IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

HUMAN MACHINE INTERFACING TO SUPPORT AND IMPROVE LIFE OF AN AMPUTEE WITH NEUROPROSTHETIC HAND

Maitri dave[1], Raksha Patel[2], Heena Patel[3] , Nitesh Jamliya[4]

[1]Lecturer, Biomedical Dept.,G.P.Gandhinagar & m.tech student , U.V.Patel college of Engineering, INDIA
[2]Biomedical Dept.,U.V.Patel college of Engineering, INDIA
[3]Biomedical Dept.,U.V.Patel college of Engineering, INDIA
[4]Lecturer, Instrumentation & control Dept.,G.P.Gandhinagar, INDIA

Abstract - Human hand is a very complex mechanism to understand. it has 27 degrees of freedom. When this movement is impaired due to any neurological disorders or in case of fatal accidents, then an amputee is not able to perform their routines. The proposed solution clearly focuses on such techniques which help an amputee to regain their self confidence by the use of such artificial hands. This system used bran signals to operate the patient through headsets. The signal is processed through a control unit and it gives signals to the mechanical system. control of hand movement can be regained through the use of brain waves. Thus human machine interaction systems can be developed at low cost so as to provide access to all amputees who can not effort high cost prosthesis. It can customised as per their need.In this way they can be independant to do their daily routine activities such as tooth brushing, picking up objects, grasping, etc.

Index Terms: Amputee,Brain,Hand,Headset, Prosthesis

1.INTRODUCTION

There are millions of people who are suffering from disabilities of upper and lower limbs.Many humans are missing hands. It is almost impossible and difficult to do daily routine activities without hands. Such inability takes them so long to complete any task which is typically considered natural and can be completed in laser time. Almost all daily activities like tying the nodes of the shoes or even opening the cap of any bottle. If any person does not have both hands then it could not lead to a healthy and normal life. He or she has to rely on others or their family members. In some cases it's so disturbing that people lose their confidence and inevitably affect their mental stability. Simple eating food or drinking water can also become so complicated which in turn never feels so in case of natural hands. For over a thousand years, men have been using artificial hands and such prosthetic hands were used to help and improve day to day life of such people who are lacking with their hands in their everyday activities, but the conventional artificial hands are just cosmetic. Only the invention of bionics had modified the concept of an artificial hand for thousands of years[1]..Here are various signals that can be used to control the bionic hand apart from the EMG signals like speech sommand, facial muscles movement and the signal like EEG be a signal to be used for the controlling mechanism of a bionic hand. it is impossible that an amputee can not give face muscles movement or speak depending on the kind of degree of his/her disabilities. Speech command is not that much popular because the user may not like to acquire the attention of the people who are around him while he operates the bionic hand at the other side the hand controlled with EEG signal is collecting the command and data from the brian, such techniques can be easily applied to majority of the prosthetic hand users across the world. Using the EEG signals, handling and controlling the bionic hand becomes much more easier and observed by many users[2]. the user feels more comfortable compared to the other way of using it. The good part of the EEG is that it is never depending on the muscles of the forearm, it can communicate with bionic hands using the brain signals.proposed system is based on EEG waves which can be used to create natural form of movement of artificial hand.

2.METHODOLOGY

Hand operation is totally based on quality of hardware. one can use different processors to control hand movement . Therefore, it is extremely important to choose proper hardware. In this system, the research goal is to enhance the quality of prosthetic hands . it must be a reliable and low cost product . it basically includes 4 categories such as acquisition of signal, processing of signal, interfacing with hardware, hand control movement.

2.1 BRAIN:

The brain consists of different lobes.frontal part of cortex leads to movement and it also coordinates with various systems such as the skeletomuscular system. When there is formation of any movement in the cortex then it gives instruction to organise the sequences of human behaviour. This organization of cortex i..e frontal-lobe areas is occured with cerebral blood flow, which is an indication of neural activity. Whenever an amputee tends to grasp something, the blood flow in the motor cortex increases. Fig 1 shows brain structure[7].

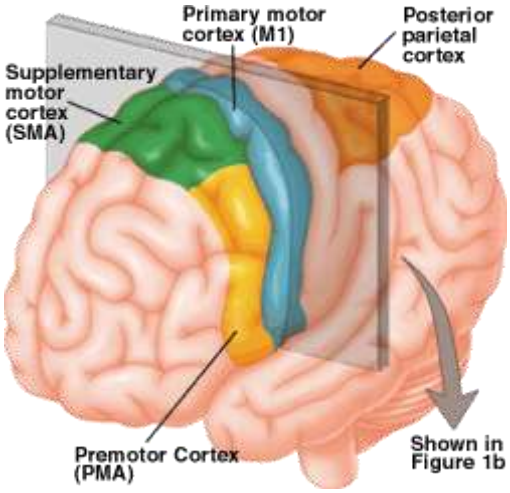

Fig- 1: Principal cortical domains of the nervous system[7].

2.2 Hardware:

2.2.1. Headset:

EEG means a way of representing electrical activity in the brain. EEG signal have certain wave patterns which composed of different waves. neurosky is used here[6].

EEG WAVES	FREQUENCY(HZ)
DELTA	0-4
THETA	4-8
ALPHA	8-13
BETA	13-30
GAMMA	30-40

Table-1. EEG frequency distribution

2.2.2. Bluetooth module :
HC-05 bluetooth is used in this system.The output of neurosky is given to the bluetooth module having two modes.
1. Data mode**:** In data mode, data exchanges take place between devices .

2. Command mode: It is used to change the setting of bluetooth module.The bluetooth module signal is fed back to the electronic circuitry which includes the control system.

2.2.3. PIC controller:

It is also termed as Programmable Interface Controller. it is very small which can be programmed to accomplish a wide area of different tasks. it is used in many devices like computers, control systems, mobile phones p Here PICF877A is used. It is a 40 pin microcontroller operated on 5V supply. PIC microcontroller architecture comprises Central processing unit , input output ports ,memory,analog to digital converter , timers and counters, interrupts and also serial communication, oscillator. It is attached with a bluetooth module and when the signal is sent to the PIC it will give pulses to the servo motor which in turn rotate the motor which is placed in an artificial hand.

2.2.4. Prosthetic hand

It is used in people who loss their upper limb function. artificial hands are in markets since so many years but technological advancement have made the hand now become 3D printed. 3D hands are advantageous to the people as they can be customised[3]. It is versatile, cheap and quickly made. Firstly, hand design is made through solid works software[4]. one of the design files STL is shown here in figure.

Fig-2 STL file of hand finger printed using 3D technology

2.2.4 Servo motor:

Servo motor is placed in hand for movement of hand in controlled manner. The programme is prepared in the PIC controller which is interfaced with the motor to give different range of motions. Each finger is connected with the servo motor which allows a degree of freedom to the 3D hand.

3. RESULTS

Proteus simulation is done before it is interfaced to the real scenario. fig-3 shows interfacing of PIC with servo motor. Moreover, for each finger different modes of movement are first planned. when the object is needed to be grasped by an amputee, finger has to be in flexon mode, at that time finger angle is adjusted through a control system such as 0,30,45 . Whenever the pulses are received in PIC, it tends to give signals to the servo motor and it will move according to the level of brain signals[5]. Generally when the person is awake its frequency is high and tends to generate alpha patterns which can be processed. programmes are designed in such a way that when the level of attention is at 50, hand flexion occurs, when a person blinks the eye, hand tends to be in relaxed state.relaxed position all the motors are having degree of motion 0 . when value increases it tends to grasp the object.

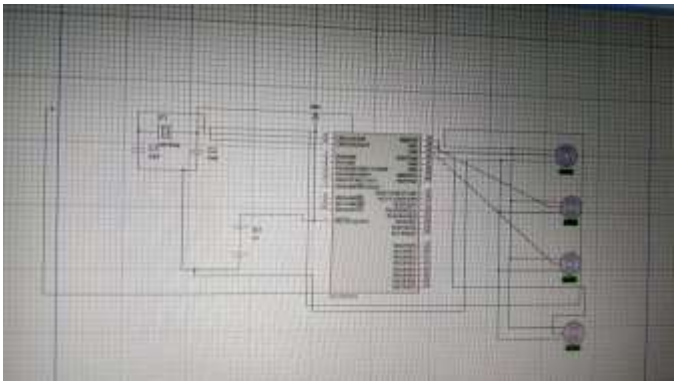

Fig-3. Proteus simulation of interfacing PIC with servo motors

4. CONCLUSION

By this technique, an effective human machine interface can be developed which is an affordable approach for prosthetic hands. The developed system is used to help an amputee to accomplish their routine task with an ease. it is completely non invasive which can be the greatest advantage in this system. data is fed to the machine through human brain signals which in turn gives more form of natural movement to an amputee.system can be more precise if each pattern of frequencies can be processed and given to the electronics part. Some sensors can be added to give feedback to the user.Some algorithms and with the use of artificial intelligence we can achieve more precise and advanced motion.it s best suitable approach for such amputees whose muscles don't have enough strength and they can not use myoelectric hand. Such additional use of tools will definitely give much more accuracy to the system .

ACKNOWLEDGEMENT

We would like to thank our parents, who have guided us throughout our career. They are the ultimate role models. We would also extend our gratitude to our project guide Prof Nitesh Jamliya, Prof Raksha Patel and all our faculties at my department for their continuous support to carry out this project. We are especially thankful to Dr. Saurabh Dave for extensive professional guidance of creating innovation in any product that helped us a lot for developing this system .We would also like to thank Prof. Achyut Trivedi for giving excellent support in 3D printing of our prosthetic hand. We would also like to thank Prof. Jainum Shah for providing his excellent sharing of knowledge of electronics and guided me throughout my research work.

REFERENCES

1. D. Salvekar, A. Nair, D. Bright, and P. S. A. Bhisikar, “Mind Controlled Robotic Arm,” *IOSR J. Electron. Commun. Eng.*, pp. 36–44, 2015.
2. E. Akyürek *et al.*, “Design and Development of Low Cost 3D Printed Ambidextrous Robotic Hand Driven by Pneumatic Muscles,” no. 10, pp. 179–188, 2014.
3. A. N. Kadhim, M. Abdulsattar, and A. Abdulghani, “Low Cost Design of 3D printed Wearable Prosthetic Hand,” *Am. J. Eng. Res.*, no. 10, pp. 110–117, 2018.
4. J. Koprnicky, P. Najman, and J. Safka, “3D printed bionic prosthetic hands,” *Proc. 2017 IEEE Int. Work. Electron. Control. Meas. Signals their Appl. to Mechatronics, ECMSM 2017*, no. August, 2017, doi: 10.1109/ECMSM.2017.7945898.
5. J. Meng, S. Zhang, A. Bekyo, J. Olsoe, B. Baxter, B. He, "Noninvasive Electroencephalogram Based Control of a Robotic Arm for Reach and Grasp Tasks", *Sci. Rep.*, vol. 6, pp. 38565, 2016.
6. http://developer.neurosky.com/docs/doku.php?id=mindwave_mobile_and_arduino
7. https://brainconnection.brainhq.com/2013/03/05/the-anatomy-of-movement/
8. Y. Mishchenko, M. Kaya, E. Ozbay, and H. Yanar, “Developing a 3- to 6-state EEG-based brain-computer interface for a robotic manipulator control,” p. 171025, 2017, doi: 10.1101/171025
9. S. Fok et al., “An EEG-based brain computer interface for rehabilitation and restoration of hand control following stroke using ipsilateral cortical physiology,” Proc. Annu. Int. Conf. IEEE Eng. Med. Biol. Soc. EMBS, no. August, pp. 6277–6280, 2011, doi: 10.1109/IEMBS.2011.6091549.
10. Dany Bright, Amrita Nair, Devashish Salvekar and Prof.Swati Bhiskar,”EEG-Based Brain Controlled Prosthetic Arm”, Pune,Jun 9-11,2016.
11. Kamlesh H. Solanki1, Hemangi Pujara2, “BRAINWAVE CONTROLLED ROBOT” , International Research Journal of Engineering and Technology (IRJET), vol. 02,pp. 609-612, July 2015
12. HC Bluetooth module [online] Available: https://components101.com/wireless/hc-05-bluetooth-module
13. Neurosky [online] available: http://neurosky.com/