Design of Mechatronics Based Virtual Telepresence for Robotic System Using Raspberry Python Interpreter

Tejaswini A[1], Vindhya S[2]. Dr. Sharanraj.V[*3], Raveendra K S[4], Dr. Vasanth Kumar

[1] Senior Grade Lecturer, Dept of Electronic and Communication, S.J. (Govt.) Polytechnic, Bangalore-560001
[2] Senior Grade Lecturer, Dept of Electronic and Communication. Government Polytechnic, Immadihalli, Bangalore-560066 .
[3*] Senior Grade Lecturer, Dept of Mechanical Engg. (W&SM), S.J. (Govt.) Polytechnic, Bangalore-560001
[4] Lecturer, Dept of Ceramics Technology S.J. (Govt.) Polytechnic, Bangalore-560001
[5]Associate Professor & Head, Department of Mechanical Engineering, Bearys Institute of Technology, VTU, Mangalore - 574153

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 consists of a VR headset, with a smartphone in dual screen to experience virtual reality and 4 wheeled robotic vehicles. 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. This robot with a camera is placed in a remote location to capture the environment in visual form using Raspberry Pi (R Pi).The captured visuals are displayed on the user's virtual reality (VR) headset. An added feature allows the camera to move in the direction of the user's head movements. This gives the user a real-time experience as if he is present where the robot is located. The robot can also be moved in any direction through an app installed in the user's smartphone.

INTRODUCTION:

Tele-presence refers to a set of technologies which allow a person to feel as if they were present, to give the appearance of being present, or to have an effect, via tele-robotics, at a place other than their true location[1].Tele-presence requires that the user's senses be provided with such stimuli as to give the feeling of being in that other location. Additionally, users may be given the ability to affect the remote location. In this case, the user's position, movements, actions, voice, etc. may be sensed, transmitted and duplicated in the remote location to bring about this effect. Therefore, information may be travelling in both directions between the user and the remote location. A popular application is found in telepresence video conferencing, the highest possible level of video telephony[2].Telepresence via video deploys greater technical sophistication and improved fidelity of both sight and sound than in traditional video conferencing. Technical advancements in mobile collaboration have also extended the capabilities of videoconferencing beyond the boardroom for use with hand-held mobile devices, enabling collaboration independent of location[3].A telepresence robot is a remote-controlled, wheeled device with a display to enable video chat and video conferencing, among other purposes which enable the participants to see and talk to remote locations, as if they were there. They also enable much more interactivity than regular video conferencing.In a distance education class, for example, a telepresence robot can move around the room and interact face-to-face with individual students, just as an on-premises instructor might. Telepresence robots can enable remote tour guides, administrative assistants, home visitors, night watchmen and factory inspectors, among many other possibilities[4].To create the same-room illusion, telepresence solutions use a combination of technology elements like high quality audio, HD video, telemetry system and remote control all working in parallel to achieve the goal.As organizations continue to become more international in their business practices, there is a rapidly growing demand for communication tools that support these activities while effectively combating the increasing costs of domestic and international travel. Although telepresence robots aren't inexpensive[5].

MATERIALS AND METHODS:

Apache web server

Apache is used in this project to configure RPi as server. Apache is a popular web server application that you can install on the RPi to allow it to serve web pages. Apache can serve HTML files over HTTP, and with additional modules it can serve dynamic web pages using scripting languages such as PHP. First install the Apache package by typing the following command in the Terminal:

Sudo apt-get install apache2 -y

By default, Apache puts a test HTML file in the web folder. This default web page is served when you browse http://192.168.1.98 from another computer on the network. Browse the default web page either on the RPi or from another computer on the network; you would see the default page. Next, install PHP5 by giving the following command in the Terminal:

Sudo apt-get install php5

RPi cam web interface. The RPi is connected to the Ethernet and configured to access the Internet. It isthen made to connect to the LAN via Wi-Fi. Then an RPi camera module is connected to Board1. Still images are captured and the result is checked in the RPi cam web interface page of the Raspberry Pi.

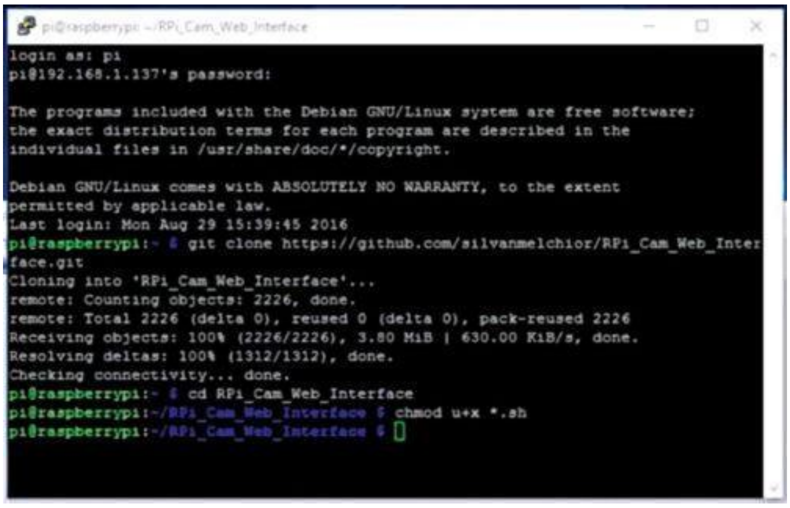

Figure.1: RPi cam web interface installation

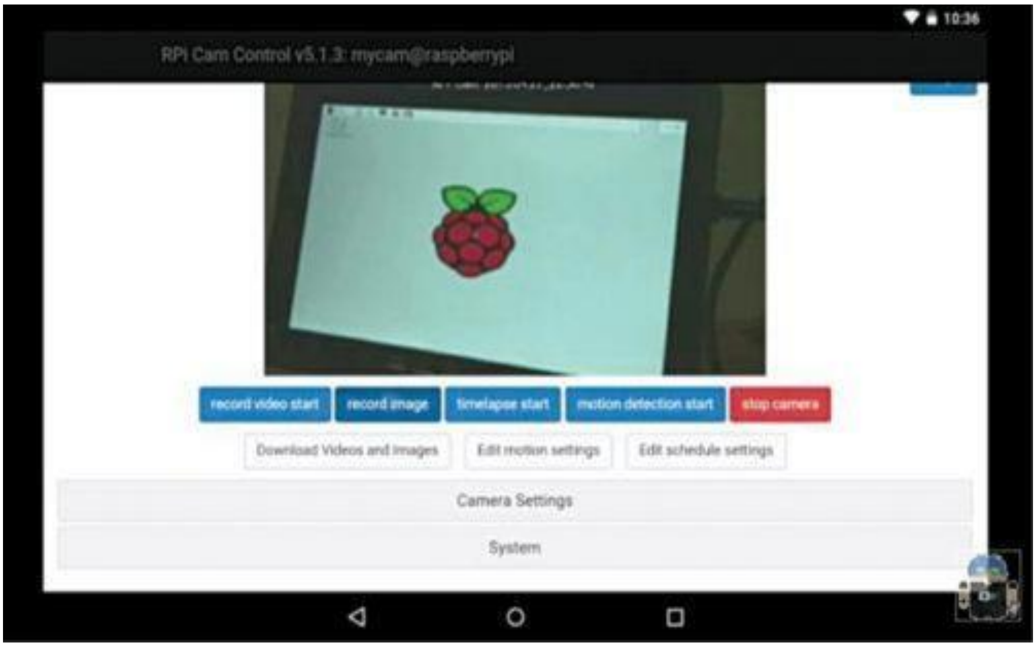

Figure.2: Final web page

Figure.3: Accessing camera settings

The same configurations are done to get video transmission. Installation of RPi Cam Web Interface is shown in Figure1, final web page in Figure2 and camera setting in Figure3. The final set up of video transmission is done by installing Dual Screen app in your smartphone that isplaced in the VR headset. This is done to increase the effect of the VR experience.

Arduino Setup and Program for Bluetooth and Four Wheels Base Control
Program

[Content_Types].xml ,[BL 5a/| W6o+ ").A zm$y }(\47 _rels/.rels jH[{ l0/% %!4! word/_rels/document.xml.rels }- ;}PB `[^^l :>S!?p hqjp ;,f%n word/document.xml )sI` fKUp` n%G!% wQx. nRWn 'L1V {rI j xZ95 4:@@ opvi G4Td "vR"6G ^pP0P0P `SP0P 5`&{k 9kM&z \KZ ] jMfz O?TE *:w& `7<7 word/theme/theme1.xml)C$m 0.&ZnI p\QD ^m%Q!@ J sn :0Rk]xdB YbB)Gc+t B&z+ 0"y& ;n3) xS;qdnd- hH^} >(t =LRb I,.3} \^>H q~9@> _/K/ tEw; *~P(5EEV?.(W Ymvj word/settings.xml x[T^ 3%Q6 E^lr -fH] 6A)X o%O{ %jmLRQ Hv?: w/du 8'<c ~A0- GRH$ 5*r- Txmn. 38ON 4^AU 3Y"VH G>3l <>Ig \]Td docProps/core.xml $(gq BuY1@E y9GEB word/fontTable.xml ZlG> Hhnr YU-O1
}WH!_E~ 6|`u]<J|g\ word/webSettings.xml Gi7r word/styles.xml ,Ze2
{dP*| _g,@ _fwY ?Y|698h &rZo_ F^YU %g:w w'xO ~[HY p,U0Sm OCN: `)G6L5 qTcW Ivu- 2|$J !rVd pqq} JFT( jABa3 .COd l{/c 042- z/dB -7]q z2 t []74 9#N{gR[ 9Z@? Qo"6&m }G|o oye!| [qdy [qdy Y^u)>vg Kqdy Kqdy .Uka qvR? m`/U docProps/app.xml Jhk0Ow 0$DaB aFcC NDj} V~vh"; l(`c} /P~z [Content_Types].xmlPK _rels/.relsPK word/_rels/document.xml.relsPK word/document.xmlPK word/theme/theme1.xmlPK word/settings.xmlPK \]Td docProps/core.xmlPK word/fontTable.xmlPK word/webSettings.xmlPK word/styles.xmlPK docProps/app.xml

Python Program for Camera and Servo MovementProgram

```
#final code for camera movement
import socket, tracebackimport serial
from time import sleep
import RPi.GPIO as GPIOimport time
GPIO.setmode(GPIO.BOARD)GPIO.setup(7,GPIO.OUT) GPIO.setup(13,GPIO.OUT)
p=GPIO.PWM(7,50) p1=GPIO.PWM(13,50)
p.start(8) p1.start(7.5)

while 1:
try:
s = socket.socket(socket.AF_INET, socket.SOCK_DGRAM) s.setsockopt(socket.SOL_SOCKET,
socket.SO_REUSEADDR, 1)
s.setsockopt(socket.SOL_SOCKET, socket.SO_BROADCAST, 1)
s.bind(('192.168.1.98', 5555))
print "Listening for broadcasts..."time.sleep(0.2)
message, address = s.recvfrom(8192) no1,no2,x1,y1,z1,no3,x2,y2,z2=message.split(',')print(message)    #whole
message signal print(z1 ,z2)
a1=float(z1)b1=float(z2)s.close();
if(a1>6):                    #uppper limita=12.3
elif(a1>5):
a=11.9
elif(a1>4):
a=11.2
elif(a1>3):
a=10.8
elif(a1>2):
a=10.5

elif(a1>1):
```

```
a=10.2
elif(a1>0):
a=9                          #middle limit
elif(a1>-1):a=8
elif(a1>-2):a=7
elif(a1>-3):a=7.5
else:
a=6.9
time.sleep(0.2)
if(b1>13):
#b=180#12.5b=12.5
elif(b1>10):
#b=170#12.3b=12.3
elif(b1>8):
#b=160#11.7b=11.7
elif(b1>7):
#b=150#11.1b=11.1
elif(b1>5):
#b=140#10.5b=10.5
elif(b1>4):
#b=130#9.9b=9.9
elif(b1>3):
#b=120#9.3                                                                                              b=9.3
elif(b1>2):
#b=110#8.7b=8.7
elif(b1>1):
#b=100#8.1b=8.1
elif(b1>0):
#b=90 #7.5b=7.5
elif(b1>-5):
#b=80#7.3b=7.3
elif(b1>-7):
#b=60#6.7b=6.7
elif(b1>-9):
#b=50#6.0b=6.0
elif(b1>-14):
#b=40#5.3b=5.3
elif(b1>-17):
#b=30#4.6b=4.6
elif(b1>-20):
#b=20#3.9b=3.9
elif(b1>-21):
#b=10#3.2b=3.2
else:
#b=0#2.5b=2.5
p1.ChangeDutyCycle(b)time.sleep(0.4) p.ChangeDutyCycle(a) time.sleep(0.4)

  except (KeyboardInterrupt, SystemExit):raise
except:
```

traceback.print_exc()

RESULTS:

The movement of the robot was successfully controlled via cell phones over Wi-Fi, The gimbal lock was able to mirror the head movement of the user using the IMU sensors of the cellphone. The live feed from camera was remotely accessible on both cell phones and personal computers. All the modules were integrated together to create a "Virtual Telepresence Robot"

CONCLUSION:

The Virtual telepresence 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. Providing accessibility to stereoscopic stream in harsh environments such as war prone areas, debris and dust affected regions, nuclear armament or industrially radioactive zones using remote links. Addressing the major problem of lack of immersion in a Telepresence Robotic system by integrating Virtual Reality headsets (such as Google Cardboard) andonline real-time head movement control and stereoscopic stream to traditional telepresence platform controlled remotely and wirelessly via the Internet. Thus, the virtual telepresence robot is a simple, cost-effective and efficient solution to multiple real world problems.

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