A project report on

Development of Mobile Robot for Inspecting of Environment Condition in Hazardous Terrains

submitted in partial fulfillment of the requirements for the degree of

B. Tech
In
Electronics and Telecommunication Engineering

By

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APRIL 2023

Abstract- This project describes the design and implementation of a model mobile robot for the purpose of inspection of environmental condition by going in a hazardous terrain. It is an unmanned vehicle capable of autonomous driving by avoiding the obstacles in the terrain,it senses the environment using sensor system , and computer vision algorithms for better understanding of the environment and live streaming the video feed on to web page using a onboard computer as a server. The robot uses a LAN communication protocol to extend its communication range by forming a chain interconnected WiFi modules where the starting and ending point being the onboard computer in the robot and the computer of the user.

Keywords-robot, computer vision, autonomous, server,sensor system , LAN.

I. INTRODUCTION

In earlier times, before technological advancement, the conventional method of testing the safety of an unexplored region was to send animals or humans with some precautions but still that was not enough of an effective method as lives were lost either on sight or later due to side effects of testing of the environment. The modern day solution to this problem is to send autonomous mobile robots which are both more efficient and also does not pose any danger to human lives, thus conducting a safe and effective testing of a terrain which was not ventured before.

Intelligent mobile robots that can move independently were laid out in the real world around 100 years ago during the second world war after advancements in computer science. since then, mobile robot research has transformed robotics and information engineering. For example, robots were crucial in military applications, especially in teleoperations, when they emerged during the second world war era. furthermore, after the implementation of artificial intelligence (AI) in robotics, they became autonomous or more intelligent. currently, mobile robots have been implemented in many applications like defense, security, freight, pattern recognition, medical treatment, mail delivery, infrastructure objective and societal impact inspection and developments, passenger travel, and many more because they are more intelligent nowadays with artificial intelligence technology.

II. METHODOLOGY AND RESULTS

The objective of the mobile robot is to go in the hazardous terrain to collect data on its environmental conditions and send back the data to the user at the base station.The autonomous driving system is made using micro-controller(Arduino) programmed in embedded C interfaced with ultrasonic sensor(HR04) mounted over a servo motor with 180 degrees of rotation to get proximity of obstructing structures in the environment for a collision free self driving.The microprocessor or onboard computer (Raspberry Pi 4)is interfaced with temperature & humidity sensor(DHT11),gas sensor(MQ2) and camera module(Pi V2.1),the DHT11 and MQ2 are programmed in python3 and the data is acquired by the 2 sensors using the raspberry PI 4 and the data is visualized using graphical techniques using python 3 with matplotlib and seaborn libraries, for live streaming raspberry pi 4 is used as a processor to stream the video feed on web page using Flask library by browzing the ULR in the search engine,further object detection,segmentation and

classification is done on the live feed using OpenCV,Pixellib and YOLO v6. In the event an unknown object or entity is observed by the human eye on the live stream whivh is not present in the dataset then image augmentation technique using augmentations library in python3 is used to create various forms of the object or entity in different in various conditions and image resolution is up scaled ESR-GAN to create a new data set to make this new item detectable by the computer vision model.

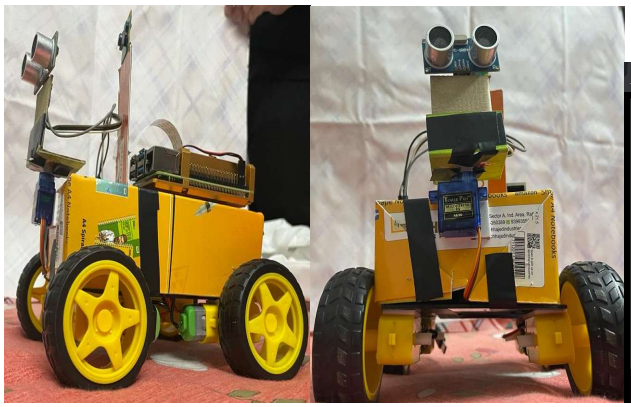

Fig 3.1: Operational Robot front and side view

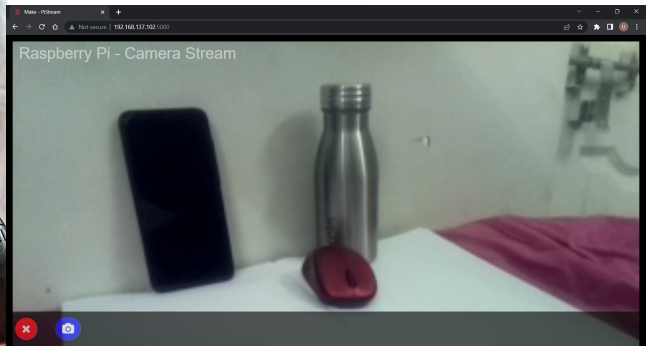

Fig 3.2: Picam live stream

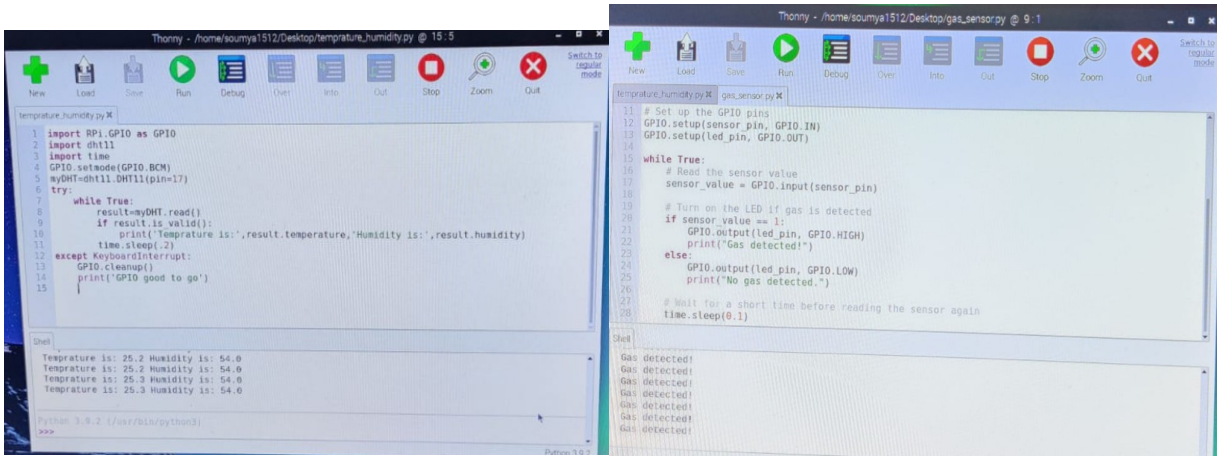

Fig 3.3: Code and live output of sensor array

Fig 3.4: Original image and augmented image

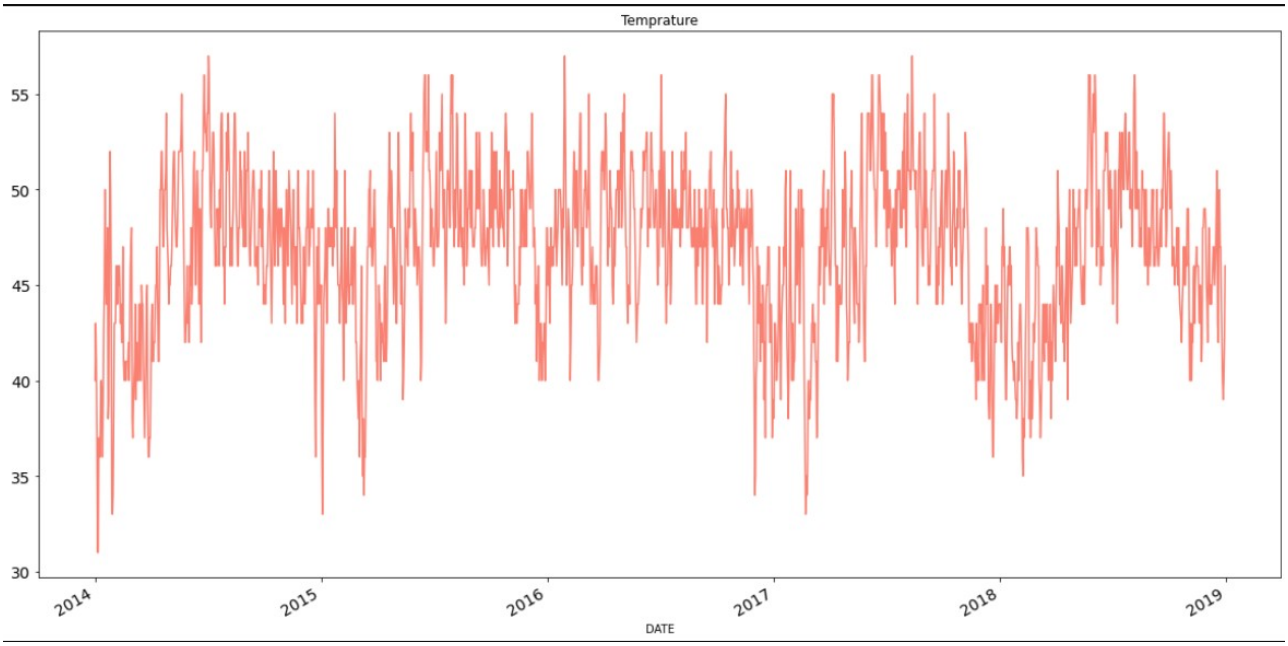

Fig 3.5: Sensor recorded data visualization

Fig 3.6: Original image and ESR-GAN up scaled image

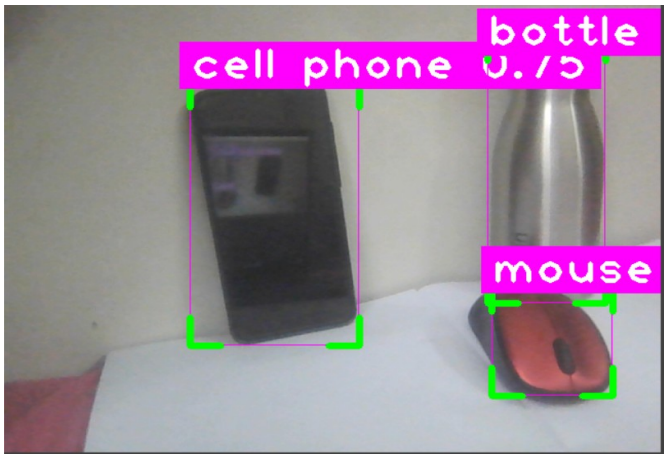

Fig 3.7: Object detection by pi camera module

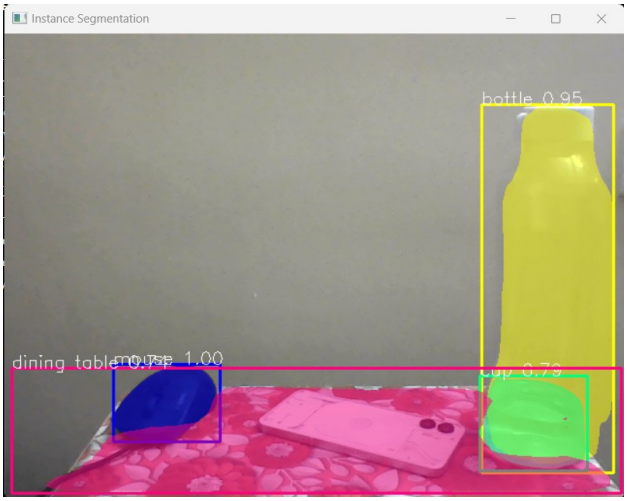

Fig 3.8: Object segmentation Output

.A LAN connection is established by interconnecting WiFi modules where the Raspberry pi 4 being the starting point(head) and the users computer in the safe zone being the ending point(tail).The user is remotely accessing the Raspberry Pi 4 by VNC Viewer using the Raspberry's IP address for the display of all the sensor data and camera feed for running computer vision algorithm(object detection)onto the users computer.

A 5V 3A power source is used to power the Raspberry Pi,it is interfaced with Pi V2 camera module and sensor array(Gas,Temperature,Humidity Sensor).It is used as a server for the LAN communication between the itself and the user's computer forming a chain of interconnected WiFi router.

A 5V 3A power source via switch is used to power the Arduino,for the autonomous mobile system it is interfaced with 4BO motors for mobility and ultrasonic sensor for detection of surrounding obstacles mounted over a servo motor to give ultrasonic sensor a 180 degree of view

III. CONCLUSION AND FUTURE SCOPE

A mobile autonomous robot that can avoid obstacles and choose the optimum path for exploration has been developed. It may be deployed in an uncharted terrain.It has a camera module installed so that it can provide us real-time data via a URL and conduct object detection,classification and segmentation using a live stream.It contains a variety of sensors implanted to provide information about the environment for sensing and visualizing.This robot is able to be put in the exploration sector, making exploration easier and safer for more people.

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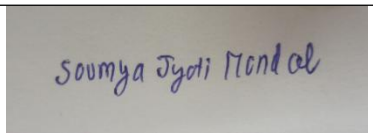
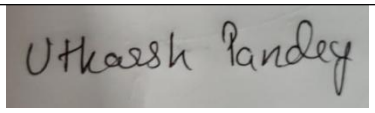
Individual Contribution of Students

Roll Number	Name	Brief Roll of students in the execution of the Project
2004099	Soumya Jyoti Mondal	Autonomous mobility system,sensor interfacing and coding,image augmentation,object segmentation and classification and data visualization.
2004104	Utkarsh Pandey	LAN communication,live streaming, GAN, object detection -segmentation and classification.

Roll Number	Name	Signature
2004099	Soumya Jyoti Mondal	
2004104	Utkarsh Pandey	

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