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Virtual Telepresence and Gesture Controlled Robot

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Abstract-In today's world telepresence is nothing less than a necessity as a person can't be everywhere and it can be used for variety of reasons including saving lives of people. This can be solved by a robot which can be controlled from a distant location. This paper deals with a new virtual telepresence robot with gesture control which can be used in defence as well as life threatening jobs like mining, for educational purposes. Robots when compared to humans can easily survive the atmosphere which is developed in the field of mining and in defence. In this paper, a method to control a robot from a distant location is discussed. Here the robot is being controlled by hand gestures which in other terms is known as accelerometer and is captured by a camera which gives the live stream video. The results of the experiments done are really promising. This method is robust and can really be helpful in the field of defence and mining.

Keywords- telepresence; gesture controlled; raspberry pi; Arduino UNO; virtual reality;

1. INTRODUCTION

A Telepresence being one of the most efficient ways of interacting with people over long distance is gaining importance and popularity. It is also being used as a useful tool in homes as well as in work in order to increase productivity and also to connect people. It is one of the emerging fields which allow an individual to be in some other place from their actual location. Video telepresence results in interactive participation of users from any part of the world. Also the ability of operating an object in any remote location facilitates the feel of actual presence of the user. The emergence of video conferencing in mobile devices, tablets, portable computers paved the way to drastic growth of Telepresence robots. Telepresence robots are basically Teleoperated robotic systems which all in all helps an individual to be in any remote locations through video conference via Smartphone or tablets and also to interact with the environment through various techniques which includes sensorial and motor abilities. On the other hand when it comes to gesture control Its been decades that we are using keyboards and mouse as the main input devices for our computers however as the time is passing the increasing popularity of ubiquitous devices which allows people to seize or clasp virtual objects, body gestures are becoming essential. It has become a very important part of the interaction between a computer and a human being. Nowadays robotics are widely used in different fields including military and hospitals. For instance we as students got this idea from a person who is divorced and wanted to be with his children so he made a telepresence and gesture control robot which helped him to be with his kids. These are being also used in domains which includes search and rescue operations in dangerous environments to interactive entertainments. All in all we can say larger numbers of robots are employed in our daily life more will be the communication with the robots is required.

1.1 Applications

1.1.1. Trying to avoid major health catastrophes like burns:

Burn injury is a major public health issue in developing countries, with most injuries being largely associated with the use of kitchen stoves. This study details the development of a cost-effective gesture and voice recognition controlled (GVC) system to be used by individuals with disabilities to reduce the likelihood of burn injury and improve their quality of life. The device replaces conventional dial controls with voice and hand gesture recognition sensors and software which are designed to be easily implemented into a household kitchen. Preliminary evaluation of the GVC system's performance in gesture and voice recognition, gas leak detection and ignition control

tests were conducted using a Bunsen burner as a stove top surrogate. The voice and gesture recognition tests yielded sensitivities of 88% and 100%, respectively. These results suggest that the GVC system may be a promising solution for burn injury prevention pending further work to improve its reliability and robustness.

1.1.2. Defence

Surveillance, Espionage or spying involves individual obtaining the information is considered as secret or confidential without the permission of the holders information and Surveillance in military ground of the Enemy activities. A robot is virtual or mechanical artificial agent. In practice, it is usually an electro mechanical system which, by its appearance or movements, conveys a sense that it has intent or agency of its own. Our aim in building this project is to create a wireless controlled Surveillance Robot vehicle.

1.1.3. Mining

Mining is considered as one of the life threatening jobs as in the very beginning the employees are made sure that their lives are at risk and might take their lives as well. So particularly in such fields robots telepresence robots are efficient when compared to human beings and by using telepresence and gesture control their efficiency can be increased as they'll be following our directions.

1.1.4. Making education interesting

Intel is using it in classrooms to make education more enjoyable and interactive. Intel created an application, called ARPedia to provide students with a digital exploration of the encyclopedia. It too uses gesture control recognition to show, for an example, how a dinosaur grows, with functions allowing the user to interact with hand gestures. This is making the education enjoyable rather making it boring.

1.1.5. Helping doctors

During surgery a nurse or doctor may not be able to touch a screen or track pad that controls a system, for health and safety reasons, but with gesture control technology, hand or finger movements can be used as a virtual mouse to control the device. Despite the opinions on how technology advances are creating a lazy, inert society, gesture control technology is not something we should be criticizing. It is part of a new wave of electronic innovations which are improving aspects of life in terms of efficiency, safety and education

2. LITERATURE SURVEY

Telepresence and gesture control when clubbed up can be very helpful and useful in fields like education; it can also be used commercially and even in fields like mining and defence which is the main priority of this paper. For instance in the very first paper which we referred Elizabeth Cha [1] has clearly explained how telepresence robots have the potential to improve access to education for students who are unable to attend school for a variety of reasons. In this paper, we seek to better understand how a telepresence robot should function in the classroom when operated by a remote student. There were many other papers [2], [7], [8], we refereed which helped us to get some information on interaction between humans and robot system based on a novel combination of sensors is proposed. D.Thalmann [3] has explained how it allows one person to interact with a humanoid social robot using natural body language. The robot understands the meaning of human upper body gestures and expresses itself by using a combination of body movements, facial expressions, and verbal language. We even got to know about a new telepresence robot with gesture-based attention direction [4], [5] to orient the robot towards attention targets according to human deictic gestures. Gesture-based attention direction is realized by combining Localist Attractor Network (LAN) and Short-Term Memory (STM). Recently a paper was published about a robot named ME-BOT [6] which allowed social expression. It explained how a telerobot that communicates more than simply audio or video but also expressive gestures, body pose and proxemics, will allow for a more engaging and enjoyable interaction.

3. PROPOSED SYSTEM

The model proposed deals with a virtual telepresence robot which is also known as remote-controlled, wheeled device with a camera to enable video conferencing. In this model the rover is controlled by hand gestures from a distant place. This proposed robot gives us a realization of being present at place other than their true location with the help of telepresence. This can be made possible by combining virtual reality and IOT using Raspberry pi. In the recent years hand gestures is getting so much attention as it makes interaction between humans and robot easy. Gesture controlling is very helpful for

handicapped and physically disabled people to achieve certain tasks, such as driving a vehicle. Gestures can be used to control interactions for entertainment purposes such as gaming to make the game player's experience more interactive or immersive.

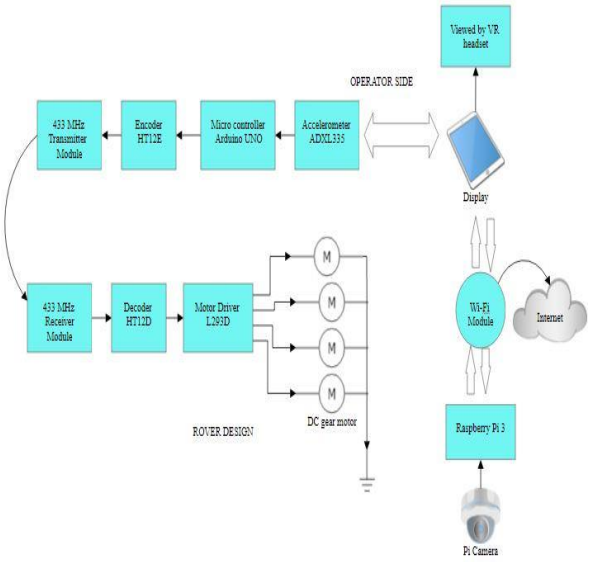

Figure 1.Block Diagram of the proposed model

The gesture controlled robot works on the principle of accelerometer where the hand movements are recorded and then it transfers the data x, y, z analog values to the Arduino which converts analog to digital and hence the information is then transferred to an encoder which makes it ready for RF transmission. Finally by using RF pair the information can be communicated wirelessly.

On the receiving end, the information is received wirelessly with the help of RF, which is then decoded by the decoder and then passed onto the motor driver. Also to make a robot move in a specific direction, various decisions are made by the motor driver based on the received information which triggers the motors in different configurations.

The hand gesture controlling directions are given from the visuals available on the phone from the Picam which is interfaced with the Raspberry pi 3. Here the live video is streamed by using raspberry pi 3 which acts as host and YouTube acting as server. Here in this method of live streaming the video is possible from anywhere provided there is Internet. Another method for video streaming can be done on VLC player in mobile which is transmitted through Wi-Fi module the range for this only method is within Wi-Fi range.

4. DESIGN AND IMPLEMENTATION

4.1. *Hardware Description*

The hardware design consists of two designs one is transmitter design where the gloves are designed and is worn for giving the commands to the rover and the second one is designing of the rover and also includes raspberry pi 3 with Picam for giving live visuals.

4.1.1 Interfacing RF module to the microcontroller Arduino UNO

Transmitter design which can also be called as gloves design consists of 3 axis accelerometer ADXL335 which is used for sensing the movement of the hand gesture which then sends the x y z values to microcontroller arduino UNO. This converts the analog values to the digital values and is given to the encoder HT12E. The encoder 4bit output is given to the TX transmitter which is operated in 434 MHz. An RF transmitter receives serial data and transmits it wirelessly through RF. Finally the RF's antenna is connected at pin4. The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter. A rechargeable battery is used for power supply.

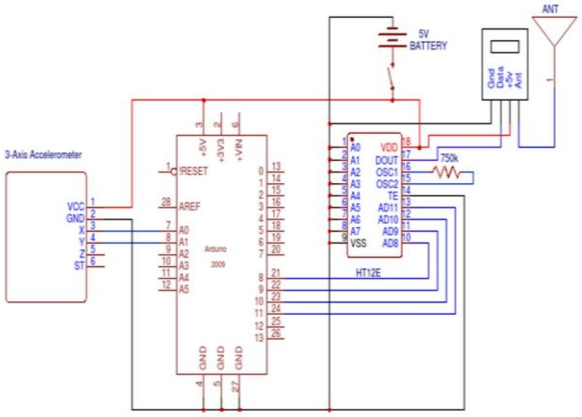

Figure 2. Transmitter Circuit

4.1.2. Receiver Design and Wi-Fi module interfaced with Raspberry pi

Receiver design which is also known as rover design consists of RX receiver which receives the 4bit data wirelessly and is sent to the decoder HT12D. The decoder decodes the 4bit data to the original data and the original data is then passed on motor driver L293D. The motor driver then takes various decisions based on the received information which triggers the motors in different configurations to make the rover move in a specific direction. The motors we are using here is 200 rpm which is powered by 12V battery which placed on the rover.

The rover also consists of raspberry pi 3 which is interfaced with Picam. It acts as a host and streams live video on the phone using YouTube as server.

Hence live visuals of the remote area are received in the operator's phone. The visuals or the video can be seen with VR headset by which we achieve virtual presence of the operator in the remote area.

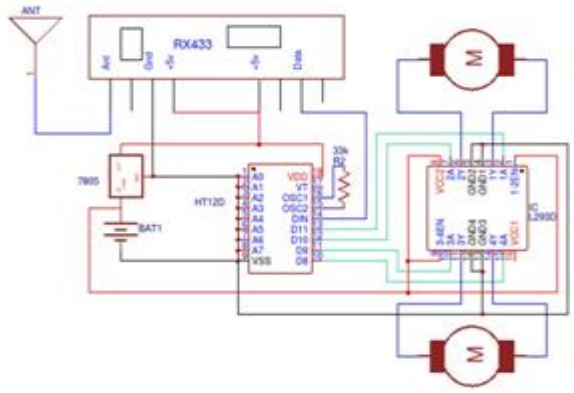

Figure 3. Receiver Circuit

4.2. *Working of Hand Gesture*

Working of the hand gesture is based on the gesture we set, here for the forward movement the gesture taken is by tilting the hand in front side, the rover starts moving forward until the next command is not given.

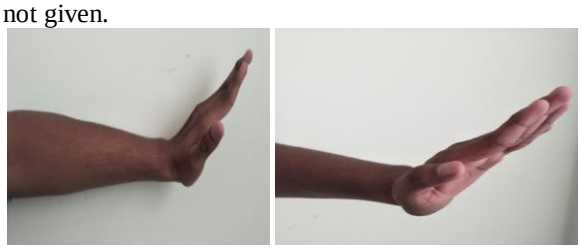

Figure 4. Hand gesture for forward movement.

For the backward movement the gesture taken is by tilting the hand in backward side, the rover from the forward state changes to move in the backward direction until the next command is not given as shown in the Fig 5.

Figure 5. Hand gesture for backward movement.

To move the robot left the gesture taken is by tilting the hand left side as shown in the figure 6.

Figure 6. Hand gesture for left movement.

For turning the robot right, the gesture taken is by tilting the hand right side as shown in the figure7.

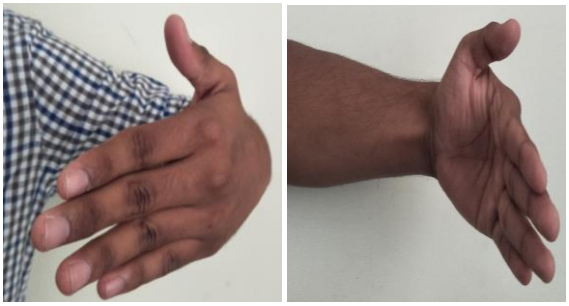

Figure 7. Hand gesture for right movement.

And for stopping robot we keeps hand in stable.

Figure 8. Hand gesture for stop position

4.3. *Software Description*

The software used for gesture control here is Arduino IDE where programming is fed to Arduino UNO. In which code is written based on the x, y, z, values and fed to Arduino UNO which in-turn controls the motor drivers to move the DC motors. Programming is done using embedded C. Telepresence is live video streaming that's done using raspbian Jessie. Here the streaming can be done using a static IP Address for a small range and dynamic IP address can be used for long range. This method is offline. Another way of live streaming can be done by using Raspberry Pi 3 as a server and host can be YouTube. This way we can access it around the world just by Internet connection with unlimited storage of data online is programmed in python.

5. RESULTS & DISCUSSION

Accurate controlling of the robot with Hand Gesture with range of communication, taken to 20m (ideal case) this range can be varied as it depends on the RF pair range. Video streaming is done by using hotspot and another method is done by using Internet which can be streamed from anywhere.

Figure 9. Transmitter Design in which the accelerometer sensors the movement and feds signals to the Arduino UNO microcontroller.

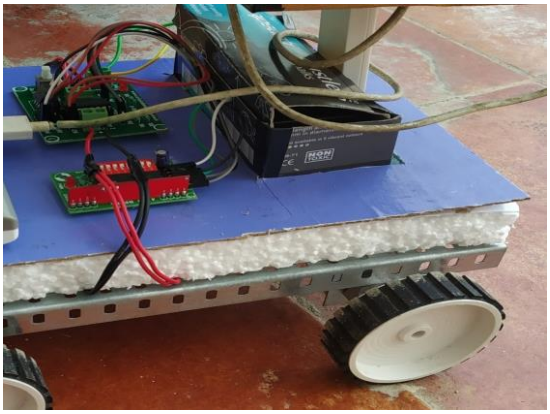

Figure 10. Rover Design in which RF receiver receives the signals which is then given to the motor driver L293D which is in turn connected to four dc motor for the robot movement.

Assembly and complete working model of the rover is done which is capable of giving live visuals continuously and hand gestures are used for the movement.

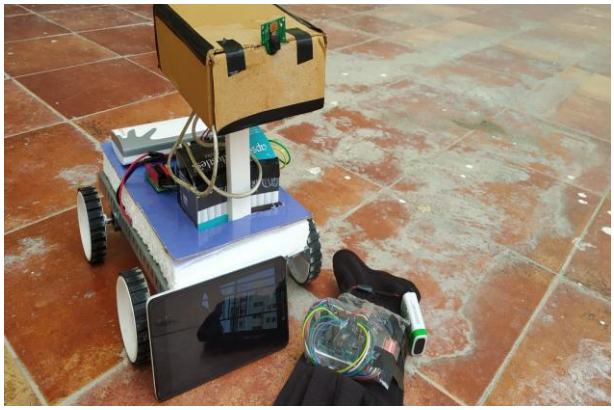

Figure 11. Over all view of the model which gives us Virtual Telepresence and controlling through hand gestures.

6. CONCLUSION

The paper focuses on two parts, first is telepresence, which gives us an esthesis of being elsewhere, made by virtual reality technology. The other is gesture control by which we can actually interact or even control robots. These two things together play a critical role, if one is planning to make a robot especially in the fields like mining and defence. People working in mining should work on one condition which clearly states that it will be a threat to their lives. In this situation we go for using telepresence and gesture control robots to give different directions.

In defence our paper is majorly focusing on surveillance. These robots are of low cost, efficient and give a good performance which makes our lives more automated and simple. Here we are designing or operating the robot for two ranges one which is of Wi-Fi, which has a range of about 20 meters (66 feet) and second which is operated from anywhere around the world with internet.

The work has scope in different applications like for office purposes, industries, education, driver less automobiles, hospitals. Further the camera movement can be with respect to the head movement of the operator by which again the telepresence feel will be improved.

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