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MULTI-TERRAIN ROBOT

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Abstract : A robot is a type of automated machine that can execute specific tasks with little or no human intervention and with speed and precision. The common types of robots are autonomous mobile robots (AMRs), automated guided vehicles (AGVs), Humanoid robots, etc. We have made an attempt to develop an autonomous guided vehicle robot for future applications, keeping in mind the fundamental knowledge,also the environmental conclusions are focused at a large extent,In our project we have aimed at developing a robot (rover) with applications on uneven terrain to help in exploration in various terrains and environments where human interference may not be safe, targeting damped areas, areas where mining is done and areas lying low from the ground level. We have used Raspberry pi as the main equipment to control the robot through various connections of sensors, This micro controller helps read the data collected by the sensors and guides the robot through the path by controlling the motors which act as wheels for the robot. The vehicle detects the temperature in the areas, can detect the amount of carbon dioxide in the environment, also it can detect the obstacle in front of it and changes its path accordingly, Hence creating a safer environment for human beings without actually being exposed to the possible dangers.

***Index-Terms* - Detection, Exploration, autonomous guided vehicle, Environment, Mining.**

I.INTRODUCTION

Multi-Terrain robots are mobile robotic systems which have enhanced drive mechanism and control system, for applications in rough topographies. This project is the first phase of a bottom-up plan for developing a rugged autonomous robotic system for navigating different rough terrains. This includes the design (i.e., mechanism and control), manufacturing, and field testing. we aim to design the mechanical structures and 3D models of this robot, as an actively suspended 4-wheeled vehicle.

These robots typically utilize a combination of sensors, including cameras, and other environmental sensors, to navigate their surroundings and collect data. Some common applications of multi-terrain robots include search and rescue missions in disaster zones, military operations, areas where human reach is not possible or which maybe hazardous for human beings, and industrial applications. These robots can be equipped with a variety of tools and attachments, such as arms and manipulators, to perform tasks such as debris removal or sample collection.

II.LITERATURE SURVEY.

1. A Survey of Multi-Robot Systems for Search and Rescue Operations by Antonios Gasteratos and Kostas J. Kyriakopoulos (2013): The survey paper reviews the research on multi-robot systems for search and rescue operations. The authors discuss various challenges and opportunities for multi robot systems in this domain, including task allocation, communication, and localization.

2. Survey of Unmanned Aerial Vehicle Path Planning and Collision Avoidance Systems by Abhijit Kurute and Balasubramanian Raman (2019): The survey paper provides an overview of path planning and collision avoidance techniques for unmanned aerial vehicles (UAVs). The authors discussed the advantages and limitations of each technique and provide recommendations for future research.

3. A Survey of Perception Systems for Autonomous Ground Vehicles by Jungwon Kim, Inhyeok Kim, and Jihong Lee (2019): The survey paper reviews the research on perception systems for autonomous ground vehicles. The authors discuss various sensors used in perception systems, including cameras, LIDAR, and radar. They also discuss the challenges and opportunities of perception systems for autonomous ground vehicles.

III.RESEARCH METHODOLOGY

Auto mobility is one of the key features of a multi-terrain robot. Detecting harsh environments which can contain hazardous gases such as carbon monoxide, methane. Detection of fire or high temperatures in the environment. Detection of obstacles which can cause hindrance in the movement of the robot. A pi camera device which is mounted on the robot which provides live streaming of the environment or click images and record videos of the environment is also provided.

- Design & Development

The model is designed to be a simple four wheeled vehicle which can be traversed through rough topographies. The chassis or the body of the robot is the heart of the robot where various types of sensors a micro computer and a surveillance camera is mounted. The wheels have an outer layer of rubber material which provides them a better grip when on uneven and the surfaces which are not planar.

- Sensor Selection

The selection of the sensors is based on the functionality of each of them. Here in this model, we have calculated the requirement of the sensors based on the surrounding environment. So according to the necessity of the locality we have adapted the use of the following sensors:

- HC-SR04 ultrasonic distance sensor (3.3V-5V)
- Infrared sensor(5V)
- Gas detection sensor(5V) - Temperature sensor(5V)

• Communication & Control

The detection of the sensors is recorded and the movement of the robot is programmed in a regulated manner which allows the robot to record the data of the environment and also move forward stating that the surrounding is cleared and is accessible for human beings.

- Raspberry pi 3(5V)

2.4 GHz and 5.0 GHz IEEE 802.11ac wireless, Bluetooth 5.0, Gigabit Ethernet
For the collection of the data provided by sensors and displaying the data provided.

- L298N dual H-bridge DC motor driver(4.5V-38V) received power from a 3-pin 3.5mm-pitch screw terminal.

• Software Requirement - Coding language: Python

- Operating system: Windows 10
- Processor: Intel 5 processor
- RAM: 8GB

• Surveillance & Data Processing

-Thingspeak: this software is used for the featuring the data recorded by the sensors when the robot is in the mobile state.
-VNC viewer: this software is used for interfacing the raspberry pi with other sensors. It is also used for the visual display of the environment through live streaming, recording videos or capturing images.

- Implementation process for windows10:
  - Installation of VNC viewer in the system.
  - Importing all the necessary libraries.
  - Importing thing speak website URL which includes API keys for interface & communication.
  - Compiling the source code for the robot.
  - Testing the program for errors.
- Implementation process for Raspberry pi:
  - Upgrade Raspberry pi.
  - Mounting USB on the Raspberry pi for installation of the program & for interface of it with the sensors.
  - Interfacing Pi camera to it.
  - Compiling and testing the program for the prototype.
  - Run the source code using python IDE.

IV. HARDWARE MODEL

figure 1: hardware model

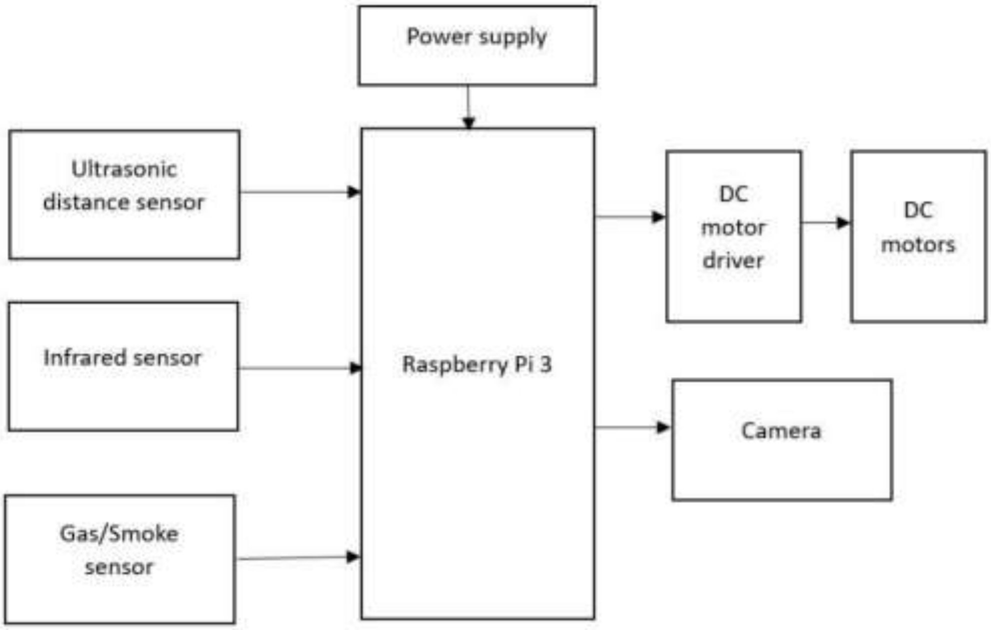

figure 2: block diagram

V.PROCESS FLOW DIAGRAM

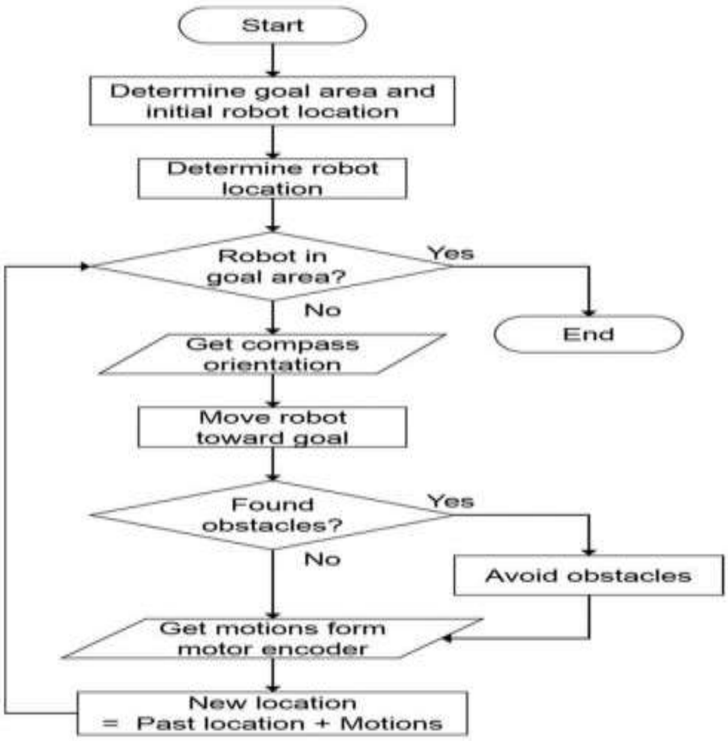

figure 3: process flow diagram

- Initiating the robot system, switching the robot on and determining the location of the robot or the target area where the robot is.
- If the robot is in the target area the process ends and the robot is ready to move to the next area.
- If the robot is not in the target location, then identifying the robot location and commanding the robot to move towards the goal area.
- If the robot finds any obstacles in the path such as, heavy moisture in the soil or the terrain is rough or any hindrance in its path.
- The message is sent back to the monitoring system and the robot is commanded accordingly.
- Once it seems that the path is clear, again the robot is ready to move forward.

ALGORITHM

1. Start
2. Initialize system (OS, drivers, sensors, actuators)
3. Read inputs from sensors (HC-SR04, IR Sensor, Gas sensor)
4. Run obstacle avoidance algorithm
5. Read user inputs
6. Run servo motor control algorithm
7. Read user inputs (motor control commands)
8. Run motor control algorithm 9. Provide feedback to the user
9. Stop.

VI. RESULTS AND DISCUSSION

The multi-terrain automation model can perform the actual allotted task like moving forward, backward, turning left and right. Active rugged mode can be performed by the robot using its four wheeling which can be used to move through rough topographies. Detection of obstacles is also a feature performed by the robot ad it can sense any obstacle in front of it and move forward by avoiding the obstacle. Detection of high temperatures & smoke in the environment.

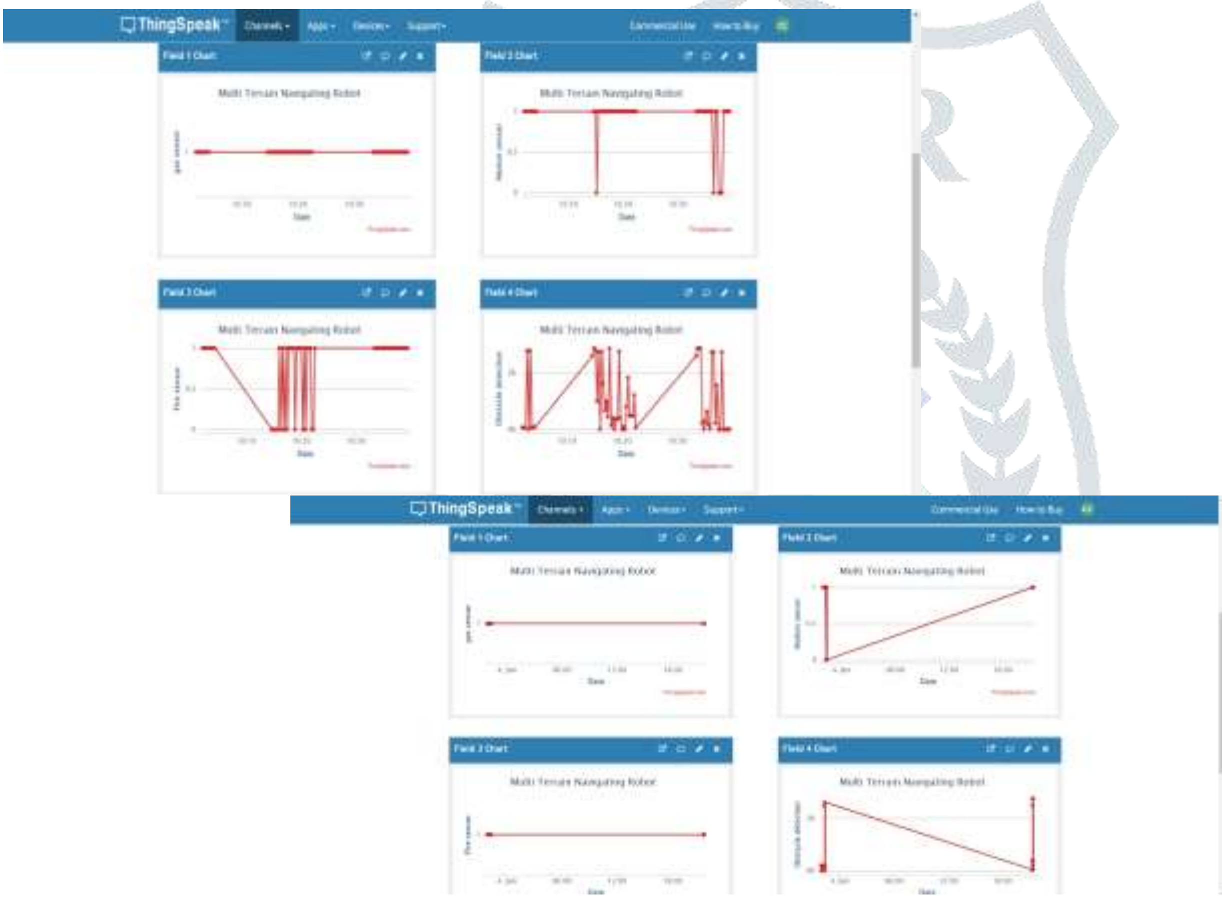

figure 4: data collected by the sensors

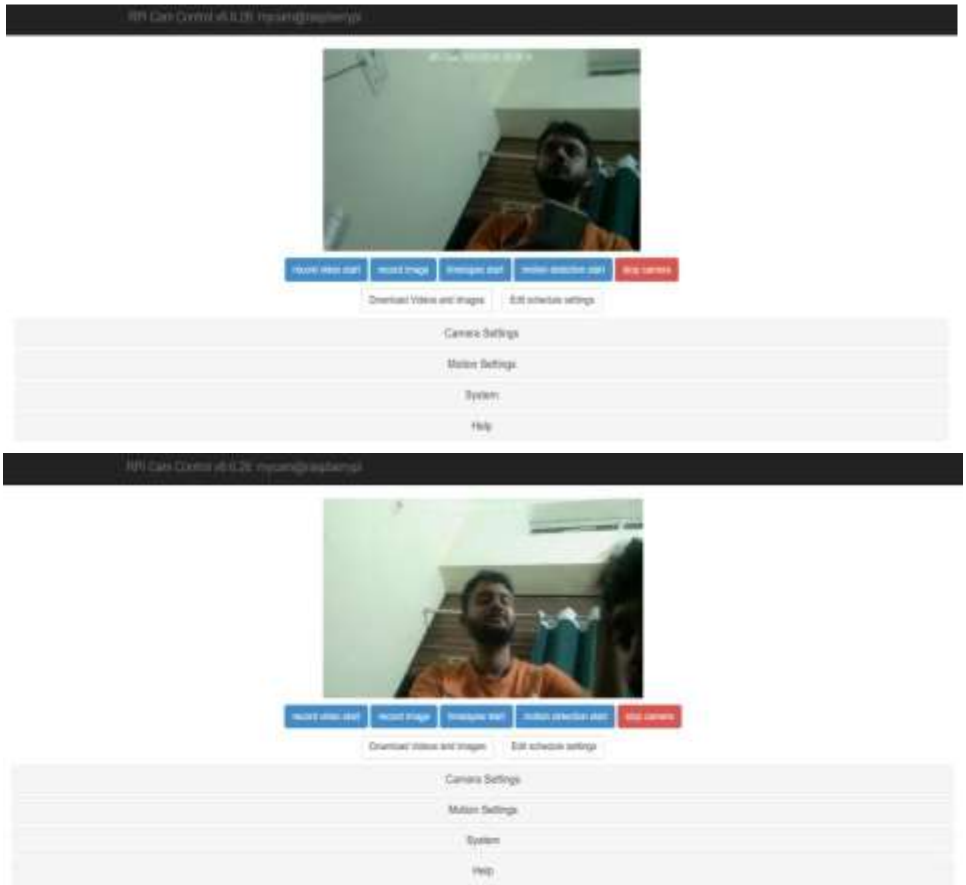

figure 5: images captured by the pi camera

VII.CONCLUSION

A lot of factors determined the accuracy of the robot we designed. These factors were the environmental phenomenon in which the robot was tested such as the number of obstacles present making the test space crowded or relatively less crowded the type and shape of the obstacle. These factors majorly affected the sensors. The accuracy of the robot is dependent on the sensors used.

Thus the nature of the sensor and its accuracy defined the accuracy of the robot.

In summary, multi-terrain robots are an exciting and rapidly developing technology that holds great promise for improving productivity, safety, and efficiency in various industries.

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