Remote Control Rover with Camera and Ultrasonic Sensor

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Abstract—Disasters and danger come without giving us warning so we must always be prepared for every situation. So for handling such situations robots can play an important role as in these situations there can be a huge risk of life too. It is wirelessly and remotely controlled through devices in order to make robots move from source to destination point. In many cases, the ground becomes uneven due to disaster effects, so robots can move through such places easily.With a rover it becomes convenient to search the area without making any trouble. As in many rescuing operations humans are widely used to overcome such situations and so for assisting them, robots can be used for gathering data from accidental places.

Keywords— Advance ip scanner, Putty, VNC, tkinter, OpenCV, GUI, GPIO.

I.INTRODUCTION

Including natural disasters human-made disaster are also very dangerous in that there are chances of increasing injured people so that for identifying their location robot is used [2].As it will go inside the accidental place before other rescuing team and hence rescuing team will exactly get to know where they have to find and rescue and due to this they do not need to search people in the entire place on their own [4]. In such places, the environment is very complex but robots can easily move and gather information in disaster prone areas. Robot has a flexible design as shown in fig no.1 which gives it more advantage to move over uneven surfaces. It is capable of moving on stairs like structure, road resistance, slope of the ground, inertia resistance. If any obstacle blocks the path of the robot and if the obstacle is not that much heighted then it can directly go through the obstacle rather than finding a new path. If this is not the case then the robot can be stopped through the GUI interface given to the user and can change the direction from wherever it gets the direction of alternate path.With the help of a rescue system, detection of

threats in the surroundings can be countered more efficiently [7]. By studying the different development techniques it gives the wide area of experimentation [10].
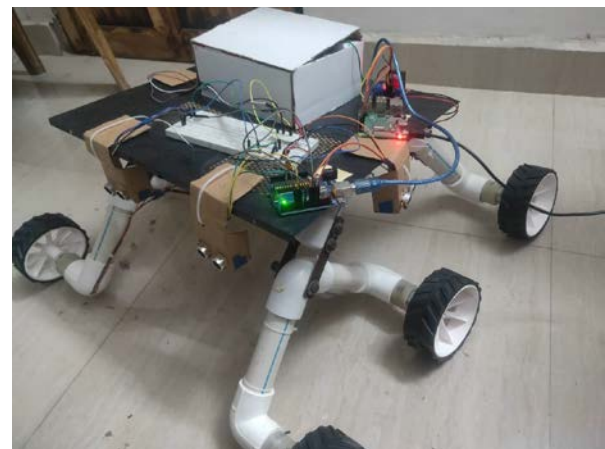

Fig.1. Outer structure of Proposed Rover

II. LITERATURE SURVEY

In [12], "Cost-Effective Autonomous Garbage Collecting Robot System Using IOT and Sensor Fusion", authors discussed the system through which they are collecting the surrounding garbage. As we are also working on a rover so we also need to connect different devices and build communication between them, this paper helps a lot. Here the author explained how they developed a 4 wheel rover with a sturdy aluminum sheet and tray for collecting garbage. In this they have used raspberry pi and Arduino uno are used for controlling devices which are attached to rovers such as ultrasonic sensor, motor driver and camera. In this they have also discussed how they have improved object detection in terms of time, memory and speed using a central server for

processing the data. Instead of using on-board processors they have used servers for processing as on-board processors are having limited processing speed and putting extra load on on-board processors can slow the other processes too. In this they have used a communication model based on Client-Server and for communicating they have used python's socket programming API. According to the authors their system architecture can work easily with more than one rover at a time as all the rovers will be connected to the central server on the same network. The rover can move autonomously on its own wheel according to the programmed feature [5].

In [13] "WI-FI AND ANDROID APPLICATION CONTROLLED MULTI-PURPOSE LAND ROVER", authors discussed the controlling of rover using Wi-Fi and android application with the help of arduino nano and NODE MCU. In this the authors have developed the robot which is only compatible with android so it will not work on other platforms such as WINDOWS, LINUX and IOS. They have solely focused on android technology for user interface from where every movement and sensors are controlled and monitored respectively. In this they have mentioned how they are collecting data on environmental nature using a variety of sensors such as temperature sensor, humidity sensor, light sensor, Gas sensor and ultrasonic sensor for detecting obstacles in the path. For monitoring the surroundings they have used cameras which can rotate up to 0-180 degrees angle in both the axis for taking view from different directions. So according to the author's all these features are fully virtually controlled using android application and for joystick control for the rover the movements are also done using virtually as physically the joystick is not used. In this the connection is established with the help of the ip address of the robot and the android phone and robot are connected on the same network.

In [8] "Research on an Efficient Single-Stage Multi Object Detection Algorithm", authors discussed how they have proposed a high efficient single shot multibit detector (HE-SSD) algorithm which is the improved version of SSD object detection algorithm. They have improved the detection process in terms of accuracy of SSD algorithms by designing efficient and dense networks and then after that the robustness of the algorithm is improved. In this they have also mentioned that for detecting small objects more accurately they have used data augmentation. In this they have also explained about SSD algorithm network structure, Loss function and they have also mentioned where SSD algorithms are lacking and the areas where improvement or advancement can be made to increase accuracy. Authors have also discussed the areas where the advancements are done to improve the accuracy

such as network structure design and focal loss function construction. They have also mentioned the detailed information upon the analysis of both the algorithm and explained with the help of graphs. HE-SSD model training is also mentioned and details of the environment is also given in which it is carried out. In this comparative analysis is also mentioned through which it is clear that HE-SSD algorithm is more accurate than SSD algorithm and the results are shown in terms of graphs.

In [14] "Live Video Streaming using Raspberry Pi in IOT Devices", authors discussed the design and implementation of the technology called Live video streaming using Raspberry Pi in IOT devices, with a single board computer which computes the Motion Detection Algorithm written in python as programming environment. They have also explained that this system uses algorithms to significantly decrease the storage space and to save the cost and that algorithm is implemented on the Raspberry Pi, which provides live streaming with motion detection. They can view the live streaming from any web browser or even from mobile in real time. It has a processing system, USB camera, LCD monitor and builds necessary peripherals for communication to complete the hardware platform. They applied the Motion detection for a live streaming camera to analyze the incoming image and recognize the movement. The video can save and store the image for the review required for the administrators. They provide the internet access, through cellular connection and Wi-Fi and enable it for the new application. Author has used a motion detection algorithm that is an automated approach in which it does not require the individual to start and stop the recording. They have decreased the storage and the cost of the equipment.

In [15] "Improving Efficiency of Ultrasonic Distance Sensors using Pulse Interval Modulation", authors have proposed a new operating algorithm for ultrasonic sensors and they are monitoring the algorithm in real time by comparing it with the conventional algorithm. Their proposed algorithm has improved the sampling rate of ultrasonic sensors through which signal to noise ratio (SNR) and detection range has also improved as compared to conventional operating algorithms. As compared to other sensors, ultrasonic distance sensors have much lower sampling rate, that's why they are hard to apply on high speed applications. Due to low sampling rate, ultrasonic sensors are used for finite range only and this problem has been resolved by the authors in this paper. In this paper, the author has proposed a novel operating algorithm and it is analyzed and tested experimentally. For improving the sample rate, authors have eliminated unnecessary waiting

time in the system which has increased the SNR in the sensor. In this paper, according to their hardware structure, they have added an analog signal enhancer for and microcontroller is used for enhancing the signal and processing respectively.

III. PROPOSED METHODOLOGY

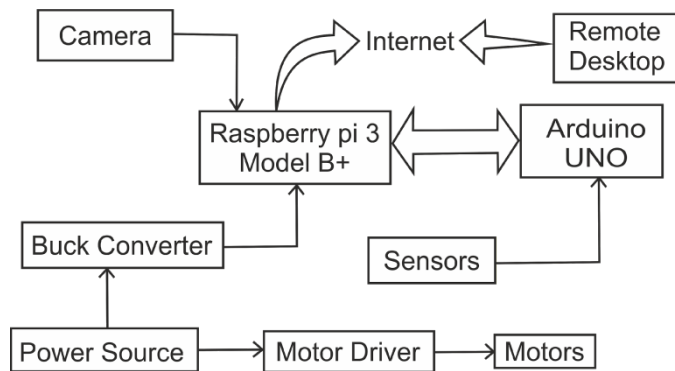Figure 2.Contains the structure of the system proposed in this paper.

Fig.2. System Structure of proposed rover

Advance ip scanner: It is a free and reliable scanner. It can locate all the computers on the local network within a second. Firstly an advanced ip scanner tool is used in the project for scanning and detecting the ip address of devices present in the current network and in this project we are detecting raspberry pi ip so that the ip address can be used for controlling the device remotely.

Putty: It is free and open-source software which gives users the option to transfer data securely and also used to upload and download files securely in computers. After getting the ip of raspberry pi using an advanced ip scanner then the ip is used to check whether the login can be done successfully or not. Once the login is successfully done it gets clear that the connection can be done successfully.

VNC (Virtual Network Computing): It is a graphical desktop sharing system that enables the desktop display of one computer to be remotely viewed and controlled over network connection. Once it is cleared that the connection can be made successfully then VNC viewer is used for monitoring and controlling the raspberry pi. With the help of VNC viewer we have controlled the raspberry pi remotely by using python programming to control the movement of the rover with the help of tkinter GUI. We have provided buttons on the GUI which are used to make the robot move from its initial place. On whichever button we click, the robot will move in that direction. So this type of mouse functionality is used.

RPi.GPIO library:-With the help of RPi.GPIO library we can control the GPIO pins of raspberry pi and by changing the inputs of different pins the movement of the rover can vary from one to another. With the help of this library one can set the pins of raspberry pi and use it to perform various operations using functionalities present in the library. We have used pins to give I/O. Those pins are GPIO 4, GPIO 17, GPIO 27, and GPIO 22. GPIO 4 is present on pin 7, GPIO 17 is present on pin 11, GPIO 27 is present on pin 15 and GPIO 22 is present on pin 15.

And the same as 5v is present on pin no.2, GND is present on pin number 6.

Arduino and Raspberry pi communication: Four sensors are connected to Arduino Uno and each sensor takes 4 pins, one for triggering, one for echo, and 2 pins for vcc and ground respectively and then code has been uploaded in the Arduino to get it working. In the coding part "Newping" library is used through which one can measure the distance.

First, the code is uploaded in the Arduino to measure the distance, and then both arduino uno and raspberry pi 3b+ are connected using USB 2.0 cable type A/B of the Arduino, so that successful communication could be established between them as well as continuous power supply can be provided to Arduino for working.

The "Serial" library is used to print the Output in Raspberry Pi from Arduino and for that firstly the port at which the arduino is showing output is set using the "Serial ()" function so that Raspberry Pi can know from where to extract output. After seating the port the " readline() " function is used to display the outputs of the arduino on the Raspberry Pi output screen.

Camera Module: 5MP camera module is attached to CSI port of raspberry pi. For capturing real time videos and for loading the image in the tkinter GUI OpenCV plays an important role in it [6]. PIL library is also used to perform various operations on the frames which are being captured in real time. These libraries are used to manage the frames and for converting them to the video format.

Casualty Detection: In this module mainly human detection is done in casualty prone areas and it is achieved using "**Imutils**" library through which the captured frame is resized according to the requirement3 **HOG or "Histogram of Oriented Gradients"** for extracting the data from the framesfor detection. "**setSVMDetector**" functionality to train the HOG for detecting human presence in the frames

IV. COMPARATIVE ANALYSIS

In the table 1, comparison is done between proposed method and Robotic Surveillance Rover.

Table 1. Comparative Analysis

| ROBOTIC SURVEILLANCE ROVER[1]	PROPOSED ROVER	ANALYSIS
Structure is very small in size	Structure is comparatively big.	Proposed Rover can work more efficiently on rough ground.
One ultrasonic sensor is used to detect obstacles.	Four ultrasonic sensors are used to detect obstacles.	Proposed Rover can detect obstacles from 3 different directions.
It can't climb stairs.	It can climb stairs.	Proposed Rover overcomes obstacle problems.
It can't handle multiple operations.	It can handle multiple operations.	Proposed Rover is multitasking.

V. RESULT
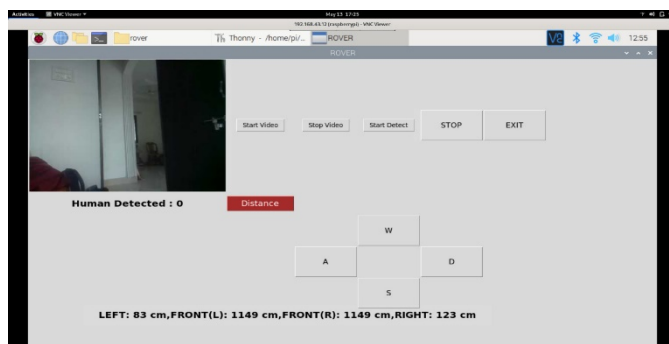
Fig.3. Tkinter GUI controller

The tkinter GUI interface and all the functionality in it are working accordingly as they are programmed to react. As in the fig.3 you can see that in the upper portion of the interface real time video is being shown and below that 4 buttons are provided which are controlling the forward, backward, left and right movement of the rover. Just below the buttons there are 4 readings showing the distance in cm gathered from different ultrasonic sensors from which two sensors are mounted in front portion to detect object distance and one sensor is mounted at left and right side of the rover. For triggering the ultrasonic sensors distance button is given for showing the readings from the respective sensor. Just above distance button in the GUI interface there are 5 buttons from which the third one is "Start Detect" to detect human presence for casualty in the area. Just next to detection button is "STOP" which stops the rover movement and another is "EXIT" which closes the complete GUI.

VI. CONCLUSION

This paper focuses on controlling the robot through tkinter GUI interface for the movement of Robot and structure is used which provides advantage for moving freely on uneven surfaces and for handling the firefighting situations robots can be a good option for reducing life casualty. As we are always putting human life at risk so for handling and analyzing the situation robots can be a good option for assisting.

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