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Design of Smart Mechanical Grass Cutter

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***Abstract*: The main objective is to design an autonomous grass cutter to incorporates all of the features from various type of grass cutter. It is an autonomous as well as manual grass cutter that utilizes each of the benefits, creating a safe, reliable, and user friendly grass cutter robot. And the main important thing is that this type of cutter is not only capable of doing grass gutting but also it can perform some of the modern tasks such as wiping the floors as well as seed drilling and also the seeding purposes. And as the entire grass cutter or the mowers which are available in the market are consuming any type of petroleum based fuel but in this type of model it is powered by the Li-po batteries and those can be charged using solar cells.**

***Keywords*: Autonomous, Robot, Li-Po, Grass cutter.**

1. Introduction

Robot technology is an interdisciplinary field that coordinates software engineering and designing. Advanced mechanics includes plan, development, activity, and utilization of robots. This technology applied in various field of applications. The robots fight to take over most of the tasks and we must recognize that often they win without too much effort. Such case is from the grass cutter used in homes. Research in this field led to creation of autonomous robots which can be used for lawn care / grass cutting at home. They can cut the grass, avoid obstacles, can recharge automatically from a designed power station, all this direct without human intervention. They are also environmental friendly because the one and only resource needed as the power source is electricity that can be powered using a rechargeable battery or directly through a solar panel.

A. Body of Paper

1) Bill of Materials and Specifications

A bill of materials, otherwise called an item structure, is an assortment of the crude materials, sub-social events, momentary assemblies, sub-sections, parts, and amounts of every that will be utilized to make the completed item. A bill of materials (BOM) is a record that depicts products as they are arranged (planning bill of materials), mentioned (details bill of materials), and fabricating bill of materials (Manufacturing bill of materials). Since the bill of materials keeps track of a wide range of item details, a few demands (planning and designing, documenting the heads, tasks, ordering, and required item information) would typically gather data from the BOM record to get everything in order. Originators and producers rely upon BOMs such a lot of that they have their own subsets, the planning bill of materials and the assemble bill of materials. The BOM coordinates positive results from business activities, for example, parts sourcing, reconsidering, and manufacturing, so making a viable, right, and present day BOM is basic. Making a precise and forward-thinking directed bill of materials is additionally significant for associations that reconsider creating works out.

Table 1
BOM for Robot vehicle

S.No.	Component name	Quantity	Cost (Rs.)
1	Dc motors	04	1200.00
2	Wheel	04	400.00
3	Hcsr05	01	100.00
4	Motor driver	01	550.00
5	Arduino uno	01	450.00
6	Chassis	01	450.00
7	Castor	01	40.00
8	Nut & bolt	1SET	50.00
9	Jumpers	1SET	100.00
10	Tape	01	40.00
11.	Mop	01	50.00
12.	Cutting blade	01	220.00
13.	SMPS 24V 10Amps or LIPO Battery	01	2500.00
14.	Hc05 Bluetooth module	01	350.00
15.	Seed Drill	01	780.00
Total			7500.00

2. Design and Modeling of Robotic Grass Cutter

1) Chassis design

The chassis is designed in such a way that it is cost effective and as well as compact and the body is made up of aluminum steel alloy of high strength as well as high corrosion resistance. The design using CAD software (Auto Cad) is shown below;

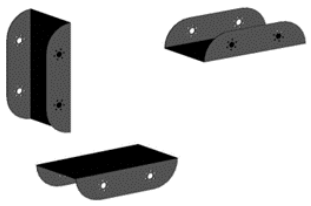

Fig. 1. CAD software

The advancement of a robot model arrangement is for the upgrade of a robot or mechanical framework and is known as automated plan. The prospects of Mobile Robots are quickly

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growing and their intricacies are expanding because of different applications. Reduced robot course strategies incorporate way planning, self-limit, and guide deciphering, among others. An obstacle keeping a strategic distance from the robot is a self-supervising versatile robot that prevents sway with abrupt impediments. By definition, obstacle avoidance is a profitable feature that should be introduced as soon as possible without interfering with the structure's overall efficiency.

Figure 2 and 3 shows both input, output, and peripherals are contained on a single silicon chip known as microcontroller. The followings are the required features of a single microcontroller:

a) Units of arithmetic and logic
b) Memory for program storage
c) Ports for input and output
d) A converter to convert Analog to digital
e) Electronic circuits

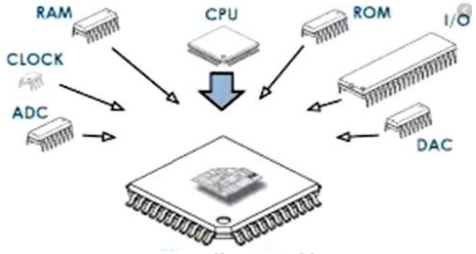

Fig. 2. Microcontroller assembly components

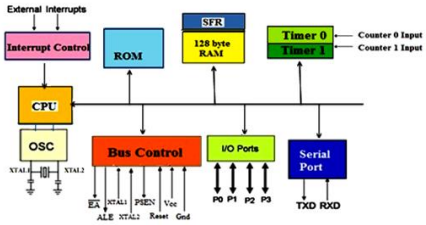

Fig. 3. Microcontroller - connectivity

The system includes: power supply, Arduino Microcontroller, Ultrasonic Sensor, IR driver/receiver sensor pair, and Geared DC Motors as given in figure 3. The equipment of this robot model contains: Arduino Uno, Ultrasonic sensor, Motor (100RPM), Motor driver IC (L298N), Battery (12V lipo), cutting blades, mop, seed drill, 8 channel relay and Breadboard. The Arduino Uno [Figure 4] is a prototyping board based on the AT mega 328p microcontroller. It's a free and open-source electronic prototyping platform that supports a variety of sensors and actuators. It is used to monitor and manage all operations as well as assign tasks to each user so connected.

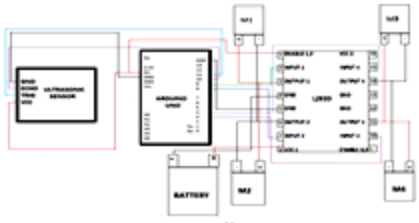

Fig. 4. Microcontroller - connectivity

2) Various features of the Arduino UNO are listed below

1. The Arduino UNO board has a sum of 20 information/yield pins. There are 6 PWM pins, 6 simple pins, and 8 digital I/O pins on the board.
2. The PWM pins are capable of Pulse Width Modulation.
3. The Arduino UNO's crystal oscillator operates at a frequency of 16MHz.
4. It also contains an Arduino Wi-Fi module. The Arduino UNO board features an ATmega328P microcontroller and an integrated Wi-Fi ESP8266 module.
5. The UNO board's input voltage ranges from 7 to 20 volts.
6. The Arduino UNO draws power from the external power supply automatically. It can also get power from a USB port.

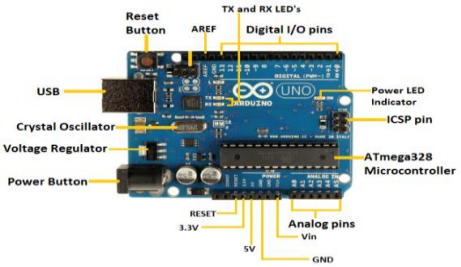

Fig. 5. Arduino UNO

B. *Motor Drivers*

Motor drivers use a low momentum control flag but send out a higher ebb and flow signal, essentially acting as a momentum intensifier. The motor is powered by the higher current symbol. The L298N is a motor driver that can drive a direct-current (DC) motor in any direction. It has two H-bridge driver circuits built in. Voltage must shift direction in order to rotate the engine clockwise or anticlockwise. Voltage can flow in both directions in the H-bridge circuit. As a consequence, H-connect integrated circuits will control a DC motor.

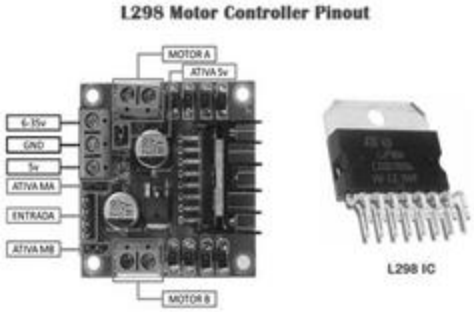

Fig. 6. Motor controller pinout

1) Algorithm and Working Principle

Algorithm for design of robot vehicle

- Step 1: Assemble all the components on the desired chassis.
- Step 2: Check all the components are working or not.
- Step 3: Make all the desired connections.
- Step 4: Check all the jumpers are working correctly or not.

- Step 5: Test power supply using a multi meter.
- Step 6: Compile the code.
- Step 7: Upload the code in the Arduino.
- Step 8: Recheck all the connections.
- Step 9: Remove the USB cable and check the power supply.
- Step 10: Now the robot is ready for use.

2) Algorithm for robot vehicle motion

- Step 1: Start the vehicle by powering on
- Step 2: Start both the grass cutter and its app.
- Step 3: Connect the cutter with the app and give the first command for working autonomously or manually.
- Step 4: After getting the command the grass cutter will start functioning.

3) Program code to function the robot vehicle

```
char t;
const int trigPin = 10;
const int echoPin = 11;
long duration;
int distance;
void setup()
pinMode(4,OUTPUT);    //left motors forward
pinMode(5,OUTPUT);    //left motors reverse
pinMode(6,OUTPUT);    //right motors forward
pinMode(7,OUTPUT);    //right motors reverse
pinMode(8,OUTPUT);    //Led
pinMode(10,OUTPUT);    //CUTTER RELAY
Serial.begin(9600);
pinMode(9,OUTPUT);
pinMode(trigPin, OUTPUT); // AUTONOMOUS MODE
pinMode(echoPin, INPUT);
pinMode(12,OUTPUT);pinMode(11,OUTPUT);
 digitalWrite(12,HIGH);
 digitalWrite(11,HIGH);}
void loop()
{if(Serial.available())
{
  t = Serial.read();
  Serial.println(t);
}
if(t == 'S')
{        //move forward(all motors rotate in forward direction)
  digitalWrite(4,HIGH);
  digitalWrite(5,HIGH);
  digitalWrite(6,HIGH);
  digitalWrite(7,HIGH);
}
else if(t == 'L')
{     //turn right (left side motors rotate in forward direction,
right side motors doesn't rotate)
  digitalWrite(4,HIGH);
  digitalWrite(5,HIGH);
  digitalWrite(6,LOW);
  digitalWrite(7,LOW);
}
else if(t == 'R')
{     //turn left (right side motors rotate in forward direction,
left side motors doesn't rotate)
  digitalWrite(4,LOW);
  digitalWrite(5,LOW);
  digitalWrite(6,HIGH);
  digitalWrite(7,HIGH);
}
else if(t == 'S1')
{    //turn led on or off)
  digitalWrite(8,HIGH);
  digitalWrite(9,0);
}
else if(t == 'F')
{     //STOP (all motors stop)
  digitalWrite(4,LOW);
  digitalWrite(5,LOW);
  digitalWrite(6,LOW);
  digitalWrite(7,LOW);
  digitalWrite(8,LOW);
  digitalWrite(9,0);
}
else if(t == 'W')
{     //CUTTER MOTOR START
  digitalWrite(10,HIGH);
}
else if(t == 'Q')
{     //CUTTER MOTOR START
  digitalWrite(10,LOW);
}
// AUTONOMOUS MODE CODE
else if(t=='A')
{
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distance= duration*0.034/2;
Serial.print("Distance: ");
Serial.println(distance);
if(distance<20)
{
  digitalWrite(4,LOW);
  digitalWrite(5,LOW);
  digitalWrite(6,HIGH);
  digitalWrite(7,HIGH);
}
else
{
  digitalWrite(4,HIGH);
  digitalWrite(5,HIGH);
  digitalWrite(6,HIGH);
  digitalWrite(7,HIGH);
}
```

4) Working principle

The autonomous grass cutter is programmed in such a way that it will grass automatically without any human interruption at any bad weather such as in a rainy day or windy day. It is programmed by Arduino CC language and some parts are coded using micro python as well as MIT app inventor tool or android studio for creation of the app that is used to control the cutter. The image shown below is the interface of the app that is used to control the grass cutter manually; on the right top corner there is a menu button that is used at starting to set that the grass cutter will work automatically or manually.

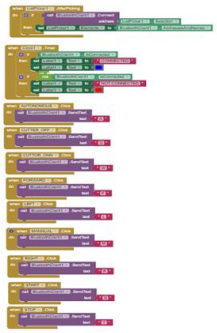

Fig. 7. Showing the codes of the controller app

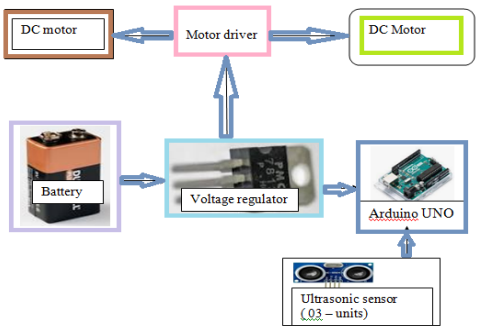

Fig. 8. Layout model of robot for data communication and control

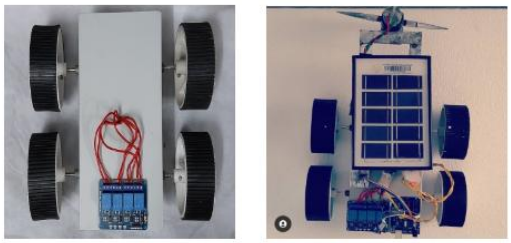

Fig. 9. Running prototype model

5) Function list

- Grass Cutter will have the ability to be controlled automatically as well as can work automatically without human instructions.
- It will have wheels that control forward and backward movement as well as turning.
- Solar power to large battery to mower batteries Automatic shut-off if it tips over.
- Micro-controller to interact with and control other components (motors for blades/wheels, and power management circuit.)
- And also it can mop the floors just a special attachment of op will be replaced and can perform this task.
- Also it can be applied for seed drilling as well as seeding purpose.

3. Conclusion

Many companies are now using robots due to comfortable execution and safety that is a huge help to humans. The advanced mechanics of obstruction evasion are used to recognize the deterrent and avoid the effect. This is a robot that can control itself. The design of a smart grass cutter robot necessitates the coordination of various sensors according to their functions. The detection of obstacles is a must for this self-contained robot. Through installed sensors on the robot, the robot obtains data from the surrounding territory. It is a great project which will work automatically without any human command and if there is a failure then it will notify through the app. And it's not only a grass cutter but a multifunction tool that be used for cutting grass as well as mopping floors and seed drilling purpose. The aim of this prototype model is to build an autonomous grass cutter robot that can detect obstacles in its path and cut the grass according to predetermined actions.

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