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HELPING HANDS - ANTHROPOMORPHIC ROBOT HAND

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Abstract — Helping hands (Anthropomorphic Robot Hand) is a robot hand that can simulate the human hand action. Preprogrammed robot can perform only the programmed activities and it do not perform some actions that human can perform. The design and control of robotic hands are high challenge in recent years to solve many of human needs. To solve this problem human action can be given to the robot as input and can perform task as human without presence. In the proposed system the flex sensors play an important role in controlling the robot hand. The movement made by the humans are sensed by the flex sensor and the input is provided to the servo motors. The servo motor moves the robotic hand to reflect the same movement as provided by the human. A prototype of robotic hand has been designed and tested under various conditions.

keywords— Anthropomorphic, Arduino, Flex Sensors, Helping hand, Servo Motor, GNU, IDE

I. Introduction

Humanoid robots [1] will perform a set of robot hand has created an interest for the researches to investigate and to realize the dexterous manipulation complicated tasks based upon the human communication. These humanoid robots will be equipped with anthropomorphic robot hands much like the human hand. [2] Designing such an anthropomorphic hand had been a challenge because of their freedom and it has only a limited payload. These challenges result in lack of actuator power, lack of durability, and poor maintainability. To overcome such issues of anthropomorphic robot hand, a novel mechanism of robot hand with detachable passive wire mechanism and hydrostatic actuator cluster has been developed. [3] An anthropomorphic robot hand is a modified version of Gifu Hand II which is now called as Gifu Hand III. For robotics research The Gifu Hand is aimed to be used as a platform of robot hands. [4] For more than twenty years the development of versatile and dexterous robot hands has been an important activity in various research institutions worldwide. The main aim for this activity is to study and analyze robotic grasping and manipulation, with the long-term goal of improving the art in artificial manual dexterity. [12] The mechanism, design, and control system of a new humanoid-type hand with human-like manipulation abilities has been discussed. The hand is designed for the humanoid robot which must work autonomously or interactively in cooperation with humans.

II. Related Work

The design and development [5] of a Four Fingered Robotic Hand (FFRH) using 8-bit microcontroller, sensors and wireless feedback is discussed. This system is based on a simple, flexible and minimal control strategy. The robot system has some certain commands to open, close, wrist up and down. [6] Developing a low-cost, low weight and easily manufactural robotic hand with a sensor module and allowing of data acquisition for autonomous intelligent object manipulation will be its main objective. [7] Robots have begun to perform various tasks on replacing the human in the daily life. To accomplish the effective performance, robot hand must have special capabilities, such as decision making, autonomy in unknown situation and stable manipulation of object. [8] The hand has a humanoid appearance while maintaining the precision of a robotic gripper. Since the gripper is actuated with flexible fluidic actuators, it exhibits an excellent power to weight ratio. It also ensures that the hand is safe for interacting with humans. [9] The robot is equipped with a tactile sensor array based on optical transducer technology whereby localized changes in light intensity within an illuminated foam substrate correspond to the distribution and magnitude of forces applied to the sensor surface plane. [10] Anthropomorphism of robot structure and motion is achieved by employing in the design process an index of anthropomorphism. Robotic hands can be easily fabricated using low- cost, off-the- shelf materials and rapid prototyping techniques. [11] During the past few decades, many multi-fingered robotic hands have been developed by various researchers. The main advantages of a multi-fingered robot hand having structural similarity with human hand motivate the need for an anthropomorphic robot hand. [13] The goal of any robotic grasping framework is the generation of a stable grasp that is both, feasible for a robotic hand to execute and suitable for achieving a specific task.

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III.Problem Description

A. Hareware Description:

Flex Sensor

A flex sensor or bend sensor is a sensor that measures the amount of angle or bending. Usually the sensor is stuck to the surface or in fingers, and resistance of sensor element is varied by bending the surface. Since the resistance is directly proportional to amount of bend it is used as goniometer, and often called flexible potentiometer.

Arduino Controller

Arduino is an open source, computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License or the GNU General Public License, permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it-yourself kits.

Servo Motor

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

4M Robot Hand

B. Software Description

Arduino IDE

The Arduino Integrated Development Environment - or Arduino Software contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

IV.Methodology

A. System Design:

In figure1, human input is given to the flex sensor and the flex sensor that can read the angle. The angle that give detected in finger will be monitored by the flex sensor and the input will be converted into values of 0 to 180 degrees. Flex sensor values that can be converted using the map functions in the Arduino. For each finger the values will be customized and optimized for proper movements. Arduino controller that receives the input from flex sensor and convert it into the servo motor angles using mapping functions. Servo motor used in this is 1kg capacity and it is connected to the Arduino controller. In Arduino code is written to read and convert the information into angle.

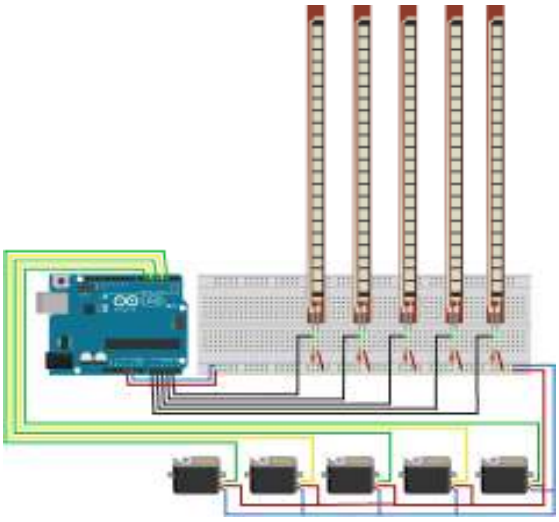

Fig. 1. Arduino and Flex Sensors

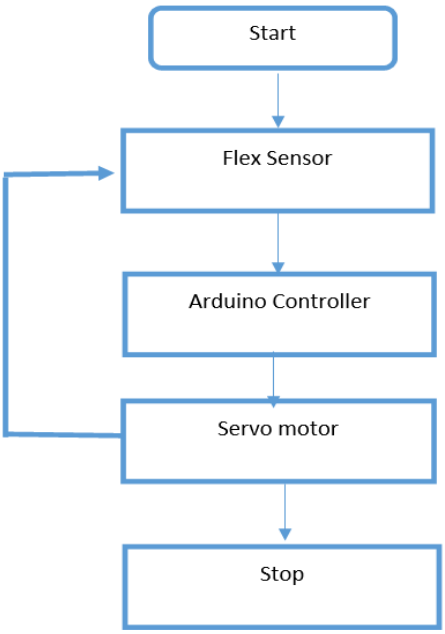

Fig. 2. Flow for working model

B. Implementation:

Hardware Implementation

Helping hands can be implemented using components such as Arduino, Flex sensor, servo motor. In this module we are reading the flex sensor reading and converting the reading into angles and controlling the servomotors.

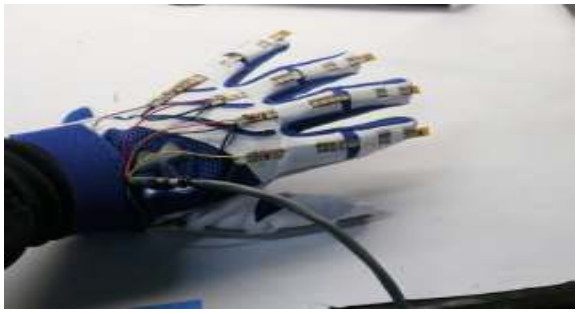

Fig. 3. Helping hand with flex sensors

Fig. 4. Helping hand with Servo motors

Following procedure can be used to implement Anthropomorphic hand, Conversion will be takes place in Arduino code which is compiled in Arduino controller. Anthropomorphic hand can be developed using various methods such as by using motors for each angle movement in fingers which is more weight and needs more power to work.

Also, this method is not suitable for small robot hands. Another method for developing the anthropomorphic hand is using thread for each finger and common motor will relate to each finger. This requires less power and easy to develop for small size hands.

Fig. 5. Helping hand circuit design

Anthropomorphic hand can be controlled by using Arduino controller. In here the Flex sensor will sense the reading and send the reading to the Arduino and the Arduino will sense the reading and convert the value in the format of angles and the angles will be send to the servo motors and servo motors will rotate to the angle by rotating it will pull and release the thread that is fixed with the hand. So, by pulling and releasing the thread the 3D hand will be moved according to the human hand.

Software Implementation:

Using Arduino IDE, flex sensor and Arduino has been controlled. Input which is collected from the flex sensor stored in a variable. The variable used to store is converted into angles using map() function. Arduino map function that converts higher value into different higher value and lower value in to different lower value. Re-maps a number from one range to another. That is,

a value of from-Low would get mapped to to-Low, a value of from-High to to-High, values in-between to values in-between, etc.

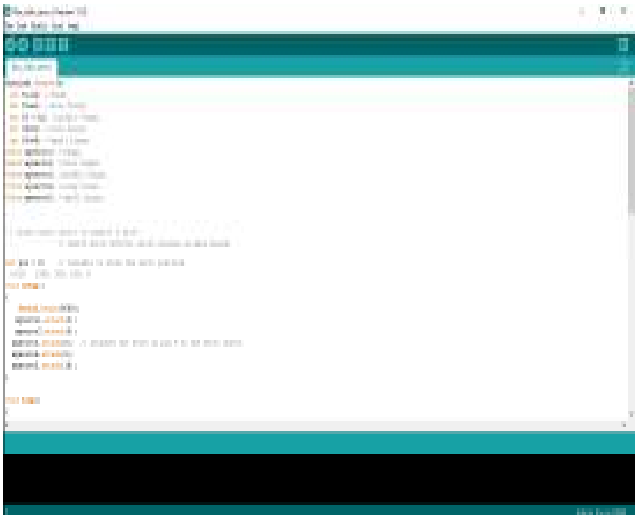

Fig. 6. Arduino implementation

Variable2 = map(flexinput, from-Low, from-High, to-Low, to-High)

Servoobject.write(variable2) ➔ To move fingers from data.

V. Future Enhancement

This project can be improved by fixing the hand in robot and complete input from human can be given to the robot for working like the human. This can be used as substitution to the human being for the hard tasks that human cannot perform physically. This also can be improved by wireless technology and can be used in remote distance without any physical connection between human and robot.

VI. Conclusion

This paper concludes that the Anthropomorphic hand (Helping Hands) is implemented with the help of flex sensor and servo using Arduino controller and hence the robot hand can get input from the human and can perform same action as given by human. This can be used for different purpose of substitution of human with robots.

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