

Smart Solar Grass Cutter

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Abstract: One of the major problems associated with grass lawn is to maintain proper height of grass and it provides aesthetic pleasure to people. Many researchers have come up with the solution of automatic lawn mover. However, major issues with such machines are high price tag & maintenance cost. It also requires skilled labour. The problem becomes very clumsy, when area to be covered is very large. In this paper, Smart Solar Grass Cutter with obstacle avoidance is presented which provides less human intervention. It operates with the help of solar power. Because of this, no pollution is caused to the environment. The system is consisting of arduino uno and ultrasonic sensors are interfaced. The system was tested on different conditions and it is observed that, it can be used efficiently on flat lawn surfaces. The main advantage of our project is to reduce the space, cost and man power requirement.

Keywords: Grasscutter, Sensors, Arduino- uno, Motor, Solar Panel, Blades.

I . INTRODUCTION

Modern gardens are incomplete without grass lawn. Grass lawn adds beauty to gardens, playgrounds, hotels, home, factories etc. Depending on how it is planted, lawn is also known as turf, pitch or field. In India, different types of grass are used in lawn i.e., Chain grass, Kikuyu grass etc. The most common grass type after seeds are sowed and requires cutting after 8-12 weeks. To maintain its proper height, rapid cutting of grass is required, which is done either manually or by using machine also known as “lawn mover”[7]. Manual cutting requires skilled labour and the work must be done under used is ‘Bermuda Grass’ also known as „doob“ grass. It grows 4 cm in height after 4-5 weeks of

supervision. To operate lawn mover, skilled labour is required as well as it requires periodic maintenance. Ultrasonic sensor is used to detect the objects in the path of the cutter[6]. When an object is detected, the grass cutter avoids the object by turning to the different direction mentioned in our code. DC motors are connected in order to make the movement of grass cutter and also for movement of blades[4]. ARDUINO UNO is used to control the entire operation of the grass cutter[2]. Solar panel [5] is connected to the battery of 12V and 7amp. 12V supply is given to ARDUINO-UNO board and power supply board. The height of the grass to be cut can be removed by adjusting the height of the blades. There is no pollution caused by grass cutter[3], as it does not use any fuel for its operation. It doesn't cause any injury to human while operation[1]. It is easy to move from one place to another and requires less space for operation.

The various sections described below are as follows: section II analyses the related work, section III describes the methodology, Section IV exhibits the applications section V gives advantages section VI gives the results and section VII gives the conclusion of the paper.

II.RELATED WORK:

In the studies from [1] The author proposed that the grass cutter is powered by solar energy that avoids obstacles and is capable of cutting grass

without human interaction. The system uses 12v battery for movement of motors and solar panel to charge a battery so there is no need of charging externally.

In [2] The creator features that the grass cutter and vehicle motors are interfaced to an Arduino family that controls the working of all motors.

In [3] the paper proposed that Automatic grass cutting machine is a machine which is going to perform the grass cutting operation on its own. This model reduces both environment and noise pollution.

In [4] the creator describes the application of solar energy to power an electric motor which in turn rotates a blade which does the cutting of grass.

In [5] the paper explained that the smart solar grass cutting machine is automatic system for the purpose of grass cutting. The source is driven from the solar energy by using solar panel from the panel and store the voltage in battery. The automatic grass cutting machine is designed using photovoltaic source and motor speed control.

In [6] the author describes the aim of project is to make the grass cutter which operates on solar energy hence save the electricity and reduces manpower and ultrasonic sensor used to detect the obstacles.

In [7] the creator proposed smart solar grass cutter system in which there is an use of sliding blades to cut a lawn at an even length .Unskilled operations can operate easily and maintain the lawn very fine and uniform surface look.

III . METHODOLOGY

The proposed system is used to cut the grass in the lawn . Now coming to the working of solar powered grass cutter , it has panels mounted in a particular 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 .Now these electrical energy is stored in batteries by using a solar charger . The main function of solar charger is to increase the current from the panels while batteries are charging . It also disconnects the solar panels from the batteries when they are

fully charged and also connects to the panels when the charging in batteries is low .The motor is connected to the batteries through connecting wires .Between these two motor driver is provided . It starts and stops the working of the motor . From this motor , the power transmits to the mechanism and this makes the blade to rotate with high speed and this makes to cut the grass .

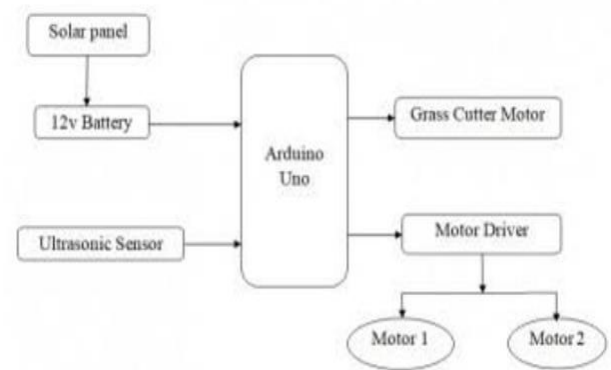


Fig 1 :The above block diagram shows a complete view of the final project module

A. Block Diagram Description

- Solar panel

How do solar panels work for your home? Step by step overview

Solar panels work by absorbing sunlight with photovoltaic cells, generating direct current (DC) energy and then converting it to usable alternating current (AC) energy with the help of inverter technology. AC energy then flows through the home's electrical panel and is distributed accordingly. Here are the main steps for how solar panels work for your home:

1. Photovoltaic cells absorb the sun's energy and convert it to DC electricity
2. The solar inverter converts DC electricity from your solar modules to AC electricity, which is used by most home appliances
3. Electricity flows through your home, powering electronic devices
4. Excess electricity produced by solar panels is fed to the electric grid

How do solar panels work to generate electricity?

A standard solar panel (also known as a solar module) consists of a layer of silicon cells, a metal frame, a glass casing, and various wiring to allow

current to flow from the silicon cells. Silicon (atomic #14 on the periodic table) is a non-metal with conductive properties that allow it to absorb and convert sunlight into electricity. When light interacts with a silicon cell, it causes electrons to be set into motion, which initiates a flow of electric current. This is known as the “photovoltaic effect,” and it describes the general functionality of solar panel technology.

The photovoltaic effect

The science of generating electricity with solar panels boils down to the **photovoltaic effect**. It was first discovered in 1839 by Edmond Becquerel and can be generally thought of as a characteristic of certain materials (known as **semiconductors**) that allows them to generate an electric current when exposed to sunlight.

The photovoltaic process works through the following simplified steps:

1. The silicon photovoltaic solar cell absorbs solar radiation
2. When the sun’s rays interact with the silicon cell, electrons begin to move, creating a flow of electric current
3. Wires capture and feed this direct current (DC) electricity to a solar inverter to be converted to alternating current (AC) electricity



Fig2: Solar Panel

Battery(12V) :

Most battery chargers stop charging the battery when it attains its maximum charging voltage set by the circuit. This 12V battery charger circuit charges the battery at a particular voltage, that is, absorption voltage, and once the maximum charging voltage is attained, the charger changes the output voltage to float voltage for maintaining the battery at that voltage. Absorption and floating voltages are dependent on the type of battery.

For this charger, voltages are set for a sealed lead-acid (SLA) 12V, 7Ah battery, for which absorption voltage is 14.1V to 14.3V and floating voltage is 13.6V to 13.8V. For safe working and to avoid overcharging of battery, absorption voltage is selected as 14.1V and floating voltage is selected as 13.6V. These values are to be set as specified by the battery manufacturer.

12V battery charger circuit

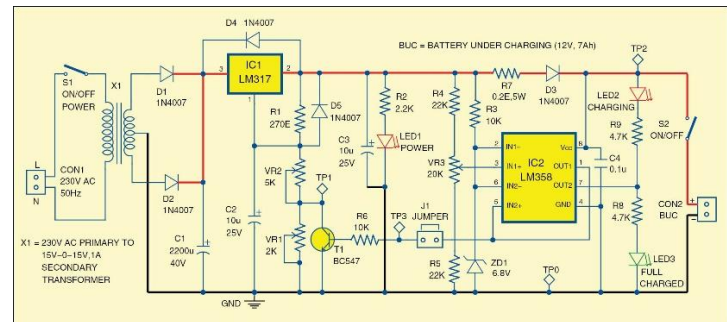


Fig3: 12V battery charger circuit

Circuit diagram of the 12V battery absorb and float charger is shown in Fig. 1. It is built around step-down transformer X1, adjustable voltage regulator **LM317** (IC1), op-amp comparator LM358 (IC2) and a few other components. The 230V AC primary to 15V-0-15V, 1A secondary transformer used in this circuit steps down mains voltage, which is rectified by diodes D1 and D2 and smoothed by capacitor C1. This voltage is given to the input of LM317 for regulation.



Fig 4: Rechargeable battery

- Ultrasonic Sensor:

As the name indicates, ultrasonic / level sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. ultrasonic / level sensors measure the distance to the target by measuring the time between the emission and reception.

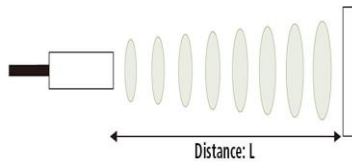


Fig 5: Ultrasonic waves

An optical sensor has a transmitter and receiver, whereas an ultrasonic / level sensor uses a single ultrasonic element for both emission and reception. In a reflective model ultrasonic / level sensor, a single oscillator emits and receives ultrasonic waves alternately. This enables miniaturisation of the sensor head.

The following list shows typical characteristics enabled by the detection system.

- Since ultrasonic waves can reflect off a glass or liquid surface and return to the sensor head, even transparent targets can be detected.
- Detection is not affected by accumulation of dust or dirt.
- Presence detection is stable even for targets such as mesh trays or springs.



Fig 6 :Ultrasonic sensor

- **Arduino uno**

Arduino is a single-board microcontroller meant to make the application more accessible which are interactive objects and its surroundings. The hardware features with an open-source hardware board designed around an 8-bit Atmel AVR microcontroller or a 32-bit Atmel ARM. Current models consists a USB interface, 6 analog input pins and 14 digital I/O pins that allows the user to attach various extension boards.

The Arduino Uno board is a microcontroller based on the ATmega328. It has 14 digital input/output pins in which 6 can be used as PWM outputs, a 16 MHz ceramic resonator, an ICSP header, a USB connection, 6 analog inputs, a power jack and a reset button. This contains all the required support needed for microcontroller. In order to get started, they are simply connected to a computer with a USB cable or with a AC-to-DC adapter or battery. Arduino Uno Board varies from all other boards and they will not use the FTDI

USB-to-serial driver chip in them. It is featured by the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

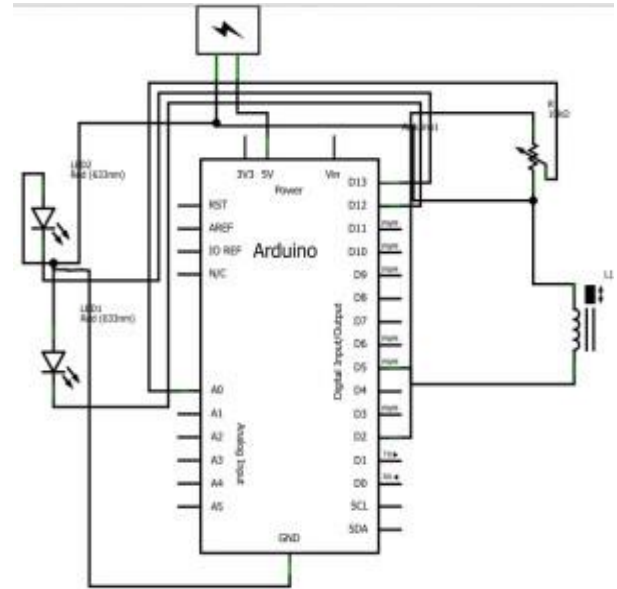


Fig 7: Arduino Uno with Digital Input/Output

There are various types of Arduino boards in which many of them were third-party compatible versions. The most official versions available are the Arduino Uno R3 and the Arduino Nano V3. Both of these run a 16MHz Atmel ATmega328P 8-bit microcontroller with 32KB of flash RAM 14 digital I/O and six analogue I/O and the 32KB will not sound like as if running Windows. Arduino projects can be stand-alone or they can communicate with software on running on a computer. For e.g. Flash, Processing, Max/MSP). The board is clocked by a 16 MHz ceramic resonator and has a USB connection for power and communication. You can easily add micro SD/SD card storage for bigger tasks.

Features of the Arduino Uno Board:

- It is an easy USB interface. This allows interface with USB as this is like a serial device.
- The chip on the board plugs straight into your USB port and supports on your computer as a virtual serial port. The benefit of this setup is that serial communication is an extremely easy protocol which is time-tested and USB makes connection with modern computers and makes it comfortable.
- It is easy-to-find the microcontroller brain which is the ATmega328 chip. It has more

number of hardware features like timers, external and internal interrupts, PWM pins and multiple sleep modes.

- It is an open source design and there is an advantage of being open source is that it has a large community of people using and troubleshooting it. This makes it easy to help in debugging projects.
- It is a 16 MHz clock which is fast enough for most applications and does not speed up the microcontroller.
- It is very convenient to manage power inside it and it had a feature of built-in voltage regulation. This can also be powered directly off a USB port without any external power. You can connect an external power source of upto 12v and this regulates it to both 5v and 3.3v.
- 13 digital pins and 6 analog pins. This sort of pins allows you to connect hardware to your Arduino Uno board externally. These pins are used as a key for extending the computing capability of the Arduino Uno into the real world. Simply plug your electronic devices and sensors into the sockets that correspond to each of these pins and you are good to go.
- This has an ICSP connector for bypassing the USB port and interfacing the Arduino directly as a serial device. This port is necessary to re-bootload your chip if it corrupts and can no longer be used to your computer.
- It has a 32 KB of flash memory for storing your code.
- An on-board LED is attached to digital pin 13 to make fast the debugging of code and to make the debug process easy.
- Finally, it has a button to reset the program on the chip.

Arduino was created in the year 2005 by two Italian engineers David Cuartielles and Massimo Banzi with the goal of keeping in mind about students to make them learn how to program the Arduino uno microcontroller and improve their skills about electronics and use it in the real world.

Arduino uno microcontroller can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller is programmed using the Arduino programming language (based on Wiring) and the

Arduino development environment (based on Processing).



Fig 8: Arduino Uno

• Motor Driver

Motor drivers act as an interface between the motors and the control circuits. Motors require high amounts of current, whereas the controller circuit works on low current signals. So the function of motor drivers is to take a low-current control signal and then turn it into a higher-current signal that can drive a motor.



Fig 9: Motor driver

Source is driven from the solar energy using photovoltaic panel. This charges the battery and is utilized for powering operation of the system. The system's control is done by the Arduino Uno. Automation for object detection is achieved by using ultrasonic sensors and Arduino Uno. Wheel movement and cutting operations are done using DC motors. To achieve compatibility of Arduino and the motors, a motor driver is used. The driver circuit enhances the Arduino's small output. A toggle switch is used to select the mode of operation and a DPDT switch for movement operations. Wheels move when two motors are driven.

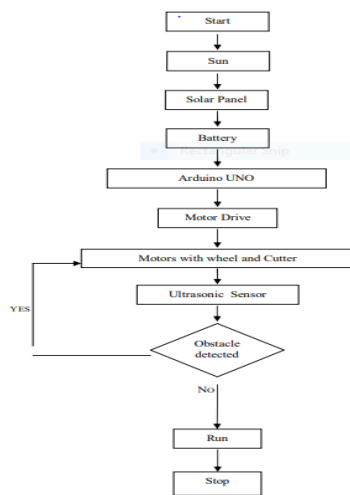


Fig 10: Flowchart

IV.APPLICATIONS

It can be used in gardens for cutting the grass evenly .Also it can be used in college campus . It is useful in lawns .It can be efficiently used in Agriculture areas .It can be used for cutting the grass of particular area of playgrounds .

examples :-cricket ,football grounds etc.

V.ADVANTAGES

Compact size and portable, No fuel cost, No pollution, Easy to move from one place to another, Less wear and tear, Non -Skilled person can also operate

VI. RESULTS

This device is easy to handle . It requires human effort only to switch ON and switch OFF the grasscutter, hence reduces the labour cost and also risk of workers .Cutting of grass is time saving process .



Fig 11: Hardware Implementation

VII.CONCLUSION :

Our project is suitable for any kind of people as it has more advantages. This can be easily handled. This system is having facility of charging the batteries while the solar powered grass cutter is in motion. The same thing can be operated in night time also, as there is a facility to charge these batteries in day light.

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