DESIGN AND FABRICATION OF SMART SOLAR GRASS CUTTER ROBOT

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ABSTRACT

From time immemorial, the sun has been the major source of energy for life on earth. The solar energy was being used directly for purposes like drying clothes, curing agricultural produce, preserving food articles, etc. Even today, the energy we originate from fuel-wood, petroleum, paraffin, hydroelectricity and even our food originates obliquely from sun. Solar energy is almost unbounded. The total energy we obtain from the sun far exceeds our energy demands. Since the industrial revolutions human have been dependent on fuels, electricity and wind energy. For human enlargement in many countries there is study and trials are going on the solar energy and the wind energy, so we make our new concept solar powered grass cutting machine in these concept we cut grass on the agricultural products or on small plants in lawns and gardens. Remote controlled grass cutter can be described as the application of Radio frequency to power a machine on which electric motor rotates which in turn rotates a blade which does the mowing of a grass.

Key words: Blade, solar Panel, DC Motor, Microcontroller, Sensor.

CHAPTER 1

INTRODUCTION

Grass cutter machines have become very popular today. Most of the times, grass cutter machines are used for soft grass furnishing. In recent time where technology is merging with environmental awareness, consumers are looking for ways to contribute to the relief of their own carbon footprints. Pollution is man-made and can be seen in our own daily lives, more specifically in our own homes. Herein, we propose a model of the automatic grass cutting machine powered through solar energy, (non-renewable energy). 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. Our new design for an old and outdated habit will help both customer and the environment. This project of a solar powered automatic grass cutter will relieve the consumer from mowing their own lawns and will reduce both environmental and noise pollution. This design is meant to be an alternate green option to the popular and environmentally hazardous fuel powered lawn mower. Ultimately, the consumer will be doing more for the environment while doing less work in their daily lives. The hope is to keep working on this project until a suitable design can be implemented and then be ultimately placed on the mark.

CHAPTER 2

LITERATURE REVIEW

1] Prof. C. J. Shende

In this paper they have prepared manually handle device which is capable to cut the grass. This device consists of linear blades and it does not affected by climatic conditions. The main objective of this paper is to move the grass cutter i s different directions to prepare various designs as per requirements. By using link mechanism the height of the cut can be adjusted. The unskilled labour can easily operate this device.

2] C. B. Mills

Today, new technology is bringing us improved mower versions. Low emission gasoline engines with catalytic converters are being manufactured to help reduce air pollution. Improved muffling devices are also being installed to reduce the noise pollution. Battery powered mowers are also becoming practical. Although slightly smaller with an average cutting swath of only 17-19", these new mowers will quietly cutting lawns without the common cloud of blue smoke hanging in the air, for about an hour per charge. Prices are comparable to a high-end gasoline powered mower.

3] Davidge E D

I'm planning on moving my entire fleet to propane. Not only is it better for the environment, it also increases my productivity. I'm saving money on fuel, and labor costs as well, since my crew isn't spending time filling up at the pump. Propane has no additives and is a clean burning system. I save on maintenance since there is no carburetor or fuel filter to maintain.

4] Edwin Beard Budding

Budding obtained the idea of the lawn mower after seeing a machine in a local cloth mill which used a cutting cylinder mounted on a bench to trim cloth to make a smooth finish after weaving. Budding realized that a similar concept would enable the cutting of grass if the mechanism could be mounted in a wheeled frame to make the blades rotate close to the lawn's surface.

5] Ms. Lanka Priyanka

In this paper they have fabricated grass cutting machine with tempered blades are attached to this grass cutter. This grass cutter is manually operated as well as automatic operated. The materials commonly used GI sheet, motor, wheel, Alsheet, switch, wire, square pipe and insulating material.

6] P.Bulski

Bulski identify the sound created by the machine is making noice pollution. He research on sound created by the machine and giving the result how to remove the sound while cutting the grass of lawn or ground. As looking to the petrol engine it make air pollution to environment so from my recommendation it should be implement on electric operated lawn mover.

7] Thomas Green & Son:

He introduced am over called the Silence Messer (meaning silent cutter), which used a chain drive to transmit power from the rear roller to the cutting cylinder. These machines were lighter and quieter than the gear-driven machines that preceded them, although they were slightly more expensive. The rise in popularity of lawn sports helped prompt the spread of the invention. Lawn mowers became a more efficient alternative to the domesticated grazing animals.

CHAPTER 3
WORKING PRINCIPLE

Here we are using fuel level sensor. The sensor level changes the resistance value depending on the fuel level. This change in resistance is converted into corresponding voltage signal which is given to inverting input terminal of the comparator. The reference voltage is given to non inverting input terminal. The comparator is constructed by the arduino 328. The comparator compares with reference fuel level and delivered the error voltage at the output terminal. Then the received voltage is given to next stage of gain amplifier which is constructed by another micro controller. In the gain amplifier the variable resistor is connected in the feedback path, by adjusting the resistor we can get the desired gain. Then the corresponding signal is given to control unit in order to find the fuel level in the petrol tank. this collected value is shown by LCD display. Here the mileage value is taken for 1 litre of petrol and the distance travelled corresponding to it is tabulated below at various speed intervals.

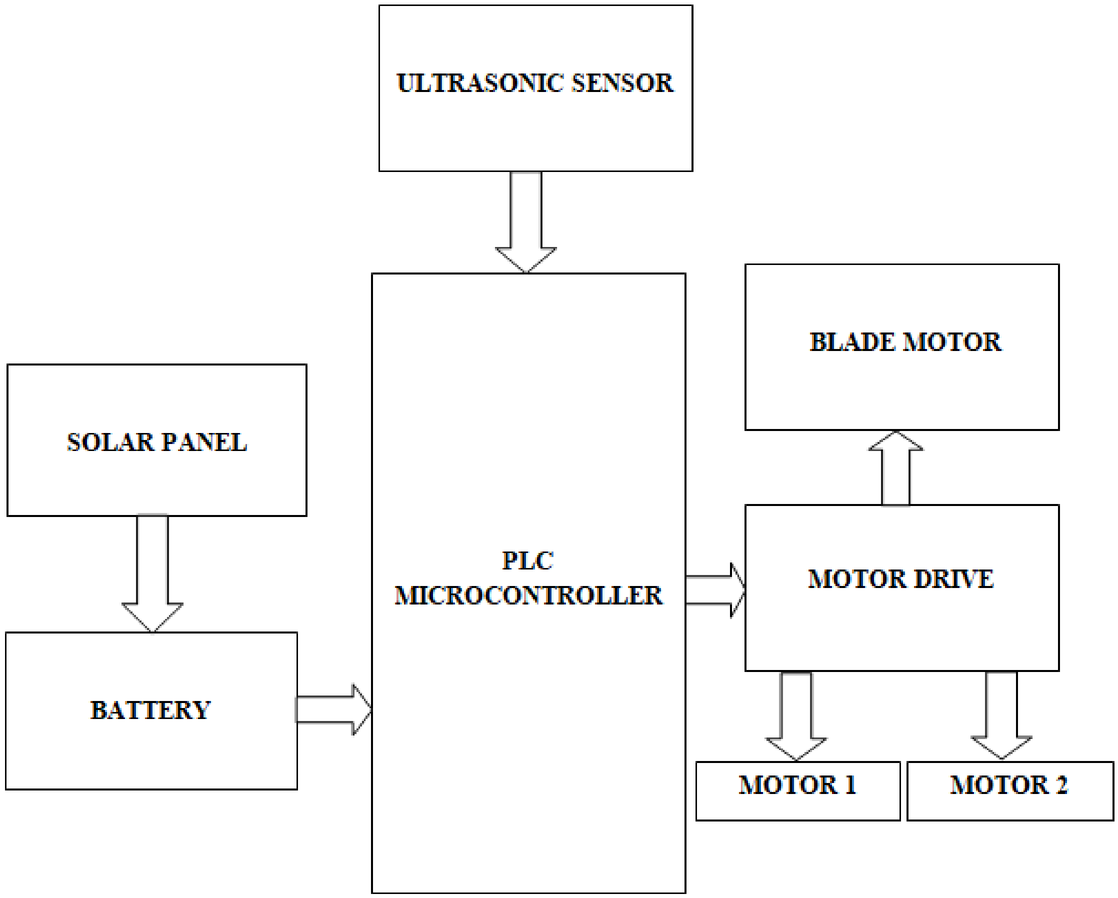

Fig. No. 3 working principle

CHAPTER 4

HISTORY

The first actual mower was invented in 1830 by Edwin Beard Budding. Budding was an engineer from England who first discovered the idea of a mower from a cylindrical machine used for cutting in a mill.The mower that he developed was composed of a large roller which provided power to the cutting cylinder using gears. The cutting cylinder contained several blades connected in series around the cylinder. There are several types of mowers, each suited to a particular scale and purpose. The smallest types, non-powered push mowers, are suitable for small residential lawns and gardens. Electrical or piston engine-powered push-mowers are used for larger residential lawns (although there is some overlap). Riding mowers, which sometimes resemble small tractors, are larger than push mowers and are suitable for large lawns, although commercial riding lawn mowers (such as zero-turn mowers) can be "stand-on" types, and often bear little resemblance to residential lawn tractors, being designed to mow large areas at high speed in the shortest time possible. The largest multi-gang (multi-blade) mowers are mounted on tractors and are designed for large expanses of grass such as golf courses and municipal parks, although they are ill-suited for complex terrain.

CHAPTER 5

TYPES OF LAWN MOWER

There are three types of lawn mower nowadays used in general.

5.1 Walk-Behind Mover
5.2 Riding Mover
5.3 Tow-Behind Mover

5.1 Walk-Behind Mover

A lawn mover (also named as mower, grass cutter or lawnmower) is a machine utilizing one or more revolving blades to cut a grass surface to an even height. The height of the cut grass may be fixed by the design of the mower, but generally is adjustable by the operator, typically by a single master lever, or by a lever or nut and bolt on each of the machine's wheels. The blades may be powered by manual force, with wheels mechanically connected to the cutting blades so that when the mower is pushed forward, the blades spin, or the machine may have a battery-powered or plug-in electric motor. The most common self-contained power source for lawn mowers is a small (typically one cylinder) internal combustion engine. Smaller mowers often lack any form of propulsion, requiring human power to move over a surface; "walk-behind" mowers are self-propelled, requiring a human only to walk behind and guide them. Larger lawn mowers are usually either self-propelled "walk-behind" types, or more often, are "ride-on" movers,equipped so the operator can ride on the mower and control it.

Fig. no 5.1

Walk-Behind Mower

5.2 Riding Mover

Riding movers, which sometimes resemble small tractors, are larger than push mowers and are suitable for large lawns, although commercial riding lawn mowers can be "stand-on" types, and often bear little resemblance to residential lawn tractors, being designed to mow large areas at high speed in the shortest time possible. The largest multi-blade mowers are mounted on tractors and are designed for large expanses of grass such as golf courses and municipal parks, although they are ill-suited for complex terrain requiring maneuverability.

Fig. no. 5.2

Riding Mower

5.3 Tow-Behind Mover

Tow-behind movers are used for much larger areas, like massive fields, and are used much more in agriculture and road sides. Tractors or powerful vehicles must tow these devices. Most are mechanical, much like some of the first lawn mowers ever invented. They use the rotation and energy from being pulled over ground to rotate and cut grass, sod or whatever needs to be cut.

Fig. no. 5.3

Tow-Behind Mower

CHAPTER 6

DESCRIPTION

The major components present in the system are

6.1 Microcontroller

6.2 Ultrasonic distance sensor

6.3 Solar panel

6.4 Battery

6.5 DC Motors

6.6 Blade Motor

6.1 Microcontroller

A microcontroller (or MCU for microcontroller unit) is a small computer on a single integrated circuit. In modern terminology, it is similar to, but less sophisticated than, a system on a chip or SoC; anSoC may include a microcontroller as one of its components.

6.1.1 ARDUINO

Arduino is an open-source platform used for building electronics projects. it consists of both a physical programmable circuit board and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware in order to load new code onto the board – you can simply use a USB cable.

Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

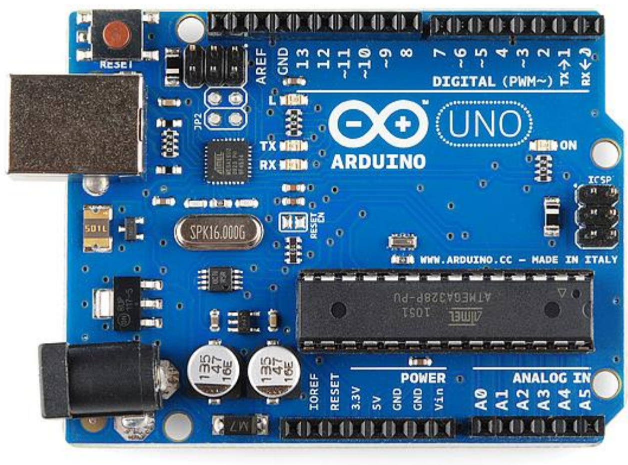

Fig. no. 6.1.1

Arduino UNO

The Uno is one of the more popular boards in the Arduino family and a great choice for beginners. We'll talk about what's on it and what it can do later in the tutorial. Believe it or not, those 10 lines of code are all you need to blink the on-board LED on your Arduino.

6.1.1.1 What Does it Do?

The Arduino hardware and software was designed for artists, designers, hobbyists, hackers, new bies, and anyone interested in creating interactive objects or environments. Arduino can interact with buttons, LEDs, motors, speakers, GPS units, cameras, the internet, and even your smart-phone or your TV! This flexibility combined with the fact that the Arduino software is free, the hardware boards are pretty cheap, and both the software and hardware are easy to learn has led to a large community of users who have contributed code and released instructions for a huge variety of Arduino-based projects.

6.1.1.2 What's on the board?

There are many varieties of Arduino boards that can be used for different purposes. Some boards look a bit different from the one below, but most Arduinos have the majority of these components in common.

6.1.1.3 POWER (USB / BARREL JACK)

Every Arduino board needs a way to be connected to a power source. The Arduino UNO can be powered from a USB cable coming from your computer or a wall power supply that is terminated in a barrel jack. In the picture above the USB connection is labeled **(1)** and the barrel jack is labeled **(2)**.

The USB connection is also how you will load code onto your Arduino board. /More on how to program with Arduino can be found in our Installing and Programming Arduino tutorial.

NOTE: Do NOT use a power supply greater than 20 Volts as you will overpower (and thereby destroy) yourArduino. The recommended voltage for most Arduino models is between 6 and 12 Volts.

6.1.1.4 PINS (5V, 3.3V, GND, ANALOG, DIGITAL, PWM, AREF)

The pins on your Arduino are the places where you connect wires to construct a circuit (probably in conjuction with a bread board and some wire. They usually have black plastic 'headers' that allow you to just plug a wire right into the board. The Arduino has several different kinds of pins, each of which is labeled on the board and used for different functions.

- **GND (3)**: Short for 'Ground'. There are several GND pins on the Arduino, any of which can be used to ground your circuit.
- **5V (4) & 3.3V (5)**: As you might guess, the 5V pin supplies 5 volts of power, and the 3.3V pin supplies 3.3 volts of power. Most of the simple components used with the Arduino run happily off of 5 or 3.3 volts.
- **Analog (6)**: The area of pins under the 'Analog In' label (A0 through A5 on the UNO) are Analog In pins. These pins can read the signal from an analog sensor and convert it into a digital value that we can read.
- **Digital (7)**: Across from the analog pins are the digital pins (0 through 13 on the UNO). These pins can be used for both digital input (like telling if a button is pushed) and digital output (like powering an LED).
- **PWM (8)**: You may have noticed the tilde (~) next to some of the digital pins (3, 5, 6, 9, 10, and 11 on the UNO). These pins act as normal digital pins, but can also be used

for something called Pulse-Width Modulation (PWM). We have a tutorial on PWM, but for now, think of these pins as being able to simulate analog output (like fading an LED in and out).

- **AREF (9)**: Stands for Analog Reference. Most of the time you can leave this pin alone. It is sometimes used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

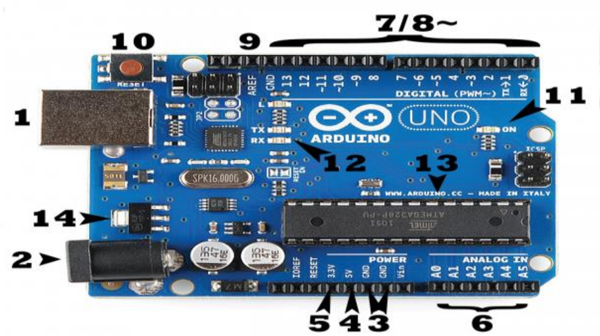

Fig. no. 6.1.5

Arduino pin configuration

6.1.1.5 RESET BUTTON

Just like the original Nintendo, the Arduino has a reset button **(10)**. Pushing it will temporarily connect the reset pin to ground and restart any code that is loaded on the Arduino. This can be very useful if your code doesn't repeat, but you want to test it multiple times. Unlike the original Nintendo however, blowing on the Arduino doesn't usually fix any problems.

6.1.1.6 POWER LED INDICATOR

Just beneath and to the right of the word "UNO" on your circuit board, there's a tiny LED next to the word 'ON' **(11)**. This LED should light up whenever you plug your Arduino into a power source. If this light doesn't turn on, there's a good chance something is wrong. Time to re-check your circuit!

6.1.1.7 TX LED AND RX LED

TX is short for transmit, RX is short for receive. These markings appear quite a bit in electronics to indicate the pins responsible for serial communication. In our case, there are two places on the Arduino UNO where TX and RX appear – once by digital pins 0 and 1, and a second time next to the TX and RX indicator LEDs **(12)**. These LEDs will give us some nice visual indications whenever our Arduino is receiving or transmitting data (like when we're loading a new program onto the board).

6.1.1.8 MAIN IC

The black thing with all the metal legs is an IC, or Integrated Circuit **(13)**. Think of it as the brains of our Arduino. The main IC on the Arduino is slightly different from board type to board type, but is usually from the AT mega line of IC's from the ATMEL company.

This can be important, as you may need to know the IC type (along with your board type) before loading up a new program from the Arduino software. This information can usually be found in writing on the top side of the IC. If you want to know more about the difference between various IC's, reading the datasheets is often a good idea.

6.1.1.8.1 VOLTAGE REGULATOR

The voltage regulator **(14)** is not actually something you can (or should) interact with on the Arduino. But it is potentially useful to know that it is there and what it's for. The voltage regulator does exactly what it says – it controls the amount of voltage that is let into the Arduino board. Think of it as a kind of gatekeeper; it will turn away an extra voltage that might harm the circuit. Of course, it has its limits, so don't hook up your Arduino to anything greater than 20 volts.

6.2 ULTRA SONIC DISTANCE FINDER

The ultrasonic sensor works on the principle of SONAR and RADAR system which is used to determine the distance to an object.

An ultrasonic sensor generates the high-frequency sound (ultrasound) waves. When this ultrasound hits the object, it reflects as echo which is sensed by the receiver as shown in below figure. By measuring the time required for the echo to reach to the receiver, we can calculate the distance. This is the basic working principle of Ultrasonic module to measure distance.HC-SR-04 has an ultrasonic transmitter, receiver and control circuit.

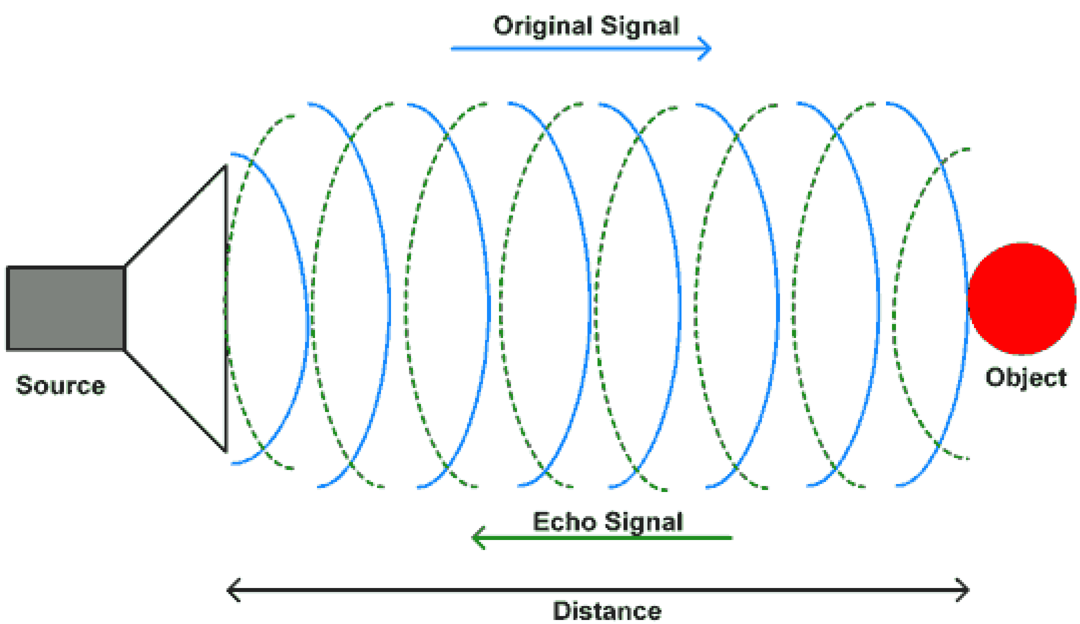

Fig. no. 6.2

Ultrasonic working principle

In ultrasonic module HCSR04, we have to give trigger pulse, so that it will generate ultrasound of frequency 40 kHz. After generating ultrasound i.e. 8 pulses of 40 kHz, it makes echo pin high.

Echo pin remains high until it does not get the echo sound back. So the width of echo pin will be the time for sound to travel to the object and return back. Once we get the time we can calculate distance, as we know the speed of sound. HC-SR04 can measure up to range from 2 cm - 400 cm.

6.2.1 PIN CONFIGURATION

VCC - +5 V supply

TRIG – Trigger input of sensor. Microcontroller applies 10 us trigger pulse to the HC-SR04 ultrasonic module.

ECHO–Echo output of sensor. Microcontroller reads/monitors this pin to detect the obstacle or to find the distance.

GND – Ground

Fig. no.6.2.1

HC-SR04 pin description

6.2.2 ULTRASONIC MODULE TIMING DIAGRAM

1. We need to transmit trigger pulse of at least 10 us to the HC-SR04 Trig Pin.
2. Then the HC-SR04 automatically sends Eight 40 kHz sound wave and wait for rising edge output at Echo pin.
3. When the rising edge capture occurs at Echo pin, start the Timer and wait for falling edge on Echo pin.
4. As soon as the falling edge is captured at the Echo pin, read the count of the Timer. This time count is the time required by the sensor to detect an object and return back from an object.

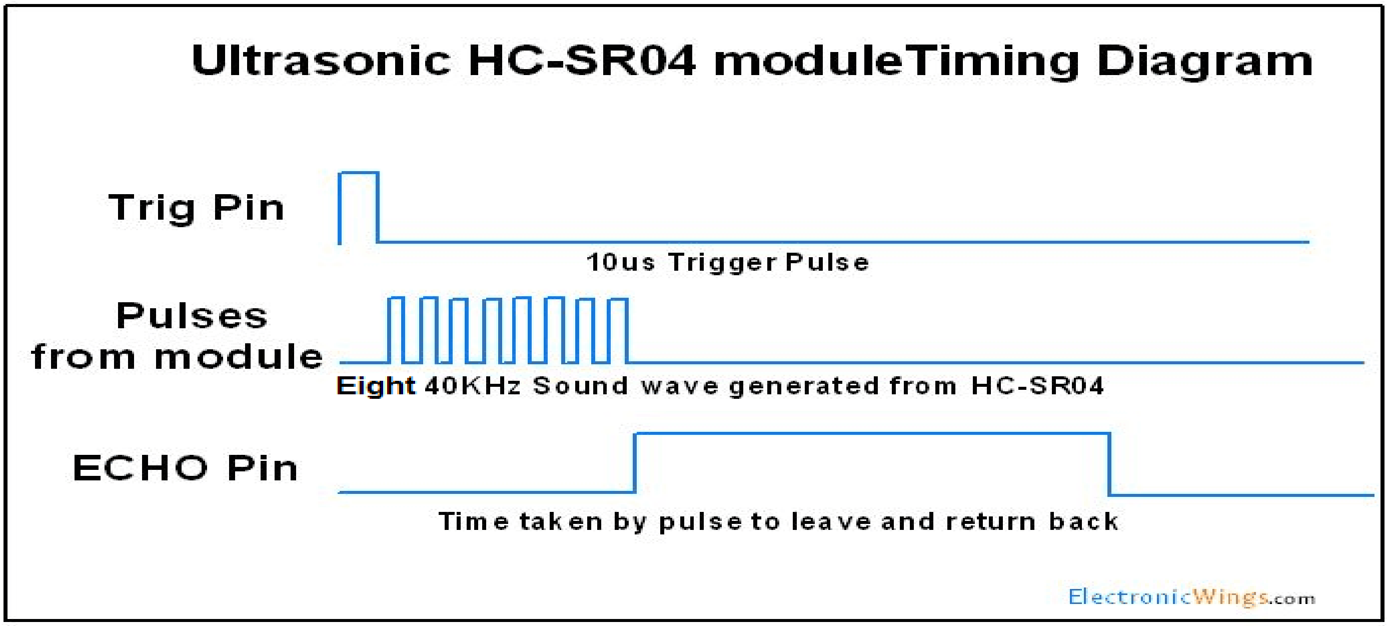

Fig. no. 6.2.2

Ultrasonic timing diagram

Now how to calculate distance?

We know that,

$$\text{Distance} = \text{Speed x Time}$$

The speed of sound waves is 343 m/s.

So,

$$\text{Total Distance} = \frac{343 \text{ x Time of High(Echo) Pulse}}{2}$$

Total distance is divided by 2 because signal travels from HC-SR04 to object and returns to the module HC-SR-04.

6.3 Solar Panel

A solar panel is a set of solar photovoltaic module electrically connected. The source is driven from the solar energy using solar panel which receives energy and convert it into electric energy. Solar panel generates energy up to12v.

Fig. no. 6.3

Solar Panel

Photovoltaic modules use light energy (photons) from the Sun to generate electricity through the photovoltaic effect. Most modules use wafer-based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module can be either the top layer or the back layer. Cells must be protected from mechanical damage and moisture.

6.4 Battery

Solar cell module produces electricity only when the sun is shining. They do not store energy. It is necessary to store some of the energy produced. So we use battery to store electrical energy generated by the solar panel. It is also used for the powering operation system. The battery is of 12V DC.

Fig. no. 6.4

Battery

Lead Acid batteries have changed little since the 1880's although improvements in materials and manufacturing methods continue to bring improvements in energy density, life and reliability. All lead acid batteries consist of flat lead plates immersed in a pool of electrolyte. Lead acid batteries used in the RV and Marine Industries usually consist of two 6-volt batteries in series, or a single 12-volt battery.

6.5 D.C Motor

There are 4 Dc motors are used for movement of the wheel. These motors are brushless DC motors. These Motors are driven by the driver IC ULN2003.The speed of the motor is30rpm. The ULN2003 is used for the current boosting. Motors require more current for work properly so these IC is used. It increases current up to 200mA. DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills.

Fig. no 6.5

D.C Motor

6.6 WIPER MOTOR

Wiper motors are devices in the wiper system that functions on a power supply in order to move the wiper blades in a smooth motion. Like other motors, the wiper motor rotates continuously in one direction which is converted into a back and forth motion. Its composition entails a lot of mechanical linkages each playing a role in initiating the movement. The gear head motor is the type of wiper motor known for its abundance in torque.

But in our project these motors are used as the movement of the lawn remover for the higher powerful torque to increase the torque of the vehicle

Fig. no. 6.6

Wiper motor

6.7 Blade

Blade motor is used for cutting operation of the grass. These motor have more Speed than the other 4 motors. These Motor has speed of about 1000rpm.blades are the cutting components of lawn mowers. These blades are very sharp. We use rotating blade for these system. We observed that the tapper blade is cut more grass compare to straight blade and larger blade. Because of the tapper blade have less material than the other blade and due to this the tapper blade is optimum out of three blades.

Fig. no. 6.7

Blade

CHAPTER 7

PERFORMANCE ANALYSIS

Program execution starts with initializing all the memory location and pointers. All the sensor modules are initialized. Commands are checked for grass cutter or sprinkler. If sprinkler is selected, sprinkler motor is started, if grass cutter action is selected grass cutter blade starts functioning. Both grass cutter and water sprinkler can also be used at a time. Under auto or manual selection condition selection, for auto made object detection signals are monitored from the sensor units and commands are executed as per the program. For manual mode commands are accepted from the external Bluetooth control module.

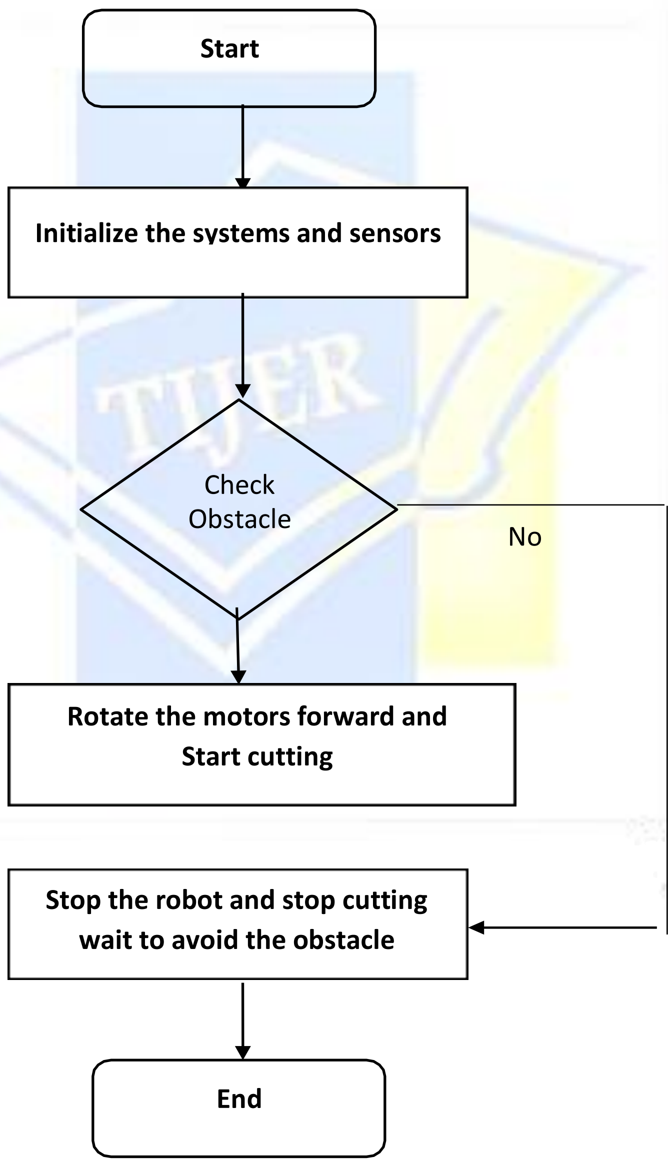

Fig. no. 7

Flow chart

CHAPTER 8

PROGRAM OF MICROCONTROLLER

```
/* HC-SR04 Sensor

https://www.dealextreme.com/p/hc-sr04-ultrasonic-sensor-distance-measuring-
module- 133696

This sketch reads a HC-SR04 ultrasonic rangefinder and returns the distance to the closest
object in range. To do this, it sends a pulse to the sensor to initiate a reading, then listens for
apulse to return. The length of the returning pulse is proportional to the distance of the object
from the sensor.

The circuit:
VCC connection of the sensor attached to+5V
GND connection of the sensor attached to ground
TRIG connection of the sensor attached to digital pin2
ECHO connection of the sensor attached to digital pin4
Original code for Ping))) example was created by David A. Mellis Adapted for HC-SR04 by
Tautvidas Sipavicius
This example code is in the public domain.

*/
const int trigPin = 2;
const int echoPin = 4;
const int motor1_1=5;     // the number of the pushbutton pin
const int motor1_2 =6;
const int motor2_1= 7;    // the number of the pushbuttonpin

void setup() {
```

```
// initialize serial communication:
Serial.begin(9600);
pinMode(motor1_1, OUTPUT);
pinMode(motor1_2, OUTPUT);
pinMode(motor2_1, OUTPUT);
pinMode(motor2_2, OUTPUT);
pinMode(cuttm1, OUTPUT);
pinMode(cuttm2, OUTPUT);
}
 void loop()
{

// establish variables for duration of the ping,
// and the distance result in inches and centimeters:
long duration, inches, cm;
 // The sensor is triggered by a HIGH pulse of 10 or
more microseconds.
// Give a short LOW pulse beforehand to ensure a clean HIGH pulse:
pinMode(trigPin, OUTPUT);
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW)
// Read the signal from the sensor:
a HIGH pulse whose
// duration is the time (in microseconds) from the sending
// of the ping to the reception of its echo off of an object.
pinMode(echoPin, INPUT);
```

```
duration = pulseIn(echoPin, HIGH);
// convert the time into a distance
inches = microsecondsToInches(duration);
cm = microsecondsToCentimeters(duration);
Serial.print(inches);
Serial.print("in,            ");
Serial.print(cm);
Serial.print("cm");
Serial.println(); delay(100);
if(cm<60)
{
digitalWrite(motor1_1,                    LOW);
digitalWrite(motor1_2,LOW);
digitalWrite(motor2_1, LOW);
digitalWrite(motor2_2, LOW);
/////stop       digitalWrite(cuttm1,      LOW);
digitalWrite(cuttm2, LOW); delay(1000);
digitalWrite(motor1_1,                    HIGH);
digitalWrite(motor1_2,                    LOW);
digitalWrite(motor2_1,                    HIGH);
digitalWrite(motor2_2,LOW);
/////back
digitalWrite(cuttm1,                      LOW);
digitalWrite(cuttm2,LOW);
delay(3000);    digitalWrite(motor1_1,
HIGH);          digitalWrite(motor1_2,
LOW); digitalWrite(motor2_1, LOW);
digitalWrite(motor2_2, HIGH);
/////turn
digitalWrite(cuttm1,              LOW);
```

```
digitalWrite(cuttm2,                LOW);
delay(7000);     digitalWrite(motor1_1,
LOW);            digitalWrite(motor1_2,
HIGH);           digitalWrite(motor2_1,
LOW);

digitalWrite(motor2_2,           HIGH);
/////stright
digitalWrite(cuttm1,             LOW);
digitalWrite(cuttm2, LOW);
delay(5000);
digitalWrite(motor1_1,           LOW);
digitalWrite(motor1_2,           HIGH);
digitalWrite(motor2_1, HIGH);
digitalWrite(motor2_2, LOW);
 /////turn
digitalWrite(cuttm1,                        LOW);
digitalWrite(cuttm2, LOW); delay(7000);
digitalWrite(motor1_1,                      LOW);
digitalWrite(motor1_2,                      HIGH);
digitalWrite(motor2_1,                      LOW);
digitalWrite(motor2_2,HIGH);
/////straight
digitalWrite(cuttm1,                        LOW);
digitalWrite(cuttm2,LOW);
delay(1000);
}

Else

{

digitalWrite(motor1_1,           LOW);
digitalWrite(motor1_2,           HIGH);
```

```
digitalWrite(motor2_1,            LOW);
digitalWrite(motor2_2,           HIGH);
digitalWrite(cuttm1,             HIGH);
digitalWrite(cuttm2, HIGH);

delay(1000);

}
long microsecondsToInches(long microseconds)

{

// According to Parallax's datasheet for the PING))), there are

// 73.746 microseconds per inch (i.e. sound travels at 1130 feetper

// second).  This gives the distance travelled by the ping,outbound

// and return, so we divide by 2 to get the distance of the obstacle.

// See: http://www.parallax.com/dl/docs/prod/acc/28015-PING-v1.3.pdf
return microseconds / 74 / 2;
}

long microsecondsToCentimeters(long microseconds)

{

// The speed of sound is 340 m/s or 29 microseconds per centimeter.

// The ping travels out and back, so to find the distance of the

//  object  we  take  half  of  the  distance  travelled.
return microseconds / 29 / 2;

}
```

CHAPTER 9

DESIGN OF STEP DOWN MOTOR

The following information must be available to the designer before he commences for the design of transformer

- Power Output.
- Operating Voltage.
- Frequency Range.
- Efficiency and Regulation

9.1 Size of core

Size of core is one of the first considerations in regard of weight and volume of transformer. This depends on type of core and winding configuration used. Generally following formula is used to find area or size of core.

$$Ai = \sqrt{P1/0.87}$$

Ai = Area of cross - section in Sq. cm. and

P_1= Primary voltage.

In transformer $P_1 = P_2$

The project requires +5V regulated output. So transformer secondary rating is 12V, 500mA. So secondary power wattage is,

$$P_2 = 12 \times 500 \times 10^{-3} w.$$

$$= 6w$$

So $\mathbf{Ai = \sqrt{6/0.87}}$

$$= 2.62$$

Generally 10% of area should be added to core to accommodate all turns for low Iron losses and compact size.

So, Ai =2.88.

9.2 Turns per Volt

Turns per volt of transformer are given by relation

Turns / Volt = 10000/4.44 f Bm Ai

Here, F is the frequency in Hz

Bm is flux density in Wb/m^2 Ai is net area of cross section.

Following table gives the value of turns per volt for 50 Hz frequency.

Flux density Wb/m^2	1.14	1.01	0.91	0.83	0.76
Turns per volt	40/Ai	45/Ai	50/Ai	55/Ai	60/Ai

Table No.9.2

Value of turns per volt for 50 Hz frequency

Generally lower the flux density better be quality of transformer. For project for 50 H_Z the turns per Volt for 0.91 Wb/m^2 from above table.

Turns per Volt = 50 /Ai

=50/2.88

@ 17

Thus for Primary winding = 220 x 17 = 3800. &

forSecondarywinding= 12 x 17=204.

9.3 Wire Size

As stated above size depends upon the current to be carried out by the winding, which depends upon current density of 3.1 A/mm^2. For less copper losses 1.6 A/mm^2 or 2.4 A/mm^2 may be used. Generally even size gauge of wire are used.

CHAPTER 10

RECTIFIER DESIGN

R.M.S. Secondary voltage at secondary of transformer is 12V.

So maximum voltage Vm across Secondary is

$$= \text{Rms. Voltage} \times \sqrt{2}$$
$$= 12 \times \sqrt{2}$$
$$= 16.97$$

D.C. O/p Voltage at rectifier O/p is 2 Vm

$$V_{dc} = 2V_m/\pi$$
$$= 2 \times 16.97/\pi$$
$$= 10.80\ V$$

PIV rating of each diode is,

$$PIV = 2V_m.$$
$$= 2 \times 16.97$$
$$= 34\ V$$

Maximum forward current which flow from each diode is 500mA. So from above parameter we select diode IN 4007 from diode selection manual

CHAPTER 11

DESIGN OF FILTER CAPACITOR

Formula for calculating filter capacitor is,

$$C= 1/4Ö3 \text{ r f } R_L.$$

r = ripple present at o/p of rectifier. (This is maximum 0.1 for full wave

rectifier.) F = frequency of mains A.C.

R_L = I/p impedance of voltage regulator IC.

C=1/4Ö3 x 0.1 x 50 x 28

= 1030 mf

@ 1000 m

Voltage rating of filter capacitor is double of Vdc i.e. rectifier o/p which is 20V. So we choose 1000 mf / 25V filtercapacitor.

IC7805 (Voltage Regulator IC)

Specifications:

Available o/pD.C.Voltage = + 5V.

Line Regulation =0.03

Load Regulation = 0.5

V_{in} maximum = 35 V

Ripple Rejection= 66-80 (dB)

CHAPTER 12

SELECTING FOR CURRENT LIMITING RESISTANCE FOR LED

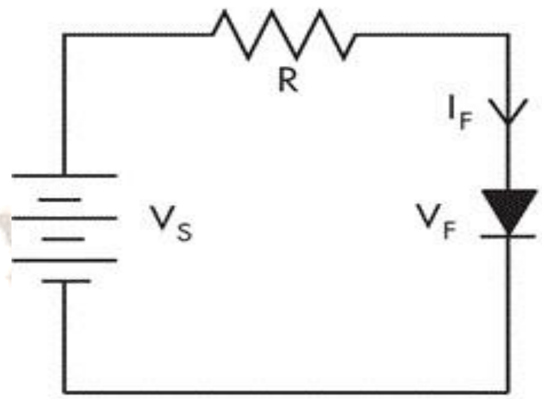

Fig. no. 12

Current limiting resistance

The output of microcontroller is equal to supply voltage i.e. +5V DC. If directly connected LED to micro controller then very high current flowing through it because internal resistance of LED is very small about 5 to 8 ohm so it is possibility to damage LED so we place current limiting resistance R in series with diode the value of this resistance is calculated.

From ohms low

$$V = R\, I$$

Where, I= If safe forward current flowing through LED which normal intensity glow and this value near about 8 to 10 mA

$$5 = R x\ 8mA$$

$$R = 625\ \Omega$$

Limiting current into an LED is very important. An LED behaves very differently to a resistor in circuit. Resistors behave linearly according to Ohm's law: V = IR. For example, increase the voltage across a resistor, the current will increase proportionally, as long as the resistor's value stays the same. Simple enough. LEDs do not behave in this way. They behave as a diode with a characteristic I-V curve that is different than aresistor. He voltage versus current characteristics of an LED are similar to any diode. Current is approximately an exponential function of voltage according to the Shockley diode equation, and a small voltage change may result in a large change in current. If the voltage is below or equal to the threshold no current flows and the result is an unlit LED. If the voltage is too high the current exceeds the maximum rating, overheating and potentially destroying the LED.As an LED heats up, its voltage drop decreases (band gap decrease). This can encourage the current to increase. It is therefore important that the power source provides an appropriate current. LEDs should only be connected to constant-current sources. Series resistors are a simple way to passively stabilize the LED current. An active constant current regulator is commonly used for high power LEDs, stabilizing light output over a wide range of input voltages which might increase the useful life of batteries. Low drop-out (LDO) constant current regulators also allow the total LED voltage to be a higher fraction of the power supply voltage. Switched-mode power supplies are used in some LED flashlights and household LED lamps.

CHAPTER 13

FUTURE SCOPE

We completed our project successfully with the available sources. But the results and modifications are not up to the expectations. This can be further improved by incorporating the following modifications to obtain better results. The mechanism which we used i.e. scotch yoke mechanism does not given excepted efficiency. This efficiency can be increased by using some other mechanism. and speed of motor is reduce because we have used heavy material and this material can be replaced by using light weight material .and design of blades should be done based on types of grass is used to cut. The project which we have done surly reaches the average families because the grass can be trimmed with minimum cost and with minimum time Finally this project may give an inspiration to the people who can modify and can obtain better results

CHAPTER 14

ADVANTAGES AND APPLICATIONS OF THE SMART SOLAR GRASS CUTTING ROBOT

14.1 ADVANTAGES

- The use of solar power saves the non-renewable energy.
- No need of human interface.
- Non skilled person can also operate.
- No required any external supply.
- It is economical.
- Compact in size and portable.
- No any fuel cost.
- Easy to move from one place to another place.
- Freedom from long extension wires.

14.2 APPLICATIONS

- In agriculture.
- In gardens.
- Big lawns.
- For a garden.
- For hospital.
- For colleges.

CHAPTER 15

COST ESTIMATION

SI. NO.	COMPONENT	SPECIFICATION	QUANTITY	PRICE(Rs.)
1	ARDUINO	UNO	1	2000
2	BATTERY	12 volt	1	3500
3	ULTRASONIC MODULE	HC-SR04	1	1000
4	SOLAR PANEL	24 VOLT	-	2000
5	DC MOTOR	12 volt	1	900
7	WIPER MOTOR	12 volt	2	1000
8	CHASSIS AND FRAME	-	-	3000
9	WIRE AND WHEEL	-	REQUIRED	800
10	TOTAL			14200

CHAPTER 16

CONCLUSION

This project provides a design method of an automated grass cutter operated on solar power, whose task is to cut grass with no need of user interaction. This task is expected to be made possible by using sensors to provide an Adriano with controlling. The obstacle is automatically avoided, here for obstacle avoidance the ultrasonic sensor is used. The system also provides power backup by using inverter. The proposed system will be cost efficient with higher reliability. Our project is more suitable for a common man as it is having much more advantages. This will give much more physical exercise to the people and 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 daylight.

CHAPTER 17

FABRICATED VIEWS OF SMART SOLAR GRASS CUTTER ROBOT

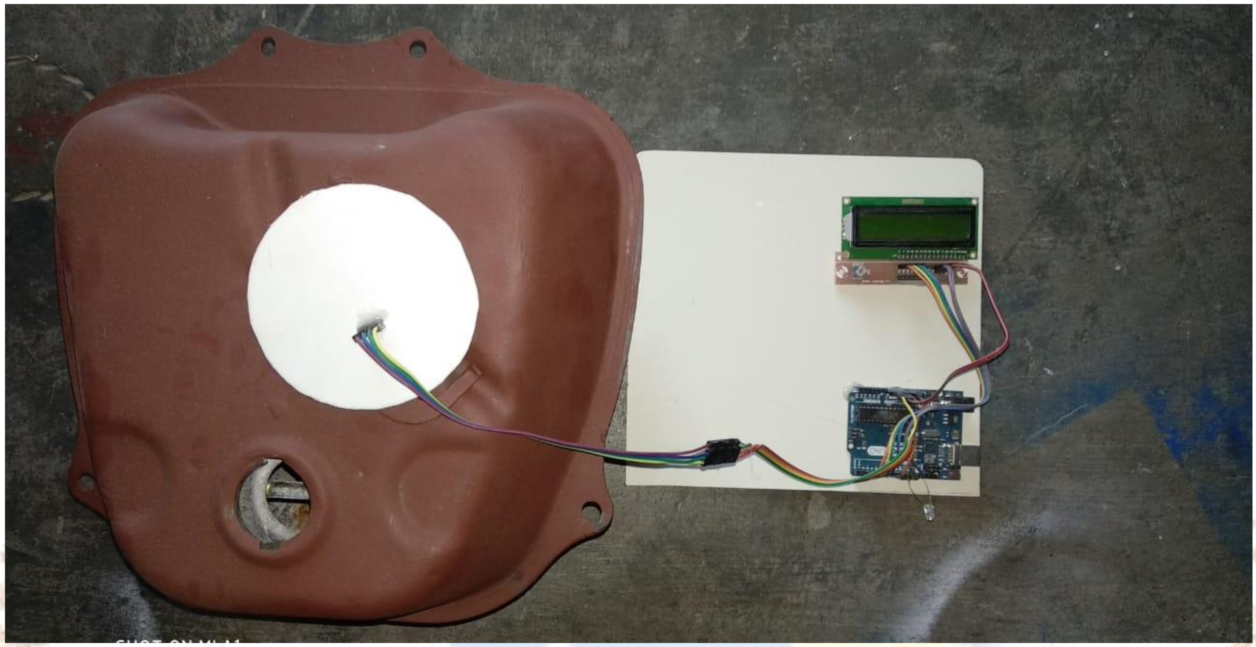

Fig. no. 17

Fabricated view of

smart solar grass cutter robot

CHAPTER 18

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