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Latest Technology In Medical Field

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Abstract – This paper deals with latest technology in medical fields. Here we look about two latest components. These components are used for disabled people. The components are 1.Bracelet and rings translate sign language, 2.Argus II. The first component is used for deaf people and the second one is used for blind people. This paper explains how these components are useful for those people.

Keyword - Argus II Retinal Prosthesis System, photoreceptors,Sign Language Ring,Braille.

I. INTRODUCTION

In the past 20 years, biotechnology has become the fastest-growing area of scientific research, with new devices going into clinical trials at a breakneck pace. A bionic arm allows amputees to control movements of the prosthesis with their thoughts. A training system called Brain Portis letting people with visual and balance disorders bypass their damaged sensory organs and instead send information to their brain through the tongue. Now, a company called Second Sight has received FDA approval to begin U.S. trials of a retinal implant system that gives blind people a limited degree of vision.[1] The Argus^{TM} II Retinal Prosthesis System is an artificial vision restoration system designed for patients with severe sight impairment due to peripheral retinal degeneration, such as in ***retinitispigmentosa***. It includes an implant designed to sit on the surface of the retina and stimulate the healthy cells of the retina. The implant receives information from a patient-worn video processing unit, which in turn receives signals from a miniature video camera housed in a pair of glasses. By learning how to interpret these signals, patients may potentially be able to continue using visual cues to guide their activities and maintain independent living for longer.[7]

A. Background :

Peripheral retinal degeneration is present in many retinal diseases, by far the most common of which is retinitis pigmentosa, a group of degenerative diseases usually caused by a wide variety of genetic mutations. These diseases all affect the layer of the retina containing cells called photoreceptors, which convert the light entering the eye into electrical signals that are sent to the brain. These cells are lost (leaving behind dark pigment deposits) as the disease progresses. The cells in the peripheral (outer) retina are usually affected before, and more severely than, those in the centre. Early in the disease, patients usually experience difficulties seeing in low-light conditions, have sensitivity to light and difficulty adjusting between different light levels. Later in life, most people experience loss of peripheral vision. Loss of central vision in daylight conditions is viewed in some people at a later stage. In most cases the disease takes several decades to progress to profound loss of sight, though this can vary greatly between individuals. The day-to-day routine activities of an individual gets affected due to the loss of peripheral vision and the later stages of retinitis pigmentosa often leave patients with only a very narrow field of vision. Complications include cataracts (clouding of the lens) and macular oedema (excess fluid and protein in the central retina). In 20-30% of patients retinitis pigmentosa may be part of a syndrome which includes other symptoms such as deafness and renal disease. [7]

There are an estimated 20-25 people with retinitis pigmentosa per 100,000 individuals in England and Wales, which equates to 11,000-13,750 people. In a study of 1,000 retinitis pigmentosa patients over the age of 45, 25% had a visual acuity of 2/200 or worse, 12% had a visual acuity of “count fingers or worse” and 0.5% had no light perception at all in both eyes. One commercial estimate is that there will be approximately 1,000 patients with severe sight impairment (2 patients per 100,000 individuals) in England who would be eligible for a retinal implant such as the one described here. [7]

II. WHY ARGUS II

The **Argus II Retinal Prosthesis System** can provide sight **--** the detection of light **--** to people who have gone blind from degenerative eye diseases like macular degeneration and retinitis pigmentosa. Ten percent of people over the age of 55 suffer from various stages of macular degeneration. Retinitis pigmentosa is an inherited disease that affects about 1.5 million people around the globe. Both diseases damage the eyes' **photoreceptors**, the cells at the back of the retina that perceive light patterns and pass them on to the brain in the form of nerve impulses, where the impulse patterns are then interpreted as images. The Argus II system takes the place of these photoreceptors. [1]

The Latin word “Argus” refers to a giant in Greek mythology with 100 eyes, Argus Panoptes, who was considered all-seeing. Argus was the servant of Hera, goddess of women and marriage as well as the wife of Zeus. Zeus seduced the nymph Io who was also the priestess of Hera. In order to hide her from Zeus, Hera transformed her into a white heifer and asked Argus to watch over Io and protect her from Zeus [3].

The implant is an epiretinal prosthesis surgically implanted in and on the eye that includes a receiving coil, an electronics case, and an electrode array. [8]

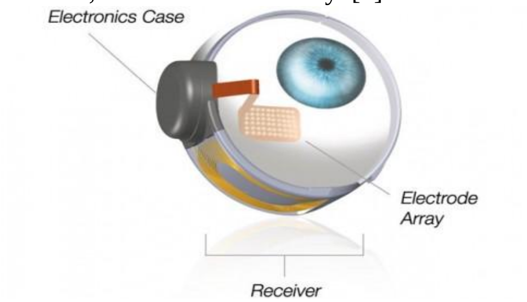

Figure: 1 The basic components of the Argus II Retinal Prosthesis, used in the experiment.

III. NEW TECHNOLOGY

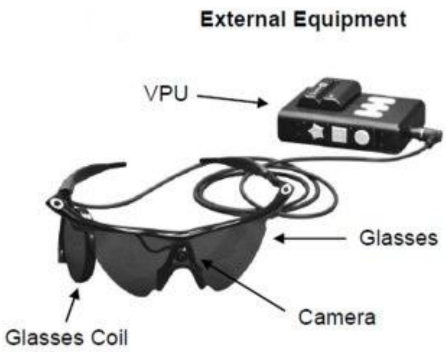

Figure: 2

The ArgusTM II Retinal Prosthesis System by Second Sight Medical Products Inc is designed for the treatment of severe sight impairment in patients with peripheral retinal degeneration and the implant component is implanted surgically in the back of the eye. It is intended for adults 25 years and over with some residual light perception or ability to respond to electrical stimulation of the retina; with functioning optic nerves and visual cortex (the part of the brain that processes visual information) and with a previous history of useful vision. [7]

A miniature video camera housed within a pair of special glasses captures images which are sent to a small video processing unit that is worn by the patient. The video is converted into signals which are sent back to the glasses via a cable and transmitted wirelessly to a receiver in an implant sitting on the surface of the retina. The signals are then sent to a 60 electrode array which emits small pulses of electricity to stimulate the healthy photoreceptor cells in the retina. These stimulate the optic nerve to the brain, causing the perception of patterns of light which patients may learn to interpret and use in their daily lives. [7]

The ArgusTM II Retinal Prosthesis System was CE marked in February 2011 and the company anticipate launch in two UK centers in late 2011-early 20126. The cost of the device is estimated to be £66,000 excluding VAT. Additional costs estimated by the company include £6,200 for surgery and £3,600 for clinical follow-up. [7]

A. Parts:

The second incarnation of Second Sight's retinal prosthesis consists of five main parts:

a. **A** digital camera
b. **A** video-processing microchip
c. **A** radiotransmitter
d. **A** radio receiver
e. **A** retinal implant

IV. THE BIONIC EYE SYSTEM

Figure: 3 A magnified image of an eye with age-relatedmacular degeneration.

The entire system runs on a battery pack that's housed with the video processing unit. When the camera captures an image -- of, say, a tree -- the image is in the form of light and dark pixels. It sends this image to the video processor, which converts the tree-shaped pattern of pixels into a series of electrical pulses that represent "light" and "dark." The processor sends these pulses to a radio transmitter on the glasses, which then transmits the pulses in radio form to a receiver implanted underneath the subject's skin. The receiver is directly connected via a wire to the electrode array implanted at the back of the eye, and it sends the pulses down the wire. [2]

When the pulses reach the retinal implant, they excite the electrode array. The array acts as the artificial equivalent of the retina's photoreceptors. The electrodes are stimulated in accordance with the encoded pattern of light and dark that represents the tree, as the retina's photoreceptors would be if they were working (except that the pattern wouldn't be digitally encoded). The electrical signals generated by the stimulated electrodes then travel as neural signals to the visual center of the brain by way of the normal pathways used by healthy eyes -- the optic nerves. In macular degeneration and retinitis pigmentosa, the optical neural pathways aren't damaged. The brain, in turn, interprets these signals as a tree and tells the subject, "You're seeing a tree."[2]

It takes some training for subjects to actually see a tree. At first, they see mostly light and dark spots. But after a while, they learn to interpret what the brain is showing them, and they eventually perceive that pattern of light and dark as a tree. [2]

The first version of the system had 16 electrodes on the implant and is still in clinical trials at the University of California in Los Angeles. Doctors implanted the retinal chip in six subjects, all of whom regained some degree of sight. They are now able to perceive shapes (such as the shaded outline of a tree) and detect movement to varying degrees. The newest version of the system should offer greater image resolution because it has far more electrodes. If the upcoming clinical trials, in which doctors will implant the second-generation device into 75 subjects, are successful, the retinal prosthesis could be commercially available by 2010. The estimated cost is $30, 000. [2]

Researchers are already planning a third version that has a thousand electrodes on the retinal implant, which they believe could allow for facial-recognition capabilities. [2]

V. TRANSMIT BRAILLE

Second Sight's Argus II Retinal Prosthesis is definitely an interesting piece of technology, allowing a blind user to "see" objects, colors and movement in their environment. Ordinarily, this is done with the help of a video-camera-equipped pair of glasses worn by the user. In a recent experiment, however, researchers bypassed the camera, transmitting visual braille patterns directly to a blind test subject's retina. [9]

Here's how the Argus II normally works. The prosthesis itself is implanted in a blind user's eye, placing an array of 60 electrodes against the surface of the retina. The accompanying video glasses take in the view in front of the user, and convert the video signal into electrical pulses. These pulses are wirelessly transmitted to the implanted electrodes, which respond by selectively stimulating retinal nerve cells. [9]

While the results aren't the same as normal vision, they're good enough to allow some users to identify individual printed letters. [9]

In a recent experiment, six of the electrodes within a single test subject's implant were selectively activated without the use of the camera. By selecting different patterns of electrodes, the researchers could form different visual patterns that represented specific braille characters – each electrode represented one of the bumps that makes up part of a braille character, which would ordinarily be felt with the fingers instead of being seen. [9]

The test subject saw each character for half a second, and was shown isolated individual characters along with words up to four letters long, made from a sequence of characters. They had an 89 percent success rate in identifying the individual characters, and up to 80 percent for short words. [9]

If some Argus II recipients can already discern *regular* letters, though, what would be the point in being able to see braille? For many users, it would likely allow them to read considerably faster than is currently possible with the prosthesis' letter-visualizing capabilities. [9]

A Second Sight research scientist told us that the braille feature may be added to the Argus II software at some point in the future, and would not involve changing the existing device or its functionality. [9]

VI. BRACELET AND RINGS TRANSLATE SIGN LANGUAGE

We recently took a look at LEAP READER, which is a device that's currently in development that helps those of us who don't read sign language understand those that only have it as their primary form of communication. If you are going to be doing a lot of sign language in the future, you may want to actually learn the language, or at least help in understanding someone who is deaf or hard of hearing. Luckily, the Sign Language Ring has been conceptualized to hopefully help all of us someday. [4]

The conceptual device is actually a bracelet and ring combo. The bracelet comes with detachable rings that, when worn, detect the signing motions that are made by the wearer. It then "translates" the signs audibly via the bracelet, which has an embedded speaker. [5]

The concept was thought up by Cao Zu-Wei, Hu Ya-Chun, Huang Ching-Lan, Liao Po-Yang, Tsai Yu-Chi, and Yang Yi-Hsien, who drew inspiration from Buddha prayer beads for the bracelet's design. [5]

The Sign Language Ring is a 2013 Red Dot Design Award winner.Sign Language Ring— inspired by Buddhist prayer beads — aims to solve the problem of communication with the hearing impaired.

Figure: 4

VII. TRANSLATES GESTURES, AUDIO TO TEXT

It consists of a bracelet and a set of six rings that snap on to the side. When deployed, three rings per hand, they use motion sensors to track the motions of the wearer's hands and fingers, translating the sign language into spoken words, which are then played by a speaker on the bracelet. [6]

The wearer can also pre-record signing motions, customizing it to the wearer's particular gestures. [6]

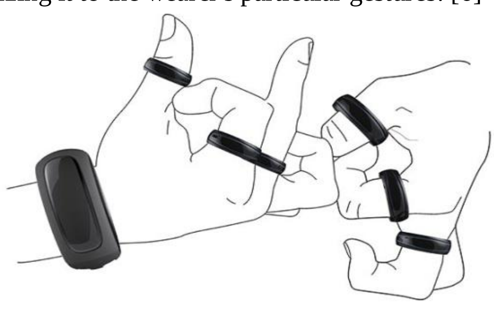

Figure: 5

The bracelet also has a microphone inside. This hears words spoken to the wearer and translates them into text, which is displayed on an LED screen on the top of the bracelet. [6]

We already have text-to-speech and speech-to-text technologies, so that integration seems fairly simple to arrange. [6]

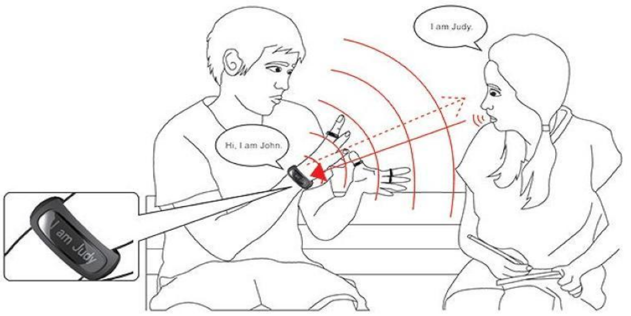

Figure: 6

There might be a few more issues with the motion sensing, but by integrating the ability to customize the Sign Language Ring to the wearer, the designers have mitigated the error margin. [6]

VIII. CONCLUSION

These devices will be useful to physically challenged people. It has got many advantages but the only disadvantage is it's very expensive in cost. This technology will take demand when this comes in an affordable cost in future.

Still, some research and development would doubtless be required to bring it from concept to reality. We hope that happens — it could prove an incredible leap forward in communication for the hearing impaired. [6]

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