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SPi-Bot : A Gesture Controlled Virtual Telepresence Robot

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ABSTRACT

In today's world, telepresence technology is thriving andwe can see its applications in a wide range. The meaning of "VIRTUAL" is being in effect though actually not. With the advent of telepresence mankind has stepped into a new era of technology. Telepresencecan be defined as a group of technologies thatenables a person to feel his environment via tele robotics even though that person is not physically present. This paperis a detailed report of agesture-controlled spider robot incorporated with telepresence which when interfaced with a handheld device provides a view of the environment, thus giving a feeling of being actually present even though not. The primary goal is to allow the user to have a near world experience even if he is not physically present.

Keywords: *Gesture, Telepresence, Tele robotics, Virtual*

I. INTRODUCTION

In the present-day scenario, we come across many situations where human beings need assistance in performing certain tasks that can present a constant threat to the people who carry out them. The challenge is to incorporate robotics and information technology to develop a system that can perform the desired task.
Machines that are programmed by a computer to carry out complex tasks automatically is called robot. They are guided by an external control device or a control embedded within robot. Robots can be physical and virtual(bots).
Here are some of the different types of robots

- Pre-programmed robots

These types of robots operate in a controlled environment, where they perform a simple single task that is assigned to them ahead of time as they cannot be assigned tasks while they are working.

- Humanoid robots

These robots are built similar to humans and they perform human like activities. They automate tasks such that it reduces the cost and increases the productivity. These humanoid robots are now becoming feasible in various commercial applications.

- Autonomous robots

Autonomous robots are machines which have the ability to perform tasks by themselves and they do not require human intervention to perform these tasks. They usually carry out tasks in open environment.

- Tele-Operated robots

Teleoperation refers to operation of a machine situated at a distance. Teleoperated robots are mechanical bots which require control instructions by human. These robots work in various geographical, weather conditions. The ability to interpret and identify the movements of a human to communicate with the computer and control it, without physical contact is called gesture control. Input devices are used to track a person's movements and interpret the gestures performed.

The different types of input devices used are:

Wired gloves are used to provide input to the computer with respect to position and rotation of the hands using magnetic or inertial tracking devices. Using cameras one can generate a 3d representation of the environment that the camera is placed in. Structured light or time of flight cameras are the specialized cameras that generate a depth map of what is being seen through the camera lens. Gesture based controllersare controllers that act as an extension of the body so that when gestures are performed, some of the mot can be easily identified by the software. Telepresence is a set of technologies that enables a person to feel as if they were present in a location via tele robotics even though that is not their current location. In this project, we are interfacing all the above technologies to build a gesture controlled virtual telepresence spider robot. This robot system uses virtual telepresence technology which provides the user, a visual of the environment in which the robot is located. By utilizing these visuals, the user controls the movement of the robot through gesture control in the remote location. This robot provides assistance in various applications such as mining, gaming, educational and military purposes.

II. LITERATURE SURVEY

In the paper titled "Android Controlled SPY Robot with night vision camera" authored by Deepanjali, Ranjini, Ruchi, Shweta and Ranjini Keshri, they have integrated a smart phone with robotic vehicle. With the help of this experiment, they were able to make use of robotic technology for reliable communication between them [1].

In the paper titled "Bluetooth Controlled Spy robot" authored by Akash Singh, Tanisha Gupta, and Manish Korde, it shows how to allow for meaningful two-way communication between an

android phone and the robot, which would allow a non-expert to interact with and adjust the functionality of a system which uses Arduino Uno [2].

In the paper titled" Smartphone Controlled Spy Robot with Video Transmission and Object Collector" authored by Md.Khalid Hossain, Md NiazMostakim, Nabil HossaiBhuiyan and SheikhDobir Hossain, a system proposed in this paper that shows how an android smartphone can be interfaced with Bluetooth modules connected to a microcontroller. This can be used as a remote controller for robot and various embedded technologies. The aim of this paper is to demonstrate a spy and rescue robot [3].

In the paper titled "Arduino Quadruped Robot" authored by V.Arun, S.V.S.Prasad, G.Sridhar Reddy, L.Ruthwik Reddy, M.Venkatesh and M.SaiPavan Kumar describes that robots with legs can access all the locations that are not accessible by wheels. They can jump or step over obstacles whereas wheels need to somehow travel over it, or take a different path. They can avoid undesirable footholds which cannot be avoided in a wheeled robot. These robot helps us in exploring human and animal locomotion [4].
In general, the robotic functions of the telepresence robot are limited and the visual angle of the camera on the robot is narrow and they are unsuitable for navigational services. In the paper titled "A remote navigation system for a simple telepresence robot with virtual reality" authored by Sugimani-ku, a remote navigation system for a simple telepresence robot is proposed. This system overcomes the difficulty by adopting architecture in which robots are controlled remoted via a server located in the internet, by using well designed virtual reality techniques for robot control [5].

III. PROBLEM DEFINITION AND OBJECTIVE

The main objective of this project is to develop a prototype robot which when placed in a place other than the user's location is capable to capture its environment in virtual form. The robot's movements arecontrolled by hand gestures. The captured visuals can be viewed through a virtual reality headset.

This project solves many problems that we face in our day-to-day life

- Can help reduce risk-factors in certain jobs like mining, spying etc.
- Can give real time learning experience in educational field.
- Can help employers when there is shortage of employees.
- Can help provide real time training in the military.
- Can help in monitoring people during lockdown.

Keeping in mind the different problems that we face regularly, this project was designed.

IV. HARDWARE AND SOFTWARE SPECIFICATIONS

- **Hardware Used:**

1. Servo motor: - It is a type of motor that can rotate with great accuracy. It consists of a control unit, a feedback system and an output sensor that helps control motion and the final position of the shaft.

Fig 4.1: Image of a servo motor

2. Arduino Nano V3: - It is an 8-bitcompact microcontroller that provides the same functionality of the Arduino Uno. It has 8 analog input pins, 14 digital I/O pins and a clock speed of 16MHz.

Fig 4.2: Image of an Arduino Nano

3. NRF2 Wireless Transceiver: - It consists of a transmitter and a receiver. In the transmitter electrical digital signals are converted into RF. At the receiver, it is brought back to the original form of message.

Fig 4.3: Image of a NRF2 Wireless Transceiver

4. Triple axis analog accelerometer: - It is a low power, 3 axes micro electro mechanical systems accelerometer with both I2C and SPI interfaces. It consists of poly silicon springs which allow it to deflect in X, Y and Z directions when subjected to acceleration in that direction.

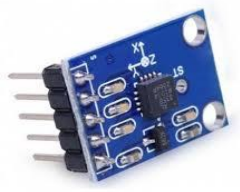

Fig 4.4: Image of a triple axis analog accelerometer

5. Raspberry Pi 3: - It is a series of small single computer boards that are of low cost and provide high performance. It has a clock speed of 1.2GHz and a 64-bit quad-core ARM Cortex-A53 processor.

Fig 4.5: Image of a Raspberry Pi 3

6. 3D printed robot parts: -It is the 3D printed frame of Spider Robot. It is the external body or the frame of the Spider robot.

Fig 4.6: Image of 3D printed parts

7. Motor driver: -Motor Drivers are used to interface between a microcontroller and the servo motor.

Fig 4.7: Image of motor driver

- **Software Used:**

1. Arduino IDE: - It is an open-source software that is used to write codes and upload it on any Arduino board.

Fig 4.7: Image of the logo of Arduino software

2. Raspberry Pi OS: -It is an open-source operating system for Raspberry Pi. This Raspberry Pi comes with beginner IDEs such as Python IDE, Mu editor and Green foot.

Fig 4.8: Image of the logo of Raspberry Pi OS

V. METHODOLOGY

A Quadruped robot is a mobile robot modelwhich uses four legs or limbs to move efficiently. This Quad robot model mainly consists of a Raspberry Pi 3, NRF Wireless Transceiver and 12 servo motors. Each leg of the robot is attached with 3 servo motors at different positions which control the rotation and movement of the leg. All the 4 legs of the robot are connected to Raspberry Pi 3 along with the NRF transceiver. The NRF transceiver on the robot is responsible for communication between the Raspberry Pi 3 and the user. The robot is powered using an external power supply.

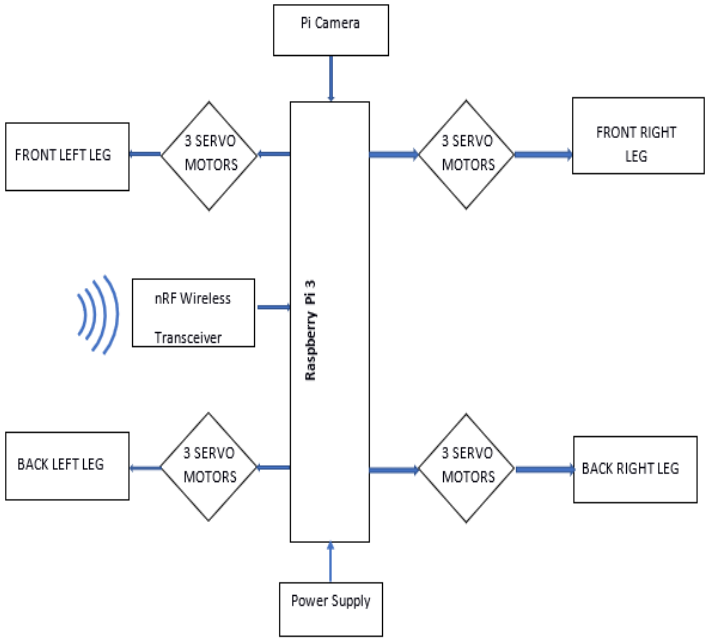

Fig 5.1: Image of block diagram of robot

The Gesture control system consists of a NRF transceiver, Raspberry Pi3 and a Triple axis analog accelerometer. The triple axis accelerometer detects and measures the acceleration in X, Y and Z directions. The data from the accelerometer obtained by the Raspberry Pi 3is transmitted to the robot model using NRF transceiver [6]. This NRF transceiver on the robot receives the data according to which the movement of the robot in a certain direction is determined. The Virtual Telepresence system consists of a servo motor, Raspberry Pi 3, Bluetooth module and a Pi camera. The user controls the movement of the Pi camera using their mobile phone [7]. The degree of tilt of the mobile phone is transmitted over the Bluetooth module to the Raspberry Pi

3.[8] The camera is interfaced with a servo motor which assists rotation of the camera in different directions according instructions provided by the microcontroller. This Pi camera captures the environment in which it is located in and retransmits the visuals back to the user through Bluetooth module.

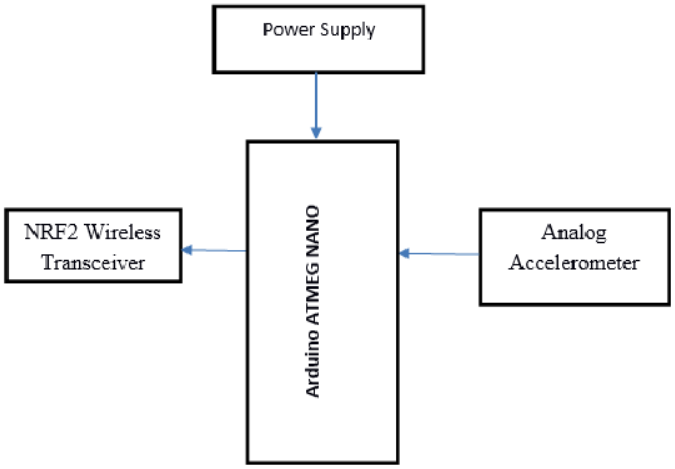

Fig 5.2: Image of a block diagram of gesture control circuit

VI. RESULTS AND DISCUSSIONS

The Gesture Controlled Virtual Telepresence Robot is implemented. Gesture control system is held in hand and based on hand movement x-y plane value changes. Arduino transfers the Accelerometer reading of x-y plane to Raspberry pi through nRF24L01 module. Based on this values robot is guided to move in the given direction. Simultaneously pi camera will live stream the surrounding to the user.

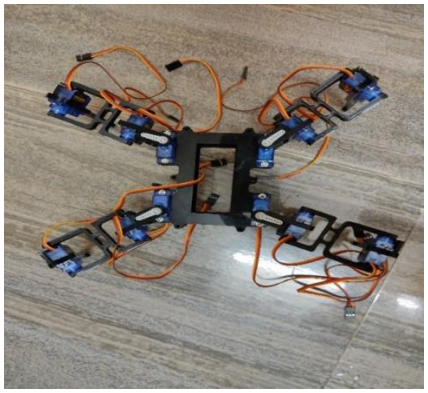

Fig 6.1: Image of the robot setup of servo motor and 3d Printed parts.

The working model of the robot is shown in Fig 6.2 and 6.3. The model is capable of moving in a remote environment and capturing visuals of that location.

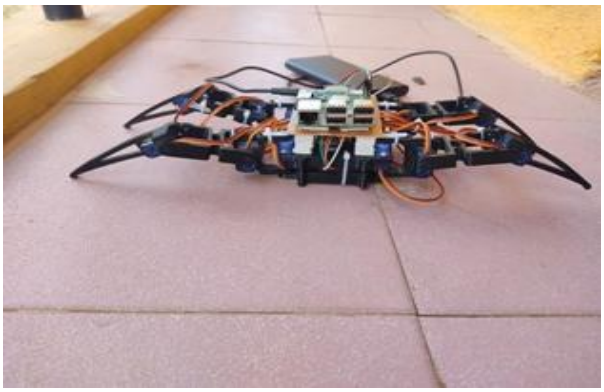

Fig 6.2: Image of the prototype Spi-Bot in resting state.

Fig 6.3: Image of the prototype Spi-Bot in standing state.

Fig 6.4: Image of Spi-bot with camera climbing uneven surface

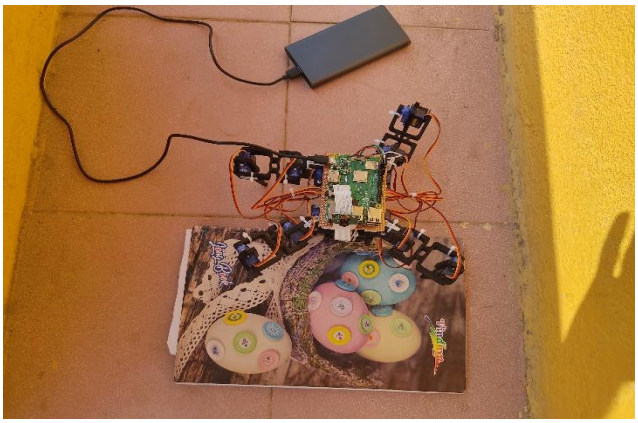

Fig 6.5: Image of Spi-bot top view

The visuals captured by the robot is shown in Fig 6.6 and 6.7. These visuals can assist the user to efficiently monitor the robot location and control its movements accordingly.

Fig 6.6: Right view image captured by the Pi – Camera of the Spi-Bot.

Fig 6.7: Front view image captured by the Pi – Camera of the Spi-Bot

VII. APPLICATIONS

- **Military purposes:** -Can be used to give real-time training, can be used for spying and to explore enemy territory.
- **Mining:** - Can be used to monitor mines.
- **Medical:** -Can be used to monitor patients in a hospital.
- **Education:** -Can be used to give real time learning experience.
- **Gaming:** -Can enhance one's experience while gaming.
- **Agriculture**:-Robot can be used to monitor the agriculture crops and field.

VIII. CONCLUSION

In this paper, a detailed report of a Gesture Controlled Virtual Telepresence Robot is successfully demonstrated. The robot model is capable of accessing remote locations and capturing its surrounding through the in-built camera. This robot is very usefuland can be used for multiple applications.

IX. REFRENCES

[1] Deepanjali, Ranjini, Ruchi, Shweta, and Ranjini Keshri , *"Android Controlled SPY Robot with night vision camera"*.

[2] Singh, Akash, Tanisha Gupta, and Manish Korde. "Bluetooth controlled spy robot." 2017 International Conference on Information, Communication, Instrumentation and Control (ICICIC). IEEE, 2017.

[3] Hasan, ASM Shamim, et al. "Smartphone Controlled Spy Robot with Video Transmission and Object Collector." International Journal of Engineering and Manufacturing (IJEM) 7.6 (2017): 50-58.

[4] V.Arun, S.V.S.Prasad, G.Sridhar Reddy, L.Ruthwik Reddy, M.Venkatesh and M.Sai Pavan Kumar,

[5] "Arduino Quadruped Robot".

[6] [5]Kato, Yuka. "A remote navigation system for a simple tele-presence robot with virtual reality." 2015 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). IEEE, 2015.

[7] [6] E-PLACEMENT ACTIVITY MANAGEMENT SYSTEM, M.GAYATHRI, A.SHARMILA, S.VEERALAKSHMI, R.YUVASHREE, V.SOWMITHA, International Journal Of Advance Research In Science And Engineering http://www.ijarse.com IJARSE, Volume No. 10, Issue No. 04, April 2021 ISSN-2319-8354(E).

[8] [7] Srinivas, G., Gowda, H. C., Harshitha, V., Shankar, H., & Vidyasagar, K. N. (2020, December). Biofeedback Glove for Stroke Rehabilitation Therapy. In 2020 Third International Conference on Advances in Electronics, Computers and Communications (ICAECC) (pp. 1-6). IEEE.

[9] [8] Pawan, C. T., S. H. Shivaraj, and Manjunath R. Kounte. "RFID Characteristics and Its role in 5G Communication." 2020 4th International Conference on Trends in Electronics and Informatics (ICOEI)(48184). IEEE, 2020.

[10] [9] Pawan C T, Thushal Y, Swasthik M, Prof. Rashmi Priyadarshini B K, Charan Raj M B, "Development of System for Human Emotional Analysis Using Facial Recognition Technique", IJAST, vol. 29, no. 10s, pp. 7782-7790, Jun. 2020.