# Gesture Controlled Virtual Reality Robot

[1]Shubham Naladkar, [2]Siddharth Nagar, [3]Yash Pundkar
[1]Designation of 1st Author, [2]Designation of 2nd Author, [3]Designation of 3rd Author
[1]Department of Electronics and Telecommunication,
[1]P.E.S.'s Modern College of Engineering, Pune, India

***Abstract :*** The paper presents the realization of hand gestured controlled robot which can be operated remotely using Virtual Reality. The essential aim of building hand gesture recognition system to control movements of robot is, to create a natural interaction between human and computer, where the Virtual Reality headset with Smartphone can be used for viewing field of operation from the robot's view, conveying meaningful information. It is easy and advantageous to control or operate robot by hand gesture and view through VR headset than other available system functionality, as accuracy matters a lot for robotics field. The robot completes certain tasks like picking, placing and robot movements (forward, backward, right and left).

***IndexTerms*** **–Hand Gesture system. Virtual Reality.**

## I. INTRODUCTION

There are situations like a person can't move from bed to go to a desired place to do task and there is no one to help or consider a scenario where any human being can't reach to a location but to go that place is necessary like some remote location to perform a special task.

Here, a robot comes into picture which can be remotely controlled very easily, give perfect view of their surroundings to go and do basic tasks.

Our robot is a boon in above described situations. It gives live streaming of its surrounding that can be viewed on smartphone fitted on VR screen to the person operating it. The alignment of camera is adjusted according to the accelerometer data from mobile which gives field of view equal to 114' to the person operating it so that he/she can control the robot without any hurdles and use hand gestures to control movements of robot and can easily do operations like pick & place.

This type of human-robot cooperation reduces physical efforts to preserve the operator's health during the execution of tasks which is impossible to be performed by him/her.
Using this robot the disabled person by resting on his/her place can do basic tasks without any help. Or we can say the human can reach to the impossible locations without itself being going there and perform the required operation easily.

## II. LITERATURE SURVEY

From the very beginning it was one of the major concerns in the industry of robot to control the robot smoothly and accurately. The hand gesture controlling system is becoming very popular day by day. Human behaviors and hand gestures are recognized and used to tele-operate a robot. There has been many research works in the field of Hand Gesture based Human Computer Interaction following different algorithms to develop a fast and reliable procedure for gesture recognition.

In Paper [3] by Youngmo Han deals with Motion data gloves, these gloves are frequently used input devices that interpret human hand gestures for applications such as virtual reality and human-computer interaction. However, commercial motion data gloves are too expensive for consumer use and if use low cost single optical data channel data there may be inaccuracy. Hand Gesture system using Infrared sensors and a camera [5] using multimodal hand gesture detection and recognition system using differential Pyroelectric Infrared (PIR) sensors and a regular camera is described. Any movement within the viewing range of the differential PIR sensors are first detected by the sensors and then checked if it is due to a hand gesture or not by video analysis the algorithm and component complexity gets increased. And since using a camera to detect IR motion the power requirements will rise.[4] Wearable device with an ego-centric camera would be the next generation device for human-computer interaction such as robot control. Hand gesture is a natural way of egocentric human-computer interaction. In this paper, we present an ego-centric multi-stage hand gesture analysis pipeline for robot control which works robustly in the unconstrained environment with varying luminance.

Taking into consideration a wide scope of modern technologies aiding the design work related with construction of manufacturing workplaces, the particular attention needs to be paid to virtual technologies. Virtual Reality (VR) is scientifically defined as an application of the computer technology to create an effect of interactive, three-dimensional world, in which objects have spatial form. Teleoperation systems for remote control of robot and the use of 3D virtual reality [6] delivers the adopted architecture of 3D virtual reality and describes the experimental implementation through simulation results for mobile robot. While [2] a virtual reality-based construction tele-robot control system is investigated. The system consists of a servo-controlled construction tele-robot, two joysticks for controlling the construction tele-robot, and virtual environment imaging system. The operator performs the teleoperation of the construction tele-robot by manipulating the graphic robot directly in virtual environment using the joysticks.

Experiments research indicated that virtual reality technology improved the task efficiency and offered the possibility of performing teleoperation with greater safety. A teleoperation system enables human operator to implement given tasks in a remote manner or enhance his/her capability to handle both the macro and the micro worlds. Its various applications can be found in several areas of space explorations, nuclear reactors, under-water operations, tele diagnosis and tele surgery in medicine, construction robot, forestry, mining, etc. . A virtual reality-enhanced hand rehabilitation support system [1] with a symmetric master slave motion assistant for independent rehabilitation therapies. The was aim was to provide fine motion exercise for a hand and fingers, which allows the impaired hand of a patient to be driven by his or her healthy hand on the opposite side so a VR environment displaying an effective exercise was created in consideration of system's characteristic

A big advantage of using hand gesture system is that the user not only can communicate from a distance, but need have no physical contact with the computer. However, unlike audio commands, a visual system will be preferable as in noisy environments or at situations where sound would cause a disturbance. There is a simplification used in this project, which was not found in any recognition methods researched. The number of different gestures recognized and the recognition accuracy are amongst the best found.

## III. SYSTEM SPECIFICATIONS

1. Robot

The robot consist of three systems and two power supply systems

a. Raspberry pi 3 Model B as live Streaming servers connected with two 5MP cameras, these raspberry pie(s) have ARM Cortex-A53 @ 1.2GHz, Broadcom Video Core IV with 1GB RAM, 2.4GHz 802.11n wireless card essential for live streaming
b. Hand gesture system Receiver with decoder HT12D and motor driver L293D. The receiver is set at 433MHz to receive transmitted hand gesture data. The motor driver drives the four 12V (~1.2A) Geared DC motors at 300rpm for robots movements and two 12v (~0.8A) Geared DC motors at 100rpm for Picking and placing system.
c. Pick and place system consist of two metal arms and a metal hand functioning with two 12V Geared DC motors.

Two power supplies are

a. Two 9V DC batteries connected in series (18V), stepped down by DC-to-DC converter to 12V to power pick and place system. And four 9V DC batteries connected in series (36V), stepped down by another DC-to-DC converter to 12V to power motors for movement.
b. Two power Bank of 10000mAh to power Raspberry pie(s) and the receiver system.

2. Hand Glove as Hand Gesture system transmitter

It consist of 3-axis Accelerometer (ADXL335) connected to Atmega 328p operating with 20MHz clock frequency, 32kB ISP, 1kB EEPROM and 2kB SRAM. The data from microcontroller is transmitted through encoder HT12E.The transmitter transmits data at 433MHz frequency all powered by 9V DC battery.

3. VR headset

It consist VR Glasses that can support smart phones varied sizes ranging: 3.5"-6" (inches).Smartphone is having raspberry pie camera app and split screen feature.

4. A Wi-Fi router at 2.4GHz with IEEE standard 802.11 a/b/g/n to create WLAN for the two Raspberry pie(s) and the smartphone.

## IV. PRINCIPLE OF OPERATION

First of all the operator wears the gloves having hand gesture system now he/she wears the VR headset and inserts the smartphone with software is responsible for creating an artificial environment to the user.

The two Raspberry pi cameras approx. 2.5inch apart connected to two separate Raspberry pie(s) on the robot, streams a live video on a Wireless Local Area Network (WLAN).This live streaming is seen on smartphone when it gets connected on the same WLAN. As two cameras are there, this will present same stream for both of the eyes separately on the smartphone, this way user(human) sees through eyes of robot and experiences the quality and clarity of robot's point of view.

Now the user can control the robot i.e. to move the robot forward, backwards, left, right and to pick & place an object with the help of gloves. The gloves have accelerometer, the ways in which user gives predefined hand gesture, the sensor (accelerometer) gives gesture data to the Atmega 328p microcontroller. The microcontroller send the instructions to the transmitter on the gloves through the encoder. The transmitter transmits the data at 433MHz.

On the robot there is 433MHz receiver is present which receives the transmitted data, this data after decoding given to motor driver to drive the motors as per the instructions from transmitter.

## IV. RESULTS AND DISCUSSION


Fig 1: Hand gesture for controlling picking object & lifting up operation.


Fig 2: VR headset's upward and downwards orientation followed by camera on robot.


Fig 3: VR headset's left and right orientation followed by camera on robot.

## V. ACKNOWLEDGMENT

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