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Design of a Prosthetic Arm Using Flex Sensor

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Abstract: *Prosthesis is an artificial device that replaces a missing body part. In medicine, prosthesis is an artificial device that replaces a missing body part, which may be lost through trauma, disease, or congenital conditions. Prosthetic amputee rehabilitation is primarily coordinated by a prosthetist and an inter-disciplinary team of health care professionals including psychiatrists, surgeons, physical therapists, and occupational therapists. A person's prosthetics should be designed and assembled according to the patient's appearance and functionalneeds.*

For instance, a patient may need transradial prosthesis, but need to choose between an aesthetic functional device, a myoelectric device, a body-powered device, and an activity specific device. The patient's future goals and economical capabilities may help them choose between one or more devices.

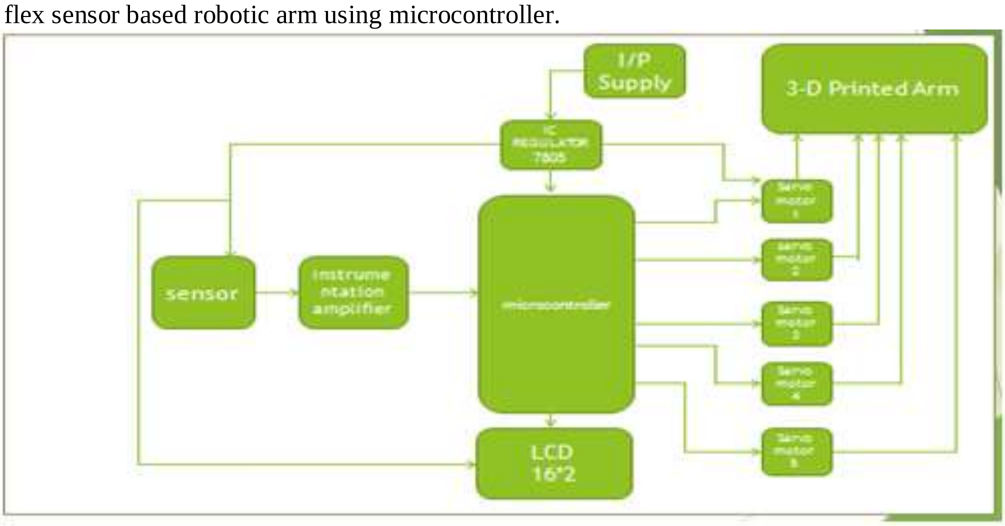
Key words: *prosthesis, flex sensor, data glove, robotic arm, human hand replica.*

I. Introduction

Many people incur an illness or experience an accident that results in the loss of a limb. They may also have been born with a congenital condition in which one or more of their limbs are missing. Fortunately, there are artificial limbs that enable those people to still do things such as run, walk, reach, and grip. These apparatuses are known as prosthetics. A robotic arm is a robot device, which can perform similar functions to a human arm. Robotic arms are the important part of almost all the industries. In industries, a robotic arm performs various different works such as welding, trimming, picking and placing etc. Moreover the biggest advantage of these arms is that it can work in hazardous areas and also in the areas which cannot be performed by human. The main objective of this research work was to design and construct a prosthesis that will be strong and can perform assigned task. The hand is the one of the most complex and load bearing part of our human body which act as an input and output device to human. These goals where targeted by using flex sensor. A sensor a device which detects or measures a physical property and records, indicates, or otherwise responds to it , and sensing plays an important role in robotics. Robotic arm manipulators can have different configurations. Few of these constraints can be effectively mapped from the human arm domain to the robot's restricted joint space. In this paper a general method of mapping human motions to the robotic arm domain has been demonstrated. The arm moment is reciprocated almost exactly by the robotic arm. Any human arm moment can be mapped on to any of the robotic arm manipulator.

1. **Robotic arm using flex sensor and microcontroller:The block diagram consists of sensor, microcontroller, instrumentation amplifier, servomotor, ic regulator, lcd.**

Figure 1 flex sensor based robotic arm using microcontroller.



1.1. Flexsensors

A flex sensor or bend sensor is a sensor that measures the amount of deflection or bending. Usually the sensor is stuck to the surface, and resistance of sensor element is varied by bending the surface. Flex sensor are analog resistors. They work as an analog voltage divider. Inside the flex sensor are carbon resistive elements with thin flexible substrate. More carbon means less resistance. When the substrate is bent the sensor produces resistance output relative to the bend radius. The flex sensor achieves great form-factor on a thin flexible substrate. When the substrate is bent, the sensor produces a resistance output correlated to the bend radius as shown in figure 2. The variation in deflection or bending of flex sensor results in variation of resistance itself. The signal conditioning circuit is used to read these resistance changes and it is given to adc. Adc converts these values into equivalent digitalvalues

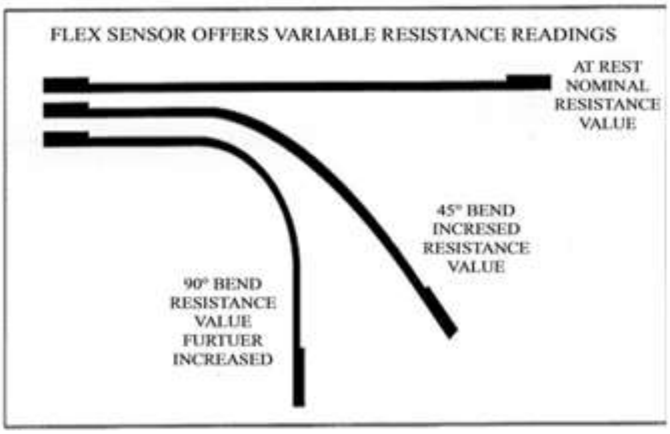


Figure 2 flex sensor bend proportional to varying degree of resistance

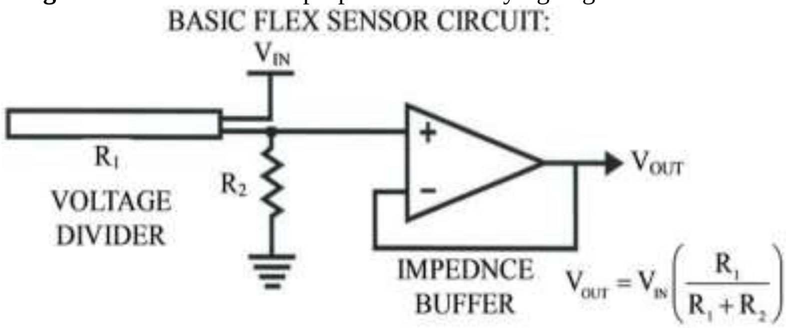


Figure 3 basic diagram of flex sensor

1.2. Microcontroller

the micro controller is responsible for the controlling the action of robotic arm. It receives input variation of the flex sensor through adc, which is given in form of proportional current variation to the motors attached to robotic arm. It consists of four ports (i.e. A,b,c,d). Atmega16 is based on enhanced risc. In this port a is used for the output. Port b is connected to lcd, port d is connected to servo motor.

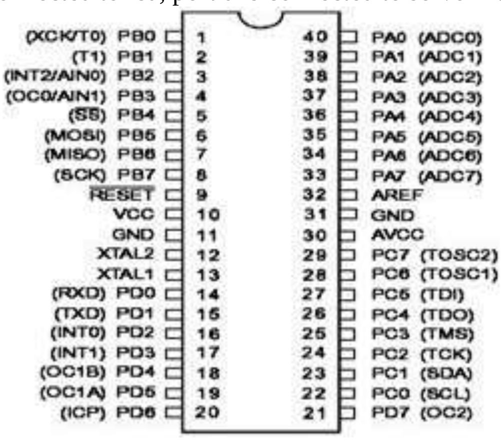


Figure 4 diagram of at mega16 microcontroller

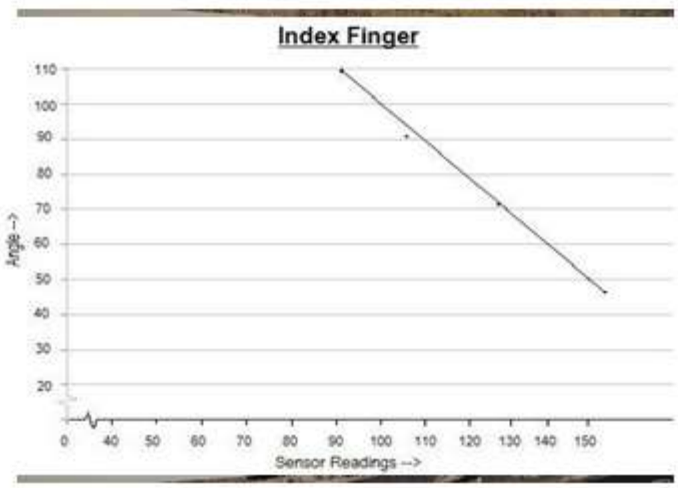
II. Methodology

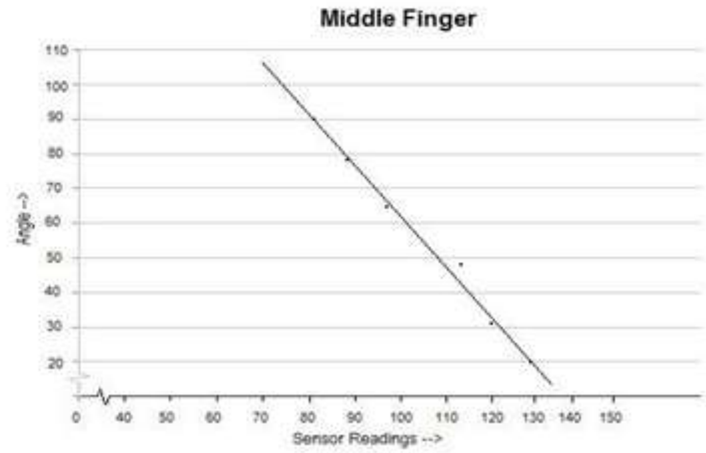
In this design we will be using flex sensor to sense the motion of our fingers. We will be using 5 such sensors that will be arranged in a hand glove, which will make the sensors comfortable to wear. The other part i.e. Mechanical hand will consist of 5 fingers that will be controlled using 5 servo motors i.e. One motor for each finger. All together it will be one hand consists of 5 flex sensor one in each finger. Bend of fingers is analysed using at mega 16 microcontroller and this data will be send to another port via serial communication, the microcontroller will generate appropriate pwm signals for controlling servo motors. The complexity of the project is reduced by properly categorising the whole project into sub design. It makes it to make a better design and work effectively. The readings of each fingers where measured in the form of voltage, while the movement of each fingers will be given with respect to angle. Thus to relate voltage with respect to angle we plot the graph of each finger and then we get a linear graph. By calculating equation of each line we can relate each other easily. Then by knowing only one of the value we can calculate another value very easily. This equation will be then feed to code of microcontroller connected in sensor unit then it will generate appropriate angle for respective finger. Ones it is done all data will be formatted in particular packet so that it will be easily handled and send over serialport.

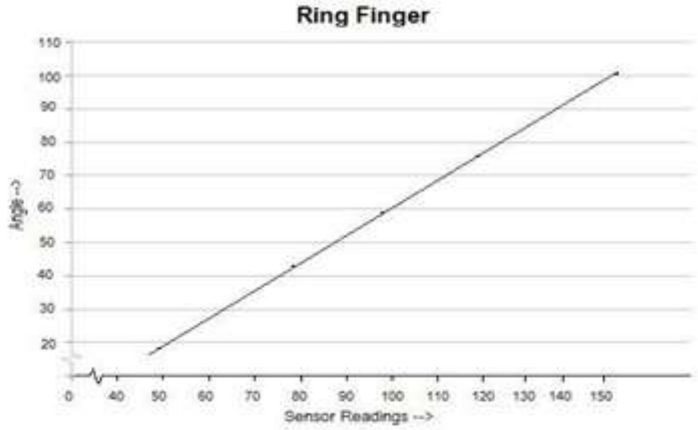
Figure 5 experimental setup

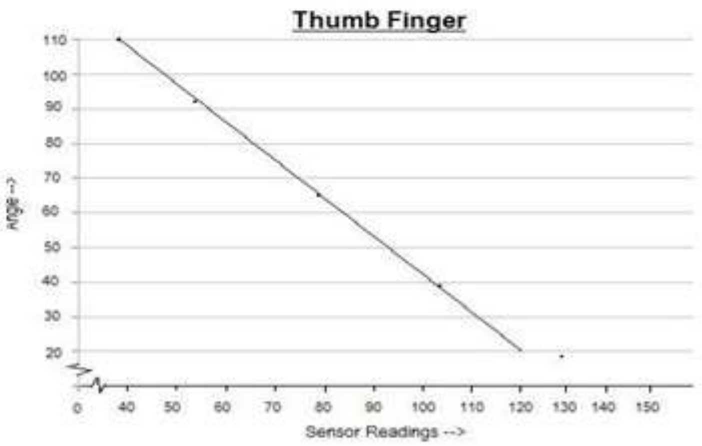
1. Graphrepresentation

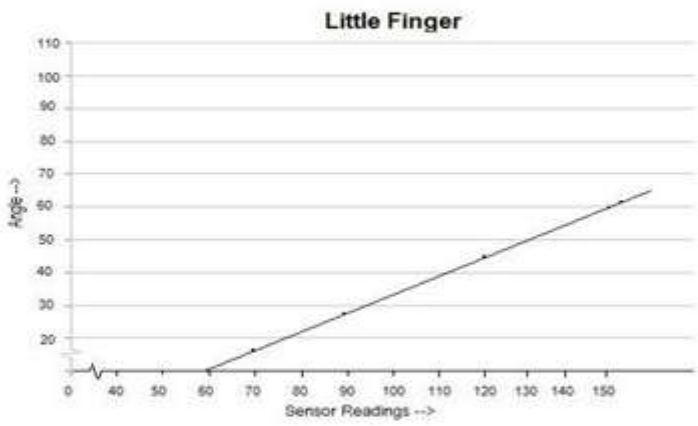
to plot graph we took the readings of flex sensor with hands, then bend each finger and move the servo motors manually to set the desired angle.











2. Flow of action for the roboticarm

- Read values of thesensor
- Micro controller processes the sensorvalues
- Send values from microcontroller toservomotors
- Pick up theobjects
- Place at the requiredposition
- Bring arm at originalposition

III. Conclusion

The paper discusses a hardware and software co design of robotic arm controller using five servomotors employing micro controller. This robotic hand is useful for the society as well as industrial application and it works successfully at the time ofdemonstration.

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