

Design and Development of an Obstacle Avoiding System for Accident Prevention

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ABSTRACT: The project focuses on the design and development of an obstacle avoiding robotic system for accident prevention. The robot is built using an Arduino Uno microcontroller based on the ATmega328, which acts as the central control unit. An ultrasonic sensor (HC-SR04) is used to detect obstacles by measuring the distance between the robot and objects in its path. This robotic system operates autonomously without human intervention and can navigate in unknown environments. It has wide applications in areas such as industrial automation, military surveillance, smart vehicles, and assistive technologies.

KEYWORDS: Key points: Arduino UNO, motor shield L293d, ultrasonic sensor HC-SR04, DC Motor, servomotor.

I. INTRODUCTION

Obstacle avoidance robots are designed to navigate in unknown environments without colliding with objects. They use sensors such as ultrasonic and infrared to detect obstacles and guide movement. These robots are widely used in applications like home automation, industrial monitoring, and autonomous vehicles. The control system measures the distance of obstacles and adjusts the robot's direction to ensure safe navigation. Although ultrasonic sensors provide accurate distance measurement.

- The robot would have the capacity to detect obstacles in its path based on a predetermined threshold distance.
- After obstacle detection, the robot would change its course to a relatively open
- path by making autonomous decisions.
- It would require no external control during its operation.
- It can measure the distance between itself and the surrounding objects in real-time.

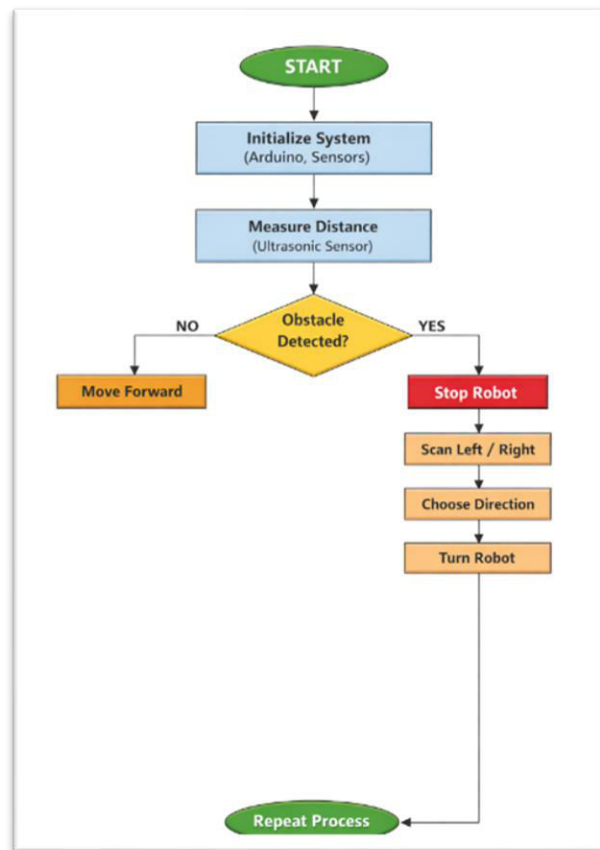
II. LITERATURE SURVEY

The study on a voice-controlled obstacle avoiding robot using Arduino focuses on developing a robotic system that can be controlled through voice commands while automatically detecting and avoiding obstacles. The methodology involves the use of an Android application that sends voice commands via a Bluetooth module to the Arduino microcontroller. Additionally, ultrasonic sensors are used for obstacle detection, allowing the robot to sense its surroundings. The key components used in this system include Arduino Uno, Bluetooth module (HC-05), ultrasonic sensor, motor driver (L298N), DC motors, and a mobile application.

The obstacle detection and avoidance robot system emphasizes creating an autonomous robot capable of sensing and avoiding obstacles without human intervention. The system uses ultrasonic sensors to measure distances, and the microcontroller processes this data to control motor movement accordingly. Key components include Arduino, ultrasonic sensors, servo motor, and motor driver.

The work in this paper is divided in two stages. 1) Text- Detection 2) Inpainting. Text detection is done by applying morphological open-close and close-open filters and combines the images. Thereafter, gradient is applied to detect the edges followed by thresholding and morphological dilation, erosion operation. Then, connected component labelling is performed to label each object separately. Finally, the set of selection criteria is applied to filter out non text regions. After text detection, text inpainting is accomplished by using exemplar based Inpainting algorithm.

III. METHODOLOGY



The methodology of the obstacle avoiding robot explains the systematic procedure used to design, develop, and implement the system. It involves sensing the environment, processing data using a microcontroller, and controlling the robot's movement based on real-time decisions. The aim is to enable the robot to navigate safely by detecting and avoiding obstacles automatically without human intervention.

WORKING METHODOLOGY

The working of the obstacle avoiding robot follows a step-by-step process:

Step 1: System Initialization

When the robot is powered on, all components such as the Arduino, sensors, and motors are initialized. The microcontroller sets up the input and output pins and prepares the system for operation.

Step 2: Distance Measurement

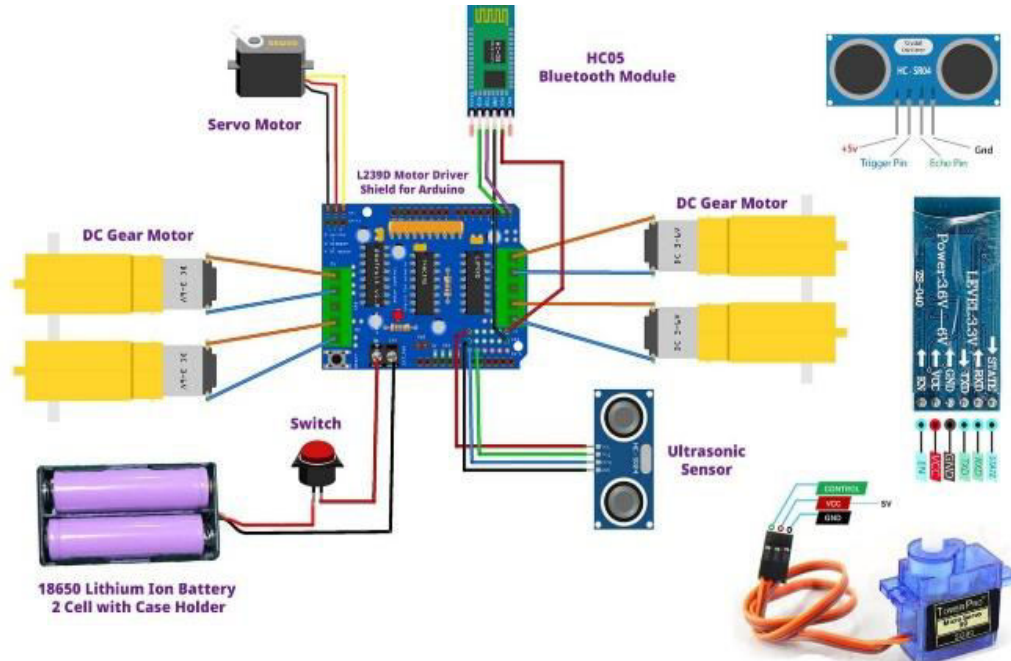
The ultrasonic sensor emits ultrasonic waves and waits for the reflected signal from nearby objects. The time taken for the echo to return is calculated and converted into distance.

Step 3: Data Processing

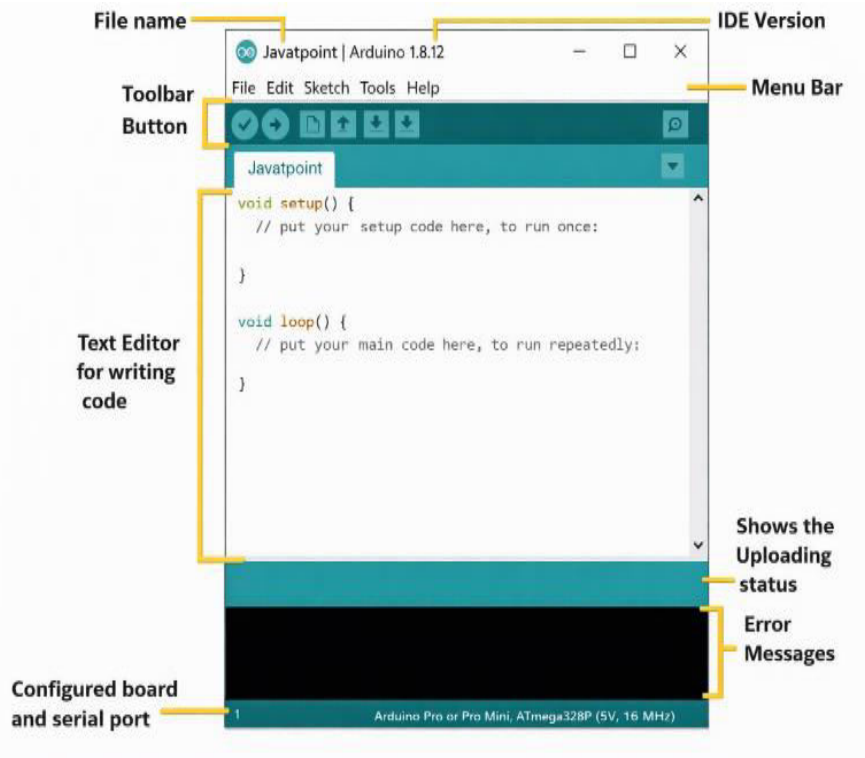
The measured distance is sent to the Arduino microcontroller. The controller compares the distance with a predefined threshold value to determine whether an obstacle is present.

IV. SYSTEM DESIGN AND COMPONENTS

The circuit diagram of the obstacle avoiding robot shows the interconnection of all essential components including the Arduino Uno, ultrasonic sensor, motor driver, DC motors, and power supply. The Arduino Uno acts as the central control unit, receiving distance data from the ultrasonic sensor, which is connected through its trigger and echo pins. Based on this input, the Arduino processes the signal and sends control commands to the motor driver L298N.



PROGRAMMING ARDUINO IDE:



1. Objective

To develop and implement an Arduino program that controls an obstacle avoiding robots using an ultrasonic sensor and motor driver.

2. Components Used

- Arduino Uno (ATmega328)
- Ultrasonic Sensor (HC-SR04)
- Motor Driver (L298N / L293D)
- DC Motors

Arduino Program for Obstacle Avoiding Robot Code

```
void setup() {  
  Serial.begin(9600);  
  pinMode(Trig, OUTPUT);  
  pinMode(Echo, INPUT);  
  servo.attach(motor);  
  M1.setSpeed(Speed);  
  M2.setSpeed(Speed);  
  M3.setSpeed(Speed);  
  M4.setSpeed(Speed);  
}  
void Obstacle() {  
  distance = ultrasonic();  
  if (distance <= 12) {  
    Stop();  
    backward();  
    delay(100);  
    Stop();  
  }
```

Program Explanation

- The ultrasonic sensor measures distance using echo signals.
- If distance is greater than 20 cm, robot moves forward.
- If obstacle is detected (less than 20 cm):
- Robot stops
- Turns right to avoid collision

Output

- Robot moves forward in a clear path
- Automatically changes direction when obstacle is detected
- Displays distance values in Serial Monitor

V. EXPERIMENTAL RESULTS

TESTING AND EVALUATION:

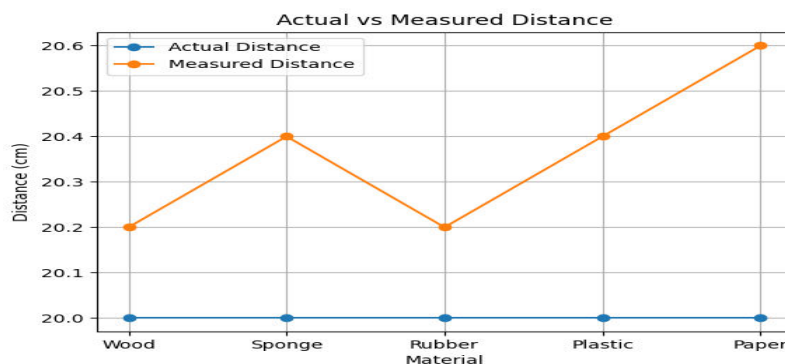
This Project Analyses and Performance of Ultrasonic sensors For Obstacle Detection using different materials. Distance Measurement is critical in robotics and navigation systems. Sensor accuracy depends on surface texture, reflectivity, transparency, and absorption properties of materials.

1. MATERIAL-BASED TESTING:

Objective: To evaluate obstacle detection accuracy and avoidance performance in short-range condition(20cm) using an ultrasonic sensor

S. No	Material	Actual Distance (cm)	Measured Distance (cm)
1	Wood	20	20.2
2	sponge	20	20.4
3	Rubber	20	20.2
4	Plastic	20	20.4
5	Paper	20	20.6

2. ACTUAL VS MEASURED DISTANCE



This graph shows that the measured distance is very close to the actual distance (20 cm) for all materials. Minor variations are observed due to material properties. This indicates that the ultrasonic sensor has high accuracy.

3. MATERIAL-WISE ANALYSIS

Wood: High accuracy due to strong sound reflection

Sponge: Absorbs sound waves, causing reduced accuracy

Rubber: Stable readings with good reflection

Plastic: Good performance with minor error

Paper: High deviation due to sound transmission

The testing analysis confirms that the ultrasonic sensor performs effectively in short-range obstacle detection. Although material properties affect accuracy, the overall system achieves high reliability (90% success rate) and is suitable for real-time applications in robotics and automation.

APPLICATIONS

- Used in automatic traffic signal control systems.
- Helpful in parking systems to detect vehicles and avoid collisions.
- Used in military and surveillance operations to explore dangerous areas.
- Can be used in smart wheelchairs for safe movement of disabled people.
- Used in industrial robots to transport materials without hitting obstacles.
- Helpful in-home cleaning robots and delivery robots.

ADVANTAGES

The main advantage of this project is that it can detect and avoid, obstacle

- collisions or accidents without disturbing its work.
- It will make higher efficiency in traffic.
- They can see better in poor visibility.

VII. CONCLUSION

Almost all navigation robot demands some sort of obstacle detection hence obstacle avoidance strategy is of most importance. Obstacle Avoidance Robot has a vast field of application. They can be used as services robots, for the purpose of household work and so many other indoor applications. Equally they have great importance in scientific exploration and emergency rescue, there may be places that are dangerous for humans or even impossible for humans to reach directly, then we should use robots to help us. In those challenging environments, the robots need to gather information about their surroundings to avoid obstacles.

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