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DESIGN A VIRTUAL TELEPRESENCE ROBOT USING VIRTUAL REALITY

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Abstract—Today remote communication is usually done through video or voice. With the emerging VR technology, a more immersive option for communication is made possible via Telepresence. The video streaming feature allows us to view a different place but it is limited to just viewing that particular place with no freedom of movement. Telepresence is a better communication than a video communication. Telepresence technology enables users to be virtually present in another location at the same time through video streaming. This kind of user interaction is further enhanced through mobility by driving remotely to form what is called a Telepresence robot. Instead of travelling to the desired location, the sensory impressions from the desired location are digitally transported to the place where the person is located. A Virtual telepresence robot is the one with which we can move around and see that place with a camera in it. With the VR headset, it gives an experience as if we are there. It can be useful in search and rescue operations. Full flexibility of viewing is made possible by a dual servomotor to rotate 180 degrees in both horizontal and vertical axis.

Keywords— Telepresence, Virtual Reality, Rover, VR, RaspberryPi, Telepresence Robot.

I. INTRODUCTION

The invention of the telephone made everyone around the Earth closer. Instead of physically travelling to the person you wished to speak with, your voice could electronically travel to that person almost instantly. This type of communication effectively replaced travelling to get the desired information. With video technology and World Wide Web, Video conferencing became an even more enhanced way of communication. Even more advancement made way to

Telepresence. This technology makes it possible to digitally transport visual contents to the user with the help of Virtual Reality. Where instead of travelling to the desired location, the sensory impressions from the desired location is digitally transported to the place where the person is located. Using this technology, arover is made with the capability of conducting search and rescue operations and other functions in places in accessible by humans.

In various Remote rovers used for visual access, it is very difficult to control the robot or it requires lots of skill to control it. With addition of the VR feature in the robot, the difficulty in controlling is reduced by one degree and an immersive experience is also obtained. The growing VR technology is so fascinating that it is becoming dominant in various fields and improving the technology.

In the case of the 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. With good extension of technology in this rover such as adding robotic arms, It can also be used to defuse bombs or detect mine bombs in war bases. 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. The night vision is an added advantage to this rover so that absence of light cannot affect vision. If the robot is made fireproof, then the robot can be used in fire and rescue operations and search and rescue can also be achieved by adding further more hardware needed for the respective environment .On further expansion of the robot and increasing its connectivity, the robot can be used in space research.

II. RELATEDWORKS

[1]Y. Kato. A remote navigation system for a simple tele-presence robot with virtual reality. In Intelligent Robots and Systems (IROS), 2015 - In this research, a detailed survey is conducted to identify the research challenges and the achievement still in this field. Accordingly, 50 research papers are taken related to root working under virtual reality environment, and those research papers are reviewed. Based on the review, analysis is provided based on the image processing techniques, objectives, accuracy level, error level, and the image data sets. The navigation system provides an idea to the robot for responding with its surroundings Finally, we present the various research issues which can be useful for the researchers to accomplish further research on robots working in virtual reality.

location. The Infrared module in the camera makes it night vision ready.

There are two setups used in this project. The rover is powered by the Raspberry Pi which acts as a brain. Another part is the user side interface where the user controls the rover using a remote desktop platform in a computer.

The User side interface consists of a VR headset with a mobile in it. The mobile must have gyroscope sensors in-built. The rover side components are RaspberryPi, wireless modem, Servomotors, Chassis and a night vision Raspberry Pi camera which is based on Infrared. Separate block diagrams of each of the setup is given below and the working is explained

further.

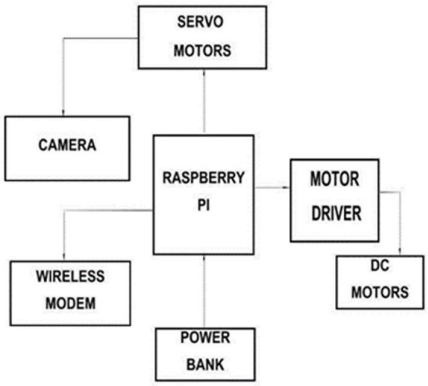

Fig.1. Block Diagram of Rover

[2] B. Zhang, J. Liu, and H. Chen. Amcl based map fusion formulti-robot slam with heterogeneous sensors. In Information and Automation (ICIA), 2013.-This paper presents a new method for the bots to
analyse the area around it with properties based on inputs received from the sensors. Usually retrieved images have low contrast due to environmental and equipment limitations which add another difficulty in image visualization. This paper discusses various techniques for upcoming the difficulties and enables the robot to analyse the sensor data and proceed accordingly. Furthermore, the analysis of more sensor data increases the accuracy of the working tendency of the robot. Morphological techniques are used in this work through successive iteration to ensure connectivity.

III. PROPOSED METHODOLOGY

This Rover is powered by the Raspberry Pi3 and which is controlled remotely from a different

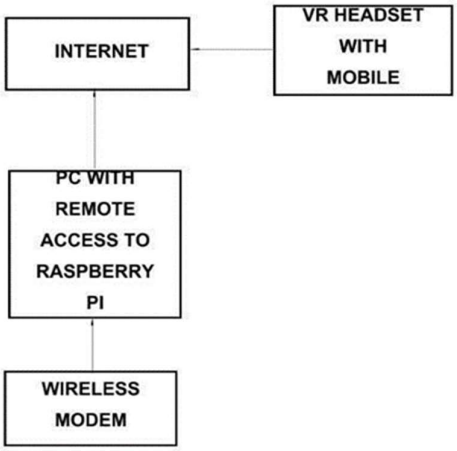

Fig.2. Block Diagram of User side Interface

In the following sections, the methodology of the system will be elaborated along with the description of the hardware used. The design of the system, the algorithm, and the flowchart will follow the hardware description.

The Rover consists of Raspberry Pi 3 which is the brain of this system. The Raspberry Pi is powered by a Power bank which gives 5V output. The rover has two 100RPM DC motors which is powered by 9V battery pack and it is interfaced with Raspberry Pi through L298N Motor Driver module. The camera is mounted in a plastic pan-tilt moving mechanism which is moved by micro servo motors each. The servo data is given by the Raspberry Pi after performing desired calculations.

The Raspberry Pi camera also comes with a dual IR module which illuminates in dark and can be used to have a clear vision in dark environments.

The user side interface setup contains a PC which is used to remote access the Raspberry Pi using the Real VNC Platform. A VR headset is worn by the user with a smart phone fixed in it. The wireless IMU application is opened in the Mobile and made to run in the background. A web page is kept open in mobile before keeping it in the VR headset which views the live visual from the Raspberry Pi camera in a format which can be viewed in the VR headset. The live visuals are made to appear in the desired format using a python program.

The gyroscope data from the mobile phone placed in the VR headset is transmitted as UDP packets to the Raspberry Pi with the help of the Wireless IMU app. The data is transmitted through the internet. With this data the Raspberry Pi calculates the Pan and Tilt data which will be fed to the Micro servo motors. the movement. The gimbal movement of the Rover is also powered by a python program. All the three python programs must be running in parallel.

IV. RESULTANDDISCUSSIONS

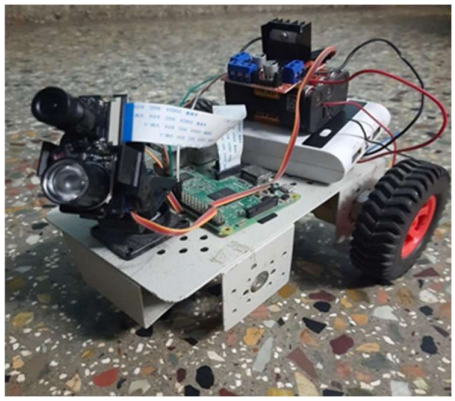

Fig.4.The Virtual Telepresence Rover

Three python programs are executed in the Raspberrypi through the Remote desktop. The gimbal Control. pyprogram is used to control the camera movements with the help of the gyroscope values obtained from the mobile in the VR headset. Rover movement Control. pyprogram takes care of the controlling movement of the rover. The input is given in the remote desktop itself. camera Live. Pyhelps with bringing the live visuals from the camera on the rover to a web page. After executing cameraLive.py program, live visuals from the camera can be accessed from the browser. The webpage is made in a format such that it can support VR as

shown in the Fig.5.

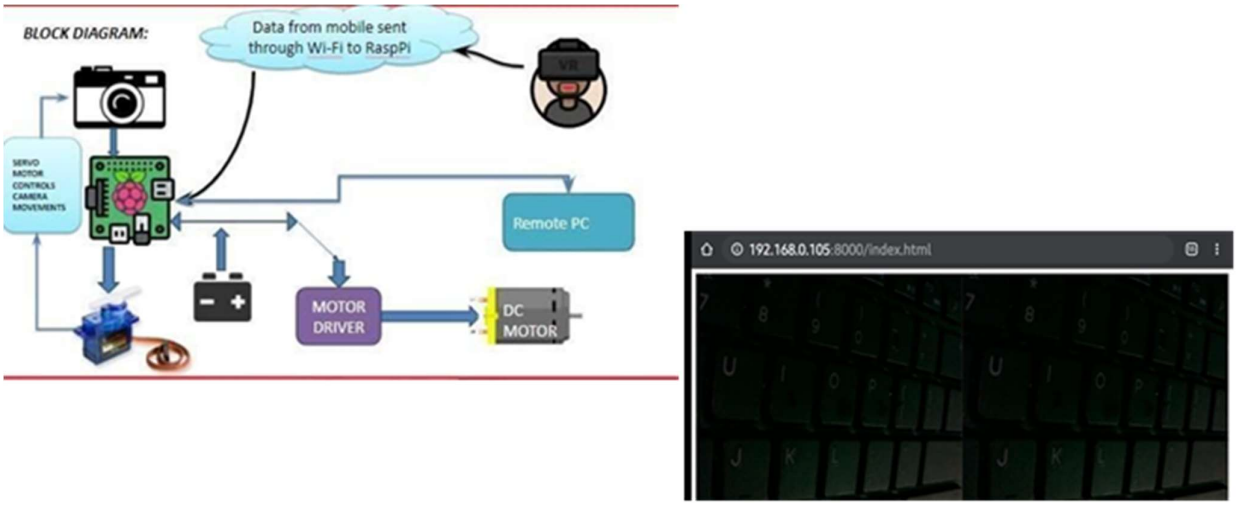

Fig.3. Flow Diagram

A python program is made for navigation of the rover. The arrow keys in the keyboard are used to control the navigation of the rover. The spacebar is used to stop

Fig.5. Live visuals from the Rover

V. CONCLUSION

In this work, we realized that this robot can be used for various problems. It can interact and observe people and pets and their surroundings without need for us to be physically present there. This robot can change the dynamics of countless domains. It can facilitate Virtual attendance in various cases. In business, these robots can be used to attend meetings and conferences reducing the need of travelling. Thus, this robot is a simple, cost-effective and effective and efficient solution to multiple real world problems. This proposed work can be improved by making a dedicated mobile application which can be used to do all the background work and includes a in-built browser to view the live feed. The latency of the live better softwares. This gimbal effect, visuals fed using gyroscope values from mobile phones, can be made even accurate so that the camera will turn smoothly. This prototype used a Google Card board like VR headset which can be replaced using a VR headset with an in built screen on it. The usage of this VR headset can substantially improve the video and stereo quality. Microphone can be embedded to the rover setup to get audio from the environment where the rover is placed

REFERENCES

1. Y. Kato. “A remote navigation system for a simple tele-presence robot with virtual reality” In Intelligent Robots and Systems(IROS), 2015 IEEE/RSJ International Conference on, pages 4524-4529. IEEE, 2015.

2. B. Zhang, J. Liu, and H. Chen. “Amcl based map fusion for multi-robot slam with heterogeneous sensors” In Information and Automation (ICIA), 2013 IEEE International Conference on, pages 822-827. IEEE, 2013.

3. Yong-ik Yoon, Jee-ae Chun, “Tracking System form obile user Based on CCTV” Information Networking(ICOIN), 2014 International Conference on, Phuket, 10-12 Feb.2014, pp.374-378.

4. J.Kuffner, “What’s Next: Cloud Enabled Humanoids?”, in Proc.on 10th IEEE-RAS International Conference on Humanoid Robots (Humanoids 2010) Workshop,2010.

5. H.Nakanishi, Y. Murakami, D. Nogami and H.Ishiguro, “Minimum Movement Matters” Impact of Robot-Mounted Cameras on Social Telepresence, in Proc.on ACMCSCW’08, 2008, pp.303–312.

6. D. Schulz, W. Burgard, D. Fox, S. Thrun and A.B.Cremers, “Web Interfaces for Mobile Robots in Public Places”, IEEE Robotics & Automation Magazine, vol.7, no.1, pp.48–56, 2000.

7. S. Noort and A. Visser, “Extending Virtual Robots towards RoboCup Soccer Simulation and @Home”, RoboCup 2012:Robot Soccer World Cup XVI, pp.332–343,2013.

8. K. M. Tsui, M. Desai, H. A. Yanco, and C. Uhlik, "Exploring use cases for telepresence robots," in Proceedings of the 6th ACM/IEEE International Conference on Human-Robot Interaction(HRI'11), pp. 11-18, March 2011.

9. Hsinchu, Taiwan, Arvind Kandhalu, Anthony Rowe, Ragunathan(Raj)Rajkumar, “Surveillance With Real time Monitoring On Web”, International Journal of Mathematics Trends and Technology-May to June Issue 2011 Page(s): 46-49.

10. Chingchun Huang, Chao-Chun Yeh, “Real-Time Video Surveillance over IEEE 802. 11 Mesh Networks”, Industrial Technology Research Institute (ITRI) Department of Electrical and Computer Engineering Carnegie Mellon University, Pitts burgh, USA 15213, Page(s)1-10.