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Design and Fabrication of Programmed Grass Trimmer

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ABSTRACT: A Programmed Grass Trimmer is developed like a robotic lawn mower with low cost. The trimmer has a different type of blade other than Reel (spiral) or rotary blade. It has the ability to cut the grass at a certain height. The trimmer has a control unit connected to the I/O device to control. The signal from the I/O device is sent to the control unit. The control unit modifies the signal give it to the corresponding systems. The trimmer has a suction unit to collect the grass. The main purposes of our trimmer are to use the trimmed grass as a cattle feed for domestic animals. The trimmer has a comb attachment to plough and lifts the grass. The trimmer is electrically controlled. The trimmer has a sensing unit to sense the obstacles around the trimmer which may damage the blade.

KEYWORDS: Grass trimmer, I/O device, Suction unit, Suction unit, Cattle feed.

I. INTRODUCTION

In the European country, King Budding aimed to cut a lawn on sports grounds and gardens and to play a virtual role in the planning of modern sporting ovals, etc. This introduction to the case of the many games, as well as basketball, court game, etc., to the garden tool diode. Ten more years back, Thomas Inexperienced introduced a lawn instrument called a silent cutter that used a sequence drive to transmit electricity, so field mowers became an additional cost-effective variety for domesticating grazing animals. Today, everything is machine-controlled, and the modern technology is like the mission of each maker to invent a commodity and make it all easier for humans. With the rapid advancement of technology, we begin to see that more people are making widespread use of it, contributing to electricity scarcity and shortages and therefore substantial emissions. Therefore, in recent years, many testing methods produced for the navigation and construction of vehicles have been measured squarely. The biggest difference we have managed to make in our system is that the use of Arduino Uno, which also serves as the heart of the grass cutter using motor drives, makes the grass cutter quick to navigate the corresponding stop until it meets an obstacle with the aid of unheardable sensors. The grass cutter and the square calculation of the engines are attached to a microcontroller that governs the operation of all the engines. In addition to the problem of safety of the assembly as human safety, the identification of obstacles may be a critical concern for the small controller to be interfaced with a sensing element unit that performs object detection. A pre-programmed action is taken by the controller to detect the target or obstacle in compliance with the conditions perceived by the sensing element. The main purpose of programmed grass trimmer is to avoid fuel consumption and reduce the human effort, operating cost, and maintenance cost. Also grass trimmer are environmentally friendly it is used for various applications. The whole machine operates on the battery which can be recharged. Mainly, the trimmed grass can be used for feeding cattle.

II. RELATED WORK

The rake attachment to the rotary reel mower was invented by **Tony Tabac (1957) [1]**, and the rakes are called tines. They are used to raise the lawn that is crushed and to hack the short grass. He vertically designed the tines so that they separated the sticks and litter from the route to provide efficient grass cutting. The tines are the metal of the built strap and are shaped with lower end parts bent forward. There is the number of tines connected by the cotter pins to the brackets and balanced vertically to the location by swinging the connections. Firmly fixed to the rod of the mower are the braces. When they are not in service, the rake is either withdrawn or turned upward. The lawn mower rake consists of a pair of connection brackets modified to be connected to a mower's frame rod over the reel blade. The comb attachment was invented by **Donald R. Douglas (1968) [2]**. He improvised the tobacco-invented rake attachment design.

He used the comb to clear the obstruction from the road and the movement of the blade to shield the user from any collision happening. Tines were used to pick and comb the lawn. For the rotary blade lawn mower, he designed the comb extension. **William R. Smith (1966)** [3] developed a lawn mower height adjustment system that works efficiently and adapts to various lawnmower styles. To raise and decrease the lawn mower's height, he invented a scalloped cam surface. The scalloped cam surface is mounted to the wheel such that the height of the mower is raised to a certain degree when the surface travels in the anticlockwise direction and the height of the mower is reduced when worked in the anticlockwise direction. In order to move the mower, **Chen et al (1987)** [4] used an internal combustion engine and he used a memory device to monitor the direction of the mower to the grass. To chart the direction of the grass, he used paper tape. Using a pen or a drawing, he recorded the route manually, so the path lawn mower is adapted for different lawns. **Robert L. Martin (1989)** [5] invented an engine-driven, self-propelled lawn mower. To drive the pedals, he used a pair of drive motors and to change the mower's course to the right or left. Each independent wheel drive is operated by computers. **Aponte et al (2019)** [6] created an automatic lawn mower with the direction of the senses according to the gravitational field or other environmental signal of the Earth. The invention consists of a drive mechanism and a drive system communication control module. The system's memory module consists of a magnetic tape, disc, hard drive, CD-RW, RAM, EPROM, EEPROM, and flash memory.

III. MATERIALS AND METHODOLOGY

Materials used in this research work are Mild steel purchased from Ambattur Chennai, Plywood from local vendor, DC motors, bearing for wheel, Bluetooth module, various sensors, and Arduino ATMEGA 2560 was supplied for Krishan Electronics Chennai. Figure 1 shows the fabricated grass trimmer.

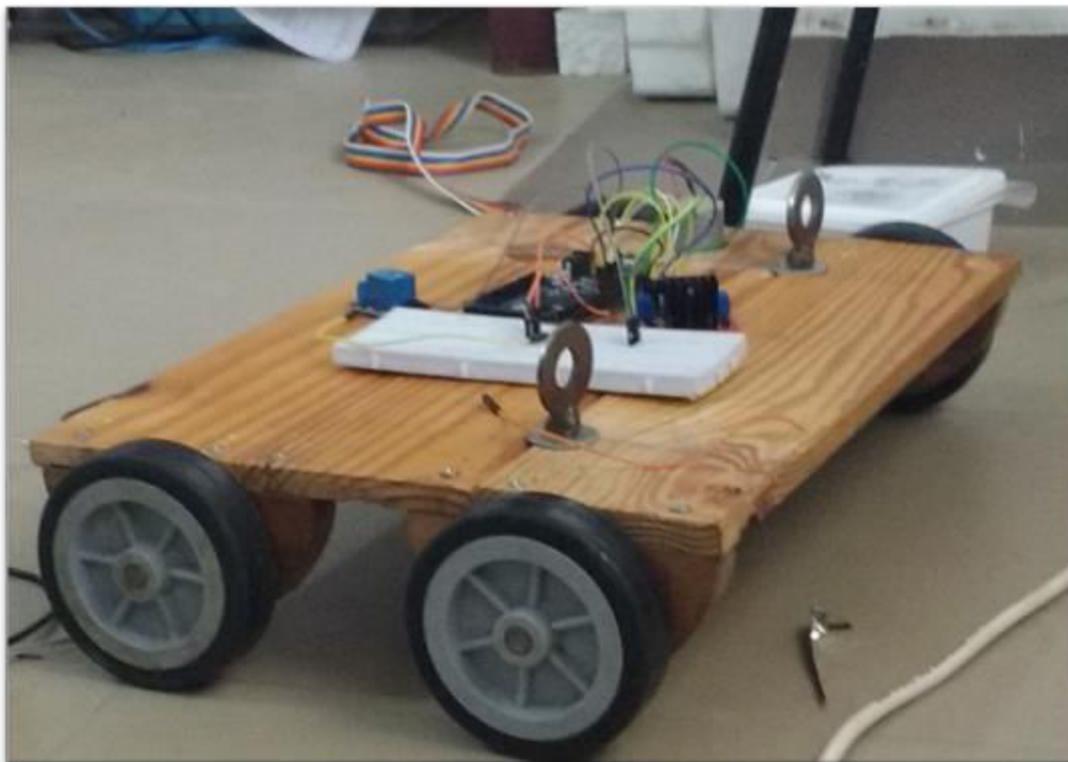
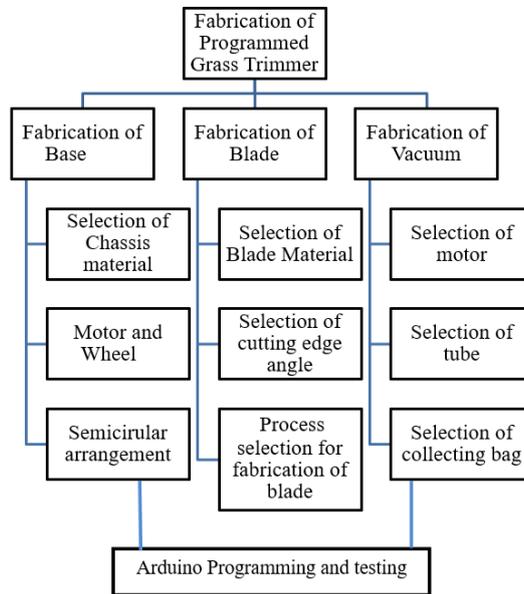


FIGURE 1 FABRICATED GRASS TRIMMER

IV. METHODOLOGY



V. DESIGN OF THE PROGRAMMED GRASS TRIMMER AND CODING OF ARDUINO

The design for the programmed grass trimmer is shown in the figure 2, which is drawn by CAD Software.

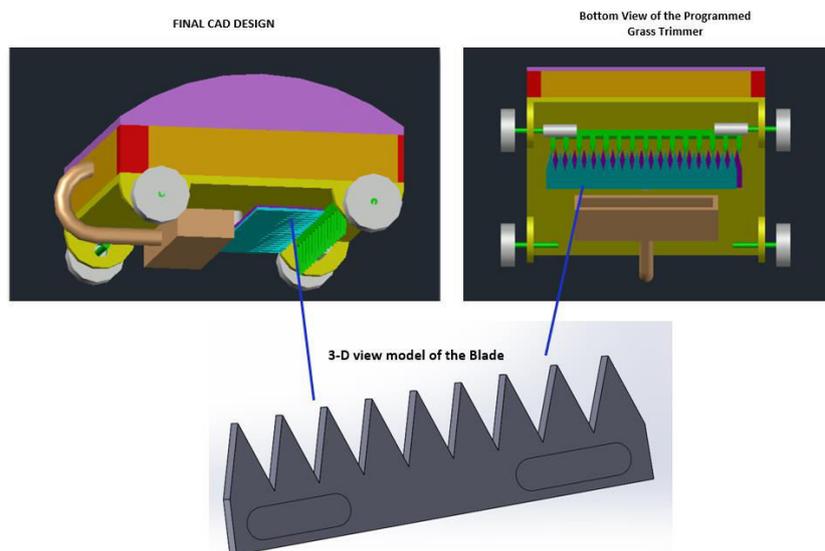


FIGURE 2 CAD 3D DIAGRAM OF PROGRAMMED GRASS TRIMMER AND BLADE

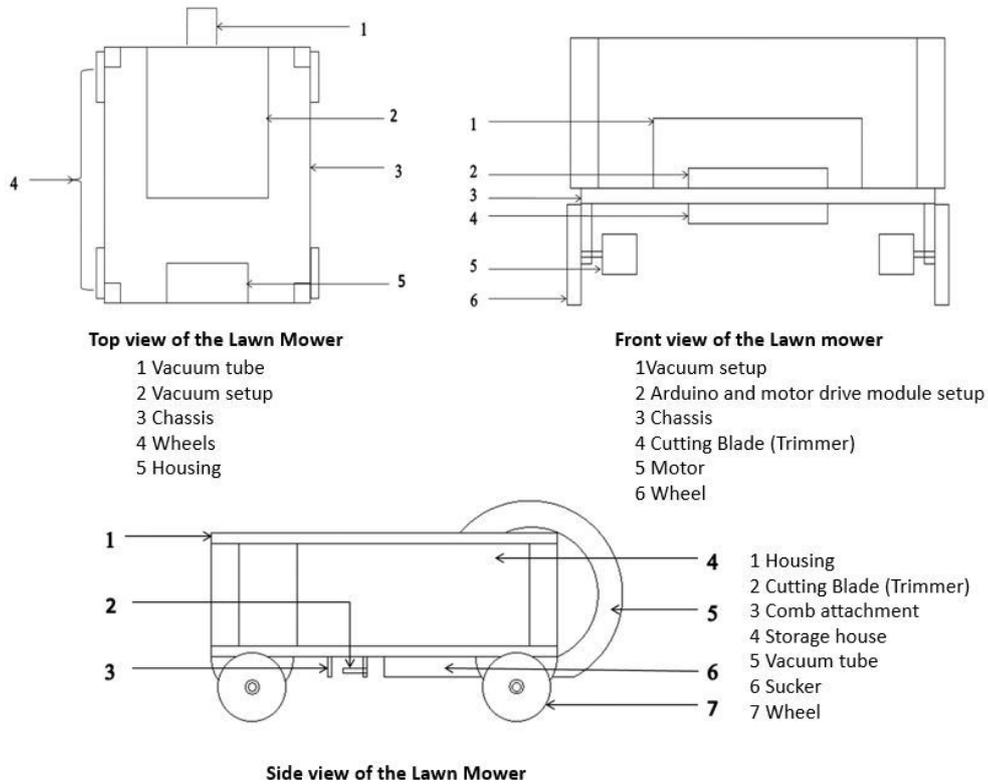


FIGURE 3 CAD 2 D DIAGRAM OF PROGRAMMED GRASS TRIMMER

Figure 3 shows the 2D images of different views of the programmed grass trimmer which is drawn in auto CAD. This image clearly explains about the grass trimmer and the specified parts in it depicts the working of the trimmer.

VI. MORPHOLOGICAL CHART

Morphological chart is a technique to create ideas in an analytical and systematic manner. Usually, functions of the product are taken as a starting point. Here, in this research work morphological chart is given below to specify the types of materials to be used for specified parts. Table 1 shows the morphological chart.

TABLE 1 MORPHOLOGICAL CHART

Functions	Options			
Base (Chassis)	Wood	Aluminium	Steel	Polymer
Control	Bluetooth	Wi-Fi	Remote control	Wired
Automation (Microcontrollers)	Arduino	Raspberry Pi	Orange Pi	Banana Pi
Wheels	Castor wheel	Tanker wheel	Normal wheel	
Motor	DC motors	AC motors	Stepper motor	Servo motor
Blade	Rotary type	Spiral type	Trimmer type	



Sensors	IR sensor	Ultrasonic sensor	PIR Sensor	
Collection of mown grass	Manual	Vacuum setup	Collecting bag	
Power	Manual power	Electric Battery	IC engine	
Type of cutting action	Shearing	Trimming		
Additional features	Adjustable height setup			

PUGH MATRIX

Table 2 shows the PUGH matrix. The Pugh matrix is a tool used to enable a disciplined, team-based procedure for concept generation and selection. Several concepts are assessed rendering to their strengths and weaknesses against a reference concept called the datum. By analysing PUGH matrix current research model plays a significant role and it was selected.

TABLE 2 PUGH MATRIX

Criteria	Concepts			
	Conceptual	IC engine lawn mower	Automatic lawn mower	Programmed grass trimmer (Our model)
Base (Chassis)	S	+	+	-
Automation	S	-	+	+
Power	S	-	+	+
Control	S	+	-	+
Wheels	S	+	-	-
Blade	S	-	-	+
Obstacle detection	S	-	+	+
Compatibility	S	-	+	+
Light weight	S	-	+	+
Weight lift capacity	S	+	-	+
Path detection	S	+	-	+
Stability	S	+	+	+
Safety	S	-	-	+
Height adjustment	S	-	-	+
Comb attachment	S	-	-	+
Vacuum setup	S	-	-	+



Total '+'	0	6	7	14
Total '-'	0	10	9	2
Total score	0	-4	-2	12

SWOT ANALYSIS

SWOT analysis (or SWOT matrix) is a tactical planning method used to help a person or organization find strengths, weaknesses, opportunities, and threats related to business competition or project planning. SWOT analysis is shown in table 3

TABLE 3 SWOT ANALYSIS

STRENGTH	WEAKNESS
<ul style="list-style-type: none"> <input type="checkbox"/> Using Arduino <input type="checkbox"/> Trimmer type blade (New model) <input type="checkbox"/> Using comb attachment <input type="checkbox"/> Height adjustments <input type="checkbox"/> Automatic control over blue tooth <input type="checkbox"/> Vacuum setup 	<ul style="list-style-type: none"> <input type="checkbox"/> Cannot connect with IOT (usage of blue tooth) <input type="checkbox"/> Usage in wet land is prohibited (using wood as chassis)
OPPORTUNITY	THREATS
<ul style="list-style-type: none"> <input type="checkbox"/> Changing connection through Wi-Fi enables to connect with IOT. <input type="checkbox"/> Can add automatic control for height adjustment. <input type="checkbox"/> Changing chassis material will extend the area if usage. <input type="checkbox"/> Attaching camera for obstacle detection. (instead of sensors) 	<ul style="list-style-type: none"> <input type="checkbox"/> The vacuum setup may not perform well. <input type="checkbox"/> Sensors may throw error or could not differentiate between grass and obstacles.

VII. CODING OF THE PROGRAMMED GRASS TRIMMER

```

int M1 = 11;
int M2 = 12;
int enA = 10;
int in1 = 9;
int in2 = 8;
int enB = 5;
int in3 = 7;
int in4 = 6;
void setup()
{
  Serial.begin(9600);
  pinMode(enA, OUTPUT);
  pinMode(enB, OUTPUT);
  pinMode(in1, OUTPUT);
  pinMode(in2, OUTPUT);
  pinMode(in3, OUTPUT);
  pinMode(in4, OUTPUT);
  pinMode(M1, OUTPUT);
  pinMode(M2, OUTPUT);
}

void loop()
{
  if(Serial.available()>0)
  {
    char data= Serial.read();
    switch(data)
    {
      case 'U': digitalWrite(11, HIGH);break;
      case 'u': digitalWrite(11, LOW);break;
      case 'T': digitalWrite(12, HIGH);break;
      case 't': digitalWrite(12, LOW);break;
      case 'Z': forward ();break;
      case 'z':off ();break;
      case 'Y':reverse ();break;
      case 'y':off ();break;
      case 'W': left ();break;
      case 'w':off ();break;
      case 'V':right ();break;
      case 'v':off ();break;
      default : break;
    }
  }
  Serial.println(data);
  }
  delay(50);
}
void forward ()
{
  digitalWrite(in1, HIGH);
  digitalWrite(in2, LOW);
  analogWrite(enA, 255);
  digitalWrite(in3, HIGH);
  digitalWrite(in4, LOW);
  analogWrite(enB, 255);
}
void reverse ()
{
  analogWrite(enA, 255);
  analogWrite(enB, 255);
  digitalWrite(in1, LOW);
  digitalWrite(in2, HIGH);
}
    
```



```
digitalWrite(in3, LOW);
digitalWrite(in4, HIGH);
}
void off ()
{
digitalWrite(in1, LOW);
digitalWrite(in2, LOW);
digitalWrite(in3, LOW);
digitalWrite(in4, LOW);
}
void left ()
{
digitalWrite(in1, HIGH);
digitalWrite(in2, LOW);
analogWrite(enA, 255);
digitalWrite(in3, LOW);
digitalWrite(in4, HIGH);
analogWrite(enB, 255);
}

void right ()
{
digitalWrite(in1, LOW);
digitalWrite(in2, HIGH);
analogWrite(enA, 255);
digitalWrite(in3, HIGH);
digitalWrite(in4, LOW);
analogWrite(enB, 255);
}
```

VIII. CONCLUSION

1. Programmed Grass Trimmer has been designed using Auto CAD software and prototype has been made.
2. A different type of blade was attached when compared to any other mower.
3. Testing was done and it cuts grasses at equal height and has the capacity to collect and store the grass.
4. Our invention is mainly to feed cattle the mown grass and has been successfully done and hence the mown grass doesn't go to the garbage.
5. Morphological chart, PUGH analysis, SWOT analysis have been done in order to evaluate the concepts drawn.

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