Animatronic Robot with Telepresence Vision

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Abstract **- We have been using tele operated robots in various industrial and military applications to reduce human efforts and avoiding endangering human life. Nearly all operating robots are controlled using a pc, keyboard or joystick and image or video captured with camera is seen on a monitor. Due to this tradition approach there is a gap between human operator wants to do and what robots do in actual. Robot can't perform exact action human want them to perform due to less interactive input system. Which reduce accuracy of the system and hence reducing the capabilities of the robot. Our project is to work on a new approach with hardware and software system which will bridge this gap.**

Animatronics is a field which uses anatomy, mechatronics, robotics to replicate human (or any other living subject) motion. [6],[7] Telepresence is a set of technologies which allow a person to feel as if he/she were present, to give the appearance of being present, or to have an effect, with tele robotics, at a place different than their true location. [2]

If we incorporate these two technics in robots, various problems mentioned above can be solved. With use of animatronics we will be controlling the robot's hand (or any mechanical part) movement by sensing human hand movement as if it mimicking it. We will be implementing telepresence vision by displaying image/video camera on a VR headset/smartphone display placed in front of operators' eyes. The camera's movement i.e. where camera is looking is controlled as per the user's head movement i.e. camera moves the same way operator's head moves. So, our project is to design a telepresence system which will provide better all-around and on field view to the operator. And the video feed will be from the direction operator wish to see now and this without any complex control mechanism but just neck movement of the operator. Above two systems along with other required things are mounted on mobile platform controlled by operator to give all direction mobility.

The new techniques used in this project can be used in various rescue and security operations like complex mechanical operation to be performed at radioactive or chemically hazardous places, bomb diffusion, repair operations on leaked gas pipes or high voltage lines.

Index Terms **- Animatronics, Joystick, Robot, Tele operated, Virtual Reality.**

I.INTRODUCTION

Every day our security and rescue force risk their lives in various operations such boom diffusion, information gathering, and response to surprise attack, ambush and many more. And many times they have to work in dangerous environment conditions. A solution to this could be wide use of AI powered robots. But still AI technology is in development stage and robot still can't make complex and critical decisions.

So, for now we need a robot who works in supervision of a human, but problem is degree of control on that robot and response of robot to human command. So, our project aims to develop a robotic vehicle for security purpose with human supervision and much higher control on its operations. Animatronics field will help us to control the robots hand movement by sensing human hand movement. We are implementing telepresence by displaying image/video on a VR headset/smartphone display. The image/video is captured by a camera whose movement is controlled as per the user's head movement.

This robot will have high resolution mounted camera with 180-degree circular movement which will directly feed the video footage of surrounding to VR head set used by the operator and the camera movement will be directly controlled as per head Movement of the operator which will give on field experience to operator and better understanding of the situation. There will be also a robotic arm to perform complex operations like cutting, lifting, pushing, opening etc. The movement of this robotic hand will be controlled as per hand movement of the operator. In simple robotic arm will be mimicking operator's hand movement.

This all setup will be mounted on four-wheel vehicle which will provide movement to this robot to reach any places desired. This whole setup will be concerted

with some network so the robot can be operated over a long distance without actually going to or near the field.

So at the end of this project we will be having a system of a camera module which will be capable of mimicking human neck movement to give exact on field view to the operator and another system like a robotic hand which will be capable of mimicking human hand movement so the robot will capable of doing various complex tasks with real-time and very responsive assistance of the operator. At the end with this robot we expect to demonstrate better awareness, better control, high agility, and accuracy while operating robot remotely.

II. RELATED PREVIOUS WORK

Humans have been developing robots form many years for various deferent purposes like work reduction, accuracy, heavy or complex works, hazardous work etc.

But in last two decades' robots are being developed for security and rescue forces purposes like safety, security, information gathering, surveillance, deserter management etc.

Few of most noticeable are:

1. Ripsaw MS1

Ripsaw MS1 is being developed by Howe and Howe Technologies. It is an unmanned light tank first developed in 2000 and is currently being reviewed by the U.S. Army.

This robot is tele operated but still controlled by a joystick and made for limited application/work. [5]

2. DRDO Daksh

The DRDO Daksh is a electric, remotely operated military robot specially designed to locate, handle and destroy hazardous objects. It is currently being used by the Indian Army.

This robot is controlled by remote with no. of buttons switches and joysticks. As the no of moving elements are many so does the controlling element which makes controlling of this robot very challenging and time consuming beside it uses monitor to display the video feed in front of camera which restricts the awareness of the surroundings. [5]

3. MULE

MULE (Multifunction Utility/Logistics and Equipment) vehicle was an autonomous unmanned ground vehicle developed by Lockheed Martin for the US Army. It could be outfitted with various equipment but was cancelled in 2011 as they were "too noisy for combat".[5]

4. Atlas

Developed by Boston Dynamics, Atlas is a bipedal humanoid robot developed for DARPA. It is 1.8 meters tall and has being developed to perform a variety of search and rescue tasks.

This is completely autonomous robot we just need to give command or feed some information and rest of actions will be performing by robot on its own. So, this robot lacks in taking critical decision due limited information and experience hence it is not reliable. [5]

III. METHODOLOGY

Entire system will be implemented with 3 sub-systems as rover, telepresence vison and animatronics robotic arm. their working is as follows.

1. Rover:

It's is a simple 4 wheels' vehicle. It will act as platform for this project. All the components for functioning of rover and other system will be mounted on this rover. The operator will control it using a joy stick which will send reading to Arduino (a microcontroller based development board) and then to Wi-Fi module which will send these reading to the raspberry pi (a microprocessor based development board/ minicomputer) over a network and raspberry will control the dc motor so manipulate the rover accordingly.

2 Tele presence vision:

In this system the operator will be wearing a vr box with a mobile phone placed inside it. A raspberry pi camera will be mounted on rover along with raspberry pi which will contentiously feed the real time video footage to the operator's mobile over a network, which he/she will be seeing in vr for 180-degree real time on field experience. And the direction of the camera will be automatically controlled by raspberry pi as per the operator's neck movement which will be tracked by sensors in mobile. Which will be sent to Arduino and then to the Wi-Fi module which will send these reading to raspberry pi over network.

3 Animatronic Robotic Arm:

In this system we will mount gyroscopes and accelerometer sensor on operator's arm and these sensors will be continuously sensing the gyroscopes and accelerometer reading and send it to wifi module which will send these values to raspberry pi over network. So, in nutshell we will be sending real time coordinate of operator's arm to the raspberry pi over the network. Using those coordinates the raspberry pi will control the robotic hand by controlling the servo motors such a way that robotic hand will mimic operator's arm movement to perform certain operations.

So with the combination of all these three system we get a robot which can be navigated to certain intended place of working or a hazardous place. Using mounted camera controlled as per operator's neck movement, will be feeding a real time on field view of surrounding situation. And with the robotic hand which mimic the operator's hand it will be possible to perform certain complex or dangerous task as operator intend to remotely and precisely. By attaching different type of mechanical tools to perform specific operation, at the end of robotic hand we can perform variety of operations.

A. DIAGRAMS:

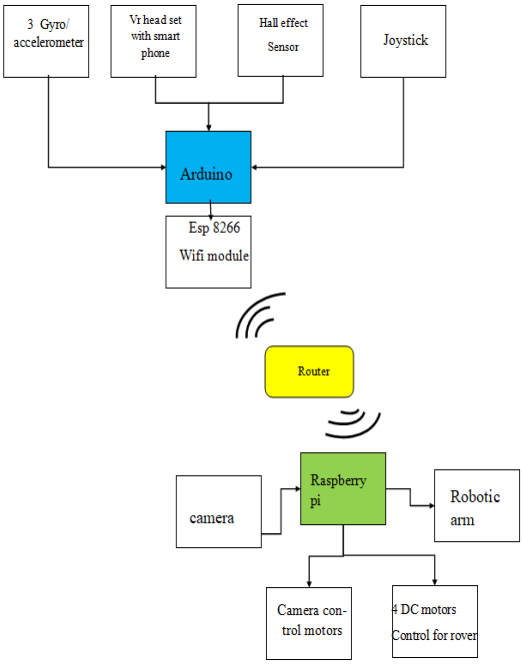

Fig.1 Block Diagram

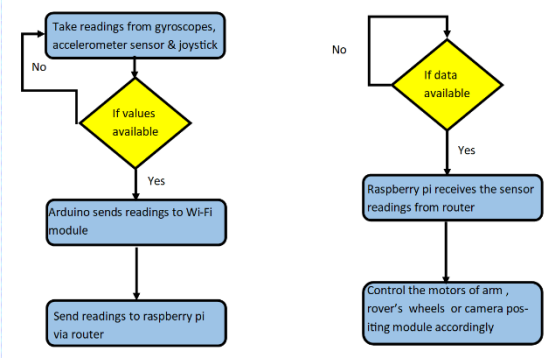

Fig.2,3 flow chart at operator and rover side

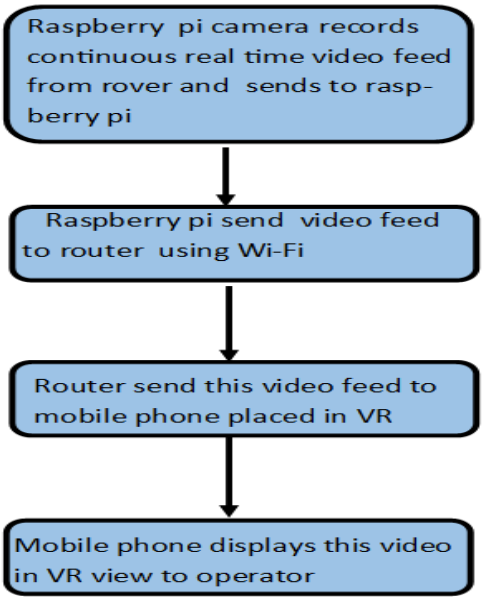

Fig.4 flow chart of operation of video streaming

IV. OBJECTIVES & RESULT

a. To implement animatronic to mimic robotic hand as per operator's hand to demonstrate better and easy control over robot.
b. To implement telepresence vision and get real-time video feed from robot in vr box and control camera as per operator's head movement, to demonstrate better understanding of situation with telepresence
c. Make a moving platform to carry above two systems to intended place

After implementing this project in real we found that various objectives where achieved like

1. We are getting continuous video feed from pi camera which we get see in 180 in field

experience in vr box giving better situation awareness satisfying objective b.

2. The robotic arm is able to mimic the operator's hand movement and was able to perform some tasks, giving better and easy control over robotic hand satisfying objective a.
3. We were able to control the rover with all other system mounted on it, with joystick over the network. Satisfying objective c.

With this project we could achieve much better control over a very complex robot very easily and got better situational awareness of field. All these results are illustrated in fig. 5,6,7,8.

parameters	Tradition Way of controlling robot	New implemented way
Control on robot	Less	High
Situation awareness	Less	High
Ability to perform complex task	Less	High
Complexity of system implementation	simple	Very complex
cost	Low	high

Table1. Comparison between old and new technic

But we encounter some problems and limitations as follows.

1. Latency. In case of every controlling action and video reception there was latency up to 1 second.
2. no feedback from robotic arm or camera module so operator will not know if controlling action was performed perfectly or not? Is there any obstacle in any movement?
3. Degree of movement. robotic arm isn't agile as human hand. Hence this fact limits the activity of robotic arm and hence the operation it will perform.

Fig.5 Implemented Model

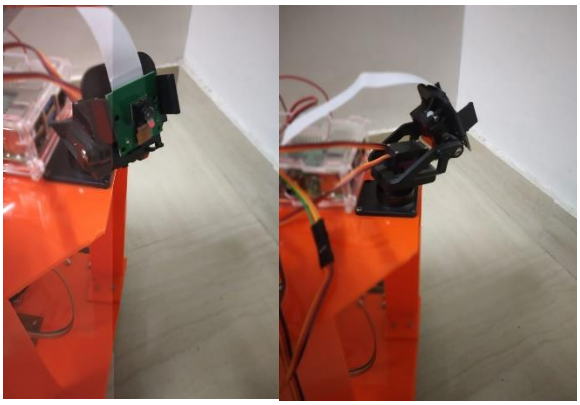

Fig 6. Camera Movement

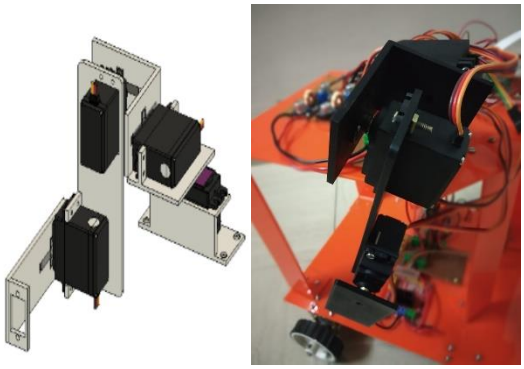

Fig 7. Robotic Hand

Fig 8. VR View on Mobile Screen

V. CONCLUSION

In today's modern world tele operated robots are being used to at various places to reduce human efforts and to avoid endangering human life. But these robots are very difficult to control and use them to perform complex task.

To overcome these problems new technic like animatronics and telepresence vison can be used to improve control and situational awareness. To demonstrate that we decided to develop a robot with a robotic hand which will mimic human hand with only tracking human hand with some sensors which is animatronics. Also, a system in which real time camera footage will be directly sent to vr and camera

will be controlled as per head movement of human i.e. telepresence.

With implementation of this project we could achieve all objectives set i.e. we got better control on robotic hand with animatronic and better situation awareness of field with telepresence vision. But we also encountered few limitation and problems which are latency, no feedback and agility of robots.

So from this we concluded that the incorporation technics like animatronics and telepresence vison in robotics, significantly increase effectiveness and capabilities of robot allowing them to perform complex tasks and with further research and development on limitation they can be discarded and such robots can be used for uncountable different purposes.

REFRANCES

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