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Design for Robotic Hand Using Flex-sensor

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Abstract: - In this author tries to design a robotic hand that is basically sensors with high degrees of repeatability, precision, and reliability. Sensor plays an important role in robotic hand. Flex sensor is such a device, which accomplish the above task with great degree of accuracy. This hand can perform the various operations and can replace in the form of prosthetic limbs with the help of a microcontroller programming. This designed work is a concept as robotic control is an exciting and high challenge research work in recent year. In the development of dexterous robotic hands different goals for the research can be distinguished. These goals depend on the type of application that the hand is used for. The two main goals were making a anthropomorphic hand (anthropomorphic approach) and making an efficient manipulator (minimalistic approach).The function of the hand is usually to displace objects in a 3D-space and a flexible way, so that different objects and displacements can be made.
Index Terms—PWM, TIP, DSO, CRO

I. INTRODUCTION

The human hand is undeniably a work of wonder. This version of hand is result of millions of years of evolution and adaptation. It has 34 sets of muscles which move the fingers and thumb. Our aim is to design a robotic hand that is basically a Mechanical hand with 5 fingers (like humans have) that gives ability to grasp object of various shapes which will be is mutually controlled by another human hand with a distance. In simple words this mechanical hand will always copy my hand movements. This type of system is very crucial in fields of medical, defence and industrial works where delicate and dangerous task can be done from a distance without actually touching it.

1.1 Servo Motor The use of servomotor is made. Automatic control of DC motor is term of rotation angel has played a vital role in the electromechanical engineering. Sensor plays an important role in robotics. Sensors are used to determine the current state of the system. Robotic applications demand sensors with high degrees of repeatability, precision, and reliability. Flex sensor is such a device, which accomplish the above task with great degree of accuracy. The pick and place operation of the robotic arm can be efficiently controlled using microcontroller programming. This designed work is an educational based concept as robotic control is an exciting and high challenge research work in recent year.

1.2 Power Supply is a crucial part of any electronic system. We have used 5 servo motor in this project with the capacity of 6Kg/cm. Each servo motor consume approximately 1Amp at 5Volt supply, thus all together 5 servo motor will consume 5-6 amp of current. So the challenge was to design a small size power supply that can deliver that much of current without effecting the voltage regulation. In our design we used power transistor (TIP41) in emitter follower configuration to deliver 6 Amp.

1.3 Servo Driver is a hart of this system. Servo motors require continuous PWM signals to achieve continuous angle settings, Thus we dedicated one microcontroller to control the entire 5 servo simultaneously. We choose to ATmega8 that is powerful low cost controller by ATMEL. Our objective was to design a servo controller in such a manner that can generate constant PWM pulse that will set require desired angle without affecting any other motor. The pulse should also be continuous else the angle sustainability will get loose.

1.4 Flex sensor is also known as bend sensor. That is capable of sensing any kind of minute bend in its structure. This sensor is designed in a thin plastic strip type material with minute carbon particles layered on its one of its surface. This carbon layer is divided into small sections and connected together in series by conductive layer.

II. SYSTEM DESIGN

2.1 System Overview: - In this design we will be using flex sensor (bend sensors) to sense the motion of our fingers. We will be using 5 such sensors that will be arranged in a hand glove (left hand in below fig) 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 (right hand in below fig). All together it will be one hand consists of 5 flex sensor one in each finger. Bend of fingers is analysed using one of the Atmega8 microcontroller and this data will be send to another Atmega8 via serial communication, The another microcontroller will generate appropriate PWM signals for controlling servo motors.

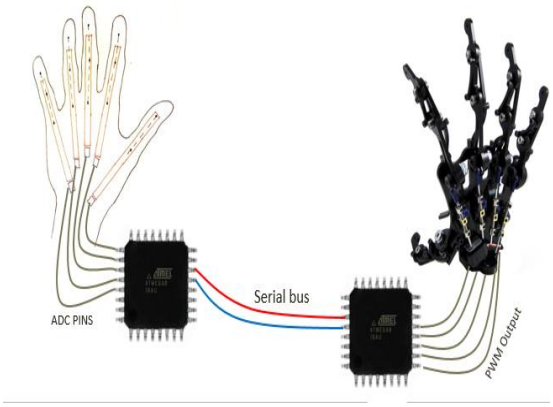


Figure 2.1 Shows configuration of Mechanical Hand and Human Hand

2.2 System Overlook: - 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 with our team mates.

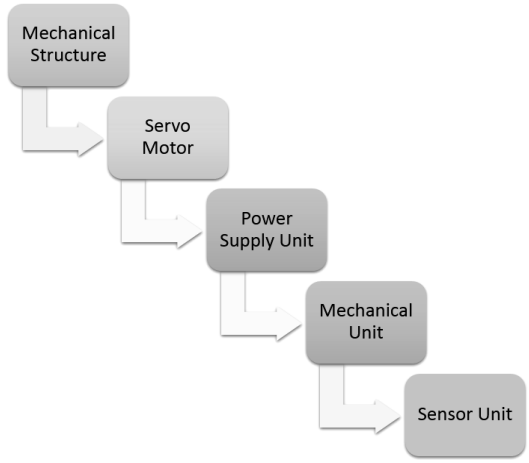
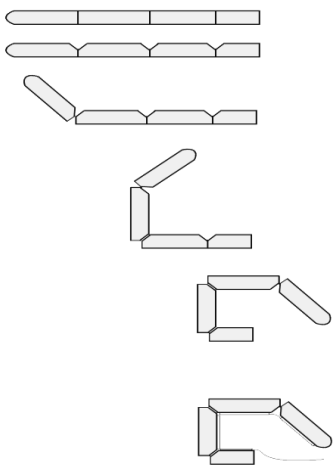
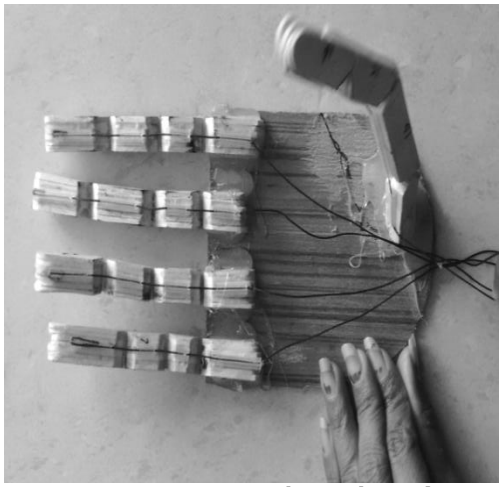


Figure 2.2. Shows Basic Blocks of ROBOTIC Hand

2.3 Mechanical Structure is the key part of the whole project. The human hand is undeniably a work of wonder. This version of hand is result of millions of years of evolution and adaptation. Its layout and suite of design features enable mankind the only possessors of this particular arrangement of bones, tendons, muscles, and nerves to type faster than 60 words per minute or swing a heavy hammer while holding a delicate potato chip. It has 34 sets of muscles which move the fingers and thumb. Design a mechanical structure of hand which looks familiar to our hand is the crucial part of the project. To keep the weight low we will be using ice-cream sticks sandwich together for better strength and support

Figure 2. 1 : Blueprint design of ROBOTIC Hand





Finger Figure 2.2: Mechanical Hand Skelton

III. GRAPH PLOTTING AND OUTPUT

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 serial port.

Figure 3.1 Graph representation of thumb

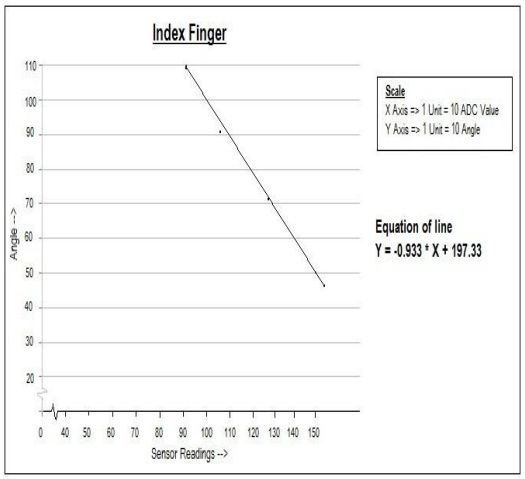


Figure 3.2: Graph plot of index finger

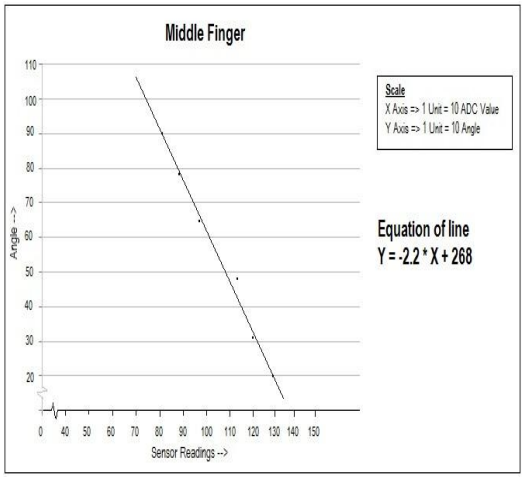


Figure 3.3: Graph plot of Middle Finger

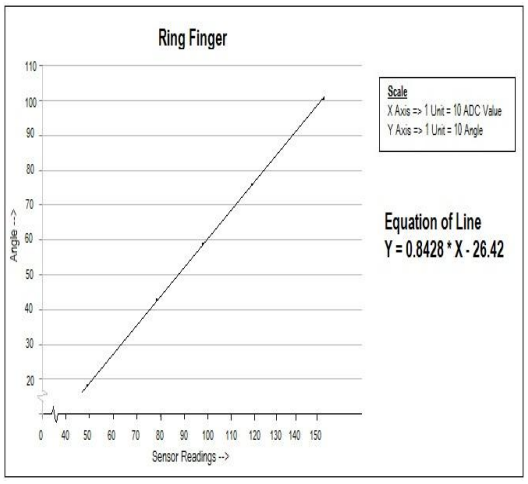
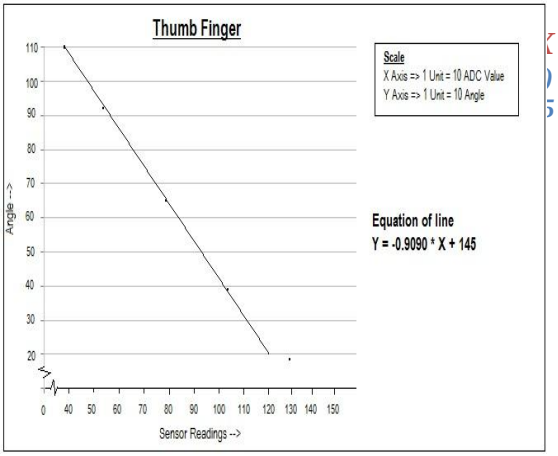


Figure 3.4 Graph plot of ring finger



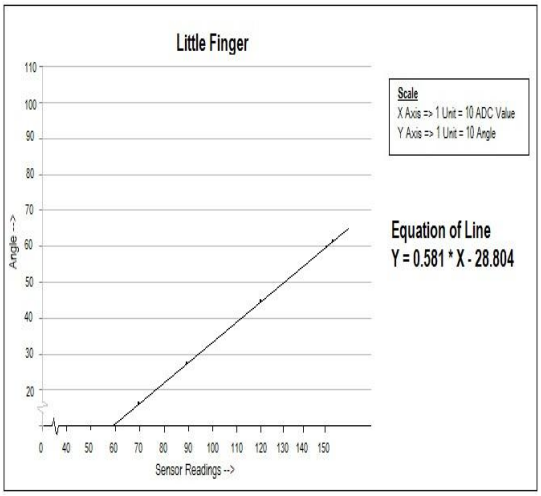


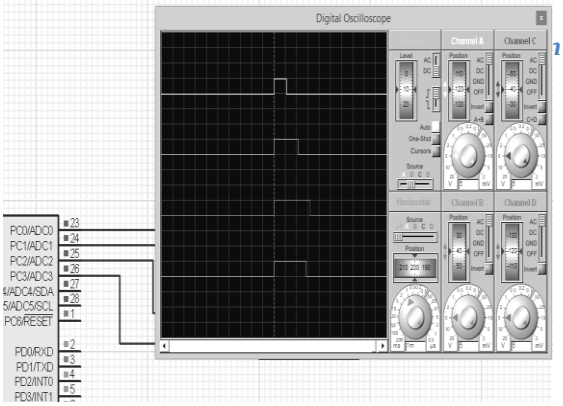
Figure 3.5 Graph plot of little ring finger

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. Mean time servo motor was controlled by computer application.

IV. SERVO DRIVER OUTPUT

Servo driver is important module of the circuit as the control all 5 servo motor thus it should work precisely, Servo motor requires proper PWM pulse. So we write the code in ATMEL STUDIO 6. And simulated it in Proteus. After testing copper tracks the component are tested with the help of instruments like multimeter, CRO, Signal generator, etc. We used Proteus Design suit to test our codes for servo driver virtually. It helps us to make better code before actual trials. We can see in above figure distinct PWM pulse for distinct servo motors. We use digital four channel oscilloscope to see the wave forms

Figure 4.1: Proteus Simulation of Servo Output



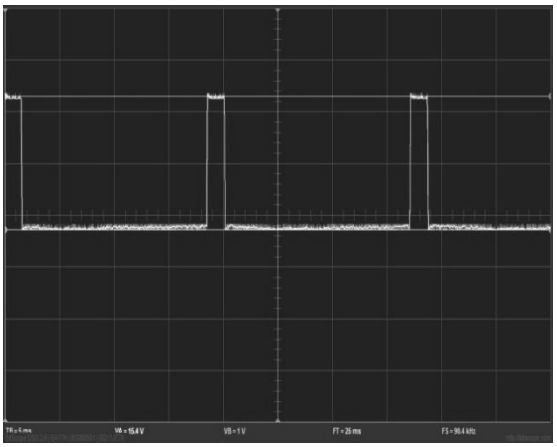


Figure 4.2 PWM output of servo driver on DSO

Ones all the distinct component are tested they are connected together to achieve the objective. Servo driver and sensor module are connected via serial communication. Power supply module provides 5.3v to both the modules as servo motor. Flex sensor is attached to flex sensor is attach to finger using transparent tape. When finger moves it resistance changes, voltage output of the voltage output of voltage divider changes. It is then sensed by ADC of sensor unit this data is converted to angle and forwarded to servo driver, servo driver generates PWM pulse based on data received from sensor unit.

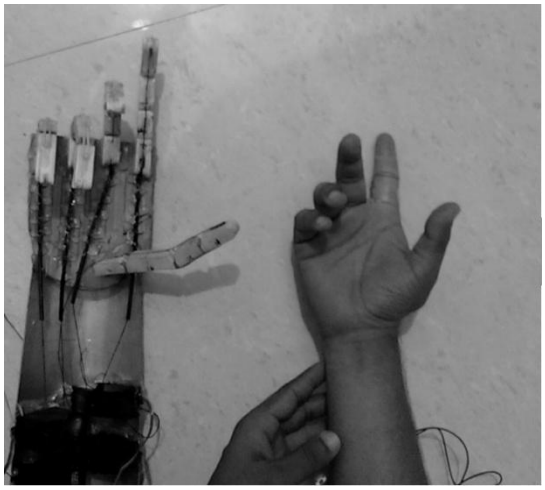


Figure 4.3 Overall Testing

V. APPLICATIONS

Robotic hand can be used in various application and domain. It can be used in place where actual human hand is required but it is dangerous to use them. It has also raised the reach of our presence. Some of the applications where we can use this technology are as follows.

Military Application: - It can be used for explosive bomb diffuse robots. Where human operation can be life costly, in such situation this type of mechanical hand can be operated over safe distance.

Industrial Applications: - It can be used in place operate with toxic, hazardous and dangerous material which will be not being safe for human hands to handle.

Medical Application: - Robotic hand can also be used in hospitals where doctor can perform complex surgical operation from far distant places.

Space Exploration: - Robotic Hand kind of technology can be used in space exploration where such robots can remotely operate and do the lab work, this will save lots of money and can also be used for very long missions which humans can't.

Exoskeleton: - Robotic hand can also be used a powerful hand that has more power capabilities then our hand, but can be controlled by our fingertip. It can be used to lift heavy loads easily.

VI. CONCLUSION

This Robotic Hand is very useful for the society as well as industrial application and it works successfully at the time of demonstration. In future it will work on wireless technology.

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