SOLAR POWERED INTELLIGENT GRASS CUTTER ROBOT

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***Abstract*: This paper presents the implementation details of an intelligent autonomous grass cutter that will provide the user the ability to cut the grass with only two inputs- length and breadth. After turning on the system, the user has to enter the length and breadth of the plot, and then grass cutter robot will automatically cut the grass in calculated area. In this project we have designed arduino controlled grass cutter that eliminated the need of human interruption. The project documentation includes all major design aspects.**

***Keywords*: Automated, Intelligent, Solar, Grass-cutter, Robot, Arduino**

1. INTRODUCTION

In the time where technology is driven by environmental awareness, consumers are looking for ways to contribute to the relief of their own carbon footprints. Most of the pollution is man-made and arise because of emission of gases from the burnt fuel into the atmosphere. So to get rid of such pollution, the abundant solar energy is available in India which can be used to drive various types of agricultural equipments. This project is driven by objectives to find alternate option for lawn mower, which is eco-friendly and doesn't require man-power.

The design of solar powered grass cutter will comprise DC motor, a rechargeable battery, keypad, LCD display, solar panel, a stainless steel blade and a controller. The purpose of this project is to design and build a grass cutter which can perform the grass cutting operation on its own without any need of operator, which means no manpower is required. The movement of the grass cutter robot is controlled by microcontroller on the basis of input received from the user.

2. LITERATURE SURVEY

G. Rahul portrays the use of solar energy to run the electric motor used for cutting grass. Bhosale and Khadake have presented the implementation of smart solar grass cutter. This system is driven by the solar energy by using solar panel and battery. This grass cutting machine was programmable for engine speed control. Ambekar and Ghate have designed a grass cutter which operates on solar energy. Hence it saves the electricity and reduces manpower. Amrutesh et al. have proposed smart solar grass cutter system which uses of sliding blades to cut a lawn at an even length. The comparative study of pros and cons of solar powered automatic grass cutter and conventional grass cutter is presented in Table 1.

Table 1. Comparison between Conventional and Solar based Grass Cutter

Sr. No.	Parameter	Automatic Solar Powered Grass Cutter	Conventional Grass cutter
1	Pollution factor	Doesn't Cause pollution	Causes pollution
2	Fuel	Not required	Required
3	Operating Cost	Low	High
4	Load carrying Capacity	Low	High
5	Man Power	Not required	Required
6	Installation cost	Little bit costlier	Cheaper

3. METHODOLOGY

The block diagram of the project represented in Fig.1 consist of components like Arduino Uno, 16X2 LCD display, DC Gear Motor X2, DC Motor for cutting, L293D Motor driver, Rechargeable Battery, Solar panel 24W, and 4X4 Keypad. All these components are described in this section.

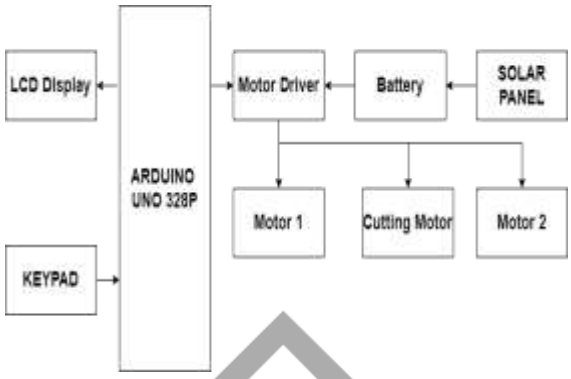

Fig.1. Block diagram

3.1 Arduino UNO

The main controlling device used in our project is Arduino Uno microcontroller board as shown in Fig.2. Arduino Uno board has ATMEGA 328p as an inbuilt microcontroller. It requires +5V power supply and it can source 20mA current at its I/O pins. The arduino is chosen in our project because of ready availability of board and on-line support.

Fig.2. Arduino UNO

3.2. 16X2 LCD Display

16X2 LCD display module as shown in Fig.3 works on input voltage range of 4.5 to 5.5V. Display consists of 16 columns and 2 rows. It consists of total 16 pins. We are using LCD display to take inputs from the user. It consists of two registers- command register and data register. It requires 1 mA current for its operation

Fig.3. 16x2 LCD Display

3.3. DC Gear Motors

The project requires two geared 12 volt dc motors of 100 rpm for movement of the wheel. These motors are driven by the motor driver L293D module. Motors require more current to work properly so this IC is used. Similarly another 12V dc motor of 1000 rpm is used to rotate the cutter blade fitted onto the robot. The motor used in the project is shown in Fig.4.

Fig.4. DC Motor

3.4. L293D Motor Driver

Usually the current required by dc motor is more than what is available at the arduino pins. Therefore when we need to control dc motor through arduino, motor driver ICs are required to boost the current level. Fig.5 shows L293D motor driver which allows driving of DC motor in desired direction. This IC consists of 16-pins which can be used to control two DC motors simultaneously. The current capacity of this driver is 600 mA, thus using this we can drive small and medium sized motors.

Fig.5. Motor Driver

3.5. Rechargeable Battery

Solar panel produces electricity in the daylight only. So, it is required to store the electricity produced by solar panel especially when we need to use the robot in night time or low light conditions. So we have to use the battery consisting of bank of cells of appropriate voltage rating to store electrical energy generated by the solar panel. Battery is also used for powering the controller. As shown in Fig.6, we have used 12V battery with the capacity of 1 Ampere hour (AH). If we use 6 volt batteries, then such two batteries need to be connected in series for getting 12 volt DC supply. The battery is charged by connecting it to solar panel and charging controller. The charge controllers are used to protect the battery from over charging and under charging since in both of these conditions, the battery life is reduced.

Fig.6. Rechargeable Battery

3.6. Solar Panel

A solar panel is nothing but solar photovoltaic cells used to convert solar energy into electricity. The solar panel shown in Fig.7 can generate 5W and it has no load voltage of 18 Volts and full load voltage of 17 Volts. The solar panel is connected to the battery through charge controller which controls the charging voltage and current for the batteries.

Fig.7. Solar Panel

3.7. Keypad

Keypad is used to take the input from the user. The keypad shown in Fig.8 has maximum voltage across each segment or button of 24V, maximum current through each segment or button of 30mA and maximum operating temperature of 0°C to 50°C. It comes with ultra-thin design and adhesive backing.

Fig.8. 4X4 Keypad

4. RESULTS AND IMPLEMENTATION

The flow chart, interfacing diagram and calculations are presented in this section.

4.1 FLOW CHART

Fig.9 shows the flowchart of the working of the system. After starting of the system, the user has to enter length and breadth of the plot for cutting the grass. Arduino checks the entered values, and it keeps on checking until the values become nonzero. When the values are nonzero then robot starts cutting grass and counter is set to 1. Robot moves lengthwise to cover the given length and it takes left and right U-turns to complete the given breadth.

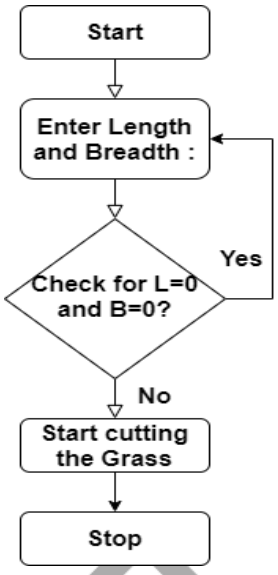

Fig.9. Flowchart

4.2 CIRCUIT DIAGRAM

The interfacing and connection diagram of different components like motor, motor driver, microcontroller, LCD and keypad is shown in Fig.10. Fig.11 shows the designed system.

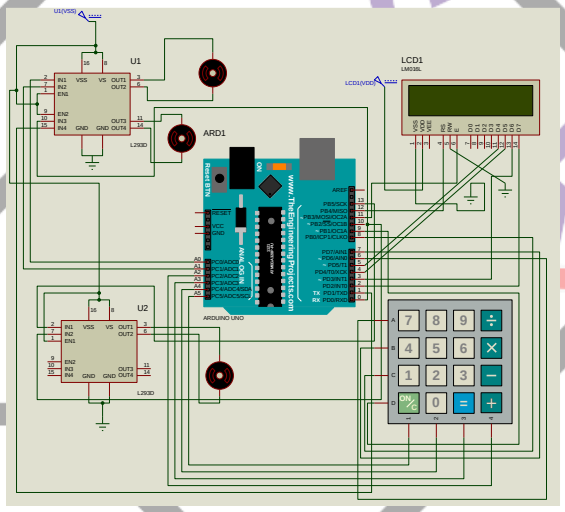

Fig.10. Interfacing Diagram

4.3 CALCULATIONS

The calculations of required torque of motor are based on the following dimensions of the robot.

a) Length of robot = 33cm
b) Breadth of robot = 9cm
c) Circumference = 2πr = 58 cm
d) Speed of Motor = 100 rpm

Accordingly delays are calculated for left and right turn for the robot.

Force required by cutting blade to shear the grass is given by eq (1) where, T = Shaft torque, R = radius of cutting blade.

$$F = T/R \quad (1)$$

Shaft torque is given by eq. (2) where P is motor power and N is motor speed in revolution per second.

$$T = P/2\pi N \quad (2)$$

But the motor speed is usually expressed in rpm, therefore eq. (2) is modified to form (3) where the motor speed is N is in rpm.

$$T = (P*60) / (2\Pi N) \quad (3)$$

Fig.11. Implementation

5. CONCLUSION

Our robot is an automatic and works on solar energy. If solar energy is not available due to weather conditions we can charge the battery using mains supply using 12V and 1A adapter. Charging of the battery is requires about 5 to 6 hours in daylight. Once battery is fully charged, robot can run continuously for 2 hours. It is a futuristic robot which works without taking of any conventional energy source and human efforts.

References

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