CONSTRUCTION OF A SOLAR POWERED FULLY AUTOMATED GRASS CUTTER USING ARDUINO.

A Thesis

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Submitted to the

DEPARTMENT OF MECHANICAL ENGINEERING

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In partial fulfillment of the requirements for the award of the degree of Bachelor of Science in Mechanical Engineering

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ABSTRACT

A manually handled device is commonly used for cutting the grass over the field which creates pollution and loss of energy. The automated grass cutter system puts forth an automated lawn mower mechanism. This will reduce the effort required for cutting grass in the lawns and the battery used will help to contribute to lowering pollution. The robotic vehicle is equipped with a grass cutter blade that allows for grass cutting at high RPM. The system has smart functionality that allows it to cover the complete area of a lawn or garden by detecting corners using an ultrasonic sensor and moving in a raster manner to cover the entire area. This efficient system uses an Arduino Uno microcontroller to achieve this functionality. The Arduino will act as the brain of the project which will send commands to the grass cutter. It also controls the movement of motors, which helps with the movement of the cutter. The main objective of this solar powered grass cutter machine is to cut grass by using battery power which is stored by using solar panel. It is also very useful for low cost of fabrication and maintenance.

Keywords: Grass cutter, Automatic, Flexibility, Arduino

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LIST OF ABBREVIATIONS

BCE	Before Common Era
DC	Direct current

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Chapter 1

INTRODUCTION

1.1 Introduction

Automation is useful at various stages of human life. The beautiful evenly cut grass increases the beauteousness of any hotel, house, park, meeting hall etc. Hence uniform grass cutting is important to maintain the prestige of any house or hotel. Manual grass cutting is possible using human beings, but it usually consumes time and energy of human being. Also, the manual grass cutting is inefficient, and many times results in non-uniform structure of grass. Hence to avoid all these issues it is better to use automated grass cutting robot machine which can be operated through android phone.

In a time when technology is merging with environmental awareness, consumers are looking for ways to contribute to the relief of their carbon footprints. Pollution is man-made and can be seen in our own daily lives, more specifically in our own homes. Due to the effect of the emission of gases from the burnt fuel into the atmosphere, this necessitates the use of the abundant solar energy from the sun as a source of power to drive various types of agricultural equipment [1].

A grass cutter with a standard motor is an inconvenience, and no one takes pleasure in it. Cutting grass cannot be easily accomplished by elderly, younger, or disabled people. It creates noise pollution due to the loud engine, and local air pollution due to the combustion in the engine. Also, a motor-powered engine requires periodic maintenance such as changing the engine oil. Even though electric grass cutters are environmentally friendly. Moving the grass cutters with a standard motor-powered grass cutter is an inconvenience, and no one takes pleasure in it. Cutting grass cannot be easily accomplished by elderly, younger, grass cutter moving with engine create

noise pollution due to the loud engine, and local air pollution due to the combustion in the engine [2-3].

These grass cutters will also be charged from the sun by using solar panels. It is also charging when work is going on. These grass cutters have an AC charging also. These grass cutters have spiral cutting blades to increase cutting efficiency. It can be operated manually or motor-driven when motor-driven it has a remote control. A grass cutter has having collecting box to collect cut grass so cut grass is put outside the lawn, ground, etc. [4]. A normal grass cutter moving with an IC engine will run based on the energy from petrol. The major drawbacks of this technology are high running costs, it creates noise pollution and air pollution. Also, an IC engine requires periodic maintenance such as changing the engine oil, and mechanical maintenance. It is an innovative technology for cutting grass without any pollution, and an electric solar grass cutter is environmentally friendly. Nowadays, the labor charge is increasing day by day. This technology can help people who are living in rural areas [5].

According to the global electricity report, we get around 80% of our electricity from traditional fossil fuels like oil (36%), herbal Gas (21%), and coal (23%). It is widely recognized that time isn't always thus far whilst these kinds of resources could be exhausted. So, alternative sources must be used to avoid electricity disasters within the nearby destiny [6]. In current days, grass cutter machines are operated by fuel and electrical energy which are costly and require high maintenance. Hence, in this study, an Arduino Automatic Grass Cutter for grass cutting was designed and fabricated by using locally available materials. Important aspects such as durability, strength, and lightweight were taken into design consideration for better performance characteristics [7-8].

1.2 Problem Statements

The grass cutter we use today is an Arduino Automatic Grass Cutter that makes it easy for humans. But there are still some weaknesses in the grass. This machine can only work with a width of 20 feet and a length of 20 feet. This machine uses a remote control, and this machine is preferred for the Disabled. Also, the problem we face when using lawns is that the grass cutter, we use today will produce noise. This is a bit like interfering with another person's hearing. It can also be categorized as noise pollution.

So, using an Arduino Automatic Grass Cutter, it will not produce noise that will interfere with the hearing of others. Then, another problem is that grass cutters nowadays mostly use fuel. The cost of owning a grass cutter using fuel is quite expensive compared to a regular grass cutter. So here we can reduce the cost because the Arduino Automatic Grass Cutter does not use any fuel and it can save money. This is because not everyone can afford to use an engine grass cutter. This is one of the factors we want to create an Arduino Automatic Grass Cutter to help those on low income.

1.3 Objectives

The objectives of this project are:

- To construct & implementation of a fully automated solar powered grass cutter using arduino.
- To construct & implementation of an automatic grass cutter that has a faster starter to turn on the machine.
- To implement an arduino automatic grass cutter that does not have any kind of pollution such as noise pollution & CO_2 emissions etc.
- Promoting renewable energy and its application to replace conventional sources of energy.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

Maintaining a neat and clean lawn can be a challenging task, particularly for large areas like parks, hospitals, etc. Grass can grow quickly, and regular maintenance is necessary to keep it fresh and looking good. Using traditional ways such as electrical grass cutters and gasoline grass cutters. These cutters require more time and a lot of human effort. Gasoline grass cutter produces pollution and electrical grass cutter requires a large number of wires connected to the socket [9]. An automated solar grass cutter is a fully automated grass-cutting robotic vehicle powered by solar energy that also avoids obstacles and is capable of fully automated grass-cutting, without the need for any human interaction. The grass cutter and vehicle motors are interfaced with an 8051-family microcontroller that controls the working of all the motors. The microcontroller moves the vehicle motors in a forward direction in case no obstacle is detected. On obstacle detection, the sensor monitors it and the microcontroller thus stops the grass cutter motor to avoid any damage to the object/human/animal. The microcontroller then turns the vehicle until it gets clear of the object and then moves the grass cutter in a forward direction again [10].

A literature survey is a proof essay of sorts. It is a study of relevant literature materials about a topic we have been given.

2.2 Literature Review

The purpose of this proposed project [11] is to design a programmable robot that can work either autonomously or can be operated wirelessly using an Android Smart phone via Bluetooth from a safe distance which is capable of cutting the grass in certain required shapes, the cutting blade can also be adjusted to maintain different length of the grass. Three ultrasonic obstacle detectors are used to detect obstacles, if any obstacle is found in front of the robot while travelling; it avoids the obstacle by taking a right or left turns automatically appropriately thereby avoiding collision.

Therefore, we have planned to implement our project "Electronic Grass Cutter" an automatic lawn mower that is fully operated by the Arduino UNO system [12]. With this, it is also capable of mowing grass automatically without the need for human discovery. This system uses a 12V battery to move the movement of the machine as well as the lawn mower. The motor for machine movement is connected to the UNO Arduino system which controls the movement of all the motors.

This robot [13] is designed to operate by a rechargeable battery and can be described as an intelligent robot because the micro-controller will receive information from sensors connected to it in avoiding obstacle to ensure a neat pattern of cut and use the information to actuate the left and right motors driving the wheels and the center motor driving string trimmer and at the same time it obeys all parameters of work and its program database. As it is well known that random motion for a lawn mower would sometimes lead to uncovered spaced, it all depends on how random is random. A few features were added with a more advanced option which allows the user to manually control the lawn mower with a PS2 controller. This, in fact, where the user can manually control the grass cutting robot that looks like a tank. The data analysis was listed in the table to test the development of grass cutter.

In this study [14], the authors develop an Arduino based lawn mower that can be controlled using an Android phone. An Android lawn mower application is developed and connected to the mower through Bluetooth and Wi-Fi. The application controls the direction of the lawn mower and activates / deactivates its

cutting blade motor. The result of this design is that the lawn mower can be controlled at a maximum distance of 10 meters without obstacles and 5 meters with trees and walls as barriers.

This work [15] discussed the fabricated model of android based grass cutter in agricultural field by implementing the new innovative concept with simpler construction and easy working. The cutting motor is employed to cut the grass in the field and the same is controlled by smartphone application. The components that are used to control the grass cutting level involve motor and gear arrangement. Below the gear arrangement, the cutting blade is fixed. And this arrangement will be simple and highly efficient for grass height adjustment system with up/down process motor. DC motor up and down motion is made using the rack and pinion gear setup. And then grass cutting motor on off control system will be achieved through android application. This application is connected to Bluetooth communication for automatic processing.

The rise in popularity of lawn sports helped prompt the spread of the invention. Grass cutters became a more efficient alternative to scythe and domesticated grazing animals.

2.3 Summary

From the literature discussed above, we gained a lot of knowledge, and we were inspired to do this project. We were able to do it with everyone's tireless work.

This project is more suitable for a common man as it is having much more advantages i.e. no fuel cost, no pollution, and no fuel residue. This system is having facility of charging the batteries while the solar powered grass cutter is in motion. So, it is much more suitable for grass cutting also. The same thing can be operated at nighttime also, as there is a facility to charge these batteries in daylight.

This project eliminated the physical power required in pushing the mower without sacrificing safety.

Chapter 3

THEORETICAL MODEL

3.1 Introduction

An electric Grass cutter is more suitable and easier to use than the grass cutter with an engine, so we can make an electrical grass cutter with an electrical motor, which is providing the high-speed rotation to the blades, cordless electric cutters are powered by a 12V rechargeable batterie. Typically, more batteries mean more run time or power. Batteries can be in the interior of the grass cutter or on the outside. If on the outside, the depleted batteries can be quickly swapped with recharged batteries. Cordless cutters have the maneuverability of a gasoline-powered cutter and the environmental friendliness of a corded electric cutter.

In this chapter, we will discuss our system methodology, system description, block diagram, circuit diagram, working principle, and instrument cost analysis.

3.2 Block Diagram

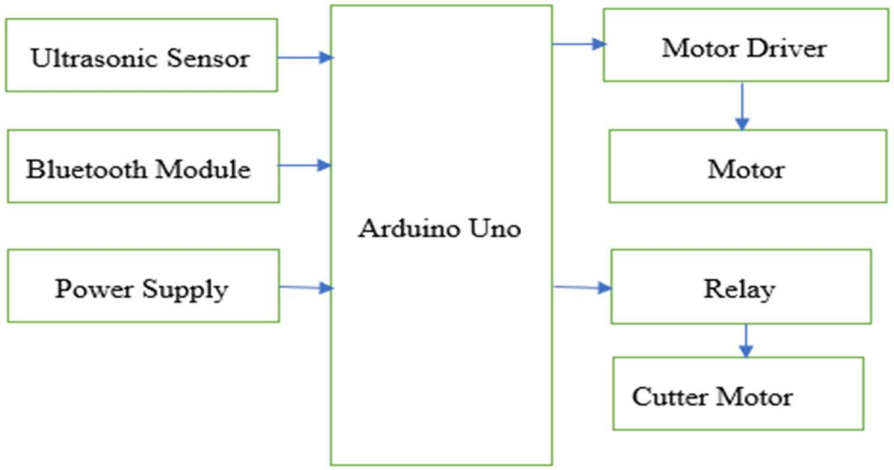


Figure 3.1: Block Diagram

3.3 Schematic Circuit Diagram

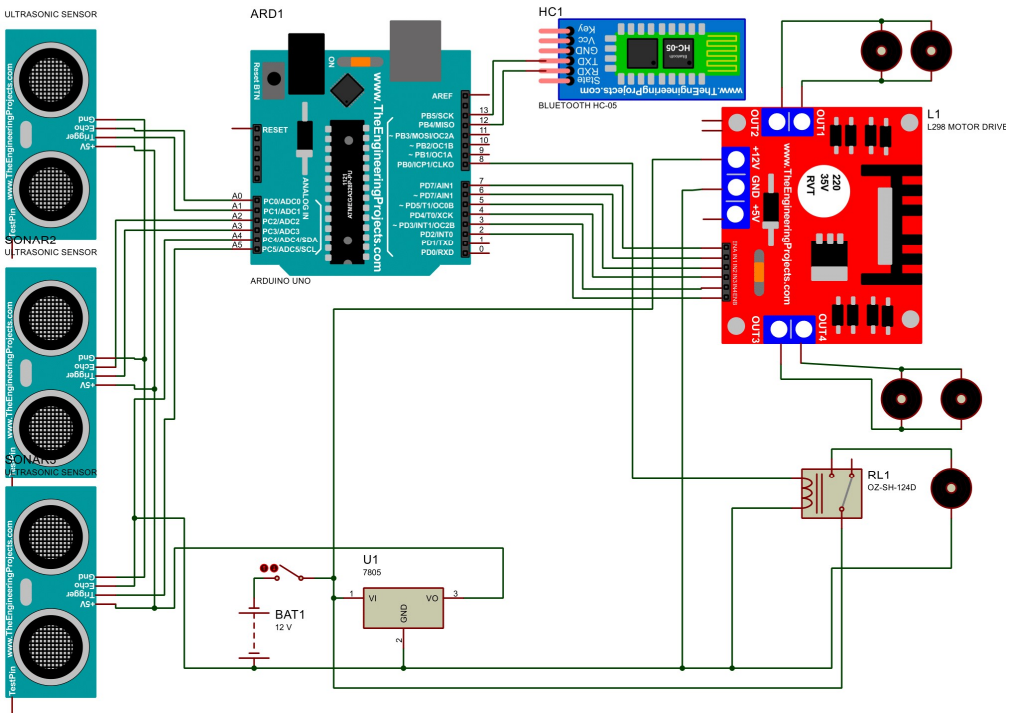


Figure 3.2: Schematic Circuit Diagram

3.4 Working Principle

This system works with solar panels as the power will be stored to battery, from there the full function will be power generate, then 4 Gear DC motors will be connected through arduino uno, so it can move forward and backward. Now we set up a transistor and a relay between the torque motor and arduino. So, we can control a 12-volt torque or any other maximum motor giving input logical high 1 and low 0 from arduino pin. And last, we connect a bluetooth module with arduino so we can control this grass cutter with our android devices. When the pin gets 1 the torque motor will start to cut the grass. We construct a model which will contain the device, motors, and battery to work.

3.5 Complete Project Image



Figure 3.3: Our Final Project Image

3.6 Components List

Hardware Part:

- Arduino Uno
- Ultrasonic sensor
- Motor
- Wheel
- HC-05 Bluetooth module
- Grass cutter motor
- Lipo battery
- Solar panel

3.6.1 Arduino Uno

In a nutshell, the Arduino Uno is an open-source microcontroller board built on the ATmega328P microcontroller. Several extension boards or shields, besides additional circuits, can be interfaced with the board's digital and analog input/output pins. A form B USB cable is essential to program the board using the arduino IDE (Integrated Development Environment). It has 6 digital pins and 12 analog pins. An external 9-volt battery can be used to power it, or a USB cable can be used. It is correspondingly related to arduino nano and leonardo. It can be downloaded from the Arduino website and dispersed beneath the creative common's attribution-share like 2.5 license. Various outline and production files are also available.

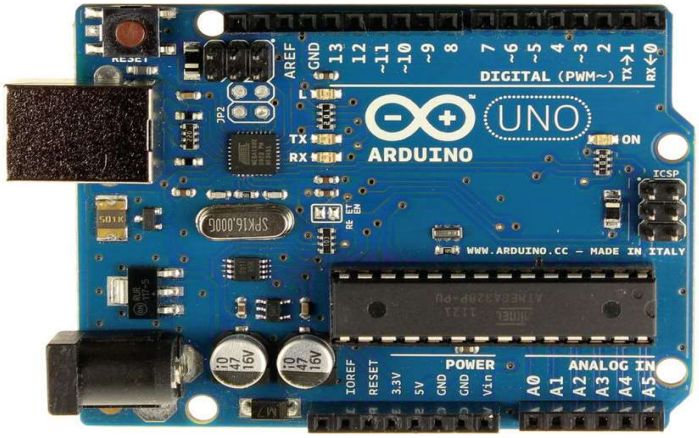


Figure 3.4: The Arduino Uno

This initial release of the arduino software was given the name "Uno" for its Italian meaning. Arduino uno was the leader of a series of USB-based arduino boards, and the arduino IDE and uno together were the first releases of arduino software. A bootloader is already preprogrammed into the ATmega328, allowing programmers to upload a new code deprived of an exterior hardware systems analyst. It is the first board not to include the FTDI USB-to-serial driver chip while using the STK500 protocol as its communication protocol. The USB-to-serial converter uses the Atmega16U2 (Atmega8U2 capable of version R2) as an analog input.

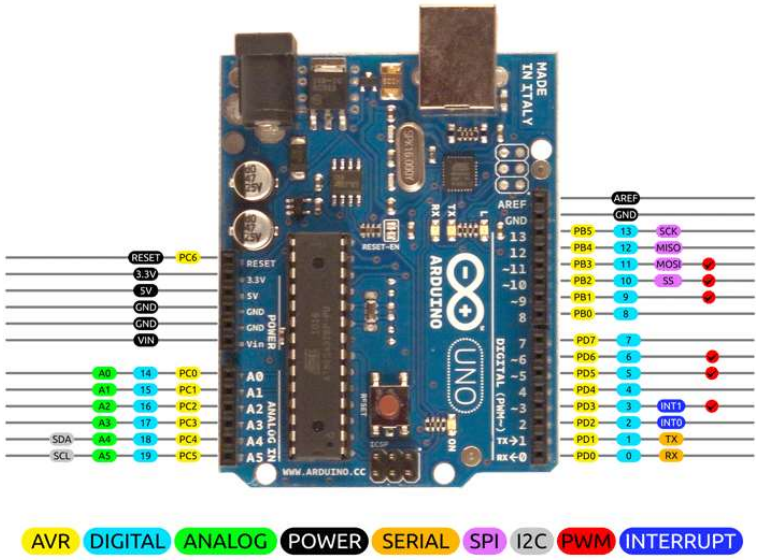


Figure 3.5: The Arduino Uno pin diagram

3.6.2 Ultrasonic Sonar Sensor

The ultrasonic sensor is a non-contact type of sensor used to measure an object's distance and velocity. This sensor operates on sound wave property to measure the velocity and distance of the object.

It sends an ultrasonic pulse out at 40 kHz, which travels through the air, and if there is an obstacle or object, it will bounce back to the sensor. By calculating the travel time and the speed of sound, the distance can be calculated. Ultrasonic sensors are a great solution for the detection of clear objects.



Figure 3.6: Ultrasonic sensor

Specification:

- Operating Voltage: DC 3.0V to 5.5V
- Product Number: AJ-SR04M
- Probe Frequency: 40 kHz.
- Measuring Angle: 75 degrees
- Input Trigger Signal: TTL Pulse
- Output Echo Signal: TTL
- Measurement Range: 02 to 400 cm
- PCB Color: Blue
- PCB Size: 42mm X 29mm X 12mm
- Wire Length: 2.5 Meter (±0.3)

3.6.3 DC Gear Motor

Electric motors turn electricity into motion by exploiting electromagnetic induction. A simple direct current (DC) motor is illustrated below. The motor features a permanent horseshoe magnet (called the stator because it's fixed in place) and a turning coil of wire called an armature (or rotor, because it rotates).



Figure 3.7: DC Gear motor

Motor Specifications

- 37GB-555 DC gear motor
- Input voltage(V): 12
- Retarder Reduction Ratio: 1:56
- No Load Speed (RPM): 300
- No Load Current (mA): ≤1100
- Rated torque(kg.cm): 16.0 Kg.cm
- Rated Speed (RPM): 195

Pin Description

No:	Pin Name	Description
1	Terminal 1	A normal DC motor would have only two terminals. Since these terminals are connected together only through a coil they have no polarity. Revering the connection will only reverse the direction of the motor
2	Terminal 2	

Table 3.1: DC Gear Motor Pin Out

Use of the DC motor:

As the name suggests the hobby DC motor is highly used by hobbyists who start exploring electronics. Hence this motor is very simple and easy to use. You can use any normal 9V battery or even a 5V supply since this motor has an operating range from 4.5V to 9V. To make it rotate just connect the positive (+) side of the battery to one terminal and the Negative (-) sign of the battery to the other end and you should see the motor rotating. If you want to reverse the speed of the motor, simply interchange the terminals and the direction will also be reversed. To control the speed of the motor you must vary the voltage supplied to the Motor. The easiest way to do this is by using a potentiometer. There are also many other ways to achieve this. Also, remember that the motor can consume up to 250mA during loaded conditions so make sure your supply can source it. If you are controlling, it through any Digital IC or any Microcontroller you should use a motor driver IC like L293D or ULN2003.

Applications

- Toy cars
- Windmill projects.
- Basic Electronics projects
- As Robot wheels

3.6.4 Wheel

A circular frame or disk that rotates on an axis, typically in or around vehicles or machines. A potter's wheel, roulette wheel, or spinning wheel is any equipment, device, or instrument that is fashioned like this or has a circular frame, disk, or revolving drum as an essential element.



Figure 3.8: Wheel

Description:

- Wheels for land rovers & explorer robots with a large diameter.
- Suitable for gear motors with 6mm mounting holes.
- The semi-pneumatic rubber side allows squishing. Exploration robots are dampened by it.
- It is recommended for 3 to 10 kg robots (4 or 6-wheel usage recommended).
- Diameter: 130mm
- Thickness: 59mm
- Weight: 173 gr (each wheel with mounting hub)

3.6.5 HC-05 Bluetooth Module

A bluetooth module (Bluetooth module) is a chip that integrates bluetooth functionality, which is used to provide short-range 2.4GHz wireless communication. Bluetooth modules are semi-finished products as far as the end-user is concerned. A common bluetooth module is the HC-05, it is capable of adding two-way (full-duplex) wireless capability.

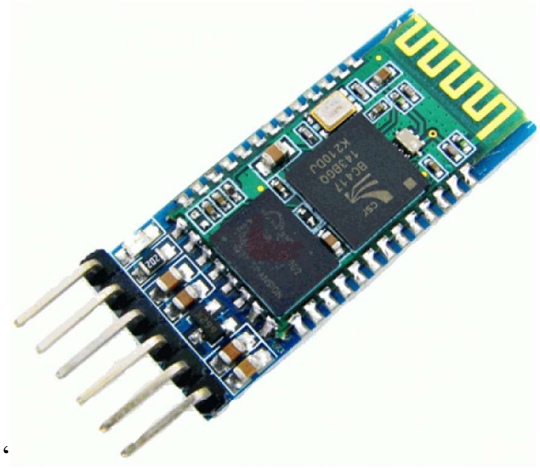


Figure 3.9: HC-05 Bluetooth module

Pin Number	Pin Name	Description
1	Enable / Key	Data Mode is toggled using this pin (set low) and AT Command Mode is toggled using this pin (set high). By default, it defaults to Data Mode.
2	Vcc	Powers the module. Connect to +5V Supply voltage
3	Ground	Ground pin of module, connect to system ground.
4	TX – Transmitter	Transmits Serial Data. This pin will receive everything that's received via Bluetooth as serial data.
5	RX – Receiver	Receive Serial Data. Bluetooth will transmit all serial data given to this pin.
6	State	It can be used as feedback to check if Bluetooth is working properly since it's connected to the onboard LED.

Table 3.2: HC-05 pinout configuration

3.6.6 Grass Cutter Motor

A lawn mower (also known as a mower, grass cutter or lawnmower) is a device utilizing one or more revolving blades (or a reel) to cut a grass surface to an even height.

Lawnmowers and grass cutters that are electrically powered are high performers, low weight, and can be used comfortably by any worker. Big grass-cutting machines have several advantages. They have heavy-duty metal blades that are meant to last long.



Figure 3.10: Grasscutter motor

Features:

- This Motor is Used in Agri Power Grass Cutter.
- 12 Volt DC Motor
- High-Speed
- High-Power
- Large-Torque
- 600 rpm

3.6.7 Lipo Battery

A lithium polymer battery, or more correctly lithium-iron polymer battery (abbreviated as LiPo, LIP, Li-poly, lithium-poly, and others), is a rechargeable battery of lithium-ion technology using a polymer electrolyte instead of a liquid electrolyte. High conductivity semisolid (gel) polymers from this electrolyte.

When sunlight strikes the solar panels, it is transformed into DC electricity. The electricity is stored in the battery as DC electricity. The DC electricity is then transferred from the battery to an inverter, where it is turned into AC electricity that may be used in storage. That's how the battery works in this project. It is a backup of our system. We used a 12-volt, 1500mAh battery here.



Figure 3.11: Lipo battery

3.6.8 Solar panel

Solar panels are those devices which are used to absorb the sun's rays and convert them into electricity or heat. Description: A solar panel is actually a collection of solar (or photovoltaic) cells, which can be used to generate electricity through photovoltaic effect. We are using a 10w solar panel.



Figure 3.12: Solar panel

3.7 Instrument Cost Analysis

Serial No	Components	Quantity	Price
1	Arduino Uno	01 pc	840
2	DC Gear motor	04 pcs	5400
3	Wheel	04 pcs	2000
4	Hex & Mount	01 set	1600
5	Lipo Battery	01 pc	2200
6	Solar panel & Charger	01 set	2000
7	Motor Driver	02 pcs	1500
8	LM2596	01 pc	90
9	Relay module	01 pc	90
10	Cutter Motor	01 pc	500
11	HC-05	01 pc	350
12	Others		500
		Total =	**17,070 Taka Only**

Table 3.3: Cost analysis of instruments

Chapter 4

ANALYSIS AND DISCUSSION

4.1 Introduction

In this project, a new approach is proposed for cutting grass based on a battery-powered Grass cutter, with minimal intervention of human involvement. The connection of physical things that are embedded with electronic components and software enables greater services for the connected things by applying computation and analysis. Here our proposed model aims at designing and developing to operate with highly versatile, much durable, highly comfortable, powerful, and avoiding obstacles in the path.

In this chapter we discuss our project result analysis and outcome, advantages, limitations, application and discussion of our system.

4.2 Result Analysis

Our Project entitled “Automated Grass Cutter” is successfully completed and the results obtained are satisfactory. It will be easier for the people who are going to take on the project for further modifications. This project is more suitable for a common man as it is having much more advantages i.e. no fuel cost, no pollution, and no fuel residue, less wear and tear because of a smaller number of moving components and this can be operated by using Android phone and Battery. This will give much less physical exertion to the people and can be easily handled. This system has the facility of charging the batteries. So, it is much more suitable for grass cutting. We have completed our project successfully with the available sources. But the results and modifications are not up to expectations. In Future we can implement grass cutter by specifying the area that is to be cut and the height at grab as per the requirement. The project which we have done surely reaches the average family because the grass

can be trimmed with minimum cost and with minimum time. Finally, this project may give inspiration to the people who can modify and can obtain better results.

4.3 Advantages

There are certainly many advantages of our project and some of the major ones have been given below:

- No fuel consumption and no pollution.
- Compact size and portable.
- Operating principle is simple.
- Unskilled people can also operate this machine.
- Low cost.
- Easy construction.
- No power is required.
- Highly reliable.
- High efficiency.
- Light weight and portable.
- No injury to the operator.
- Less noise.
- Time consumption for cutting the grab is less.
- Less space is required.
- Highly versatile.
- Highly comfortable.

4.4 Limitation

This project has some disadvantages. These are –

- The proposed specifications were developed for use as design specifications, not for evaluation of existing structure.
- Due to constraints of time, the sample size is limited.
- As the questionnaire was condensed, certain factors could not be studied.
- Most of the information provided in the project report is collected from different projects.
- Maintenance is needed.
- Repairing and replacing is not an easy task.
- The range of Bluetooth communication is limited.
- Make sure that sufficient power is provided to all the modules, especially the Bluetooth module. If the power is not sufficient, even though the Bluetooth module powers on, it cannot transfer data or cannot be paired with other Bluetooth devices.

4.5 Application

If you live in a home with a yard, you probably use at least one kind of grass cutter to keep your yard looking beautiful. Grass cutters have different intended uses and come in many types and sizes, but all have roughly the same use to keep the grass trimmed. Your grass cutter needs a tool ready to help you do it. Choosing the right grass cutter for the task makes the work easier and leads to satisfying results. A grass cutter is the most common kind of grass cutter that most homeowners use. Cutters may be rotary types, where blades swirl horizontal to the ground, or reel cutters where blades cut vertically. Typically, gas or electric powered, rotary cutters may be self-propelled or rely on manpower to make them move. For large areas, reel cutters are pulled behind lawn tractors. Smaller versions are manually pushed across lawns. Grass cutters are designed to keep grass cut short, but a good rule is to never cut off more than one-third of the height of your grass. Most cutters have levers that allow you to raise or lower the cutting blades to cut the grass to your desired length. Such as-

- It is suitable for small residential lawns and gardens.
- It is widely used to cut small grasses and it can also be used for cutting small plants.
- It is also used for trimming grass of playgrounds and sports grounds.
- In short, agricultural, gardens, big lawns, hospitals, for college, for small farm, for nurseries.

4.6 Discussion

From the received data during the tests, it has been seen that the total machine consumes little amount of power which is so effective and cost saving. The discharge rate is so adequate and small in value. On the other hand, the charging capacity is remarkable and is too fast along the requirement. There is no noise during grass cutting and rotating the machine. A little problem arises there and that is the low rpm of torque motor though it has a benefit also and for the low rpm the machine moves slowly but cuts the grass smoothly.

Chapter 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

We have presented a detailed description of an automated grass cutter. In this, we concluded that the modern grass cutter machine has better efficiency as compared to old machines it consumes non-renewable sources of energy received from battery far exceeds our energy demand. It meant to be an alternate green option to the popular and environmentally friendly hazardous gas-powered grass cutter and reduce human effort. Un-skilled people also handle it easily by using Android app and control within less time. It is highly efficient and accurate this method is having good, expected results. Moreover, the usage of this machine makes the grass cutting process faster by reducing cutting time.

Besides that, it is lighter, environmentally friendly and cost effective which is helpful for non-commercial use (home users) in maintaining and trimming the grass in gardens, homes, or yards. It has a minimum noise level and does not have any known negative effort on either the environment or the operator. This grass cutter with several features has been proposed. Several related works have been studied in order to gain an idea on how to build the grass cutter. Which will bring revolution in the agricultural field. In the near future a deformable grass cutter can be designed so that the vehicle can be used on any type of field. This project helped us to improve our practical knowledge and also to express a new idea in the workshop.

Finally, this project may give inspiration to the people who can modify and can obtain better results. However, by completing this project, we feel that our aim and objectives of the project are fulfilled.

5.2 **Future Work**

We have completed our project successfully with the available sources. But the results and modifications are not up to expectations. In future, we can implement grass cutter by specifying the area that is to be cut and also the height of grass as per the requirement. The project which we have done surely reaches the average family because the grass can be trimmed with minimum cost and with minimum time. In future what we can develop in this project –

- Programming can be enhanced to make the device perform different operations.
- We can install the grass collector to collect the grass, instead of leaving behind it.
- If panel used of high watt, then the machine can be used during nighttime for garden lighting or room lighting, because we can accumulate more power. And at nighttime, however, you keep it apart. So, the power in the battery can be used for this intention.

5.3 Recommendation

Solar grass cutters have some advantages over traditional lawn mowers, including reduced environmental impact, Reduced harmful gas emissions, Low maintenance, less human interaction, and Zero running cost. We recommend using this.

Finally, this project may give inspiration to the people who can modify and can obtain better results.

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Appendix

```
#define motor1 5
#define motor2 6
#define motor3 9
#define motor4 10

#define relay  11

#define trigPinA1              A5
#define echoPinA1              A4
#define trigPinA2              A3
#define echoPinA2              A2
#define trigPinA3              A1
#define echoPinA3              A0

int adc = 250;
int mood = 0;

void setup() {
  Serial.begin(115200);
  pinMode(trigPinA1, OUTPUT);
  pinMode(echoPinA1, INPUT);
  pinMode(trigPinA2, OUTPUT);
  pinMode(echoPinA2, INPUT);
  pinMode(trigPinA3, OUTPUT);
  pinMode(echoPinA3, INPUT);

  pinMode(motor1, OUTPUT);
  pinMode(motor2, OUTPUT);
  pinMode(motor3, OUTPUT);
  pinMode(motor4, OUTPUT);
  pinMode(relay, OUTPUT);
  digitalWrite(relay, HIGH);
}

void loop() {
  if (mood == 1) {
    if (Serial1.available() > 0) {
      char command = Serial1.read();
      switch (command) {
        case '0':
          adc = 0;
          break;
        case '1':
          adc = 50;
          break;
        case '2':
          adc = 60;
```

```
      break;
    case '3':
      adc = 75;
      break;
    case '4':
      adc = 100;
      break;
    case '5':
      adc = 125;
      break;
    case '6':
      adc = 150;
      break;
    case '7':
      adc = 175;
      break;
    case '8':
      adc = 200;
      break;
    case '9':
      adc = 225;
      break;
    case 'q':
      adc = 255;
      break;
    case 'x':
      mood = 0;
      break;
  }
}
if (mood == 0) {
  digitalWrite(relay, HIGH);
  Stop();
}
else {
  digitalWrite(relay, LOW);
  int Font = sennorA2();
  if (Font < 30) {
    Stop();
    delay(500);
    int Left_s = sennorA3();
    delay(100);
    int Right_s = sennorA1();
    if (Right_s < Left_s) {
      left();
      delay(500);
    }
    else {
      right();
      delay(500);
```

```
      }
    }
    else {
      forward();
    }
  }
}
else {
  if (mySerial.available() > 0) {
    char command = mySerial.read();
    if (command == 'S') {}
    else {
      Serial.println(command);
    }
    switch (command) {
      case 'F':
        forward();
        break;
      case 'B':
        back();
        break;
      case 'L':
        left();
        break;
      case 'R':
        right();
        break;
      case 'S':
        Stop();
        break;
      case 'G':
        Fleft();
        break;
      case 'I':
        Fright();
        break;
      case 'H':
        Bleft();
        break;
      case 'J':
        Bright();
        break;
      case '0':
        adc = 0;
        break;
      case '1':
        adc = 50;
        break;
      case '2':
        adc = 60;
```

```
          break;
        case '3':
          adc = 75;
          break;
        case '4':
          adc = 100;
          break;
        case '5':
          adc = 125;
          break;
        case '6':
          adc = 150;
          break;
        case '7':
          adc = 175;
          break;
        case '8':
          adc = 200;
          break;
        case '9':
          adc = 225;
          break;
        case 'q':
          adc = 255;
          break;
        case 'V':
          digitalWrite(relay, LOW);
          break;
        case 'v':
          digitalWrite(relay, HIGH);
          break;
        case 'X':
          mood = 1;
          break;
        case 'x':
          mood = 0;
          break;
      }
    }
  }
}

void forward()
{
 analogWrite(motor1, adc);
 analogWrite(motor2, 0);
 analogWrite(motor3, adc);
 analogWrite(motor4, 0);
}
```

```
void back()
{
 analogWrite(motor1, 0);
 analogWrite(motor2, adc);
 analogWrite(motor3, 0);
 analogWrite(motor4, adc);
}

void left()
{
 analogWrite(motor1, 0);
 analogWrite(motor2, adc);
 analogWrite(motor3, adc);
 analogWrite(motor4, 0);
}

void right()
{
 analogWrite(motor1, adc);
 analogWrite(motor2, 0);
 analogWrite(motor3, 0);
 analogWrite(motor4, adc);
}

void Stop()
{
 analogWrite(motor1, 255);
 analogWrite(motor2, 255);
 analogWrite(motor3, 255);
 analogWrite(motor4, 255);
}

void Fleft()
{
 analogWrite(motor1, (adc);
 analogWrite(motor2, 0);
 analogWrite(motor3, adc);
 analogWrite(motor4, 0);
}

void Fright()
{
 analogWrite(motor1, adc);
 analogWrite(motor2, 0);
 analogWrite(motor3, (adc);
 analogWrite(motor4, 0);
}

void Bleft()
{
```

```
  analogWrite(motor1, 0);
  analogWrite(motor2, (adc);
  analogWrite(motor3, 0);
  analogWrite(motor4, adc);
}

void Bright()
{
  analogWrite(motor1, 0);
  analogWrite(motor2, adc);
  analogWrite(motor3, 0);
  analogWrite(motor4, (adc - ((adc / 100) * 40)));
}

long sennorA1() {
  digitalWrite(trigPinA1, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPinA1, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPinA1, LOW);
  long duration = pulseIn(echoPinA1, HIGH);
  int distance = duration * 0.034 / 2;
  return distance;
}

long sennorA2() {
  digitalWrite(trigPinA2, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPinA2, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPinA2, LOW);
  long duration = pulseIn(echoPinA2, HIGH);
  int distance = duration * 0.034 / 2;
  return distance;
}

long sennorA3() {
  digitalWrite(trigPinA3, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPinA3, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPinA3, LOW);
  long duration = pulseIn(echoPinA3, HIGH);
  int distance = duration * 0.034 / 2;
  return distance;
}
```