

Web Controlled Raspberry Pi Surveillance Robot

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ABSTRACT

This paper presents a sophisticated approach for surveillance of dangerous areas using robots. This robot can be used for surveillance purpose in military, mines, industries. This robotic vehicle can enter any place which are difficult for humans to enter. The Robotic vehicle works as a manually controlled vehicle using internet communication medium. It provides live streaming using the raspberry pi camera. Multiple sensors are used in this paper. It is a multipurpose Robot. PIR sensor is connected with the robot to detect the objects. The live streaming provided by the robot can be seen through a web page. The user can operate the robot with buttons on the web page. Ultrasonic sensor indicates the distance of the object. Gas sensors are used to detect dangerous gases in that area.

KEYWORDS

Raspberry pi, pi Camera, Ultrasonic Sensor, Gas Sensor, PIR Sensor.

Introduction

In this modern world, there are high risks for military soldiers in military application. Terrorists and other countries gives many security threats. It is not possible for a human being to provide surveillance 24/7. In military, soldiers are supposed to enter extremely cold places, hot places, tunnels etc. There are many possibilities of bomb explosions. So, there is a more risk for human lives. A Robot is a machine-particularly one programmable through a laptopable to be sporting out a complicated collection of actions. Robots may be guided through an outside managetool or the managetool can be embedded within. Sensors are related to robotic to offer extra information. Robots have displaced human beings in acting repetitive and threatening duties which human beings not able to do due to length limitations.

Robots are used in various fields such as in industries, hospitals, homes, mines, schools, military. There are many kinds of robots used in military. They are used for transportation purpose, rescue purpose and as weapons. The main components of the proposed system are raspberry pi, pi camera, sensors. Raspberry pi camera is connected with the raspberry pi to provide live video streaming. It can capture images and record video based on the command given by the user. There are three sensors used in the proposed system. ultrasonic sensors are used to detect the obstacles in front of the robot. A range is fixed for the ultrasonic sensor. within the range if any object is detected then it turns the robot without hitting the object. Ultrasonic sensor helps to identify the distance of the enemies. Gas sensor is used to detect gases. In mines there is a high possibility of emission of harmful gases. To detect harmful gases in mines gas sensors are used. There are various gases which affects the human body. When humans are exposed to such gases, it may affect the Central nervous system. It may cause dizziness, drowsiness, lack of concentration, confusion, coma and death.

Related Works

There are many researches done using robots. They have wide range of applications. Wheeled robots are mainly used for surveillance and transport purposes. Mayank Dharaskar [6] developed a robot using Raspberry pi 3, webcamera, L298N for surveillance purpose and a web page is created for controlling the robot. SSH is used for communicating from one computer to another in an encrypted way. Apsara G [16] designed a robot with Raspberry pi 3, PIR Sensor, IR sensor. Facial recognition concept is used to identify people. The captured image will be sent through email to the

user.K. Krishnaveni [14] proposed a robot using beagle bone black board especially for surveillance without the use of external source. The main aim is to move in the given environment and transmitting back the video captured and a webpage created using HTML and JavaScript. The existing system have not used Gas sensor and ultrasonic sensor. Ultrasonic sensor is used to detect the distance of objects and gas sensor to detect gases. While working in the mines, there is a high possibility of gas emission. In the proposed system both the sensors are used. Raspberry pi 3B+ is used in the proposed system which has upgraded Bluetooth, PoE support and has a better performance.

Any Desk software is used in this paper. So only authorized person can access the robot.

Methodology

The components/modules used are Raspberry pi 3B+, Raspberry pi camera, two DC motors, L298N H-Bridge motor controller, PIR Sensor, Ultrasonic sensor, Gas sensor. L298N H-Bridge motor controller is interfaced with raspberry pi 3B+ to control the two DC motors. A Battery is connected with L298N for power supply. A power bank is connected with Raspberry pi 3B+ for power supply. Internet is provided to Raspberry pi 3B+ through Wi-Fi. Raspberry pi 3B+, Raspberry pi camera, L298N, two DC motors are mounted on the chassis board. Raspberry pi camera is connected with Raspberry pi 3B+ to provide live streaming. An HTML page is created with buttons Forward, Backward, Left, Right and Stop. Based on the user clicks the buttons, the Robot moves in the respective directions. Here, motion software is used for getting live information from the pi camera. Flask is used for sending commands from web page to raspberry pi. The web page can be viewed from any electronic gadgets such as mobile phones, tablets and laptop by entering the IP address. HTML is used for constructing web page. Sensors are connected using python language. PIR Sensor is used for detecting motion. If the PIR Sensor detects motion, it prints motion detected. If not detected, it prints motion not detected. Ultrasonic sensor is used for calculating the distance of the object in front of the sensor. It gives the distance of the object. MQ-2 Gas sensor is connected with raspberry pi using MCP 3008(Analog to digital converter). If the gas sensor detects smoke or any type of gases, it indicates the gas.

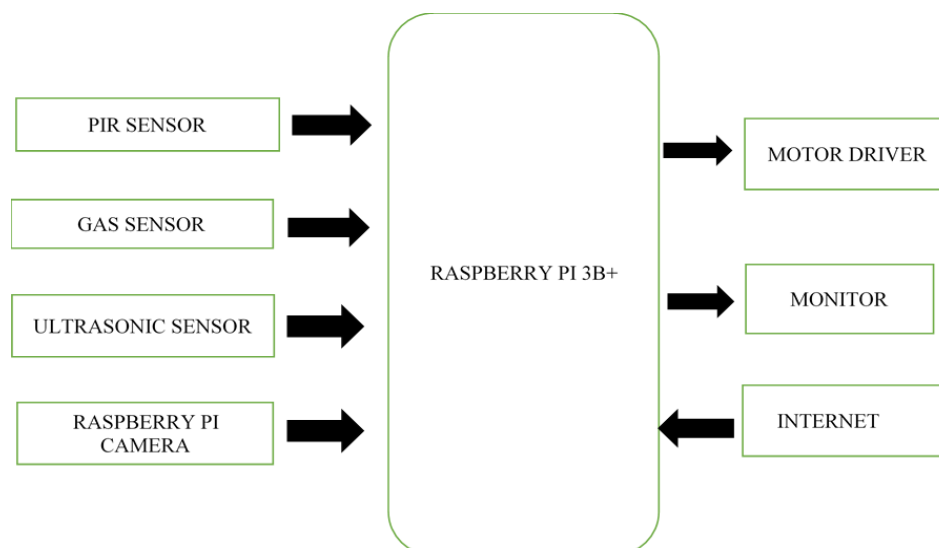


Fig. 1. System architecture

Design and Implementation

Raspberry pi 3B+

Raspberry pi is a small sized computer. Raspberry pi provides an open source platform. Raspberry pi 3 B+ is the advanced version of raspberry pi 3. It has 5 GHZ of wireless Local Area Network. 4 USB Ports and 40 GPIO Pins are present in Raspberry pi 3B+. Operating system loading, and data storage is done with the help of micro SD Card.

Power outputs are 5volts and 3.3volts. communication interface is Universal Asynchronous Receiver Transmitter. It consists of Bluetooth and Ethernet for internet connection. Raspbian OS is used for Raspberry Pi Boards.

Raspberry pi Camera

Raspberry pi 3 B+ has a 15-pin MIPI Camera Serial Interface (CSI-2) for connecting camera. Raspberry pi camera is small and can be easily connected with the Raspberry pi. It has a ribbon cable and it should be connected to the camera serial interface port of the pi. It is used for capturing pictures and video recording.

Ultrasonic Sensor

An ultrasonic sensor is used to measures the distance of an object and the obstacles. To send and receive ultrasonic pulses Transducer is used. This sensor is used for avoiding obstacles. Ultrasonic sensor can work in smoke-filled environment. It is a 4-pin module, whose pin names are VCC, Echo, Trig and Ground. The module has an ultrasonic transmitter and receiver. It can measure the distance within a wide range of 2cm to 400cm.



Fig. 2. Ultrasonic Sensor

MQ-2 Gas Sensor

MQ-2 Gas sensor is used for measuring the concentration of gases such as Methane, butane, propane, alcohol, LPG, smoke and carbon monoxide. There are four pins in MQ2 Gas sensor: VCC, GND, AO, DO. It can detect gas levels present in the particular area.



Fig. 3. Gas Sensor

PIR Sensor

PIR sensors are used for detecting the motion of human beings. It is used to detect the human whenever crossed the sensor range. sensitivity and output timing can be adjusted. PIR sensor has the sensitivity range of about 6 meters. It has the detection range of about 110 degree*70 degree, it detects when someone is present in that range. They have a 3.3v regulator. The header has 3 pins: ground/digital Out/power.

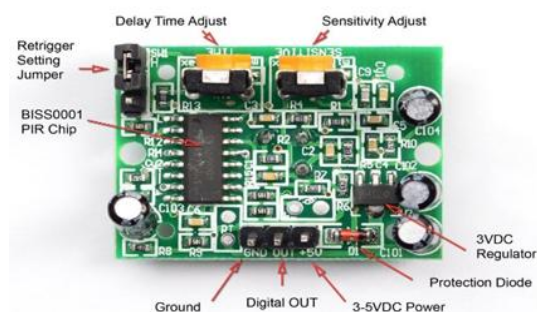


Fig. 4. PIR Sensor

DC Motor

A DC motor functions by obtaining electrical supply from the battery. For heavy weight stronger motors are required. Many parameters should be taken into consideration while choosing an electric motor. There are various types of motor used for robots. Based on the application, motor should be used. DC Motors provide high torque and high efficiency. DC motors are used for wheeled because of its simple design. The wheels can be easily connected to DC motors. The Most commonly used electric motors in wheeled robots are the DC motors. By applying torque in response to load, the DC motors are often characterized by the speed and torque curve. Voltage ratings commonly preferred for DC motors used in robots are 3, 6, 12 and 24 Volts. Lower voltage should not be given to the DC motor, it may cause damage to DC motors. If a higher voltage is applied to the motor, it may get heat up and can get damaged. A heavier robot requires stronger motors

L298N Dual H-Bridge Motor Controller

L298N Motor Driver Module with Raspberry Pi is employed to regulate the DC motors. Motors and power supply are connected using Screw terminals and different pins like enable, IN1, IN2 are connected using male headers. A jumper is present near the power supply terminals of the L298N Motor Driver Module. If the jumper is connected, it will enable the 5V regulator. It supplies +5V logic supply for L298N IC. Each motor is connected to A and B connections on the L298N motor controller. There are four inputs in L298N namely IN1, IN2, IN3, IN4. It consists of four outputs OUT1, OUT2, OUT3, OUT4 and two Enable pins ENA, ENB. Enable pin is used to control the speed and enable the motor. Input is 12volt and output is 5Volt. In this paper, two DC motors are used, therefore digital pins D4, D14, D17 and D18 are connected to pins IN1, IN2, IN3 and IN4 respectively. Then connect D22 to ENA on the module (remove the jumper first) and D23 to ENB of the module (again, remove the jumper). The motor will run only when the enable pin is high.

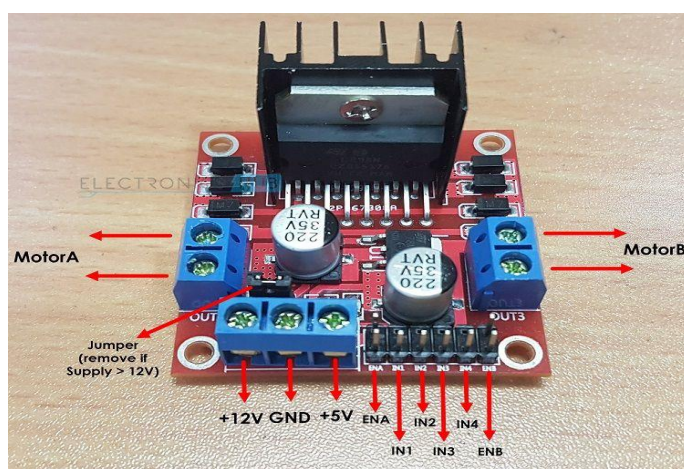


Fig. 5. L298N Dual H-Bridge Motor Controller

System Implementation

Motion

Motion is a highly configurable program that monitors video signals from various types of cameras. Motion is a surveillance software. It is free and open source. It starts recording, when the user runs the code. Live streaming can be watched from the web browser by entering the IP address. It takes photo and record the video based on the command given by the user.

Flask

Flask is particularly used for developing web applications. Flask creates a web server. It helps to send the commands from web page to Raspberry pi to control the robot over the network. It allows to run the python code through the web page.

Programming

HTML is used for designing web pages. It can be used with cascading style sheets and Scripting languages such as JavaScript. HTML is used to format web pages with the help of different tags available in HTML language. HTML documents from a web server or from local storage are received by the web browser and render the documents into multimedia web pages. There are various tags used for defining a paragraph, heading and title. With the help of the HTML tags the color and style of the font can be changed. Hyperlink is used for redirecting to another page when event occurs. In this paper, buttons are created using the HTML tags. We can also provide live video using HTML. Python is used for software development, data science and back end development. It is an integrated language, open source and easy to use.

Any Desk

Any Desk is a kind of desktop software. It provides platform independent remote access to computers and other devices running host application. Any Desk can be used for remote control, file transfer and VPN functionality. In this paper codes are executed with the help of Any Desk.

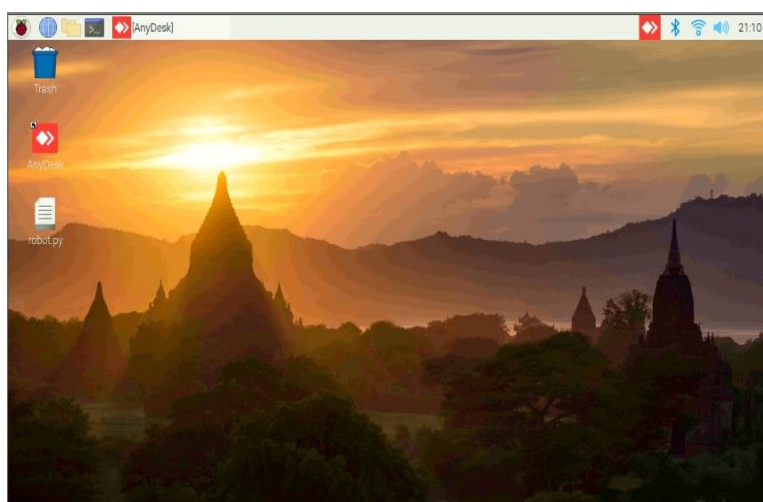


Fig. 6. Any Desk Software

Result and Discussion

This paper aims to surveillance the surrounding and harsh areas using the Raspberry pi camera. The output of

<http://annalsofrscb.ro>

ultrasonic sensor, PIR Sensor, MQ2 Sensor are displayed in Any Desk by running the code. Any Desk can be accessed by entering the address of the remote desk that user wants to access. By entering the IP address of Raspberry pi, a web page is displayed in the web browser with live video streaming and five buttons.

When forward button is pressed by the user, the browser send command to Raspberry pi using flask. Then Raspberry pi send the command to L298N Motor Controller. L298N Motor Controller sends command HIGH to motor1. L298N Motor Controller sends command HIGH to motor2. As a result the Robot moves in the Forward Direction. The Robot runs until the next command is given. Based on the command given by the user the L298N Motor controller gives HIGH and LOW command to the two motors. As a result, the Robot moves in the respective directions. Compared to the existing system robot, the proposed system consists of three sensors and the sensor output can be seen in the Any Desk software.

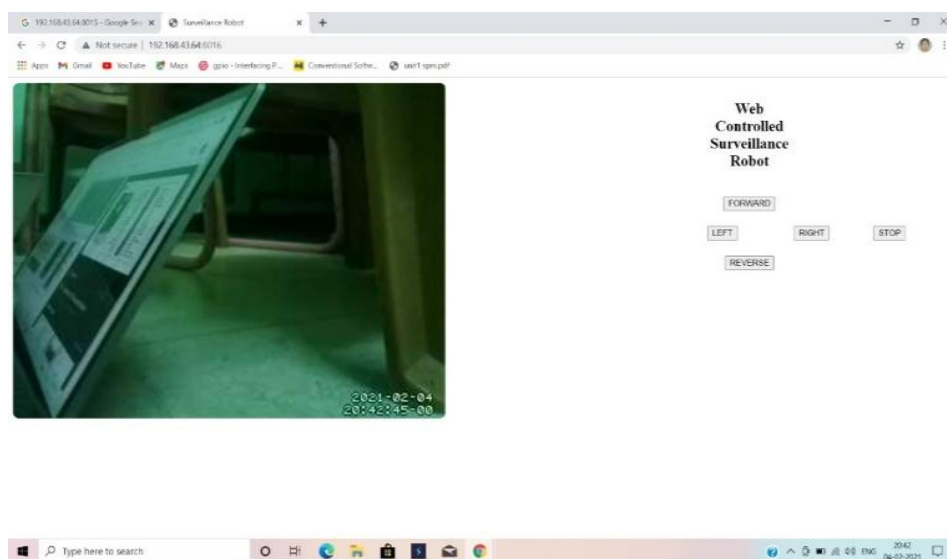


Fig. 7. Output displayed in the web page

Conclusion and Future Work

The future scope for this paper are:

1. GPS can be connected with the robot to track the robot.
2. Solar panels can be used for power supply instead of battery.
3. Machine Learning and image processing can be added in this paper.
4. Metal detecting sensors can be used in this paper to detect metals.

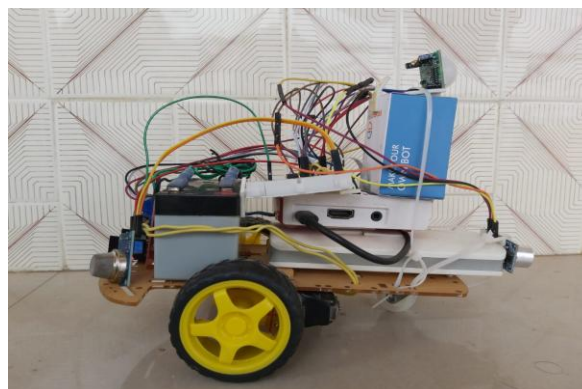


Fig. 8. Side view of the Robotic setup

The Robot is controlled manually, and we can see the live streaming in the web page. The Robot is particularly designed for substituting human beings in harsh climatic conditions and dangerous places. It gives the information regarding the surrounding environment like distance and presence of humans through the sensor. The Robot is easy to handle and operate. It can be operated anywhere using electronic gadgets like mobile phones, laptop and tablets by entering the ip address of the Raspberry pi. It is a complete surveillance Robot for spying purpose. Raspberry pi is connected using Wi Fi.

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