Artificial Vision Towards Creating the Joys of Seeing For the Blind

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ABSTRACT
In 1929, a discovery was made that encouraging the visual cortex(part of the cerebral cortex) caused the interpretation of the specks of light, known as phosphenes, in an individual. The prime focus of artificial vision systems is to provide an alternative for normal human vision utilizing the perception of phosphenes. Presently, four locations are being researched for electrical stimulation; behind the retina(The Bionic Eye);in front of the retina(Cortical implant);the optic nerve and the visual Cortes. [6]

Keywords
Artificial vision, Blind Mobility, Bionic Eye

1. INTRODUCTION
Blindness- In 1997, the World Health Organization estimated that there were close to 150 million individuals with significant visual disability worldwide. In economically, developed societies, the leading cause of blindness and visual disabilities in adult are diabetic retinopathy.[7] In general, more than two thirds of today's blindness could be prevented or treated by applying existing knowledge and technology. Nearby half of all blindness is due o cataract and a quarter of the world's blindness is due to trachoma. Other major causes of blindness are glaucoma, trachoma, onchocerciasis, and exophthalmia. [8]

Blind Mobility- Blind Mobility is affected by physical and mental health factors, such as multiple disabilities. Age is a mobility issue as many of blind are elderly, which can restrict their ability to use some mobility aids. Many congenitally blind children have hypotonia or abnormally low muscle tone which can affect mobility. [10]

Main techniques used under this technology nowadays are mentioned below:

- Artificial human vision for blind by connecting a television camera to the visual cortex
- The Bionic Eye
- Cortical Implant
- Optic Nerve Implant

In 1996, the US Research Council gave the following summary for the blind [11]:

Detection of obstacles in the travel path from ground level to head height for the full body width can also be done easily. Travel surface information. It helps in detection of objects bordering the travel path. Distant object and cardinal direction information is detected. Landmark location and identification information is easy to detect by visual imparts. Information enabling, self- familiarization and, mental mapping of an environment can be done.

Most existing mobility aids for the blind provide information in either tactile or auditory form.

2. EXISTING TECHNOLOGIES AND METHODOLOGIES
Artificial vision system is being studied worldwide. There are many types of artificial vision systems being proposed. The basic concept of artificial vision system is- "Electrically stimulating nerve tissues associated with vision help to transmit electrical signals with visual information to the brain through intact neutral networks."[9] Many systems are being proposed because of its potential for the development of various types devices with existing technologies. These take into consideration about the patient condition, nerve tissues that subject to stimulation and their role in the visual network. This review discusses the system being researched and developed these days. These devices mainly use electrodes and tissues targeted foe electrical stimulation.[10] Totally implantable system with all the functions however is not develops yet with the present technology for any type of system. Systems being used nowadays are electrodes implanted in the body, which work with several devices worn outside the body.

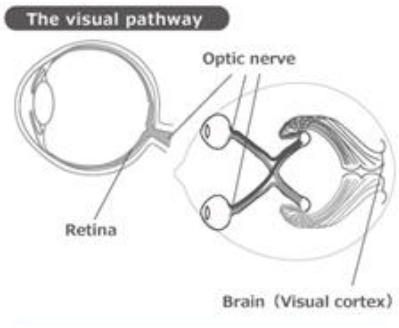

Figure 1. The Visual Pathway

The main techniques used under this technology are discussed in detail here one by one:

2.1 Artificial Vision For Blind By Connecting A Television Camera To The Visual Cortex
This new visual prosthesis produces black and white display of visual cortex "phosphenes". The system was primarily designed to promote independent mobility, not reading. A battery has been provided for the electronic interface that is RF isolated from line currents for safety. This permits the volunteer to directly watch television and use a computer, including access to the internet. Because of their potential importance for education , and to help integrate blind people into the workplace, such television,

computer, and internet capabilities may prove even more valuable in the future than independent mobility. This system can also store the past time conditioning which can be viewed by the volunteer through an RF link to remote videotape recorder and viewing screen. Therefore, this system allows real-time monitoring camera, as well as post-trial analysis, by the volunteer. [2]

The television camera, which is built into a pair of sunglasses (Fig-2), the prosthesis, as worn by the blind volunteer (Fig-3) and complete system, is described schematically , including both the television/computer/Internet interface and the remote Video Screen/VCR monitor.[2]

Figure2. Blind volunteer with sub-miniature TV camera mounted on the right lens of his sunglasses, and the laser-pointer (position monitor) on the left temple piece.

Figure3. Complete artificial vision system that contains a computer and other electronic packages connected with the electrodes to eye.

2.2 The Bionic Eye

This article talks about the first bionic eye implant on Dianne Ashworth a 54 year old blind women. After the implantation she recalls seeing flashes, shapes and light after the surgery. By using the information given by Ms. Ashworth's implant, certain research is done on how to make it exactly like a proper, working eye. Bionic eye is visually a prosthetic one which helps people with optic impairments. [1]

Main constituents of bionic eye:-

Camera which is attached to a pair of glass which makes high frequency radio signals.

A microchip inserted into the retina. The signals get turned into electrical impulses by electrodes in the chip. This replaces the cells in retina which are connected to optic nerve. [3]

These impulses are transferred through optic nerve to brain thus; it is interpreted into a picture. The invention is predicted to be most beneficial to those with macular degeneration- damage to the macula which is central part of retina where light is focused and changed into nerve signals in the brain. Scientists hope to develop an eye that has anywhere from 50 to 100 electrodes. [1] Which would allow the patients to see a much more complete visual image? While the image would undoubtedly still look hazy and unclear to the seeing person this is considered an enormous leap forward currently, the eyes allows people to do things such as find their way through a building, find a door or window and avoid obstacles that might be in their path. [4]

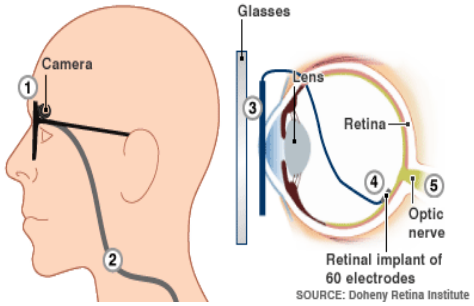

Figure4. The Bionic Eye Implant [5]

2.3 Cortical Implant

This system stimulates the visual cortex in the brain responsible for vision with electrode arrays. This visual cortex is located at lower back section of head that bulges out slightly. The brain is the only final destination of the visual information network. [6]

The main challenges for this stimulation approach are there is lot of risks involved during and after surgery and other safety issues.

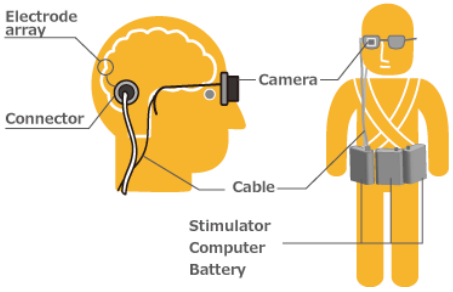

Figure5. The Cortical Implant [5]

2.4 Optic Nerve Implant

This system composed of a bundle of nerve fibers from retinal output cells called retinal ganglion cells (RGC's). Bundle exists from the eye and is connected to nerve cells in the brain. Artificial vision system with electrode array having embedded electrons in a film substrate is wrapped around optic nerves from outside as well as a type stimulating optic Nerves head with wire electrodes are being proposed. This is considered a feasible method. [7]

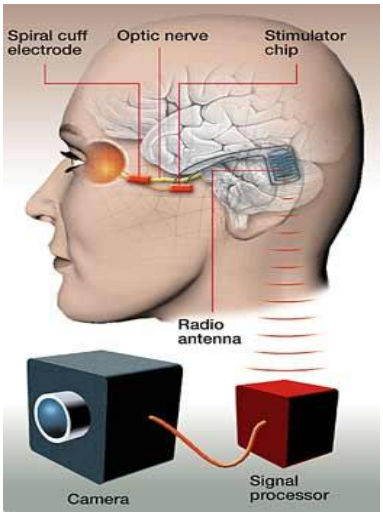

Figure6. The Optic Nerve Implant [5]

3. KEY ISSUES-

Artificial human vision (AHV) involves the electrical stimulation of a component of the human visual system, which may invoke the perception of a phosphenes or point of light. Four locations for AHV implant are currently utilized; subretinal, epiretinal, optic nerve and the visual cortex (using intra- and surface electrodes).[9] The only commercially available system is the cortical surface stimulation device from the Dobelle Institute. The most impressive gains in vision have been reported from the subretinal device developed by the Opt bionics Corporation; however, these results may not be related to the Micro photodiode device used. Psychophysical and mobility assessment standards would help in comparing AHV systems with other technical aids for the blind. [10]

4. CONCLUSION-

This review contains all the existing technologies about artificial human vision and all the scope of future research being done. With this review article one can read all the existing technologies and there benefits and disadvantages regarding the existing technologies

This review also discusses about the key issues about all the technologies and future things being preferred for the improvement in the visual technologies for the visually imparted person's. This is a revolutionary method by which am visually imparted person can perform his daily tasks with a great ease and efficiency and can somehow become independent foe some tasks of his regular use and nessecity.

5. REFERENCES

[1] Sarah Irvine Belson, The Special Ed wiki, Bionic Eye

[2] Wm.H.Dobelle, ASAIO Journal 2000, Artificial Vision for the Blind by Connecting a Television

[3] Camera to the Visual CortexBridie Smith, 2014, Vision for high-performance bionic eye jeopardized by lack of funds

[4] Terasawa, Y.; Osawa, K.; Tashiro, H.; Noda, T.; Ohta, J.; Fujikado, 2013, Engineering Aspects of Retinal Prosthesis by Suprachoroidal Transretinal Stimulation

[5] Terasawa, Y.; Ozawa, M.; Ohta, J.; Tano, Y. 2008, Bulk Micromachining-based Multielectrode Array for Retinal Prostheses

[6] Jason Dowling, 2005, Artificial Human vision

[7] Agnew WF,

[8] McCreery DB (Eds). Prentice Hall, NJ, 1990, Neural Prethesis: Fundamental studiesWorld Health Organisation, 1997, Blindness and Visual Disability: seeing ahead-projections into net century World Health Organization, 1999, Blindness and visual disability: other leading causes worldwide.

[9] Chawla H., 1981, Essential Ophthalmology.

[10] World health organization factsheet, 1997, blindness and visual disability: socioeconomic aspects.

[11] Blasch BB, Weiner WR, 1997, Foundations of orientation and mobility