SRI VENKATESWARA COLLEGE OF ENGINEERING AND TECHNOLOGY

(AUTONOMOUS)

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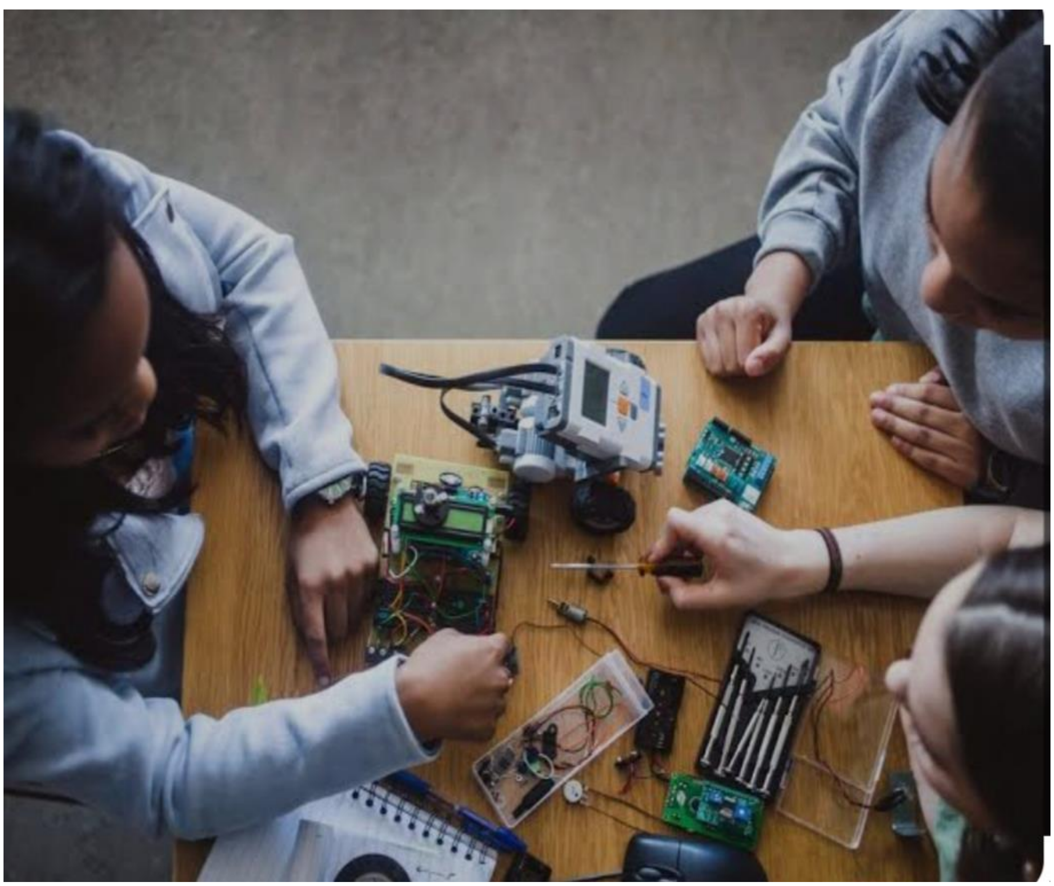
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

L & T Project



Automatic Grass Cutting Robot

Title:

Automatic grass cutting robot.

Abstract:

This project focuses on the design and implementation of an automatic grass-cutting robot utilizing Arduino microcontroller technology. The robot is aimed at providing an efficient and autonomous solution for maintaining lawns by intelligently navigating the terrain, detecting obstacles, and accurately cutting grass to desired heights.

The system comprises several key components, including motors for movement and cutting blades, sensors for obstacle detection and boundary tracking, for navigation and prolonged operation. These components are integrated and controlled using Arduino, a versatile platform known for its flexibility and ease of programming.

The project involves a systematic approach, beginning with the hardware setup, where the robot's chassis is designed and motors, sensors, and cutting blades are installed. Motor control algorithms are developed to facilitate smooth movement and precise maneuvering. Sensor integration enables the robot to perceive its surroundings, avoid obstacles, and stay within defined boundaries.

Decision-making logic is implemented to guide the robot's movements, ensuring efficient coverage of the cutting area while avoiding collisions. Safety mechanisms are incorporated to prevent accidents and ensure the well-being of users and bystanders. Additionally, power management techniques are employed to optimize battery life and extend operating durations.

Throughout the development process, rigorous testing and debugging are conducted to validate the functionality and performance of each component. The project culminates in the creation of a fully functional automatic grass-cutting robot capable of autonomously maintaining lawns with minimal human intervention.

This project not only demonstrates the capabilities of Arduino-based robotics but also highlights the potential for automation in outdoor maintenance tasks. The resulting grass-cutting robot offers a practical and innovative solution for

homeowners and lawn care professionals alike, exemplifying the fusion of technology and practicality in everyday applications.

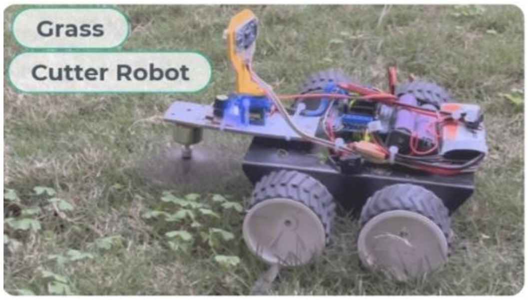
Introducion:

Maintaining a well-manicured lawn often demands significant time and effort. However, with advancements in robotics and automation, the task of lawn care can be streamlined and made more efficient. In this project, we embark on the journey of creating an automatic grass-cutting robot using Arduino, a versatile microcontroller platform known for its flexibility and ease of use.

The objective of this project is to develop a robotic solution that can autonomously navigate a lawn, detect obstacles, and precisely cut grass to maintain an aesthetically pleasing lawn surface. By harnessing the power of Arduino, along with sensors, motors, and clever programming, we aim to create a cost-effective and efficient alternative to traditional lawn mowing methods.

Throughout this endeavor, we will delve into various aspects of robotics and electronics, including motor control, sensor integration, decision-making algorithms, and power management. Each component plays a crucial role in the overall functionality and performance of the grass-cutting robot.

By the end of this project, not only will we have constructed a functional automatic grass-cutting robot, but we will also have gained valuable insights into the



realm of robotics and automation. Our creation will serve as a testament to the ingenuity and creativity that can be achieved through the fusion of technology and practical problem-solving.

Join us on this exciting journey as we embark on the development of an innovative solution for maintaining lush green lawns effortlessly, one blade of grass at a time. Let's dive into the fascinating world of robotics and Arduino to bring our vision of an automatic grass-cutting robot to life.

About the project:

Problem statement:

Design an automatic grass-cutting robot using Arduino technology to efficiently navigate outdoor terrain, detect obstacles, and maintain uniform grass height, addressing the labor-intensive and time-consuming nature of traditional lawn maintenance methods.

Scope of the Solution:

Developing an automatic grass-cutting robot using Arduino technology, including:

Hardware development: Chassis, motors, sensors, cutting blades.

Software implementation: Control algorithms, obstacle avoidance, boundary tracking, decision-making.

Power management: Maximize battery life, low-power modes.

Safety features: Blade control, fail-safe mechanisms.

Testing and validation: Robust operation under various conditions.

Documentation and user guidelines.

Future enhancements: Remote monitoring, scheduling, scalability.

REQUIRED COMPONENTS TO DEVELOP SOLUTIONS FOR AUTOMATIC GRASS CUTTING:

Hardware Components:

1.Microcontroller(Arduino UNO Board) :

BThe brain of the robot, responsible for processing sensor data and controlling motors and other peripherals. Arduino boards are commonly used due to their ease of programming and wide availability of libraries and resources.

2.L293D Motor Driver Shield:

The motor driver module is used to control the direction and speed of the DC motors. It takes input signals from the Arduino and provides higher current and voltage to the motors.

3.Ultrasonic Sensor:

An ultrasonic sensor can be added for obstacle detection. It helps the robot detect obstacles in its path and navigate around them.

4.Ultrasonic sensor holder:

With this Ultrasonic Sensor Mounting Case Holder, you can attach the HC-SR04 module to your application such as small robots or DIY projects very quickly and conveniently. This module is Only suitable for HC-SR04 Ultrasonic Sensor. This Bracket has a flexible arm and there is no need for any screws to fit the sensor.

5.Chassis:

Provides the structure and support for the robot. It should be durable and able to withstand outdoor conditions.

Motors:

Needed for propulsion and controlling the cutting blades. Typically, DC motors or stepper motors are used for movement, while brushless DC motors or geared motors are used for cutting.

Cutting Blades:

Blades or cutting mechanisms are attached to the robot to trim the grass. They should be designed for efficient cutting and adjustable to control grass height.

Power Supply:

Batteries or power sources to provide energy to the robot. Depending on the size and weight of the robot, rechargeable lithium-ion batteries or lead-acid batteries are often used.

Sevo motor:

Servo motors or “servos”, as they are known, are electronic devices and rotary or linear actuators that rotate and push parts of a machine with precision. Servos are mainly used on angular or linear position and for specific velocity, and acceleration.

Wheels:

Wheels or tracks are attached to the motors for movement across the lawn. Depending on the terrain, you may need to choose between different types of wheels for traction and stability.

Frame Mounting Hardware:

Bolts, nuts, screws, and brackets to assemble and mount components securely to the chassis.

Safety Features:

Emergency stop buttons, blade guards, and other safety mechanisms to ensure safe operation and prevent accidents.

Software components:

Main Control Code:

This is the primary code that runs on the Arduino microcontroller. It includes functions for motor control, sensor readings, decision-making algorithms, and overall control logic for the robot’s behavior.

Motor Control Functions:

These functions control the movement of the robot by sending commands to the motors. They specify the direction and speed of each motor to achieve desired movements such as forward, backward, left turn, and right turn.

Sensor Reading and Processing:

Code is written to read data from sensors used for obstacle detection, boundary tracking, and other purposes. This may involve processing sensor data to detect obstacles, determine distances, or detect changes in the environment.

Obstacle Avoidance Algorithms:

Algorithms are implemented to analyze sensor data and make decisions to avoid obstacles in the robot's path. This could involve simple behaviors like stopping and changing direction when an obstacle is detected, or more complex path planning algorithms to navigate around obstacles.

Boundary Tracking Logic:

If the robot needs to stay within a defined area while cutting grass, code is written to track boundaries using sensors or other methods. This ensures that the robot stays within the designated cutting area and doesn't stray into unintended areas.

Decision-Making Logic:

The main control code includes decision-making logic to determine the robot's behavior based on sensor inputs and other factors. This could involve prioritizing tasks, choosing optimal paths, and adjusting cutting patterns to efficiently cover the cutting area.

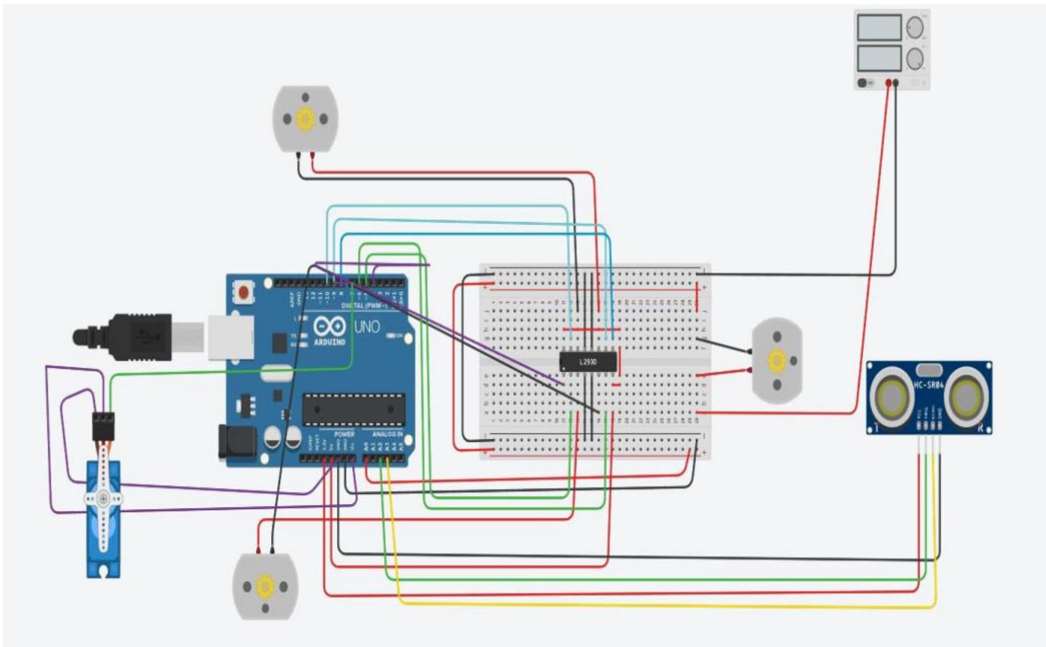
Safety Features:

Code is written to implement safety features such as emergency stop mechanisms, blade control to prevent accidents, and fail-safe behaviors to handle unexpected situations.

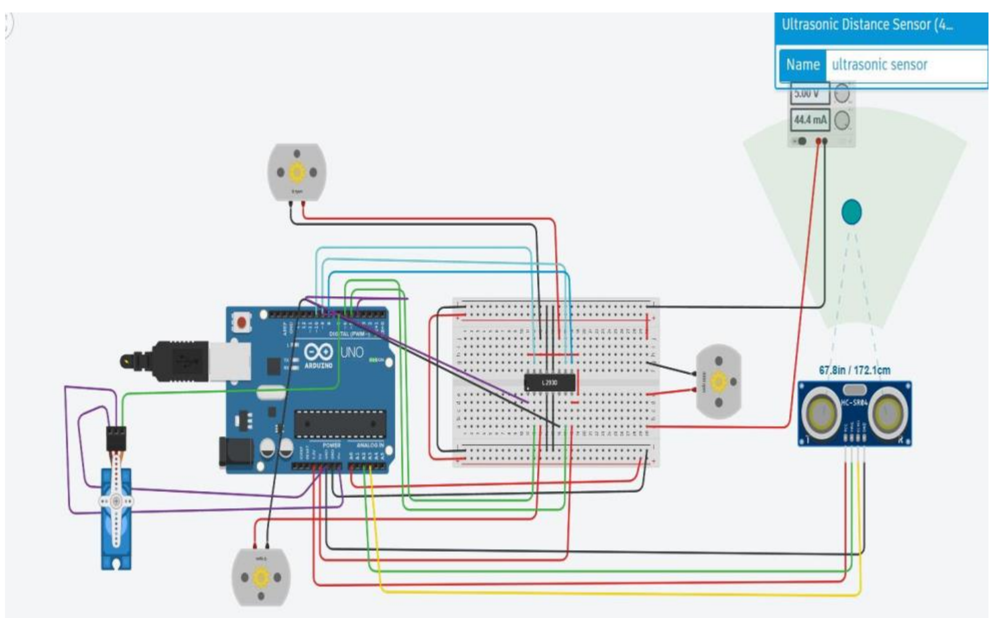
These software components work together to control the behavior of the automatic grass-cutting robot, ensuring safe and efficient operation while effectively maintaining the lawn.

Simulation circuit:

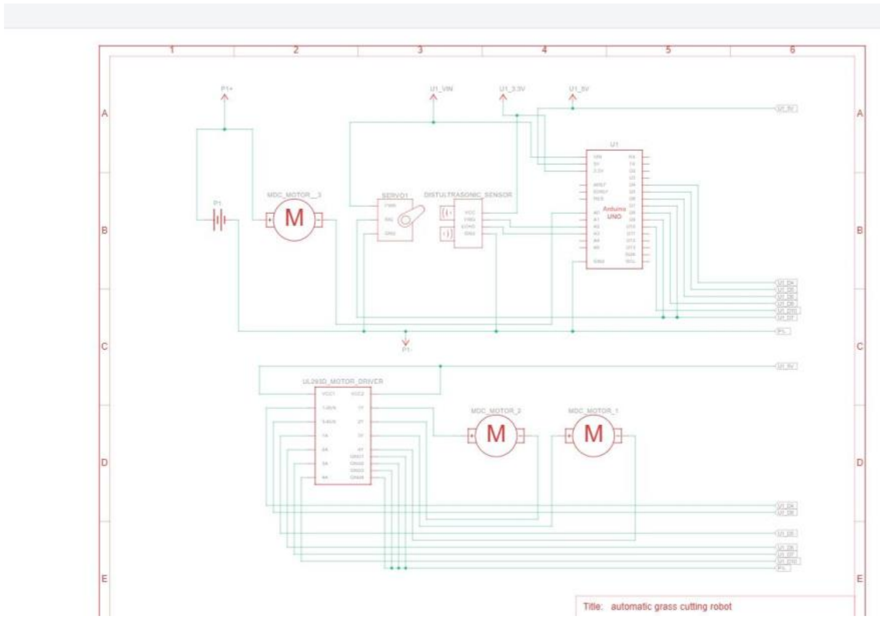
Before simulation:



During simulation:



Gerber file:



Code for the solution://c++ code

```
//

#include <Servo.h>//ultrasonic sensor connections

Int trig=A2;

Int echo=A3;

Int dt=10;


// Motor A connections

Int enA = 8;

Int in1 = 10;

Int in2 = 9;

// Motor B connections

Int enB = 4;
```

```
Int in3 = 6;
Int in4 = 5;


//int distance,duration;
Void setup() {
 // put your setup code here, to run once:
  pinMode(trig,OUTPUT);
  pinMode(echo,INPUT);
  Serial.begin(9600);
  pinMode(A0,HIGH);


        // Set all the motor control pins to outputs
        pinMode(enA, OUTPUT);
        pinMode(enB, OUTPUT);
        pinMode(in1, OUTPUT);
        pinMode(in2, OUTPUT);
        pinMode(in3, OUTPUT);
        pinMode(in4, OUTPUT);

        // Turn off motors – Initial state
        digitalWrite(in1, LOW);
        digitalWrite(in2, LOW);
        digitalWrite(in3, LOW);
        digitalWrite(in4, LOW);
```

```
}

//This code is written to calculate the DISTANCE using ULTRASONIC SENSOR

Int calc_dis()
{
  Int duration,distance;
  digitalWrite(trig,HIGH);
  delay(dt);
  digitalWrite(trig,LOW);
  duration=pulseIn(echo,HIGH);
  distance = (duration/2) / 29.1;
  return distance;
}

Void loop() {
	directionControl();
	delay(1000);
	speedControl();
	delay(1000);
}

// This function lets you control spinning direction of motors
Void directionControl() {
	// Set motors to maximum speed
	// For PWM maximum possible values are 0 to 255
```

```
	analogWrite(enA, 255);
	analogWrite(enB, 255);

	// Turn on motor A & B
	digitalWrite(in1, HIGH);
	digitalWrite(in2, LOW);
	digitalWrite(in3, HIGH);
	digitalWrite(in4, LOW);
	delay(2000);

	// Now change motor directions
	digitalWrite(in1, LOW);
	digitalWrite(in2, HIGH);
	digitalWrite(in3, LOW);
	digitalWrite(in4, HIGH);
	delay(2000);

	// Turn off motors
	digitalWrite(in1, LOW);
	digitalWrite(in2, LOW);
	digitalWrite(in3, LOW);
	digitalWrite(in4, LOW);
}

// This function lets you control speed of the motors
Void speedControl() {
```

```
	// Turn on motors
	digitalWrite(in1, LOW);
	digitalWrite(in2, HIGH);
	digitalWrite(in3, LOW);
	digitalWrite(in4, HIGH);

	// Accelerate from zero to maximum speed
	For (int I = 0; I < 256; i++) {
		analogWrite(enA, i);
		analogWrite(enB, i);
		delay(20);
	}

	// Decelerate from maximum speed to zero
	For (int I = 255; I >= 0; --i) {
		analogWrite(enA, i);
		analogWrite(enB, i);
		delay(20);
	}

	// Now turn off motors
	digitalWrite(in1, LOW);
	digitalWrite(in2, LOW);
	digitalWrite(in3, LOW);
	digitalWrite(in4, LOW);
}
```

```
// Define the pin for the servo
#define SERVO_PIN=7

// Create a servo object
Servo servo;

Int angle = 0;
Int angleIncrement = 1;
Unsigned long previousMillis = 0;
Unsigned long interval = 1000; // Interval in milliseconds


// Main program
Int main() {
 Setup();{// Call the setup function
  // Attach the servo to the pin
 Servo.attach(7);
}

 While (true) {
  Unsigned long currentMillis = millis();
  If (currentMillis – previousMillis >= interval) {
   // Save the last time you blinked the LED
   previousMillis = currentMillis;

   // Move the servo
```

```
    Servo.write(angle);
    Angle += angleIncrement;

    // Reverse direction when reaching the limits
    If (angle <= 0 || angle >= 180) {
     angleIncrement *= -1;
    }
   }
  }

  Return 0;
}
```

Conclusion:

By combining robotics, electronics, and programming skills, the automatic grass-cutting robot project demonstrates the potential of Arduino technology to revolutionize outdoor maintenance tasks. The resulting robot offers a practical and innovative solution for maintaining lush green lawns with minimal human intervention, showcasing the power of automation in everyday applications.

Video demo:

Softcopy:

1) https://drive.google.com/file/d/1NFloT23JCZ-6jo6Ki1DtAliKhwiiukKu/view?usp=drivesdk

***2)**https://drive.google.com/file/d/1NKITANjhQYL7L47tHn4vvvoSS2yxl_1g/view?usp=drivesdk*

Hardcopy:

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