Removes humans from danger of mowing blade.

Mows your lawn by pressing a button.

Can cut multiple small areas.

Offers highest cutting height.

Easy Charging.

Weatherproof

Least Expensive

VII. CONCLUSIONS

Robotics is very vast field which comes with different combinations of technology this will helps to reduce the human effort and gives maximum efficient output for the work, nowadays lot of energy is wasted for mowing lawn in different areas of the world and also takes lots of human effort for the work. The main aim of this project is to make a solar powered automated robotic lawn mower system which will helps to mows the lawn in different design with lesser human effort. Advantages of this system are used components are of low cost and light weight. From the critical review of the related literature, advantages of each system are studied with their respective design constraints, cost and limitations. Therefore, a strategized system is proposed to develop a successful automated grass cutting systems, in which the proposed could be implemented commercially with minimal production and operating cost.

It is intended to prepare a prototype of the lawn mower which satisfies the requirements of the customers. Simple and attractive design with good performance should be the primary objective while designing a lawn mower. Keeping in mind all of these customer requirements, all of the calculations of mechanical design has been successfully done. These calculations were helpful while designing and preparing mechanical structure of the mower. The attractive look, safe system and good path planning technique are considered to be the main objective of this study.

REFERENCES

- [1]Sivarao,T.J.S Anand, Hambali, Minhat, Faizul , "Solar powered grass cutting machine",International journal od advanced electronics and instrumentation engineering, Vol.6,Issue 4,April 2017.
- [2] Pratik Patil, Ashwini Bhosale, Prof.SheetalJagtap, " Fully Automated Solar Grass Cutter", International journal of Science Technology and Engineering, Vol.3,Issue 9, May 2017
- [3] Ernest L. Hall , " A Survey of Robot Lawn Mowers", Conference Paper in Proceedings of SPIE, May 2014
- [4] Husqvarna , Swedish Manufacturer, http://www.husqvarna.com/index_body.htm ,2014
- [5] Srishti Jain, Amar Khalore , Shashikant Patil, " Self Efficient and Sustainable Solar Powered Robotic Lawn Mower", Vol.2, Dec 2015.
- [6] M. Baloch, " Design and modelling a prototype of Artificial Intelligence robots ", International IEEE Conference on Robotics and Automation, vol. 4, pp. 1277-1286, New York, Jan, 2015.
- [7] P. Tint & G. Tarmas, T. Koppel, K. Reinhold and S. Kalle, Vibration and noise caused by lawn maintenance machines in association with risk to health,AgronomyResearchBiosystem Engineering Special Issue 1(2012) 251260.
- [8] Muhammad Wasif, Design and Implementation of Autonomous Lawn- Mower Robot Controller, IEEE978-1- 45770768(2011).
- [9] Jason Smith, Scott Campbell, Jade Morton (July 2005). Design and Implementation of a Control Algorithm for an Autonomous Lawnmower. Department of Electrical and Computer Engineering Miami University. 456-459. Retrieved on May 6, 2009 from IEEE explore.
- [10] AaqibGulzar Khan &Adeel-ul-HaqQurishi, Commercial Grass Cutting cum Collecting Machine, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Volume 10, Issue 1 (Nov. - Dec. 2013), PP 35-38. 5. Basil Okafor, Simple Design of Self-Powered Lawn Mower, International Journal of Engineering and Technology Volume 3 No. 10, October, 2013.
- [11] Guoping Wang, and Zhuming Bi, Incorporating Systems Engineering Into The Senior Design – Autonomous Lawn Mowing Machine,American Society for Engineering Education March 17, 2012
- [12] Technical Solutions, J. Hammond and R. Rafaels, "Build the Lawn Ranger," Radio Electronics, June 1990, pp. 31-49.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 4, April 2018

- [13]. Weed Eater Corporation, "Attractive Lawns Without Exertion, Robotics World, Summer 1994, pp. 48.
[14]. Russell G.Nelson; U.S. Patent 5,974,347, Automated lawn mower , October 26, 1999.
[15]. Robert Zondlo, U.S. Patent 5,461,292, Remote controlled guidance system for working vehicle ,October 24, 1995.
[16]. Andre Colens, U.S. Patent 5,444,965, Continuous and autonomous mowing system , August 29, 1995.

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