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THE IRON FIST

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ABSTRACT

The COVID-19 epidemic has spread worldwide. The epidemic is a major challenge to the health and safety of the general public, medical staff, and the global medical system. It has been proposed worldwide to use robots during the epidemic, improving patient treatment, maintaining social isolation, and decreasing the burden of the medical system. In this paper, we employ the hand of a robot that helps to clone the actions of the end user's arm and hand. Based on the gesticulation of a human hand, the robot handles the function and repeats the movement of the human hand. This robotic arm is highly adaptable and highly suited for medical and military purposes during the COVID-19 epidemic when the environment is unsafe for humans. There are various ways to control the robot arm. This paper is about motion replication based on flex sensors, gyroscopic sensor, and IOT, operating the robotic arm wirelessly.

KEYWORDS

Arduino, ESP8266, IOT, Glove.

1. INTRODUCTION

This mechanical arm and hand is a scientific, engineering, and technological breakthrough that replaces (or duplicates) human actions. Robotics has created a great impact on our society and retains its place in all fields such as Engineering, medicine, Space science, and many more. As suggested by the researcher of the "A literature survey of the robotic technologies during the COVID-19 pandemic" the use of robots in the Medical sector is a global need for the betterment the treatment of the patients and to maintain effective and better social isolation during the span of COVID-19 pandemic[1]. The engagement of the Robotic system can be done by any kind of analog controller & the one that we are using is the Arduino controller. Arduino is a small open-source controller that can be easily edited, deleted, and can be reset at any time [2]. The wireless transmission comes into action for transferring the signal from one end to another. For wireless transmission, we use the ESP8266 module, which is used for communication when the transmission and the receiving end is not bound by any electrical conductor. There are various protocols that are used for wireless communication such as ZigBee, Bluetooth, Infrared and Wi-Fi technology. The one that we are using is Wi-Fi technology because this means of wireless communication is more flexible and adaptable.

2. LITERATURE SURVEY

Some of the recent studies show about the gesture sensing the robotic arm. And also gives information about the wirelessly controlled robotic arms.

A. Jenifer, V. Deepak[3], have created a robotic hand-operated robot arm that effectively translates hand gestures into arm movement. The aim of this project is to reduce humanly efforts to control the robotic

environment, use remote wearable controls, and thus transfer higher calibrated and refined output performance.

Ovidiu Vermesan, Roy Bahr, Marco Ottella, Martin Serrano, Tore Karlsen, Terje Wahlstrøm, Hans Erik Sand, Meghashyam Ashwathnaryan, Micaela Troglia Gamba[4], presented an idea of IoRT (Internet of Robotic Things) where collaborative robots can interact with other objects and accelerate practical usage development. The paper was produced for participating researchers and developers in IoT environments, robots, wireless communications, and software technologies.

Mehnaz Kazi, Michelle Bill[6], developed a fully functional robotic hand-controlled glove using wireless communication. They make use of flex sensors and servo motors to achieve the desired results. The aim was to investigate how the robot's hand could mimic the movement of a user's controlled glove and grip too, both with wireless communication.

S.S. Dheeban, D.V. Harish, A. Harivignath, M. Prasanna, N. Senthil Kumar[7], developed a motion mimicking robotic arm. The proposed had an Arduino controller, the sensing glove, and the robotic arm. This paper is about accelerometer-based motion recognition to control the arm's movement with wireless controls using the Zig bee protocol.

3. METHODOLOGY

Proposed method targets to construct a gesture sensing and mimicking the robotic arm that effectively replicates hand movements into ARM robotic movements. The Flex sensor embedded over a glove will send a command to the robotic hand over a wireless network through ESP8266 module using IOT.

The developed model is cleaved into 2 portions as Transmitting section and Receiving section. Figure 1 shows the block of the entire environment setup, i.e., active user hand positioning and movement identification, transmitting the signal over the cloud server and robotic manage. On the bases of gesture or signal transmitted to the cloud server, the mechanical robotic hand mimics the similar positioning and movement as done via hand.

Hand gestures will be transmitted using a flex sensor embedded on a wearable glove, on a cloud server with a wireless protocol using the ESP8266 module. The cloud will continue to transmit signal to the robot. The transmitted signal is then detected by the robot using another ESP8266 module. After receiving, the robotic hand replicates the gesture of the wearable glove.

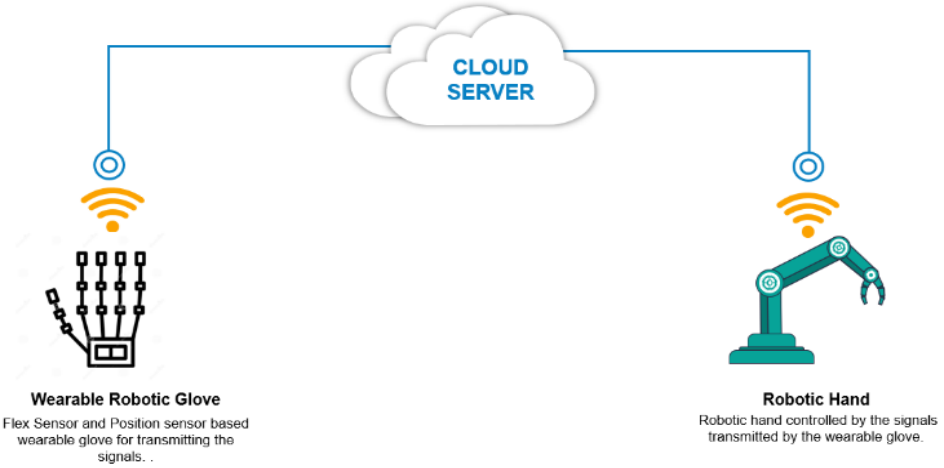

Figure 1. Block Diagram of the entire robotic environment

3.1 Transmitting End

The transmitter end consists of the five flex sensor (one sensor per finger), position sensor, Arduino UNO, the ESP8266 module for sending the signal to the cloud server. The whole system is embedded over a wearable Glove.

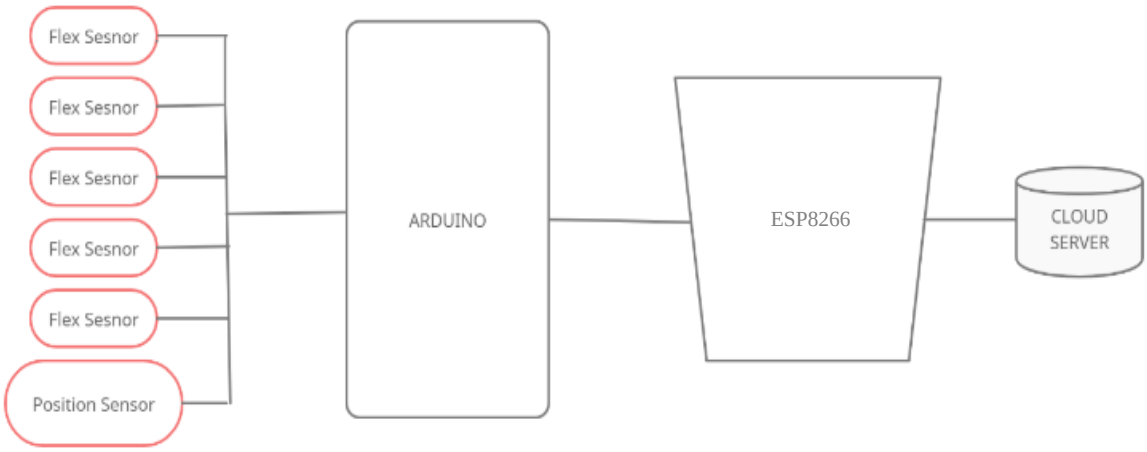

Figure 2. The Block diagram of the transmitting end

3.2 Receiving End

The receiving end consist of the ESP8266 module to receive the signal from the cloud sever, Arduino UNO, Servo controller to control the servo motors present in the robotic hand for the movement of the fingers of the robotic hand, and the five servo motors.

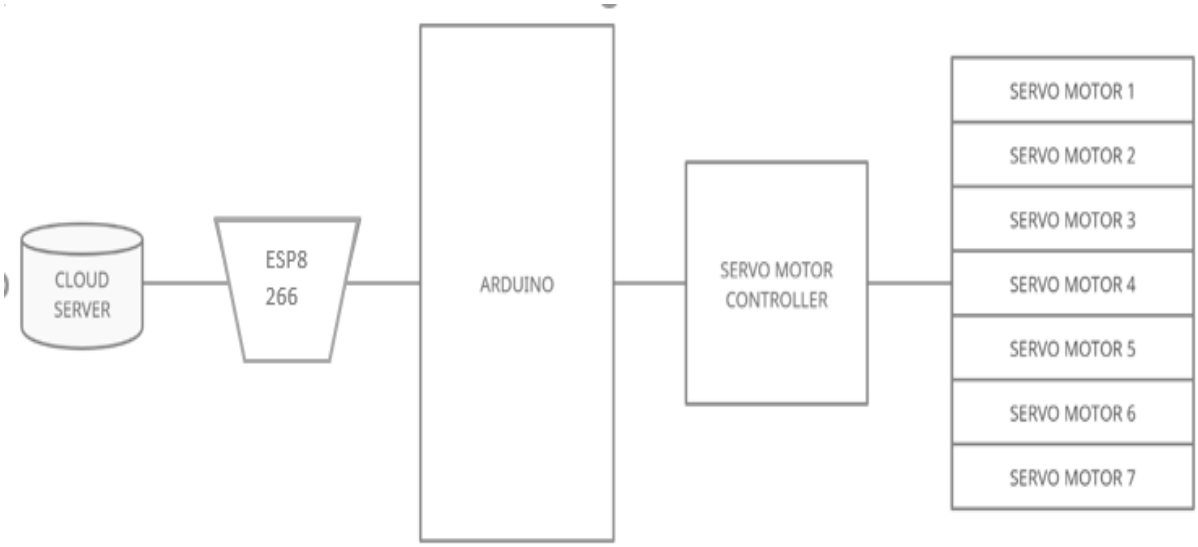

Figure 3. The Block diagram of the receiving end

It requires two 3.7V power supply to be used in each phase. Arduino UNO will learn analog output values from flex sensors and will convert analog values into digital values. The virtual values might be processed by the means of Arduino UNO and may be despatched to Wi-fi module that's obtained by the Receiver and might be processed at the receiver end which drives the motor to the unique direction. The whole system block diagram for controlling the robot hand wirelessly. [3]

4. IOT

The main objective behind this robotic hand is to provide extra help to the medical and military sectors during the pandemic. The robotic hand is manually controlled by the doctors and the military men to maintain social distancing to eliminate the contamination of the virus and to avoid fatality at the border. This manual control over the robotic hand can be achieved through IoT(Internet of Things). IoT robots are known as IoRT (Internet of Things Robots). IoRT empowers robotic devices in different

environments to become active participants in different systems and to share information with other robotic devices, IoT / IIoT devices, and humans. Robotic objects are able to detect events and changes in their environment while they are automated and respond appropriately. These capabilities enable the integration of real, digital, virtual, cyber robotic objects, and the creation of intelligent environments that make robotic objects in power, mobility, architecture, manufacturing, and other fields extremely intelligent.[4]

In this proposed project we have used IoT as the platform for transmitting and receiving signals wirelessly. The transmitting end (wearable Glove) transmits the gesture of the human hand as the signal to the cloud server and the cloud server further transmits the input signal to the receiving end (Robotic hand). Here we have used Firebase as the cloud server. This clod server(Firebases) acts as a communication gateway between the transmitting end and the receiving end.

5. WIRELESS COMMUNICATION

We use Wireless communication to transfer information from one place to another without the use of live connecting cables, wires, or any other physical object. The IoT-based wireless communication protocol that we are using is Wi-Fi(Wireless Fidelity). Wi-Fi is the most popular IoT communication protocol.ESP32 and ESP8266 are the most commonly use Wi-fi modules for embedded applications.

ESP8266- The ESP8266 is a low-cost Wi-Fi microchip, with built-in TCP / IP communication software, and minimal, manufactured control capabilities. [5]

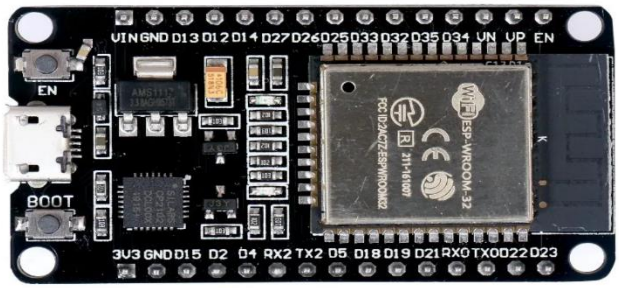

Figure 4. ESP8266 module

In this proposed embedded system two ESP8266 modules have been used, one at the transmitting end and the other at the receiving end. The ESP8266 module at the transmitting end will transmit the signal wirelessly to the cloud server(Firebase) and the ESP8266 module will receive the signal at the receiving end wirelessly from the server. This is the wireless communication flow between the transmitting and the receiving end.

6. HARDWARE REQUIREMENT

The Hardware requirement for the proposed concept containing the following constituents: -

The Transmitting End (Wearable Glove) and the Receiving End (Robotic Hand).

6.1 Design of Wearable Glove

The wearable glove is the transmitting unit of the system. The Flex sensor and the position sensor are embedded over the glove. The glove is the controller of the robotic hand consists of five flex sensors. Each finger is operated by a single unit of flex sensor. These flex sensors and Gyroscope are embedded onto the glove and further communicating with the Arduino UNO.
By mapping, the flexible resistance of the flex sensor to the rotational level in servo motors of both expansion and hand flexibility is achieved. The control glove is made wireless by connecting the

Arduino UNO to the ESP8266 module. The Arduino UNO glove controller is powered by an external power source of 3.7V.

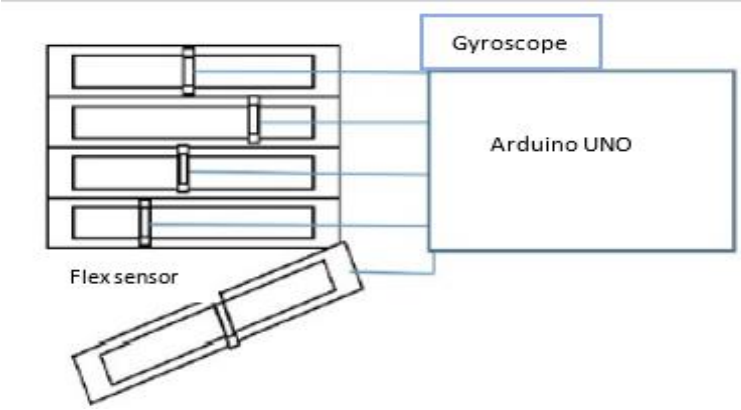

Figure 5. Design of Wearable Glove

6.2 Design of Robot Hand

The fabrication of the mechanical assembly included the design of the robotic hand and arm, and the design of the fingers. The arm was constructed by having a metal plate as its base. All the five fingers are screwed together to form the hand. The servo motors are connected to the fingers and these precise controlled motors are behind the action for the up and down action of the arm and the hand. The entire body of the arm is made of thick aluminium plates that are light in weight and support the weight of the palm and fingers. The fingers move in such a way that the whole hand can hold and handle an object. So the weight of the finger should be as light as possible and the structure should be stiff and not weak. Springs were used for finger formation. At the top of each finger, zip ties were attached to make the fingers work. The zip ties are then attached to servo motors which are mounted on the arm body.[7]

7. SOFTWARE REQUIREMENT

The software used for the configuration of the Arduino and ESP module is Arduino IDE. Arduino IDE Arduino software. Used for coding, compiling code to check for errors, and uploading code to Arduino. It is a cross-platform software available on all Operating Systems such as Windows, Linux, macOS. Supports C / C ++ language

8. RESULT

The robotic hand works with five servo motors. The robotic hand successfully sensing the hand gesture and replicating them. It is able to do grip, left, right, downward, upward, forward, backward motion. The proposed system is successfully transmitting the signal to the server and successfully receiving the signal from the server.

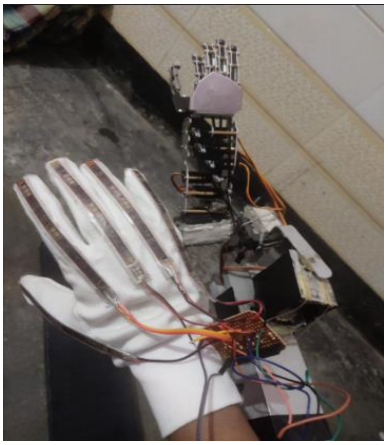

Figure 6. Working system

9. CONCLUSION

This proposed gadget, named IRON FIST is able to successfully sense and replicate the gestures of the hand. In the rough time of COVID-19 this Iron fist gives an alternative and safer way of performing medical and military based task. It also involves Wi-Fi protocol for wirelessly sending and receiving data from the glove and the robotic hand. The configuration of ESP8266 module is done on Arduino IDE software for wireless communication. The wireless control of this gadget make it more easy and efficient.

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