iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VI **Month of publication:** June 2020

DOI: http://doi.org/10.22214/ijraset.2020.6135

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

Design and Manipulation of Robotic Prosthetic Hand

Prof. S. B. Lokhande[1], Akash Gawai[2], Saurabh Panse[3], Onkar Pawar[4], Unmesh Chapte[5]
[1, 2, 3, 4, 5]*Mechanical Engineering Department, PES Modern College Of Engineering, Savitribai Phule Pune University, Maharashtra*

Abstract: Continuous growth in industrialization and lack of awareness in safety parameters the cases of amputations are growing. The search of safer, simpler and automated prosthetic arms for managing upper limbs is expected. Continuous efforts have been made to design and develop prosthetic arms ranging from simple harness actuated to automated mechanisms with various control options. A prosthetic implant is an artificial device that replaces a missing body part, which may be lost through Traumatic injuries, disease, or a condition present at birth (congenital disorder).
Prostheses are intended to restore the normal functions of the missing body part. If a body part is missing, an artificial device (prosthesis) is often recommended to replace that part. At a minimum, a prosthetic hand should enable the user to perform daily activities (such as walking, eating, and dressing) independently and comfortably.
The search of safer, simpler and automated prosthetic hand for managing upper limbs is expected. Hence our aim is to design automated prosthetic hand to help disabled people in their day to day life.
Keywords: Prosthetic hand, flex sensor, servo motors, mechano links, Arduino uno

I. INTRODUCTION

The human hand is a complex part of our body. This part enables us to interact with our environment and also use to communicate with one another. Also thumb of our hand helps us to perform various activities that differentiate us from other creatures on earth. To perform complex hand movements we need to know information about our environment including fine touch, vibration, pain, temperature. Our hand is connected to our central nervous system hence we can easily identify and sense our environment. Therefore our hand allows us to perform complex activities like writing and opening doors. Loss of hand decreases our strength to do different activities and functions. Hence our aim is to make prosthetic robotic hand to help amputee person.

II. LITERATURE REVIEW

SR.NO	NAME OF PAPER	AUTHORS	DESCRIPTION
1.	A low-cost 3d-printed prosthetic hand for children with upper-limb differences	Jorge Zuniga, Dimitrios Katsavelis , Jean Peck , John Stollberg , Marc Petrykowski , Adam Carson and Cristina Fernandez	This paper describes about a low-cost 3D-printed prosthetic hand for children and proposes a distance fitting procedure. The prosthetic hand and the proposed distance-fitting procedures may represent a possible low cost alternative for children in developing countries and those who have limited access to health care providers.
2.	Bionic hand versus customized body-powered technology in a highly demanding work environment	Wolf Schweitzer, Michael J. Thali and David Egger.	This paper give information about research and development of functional prostheses may want to focus on body-powered technology as it already performs on manually demanding and heavy jobs whereas eliminating myoelectric technology's constraints seems out of reach.
3.	Bionic prosthetic hands: A review of present technology and future aspirations	R.G.E. Clement, K.E. Bugler, C.W. Oliver	This research paper focuses on understanding of the development of bionic hands and the technology underpinning them as this area of medicine will expand.
4.	Performance Characteristics of Anthropomorphic Prosthetic Hands	(2011 IEEE International Conference on Rehabilitation Robotics Rehab Week Zurich, ETH Zurich Science City, Switzerland, June 29 - July 1, 2011)	In this paper we set forth a review of performance characteristics for both common commercial prosthetics as well as anthropomorphic research devices. Based on these specifications as well as surveyed results from prosthetic users, ranges of hand attributes are evaluated and discussed. End user information is used to describe the performance requirements for prosthetic hands for clinical use.

5.	Learning EMG control of a robotic hand: Towards Active Prostheses	Proceedings of the 2006 IEEE International Conference on Robotics and Automation Orlando, Florida - May 2006	In this paper they introduced a method based on support vector machines which can detect opening and closing actions of the human thumb, index finger, and other fingers recorded via surface EMG only. The method is shown to be robust across sessions and can be used independently of the position of the arm. With these stability criteria, the method is ideally suited for the control of active prosthesis with a high number of active degrees of freedom. The method is successfully demonstrated on a robotic four-finger hand, and can be used to grasp objects.
6.	The Impact and Application of 3D Printing Technology	Thabiso Peter Mpofu1, Cephas Mawere , Macdonald Mukosera, M. Tech. Students, Department of Computer Science, School of IT, Jawaharlal Nehru Tech. University.	In this paper they explored 3D printing and how it works and the current and future applications of 3D printing.

III. PROSTHETIC ROBOTIC HAND

A prosthetic implant is an artificial device that replaces a missing body part, which may be lost through Traumatic injuries, disease, or a condition present at birth (congenital disorder).

Prostheses are intended to restore the normal functions of the missing body part. If a body part is missing, an artificial device (prosthesis) is often recommended to replace that part. At a minimum, a prosthetic hand should enable the user to perform daily activities (such as walking, eating, and dressing) independently and comfortably.

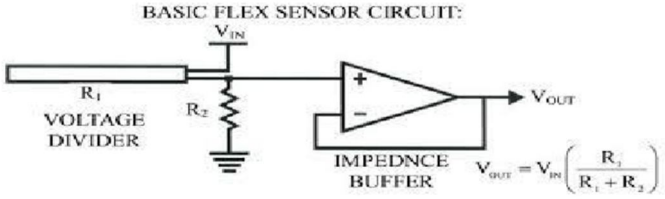
The search of safer, simpler and automated prosthetic hand for managing upper limbs is expected. Hence our aim is to design automated prosthetic hand to help disabled people in their day to day life.

IV. WORKING AND DEVELOPMENT

A. Working Of Flex Sensor

(Flex sensor connection with arduino)

A flex sensor is also called as bend sensor. This device measures the amount of bend or angular deflection. Flex sensor is made up of variable resistive surface. The amount of resistance varied by bending the sensor. Flex sensors are analog resistors and works as analog voltage divider. Flex sensor carries carbon resistive element that contains flexible substrate. Here, more carbon means less resistance. When substrate is bent then the sensor produces resistance output, according to the bend radius. When substrate is flexible then sensor achieves great form factor. If there is variation in deflection or bending of flex sensor then that results in variation of resistance itself. Hence signal conditioning circuit is used to read these changes in resistance which will be given to ADC. ADC converts these values into equivalent digital values.



B. Block Diagram

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

C. Types of Flex Sensor

On the basis of resistive material used on the surface of flex sensor, different types of sensors are-

1) Carbon Resistive Flex Sensor • Capacitive Flex Sensor • Fiber optic Flex Sensor • Conductive Flex Sensor

2) Hence in our project we used Carbon Resistive flex sensor, which is sometimes called a velostat flex sensor

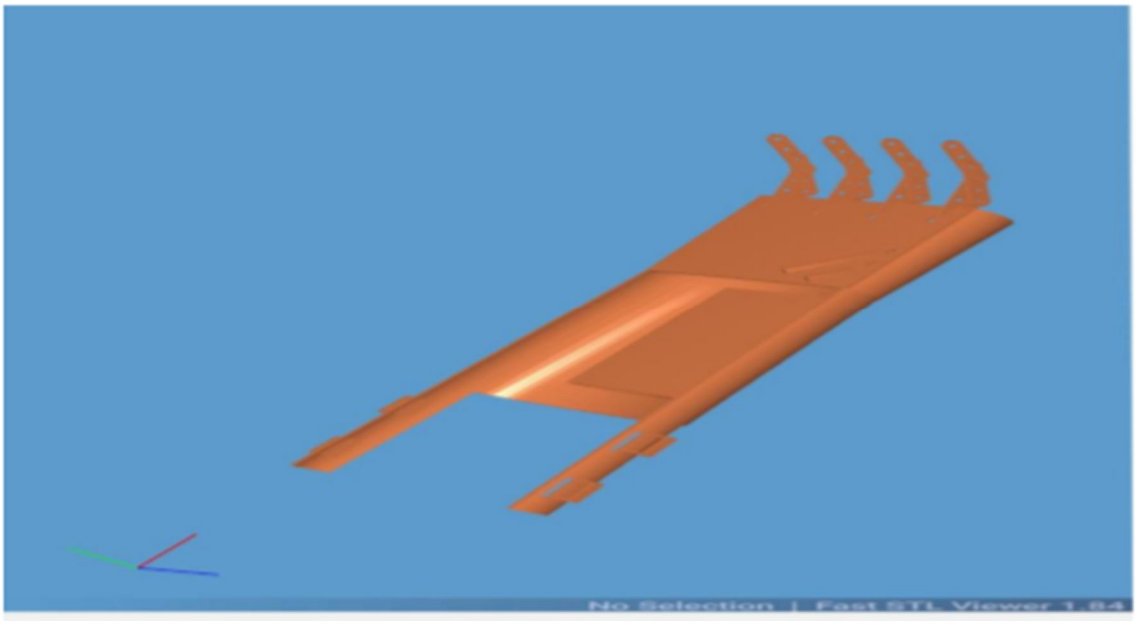
V. DESIGN APPROACH AND MATERIAL USED

Component	Name
	Mechano links
	Servo motor
	Flex sensor
	Battery
	Arduino uno

A. Design Calculations

1) Our Design

2) 3D Model



3) Calculations: Finger has been designed by using metal links by Mechano company. According to the company standards length of a link is measured by half the number of holes drilled on it. In our design of fingers we have used metallic links having 3,4,6 number of holes

Therefore,

Length of metallic link having 3 holes = 3*1/2

=1.5 inches = 38.1mm

Length of metallic link having 4 holes = 4*1/2

= 2 inches =50.8 mm

Length of metallic link having 6 holes = 6*1/2

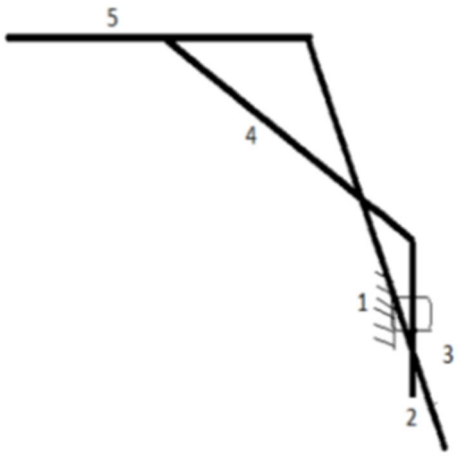
= 3 inches = 76.2 mm

When finger is in completely open position 4 holes links with each other, hence total no. of holes happens to be 7

Therefore total length of total finger = 7 *1/2

=3.5 inches = 88.9 mm

a) Calculation of Degree of Freedom



Number of links = 5

b) Number of one degree of freedom = 3 (pins) = 3
Therefore total DOF = 3*(5– 1) – 2*5 =2

c) Weight of each metal link corresponds to number of drilled holes
Weight = 3*1 + 2*4 + 6*1 =17 grams , Total weight = 17 * 4 = 68 grams.

VI. CONCLUSION

Upon starting this project we were very ambitious. Our initial idea before proposing the project was to work with creating a hand. However with efficient movement of the fingers our wrist became more simplistic.

The sensor could prove some difficulty based on its wiring but on further research the Flex sensor that we have choose to use provides simplified connections with the microcontroller.

We are using low cost materials such as mechano links made up of nickel alloy which reduced the cost of our project. Also using servo motor we are able to produce more torque.

We have selected two materials that are PLA (polylactic acid) and PETG (polyethylene terephthalate) for 3D printing out of which PLA is having more strength which will increase capacity of our hand to lift loads.

VII. SCOPE

A. Recent data have shown that there is a wide scope to develop a low cost and light weight upper limb prosthesis.

B. This research on prosthetic arm is limited to just provide support with no movements of its fingers, so the scope of our project is to provide movements of the fingers and hand by receiving signals by the nerves through muscle sensor.

C. Interdisciplinary between the field of medicine and engineering.

REFERENCES

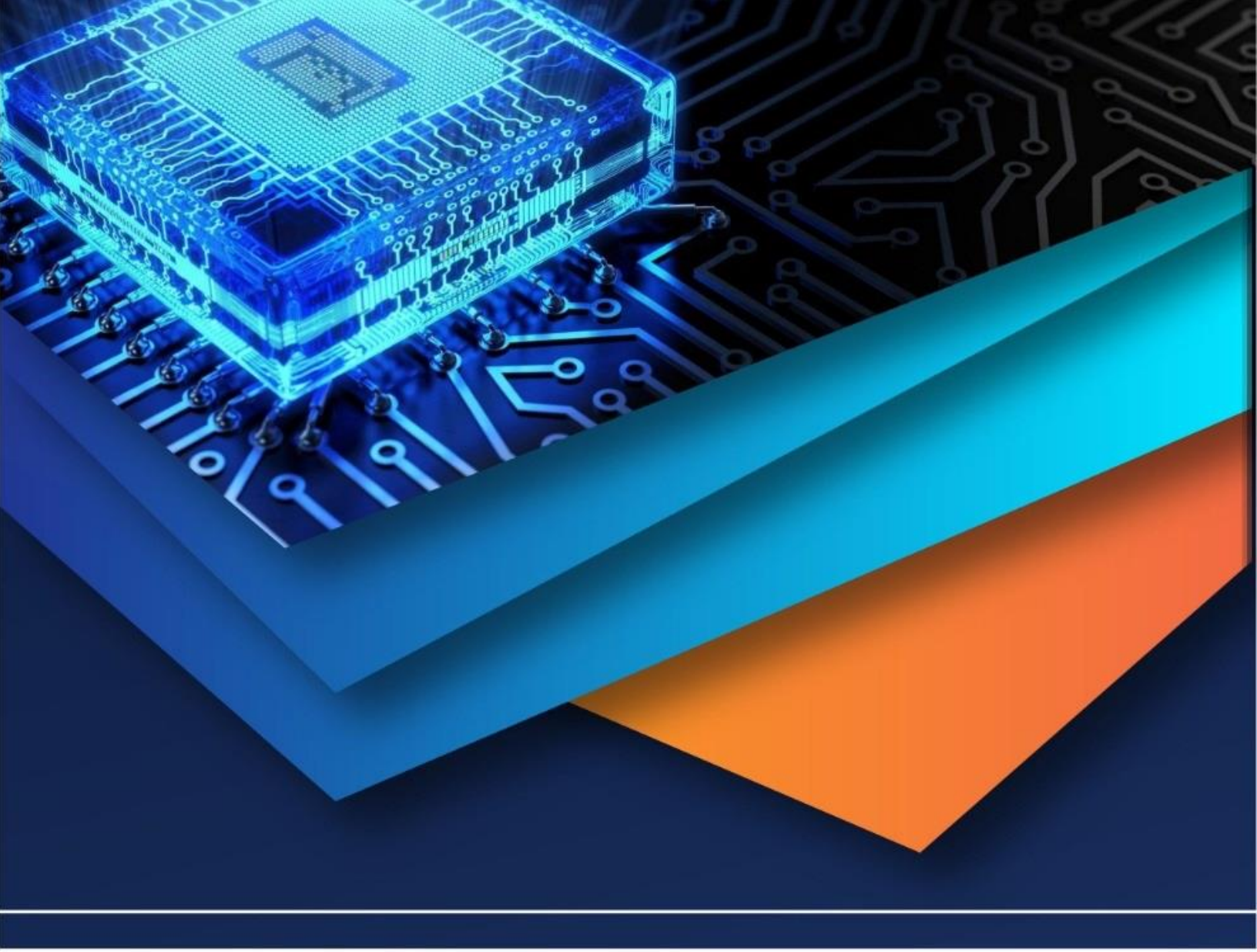
[1] Jorge Zuniga, Dimitrios Katsavelis , Jean Peck , John Stollberg , Marc Petrykowski Adam Carson and Cristina Fernandez, A low-cost 3d-printed prosthetic hand for children with upper-limb differences BMC Research Notes (2015)

[2] Wolf Schweitzer, Michael J. Thali and David Egger Schweitzer , Bionic hand versus customized body-powered technology in a highly demanding work environment. Journal of NeuroEngineering and Rehabilitation (2018)

[3] R.G.E. Clement, K.E. Bugler, C.W. Oliver. R.G.E. Clement*, K.E. Bugler, C.W. Oliver Bionic prosthetic hands: A review of present technology and future aspirations, Department of Trauma and Orthopaedics, Royal Infirmary of Edinburgh, 51 Little France Crescent, Old Dalkeith Road, Edinburgh EH16 4SA, UK,13 February 2011 Received in revised form 19 April 2011, Accepted 5 June 2011, Available online 13 July 2011

[4] Learning EMG control of a robotic hand: Towards Active Prostheses , 2006 IEEE International Conference on Robotics and Automation Orlando, Florida - May 2006

[5] Thabiso Peter Mpofu1 , Cephas Mawere , Macdonald Mukosera ,The Impact and Application of 3D Printing Technology, M. Tech. Students, Department of Computer Science, School of IT, Jawaharlal Nehru Technological University Hyderabad, India. International Journal of Science and Research (IJSR) ISSN (Online),2012.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY