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Virtual reality robot with 3D vision

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ABSTRACT

This paper gives us an idea about Virtual reality robot with 3d vision is a set of technologies to enable users to be "present remotely these technologies allow users to be present and to interact with an environment from a place (tele robotics). Telepresence is becoming common in the field of social interactions. This gives the user a real-time experience as if he is present where the robot is located. Also, the motion of this robot can be controlled by the user. Our project has a wide range of applications. It can be used extensively in remote location monitoring, healthcare services, as baby monitors and in surveillance and monitoring for security purposes.

Keywords—Telepresence, Tele Robotics, Social Interaction, Remote Location Monitoring.

Introduction

The main objective of making this project is to provide 3d immersive view to the user hence the user will feel he is present there itself at the distant location. From time immemorial, people faced a lot of limitations without technology. But now as time has passed, people are unable to live without technology. The evolution of mechanical computers to portable tablets and mobile phone has advanced the human race to a next higher level. The world we live in now is one that provides the required entity at just one click. It is also to be noted that the development in science and technology has introduced the concept of virtual reality and robotics. The term virtual means near and reality is what we experience as human beings. Hence 'virtual reality' means 'near reality'. Robots have increased widely in today's world. In almost all the industries the concept of robotics is used. Robots are also user friendly.Virtual reality robots can enable remote tour guides, administrative assistants, home visitors, night watchmen and factory inspectors, among many other possibilities.

Problem Statement

Head movement is frequently associated with human motion navigation, and an indispensable aspect of how humans interact with the surrounding environment. In spite of that, the incorporation of head motion and navigation is more often used in the VR (Virtual Reality) environment than the physical environment. We present a very cost-efficient futuristic technology called Virtual Tele-presence Robot. The technology available in market is too costly that common man cannot afford it. The Virtual Tele-presence system is the technology which is very useful. The aim is to provide cost efficient virtual telepresence system for various applications. The components used are raspberry pi cheap credit size computer with video streaming server. It gives 3Dimensional immersive view. By using VR and simple smart phone we can achieve the same 3D effect.

Objectives

Objective 1:
To control the chassis wheels to help the movement of the robot.

- Methodology –

a) The navigation circuit controls movement of the robot.
b) Directional command is processed by Raspberry Pi and node MCU and then fed to motor driver.
c) Motor driver operates the DC geared motors instantaneously.

Objective 2:
To align camera tilt movements according to user's head movement.

- Methodology –
  a) Wireless app is used to process the user's head movements and accordingly align the camera.
  b) This app reads accelerometer and magnetometer values of the smartphone placed in the VR headset.
  c) The app sends real time signals to the servo motors which in turn move the camera.

Objective 3:
To provide a 3D visual experience to the user by transmitting real time video and audio information.

- Methodology –
  a) Raspberry pi helps obtain a real time experience through live streaming.
  b) The camera module is connected to the Raspberry pi. The real time casting of captured video and audio is done through the app.
  c) The software co-operates to live streaming.

Literature Survey

The 1st stage of project hardware is the power supply. Rechargeable batteries are used in the power supply in order to store the power. This is charged up by connecting to a 12V charger. The navigation circuit is the one which controls the movement of the robot. The directional data is sent to the navigation circuit. It is processed by the International Journal of Innovative and Emerging Research in Engineering Volume 4, Issue 2, 2017 56 Arduino and then provided to the driver IC which drives the gear motor in the required direction. This operation can be controlled by transfer of data through Wi-Fi or Bluetooth or RF modules as transmitter and receiver. The casing to hold the gear motors, servo motors, camera and Raspberry Pi was made intact. The next main procedure is the setting up of the Raspberry Pi. The initial configurations are done. The board is connected to the Wi-Fi. An IP address is programmed and setup which links to the Raspberry Pi. The video that is captured by the camera is sent over to the Wi-Fi modem. The modem creates a LAN where in both the smartphone and the Raspberry Pi is connected. It is through this LAN that the data (head movement and video) is shared. This transmitted output can be viewed by connecting the smartphone or the laptop to the same Wi-Fi connection and IP address [3]. This transmitted output is viewed in a smartphone placed in the VR headset. The smartphone is switched to dual screen mode for this purpose. The project also has the feature of letting the user experience virtual reality by swinging the VR headset. The smartphone reads the accelerometer and magnetometer data of the direction in which the user had turned. This data is sent to the modem over Wi-Fi and to the Raspberry Pi board which in turn provides these values as input to the servo motor. There are two servo motors which are used to move the camera. One for the vertical and other for the horizontal movement [1]. The raspberry Pi on the robot is configured to a Wi-Fi access point; we can connect to the robot with multiple devices. The PC is the remote controlling machine. It sends the connected keyboard command to the robot via sockets by a python program. Separate raspberry pi is used for the movement control from the PC keyboard, and for the head tracking [2]. Another socket program for the head movement is developed. In this program socket from wireless IMU android app on raspberry pi is received and it gets the mapping to servo positions. In the program user can limit the servo movement to the physical limits of the mechanic. For the video stream UV4L streamer solution is used. User can connect to the stream with browsers, so it's really universal. In the current experimental setup 640x360 videos is streamed. User can connect to this stream via mobile [5].

Block Diagram

Block diagram of wifi controlled robot:

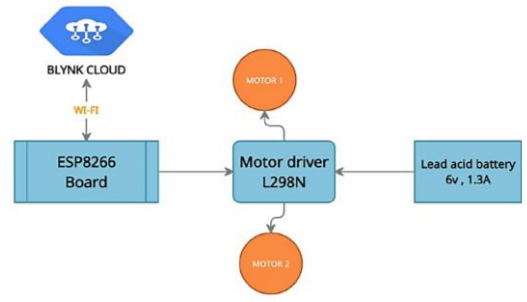

Fig. 1: block diagram of wifi controlled robot

The block diagram describes that blynk acts as a server for the robot which givescommands to the ESP8266 wifi module through wifi and that command's inputs are given to themotor driver L298N that's output is connected to the pair of motor which drives those motor ineither direction according to the command from the server by the user using blynk application.And the motor driver and the wifi module is powered by lead acid battery.

Block diagram for Raspberry Pi camera movement:

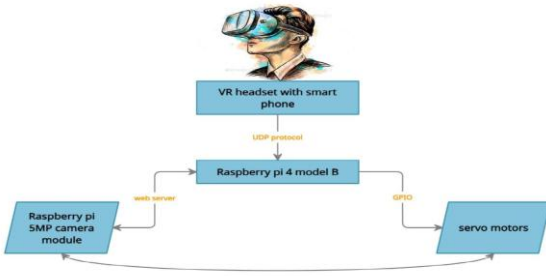

Fig. 2: block diagram of raspberry pi camera

This block diagram describes that the readings from the mobile phone inside VR box sendthe IMU sensor values to the targeted IP and PORT of the raspberry pi through UDP protocol which is used to map the head movement of the user so the PWM signals according to the readingsare sent to servo motors. the raspberry pi 5 MP camera module is connected to CSI port of theraspberry pi which live stream the footage on the web page. then finally the camera module andthe servos are arranged in the gimbal.

Circuit Diagram

circuit diagram of Rpi camera movement with servo motors:

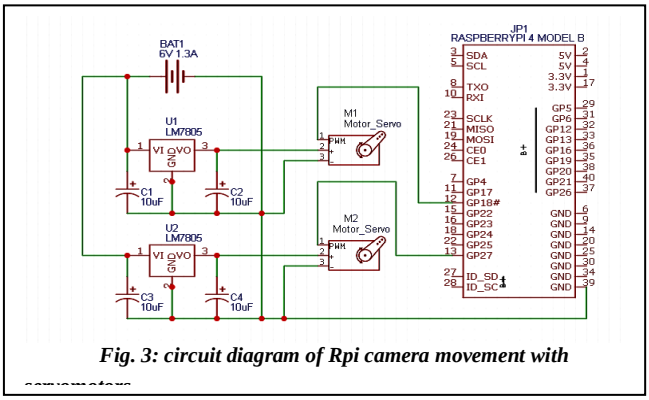

Fig. 3: circuit diagram of Rpi camera movement with servomotors

This circuit diagram describes that the two servo motors SG 90's pulse pins are connected tothe PWM pins GPIO 13 and GPIO 12 of the raspberry Pi 4 and the positive terminal of the servoare connected to the external power supply 6v lead acid battery's positive terminal and the blackpin of servo is connected to the negative terminal of the external power supply and the any oneground pin of the raspberry Pi 4 is commonly grounded with battery's ground.

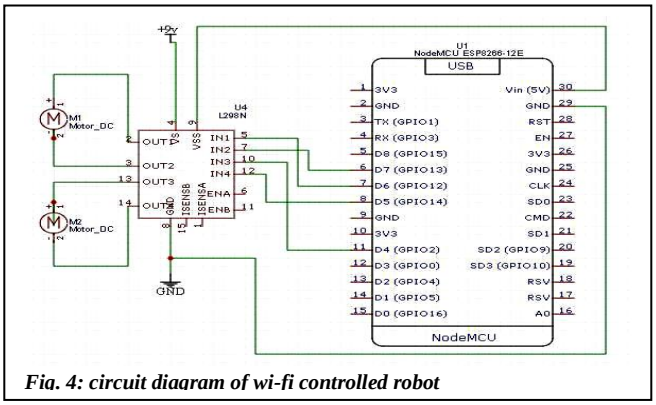

Fig. 4: circuit diagram of wi-fi controlled robot

Circuit diagram for Wi-Fi controlled robot:

The circuit diagram describes that the motor driver (L298N H - bridge driver) isconnected with the microcontroller (Node MCU, which comes with the ESP-12E modulecontaining ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor). The inputpins of Motor A (IN1 & IN2) in L298N driver are connected to the node MCU digital I/O pins(D6 & D7). The input pins of Motor B (IN3 & IN4) are connected to the digital pins of node MCU

(D4 & D5). The L298N driver output pins are connected to the geared motors of the robot. Theseinput and output pins are connected in order to control the speed and rotation of the motor. Themicrocontroller is provided with a local hotspot to receive commands.

Advantages

- It allows real-time two-way collaboration between people who aren't in the same location. They are able to speak as if they are in the same room and share data with ease. This technology allows for greater communication and collaboration and provides benefits to your business.
- Stereoscopic vision aids the operator in their tasks because it lets the operator view the object under investigation as if they were seeing through the "eyes of the robot."
- Brings down corporate travel costs.
- Does away with the fatigue occasioned by long journeys for work.
- Makes telework easier.

- Reduces CO2 emissions.
- Allows people unavoidably elsewhere to be virtually present at meetings/in the office.
- Has lots of future potential.

Applications

- This robot can be used as a surveillance robot. In situations where the house owner needs to keep an eye of what the servant is up to at home.
- In the case of military, instead of sending a soldier to a sight for monitoring the robot can be sent. In this way, even if there is an unexpected attack no life is lost only the robot is under damage.
- In the Medical case, at times when the doctor is not able to go on rounds, the robot can be used to check the state of the patient.
- If the robot is made fire proof, then the robot can be used in fire and rescue operations.
- On further expansion of the robot and increasing its connectivity, the robot can be used in space research.
- It can also be used in life threatening mining sites where the lives of workers are in danger.

Conclusion

With the successful integration of the hardware and software components, the Virtual reality robot moves almost simultaneously with the robot operator. Positions are successfully obtained by the Wireless IMU app and sent to the servo controller raspberry pi and the robot controller via the PC. This unilateral control method provides the human operator with visual telepresence and enables him/ her to remotely control the robot solves the lack of cost-efficient telepresence robotic platform for complete and immersive remote operation, with stereoscopic machine vision and suggestive feedback and ready deployment in indoor environments such as hospitals, museums.

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