

Virtual Reality Telepresence Robotic Platform using Raspberry Pi

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Abstract- A Telepresence Robot is the one which allows a user to have a limited virtual access to an outside world. The proposed system aims to use the concept of telepresence robots incorporating Virtual Reality to create a VR Robotic platform. Telepresence is the technology, which helps a user to feel that they were in a situation without being present at the actual location. The robot design is implemented in two ways using Raspberry Pi and Arduino Board. This robot with a camera is placed in a particular area to capture the scene which will be able to be displayed on the VR headset using Raspberry Pi (RPi). Another feature allows the camera to move, in based on the user's head motion from the accelerometer, gyroscope, and magnetometer and the data processed using Arduino board [3]. Video captured is received via a cellphone using a specified IP address. This gives the user a real time experience as if he is present on the location where the robot is placed. The robot is moved in any direction (say left right) through an app which installed in the user's smartphone.

Keywords—: Raspberry Pi (RPi), Smartphone controlled, Telepresence, Video streaming, and Virtual reality.

I. INTRODUCTION

A Telepresence robot is the next step of evolution in the field of digital interactive communication world. With this concept, people feel as if they are to be at more than one place at the single time. It allows the person to feel more connected by giving a virtual presence where one can't give in physical. Telepresence robot enables the people to observe the surrounding without the person being physically present. Robots have increased widely in today's world. In almost all the industries, the concept of robotics is used as they are user friendly. Telepresence uses virtual reality technology [2]. Simply, the telepresence robot gives a VR (virtual reality) experience that can be felt when the robot is in any remote location. It combines high quality video conferencing capabilities with robotics.

The idea about this project is taken from ref. paper [1]. This paper explains the working and the mechanism of the robot movement and capturing of the visuals. Ref. paper [2] talks about Virtual reality and its architecture including both hardware and software. The ref. paper [3] deals with the office-related use cases in a series of studies using two prototype tele-presence robots (one for conference room meeting and other for moving hallway conversation).

This paper explains the working of the robot and capturing of the visuals by camera, how to configure Wi-Fi and interfacing servomotors with Raspberry Pi and geared motors with Arduino. It also explains how the data is received, from an android application and sent to Raspberry Pi and Arduino. As the robot moves, the camera moves along. In this proposed system, the camera is moved accordingly to our head movement. Also, the robot is able to move according to the signals which are going to be send from the android application.

II. BLOCK DIAGRAM DESCRIPTION

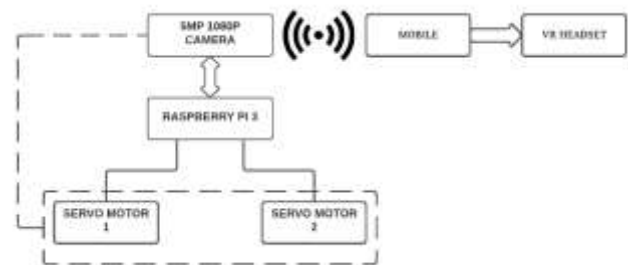


Fig. 1

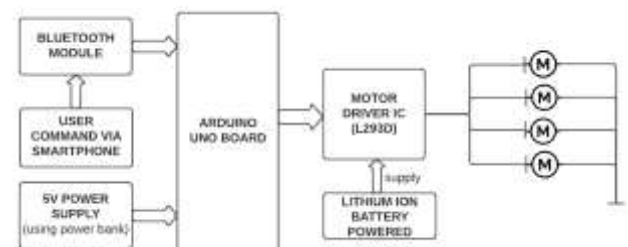


Fig. 2

The block diagram of the VR telepresence robot is shown: Raspberry Pi is the brain of this project. RPi receives input data from an android phone via WiFi which is further sent as controlling pulse to the servo motors attached with the camera which rotates the camera in 2 axis planes. The android smart phone also sends the input directional data to the Arduino board from a Bluetooth app for the movement of the robot. The DC motors are interfaced with the Arduino UNO board via motor driver IC (L293D) at the end of the navigation system.

III. METHODOLOGY

Virtual Telepresence Robot is a user-controlled, wheeled device with an enabled camera and give the appearance of being present at place other than their true location. The VR telepresence robot consists of a 4 wheeled robot as the basic structure. A camera mount with servo motors is attached on the gimbal mount at the top of the robot in order to capture the live video footage of the environment where it is placed. This video is displayed on the smartphone placed in the VR headset (google cardboard) which is worn by the user. As the user makes the movement of the head, these movement is mapped by the RPi and accordingly the gimbal moves in required direction based on the user's head movement. The overall system of the Virtual Reality Telepresence robot can be split up into VR section, robotics section and user section. The VR section has a Raspberry Pi 4 Model B at its heart. The Video is taken by a 5 MP 1080p camera module. The pan and tilt movement of the camera module can be achieved with the help of two servo motors connected to the Raspberry Pi. This camera movement corresponds to the user's head

movement. The Robotics section is basically a 4 wheeled Robot with an Arduino UNO as its brain. It uses DC motors to drive the wheels. The motors are driven by an L293D motor driver shield which is powered by the Arduino UNO. The robot movement is made to correspond to the user movement using data transmitted via HC-05 Bluetooth module. The User Section consists of the wearable VR headset holding an android smartphone running the dual screen app. The Android phone displays the video which is received from the camera module of the Raspberry Pi. Through the IMU app user head movement signals are sent from the smartphone to the Raspberry Pi via Wi-Fi.

IV.FLOW DIAGRAM

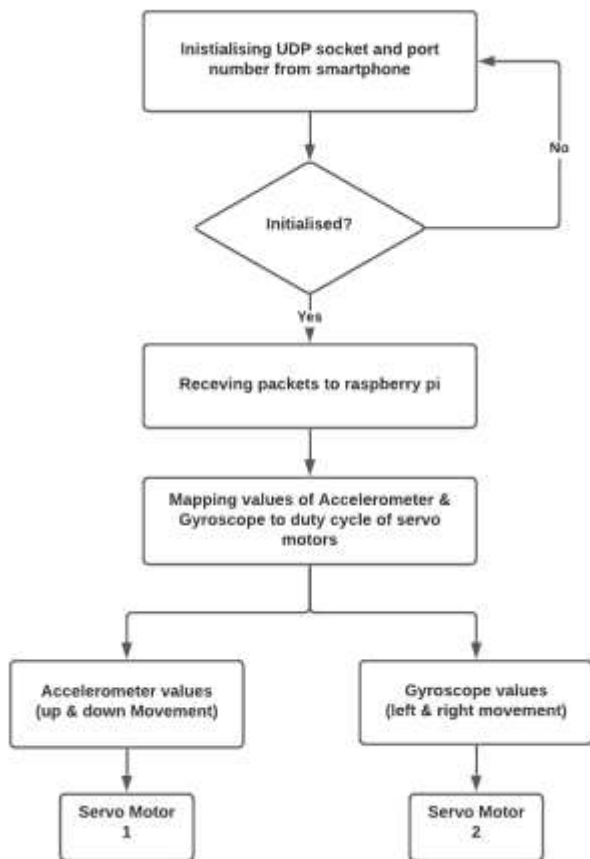


Fig: 2.1 Movement of the Gimbal Control

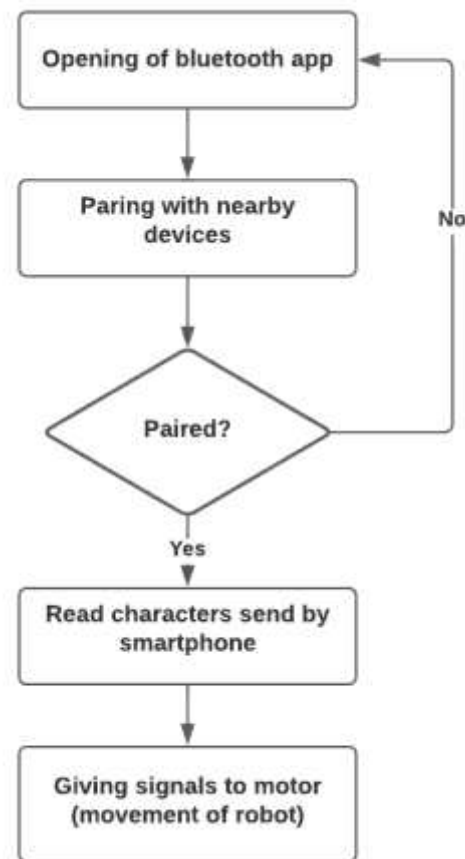


Fig:2.2 Movement of the Robot

V. RESULT

After assembling the hardware and installing and running the software we successfully demonstrated that the telepresence robot provides us the experience of immersive virtual presence without actually being present.

VI. CONCLUSION AND FUTURE WORK

This paper has presented overview on the VR telepresence robot which captures the visuals from RPi camera. The visuals from the camera are display on the smartphone mounted on VR headset and the camera moves according to the movement of head.

The stronger body of the robot, or designing the specified wheels will allow it to run over rougher terrains. Use of the robot will be more in the defense and military areas, where the robot can be sent for monitoring instead of a soldier.

The robot can be also be used for a security purpose in the house where the owner wants to keep an eye. In Medical field, to check the condition/state of the patient when the doctor is unable to go on the rounds, the robot can be sent so that it can give the virtual view of the patient's room.

Stereoscopic Sound can be integrated to provide a more 3d virtual experience.

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VIII. REFERENCES

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