

NEUROTECHNOLOGY FOR SUPERIOR BRAIN

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Abstract - One of the clinical solicitation is neurotechnology. But for the technology to work, it needs to be implanted in brain with the help of surgery and hence can be worked or simulated. It generally records the neural signals and tend to decode the output signal thus gained and so the disable person can have movement of their body part with the help of artificial arm or anything else fitted over there. It can be implemented with the help of a source that is a battery or any supply energy source like induction coil so that the device should work properly. Such cause is accomplished by a device call as AIMD that is Active Implantable Medical Device. It can be implanted in a human body completely or limitedly. 30 days and plus are sufficient for that device to be safe in any human body.

1. INTRODUCTION

AIMDs are specially invented for the treatment of some neurological problems in the nervous system and some disorders of the brain, and these applications in the field of brain study is called as neurotechnology, or in short we can say neurotech. Examples of such neurological problems are stimulations for Vagus nerve or deep brain and also surgeries like Parkinson's disease, obesity, leprosy, chronic pain etc.

Moreover, there are lot many things to be evolved in respect of neurological problems or we can sat neurological disorders. In the era of high resolution that is 21st century many of the applications of AIMD has evolved, also in the area of brain computer interfaces (BCI). There are trails going on for the wireless transfer of intracortical BCI in a human brain. Such trails are going under Neuroengineering and biological center Wyss. There are many challenges faced by such institutions to evolve the wireless BCIs also some other technologies are made available to reduce the mitigate risks which is suffered by human brain.

1.1 WORKING OF AIMD

The human structure, what we call it as a human body is having an exceptional habitat. It is greatly antagonistic for certain implants because a human body is humid, warm, sweet, salty, moderately movable, greatly oxygenated, flexible, varying, sensible, and soft. But even the worst case is of the brain since it is having reactions of various Foreign Bodies to the implants that initiates or activates the macro tissues or cells which can stimulate Reactive Oxygen Species (ROS). Hence, for neurotech AIMDs to cope up with such varying parameters of human body, AIMDs should go through some barriers. Or we can say that AIMDs should be designed in such a way that they should possess following technical parameters to work successfully.

Electronic systems contains active devices, which are moisture sensitive. Those devices should be packaged in following manner.

1. Hermiticity

There should be precautions made in any electronic systems that it should avoid leakage of gas and certain fluids, over many years or more than 10 years. Also the materials should be chosen such as it should prevent corrosion and proper insulation to the devices should be maintained so that toxic gases or toxic materials, chemicals are not coming out of the systems. Also the material chosen should pass on certain tests like resistivity, mechanical effects, electrical effects, heating effect or heat dissipation.

2. Biocompatibility

Since the system is implanted in human body it comes in contact with tissues and body cells, so there should be zero flow of toxic gases or toxic fluids. These toxic substances can be formed by some soldering or blending of two materials on top surface of the device. Examples of such toxics substances are lead, copper, aluminium, indium, steel, gallium, etc. To prevent all such things there are some standardized guidelines given by ISO 10993 for checking such biocompatibility issues.

3. Bio stability.

Insulating materials used in AIMDs which are transplanted in human body should work very specifically that means it should target those organs which are meant to be affected, such should be the packaged material of AIMDs. For this purpose again ISO 10993-9 has given some guidelines for deterioration of AIMDs after implantation in human body.

4. Sterility.

Sterility itself in biology means that ineffectual in duplicating or increasing. That means the device itself should kill the germs whichever are present there. These sterilization methods can be through irradiation gas or through some chemical treatment.

5. Cleanliness

Cleanliness is the major concern while forming such devices. It should take care of dirt particles, dust, oil etc. For such precautions there should be assembly of clean rooms in the labs.

These are some of the basic precautions to be taken care off, with respect to these precautions, now-a-days, there is increased protection against electromechanical radiations. These electromechanical radiations are mostly caused by mobile phones.

2. NEUROTECHONOLOGICAL PROBLEMS RELATED WITH SENSING

Antecedent relationships between the human behaviour which is measured through its brain functioning and the electronic devices are the drastic queries occur in the neurotechnology.

There are various level of brains which can be differentiated at various levels of complexity. These complexities of brain are given by certain level, and all those levels should be taken care. The levels of complexity of brain are regional, connectivity, columns, circuits, neurons.

Working area of brain is described in regional area, which are given by some activity patterns. In the connectivity level, all the dynamic functions are interrelated with cells and cell convention of the brain. Column level describes the response properties with the interconnections in a proper structure. All these interconnections are managed by specially columns which are grouped together. Neuron networks are especially live like a defined calculated circuits, like a strip formed by cortical. This is all about circuit level of brain's complexity. Final level of brain complexity is neuron level. At this level, rebuild neurons and circuits are present. These neurons are individuals irrespective of groups and circuits are composed of spikes and potentials which are present there itself. There are various sensing methods present for this purpose. Sensing methods are EEG, MEG, FNIRS, and FMRI. These are electromagnetic sensing methods, magnetic sending methods etc. The sensing is done by sensing neural activities comparing the primary activities of the respective person. These primary activities are recorded by sensing type of electromagnetic sensing method and magnetic sensing method. There are some secondary activities which are performed by the brain are these secondary activities are brain metabolisms. FNIRS and FMRI are the sensing techniques used for recording such secondary activities. FNIRS is Functional near- infrared spectroscopy and FMRI is Functional magnetic resonant imaging. FNIRS works as when the light sources which are infrared in nature and detectors helps in measuring the upward flow of blood oxygen. FNIRS is highly portable. And thus any changes in blood's vital components can be sensed using MRI machine, example haemoglobin. The problem accompanied by this is that many techniques are evolved and there are complexity for brain level which is having advanced or ample of temporal sampling and spatial sampling having different portability profiles.

2.1 STIMULATIONS FOR NEUROTECHNOLOGICAL DEVICES.

There can be many ways of stimulations called for neurostimulations. One major factor used for stimulations can be electrical stimulation which possesses transracial stimulation. Transracial stimulation can be short formed as tCS. This stimulation method is becoming more popular compared with other types as this technique can easily stimulate the signals of brain functioning. Also tCS method of stimulation is inexpensive to work with. In US, they have been using direct current stimulations

There is also a type of stimulation called tES stimulation in which scalp is exposed to electrodes. So the artificial brains that is AIMDs directly targets the natural human brain. Electromagnetic field and neural imaging are the most widely used area in the neurotechnology.

3. CONCLUSION

Device, its application, interest of a researcher, user's experience plays a vital role in usability of neurotechnology. Now-a-days neurotechnology have been evolved in such a way that it's not only the indoor game left with the people, it has evolved in mobility also. The researchers are now interested in humidity and temperature control as, temperature and humidity affects human's sweetness and oiliness which leads to change in electrode capacitance, which is not desirable. Many of the devices made are battery operated and low power, in future it is opted for advanced power and for long time application. Such high power devices can be used for military applications, which requires immediate results.

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