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Smart Eye Implementation using Smart Glass and Bio Chip

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Abstract: *In a world of 7 billion people, estimated no of visually impaired people is whopping 285 million, from which 39 million people are blind and 246 million have partial vision. About 90% of the world's visually impaired live in low or middle income countries. 82% of people living with partial or full blindness are ranged in aged 50 and above. While world needs 100 million pair of eyes every year. On the other hand shortage of eyes is becoming a huge problem. The aim of "smart eye" is to give visual clues to people who are suffering from various eye diseases. The smart glass contains a video camera, audio system and memory chip. A memory chip is fitted into a smart glass which contains algorithms such as face detection .Now a video camera will capture image and processes it and forward it to audio system and another signal is sent to biochip wirelessly. Biochip will receive signals from processor which is attached to glass. Now biochip will convert this input signal into points of light (phosphenes) which are understood by brain. This will help blind people to get vision. This will help blind people to get vision.*

Keywords: *About Biochip, Implantation,Smart glass*

I. Introduction

Information Technology has becoming an integral part of medical field nowadays. The needs of medical field increases every day but technology helps us reach that demand. The enhancement in the technology has help to build a prototype of human organs to help disabled people. Bionic eye is one such example which replaces human eye with electronic eye but, bionic eye has some limitations which we are trying to overcome in Smart eye. Basically, the purpose of Smart eye is to give vision to visually impaired or blind people with extra features than bionic eye.Smart eye is a combination of hardware and software. Hardware includes camera, audio system, and biochip along with an algorithm for face detection.

The biochip is designed specially to work like damaged retina.This chip is implanted behind the eyes of user with microsurgery, linking electronics and biotechnology. Signals sent to biochip stimulate dormant optic nerves to generate points of light (phosphenes) that form the basis of images in the brain. Thus blind people can have vision.

II. Literature Review

Humans are able to see because eyes convert light into signals that are understood by brain. [1] Human eye is made of various components which includes but are not limited to the Cornea, Iris, Crystalline lens, Retina, Optic nerve, Focal point together.

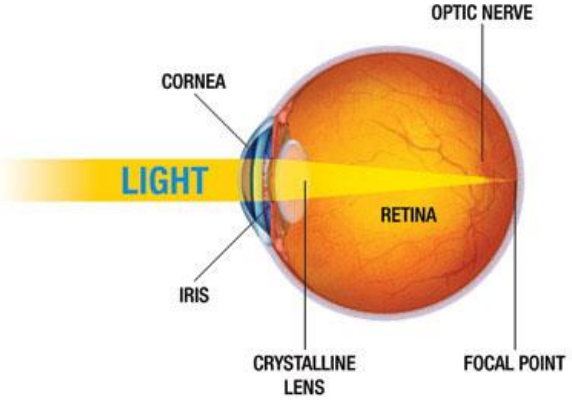

Fig 1: Human Eye (Source: www.nkcf.org/about-keratoconus/how-the-human-eye-works/) [5]

As shown in Fig 1. Light rays enter into eyes through cornea. The cornea's refractive power bends the light rays and passes through pupil the opening of iris through which it enters eyes. After passing through the

iris, the light rays pass through the eyes crystalline lens. Retina converts received images into electrical impulses which are carried to the brain through optic nerve.

We can say, a thought of an electronic retinal implant was proposed by Graham Tassicker, who in 1956 described how a photosensitive selenium cell attached behind the retina of a visually impaired person which resulted in formation of phosphenes. Later, in 1960s and 1970s, Brindley and Dobelle took the research of artificial vision forward by introducing the concept of electrodes by implanting into the visual cortex. Until 1990s, nothing much happened in the field of artificial vision. Later, preclinical studies performed in this decade would lead to the large number of clinical experiments in this decade from 2000-2010. [3]

The current Retinal Prosthesis System uses a spectacle mounted camera to capture the scene which sends signals to electrodes; it is meant to provide electrical stimulation of the retina to induce ability to see in visually impaired people. The 100 electrodes are used in this system. The no of electrodes used here are insufficient to get clear vision.This will allow visually impaired people to see difference between light and dark. [2]

The proposed system also uses spectacle mounted camera to capture the scene which sends information to electrodes. The quality of vision depends on the no of electrodes. The current system got up to 100 electrodes, enough for building a shape. The proposed implant will have more electrodes which will produce 1000 pixels, enough for clarifying the object. But even after increasing the no of electrodes we are not getting the vision as clear as human eyes do. Therefore we are introducing a new audio technology which uses detection algorithms to identify person and object, and gives instruction to user about person and object placed in front of him.

III. System Features

This system includes two major components namely the biochip and the Recognition and auditory system.The USA based company Second Sight developed a biochip. As shown in fig.2 this chip is approximately 10 millimeter in size and 10/1000 in thickness. It contains 200+ electrodes. It consists of three parts Electronic case, receiver and electrode array. Signals are received from transmitter placed on glass frame, this signal is then transferred to electrode array which converts signals into electrical pulses, and these pulses stimulate other cells and transmit the signals to brain via optic nerve which contains patterns of light.The signals generated by electrode are understood by brain, which helps it understand the flashes of light. By this,user gets to know where light areas meet the dark ones.

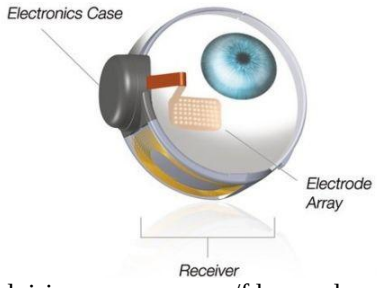

Fig 2: Biochip (Source:http://opticalvisionresources.com/fda-panel-recommends-fda-approval-for-second-sights-%E2%80%A8argus-ii-retinal-prosthesis#.WHh2pht97IU) [6]

The second component is Recognition and auditory system. The research done in field of artificial vision does not give clear vision to the visually impaired people. Providing a clear view to visually impaired individuals is a challenge. As an attempt to make the vision understandable for such individuals this paper proposes a system with two key components that are face detection and voice auditory system. When system is on, camera will start fetching the scene,and then the input will be forwarded to recognition system. Using the biometric algorithm, with the combination of facial metrics to detect and identify face. It then identifies the person against an images stored in memory of known faces. Once a match is found, user will hear the name of person through auditory system. If no match is found then the user will be notified as unknown person. Fig.3 explains the description of Recognition and auditory system.

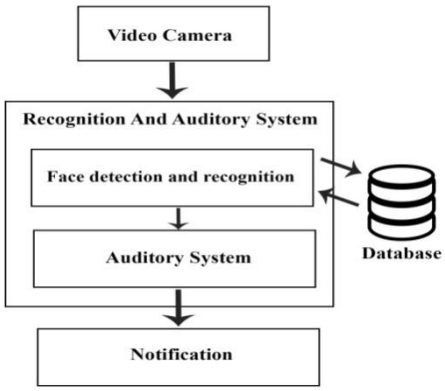

Fig 3: Recognition and auditory system

IV. Implementation

A Smarteye system gives a partial vision to visually impaired people. The Smarteye glass is placed on user's eyes and one chip is implanted behind the damaged cornea of visually impaired person.

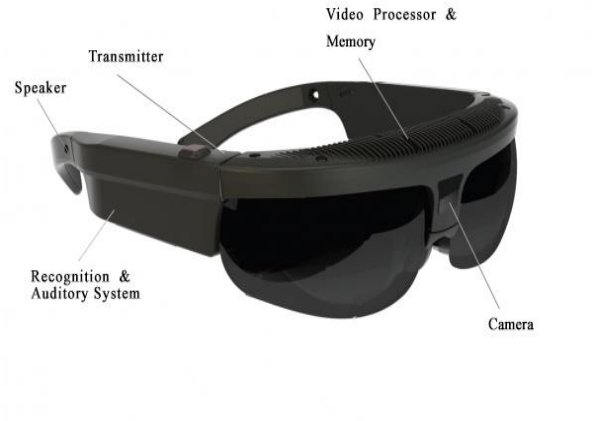

Fig 4: Prototype of Smart eye

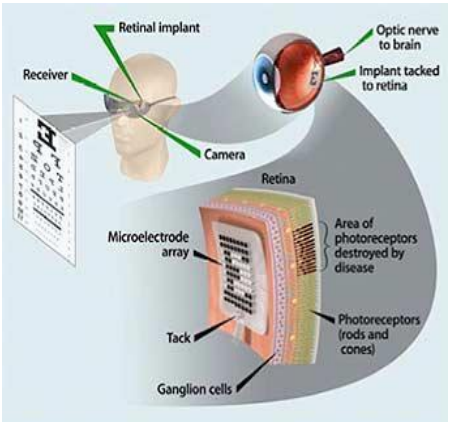

Fig 5: Working of Biochip (Source: http://caho-hospitals.com/bionic-eye-a-canadian-first-successful-implant-of-prosthetic-eye/)

As shown in Fig.4 a miniature video camera in the smart glasses will capture the scene.A Video processor will process the images and converts into the signals and these signals are sent to transmitter.Transmitter will transmit the signals wirelessly to receiver attached to biochip which is located behind the eyes near optic nerve of a person as shown in Fig 5.The electrode stimulates certain brain cells and signals are transferred to brain. The brain receives specks of light. Depending on patterns he gets vision that where the light area meets the dark one. [7]A memory chip is attached to the frames of smart glass to store face recognitionalgorithm.When video camera captures the scene, then faces stored in the memory are matches with input image using algorithms and through the audio systems installed on frames it can be audible to person.Audio system will help person to listen the instructions.

V. Conclusion

The researchers worldwide are trying to restore the sight of visually impaired people. Lots of research has done in the corresponding area. The present system does not give clear vision to visually impaired people. This paper has tried to incorporate and present the concept of auditory system that can help to make the vision audible and more understandable for the visually impaired individuals thus helping the differently abled community.

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