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Bionic Eye

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ABSTRACT:

Here, we present a description of a block scheme, specific features of design and results of testing for a prototype of a bionic eye, types of them and its applications. The bionic eye is intended to provide vision, partially to the visually impaired by use of the modern day electronics devices like CCD cameras. The comprises a computer chip that sits in the back of the individual's eye, linked up to a mini video camera built into glasses that they wear. Images captured by the camera are beamed to the chip, which translates them into impulses that the brain can interpret. Although the images produced by the artificial eye were far from perfect, they could be clear enough to allow someone who is otherwise blind to recognize faces. The paper discusses the differences working methodologies used in each of them. During the tests and the clinical trails, this device made six blind people to regain their vision partially. The potential advantage of using bionic eye is to be able to remove the blindness completely by making the advances in the present research and improving manufacturing technologies. This breakthrough is likely to benefit approximately one crore world population who suffer from the most common causes of blindness, Retinitis Pigmentosa, Macular Degeneration. The implant bypasses the diseased cells in the retina and stimulates the remaining viable cells. This is a revolutionary piece of technology and really has the potential to change people's lives. But we need to be aware it is still some way in the future.

I. INTRODUCTION:

Bionic Eye is a device, which acts as an artificial eye. It is a broad term for the entire electronics system consisting of the image sensors, processors, radio transmitters & receivers, andthe retinal chip. Based on the institute developed these devices are developed but with minor to major differences, of these the devices with functional capability and those which are clinically tested and results proved are discussed here. Here the designer's objective is to go for a system that is technically perfect with no loop holes and that is harmless to the human body which receives the system and that is commercially viable both in terms of ease of manufacture, cost and the process of implanting.

Blindness means loss of vision. Rods and Cones, millions of them are in the back of every healthy human eye. They are biological solar cells in the retina that convert light to electrical impulses -- impulses that travel along the optic nerve to the brain where images are formed. Without them, eyes lose the capacity to see, and are declared blind. Degenerative retinal diseases result in death of photoreceptors--rod-shaped cells at the retina's periphery responsible for night vision and cone-shaped cells at its center responsible for color vision. Worldwide, 1.5 million people suffer from retinitis pigmentosa (RP), the leading cause of inherited blindness. In the Western world, age-related macular degeneration (AMD) is the major cause of vision loss in people over age 65, and the issue is becoming more critical as the population ages. Each year, 700,000 people are diagnosed with AMD, with 10 percent becoming legally blind, defined by 20/400 vision. Many AMD patients retain some degree of peripheral vision. Currently, there is no effective treatment for most patients with AMD and RP, the researchers say . However, if one could bypass the photoreceptors and directly stimulate the inner retina with visual signals, one might be able to restore some degree of sight.

II. Need for the BIONIC EYE:

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It has been shown that electric stimulation of retinal neurons can produce perception of light in patients suffering from retinal degeneration. Using this property the eye and make uses of the functional cells to retain the vision with the help of electronic devices that assist this cells in performing the task of vision, we can make these lakhs of people get back their vision at least partially. A design of an optoelectronic retinal prosthesis system that can stimulate the retina with resolution corresponding to a visual acuity of 20/80—sharp enough to orient yourself toward objects, recognize faces, read large fonts, watch TV and, perhaps most important, lead an independent life. T he researchers hope their device may someday bring artificial vision to those blind due to retinal degeneration.

III. BIONIC EYE DEFINED:

Bionic Eye, Bio Electronic eye, is a device that can provide sight -- the detection of light. It replaces the functionality of a part or whole of eye. it is used to replace functionality as well as add functionality. It is a complex combination of multiple devices which work together for restoration of the vision of the subject

The Diseases that cause blindness:

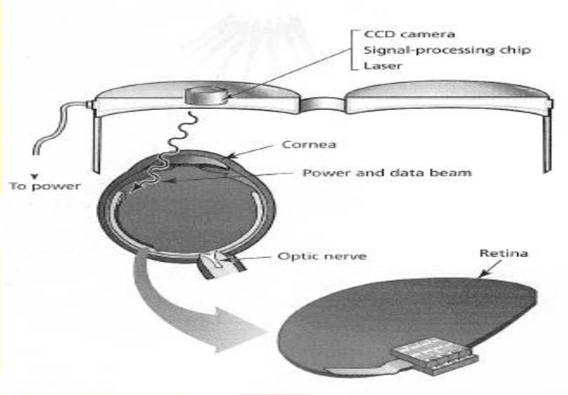
- Retinitis Pigmentosa
- Macular Degeneration

Of these, **retinitis pigmentosa** is a disease, which is a hereditary genetic disease in which peripheral rods degenerate gradually progresses towards center of eye and results in tunnel vision.

As for **macular degeneration**, it is also genetically related , it degenerates cones in macula region, causing damage to central vision but spares peripheral retina.

IV. MIT- HARVARD DEVICE:

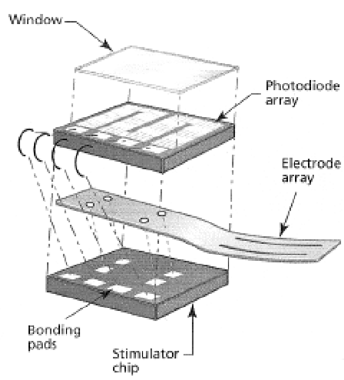
This device follows an Epi-Retinal Ap photoreceptors, which act proach. In this Micro electrode array replaces damaged in the place of rods and cones to send the signals to optic nerve. The power source – Laser(820nm wavelength). For image acquisition it uses a CCD Camera. Patient spectacle holds the camera and power source.



It consists of two systems

System 1

- CCD camera input – External light intensity
- CCD output amplitude-modulates laser source
- This hits photodiode array of implant
- This in turn powers stimulator chip (SC)



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System 2:

- SC drives current to electrodes facing retina
- This excites the ganglionic cells > axons >optic nerve > visual cortex in occipital lobe of brain
- Brain helps in perceiving an image

Advantages:

- Very Early in the visual pathway
- No Batteries implanted within body
- No complicated surgical procedure
- Power Requirement – ¼ of milliwatt

Disadvantages

- Axons b/w electrodes and ganglionic cells
- Other axons get excited – unwanted perception of large blur
- Extra circuitry required for downstream electrical input

V. IMPLANT DESIGN:

Primitive devices

Single photosensitive pixel(3mm in diameter) Neo devices The current micro photodiode array (MPA) is comprised of a regular array of individual photodiode subunits, each approximately 20×20-µm square and separated by 10-µm channel stops (37). The resulting micro photodiode density is approximately 1,100/m2.

VI. IMPLANT features

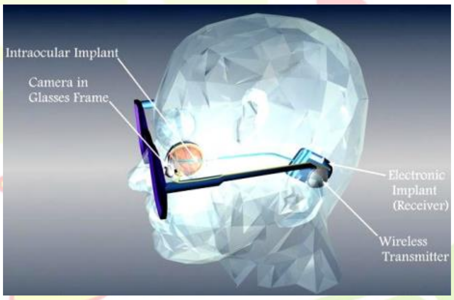
The size of implant is 50um. And it needs no external power supply. The response 500nm to 1100nm wavelength response

Working:

For the technique to work, the patient must still have some functioning ganglion cells - nerve cells that transmit visual information from the retinal cells to the optic nerve as well as a fully-functioning optic nerve. A tiny electronic pad is placed onto the retina of one eye, so that the electrodes are in direct contact with the ganglion cells. Each of the devices' 100 electrodes can stimulate 20 to 30 cells.

VII. Real-time vision:

The user wears a pair of glasses that contain a miniature camera and that wirelessly transmits video to a cellphone-sized computer in the wearer's pocket. This computer processes the image information and wirelessly transmits it to a tiny electronic receiver implanted in the wearer's head.



When received in the implanted chip, the digital information is transformed into electrical impulses sent into the ganglion cells. From there, the brain takes over as the information travels down the optic nerve to the visual cortex at the back of the brain. The whole process occurs extremely rapidly, so that patients see in real-time. This is important any noticeable lag could stimulate the "vestibular-ocular reflex", making people feel dizzy and sick.

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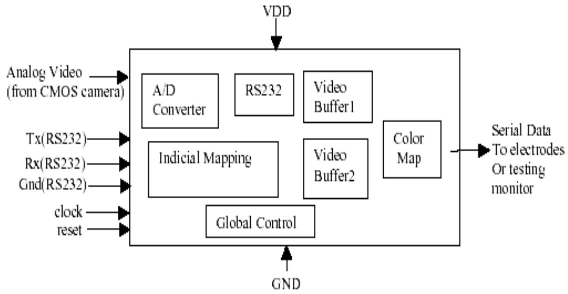
Currently recipients of the device experience a relatively narrow view, but more electrodes should provide a greater field of vision. By stimulating more ganglion cells, he hopes that visual acuity will increase dramatically. His team's next goal is to design a device with 1000 electrodes.

VIII. MANUFACTURING PROCESS:

Implants are comprised of a doped and ion-implanted silicon substrate disk to produce a PiN (positive-intrinsic-negative) junction. Fabrication begins with a 7.6-cm diameter semiconductor grade N-type silicon wafer.

For the MPA device, a photomask is used to ion-implant shallow P+ doped wells into the front surface of the wafer, separated by channel stops in a pattern of individual micro photodiodes. An intrinsic layer automatically forms at the boundary between the P+-doped wells and the N-type substrate of the wafer. The back of the wafer is then ion-implanted to produce a N+ surface. Thereafter, an insulating layer of silicon nitrate is deposited on the front of the wafer, covering the entire surface except for the well openings. A thin adhesion layer, of chromium or titanium, is then deposited over the P+ and N+ layers. A transparent electrode layer of gold, iridium/iridium oxide, or platinum, is deposited on the front well side, and on the background side. In its simplest form, the photodiode and electrode layers are the same size. However, increasing the photodiode collector to electrode area ratio can increase the current density available at each individual micro photodiode subunit.



IX. MARC HERMETIC SEALING AND POSITIONING:

The RF coils either intra ocular or extra ocular coil arrangement as shown in figure. This rf probes receives the transmitted RF energy and give it to the MARC chip. The AC wires from this coil is sent to the MARC chip. Thischip is hermetically sealed in silicone gel and the other sides of the chips have the electrodes, which stimulate the cells in eye

Advantage of the Marc system:

- Compact Size – 6x6 mm
- Diagnostic Capability
- Reduction of stress upon retina

X. CONCLUSION:

Researchers throughout the world have looked for ways to improve people's lives with artificial, bionic devices. Its been 40 years since Arne Larsson received the first fully implanted cardiac pacemaker. Researchers throughout the world have looked for ways to improve people's lives with artificial, bionic devices. Bionic devices are being developed to do more than replace defective parts. Researchers are also using them to fight illnesses. Providing power to run bionic implants and making connections to the brain's control system pose the two great challenges for biomedical engineering. But whatever be the pro and cons of this system. If this system is fully developed it will change the

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lives of millions of people around the world. We may not restore the vision fully, but we can help them to least be able to find their way, recognize faces, read books, above all lead an independent life.

XI. BIBLIOGRAPHY:

- http://www.howstuffworks.com
- http://www.softpedia.com
- http://www.newscientist.com
- http://www.cnn.com
- http://www.bbc.com
- http://www.weikipedia.com