A Low Cost Smart Hand Glove By Using Flex Force Sensor, Arduino And Servo Motor

Deepali Mate[1], Prof. S. G. Shinde[2]
[1]Dept of Electronics and Telecommunication Engineering
[2]Professor, Dept of Electronics and Telecommunication Engineering
[1, 2] TPCT'S College of Engineering, Osmanabad, Maharashtra, India

Abstract- *In this paper, an artificial hand glove is designed using solid work to simulate a hand model action. A human hand is a very complex grasping tool which can handle object of different sizes and shapes. Most part of this research are dedicated to control of multi finger grippers with emphasis on the finger tips or finger joint. In this paper the mechanism and design of a new humanoid type hand or artificial hand with human like manipulation abilities is discussed. The ideal end-effecter for such an artificial arm or a humanoid would be able to use the tool and objects that a person uses when working in the same environment. This includes the number of fingers and the placement and motion of the thumb, the proportions of the link lengths and the shape of the palm. It can also perform most part of human grasping types.*

Keywords- Flex force sensor, human hand, power supply, signal amplifier, arduino UNO, and servo motor

I. INTRODUCTION

Robot of the current generation has been used in field isolated from the human society. They suffer major shortcoming because of their limited abilities for manipulation and interaction with human. This high stroke incidence in combination with an aging population, which implies future increases in incidence, greatly strains national healthcare service and related costs. In this majority of these cases, patients experience either partial or total absence of hand motion ability, and this loss of functionality can greatly restrict activities and task specific upper limb treatment consisting of active, highly repetitive movement is one of the most effective approaches to arm and hand function restoration is labour intensive and required one-to-one manual interaction with therapists. These systems are typically expensive and are designed for in clinic use as they are generally not portable. An intelligent prosthetic hand is defined as a hand that the natural movements of the human hand.

II. LITERATURE SURVEY

S. G. Shinde, D.D. Mate.," Proposed a survey of smart hand glove by using flex sensor. In this a glove with flux sensor attached is use to control the artificial hand.

Shruthi k," A low cost prosthetic hand using flex sensor and servo. International journal of engineering research and technology, ISSN: 2278-0181 NCESC- 2018. In this paper the research goal is try to develop an affordable five degree of freedom robotic hand and two joints in each finger. S. M. Mane, R. A, Kambli, F. S. Kazi, N. M. Singh," hand motion recognition from single channel surface EMG using wavelet and artificial neutral network." Procesia computer science, vol. 49,pp58-65.2015.

M. Ariyanto et al.," finger movement pattern recognition method using artificial neutral network based on electromyography sensor." 2015 international conference on automation, cognitive science, optics, micro electromechanical system, and information technology, bandung, 2015,pp.12-17.

Most of the designs and research efforts in developing artificial hands for grasping purposes follow the direction established by Cutkosky . In his paper, he classified the grasping constraints as task, object and gripper constraints, and developed the taxonomy of grasps See also for an overview on grasping and dexterous manipulation issues, for a study on the grasp quality measure, for a study of the grip force distribution in the natural hand, and for a study of under actuated grippers for grasping diverse objects.The study of grasping from the geometric and static point of view has been extensively studied; recently. Bicchi [4] presents a survey of the different trends in hand design based on three types of requirements: dexterity in manipulation, grasping capabilities and human operability. See also [5], [2]. For dynamic grasping,].

III. BLOCK DIAGRAM AND IMPLEMENTATION

Fig.1. shows the block diagram of artificial hand or humanoid hand. In this a glove with flex sensor attached is use to control the prosthetic hand. Each flex sensor will be used to control one servo motor. Signals from flex sensor are sent to the Arduino UNO kit to process and control servo motors. The fishing lines are attached to the fingers as tendons to help them move. An arduino combined with servo SG90 to control the action of the prototypes.

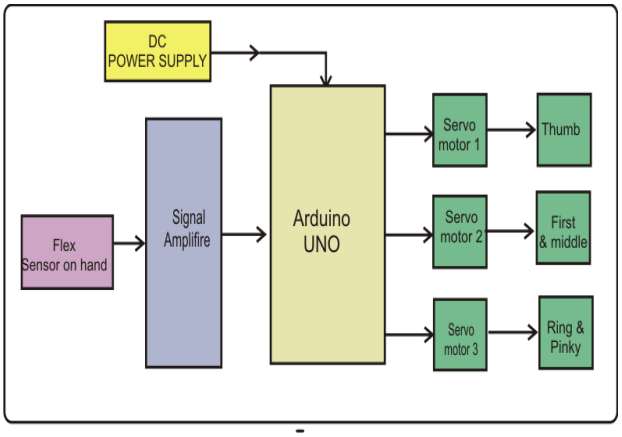

Figure 1. Block diagram of artificial hand

Signal Amplifier

Most analog signals require some form of preparation before they can be digitized signal amplifier is the manipulation of a signal in a way that prepares it for the next stage of processing. Many applications involve environmental or structural measurement, such as temperature and vibration, from sensors, switches.

Arduino

Arduino is an open source hardware and software. Most arduino boards consist of an Atmel 8-bit AVP microcontroller with varying amounts of flash memory, pin, and features. The 32-bit arduino due, based on the Atmel SAM3X8E.Arduino boards are available commercially in preassembled form, or as do-it-yourself kits. Arduino board designs use a variety of microprocessors and controllers.

Figure 2. Arduino board

The boards are equipped with sets of digital and analog input/output(I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.The hardware reference designs are distributed under a Creative Commons Attribution Share-Alike 2.5 license and are available on the Arduino website. Layout and production files for some versions of the hardware are also available. Many arduino compatible and arduino derived boards exist. Some are functionally equivalent to an arduino and can be too interchangeable. The basic arduino by adding output drives, often for use in school- level education, to simplify making buggies and small robots. The boards use single or double-row pins or female headers that facilitate connections for programming and incorporation into other circuits. These may connect with add-on modules termed shields. Multiple, and possibly stacked shields may be individually addressable via an Ibus. Most boards include a 5 V regulator and a 16 MHz crystal oscillator or. Some designs, such as the LilyPad, run at 8 MHz and dispense with the onboard voltage regulator due to specific form-factor restrictions.

Servo motor

Servo motor is an electrical device which can push or rotate an object at some specific angles or distance then you use servo motor. It just made up of simple motor which run through servo mechanism. If a motor is used in DC powered motor then it is called DC servo motor, and if it is used in AC powered motor then it is called AC servo motor.

Figure 3. Servomotor 4 *Flex Sensors:*

A flex 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.

Bending is similar to varying voltage and hence it is often called flexible potentiometer.

Figure. 4 Flex sensor

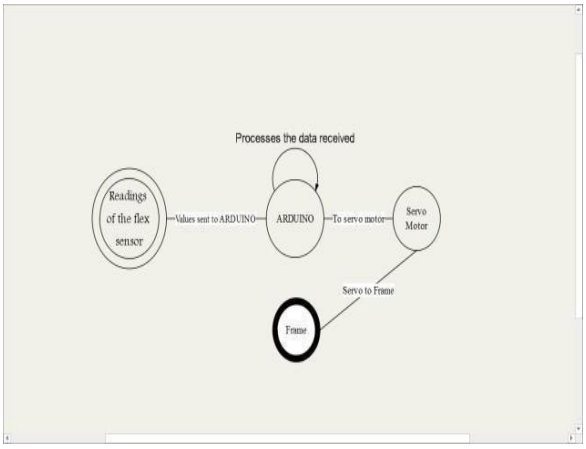

Figure.5 Data Flow diagram

5 Artificial hand

This part of the paper is the real show-stopper. This is Artificial hand's frame. It can be made from a lot of things like wood, plastic, metal, etc. It is the part that drives the main motive of the project. A 3D printed frame is the most suitable for this paper since it is easy to make, light weight and cheap. Almost any design specification can be met using 3D printing techniques.

- Other than these main components we need jumper wires for connections.
- We need a bread board for converging all the connections into one place.
- A 7.4v 2200 mAh Lithium-Polymer battery to power the servo motors and 9v Nickel- Cadmium battery for powering the ARDUINO.
- Fishing nylon wires for the movements of the hand frame.

Working

The Fig 4 shows the flow of data through various hardware components used in the paper. It starts from the Flex sensors , passes through the ARDUINO, goes to the servo motors and finally terminates in the hand frame simulation.

- The first step is to make sure all the connections are proper and ensure that there are no loose connections.
- We also verify whether all the servo motors are getting enough power from the battery.
- When the user wears the gloves, that have flex sensors attached to it and moves the hand, there is a change in the voltage due to the change in the resistance caused to the particles in the flex sensor.
- These voltage values are read as analog values from analog pins and given as input to the Arduino.
- These analog values must be converted to angles, which the servo motor will take as input. A function called 'map' is used for this.
- Once the values are in angles, they are given as the input to the servo motors. The value indicates the amount (angle) by which the servo motor must rotate.
- The flex values are converted in such a way that the amount of bend of the flex sensor in the glove is same as the amount by which the servo turns.
- This is done by lots of trial and errors and by extensive calibration.
- Doing this will ensure that the hand frame bends just like the hand of the user.
- The servo motors and the hand frame is connected using fishing nylon wire.
- When the servo motor rotates it pulls the string and hence the hand frame.
- Since the motor is a 180° non-continuous motor, the rotation can happen in both clockwise and anticlockwise direction, and the hold and release simulation of the fingers of the hand can be achieved.
- When folded the motor turns in the clockwise direction and vice versa when released.

IV. RESULT

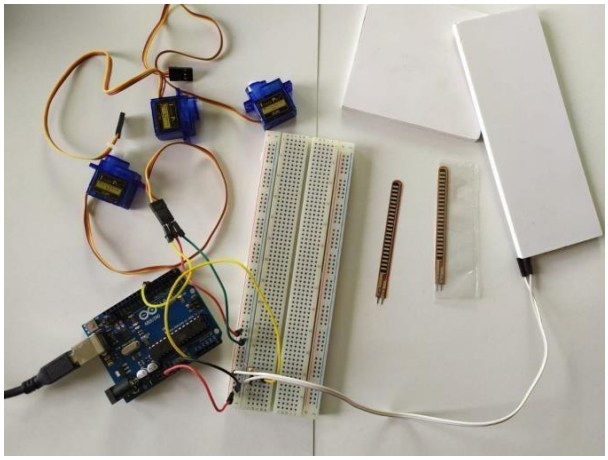

Fig. 5 snapshot of project implementation

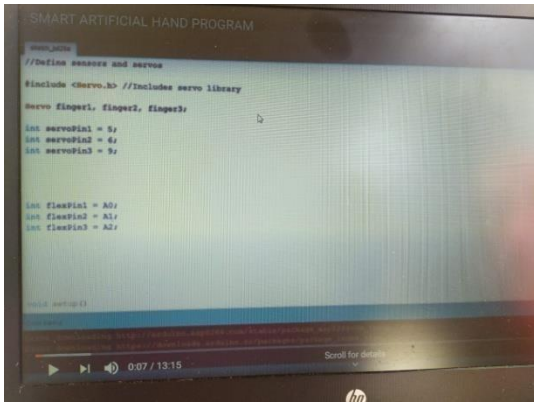

Fig. 6 screenshot of arduino software complete the code

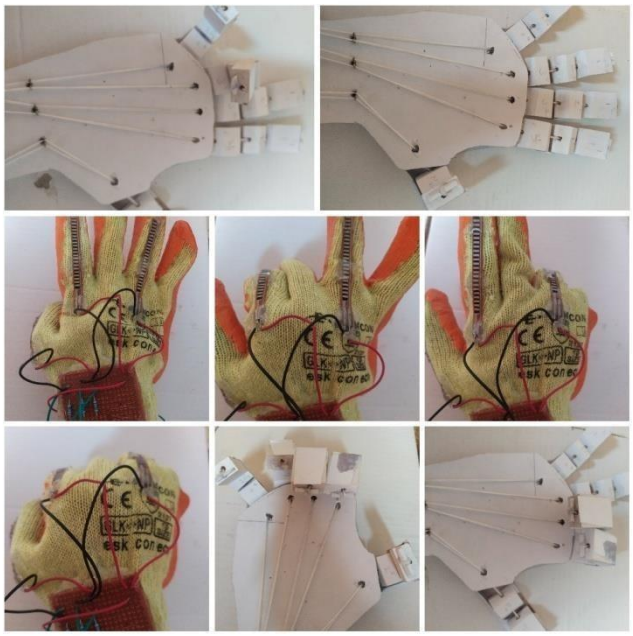

Fig. 7 Hand movement with its replicated artificial hand movement

Thus we can see the fingers in the robotic arm moving as we flex the various flex sensors in the glove. Hence, by mounting three sensor on the fingers of glove, fingers of the artificial hand can be controlled separately providing greater degree of motion and more number of combination with the fingers as seen above.

V.CONCLUSION AND FUTURE SCOPE

Conclusion

In this paper we presented the mechanical design concept and experimental result of the smart artificial hand or humanoid hand. The humanoid hand is able to hold objects with the finger and palm by adapting the grip to the shape of the objects, through a self-adjustment functionality. The hand is driven by only one actuator. The hand was initially designed to assist handicap individual in providing them with an enhanced version of the normal providing them with an enhanced version of the normal prosthetics which are economical and affordable.

It shows a lot of promise and was even applied in hand-on training with the application of visual basic interfacing software among university student with encouraging feedback. With support from the industries and government agencies, the artificial hand gripper could be better develop and achieved its intended target. Finally, the preliminary findings of this study cannot be understated.

Future scope

This is greatly useful to simplify the hand control system. With some modification we can use make it for three direction. Artificial hand or robotic has a wide scope of development. In the near future the hand will be able to perform every task as humans and in much better way.
It can be a real boon for handicapped people, who are paralyzed or lost their hands in some accident. The arm can be trained to listen to the command from a human and perform that task. A precise gesture controlled system is also possible. Wearable devices can be used to send the command and control the movement of the arm.

REFERENCES

[1] T. Asfour, K. Berns and R. Dillmann, “The Humanoid Robot ARMAR”, Proc. of the Second International Symposium on Humanoid Robots (HURO´99), October 8-9, 1999, Tokyo, Japan
[2] T. Asfour, K. Berns, J. Schelling and R. Dillmann, “Programming of Manipulation Tasks of the Humanoid

Robot ARMAR", The 9th International Conference on Advanced Robotics (ICAR'99), 25-27 October, Tokyo, Japan

[3] S. Toyama, S. Hatae and S. Sugitani, "Multi-Degree of spherical ultrasonic motor", Proc. ASME Japan/USA Sympo. Flexible Automation, 169, 1992

[4] N. Fukaya, S. Toyama and T. Seki, "Development of an artificial arm by use of spherical ultrasonic motor", The 29thInt. Sympo. Robotics, Bermingam, England, 74, 1998

[5] S.C. Jacobsen, E.K. Iversen, D.F. Knutti, R.T. Johnson and K.B. Biggers, "Design of the Utah/MIT dexterous hand ",Proc. IEEE Int. Conf. On Robotics and Automation, pp.1520-1532, 1986

[6] S.M. Mane, R.A. Kambli, F.S. Kazi, N.M. Singh," Hand Motion Recognition From Single Channel Surface EMG Using Wavelet & Artificial Neural Network, "Procesia Computer Science, vol.49, pp.5865 2015.

[7] M. Ariyanto et al., "Finger movement pattern recognition method using artificial neural network based on electromyography (EMG) sensor," 2015 International Conference on Automation, Cognitive Science, Optics, Micro Electro-Mechanical System, and Information Technology (ICACOMIT), Bandung, 2015, pp. 12- 17.

[8] J Raines, Robotics Hand Development Kit-Ada V1.1 Datasheet, United Kingdom, Open Bionics, May 2016.

[9] Open Hand Project, Bristol (United Kingdom), Dextrus Hand, 2014.

[10] Vincent Systems, Weingarten (Germany), Vincent Hand, 2014.

[11] Michelangelo operation manual. Duderstadt (Germany): Otto Bock; 2012.

[12] RSL Steeper web site. Leeds (United Kingdom): RSL Steeper; 2013. Available from :http://rslsteeper.com/.

[13] Touch Bionics Inc, Mansfield (MA), Touch Bionics, 2014. Available from:http://www.touchbionics.com/.

[14] Cipriani C, Controzzi M, Carrozza MC. "Objectives, criteria and methods for the design of the Smart Hand transradial prosthesis". Robotica. 2010;28(6):919–27.

[15] Belter JT, Segil JL, Dollar AM, Weir RF. "Mechanical design and performance specifications of anthropomorphic prosthetic hands: A review" .J Rehabil Res Dev.;50(5):599–618,2013.