Virtual Reality Fire Fighting Robot

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Abstract: The modular design propose fire fighting scenarios based training system on virtual reality platform. The main objectives of this work is to provide information concerning fire incident and how to deal with this critical situation as realistic as possible. The players interact with this system by means of virtual reality head-mounted display and our custom controller that mimic the fire extinguisher. The robotic vehicle is loaded with fire extinguisher which is controlled over wireless communication to throw chemicals. A Raspberry pi tiny computer is used for the desired operation. At the Controlling end, Mobile phone commands of accelerometer and gyrometer sensor s are sent to the VR Glass using an Android app with a protocol TELNET 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 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 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. A camera is interfaced with Raspberry pi and the output carried through WiFi module which captures the images in a Virtual Reality platform.

Keywords: Virtual reality, Robotics, Raspberry pi, Wifi.

I. INTRODUCTION

Fire Safety is the set of practices intended to reduce the destruction caused by fire. Fire safety measures include those that are intended to prevent ignition of uncontrolled fire and those that are used to limit the development and effects of a fire after it starts. Fire fighters face risky situations when extinguishing fires and rescuing victims, it is an inevitable part of being a fire fighter. The major hazard associated with fire fighting operations is the toxic environment created by combustible materials, the four major risks are smoke, poisonous atmosphere, oxygen deficiency, and elevated temperatures. Additional hazards include falls and structural collapse that can exacerbate the problems entailed in a toxic environment. With the development in the field of robotics, human intrusion has become less and robots are widely used for safety purposes including fire fighting. By means of fire fighting robot, people and properties can be saved from fire accidents. By incorporating the technology of Virtual Reality, it is possible to deal with fire accidents as realistic as possible and to control the fire causing no harm to fire fighter. Robot is defined as a mechanical design that is capable of performing human tasks or behaving in a human-like manner.

Robot is a branch of applied science, the popular conception of which came not from science, but from drama, fiction and cinema. The word "robot" was first used in 1921 by Czech Playwright Karel Capek in his play "Rossum's Universal Robots" where robots were machine resembling human beings except that they were exceptionally hardworking Science fiction writers including Asimov and film makers used the concepts of robots widely and projected robots as human-like mechanical beings with tremendous physical and intellectual capabilities, compared to which even the most sophisticated robots of today will look very primitive. This building of the new science in the cradles of arts had two-fold results. On one side, robotics got a natural terminology straight from human anatomy with words like arm, shoulder, elbow, wrist, hand, finger, leg knee, ankle, foot etc and ideal systems, namely the human body, to get new ideas and to evaluate the performance of existing systems. One the other hand, a myth was created in the minds of lay-men regarding human-like machines called robots, the sophistication of which is quite phenomenal. To many people, the word "robot" gives rise to a mental picture of a metallic human of tremendous strength and a picture of an actual robot would be rather disappointing. A standard definition describes a robot as a "reprogrammable mulfuctional manipulator". In the perspective, hard automation systems and numerically controlled machines do not fall within the scope of robotics. Teleoperators ortelerobots also fall near the border line. Nowadays, robots are used for material handling, welding, spray painting, teleoperationsassemby, machining etc.Building a robot requires expertise and complex programming. It is about building systems and putting together motors, sensors and wires among other important components. A fire fighter robot is one that that has a small fire

extinguisher added to it. This paper covers the design and construction of a robot that is able to sense and extinguish fire.

Virtual reality is a computer technology that uses virtual reality headsets, sometimes in combination with physical spaces or multi-projected environments, to generate a realistic images, sounds and other sensations that simulate a user's physical presence in a virtual or imaginary environment. A person using virtual reality equipments is able to "look around" the artificial world, and with high quality VR move around in it and interact with virtual features or items. The effect is commonly created by VR headsets consisting of head-mounted goggles with a screen in front of the eyes, but can also through specially designed spaces with multiple large screens. VR systems that include transmission of vibrations and other sensations to the users through a game controller or other devices are known as haptic systems. This tactile information is generally known as force feedback in medical, video gaming and military training application. Virtual reality also refers to remote communications environments which provide a virtual presence of users through telepresence and telexistence or the use of Virtual Artifact (VA). The immersive environment can be similar to the real world in order to create a lifelike experience grounded in reality or sci-fi. Augmented reality systems may also be considered a form of VR that layers virtual information over a live camera feed into a headset, or through a smartphone or tablet device. The Virtual Reality Modeling Language (VRML), first introduced in 1994, was intended for the development of virtual worlds without the dependency on headsets. These components led to relative affordability for independent VR developers, and led to the 2012 Oculus Rift Kickstarter offering the first independently developed VR headset. Independent production of VR images and video has increased by the development of omni directional cameras, also known as the 360 degree cameras or VR cameras, that have the ability to record in all directions, although at low-resolutions or in highly compressed formats for online streaming. In contrast, photogrammetry is increasingly used to combine several high-resolution photographs for the creation of detailed 3D objects and environments in VR applications.

The following are the main components of a virtual environment:

- The visual display that immerse the user in the virtual world and block out contradictory sensory impressions from the real world.
- The graphics rendering system that generates the ever changing images at 20 to 30 frames per second.
- A tracking system that continuously informs the position and orientation of the users movements.
- The database construction and maintenance system to build and maintain a detailed and realistic model of the virtual world.
- A sound system that can produce high quality directional sounds and simulated sound fields.
- Devices like tracked gloves with push buttons to enable users to specify their interactions with the virtual objects.

II. PROPOSED SYSTEM

The proposed system has client and server sections. The system we use in this work is Raspberry pi 3. At the Controlling end, Mobile phone commands of accelerometer and gyrometer sensors are sent to the VR Glass 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 wireless communication protocol. A camera is interfaced with Raspberry pi and the output carried through WiFi module. Using WiFi camera captures the images and performs the actions as realistic as possible. Servo motors are used for tilt and pan and for the controlling of opening of fire extinguisher. Servomotors are drived using PWM Hat . L293D is a motor driver act as a interface between microprocessors in robots and the motors in robot . Here 2 DC motors are used which converts direct current electrical energy into mechanical energy.
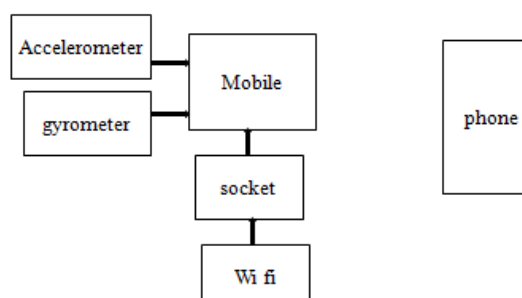

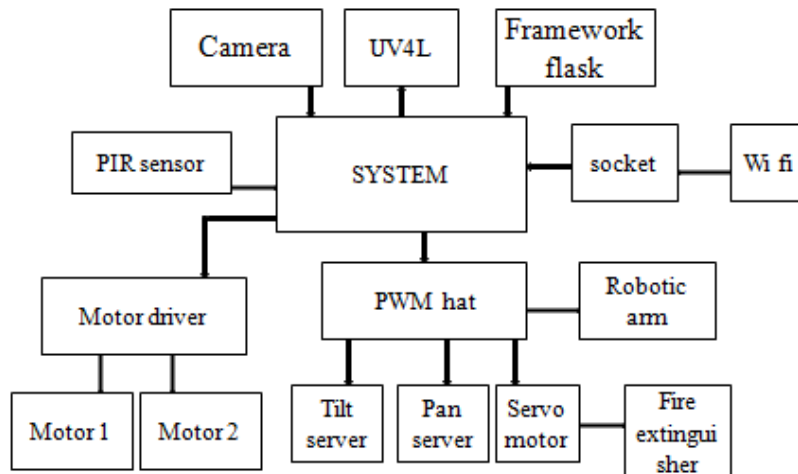Fig 1 : Block diagram of client

Fig 2 : Block diagram of server

The robotic vehicle is loaded with fire extinguisher which is controlled over wireless communication to throw chemicals. Fire extinguisher is an active fire protection device used to extinguish or control fires in emergency situations. PIR sensor is used for the detection of human, whether a human has moved in or out of the sensors range. Pick and place robotic arm is used for rescue purpose.

III. COMPONENTS DESCRIPTION

3.1 RASPBERRY PI 3
The Raspberry pi 3 model B is the third generation Raspberry Pi. It is the latest model which includes 802.11n WIFI, Bluetooth 4.0, and a quad-core 64 bit ARM Cortex A53 running at 1.2GHz. It's a usable desktop computer. Compared to Pi 2, the RAM remains the same- 1GB of LPDDR2-900 SDRAM, and the graphics capabilities, provided by the Video Core 1V GPU, are the same as RPI2.

3.2 VIRTUAL REALITY GLASS
It allow users to be fully immersed into a virtual 3D world. They comprise a stereoscopic head-mounted display (providing separate images for each eye), stereo sound, and head motion tracking sensors (which may include gyroscope, accelerometer, structured light systems, etc.). They take the form of one or two display screens which are worn in front of the face and project graphical images, often accompanied by sound and video. The viewer sees two separate images – one in each eye which the brain combines to form a three dimensional image. They show an illusion of depth which is a characteristic feature of virtual environments.

3.3 RASPBERRY PI SPY CAMERA
The camera module can be used to take high definition video as well as stills photographs. The camera consists of a small circuit board, which connects to the Raspberry pi's Camera Serial Interface(CSI) bus connector via a flexible ribbon cable. The camera's image sensor has a native resolution of five megapixels and has a fixed focus lens.

3.4 SERVO MOTOR
A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or liner position, velocity and acceleration .it consists of suitable motor coupled to a sensor for position position feedback. It also require a relative sophisticated controller ,often a dedicated module designed especially for use with servo motors.

3.5 DC MOTOR
The working principle of DC motor is that "whenever a current carrying conductor is placed in a magnetic field, it experiences a mechanical force". Here the DC motor controls the operation of robotic vehicle.

3.6 PIR SENSOR
PIR is an electronic sensor that measures infrared light radiating from objects in its field of view. PIR sensor allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range.

IV. ADVANTANTAGES AND DISADVANTAGES

A. *Advantages*

- ✓ Virtual reality creates a realistic world .
- ✓ Prevention from dangerous incidents .
- ✓ Through virtual reality user can experiment with an artificial environment.
- ✓ Minimization of
- ✓ Ecological consequences
- ✓ Financial loss
- ✓ A threat to a human life

B. *Disadvantages*

- The equipments used in virtual reality are very expensive.
- It consist of complex technology in virtual reality environment we can't move by our own like in the real world.

V. RESULT

Hardware design for fire extinguisher function is implemented. And the rescue purpose system and vehicle movement is done successfully. The rescue system include PIR sensing and pick and place robotic arm functioning . PIR sensor is used to detect the presence of human beings and animals . The PIR sensing is based on IR radiation from the body . If the presence of any animal or human being is detected , then pick and place robotic arm is used for rescuing the animal or human being from the critical fire incident place. Virtual reality software section is completed.

VI. CONCLUSION

The approach of modular design strategy was a good solution in implementing the fire fighting robot as it made it easier for individuals to work on their tasks independently. The literature survey for the proposed system was completed by studying and analyzing the papers and the relevance of the project was also found out. On the basis of study, new and innovative ideas were included to project with greater efficiency. New ways to improve the existing methods and technologies were also analyzed. By choosing appropriate components, circuit was designed and implemented to obtain the desired output.

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