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DESIGN OF ROBUST ROBOTIC ARM BY LEARNING AND MIMICKING THE HUMAN HAND GESTURE

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Abstract: **In the recent scenario, employing robots for handling precise tasks were seen in abundance in industrial, medical and rescue operations etc., Hand gesture controlled Robotic arm is a robotic arm which can be controlled by simple hand gestures. This work presents the development of a wireless, low cost, wearable sensor glove for the purpose of controlling a robot arm by mimicking the motion and behavior of a human's hand. The system is comprised of a wearable glove which is embedded with Accelerometer and flex sensors to detect and track the wearers hand movements and behavior. The usability, accuracy and precision of our glove system is evaluated and the results demonstrates that our system is more accurate and easier than a conventional robotic arm joystick controller.**

Keywords: **Microcontroller, Accelerometer, Flex Sensor, ZIG-BEE Module, Robotic Arm.**

I. INTRODUCTION

A real-time visual hand tracking and posture estimation system to guide a robotic arm in gripping gestures. Presenting an original degree-of-freedom model of the hand, for which forward and inverse kinematics formulations have been developed. The hand, wearing a glove with sensors helps in completing a grasping task. The position of the hand is used to reconstruct the robotic arm's pose. Occlusions are handled by position prediction and validation. A robot gripper can then be guided by the different configurations of the hand with respect to the object to be grasped, provided the relationship between the hand and the gripper is known.

Most of industrial robots are still programmed using the typical teaching process, through the use of the robot teach pendant. The aim is to alternate the existing robotic arm available in the industries and hospital and to introduce new and easy way of handling it. This reduces the time complexity of user to learn the methodology of controlling and handling the robotic arm.

The goal of this is to allow a human to control a robot in a situation where it is inconvenient or unsafe to place a human and difficult to program a robot to autonomously perform complex operations. Now many industrial tasks demand the robot to perform more complex and difficult works. The aim is to present some experiences from the use of accelerometers to flexible mechanical systems.

II. MOTIVATION

To provide comfort to human kind in a wireless fashion rather than difficult, unsafe or bore for a real person to do alone.

III. EXISTING SYSTEM

The existing system of robotic arms were pre-programmed and controlled with use of joystick or lever. The pre-programmed robotic arm is used in industries to do specified tasks like lifting and assembling of materials. Joystick or lever control is used in heavy object lifting, handling of hazardous material, surgery etc.

IV. PROPOSED SYSTEM

A real-time hand tracking and posture estimation system to guide a robotic arm in handling and gripping gestures. The human, wearing a glove with sensors on it helps in completing a grasping task. Position of the human hand is used to reconstruct the robotic arm's pose.

A. POSITION ESTIMATION:

The accelerometer present in the glove used to estimate exact hand position and produces corresponding XYZ voltage.

B. BEND ESTIMATION:

The flex sensor in index finger of glove used to detect the bend of the finger.

C. ROBOT CONTROL:

The accelerometer value is taken for controlling robotic hand position and flex sensor value taken for controlling gripper closure for picking objects.

V. SYSTEM DESIGN MODULE

The system design module used for Wireless controlling robotic hand using flex sensor and Accelerometer is as shown in below figures.

- *Figure 1 - Master(glove part)*
- *Figure 2 - Slave(Robotic part*)

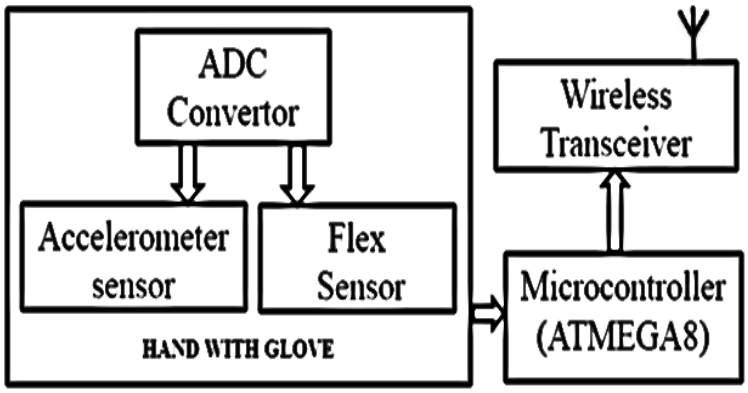

FIGURE: 1 (GLOVE PART)

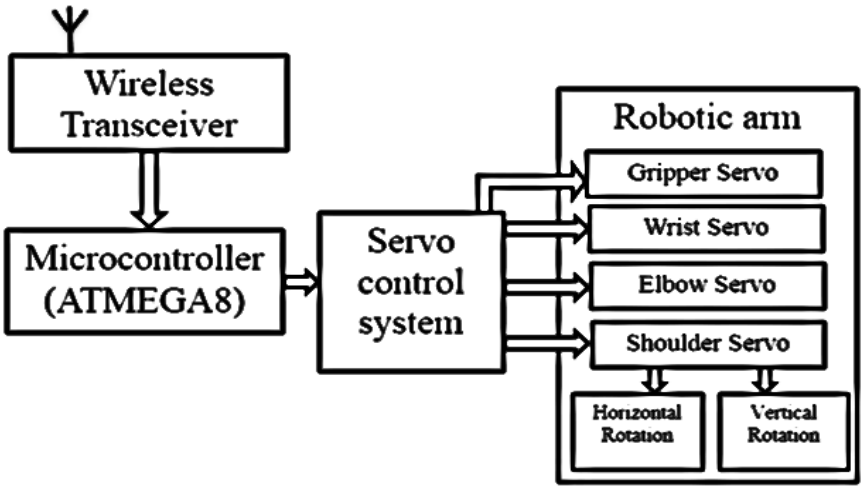

FIGURE: 2 (ROBOTIC PART)

VI. METHODOLOGY

Controlling the movements and position of arm robot with human hand gestures includes two categories. Parts attached to the gloves in the hand and parts of the robotic arm. The glove consist of three major components namely.

- Accelerometer,
- Flex sensor and
- Wireless transceiver

A. ACCELEROMETER

The accelerometer is the one which used to prescribe the exact position of glove in space. The output of accelerometer is analog voltage from three pins based on xyz positioning.

B. FLEX SENSOR

Flex sensor is stick like structure has the characteristics of changing the resistance value when stick is bent with different stress. Flex sensor connected in the glove use to control the gripper. When the forefinger bends to pick an object the resistance varies and used to close gripper.

C. WIRELESS TRANSCEIVER

The signal output of the accelerometer and flex sensor is transmitted through wireless transceiver. The block diagram of the glove part is shown in Figure 1 describes the conversion of analog to digital data through controller and then converted to serial data and transmitted wirelessly.

The robotic arm consists of three major components namely,

- wireless transceiver,
- microcontroller and
- servomotors

WIRELESS TRANSCEIVER

The signal received by wireless module from the glove is processed in microcontroller. The positioning of all the servo motors is controlled with the help of microcontroller here.

There is a gripper used to hold the object which is also controlled with servo. At first the hand movement and its position is predicted using accelerometer and transmitted through wireless transceiver. The received signal from the wireless transceiver is transferred to the microcontroller.

MICROCONTROLLER

Then microcontroller controls the servo motor and gripper. The block diagram of the robotic part which gives the detail of individual servo present in the robotic arm is shown in Figure 2.

SERVO MOTOR

In general robotic arm consists of seven servos for different positional movements. The base servo used to horizontal rotation, two shoulder servo present is used to lift the robotic arm vertically. Elbow and wrist servo is also vertical used for partial bending and vertical lifting. The gripper servo used to open and closure of gripper. This used to hold the object to be lifted. The base servo to elbow servo have 15 kg/cm of torque and other have 7.5 kg/cm of torque.

VII. ALGORITHM AND FLOW CHART

1. Start the process.
2. Read the accelerometer and flex sensor values.
3. Send the data wirelessly through Xbee transmitter.
4. Receive the data wirelessly through Xbee receiver.
5. Process the data and send to the servo via AURDUINO.

6. Stop the process.

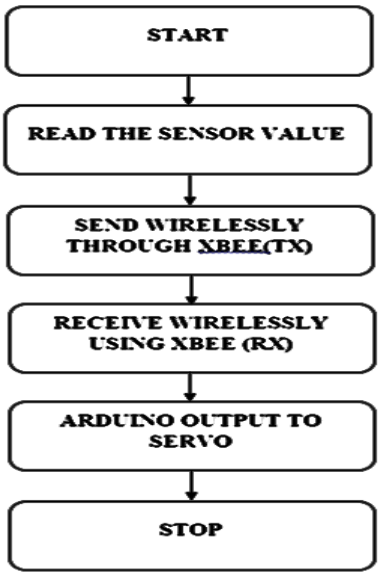

FIGURE: 3 (FLOWCHART)

VIII. CONCLUSION

Nowadays, robotics are becoming one of the most advanced in the field of technology. The application of robotics mainly involve in automobiles, medical, construction, defense, etc.so, This project is designed in order to control the robotic arm with simple human hand gesture using accelerometer and flex sensor.

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