



Robotic Solar Lawnmower

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Abstract : A lawnmower can be defined as a machine that uses revolving blades to cut grass surface to uniform height. Lawnmowers are primarily used for cutting uneven grass surface on sports grounds and extensive gardens. There are several types of grass cutting machine or lawnmowers presently in use. Our Project proposes easy and efficient method to cut grass using solar power. It is capable of detecting and avoiding obstacles also it functions without any human interaction. This project is equipped with a solar panel which is used to charge the battery, 12V rechargeable batteries are used. Microcontroller Arduino UNO is interfaced with ultrasonic sensor and is used to control the movement and motion of lawnmower. The arduino UNO is interfaced with motor driver IC and ultrasonic sensor for control and for detecting obstacles, this enables smooth operation of the lawnmower without any havoc. The motors of the revolving blades and the vehicle wheels are connected to the UNO board which controls working of all the motors. An Ultrasonic sensor is interfaced for object detection. The robotic lawnmower is programmed in embedded C language using Arduino IDE software in such a way that the microcontroller moves the vehicle motors in forward direction when no obstacle is detected, on detection of any obstacle the ultrasonic sensor senses and provide signal to the microcontroller, hence it stops rotation of cutter blades to avoid any damage to object/human/animal or whatever it is. The microcontroller then changes the direction of the robotic grass cutter until the object is out of its way and the grass cutter moves again in forward direction..

IndexTerms – Lawnmower, Solar Energy, Solar bus, Motor.

I. INTRODUCTION

A grass cutter or a lawnmower is used to cut the uneven grasses in gardens, lawns and playgrounds in order to maintain them and make it look beautiful and attractive. For this purpose lawnmowers are used regularly in large gardens, cricket fields and playgrounds. The conventional and manually operated lawnmowers might not be able to perform the grass cutting function perfectly with accuracy. Hence there is a requirement for automated grass cutters to give maximum accuracy with minimum human interaction for maintaining gardens and playgrounds. In the near past and even until now, cutting of grasses in gardens, schools, sports tracks, fields, industries, hotels, public center, etc. was done with the use of mechanical grass cutting machines. This method of manual cutting was time consuming and also inaccuracy in cutting was observed as human effort is needed for motion and usability of machines. The first kind of lawnmower was first invented by Edwin Budding in 1830. This machine was made of iron frame, the mower was to be pushed by behind. Cast iron gear wheels transmitted power from the rear roller to the cutting cylinder. There are several types of lawnmowers available in the market. Cylinder or reel mowers: A cylinder mower or a reel mower carries a fixed horizontal cutting blade at desired height of cut. Over this a fast spinning reel of blades which force the blades past the cutting bar. Rotary mowers: This type of mowers rotates about a vertical axis with a blade spinning at high speed relying on impact to cut the grass. Gasoline (petrol/diesel): This type of lawn mowers are powered by vertical shaft single cylinder petrol/diesel engine. Electricity: These are powered by rechargeable batteries to perform the cutting operation.

All these types of conventional lawnmowers are not economical as most of them need human effort to perform the grass cutting and moreover the petrol/diesel powered lawnmowers produce hazardous gases and sounds up to 90dB and more, which causes air and noise pollution respectively.

According to a survey lawnmowers contribute 33% to total pollution in metropolitan areas. This project intends to make grass cutting fully automatic by using solar power, to avoid usage of conventional energy sources such as petrol and diesel which produces gases that affect the environment. In this project we are using Microcontroller- Arduino Uno, Solar panel, DC motors, a Battery, motor driver, ultrasonic sensor, rain sensor and LED display.

Arduino Uno acts as a brain for this project as all other components are interfaced with it and this controls the movement and functioning of the lawnmower. A high quality crystalline solar panel of 20 MW is being used to receive energy from the sun in order to charge the 12V Li-ion battery. Four DC motors are used, a 5000 RPM motor to provide high rotational speed to the blades, and two 60 RPM motors for motion of the lawnmower in forward and backward direction. An ultrasonic sensor is used to provide signal to arduino if any obstacle is detected during the cutting process, Hence if the obstacle is detected the lawnmower stops the operation and moves in other direction. A rain sensor is used to detect rain and to stop the operation when it rains in order to avoid the damage of the machine. LCD display is used for better understanding of the machine by the user. Hence the operation of the

lawnmower can be made fully automatic with minimum human interaction this could save the labor cost to some extent and usage of solar panel completely eliminates the fuel cost. Thus this project helps in maintaining the gardens and playgrounds effectively.

2. LITERATURE SURVEY

In [1] Paper Present the design of Solar based Robot for Garden Grass Cutting and Watering Plants The authors gives the idea about developing this Solar based Robot for garden grass cutting and watering Plants, the idea is based on IoT for cutting grass and watering which helps farmers without much manual interaction, they have made some changes in the existing machine to make its application easier at reduced cost. Their main aim was to control pollution. It was published in 2019 National Conference on Emerging Research Trend in Electrical and Electronics Engineering .

In [2] Paper Present the design of Design of a fully Automated Solar Grass Cutter for campus cleaning: The authors have given a brief description of how grass cutting is a time-consuming and labor-intensive process. They insisted on the technology that is available in the present-day for grass cutting operation which 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. This was published in 2020 International Journal of Creative Research Thoughts.

In [3] Paper Present the design of Solar Based Grass Cutter Using Remote Control Technique The main aim of the paper at developing a grass cutting machine which is operated on natural source of energy, the reason behind it is constantly increase in cost of fuel. The solar energy is plentifully available in nature. In present the manually handed grass cutter is commonly used. In this paper we try to make automatic grass cutter including obstacle detection unit. Due to the above features the damage to the hardware of the device is avoided. Our main objective is pollution control and the consumption of fuel or non-renewable energy source it was published in 2017 International Engineering Research Journal .

3. OUTCOME OF LITERATURE SURVEY

After studying the above papers and considering the different methods of building lawnmowers and taking in to picture the disadvantages of the conventional lawnmowers we came up with an idea of 'Robotic Solar Lawnmower' and it is basically powered by solar energy which a clean form of energy freely available in nature. This produces no harmful gases and no human interaction is required as it is fully automatic also it produces very less noise as compared to the conventional ones. The most important thing about the Robotic solar Lawnmower is that it is charged by the solar power so there will be no power loss on a good sunny day. If its cloudy or little sunlight is available the option of external charging is always there. This machine has special obstacle sensing and rain sensing ability using ultrasonic and rain sensors respectively. The ultrasonic sensor detects the object in all direction thus prevent any damage to the foreign object on the field.

4. PROBLEM STATEMENT

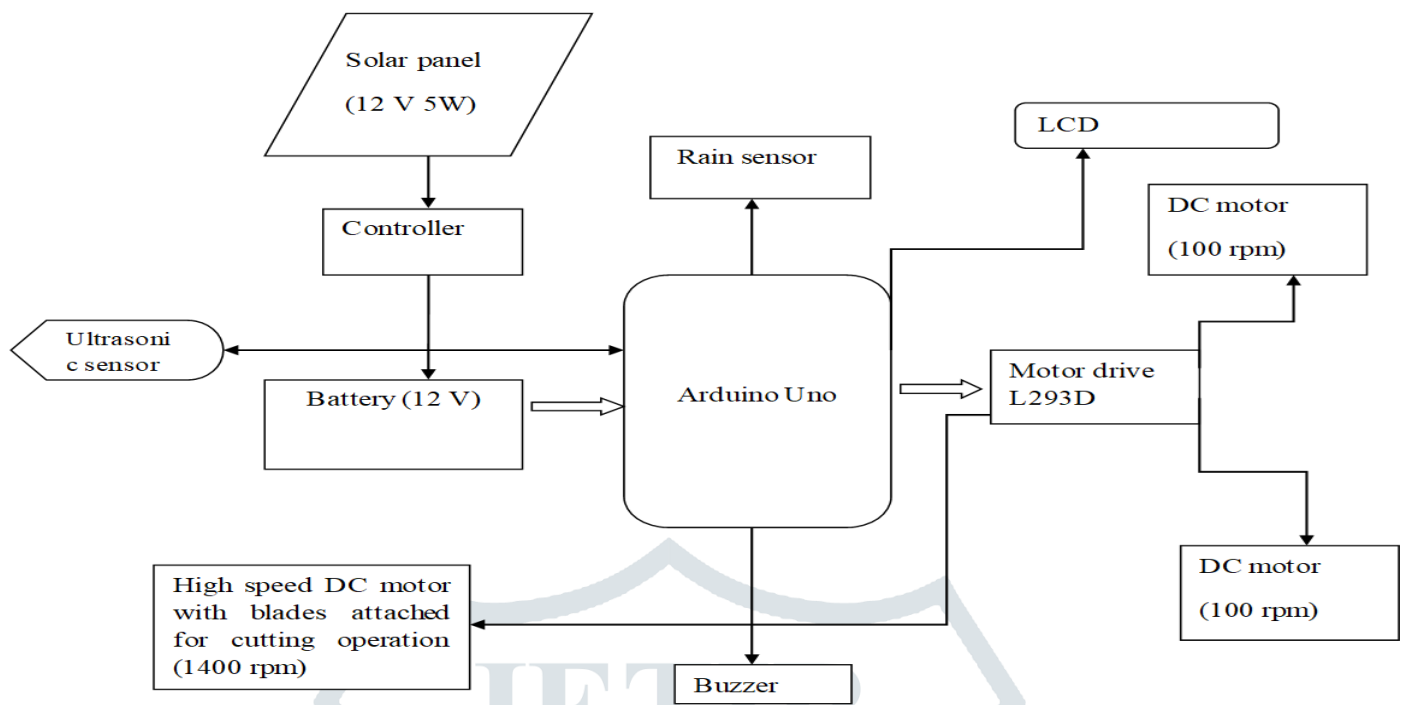
The conventional type lawnmowers are uneconomical, inaccurate, time consuming, need human effort and causes pollution. To overcome the same 'Robotic Solar Lawnmower' is proposed which eliminates all the above mentioned disadvantages of the conventional lawnmowers.

5. OBJECTIVES

The main Objectives of the project are:

- To make the grass cutting fully automatic and reduce human effort for cutting grass in lawns and fields.
- To use solar as a source of energy thereby reducing operating cost and pollution.

6 METHODOLOGY



Block Diagram of Robotic Solar Lawnmower.

The above figure shows the schematic block diagram of the Robotic Solar lawnmower. The solar panel is mounted over the machine in such a way that it could receive maximum sunlight. A 12V 10W solar panel is being used to charge 12 V batteries using a solar charging circuit. The charging circuit has a voltage regulator which regulates voltage to 15 V and one transistor to amplify the maximum current to the circuit. The 12 V battery supplies power to the whole circuit. The Microcontroller Arduino Uno is the brain of the lawnmower as it controls the functioning of the device in order to operate it automatically. An ultrasonic sensor and motor drive L298N is interfaced with arduino, the ultrasonic sensor detects the obstacle within 20cm range and gives feedback to the arduino then according to the program the arduino turns in other direction and continues the operation. The motor driver is further interfaced with three DC motors, the main purpose of using motor driver is because DC motors require minimum of 9V as input but the microcontroller board only gives 5V output so we require 9V to 12V for driving the motors, the rotation of the blade is performed by 5000 rpm high speed motor for grass cutting purpose and movement of lawnmower is done by using tow DC motors of 60 rpm. The relay switches are used for controlling movement of lawnmower and the cutting blade separately.

7. RESULTS AND DISCUSSIONS

The Robotic Solar Lawnmower is constructed and tested by using the proposed methodology. This automatic machine trims the grass surface to a even length which is set and programmed in the microcontroller. The lawnmower also avoids contact with any obstacle in its way as we are using ultrasonic sensor for this purpose, this also reduce the risk of any damage causing to the lawnmower as well as the obstacle. As soon as the sensor sense any obstacle the cutting motor stops rotating and also the lawnmower changes its path to other direction as set and programmed.

Machine Performance Evaluation

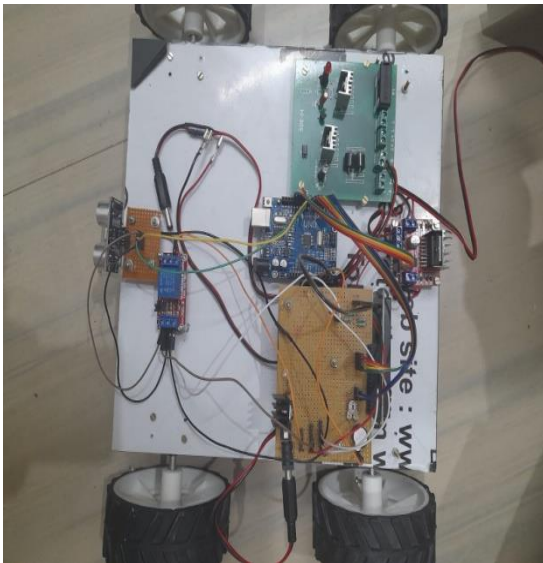
Calculations:

- Solar panel rated power = 10 W
- DC motor rated voltage = 12V, Rated current = 300mA
- DC Battery rated voltage = 12V , Ampere hour = 1.3Ah

Assumptions

- Solar panel efficiency = 18%
- DC Motor efficiency = 85%
- Battery charge/discharge efficiency=95%
- Operating hour per day= 1hr DC Motor power = $12 \times 300 \text{mA} = 36 \text{ W}$

- DC Motor o/p power supplied to wheel and blade = $36 \times 0.85 = 30.6 \text{ W}$
- Output power of Solar panel = $10 \times 0.18 = 1.8 \text{ W}$
- Time required to fully charge = $(12 \times 1.3) / 1.8 = 8.67 \sim 9 \text{ hours}$
- Output of the DC Battery supplied to the motor = $0.95 \times 12 \times 1.3 = 14.82 \text{ Wh}$
- Input power required for DC motor per day = 36 Wh
- Therefore, when the battery is fully charged the lawnmower can approximately be operated for:
- Operating time = $14.82 \text{ Wh} / 36 \text{ Wh/day} = 0.411 = 9.8 \text{ hrs.}$



8. ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- Solar panels eliminate the operating fuel cost.
- Human effort is reduced.
- Fast and accurate grass cutting.
- Causes no environmental pollution.
- User friendly.

DISADVANTAGES

- The charging speed of machine decreases on a cloudy day, which causes delay in completion of work.
- It cannot be used on a rainy day.

9. APPLICATIONS

- Robotic solar lawnmower can be used in large gardens, schools, hotels, industries, lawns and large playgrounds.

10. CONCLUSION

It consumes renewable source of energy i.e. solar energy which is abundantly available in the nature. The cutting of grass is made easier without human effort and also it produces less sound than the older ones. It causes no damage or any kind of pollution to the environment as net emission is zero. The automatic feature of this machine detects any obstacle during cutting process and stop the blades and further moves away in other direction in order to avoid any damage.

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