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VR based Tele-Presence Robot using Raspberry Pi

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Abstract: ***A telepresence robot is a remote-controlled, wheeled device with a display to enable video streaming which enable the participants to view remote locations, as if they were there. The project consist of a VR headset, with a smartphone in dual screen to experience virtual reality and 4 wheeled robotic vehicle. The movement of the Robot is controlled using a remote controller. The motion of the camera of the robot is controlled by the accelerometer and magnetometer data processed by Arduino and Raspberry Pi. Video streamed is received by the smartphone using the IP address specified by the Raspberry Pi.***
Keywords: **Video streaming, Raspberry Pi, Arduino**

I. INTRODUCTION

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. Like all real world applications robots has its own disadvantages. Robot needs a supply of power. The robot used in this project uses rechargeable battery. Telepresence is the use of virtual reality technology, especially for remote control of machinery or for apparent participation in distant events. Virtual telepresence robot allows the user to experience virtual reality even when the robot is in a remote location.

The idea behind this project is taken from ref. paper [1]. This paper explains the working of the robot and capturing of the visuals. Ref. paper [2] talks about Raspberry Pi and its architecture including both hardware and software. The ref. paper [3] gives us a highlight of connecting and controlling motors to the Raspberry Pi. Ref paper [4] talks about Automatic Photography and the communication between the camera module and Raspberry Pi. Ref. paper [5] tells about robotic arm controlled by Raspberry Pi and android application software using Wi-Fi protocol. It also tells about how to configure Wi-Fi and interfacing servo motors with Raspberry Pi. It explains about how to send data from android application to Raspberry Pi.

In the case of Ref. paper [1] the mini rover camera is stationary. As the rover moves the camera moves along. Here the visual received is the one that is directly in front of it. In the proposed system we have the facility to rotate the camera according to our head movement. The mini rover gives a normal display. Whereas in the proposed system we get a virtual reality effect.

II. PROPOSED SYSTEM

1) *Raspberry pi:* The choice of Raspberry pi is because it allows easy video transmission over Wi-Fi. The Raspberry pi is considered as the CPU of the robot. The Raspberry Pi 3 Model B is the third generation Raspberry Pi. This powerful credit-card sized single board computer can be used for many applications.

Figure 1. Raspberry pi

2) *Arduino:* Arduino is an open-source platform used for constructing and programming of electronics. It can receive and send information to most devices, and even through the internet to command the specific electronic device.it uses a hardware called Arduino Uno [3] circuit board and software programmer(Simplified C++ [1]) to programmer the board.
3) *L239D Motor Driver IC:* The L293D allows the DC motor to drive in either direction. L293D is a 16-pin IC which can control two DC motors simultaneously. The gear motors are turned in the direction specified by the Arduino. It is seen that the power from the Arduino is insufficient to Drive the gears hence we use the motor driver IC.

Figure 2. Motor driver

4) *Accelerometer:* The accelerometer sensors measure the acceleration by measuring the change in capacitance. Its structure has a mass attached to a spring which moves along one direction and has fixed outer plates. So, when acceleration is applied in any direction, the capacitance between the plates and the mass will change. This change in capacitance is measured and corresponds to the acceleration value.

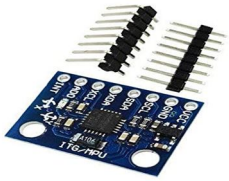
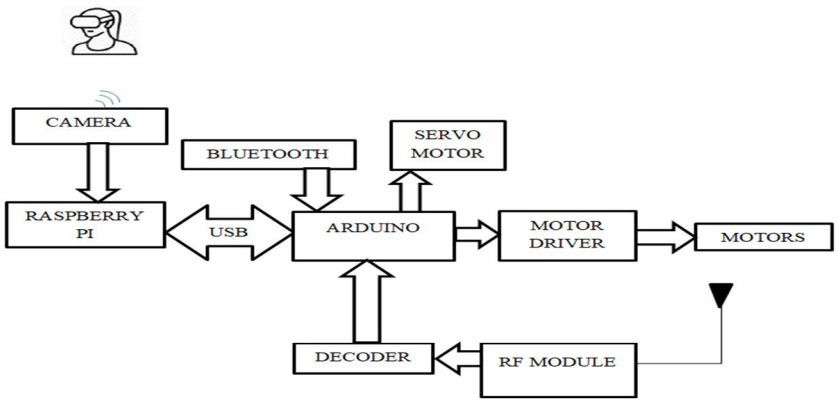


Figure 3. Accelerometer

5) *Bluetooth Module –HC05* - HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module designed for transparent wireless serial connection setup. This serial port Bluetooth module is fully qualified Bluetooth V2. 0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband.

Figure 4. Bluetooth

III. WORKING MODEL



Block Diagram Of Proposed System

IV. OBJECTIVES AND METHODOLOGIES

1) Objective 1- To control the chassis wheels to help the movement of the robotic car.

Methodology

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

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

Methodology

a) Wireless IMU app is used to process the user's head movements and accordingly align the camera.
b) This app reads accelerometer, gyroscope 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.

3) 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 done through various web applications.
c) The software protocols like HTTP supporting web application co-operate to live streaming.

V. APPLICATIONS

A. 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. Other applications include:
B. 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.
C. 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.
D. If the robot is made fire proof, then the robot can be used in fire and rescue operations.
E. On further expansion of the robot and increasing its connectivity, the robot can be used in space research.

VI. LIMITATIONS AND SOLUTIONS

In order for video transmission to happen a Wi-Fi connection is required. Over a LAN the transmission is almost instantaneous but it keeps varying over slower Wi-Fi. High speed internet connectivity can solve this problem. The directional data are transferred as the head moves. In the case when the head moves very fast the data transfer rate is high. This in turn requires the Raspberry Pi to process the data very quickly. The app should be programmed in such a way that the Raspberry Pi board gets enough time to process the data and prove it as input to the servos. The currently designed robot is suitable to run over smooth surfaces. Stronger body of the robot allows it to run over rougher terrains.

VII. CONCLUSIONS

Virtual Telepresence robot moves simultaneously with operator. Positions of robot can be monitored using wireless application and sent to the motors through Arduino. The camera includes audio and video communication. Telepresence integrated with VR headset with online real time head movement control. The camera gives 90-degree range of vertical movement and up to 355-degree horizontal movement.

Virtual Telepresence robot moves simultaneously with operator. Positions of robot can be monitored using wireless application and sent to the motors through Arduino. The camera includes audio and video communication. Telepresence integrated with VR headset with online real time head movement control.

The Raspberry pi implemented in the system helps to control the camera and wheel movements (and maintain low latency). The system runs on commands sent through python code. The 3D real time view can be displayed using VR headset. This system also provides video facilities.

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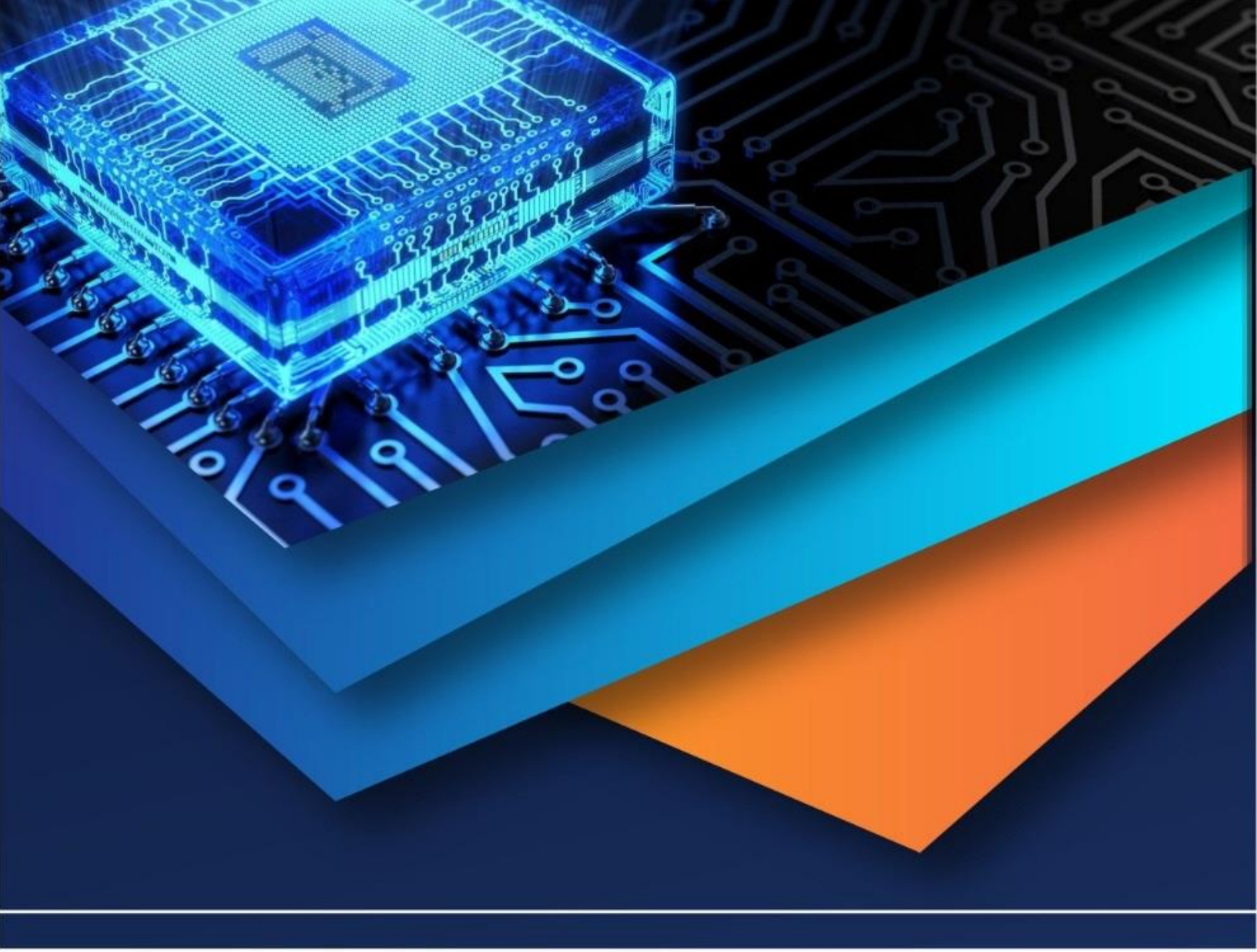

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