e-ISSN: 2455-5703

Virtual Reality Fire Robot on Internet of Things Platform

[1]Alen Maria Raj [2]Anju Jyothi [3]Niya Tojo
[1,2]Department of Electrical And Electronics Engineering
[1,2]Adi Shankara Institute of Engineering & Technology, Kalady, India

Abstract

Increasing human population and technological development has led to increase in fire accidents and hazards. Adverse conditions and physical limitations of human being make fire extinguishing challenging and demanding task. Fire extinguishing is very risky task and it may involve loss of life. Robotics is the emerging solution to protect the surrounding and human lives. Fire extinguishing robot model can be used for extinguishing the fire during fire accidents. It can reduce the errors and limitations faced by the humans during fire extinguishing task. Our designed robot can locate the fire and extinguish fire before it rages out of control. Our proposed robot can efficiently extinguish any kind of fire in a plane geographical location. We propose firefighting scenarios based training system on virtual reality platform. The main objective of this work is to provide information concerning fire incident and how to deal with this critical situation as realistic as possible. The user interacts with our system by means of virtual reality head-mounted display and our custom controller that mimic the fire extinguisher.

Keyword- Virtual Reality, Robot, Raspberry Pi, IoT, Mini Pan Tilt Kit

I. INTRODUCTION

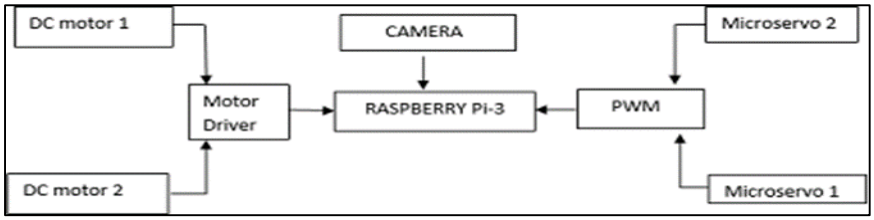
The application of robots is becoming more and more extensive in many dangerous and harsh working environments. So higher requirements are put forward on the interaction and control. Virtual Reality (VR) technology allows people to interact with the virtual environment in a natural way, and can improve the telepresence of the remote control for robot. For example, the Mobile Robot Teleoperation based on the Oculus Rift HMD make the interface more comfortable and efficient. The VR robot designed in this paper aims to bring a sense of immersion and improve human- computer interaction through Pan/Tilt/Zoom (PTZ) with camera.

A person using virtual reality equipment is typically able to "look around" the artificial world, move about in it and interact with features or items that are depicted. Virtual realities artificially create sensory experiences, which can include sight, touch, hearing, and, less commonly, smell. Most 2016-era virtual realities are displayed either on a computer monitor, a projector screen, or with a virtual reality headset (also called head-mounted display).The project is designed to develop a Virtual Reality Fire Fighting Robot using IoT technology for remote operation. The robotic vehicle is loaded with fire extinguisher which is controlled through the wireless communication to spray water.

At the Controlling end, Mobile phone commands of accelerometer and gyro meter sensors are sent to the VR Glass with another mobile to control the movement of the robot either to move forward, backward and left or right etc...The instructions are send to the robotic section using Internet of Things based wireless communication protocol. At receiving end five motors are interfaced to the Raspberry pi where two of them are servo motors for pan and tilt controlling of the camera and other three are used for robot movement and fire extinguisher control. A motor driver IC is interfaced to the Raspberry pi through which the controller drives the DC motors.

Servomotors are drived using PWM Hat. A fire extinguisher is mounted on the robot body and its operation is carried out from the Raspberry pi output through appropriate signal from the transmitting end. Further a camera is interfaced with Raspberry pi and the output carried through Wi-Fi module. Using Wi-Fi camera brings the Virtual Reality concept which is a computer technology that uses software- generated realistic images, sounds and other sensations to replicate an a real environment or an imaginary setting, and simulates a user's physical presence in this environment to enable the user to interact with this space.

II. BLOCK DIAGRAM



III. COMPONENTS

- Raspberry Pi

Processor speed ranges from 700 MHz to 1.4 GHz for the Pi 3 Model B+; on-board memory ranges from 256 MB to 1 GB RAM. Secure Digital (SD) cardsare used to store the operating system and program memory in either SDHC (early Raspberry Pi's) or MicroSDHC (Later Raspberry Pi's) sizes.

- Raspberry Pi Camera Module

The Raspberry Pi Camera v2 is the new official camera board released by the Raspberry Pi Foundation. The Raspberry Pi Camera Module v2 is a high quality 8 megapixel Sony IMX219 image sensor custom designed add-on board for Raspberry Pi, featuring a fixed focus lens. It's capable of 3280 x 2464 pixel static images, and also supports 1080p30, 720p60 and640x480p90 video. It attaches to Pi by way of one of the small sockets on the board upper surface and uses the dedicated CSI interface, design.

Features:

- Fixed focus lens on-board
- 8 megapixel native resolution
- Sensor-capable of 3280 x 2464 pixel static images
- Supports 1080p30, 720p60 and 640x480p90 video
- Size 25mm x 23mm x 9mm
- Weight just over 3g
- Connects to the Raspberry Pi board via a short ribbon cable (supplied)
- Camera v2 is supported in the latest version of Raspbian, Raspberry Pi's preferred operating system

- Mini Pan-Tilt Kit

This unassembled pan-tilt kit is the perfect way to give your project customized full range motion! The pan-tilt can rotate roughly 180Â° from side-to-side and can tilt downwards roughly 150Â° (it may be less depending on the servos you use, of course). This version comes in kit form without any servos.

Dimensions:

- Base: 37mm x 33mm x 3mm / 1.5" x 1.3" x 0.1"
- Mounting Hole Distances: 30mm x 26mm / 1.2" x 1"
- Standing Height (zero tilt): 67mm / 2.6"
- Top Platform: 38mm x 36mm / 1.5"x 1.4"
- Weight: 37g

- Google Cardboard Kit

Google Cardboard is a virtual reality (VR) platform developed by Google for use with a head mount for a smart phone. Named for its fold-out cardboard viewer, the platform is intended as a low-cost system to encourage interest and development in VR applications. To use the platform, users run Cardboard-compatible applications on their phone, place the phone into the back of the viewer, and view content through the lenses.

- 16 Channel PWM Hat

The Adafruit 16-Channel 12-bit PWM/Servo HAT will drive up to 16 servos or PWM outputs over I2C with only 2 pins. The on-board PWM controller will drive all 16 channels simultaneously with no additional Raspberry Pi processing overhead. We can stack up to 62 of the to control up to 992 servos - all with the same 2 pins. Works with any servo that can be powered by 5V and take 3.3V logic level signals.

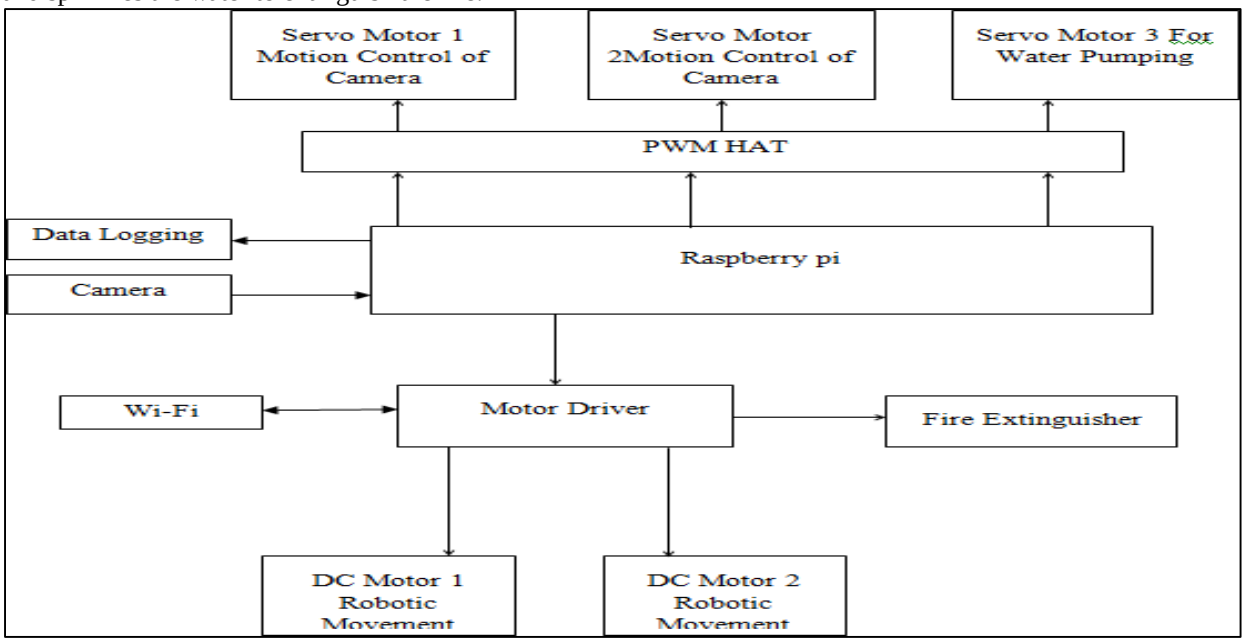
IV. WORKING

The main motive of the VR fire robot is to make it user friendly. It can move easily, capture images and wirelessly transmit them, thus giving the people information about the dangers and situations in the field.

The robot fire detection system comprises of a camera module which is mounted on mini pan tilt kit. It helps to rotate roughly 180 degree from side-to-side and can tilt downwards roughly 150 degree.

We have used android phone as a camera and another android phone as a monitor to watch and control robot automatically. The robotic vehicle can be easily operated from any android device. It provides a good user interface for handling the vehicle. The android device can operate the vehicle at a good Wi-Fi communication range. Place the camera on robot then we can connect the camera to handset through IP address and used it to see the situation in the fire field.

Location of fire can be detected with the help of camera of robot. After the water is pumped, fire is extinguished to ground level. Motor Driver IC's act as an interface between the microcontroller and the motors of the robot. Motor Driver IC L293D is a dual H bridge driver [12]. They act as a current amplifier since they take low current control signal and provide high current signal. High current signal is used to drive the motor. This IC contains two in-built H bridge driver circuits. In its common mode of operation, it can drive two DC motor simultaneously both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at the input pins. 00 and 11 will cause the corresponding motor stop. 01 and 10 will rotate motor in clockwise and anticlockwise direction. The enable pins corresponding to each motor should be high to start the operation. When an enable pin is HIGH, the associated driver gets enabled. As a result, the outputs became active and work in phase with their input. When the enable pin is LOW, that driver is disabled and their outputs are off. The movement of the robot is controlled with the help of dc motor. Servomotors are used to control the movement of camera and to control the sprinkling action. PWM hat can take all the three inputs from the three servomotors and give it to the raspberry pi. Robot detects there is fire then robot take the action and sprinkles the water to extinguish the fire.



V. ADVANTAGES

1) We use battery for the working of the robot and therefore charger is not required.
2) No need of specific remote as any mobile android device can control.

3) Since robots can carry out risky actions that cannot be done by human it reduces great human loss.

VI. RESULT

The final finished robot with raspberry pi camera module of VR Robot enhances telepresence of operations. And the control part integrated in an Android phone improves portability. The cost is low, but the effect is well. Affected by the PTZ shaft and the steering gear itself, horizontal view range and vertical view range of PTZ is 180°and 150°, and step angle of the steering gear is 1°.

VII. CONCLUSION

A VR fire robot detects and extinguishes fire meanwhile the system can be extended functionally according to demand, such as the installation of the robot arm can achieve long-range precision control. The installation of water sprinkle helps in extinguishing the fire. We can connect the camera to handset through the IP address and is used to see the situation in the fire field. When the robot detects fire it takes action to sprinkle water to extinguish fire.

REFERENCES

[1] A Study on the Disaster Response scenario using Robot Technology 2017 14th International Conference on Ubiquitous Robots and Ambient Intelligence (URAI)
[2] A smart spy robot charged and Controlled by wireless systems
[3] War Field Spying Robot and Fire Extinguisher with Wireless Night Vision Camera.RajshreeNikhare, Prof. S. Raut, Prof. Raman Bondare
[4] Virtual Reality Simulator For Robotics Learning IEEE 9-11 December 2015, Tecnológico de Monterrey, Mexico City Campus, Mexico City
[5] Design of Virtual Reality Robot Based on Android Platform
[6] A Design of Firefighting and Supervising Self-Sufficient Robots
[7] Jung-Hyun Park, Byung- Wook Kim, Dong-Jo Park and Moon-June Kim. A System architecture of wireless communication for fire-fighting robots
[8] Vector Field Path Following for Miniature Air Vehicles
[9] W. R. White, "Vehicle mounted firefighting system."U.S. Patent No.5, 836,398, November 1998.
[10] Doshay, "Robotic fire protection system," U.S. Patent No. 6,364,026.
[11] Development and Implementation of Arduino Microcontroller Based Dual Mode Fire Extinguishing Robot
[12] https://www.robotix.in/tutorial/auto/motor - driver

