Design And Implementation of Haptic Tele-Existence Transatlantic Robot

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The main purpose of the project work is to design and develop a robot that is driven into motion using a wireless system by recognizing the hand motion that is controlled by haptic technology for the virtual climate. The distant person can connect with the robot through a wireless medium. This interaction can be enhanced by haptic technology as the user can directly manipulate virtual objects and obtain immediate haptic feedback. The process will progress simultaneously on both sides. As the remote person moves his hand, the robotic arm is also moving in that direction at the same time or with a delay as low as possible at minimum time lag. The user can see the working of the robot on his laptop or mobile phone through an application. Hence, the user can feel his existence at the place where the robotic arm is installed for operation.

Keywords: Haptic, Transatlantic, Robot, intelligent, teleexistence

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1. Introduction

Engineering Science which deals with designing, modeling, controlling, and robot utilization is known as Robotics. The main objective of robotics is to build an intelligent machine that can help humans in various fields. Nowadays robots play the main role in everyday life and take over people's daily routine procedures. Robots are settled as gadgets that have a definite variety of usages. The paper focuses on the design and implementation of a robot's arm and then controlling it by a person's arm using haptic technology.
Haptics is the science of applying touch sensation and control for interaction with physical and implicit applications. Haptics is one of the developing areas in the human-computer association that deals with the sensory interaction with computers. The word haptic comes from the Greek word haptikos which means tactual and concerning the sense of touch. Haptic is utilized in engineering to create a virtual environment. It is a palpable technology that holds the benefit of the feel of touch by applying motions, forces, or vibrations to the user.
Haptic-based systems have a primitive role and in various cases, they are the starting point for the transformation of robotics in all the areas where force feedback from the robot is a dominant issue for the success of the robotic tasks.

Our research is concerned with modifying the tools and principles needed to recognize human-machine systems and advanced robotics capable of haptic interaction. The project is divided into two modules namely, the Haptic glove (Transmitter) and Robotic arm (Receiver).

2. Literature Review

Some of the relevant literary works in this field are briefed below:
Katsunari Sato and Kouta Minamizawa developed inventive devices and created a master-slave system to recognize "Haptic Tele-existence". Human interaction will be fiercely advanced by this perception that grasps us of the properties of matter. [1]

The research work performed by Ankit Purohit and Makarand Kakatkar described the Tele-operation system with the help of haptic technology, a user manages the movements of a robot that is placed at some location. [2]

Vipul J. Gohil and Dr. S D. Bhagwat described the main aim of the project is to construct and developing a Robot that is used to move using WI-FI by perceiving hand motion that is conducted by haptics technology for virtual surroundings & human-machine system. [3]

Ahmed S Ali and Mohamoud A. Hussein worked on the advancement of a Robotic Arm with haptic technology. This system has a device to measure the location when the master system connects with a virtual or real object. [4]

Sanjay Kumar and Deepak Jaiswal designed the robotic arm by observing hand motion. The main idea is to devise electric signals using the sensors on the haptic device which work as transducers and switches hand motions into electrical signals. [5]

Avi Kumar R, Papiya Mandal, Preethi K S, Ranjitha N, Nishkala designed and developed the Robot that is used to move using wireless system by recognizing hand motion that is controlled by haptics technology for virtual environment & human-machine systems capable of haptic interaction. Without risking human life or limb, this research has applications in many areas. [6]

3. Proposed Methodology

"Haptic Tele-existence" intends at exploiting highly practical haptic interaction among humans and articles placed in remote places. To observe a captive hand with fulfilling portability and a master hand that can engage the captive hand easily are required. In this paper, we designed a robotic arm using WI-FI by perceiving hand gesture that is composed of potentiometers for the virtual environment & human-machine interaction.

3.1 Schematic Diagrams

The Schematic Diagram of the Transmitter is given below:

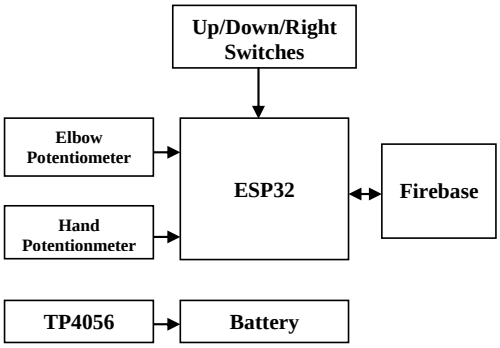

Fig.1. Block Diagram of Transmitter Side

The Schematic Diagram of the receiver is given below:

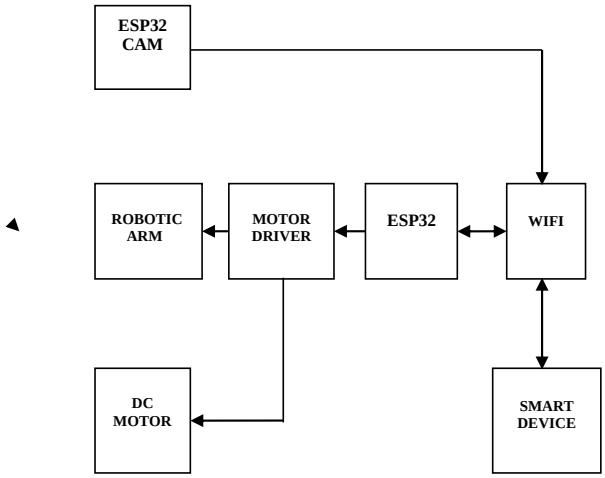

Fig.2. Block Diagram of Receiver Side

(a) Description

The Robotic Arm is anticipated to apply an ESP32.C- The embedded program is uploaded into the ESP32. The code is coded into Arduino IDE software by downloading an ESP32 library into it.
The project is divided into two parts:

(i) User Hand Glove
(ii) Robotic Arm

(i) User Hand Glove: The user Hand Glove consists of two potentiometers. One is hooked up to an elbow and the other one is hooked up to the hand. ESP32 is assembled which sends the data to firebase. The data is collected by potentiometers. The potentiometers conduct the movement of the hand and an elbow. Four push buttons are tagged on the hand to control the directions of dc motors.

Fig.3: User Hand Glove

(ii) **Robotic Arm**: On the robotic side, there is a haptic arm that consists of a servo motor. Four DC motors are connected which provide the motion to the robot in four directions. A haptic arm is assembled at the center of the board to the ESP32 which receives and reads the required data from the firebase. As a result of this whole process, A robotic arm can move and pick any lightweight item according to the remote user's desire. The alteration of the robotic arm is fully held by the User.

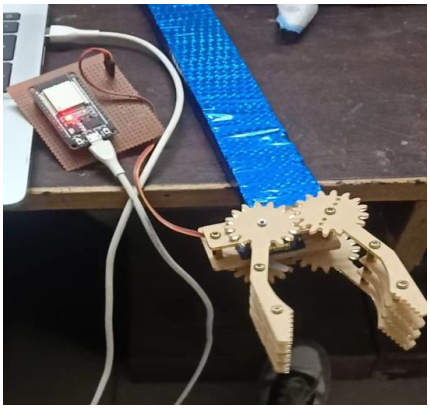

Fig.4. Robotic Arm

The methodology used for this project is clearly understood by the following flow charts:

(1) The strategy used for a Remote User

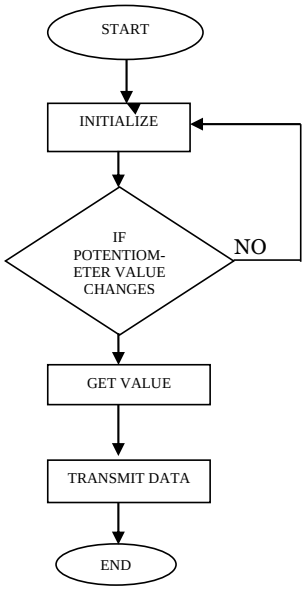

Fig.5. Flow Chart of Remote User

(2) The strategy used for Robot

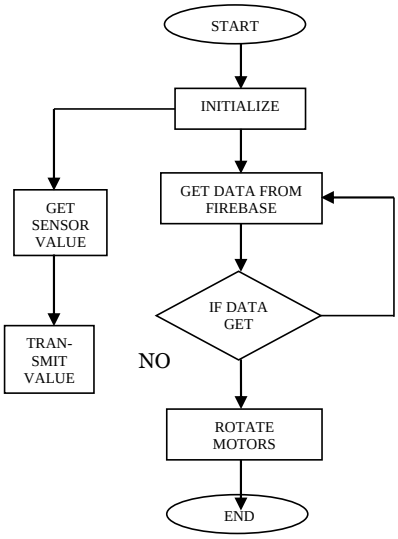

Fig.6. Flow Chart of Robot

4. Result

We have established a robot that does the task based on haptic technology. The robot receives the commands from the user's hand which is at any other location throughout the world. The potentiometer which is assembled at the transmitter side will provide the gesture to the robotic arm.

The Haptic Robotic Arm was auspiciously constructed and implemented. All the activities of the robot will be captured by an ESP32CAM and then the required information and live video can be received by a remote user. The operations are done by a haptic robot according to the remote user are given below:

TABLE 1: Range: Worldwide

User Hand movements	Robot Activity
Elbow will move upwards	The robotic arm will move upwards within 0^o to 90^o
Elbow will move downward	The robotic arm will move downwards towards 90^o to 0^o
Opening the hand	The gripper will open within 0^o to 180^o
Closing the hand	The gripper will close towards 180^o to 0^o
Pressing the push button 1	The robot will go in the forward direction
Pressing the push button 2	The robot will go in the backward direction
Pressing the push button 3	The robot will rotate in the right direction up to 360^o
Pressing the push button 4	The robot will rotate in the left direction up to 360^o

5. Conclusion

We can conclude that in this paper, A Haptic Arm Robot is designed with the simplest mechanism and reliable components to examine the haptic technology-based structure that will be helpful in the military area, Medical field, Industrial purposes, and in hazardous situations etc. This robot can be sent to a place where a human's reach is fraught with danger. For example, where the bomb is implanted and activated, we can deactivate the bomb by sending and controlling this robot from a remote location.

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