Wireless Based Visual Prosthesis System Using Artificial Silicon Retina

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Abstract- *According to a recent survey done on the number of visually impaired people in the world, it is found that about 285 million people in the world are blind of which 246 million have low vision and 39 million people in the world are completely blind due to the diseases such as macular degeneration, retinitis pigmentosa and glaucoma. Medical treatments are available to slow down the process of these diseases but there is no complete cure for regaining the lost vision. This paper is about visual prosthesis system where the blind is enabled to see the world virtually.*

I. INTRODUCTION

This system comprises of a digital camera lens focused to an ASR, where the electrical impulses of the image is directly fed to the visual cortex of the brain using several micro sized electrodes. The brain slowly interprets these signals into vision. Thus, this system is a hope for many of the visually impaired people around the world with multi sensory defects also.

II. LITERATURE SURVEY

2.1 BLIND AUDIO GUIDANCE SYSTEM

AUTHOR: Arjun Sharma, Rahul Patidar, Shubham Mandovara, Ishwar Rathod

PUBLISHER: Institute of Electrical and Electronics Engineers

DESCRIPTION

This system uses IR and Ultrasonic sensor for detecting an obstacle before it. Then output of the sensors will be processed and based on the sensor output, an instruction already fed in the microprocessor will be heard in the microphone as the system output.

PROBLEM IDENTIFIED

This system uses ultrasonic and IR sensor for detecting only the distance of the object before it. It can't be used to predict the object's physical characteristics, so it can be used only for indoor applications. And also it can't be used for the deaf people.

2.2 BLIND NAVIGATION SYSTEM USING RFID FOR OUTDOOR ENVIRONMENTS

AUTHOR: Kushagra Tandon, Tanuja Pande, Mohammad Adil, Govind Dubey, Amit Kumar

PUBLISHER: Institute of Electrical and Electronics Engineers

DESCRIPTION:

This system uses RFID and Electronic Orientation Aid's(EOA) for the navigation of the blind people in both indoor and outdoor environment. It was developed with help of KEIL software and EC Lab.

PROBLEMS IDENTIFIED:

This system requires line of sight for the IR sensor and active transmitters must be installed on every place and requires unlimited power supply. Upon the technical disadvantages this system has many limitations in the capability and it is not cost efficient technique. And even this system also can't be used for deaf people.

2.3 USING ULTRASONIC SENSOR FOR BLIND AND DEAF PERSONS COMBINES VOICE ALERT AND VIBRATION PROPERTIES

AUTHOR: Mahdi Safaa A., Muhsin Asaad H. and Al-Mosawi

PUBLISHER: Institute of Electrical and Electronics Engineers

DESCRIPTION:

This system also uses ultrasonic sensor for the detecting the obstacles but the output of the system has to devices (i.e.,) an buzzer and an vibrator. When an obstacle

was found before the ultrasonic sensor based on the settings, blind people will be warned using the audio system(eg: buzzer) and deaf cum blind people will be warned using vibrator.

PROBLEM IDENTIFIED:

In this system the person who is both blind and deaf is enabled to navigate with the help of ultrasonic sensor. But, the person who is deaf can only sense the vibration of the obstacle alert. He/she cannot be able to recognize or understand what kind of alert it is. This is the drawback of the system.

2.4 ARTIFICIAL VISION FOR THE BLIND BY CONNECTING A TELEVISION CAMERA TO THE VISUAL CORTEX

AUTHOR: W.H.Dobelle

PUBLICATION: ASAIO Journal 2000

DESCRIPTION:

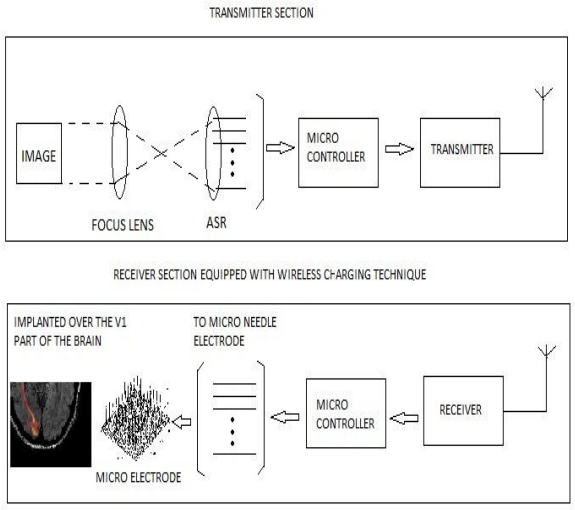
This system was somewhat advanced compare to the above proposed systems. In this system, an digital camera is used to capture the video signal and a big processing unit is used to convert the images into an audio signal. These audio signals are carried through group wires into the skull and fed to the visual cortex by using micro electrodes.

PROBLEMS IDENTIFIED:

Here author proposed a system with help of digital camera and digital signal processor since it can't give proper electrical impulses required for the visual system of human and also human visual system consist of 125 million photoreceptors which requires separate electrode for separate receptor. In this system there are only 64 electrodes are used which results in poor imaging.

III. PROPOSED SYSTEM

Our proposed system enables the visually impaired people to see the world virtually without the help of their eyes. To implement this system a small microsurgery needs to be performed inside the patient's skull exactly on the visual cortex in order to impound receiver and micro sized electrodes over the visual cortex. The person is given a pair of coolers embedded with digital camera lens to wear. This lens will focus the images to the Artificial Silicon Retina(ASR). The ASR converts each pixel of the image into equivalent electrical signals. These electrical signals are given to the visual cortex using the micro sized electrodes through a wireless transceiver. The brain slowly learns to interpret these electrical signals as sight. Thus, the person can able to see.



WIRELESS BASED VISUAL PROSTHESIS SYSTEM USING ARTIFICIAL SILICON

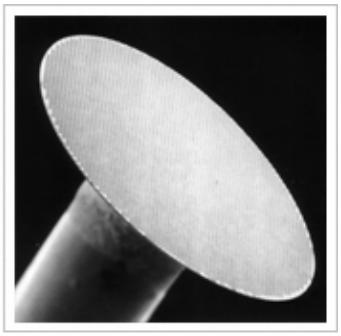
IV. MATERIALS AND METHODS

4.1 FOCUS LENS:

A high-resolution focus lens is required for this system. The optical energy from the image is focused to the ASR.

4.2 ASR (Artificial Silicon Retina):

ASR is a very tiny integrated device with a diameter of 2 mm which is thinner than human hair. It has large number of solar cells (photodiodes) integrated in them. These photodiodes are used to convert the optical energy of each pixel from the images into electrical signals for a particular electrode.



Magnified image of an ASR® device

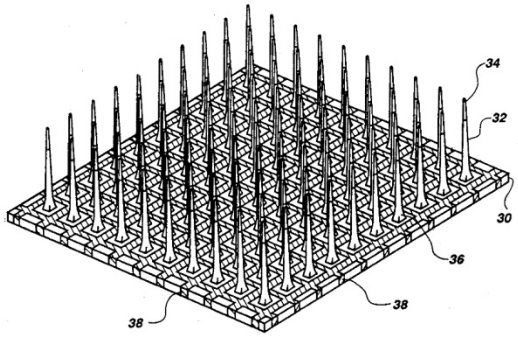
The ASR does not require any kind of external power to perform its operation. It attains power from the light falling on over them. In human eye we have cones and rods for converting the light into electrical signal. The ASR can do this process as like the human eye system.

4.3 WIRELESS TRANSMITTER AND RECEIVER:

The above process will be done in the outer side of the skull which is a transmitter section. The receiver section consist of an microprocessor which receives the electrical impulse from the ASR and fed it to the corresponding micro electrodes. The connection will be done using Wireless-Fidelity(WIFI) technique. The transmitter is charged outside the skull so it can be charged externally but the receiver will be inside the skull so it will be implanted with an lithium battery and a wireless coil charging technique to recharge it. When the charge of the receiver is down it can be recharged using this technique easily without any pain and harmfulness.

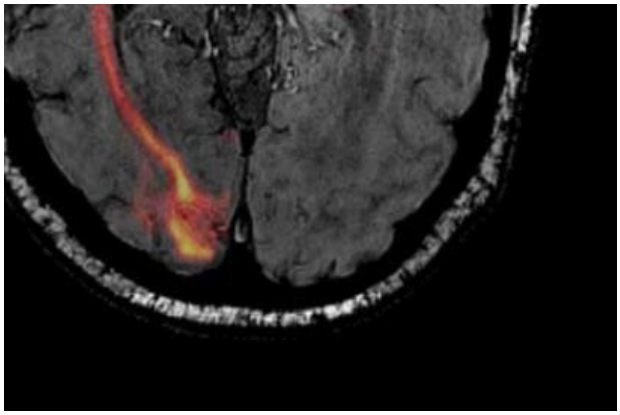
4.4 MICRO ELECTRODES:

Micro Electrodes are very tiny bio electrodes basically used for receiving a very accurate signals. In this system we use this micro electrodes to give the signals directly into the visual cortex. These electrodes are places exactly over the neurons of the visual cortex.



4.5 IMPLANTATION:

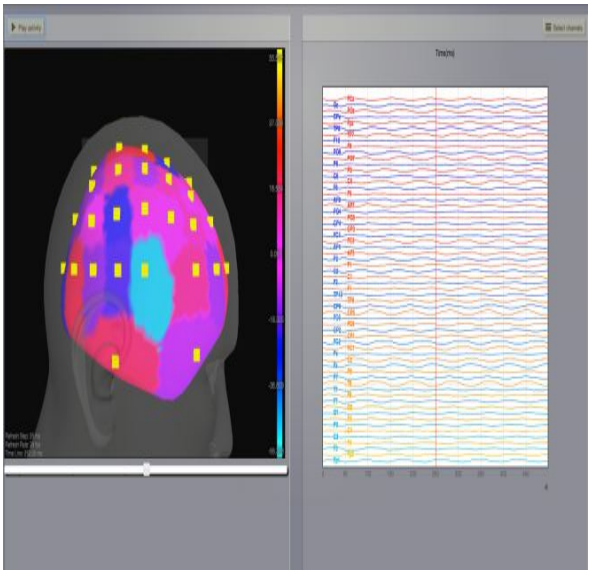
A microsurgery needs to be done in the patient's skull exactly on the visual cortex in order to impound the micro sized electrodes. The electrodes need to be punched through the pia mater of the brain at a particular speed using finely equipped instruments. A high resolution MRI scanning or a stereotactic imaging can be used to locate the exact position of V1.



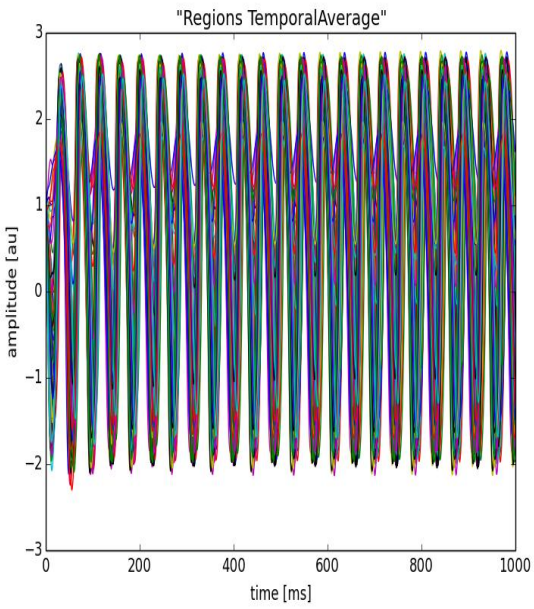
V. RESULT

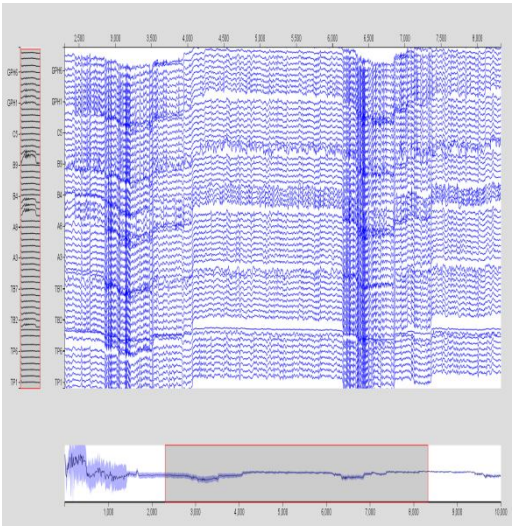
Electric brain potentials were recorded from 32 electrodes mounted on elastic cap including cz electrode as reference and masteroid electrode as ground.Data acquisition is made at 1000Hz with synamps recording system coupled with pc.Impedance is kept below 5 kohm.The main objective is to get the alpha waves with best resolution from the posterior side of the occipital lobe where the visual cortex is present.

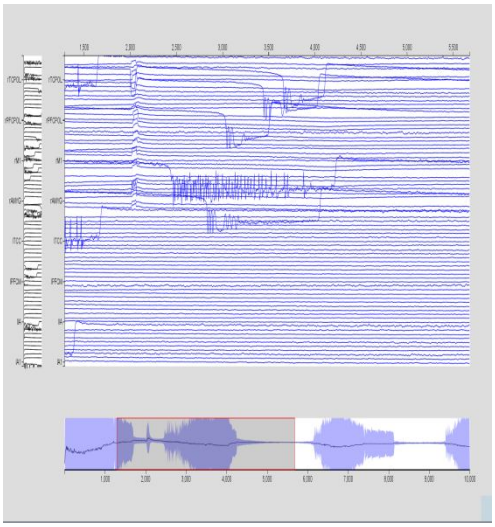
MONTAGE DIAGRAM:



SIMULATION OUTPUT:







VI. CONCLUSION

From this paper the resultant output brings the hope for the people with complete blindness and deaf cum blindness to see the world. Because of the microelectrodes the visibility of the object will be more clear than the previous systems. Because of the wireless technique used, this system is more compact and painless method to obtain the vision. Though it requires high cost for implanting, the vision of the blind people can be completely achieved.

VII. FUTURE WORK

The system implementation can give blind people vision better than any other systems proposed before. But the vision achieved will have no color in it. So in future, research can be done to improve the system to provide colorful vision to the blind people.

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