Project Title: - BMIP: Brain Muscle Interface for Paralyzed

PROBLEM STATEMENT

The total population of India is 1,028,610,328 according to the Census published by the Government of India in 2015. The total number of differentially abled people limited by paralysis is a whopping amount of 21,906,769 which amounts for 27.9% of the total population. The number of people who suffer from disability in movement is 6,105,477. Among the total disabled in the country, 12.6 million are males and 9.3 million are females. The highest number of disabled is in the state of Uttar Pradesh and the count is 3.6 million. According to Reeve foundation 29% of US population is paralyzed due to stroke. So approximately on an average the 15% of world population is suffering paralysis due to stroke. These numbers are not mere statistical figures, these are reflections of how a small portion of the world suffers from a pertinent problem like paralysis. This has been the undying motivation for building the BMIP so that it can help a great deal in making the world a better place.

The idea is to create a muscle to machine interface for assisting a paralyzed person for facilitating movements in a paralyzed person. Our machine will be designed in a wearable format, such that using electrodes, the stimulation can be given to the limbs for movement. Therefore, this project has an added advantage since it does not require any incision or implant for the machine to work. Once the wearable is attached to a controlling person and the desired movement takes place, the corresponding movement is converted into an EMG signal with the help of the electrodes attached. These EMG signals are further sent to the controlled person's hands, which is also connected with the help of sensory electrodes. These received

impulses stimulate a pulse, which is very much similar to the electrical pulses that are received from the brain to the nerves of the paralyzed person, thus causing movement in their hands.

METHODOLOGY

The research procedure is to follow the controlled person who is interfaced with the BMIP with the movable human part of the controlling person. The BMIP generates an electrical stimulation and in response to the stimulus the subject under test which is the controlled person perform its operations.

During the operation, the BMIP records the EMG signals, processes the signals and classify it to different operations. The recorded operation is compared with the actual operations. The performance accuracy is measured. The performance accuracy is the number of correct classification divided by number of physical operations. In the first phase of the research, real physical operations are performed, detected and recorded. In the second phase the nerves responsible for the muscle movement of controlled person has to be identified.

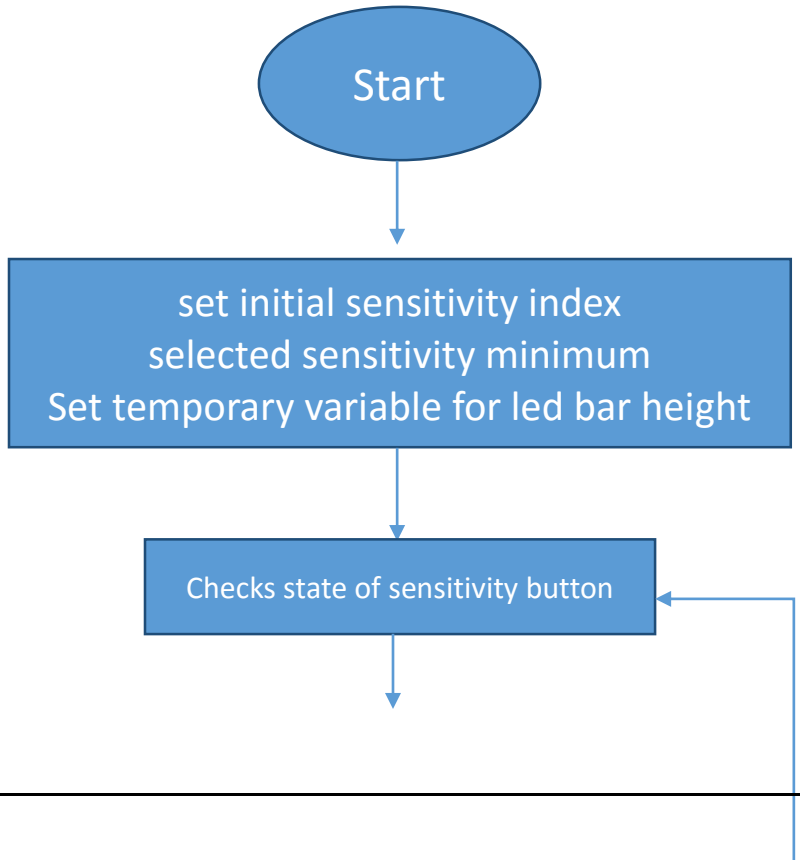
A pair of EMG electrodes has to be placed on the identified location. The phases are compared and tested for the accuracy. If the result is not satisfactory a Bio-feedback is given and the process is repeated till the performance accuracy is achieved.

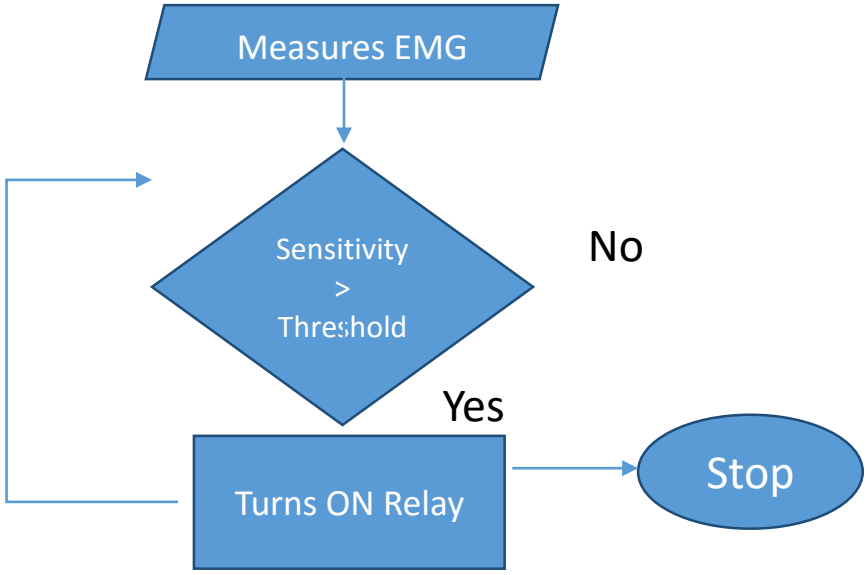
FINAL APPROACH AND DESIGN

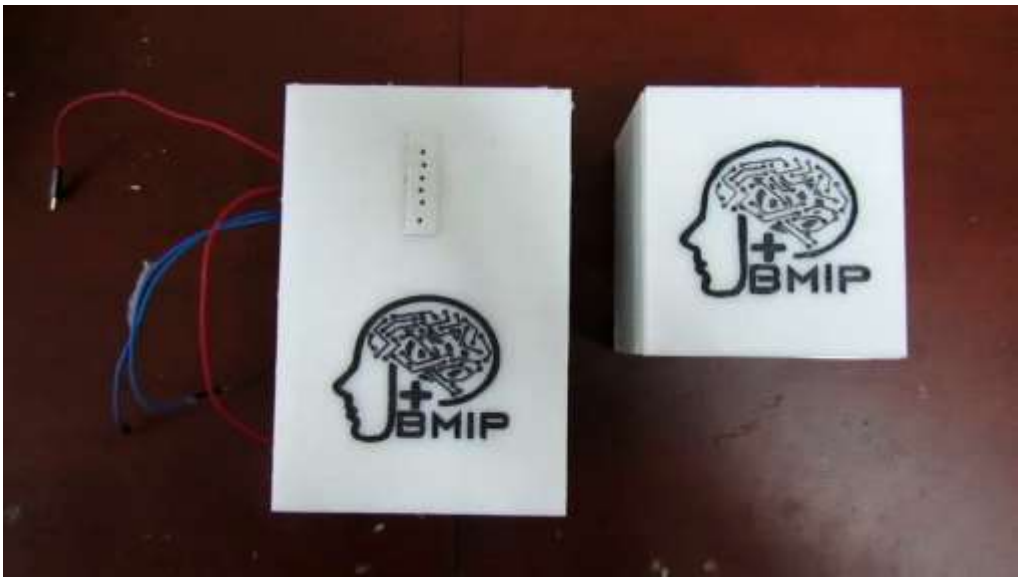
Paralyzed person has a clot in the brain cells that blocks the signal transmission from brain to muscle. To solve this problem, we introduce the brain to muscle interface for paralyzed (BMIP) technique. The BMIP will act as a direct interface between brain and muscle by bypassing the clotting between them. This interface helps brain to control the muscle movements according to his thinking and concentration.

The wearable glove that is attached to the controlling person contains the EMG electrodes which tap the excitation produced due to the corresponding movement and it is then converted into an EMG signal. We use TENS (Transcutaneous Electrical Nerve Stimulation) device that provides electrical stimulation for excitation. The headset contains 16 EEG electrodes in total(14 live electrodes & 2 reference electrodes).These electrodes are placed in contact to the necessary nerve excitation points in head. Arduino is used as an interface between the spiker shield, TENS device and the hand gloves. Most of the product parts are 3D printed.

The person controls the movements by thought and it's an efficient way of helping the paralyzed to do their real time activities.




Measures EMG
Sensitivity
>
Threshold
No
Yes
Turns ON Relay
Stop


BMIP
BMIP

OUTCOMES OR TEST RESULTS

We have tested this device on a village lady named Mallika. Her right-hand finger was not moving for one year. Hence, we have placed this device on her hand and placed the BMIP headset to her head so that the brain signals could reach her hand. After the setup was done, we asked her to think about moving her fingers. The signals from the brain is bypassed to her hand via our device and a pulse signal is given to her hand by TENS device and finally, after one year her fingers moved by her own thoughts.

The video link of this testing is attached below.

https://www.youtube.com/watch?v=TBGHGflR2GM

Product Description Video Link:

https://www.youtube.com/watch?v=_0_dCyzED70

COST OF PRODUCTION

Total cost of production – approximately 7600 INR

Expected Pricing - 10000 INR

SIGNIFICANCE

- Low cost
- It can be used by a common man without the help of an expert medical professional
- Exoskeleton and other devices can be made precisely for single person use but BMIP can be used on any person, thus making the product commercially viable.

The MMIP product is a path breaking innovation which can help a great deal to people who suffer from paralysis, such that within the next 5-10 years after the commercialization of the product, the paralyzed people can also bring in productivity at par with the common people today.

We have started and have only performed movement in the hands of the controlled person, and that too up to a certain extent. If after taking certain research considerations and studies are conducted, we can bring in the hand movement in full capability. We can also not only perform the movement in the hand of the controlled person, but if the vein anatomy of the legs are studied

and if nerve tracing can be properly done from the legs, we will be able to instill the walking movements in a paralyzed person.

If a paralyzed person is able to walk with assistance, that could be something which could be a scientific invention that would blow every invention that has been made in the 21st century out of proportion. Further, we can also undergo studies on how to remove the assistance part and bring in movements in a paralyzed person using his or her own free will.

ACKNOWLEDGMENT

First and foremost, we thank God Almighty for leading us to the realization of this project. We take this opportunity to thank, the principal of SSET Karukutty, Prof Praveensal for providing all the facilities that allowed me to complete this project. I also extend my gratitude towards the HOD of ECE Department, Prof Dr.Saira Joseph for her constant support.

This project would not have been a success if not for the timely advice, guidance and support of our project guide Professor Dr. Sunil Jacob, I express my sincere gratitude towards him. I would also like to express my sincere gratitude to the lab assistants for their valuable help and support throughout the work on this project.

I thank all my friends whose help and support were indispensable for the successful completion of the project. I convey my whole-hearted gratitude towards my parents.

REFERENCES

Research works and publication of our work by our guide Dr. Sunil Jacob

https://ieeexplore.ieee.org/document/7947299/

https://transmitter.ieee.org/makerproject/view/250b5