Obstacle Avoidance Ground Robot

Mind Bogglers

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Introduction

What does our model do?

- Our model detects an obstacle in front of it autonomously and changes its path dynamically with the help of sensors and motors. Thus, aiding in usage in robotics and autonomous systems.
- This system can be used in self-driving cars, military, drones and many such stuff.

Applications

- Autonomous vehicles
- Drones
- industrial robots

Objectives

Key Goals

- Design and develop a car that avoids obstacles autonomously.
- Improve safety and efficiency in navigation.

Outcomes

- A prototype demonstrating real-time obstacle detection and avoidance.

System Architecture

Flow and connection

We have a basic car-like structure model wherein the wheels are connected with motors which are further connected with a motor driver and the sensor used is ultrasonic which is used for obstacle detection. This whole model is connected with arduino which leads to two paths one using thingspeak where the data is being collected and represented as graphs and another is a website which controls theworking of the model being automated or user controlled.

Components used

- **Hardware**
  - Ultrasonic Sensors
  - Servo Motors
  - DC Motors
  - Arduino
  - Motor Driver
  - Rechargeable Battery
- **Software tools used**
  - Arduino IDE
  - Thingspeak
  - Python libraries
  - HTML for website

ThingSpeak™

ARDUINO IDE

Working principle

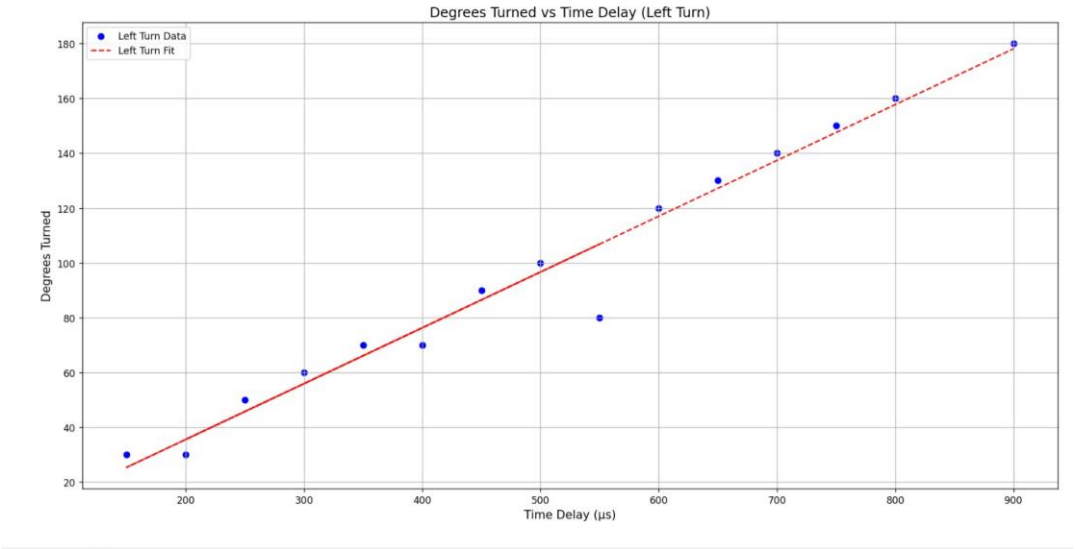
Step-by-Step Process:

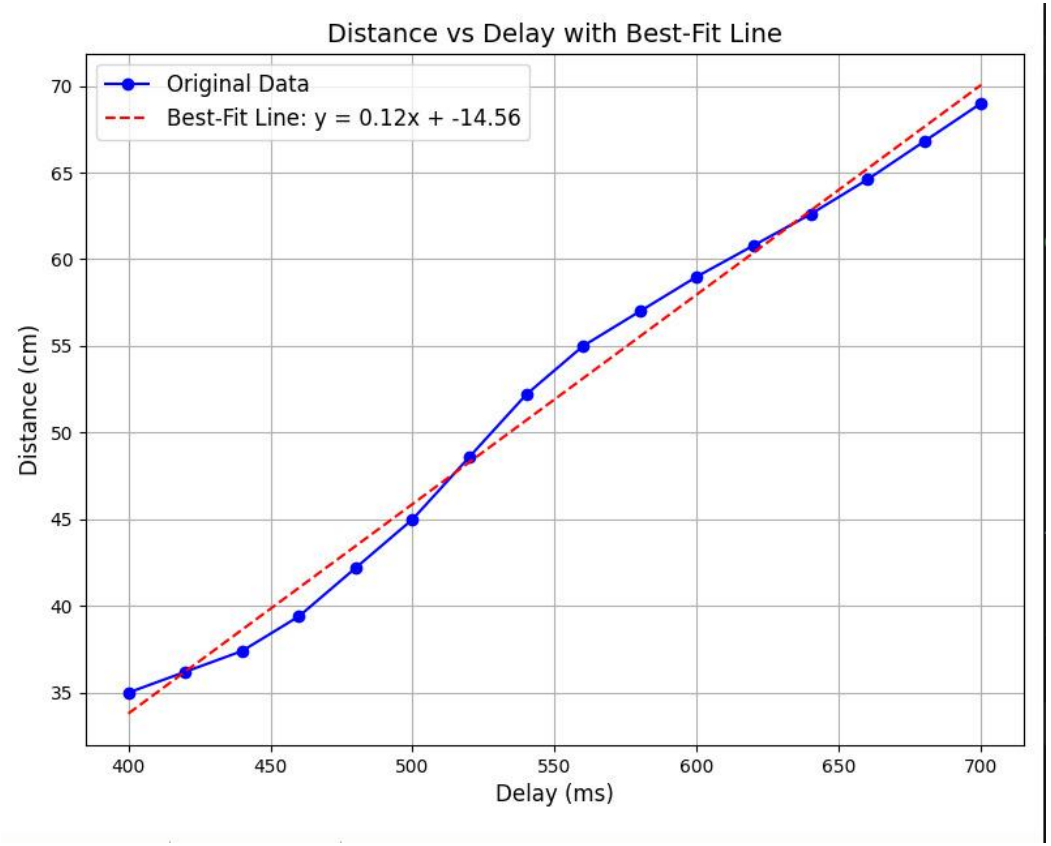
- Obstacle detected by ultrasonic sensor.
- Path being found by rotation of servo motor.
- Decision-making logic for movement, i.e. backward forward or right or left movement of model according to available path.
- Actuation of motors to change direction to desired one.
- This model can also be user operated by selecting from the website.

Individual contribution

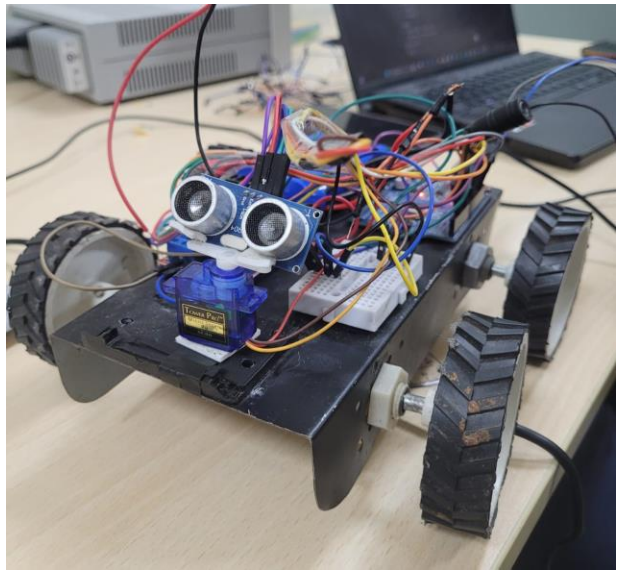
- **Aditya Gaur:** Data collection and preliminary analysis.
- **Bibek Dhody:** Hardware integration, including motors and sensors, calibration of sensors for accuracy.
- **Navishaa Agarwaal:** Slide preparation, video creation, and motor integration.
- **Virat Garg:** Code implementation and GitHub management, data analysis and graph generation.

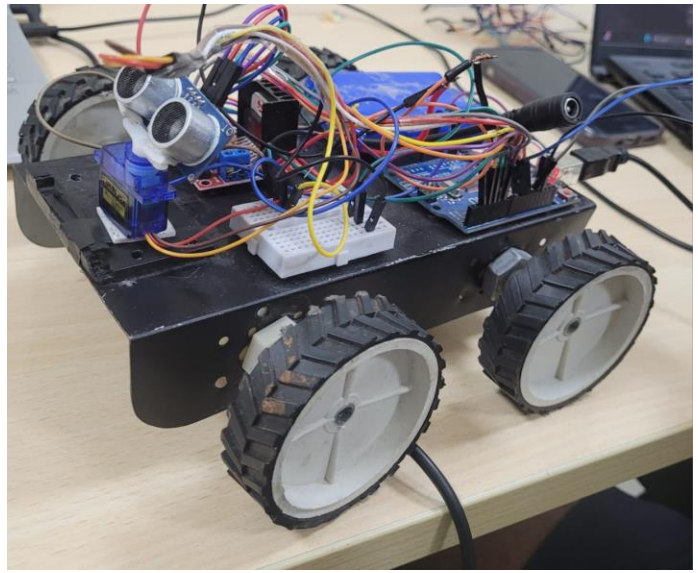
Calibration curves

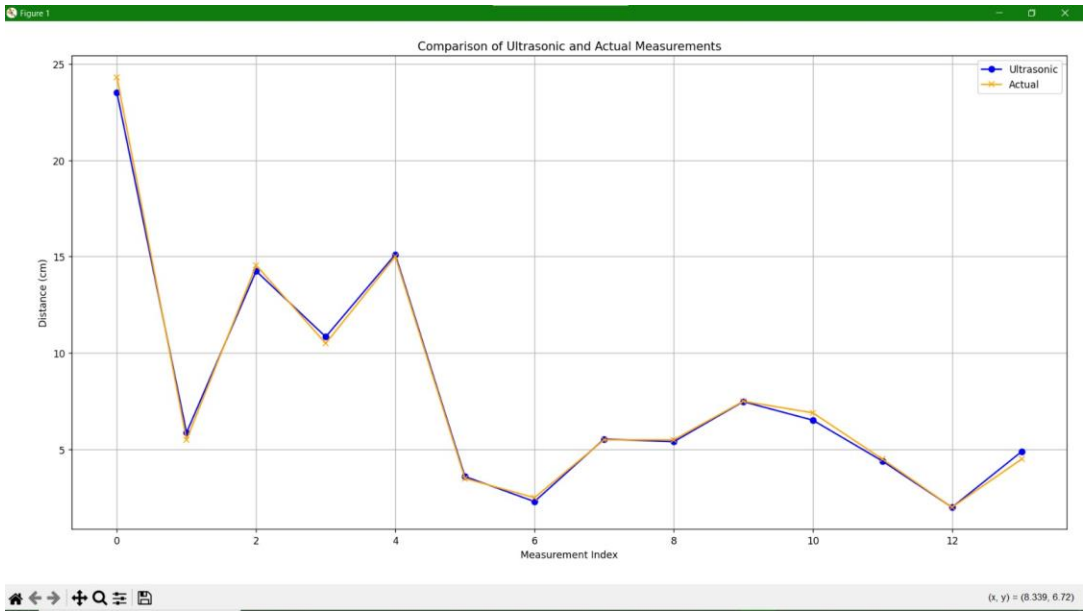




Results and demonstration







[Video Link]

[Github repo link]

Challenges

- **Sensor Limitations:** Issues with sensor range, accuracy, and environmental interference.
- **Power Consumption:** High processing demands reduce operational time.
- **Mobility Issue:** Data collection as well as mobility control is not functional when USB cable is disconnected from the PC.
- **Delays:** The script reads data from the serial port continuously, but there is a time.sleep(0.01) (10 milliseconds) delay before processing the next piece of data.If data arrives faster than the script can process and send it to ThingSpeak, some data points may be missed.

Applications and Future Scope

Real-World Applications:

- **Warehouse Automation:** Robots navigate warehouses to pick and place items efficiently, avoiding shelves and workers.
- **Autonomous Delivery**: Robots deliver packages or food while avoiding pedestrians and obstacles in urban environments.
- **Home Cleaning**: Robotic vacuum cleaners, like Roomba, avoid furniture and walls to clean floors autonomously.
- **Agricultural Assistance**: Robots avoid trees and rocks while planting, spraying, or harvesting crops.

Future Enhancements:

- Integration of AI for smarter navigation.
- Use of advanced sensors like LIDAR or cameras.

Conclusion

The project successfully demonstrated obstacle avoidance in ground robotics. Key insights include the importance of sensor calibration and efficient algorithms for real-time processing. While effective in static conditions. Future improvements will focus on dynamic environment handling and enhancing energy efficiency.

Thank You