Vision Substitution Using Photosensitive Array

Implementation of photosensitive sensor array to by-pass the function of eye to transmit signal of visual to the optical nerve to assist blind person to see actual world as it is.

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Abstract: : Study and experiments done by international team of researchers Co-lead by scientist at Washington university school of medicine in St. Louis has found that the certain condition, the retina can sense infrared light concluding that optical nerve of human is able to conduct the wavelength and frequency lies in the range of infrared light. In addition, Infrared light is able to penetrate more than 5 mm of skin. Considering and merging this two concept, converting visual signal of camera in the range of infrared wavelength and then impose on eye and possibly nearer portion of visual nerve, consequently will acquired by visual nerve which will transfer it to visual cortex as usual for giving vision to blind person.

Index Terms **– Camera/Image Sensor, Magnitude Comparator and pulse generator, Optical fiber, array of infrared diodes.**

I. INTRODUCTION

Vision is integral part of Human body plays pivotal role in vision, reacting and balancing of entire body. Initiating with the physiology of the eyeball to understand the basic fundamental information. The visuals are captured by the reflection of light from object falling on it. Eye is divided in several layers and cavity to propagate and concentrate visual on retina. First, reflected light which is lying in the range of visual electromagnetic spectrum are pass through the cornea and continue propagation toward retina by passing through anterior chamber of eye, lens, posterior chamber of the eye respectively. It propagate to reach at retina which is innermost layer of the eye, delicate and sensitive to adapt light signal. Light sensitive cells are lying beneath the retina are activate by light falling on retina. Identification of color or black and white image is done because of this cells. This nerve impulses are conveyed to cerebrum through lateral geniculate bodies.

In case of accidents, infection, cataract, macular degeneration vision becomes injured and loss of sight happens. Implant Bionic eyes, artificial eye, Surgeries are recommended to revert blind individual with vision and let him persuade regular activity normally. Surgeries are quite complex and convoluted, every surgery does not state successful result. Hence many people afraid of surgeries and elect to stay away from it by choosing vision substitute equipment to support themselves in actual world.

II. RELATED WORKS

In 2002, Mass of reported that approximately 3% of Caucasians 65 and older and 5% of African American 65 and older were visually impaired. The Society for the Prevention of Blindness has determined that less than 10% of these people are totally blind and 80% of them have usable vision that could potentially benefit from vision rehabilitation. The portion of America's Population that is older than 85 is the most rapidly increasing segment. It is estimated that by 2040, 12 million people in the United States will be older than 85.7. There is going to be an increasing need for vision rehabilitation over the next few decades! Furthermore, the United States needs to develop a system by which this form of rehabilitation can be provided to older adults.

Over the last few years, significant changes have occurred in Medicare funding for vision rehabilitation services. On January 1, 2000, Medicare policy took effect that provided for occupational and physical therapists to provide vision rehabilitation services such as training with optical devices to improve vision, training for driver rehabilitation when possible, and training for balance and independent mobility. However, gaps remain in Medicare's funding of vision rehabilitation services for older adults. Medicare does not provide funding for optical devices to help older adults maximize remaining vision. Professionals trained specifically to work with patients with visual impairment do not receive Medicare reimbursement for their services (low vision therapists blind, rehabilitation teachers, and orientation and mobility specialists). Congressional legislation passed in December 2003 mandates a report from CMS in January 2005 that develops a nationwide reimbursement policy for vision rehabilitation, including the services provided by these professionals. However, vision rehabilitation has yet to become a part of the medical rehabilitation model in the United States. Please to change this policy have been made for more than 2 decades.

- Neurological approach

There are many treatments and therapies to slow degradation of vision loss or improve the vision using neurological approaches. Studies have found that low vision can be restored to good vision. In some cases, vision cannot be restore to normal levels but progressive visual loss can be stopped through interventions.

- Chemical treatments

Probably, the chemical treatments are designed to slow the process of vision loss. Few of those research is done with neuro protective treatment that will slow the progression of vision loss. Despite other approaches existing, neuroprotective treatments seem to be most common among all chemical treatments.

- Gene therapy

Gene therapy uses DNA as a delivery system to treat visual impairments. In this approach, DNA is modified through a viral vector, and then cells related to vision cease translating faulty proteins. Gene therapy seems to be the most prominent field that might be able to restore vision through therapy.

- Physical approach

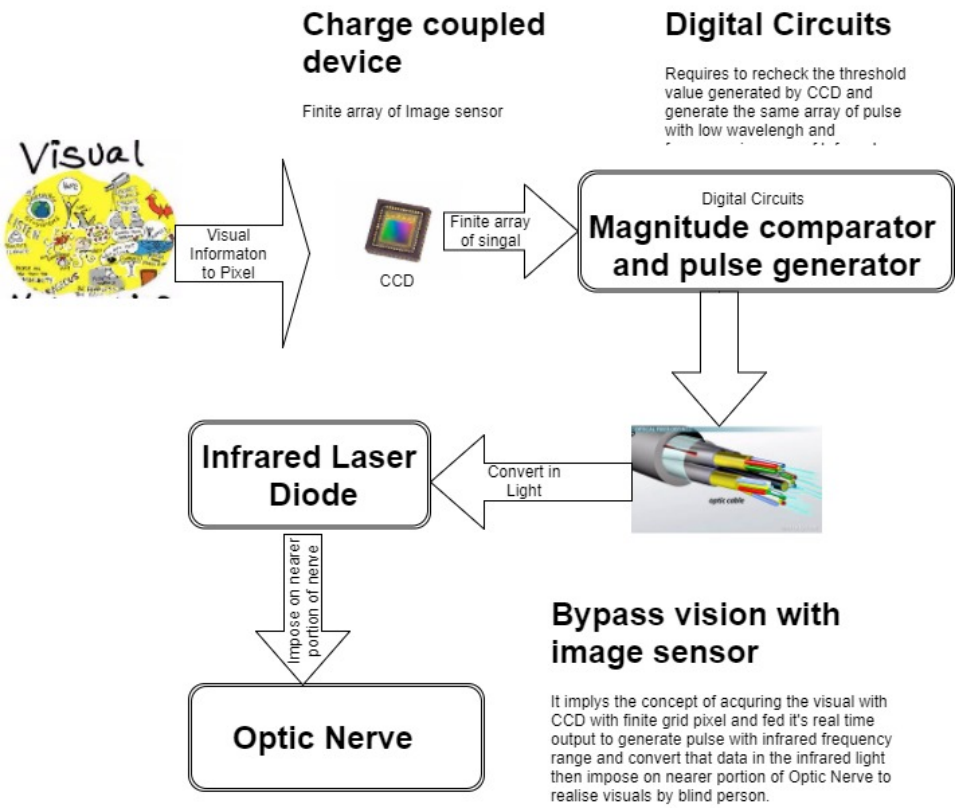
For physical approaches to vision rehabilitation, most of the training is focused on ways to make environments easier to deal with for those with low vision. Also, there are devices that help patients achieve higher standards of living. These include video magnifiers, peripheral prism glasses, transracial direct current stimulation (tDCS), closed-circuit television (CCTV), RFID devices and electronic badges with emergency alert systems, virtual sound systems, and smart wheelchairs.

- Mobility training

Mobility training improves the ability for patients with visual impairment to live independently by training patients to become more mobile. For low vision patients, there are multiple mobility training methods and devices available including the 3D sound virtual reality system, talking braille, and RFID floors.

III. RESEARCH METHODOLOGY

Vision rehabilitation is explained by the following Block-diagram. Several aspects are considered from logical approach study. The purpose of implying this flowchart is to represent possible outcome with appropriate reasons. In this method we are dealing with real time visuals are been captured by charge couple device and with some digital calculation and procedure imposing that signal on the optical nerve recognize as II cranial nerve. Prior steps to let blind person achieve vision is mentioned below accordingly.



1) Charge Couple device is employed to capture the visual in terms of digital data instead of using camera which is been developed already with digital circuits. Because camera itself with the help of inbuilt circuitry encodes data which is been captured by itself because of its Universal Standard Bus standards and protocol to transfer data. In case of direct utilization of camera it is recommended are required to decode its manufacturer protocol to receive unencrypted information of our interest.

2) Digital Circuits employs the combine use of magnitude comparator and pulse generator. Magnitude comparator rechecks the threshold value generate by grid array of image sensor when reflected flash of light falls on that sensor. It will check the intensity of threshold and will be replicated by using pulse generator.

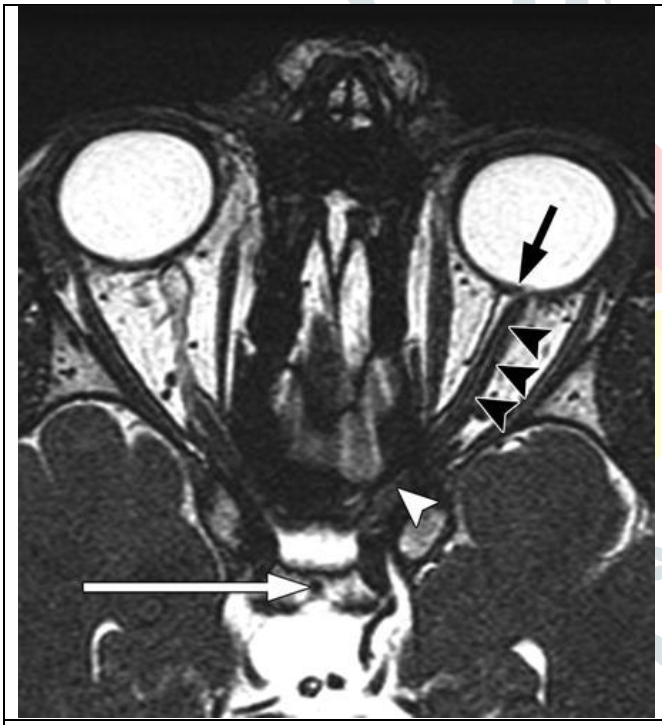
3) Pulse generator assigned with reference value of finite infrared range. Purpose of digital circuit is to compare acquired value with reference value and let generate the value satisfy the criteria of comparison.

4) Digitally windowed value is fed to optical fiber to avoid any kind of information loss may be encounter due to irrelevant medium of data transfer. Optical fiber yield higher accuracy and speed in propagating real time data because of multimode facility.

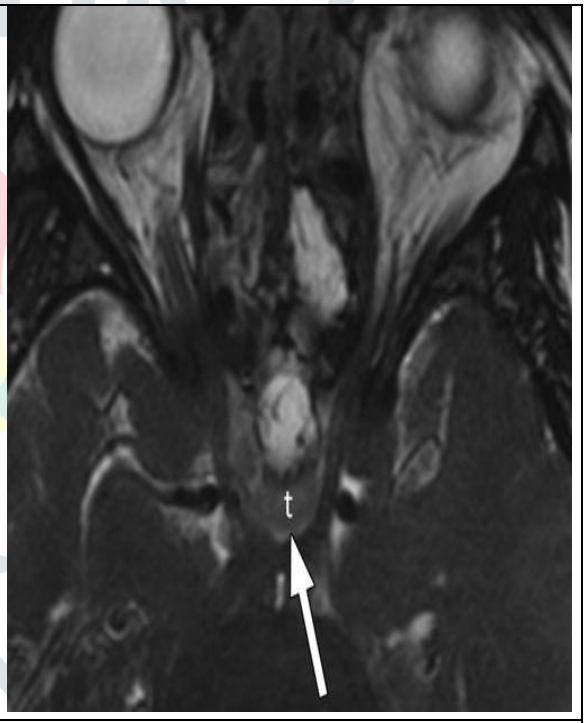
5) Digital coded data with reference value of Infrared wavelength and frequency are been fed to Infrared Laser Diode array which convert the digital data in to the concentration of infrared light.
6) Array of Infrared laser light and charge couple device should be equal in manner to achieve the same result and resolution.
7) After converting the data in meaningful way it is need to impose on the nearer portion of the Optic nerve (II Cranial nerve) since optic nerve is able to process and propagate the data comes to it and forward till cerebrum via lateral geniculate bodies.
8) Infrared light is able to penetrate more than 5 mm in skin according to research concluding that imposing that meaningful information in medium of infrared will convey it very nearer region of optical nerve.
9) Placement of IR laser diode is important because each and every nerve deal with visual is lies beneath the skull which we can't penetrate. Therefore light diodes must be place under the cavity of eyeballs.
10) Power of laser must be in limited range thus ensuring not making any harmful effect due to high power and energy.

B. RESULT AND DISCUSSION

Result of this experiment are computed logically and can be seen on either simulator or CRO, DSO and further comparison with ideal results. Output of digital circuits required to compare with ERG and Magnetic resonance imaging of the II Cranial nerve. ERG represent the result of retina impulse response according to perception of light falling on it. The same response is conveyed to II cranial nerve to achieve sight. Pigments of rods and cons which are light sensitive cells lies in beneath the layer of retina generates an electrical pulse which can be measure practically using Electro-retinography. If output of digital circuit is representing the same nature as obtained using magnetic resonance imaging it can be say that visual nerve will percept and process the visual so visual impaired person will be able to see.
Ideal result achieved using MRI of Cranial nerve II and Visual cortex are represented below as well result of ERG is also mentioned. Any changes happens in state of visual cortex and cranial nerve II/ optic nerve and ERG after imposing real time visual using this method implying that visual are been transmitting to that region will let blind person see.



Optic nerve. Axial oblique 0.8-mm-thick SSFP MRI shows three of four segments of the optic nerve: the retinal (black arrow), orbital (black arrowheads), and canalicular (white arrowhead) segments. The infundibulum of the pituitary gland (white arrow) also is seen. The fourth (cisternal) segment of the optic nerve would be visible on more superior images.



T represent the area of optical chiasms where image formation takes place, so this area will give some response and show some activity to ensure something is being percept by the blind person.

IV. CONCLUSION

Vision rehabilitation is the novel and meaningful concept for reverting blind individual with sight. Based on theoretical study, Logical approach and comparing some result concluding that revert sight without any kind of Bio-implant is possible. To make this possible it recommended to stimulate visual nerve rather than stimulating the retina. Because retina requires consistently dual time stimulation to generate visual nerve impulse proved by experiments while visual nerve is adaptive to signal directly and propagate it to cerebrum via lateral geniculate bodies to let blind individual see.

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