Brain Port Vision Device

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Abstract:- **A new device to help the blind see has been developed by scientists. The electric lollipop or BrainPort vision device captures images using a tiny camera and then converts the image into tiny tingles on the tongue. The tingles are then sent to the brain which then converts the tingles into pictures. After a few days practicing people, who otherwise couldn't see, were able to make out shapes, read signs and even read letters. Using the unique resources of the DOE national laboratories in materials sciences, micro fabrication, microelectrode construction Photochemistry and computer modeling, the project's goal is to construct the device, capable of restoring vision, with materials that will last for the lifetime of a blind person. Just as blind people read words by touching Braille bumps, some are now able to "see" objects via a special lollipop that stimulates their taste buds. Theextraordinary device converts images captured by a tiny camera into a series of electrical tingles, which can be felt on the tongue. Nerves then send these messages to the brain, which turn the tingles back into pictures.**

INTRODUCTION:

An electric lollipop that allows the blind to 'See' using their tongue has been developed By scientists The machine is called the Brain Port vision Device and is manufactured by Wicab, a Biomedical engineering company based in Middleton, Wis. It relies on sensory substitution, the process in which if one

Fig.1 Position of BrainPort vision device

Sense is damaged; the part of the brain that would normally control that sense can learn to perform another function. About two million optic nerves are required to transmit visual signals from the retinathe portion of the Eye where light information is decoded or translated into nerve pulsesto the brain's primary visual cortex. With Brain Port, the device being developed by neuroscientists at Middleton, Wisc.based Wicab, Inc. (a company co-founded by the late Back-y-Rita), visual data are collected through a small digital video camera about 1.5 centimeters in diameter that sits in the center of a pair of sunglasses worn by the user. Bypassing the eyes , the data are transmitted to a handheld base unit, which is a little larger than a cell phone. This unit houses such features as zoom control, light settings and shock intensity levels as well as a central processing unit (CPU), which converts the digital signal into electrical pulses replacing the function of the retina. Part of the challenge of Brain Port is to train the brain to interpret the information it receives through the stimulation device and use it like data from a natural sense. Research from prototype devices showed such training is possible, as patients with severe bilateral vestibula loss could.

TESTING DEVICE:

Other than normal use of tongue for tasting Food, eating, talking there are also many other uses. One of them is for sensing of light. It is called as tasting because it can taste the light and sense the objects. It is this property which is used in BrainPort vision device

POSITION OF ELECTRODEARRAY:

Fig.2 position of electrode array on tongue

Other parts of the body, such as the back, were not sufficiently sensitive. The fingertips were sensitive enough, but people wanted full use of their hands to grip a cane or to grab objects.

- placing the device on the tongue inside the Mouth, frees the hands to interact with environment, Plus, the device can be hidden in The Mouth.
- The key to the device may be its utilization of the tongue, which seems to be an ideal organ for sensing electrical current. Saliva there functions as a good conductor.

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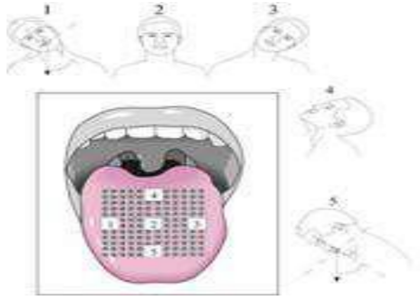

Fig.3 Exact location of electrode array on tongue

- There is a high level of nerve endings in the Tongue, similar to a finger. And the tongue is constantly moist, so there is constant electric Conductivity.
- Finger would require 10 times more electric stimulation than the tongue does to produce the same results in the visual cortex.

PARTS OF DEVICE:

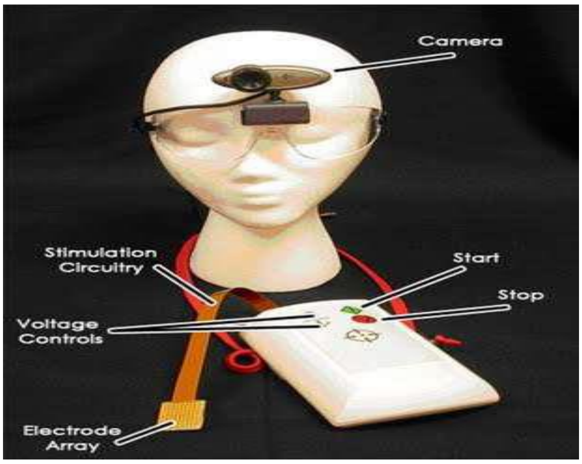

Fig.4 Parts of Brain port device

1. Digital Video Camera

Brain port vision device consists of a digital Video camera placed in the pair of glasses as shown in the figure. Visual data is captured through the camera (1.5cm in diameter). Signals from the camera are then passed to the Brain port device along a cable and then to the lollipop-shaped stick, placed on the tongue.

2. Brain Port Balance

- Power Button: Used to start and stop the brain port balance.
- Control Unit: This unit comprises of a CPU and Battery CPU is used here to convert the digital output from the camera into electric pulses. Brain port balance works with the help of a battery.
- Lollipop shaped stick : It consists of Three Parts, they are: Electrode Array, Simulation Circuitry, Accelerometer

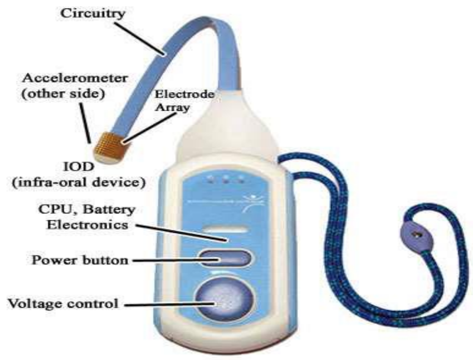

Fig.5 Brain port balance

Electrode Array:

The electrode array is a square grid consisting of about 400 electrodes placed on the tongue. The control unit of the brain port vision device helps in conversion of the image into a black, grey and white picture. This picture is then recreated to the electrode array. Each electrode present in the array will provide an electronic pulse on the tongue according to how much light is present in the area of the picture. Usually strong pulse vibrations from the electrode array represent white pixels, medium pulse represent grey, and zero vibrations represent black pixels.

Stimulation Circuitry:

It consists of

- User Interface: User interface allows selection of current and voltage mode.
- Processor: Configures the brain port device.

Accelerometer:

Accelerometer is used on the other side of the electrode array to give information about body and head position to brain through electrical stimulation of tongue.

WORKING PROCEDURE:

- About two million optic nerves are required to transmit visual signals from the retinathe portion of the eye where light information is decoded or translated into nerve pulses to the brains primary visual cortex.
- Visual data are collected through a small digital video camera. Bypassing the eyes, the data are transmitted to a handheld base unit, which is a little larger than a cell phone.

Fig.6 Working of Brain port device

From the CPU, the signals are sent to the tongue via a lollipop an electrode array about nine square centimeters that sits directly on the tongue.
Densely packed nerves at the tongue surface Receive the incoming electrical signals, which Feel a little like Pop Rocks or champagne bubbles to the user.
These signals from tactile or touch receptors cells are sent to the somatasensory cortex in response to stimulation in the form of pattern impulses.
. Although users initially 'feel' the image On their tongue, with practice the signals Activate the 'visual' parts of the brain for Some people.
. In any case, within 15 minutes of using The device, blind people can begin Interpreting spatial information via the Brain Port.

B VBCA Algorithm:

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Initialize: load RF1 with 8192 entries of size 120 bits (ROM) load RF2 with 1024 entries of size 8192 bits (RAM)
Capture Video Frame:
extract 400 to 600 line segments (32 bits each) group 20,000 to 100,000 line triples (30 bits each) depending on scene complexity
Calculate LSH:
 let lsh Vector be a locality sensitive hash (LSH)
 based on frame and line data
RF1 Compute:
 //Computes the dot product of RF1 neurons with a
//120 bit vector based on input frame data; //Additionally computes a threshold so that about 512
 //RF1 neurons are active
popRAM[] = array of 8192 elements of 7 bits each
sums[] = array of 121 elements of 13 bits  each
for i=1…8192
for j=1…20
popCount = popCount + Max(0, 8 - Abs(lshVector - RF1[i]))
lshVector = lshVector >> 6
RF1[i] = RF1[i] >> 6
popRAM[i] = popCount
sums[popCount] = sums[popCount] + 1
K-WTA Compute:
//Computes a vector indicating what RF1 neurons are
//receptive i=120
 while totalSum < 512 || i != 0
totalSum = totalSum + sums[i--]
 threshold = i
 threshold2 = popCount / 4
 for i=1…8192
if popRAM[i] > threshold
midVector[i] = 1
 else
 midVector[k] = 0
```

TESTING:

This device has been tested on several blind People; one among them is ErikWeihenmayer. A genetic eye condition known as retinoschisis caused him to be visually impaired at birth and completely blind by age 13. In retinoschisis, tiny cysts form within the eyes delicate retinal tissue, eventually causing its layers to split apart. Neither medication nor surgery can restore sight. But with the help and practicing this device he was at least able to identify the obstacles, objects around him and can also read the signs. And by use of this device he has climbed mountains around the world highest peaks, in fact, on every continent.

Fig.7 blind person climbing wall

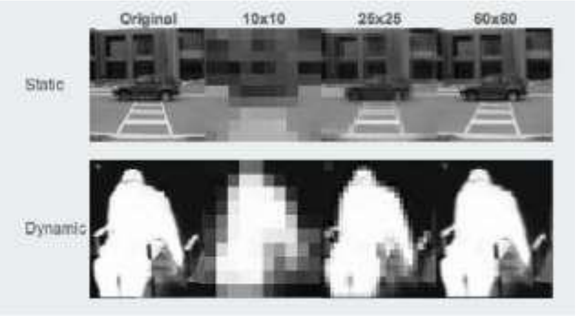

Fig.8 shows static and dynamic images

Interpreted by blind people using device

APPLICATIONS OF BRAIN PORT DEVICE:

1. One of the applications which has been Commercialized is providing vestibular or balance information for people with balance disorders. This is a simple form of sensory substitution, in which the tongue is used to present information from an artificial balance Sensor.
2. Another application is providing directional or navigational information for people who operate under central command and control scenarios, such as military and civilian rescue personnel. Providing information via the tongue allows them to fully use their vision and

hearing to respond to unforeseen threats or hazards. We have shown in the laboratory that it is possible to navigate a virtual maze (like a simple video game) using only information received on the tongue (i.e., buzz on right side of tongue means turn right, etc.).

3. A third, more ambitious application would be providing very crude visual information through the tongue for persons who are completely blind. Our colleague Eliana Sampaio at the Louis Pasteur University in Strasbourg, France has used our tongue stimulator with a small video camera and demonstrated an equivalent visual acuity of about 20-to-830, which is very poor vision, but possibly useful for certain limited activities with enough practice. Wicab, Inc continues to improve this technology with the aim of commercializing it.

4. A fourth application would be providing tactile feedback to the human operators of robots used for various tasks. For example, UW professor Nicola Ferrier is developing a robot controlled by the tongue of persons With quadriplegia which could incorporate touch sensors into its gripper, relaying the touch information back to the user's tongue.

ADVANTAGES:

1. Brain Port device does not replace the sense of sight, it adds to other sensory experiences to give users information about the size, shape and location of objects.
2. Users can operate it independently with a handheld controller.
3. A pair of sunglasses wired to an electric "lollipop" helps the visually impaired regain optical sensations via a different pathway
Therefore device is like normal sunglasses hence it does not look bad.
4. It uses a rechargeable battery like in normal cell phones.

FUTURE ENHANCEMENT:

· This technology can't be adapted to work on senses the brain doesn't already have. So,
The research center wibac is trying to implement this kind of people also.

· The Brain Port requires training the brain incrementally using daily practice sessions.
Reduce time period of learning classes

· When it comes in market its cost is around $10,000 so it cannot be afforded by common
People, and it will reduced in future.

· Occasionally it will produce weak metallic taste sensations, a minor side effect. We have never observed any kind of tissue irritation with the gold-plated electrodes**.**

CONCLUSION:

To substitute one sensory input channel for Another, you need to correctly encode the nerve signals for the sensory event and send them to the brain through the alternate channel. The brain appears to be flexible when it comes to interpreting sensory input. You can train it to read input from, say, the tactile channel, as visual or balance information, and to act on it accordingly. "It's a great mystery as to how that process takes place, but the brain can do it if you give it the right information." There is a hope that a balance device that uses nerve fibers on the tongue to transmit information about head and body position to the brain can make a serious Difference for patients whose sight cannot be replaced. Thus we hope that blind people can also see this colourful world by using this brain port device.

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