International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 3, Issue 1, January 2014

A Technique of transferring Visual Information between the brains – An Eye to visually impaired persons:

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ABSTRACT-This thesis details about the transmission of Visual Information that is being seen by one person, to another person so that such information makes the second person's brain to visually percept the image from such transmitted information. Through this thesis I had explained my idea of transmitting visual information from one person's brain to another. Here, in this project the transmission and reception process obeys the earlier available techniques, except the source from which the information is got and also except the usage of such information. This transmission uses Internet facility to transmit such information by creating a separate database. Finally when information is received from internet it is again fed to brain, so as it could perceive the visual information.

I. INTRODUCTION:

Our human brain is the Central Processing Unit of the Human Body (which is considered as a complicated Device in my point of view). It controls each and every activity of our human body. Without its order not even involuntary actions are performed in our body. In this thesis my main objective is just one of the major parts of the human body, that is EYE. It is a well know fact that the image which we see is just a perception of our human brain. When we say this the question that arises in our mind is, "Can't we provide such perception artificially?" The answer is yes we can. But one of the limitation is that the brains electrical activity is not completely studied, and hence we cannot artificially generate such signals, as the probability of harmful effects that this may cause is much high. At this condition the solution to this problem could be the transfer of visual information from one brain to another brain. It is because of the fact that each and every person's anatomy of human brain is same. Though they perform different actions at different time, the intensity of signals that is generated by the brains of different person for a same activity is more or less same. Thus this could be made possible as the brain can understand the corresponding signal of other brain. Thus through this thesis I present a system of techniques through which we can transfer the information (Visual information) from the brain of one person to the brain of other. The basic elements used are,

→EOG

→Eye activity signal imagery detector

→TMS

After providing an insight to these basic elements, I have explained the proposed model, Advantages, and Application has been discussed.

II. BASIC ELEMENTS:

A. ELECTO-OCULOGRAM (EOG):

An electro-oculogram is a technique of recording the electrical equivalent signal of corresponding eye movements. It records the signal that can be used for measuring the resting potential of the retina in the eye. By taking this measurement one can determine which way the eye is looking.

The human eye is polarized, with the front of the eye being positive and the back of the eye being negative. This is caused by a concentration of

ISSN: 2278 – 909X

negatively charged nerves in the retina on the back of the eye. As the eye moves the negative pole moves relative to the face and this change in the dipole potential can be measured on the skin in micro volts. To translate this voltage into a position, two sets of electrodes are used to measure the differential voltage in the vertical and horizontal direction. Figure 1 indicates how the electrodes are placed on the face. The red and black leads measure movement in the horizontal direction and the white and brown leads measure movement in the vertical direction. The green sensor is placed behind the ear or on the ear lobe to provide a ground reference.

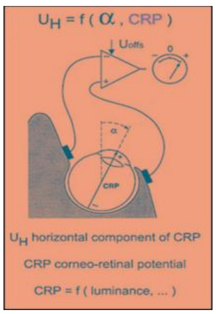

Figure 1. Top view of a cross section of an EOG measurement; demonstrating sensor placement as well as the dipole of the eye and equations used for determining electric potential between the sensors.

Using these leads we can translate each change in voltage into a change in the eye's position. If the eye looks to the right for instance, the positive pole of the eye will be nearest the right side sensor causing it to read a positive voltage while the back of the eye will be nearest the left side sensor causing it to read a negative voltage. From the voltage potential between these two sensors the left/right position of the eye can be determined. The same technique is used to determine the vertical position.

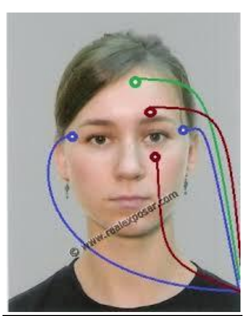

Figure 2. Shows the points where the electrodes should be placed so as to record the electrical activity of eye.

B. EYE ACTIVITY SIGNAL IMAGERY DETECTOR:

It is one of the image processing techniques that which processes the input signal, contains the information about the Electrical signals of Eye, and compares it with the input signals, so as it allows only the desired signals at the output as it eliminates the unnecessary signals like noise and various other signals.

I/P Brain s/l o/p Eye s/l

C. TRANSCRANIAL MAGNETIC STIMULATOR:

Magnetic stimulation is a non-invasive method of stimulating the brain and peripheral nervous system using induced currents. When used to stimulate the brain it is normally referred to as Transcranial Magnetic Stimulation or TMS.

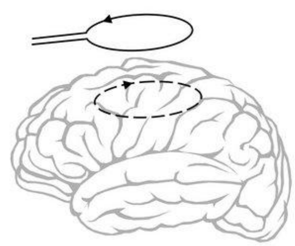

Figure 3. Axons and nerve endings in brain.

Magnetic stimulation can be used as an alternative to conventional electrical stimulation of nerves in some applications because it has a number of advantages. Applications include deep peripheral nerve stimulation and the non-invasive and painless stimulation of the human brain, both to elicit responses directly and to modify excitability and plasticity.

Background

Electrical stimulation of nerves and muscles was first shown by Galvani and Volta in the 1790s and its mechanism is now well understood[1]. Such stimulation, whereby excitable membranes are depolarized using current injected into the body via

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surface or implanted electrodes, is today widely used in both diagnosis and therapy. Examples of the former include measuring the speed of conduction of nerve action potentials in health and disease, and of the latter to stimulate muscles whose neural connections have been compromised to produce functionally useful contractions. Typical pulse parameters used to stimulate superficial nerves via surface electrodes are of the order of 20mA for 100µsec, with up to 250 volts needed to drive this current through the relatively high electrical resistance of the skin. Whilst very effective in many applications, electrical stimulation has some disadvantages. It can sometimes be painful, it is difficult to stimulate deep structures non-invasively, and the human brain is relatively inaccessible because of the high electrical resistance of the skull.

Practical implementation

Typical parameters of the magnetic field pulse required to depolarize nerves include a rise time of order 100µsec, a peak field of order 1 Tesla (depending on a number of factors including local anatomy and the stimulating coil geometry) and magnetic field energy of several hundred joules. The circuitry used to generate the magnetic field pulses is usually based on a capacitor discharge system (shown in its simplest form in figure 4) with typical peak coil currents in the range of several kilo amps and discharge voltages of up to a few kilovolts. The relatively high voltage is required to give the required rapid rise of current into the inductance of the stimulating coil. The choice of rise time is a compromise between minimizing the effect of charge leakage due to the time constant of the nerve membrane and the low inductances and high voltages required to give the shorter, and potentially more efficient induced stimuli[4]. In order to keep the coil resistance as low as possible it is usually wound as a spiral of either solid copper or Litz wire having a cross section of several square mm.

The circuit of figure 4 produces so-called ‘monophasic’ stimulating pulses in the tissue. This is not strictly true because the induced fields are inherently charge balanced, i.e. the charge induced in the tissue integrates to zero over the duration of the magnetic field pulse, the induced current flowing in one direction in the tissue as the magnetic field rises and then in the opposite direction as it falls. However it is a useful description because it indicates that stimulation will occur during the first phase of the induced electric field, corresponding to the rising edge of the applied magnetic field).

The disadvantage of the circuit of figure 4 is that all the energy in each pulse is subsequently dissipated in the diode/resistor combination which controls the decay of the magnetic field. If fast repetition rate (tens of Hertz) stimuli are required then the use of an oscillatory magnetic field waveform, approximating to 1 cycle of a sine wave (resulting in a cosine induced field), is used in several commercial designs as this enables the energy from each pulse to be partially recycled and used again for the next pulse. Circuit losses at present limit this recycling of energy to about 60% of the initial energy.

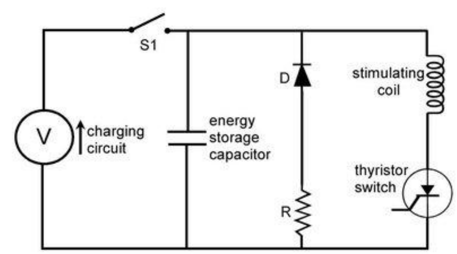

Figure 4. Circuit diagram of TMS

A number of stimulating coil geometries have been proposed but the only ones which are widely used are either circular or ‘figure-of-eight’[5]. The latter, which takes the form of two circular coils placed next to each other and connected such that the induced currents from each add on the midline of the combined geometry, partially addresses one of the main limitations of the technique, namely that of uncertainty as to the site of stimulation. The circular coil induces concentric current loops in the tissues whose amplitudes are zero on the axis of the coil, rise to a maximum approximately under the mean diameter of the winding and then decay at greater distances from the axis. Stimulation can occur at almost any position on these diffuse current loops and as circular coils can be as large as 100mm in mean diameter this can result in considerable spatial uncertainty as to the site of stimulation in the body. In contrast, conventional electrical stimulation of superficial structures normally occurs relatively close to, and beneath, the cathode electrode. The figure-of-eight coil, by inducing two adjacent circular current distributions which sum together, has higher induced current densities in the tissue below its midline (by a factor of about two) and hence is more likely to stimulate on this midline when used at intensities just above threshold. The use of multiple small coils to achieve more localized stimulation has been investigated[6] but has not been implemented in practice because the additional gains are small. Selective stimulation of a small volume of tissue at

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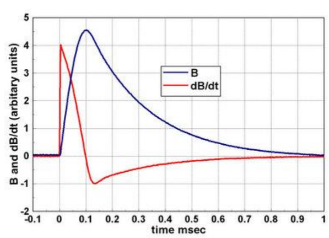
depth has not proved possible because the magnetic field, and hence the induced electric field, decreases and become more diffuse with distance below the coil. Thus, whilst greater depth of stimulation can be achieved by the simple expedient of increasing the stimulus strength, this inevitably results in more intense stimuli closer to the surface of the body

The construction of practical stimulators presents some engineering challenges because of the high voltages and currents being delivered to the stimulating coil. Continuing technical advances have addressed some of the limitations of the early hardware, such as stimulus repetition rate, and modern stimulators which can run at tens of stimuli per second are now widely used. However, there is scope for more development, particularly in the areas of coil cooling, electrical efficiency and the use of ferromagnetic materials in coil construction.



III. PROPOSED MODEL:

Through this thesis, I propose a model to transfer the visual information form one person's brain to another. As mentioned above, the Electro-oculogram and TMS are the core component of this model. The Electro-oculogram which records the electrical activity of the brain is first sent for image processing.

Then the processed image is sent to the "Eye activity signal detector", which contains a pre-defined series of information about the various electrical records caused due to activity of eye. The output of EOG is sent to this device, and it compares the input image with pre-defined image information, and allows only the Electrical Signals caused due to corresponding eye activity. Moreover it rejects the unwanted (considered as noise signals).

The next stage is that the Electrical information caused due to activity of the eye, is sent to the "Internet cloud".

The transmitted signals are again received by the Receiver at the reception end, and then the equivalent amount of information is generated at the receptor side. Once again it is sent to the "Eye activity signal detector", which allows only the desired signals at the output.

It is then fed to the TMS-Transcranial Magnetic Stimulator, which produces "Magnetic equivalent" of Electrical signals received from the data transmitted.

Next comes the striking phenomenon,

"When the magnetic field strikes the conductor, a current is produced in perpendicular direction."

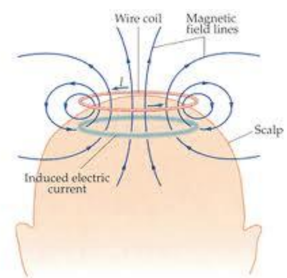


Figure 5. Electric current induced due to perpendicular magnetic field.

According to this, the TMS placed at the outer surface of head of another person, just behind the ears. The reason to mention this place is that it is the place where "Optical Nerve" is present which is connected to "Visual Cortex" of the brain, actually where the visual image is perceived in the brain.

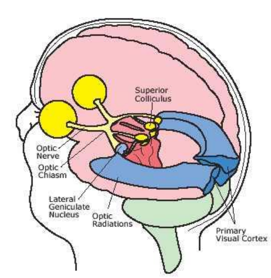


Figure 6. Shows the position of visual cortex and optic nerve in brain.

When the TMS is placed at concern position, it produces magnetic field which induces electrical current in optic nerve. According to the information received the electrical current is induced in the optic nerve. Thus the concern image is perceived in the other person's brain.

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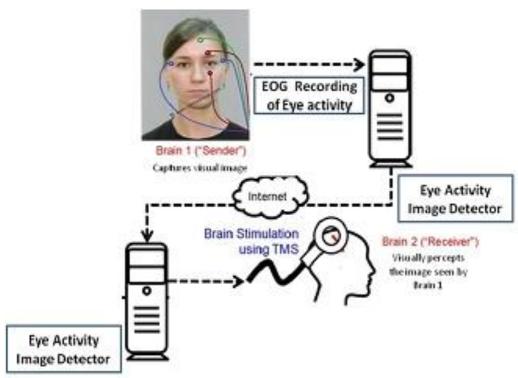
IV. BLOCK DIAGRAM OF BRAIN TO BRAIN VISUAL IMAGE TRANSMISSION:



V. ADVANTAGES AND APPLICATION:

This thesis provides a detailed manner of Transfer of Visual Image captured by Eye of one person to the visual perception of other person's brain. The main application of this technique is that the Blind persons can be provided with a means of visual perception, as this does not require the function of Eye to visually perceive the image. But the major limitation is, this technique cannot be applied to visually impaired persons whose optical nerve or visual cortex is affected. It can be implemented in persons whose eye or retina is affected. It can also be used in various security purposes.

VI. LIMITATIONS:

One of the major limitation of this proposed model is that if this visual information is transferred to a normal person who doesn't have any visual defects, the image actually captured by the person and the signal generated from the information transmitted may mix and there is a fear of collapse in the signal that reach the visual cortex of the brain.

VII. FUTURE ENHANCEMENT:

Now this technique is proposed for transfer of image seen by one person to another person. But it will be more helpful for the visually impaired person, if this technique is proposed by directly transmitting the image from a device like video camera to the Optic Nerve of Brain, so that they could take it along with them where ever they go and it will be sight for them. Hope this would come in future…….

VIII. CONCLUSION:

Finally to conclude, as this technique is non-invasive, it does not cause any harmful effects to the brain, and it has been practically proved in various cases. Thus this technique of transferring the image captured by one's eye to the perception of another's can be used in various applications to a great extent.

IX. ACKNOWLEDGEMENTS:

I wish to thank the faculty members, management of my college, my parents, and my colleagues for their kind encouragement and support.

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