ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

EOG Technology for Communication Between Deaf and Dumb People Using Eye Blink Sensor.

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ABSTRACT

Humans suffering from neurological conditions leading to severe disorders are not able to communicate with the outside world. In this paper it deals with the interaction of humans with the outside world based on Electro-oculography (EOG). The fast growing technology helps the disabled community to easily grapple with the society. The art of tracking the movement of the eyes and selection of alphabets with the help of blinks are detected using electrodes and IR sensor respectively for interaction using a visual keyboard on the personal computer. This communication system support is developed using Electro-oculography.

Keywords: Communication device, Electro-oculogram, Eye blink sensor, ARM7.

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INTRODUCTION

Communication is the technique of elucidating or imparting or exchanging information between humans. Interaction between people is a constituent piece of a complex structure. Humans are a social being so it's natural for him to interact with the outside world. Without interaction between each other will create a serious imperfection physically and mentally in humans.

The problem that our society faces nowadays is that people with disability are finding hard to grapple with the fast growing technology. The access to communication technologies has become essential for the handicapped people [1]. The natural language for the deaf/dumb community is the Sign language. But they find hard to deal with people who can't grasp the idea of sign language. And therefore they can't communicate with normal people. The limitations prevent them to interact with the outside world, to share their creative ideas. The project deals with an advanced communication system which can give the ability to speak in the public domain through EOG technology. In this scenario the user uses eye blink sensor to communicate a sentence or word through EOG technology using a visual keyboard on the personal computer.

As per 2000 census India has almost 4 million disabled people and most of them live below poverty line, in which 2.4 million people are deaf and dumb population. And therefore there is a need for a cheap and reliable communication support system for the underprivileged. These people lack the features which a normal person should access. The survey analysis shows that a decreasing ratio of literate and employed deaf and dumb population yields to lack of communication between normal person and deaf and dumb people. It actually becomes the same problem of two persons who knows two different languages, so there will be a communication gap between two people and therefore they require a translator, which may not be convenient.

People who have speaking problems mostly use the sign language as a way to communicate with each other. Sign language is a language that use hand gestures and body language to convey messages. Even though sign language is widely used around the world, many people who are suffering because of hearing issues do not know how to interpret or share messages with each other.

Movements of the eyes are some of the fastest and the most accurate movements made by animals and provide a tantalizing window into biological motor control algorithms [2]. The eye has a good communicative power. The eye is said to be a mirror to the soul or window into the brain. Practical devices have used eye movements for communication purpose. The video-oculogram, which captures eye movements from pictorial images of the eyeball, is expensive because it consists of a video camera to observe eye movement in real time [3]. Eye movement detection using infrared reflectance of the cornea is difficult to use over a period of time because eyes are easily dried and fatigued [4]. The sclera reflection method observes the eye movements using differential reflectivity of eyes, but its accuracy is not efficient for practical situations [5]. They are various methods that use electro-oculogram (EOG) occurring in eyes movements have been developed earlier [6–9].

Technology is the only way to remove this hindrance and benefits the people. Therefore the proposed project includes a communication between deaf/dumb using an eye blink sensor. Sensor based technique offers mobility. This design will help normal as well as deaf and dumb communities to communicate with each other and thus will reduce the communication gap between them.

Since it contains a communication with eye blink sensor, they are few existing works. Eye movement based Electronic wheelchair for Physically Challenged person using IR sensor since it uses IR sensor it is harmful for the eyes therefore it's a drawback. The proposed project describes the system that overcomes the problem faced by the existing system. The main objectives of the proposed system is to develop an innovative communication system, this can give voice to voiceless people and to design and develop a system which lowers the communication gap and can interact efficiently with each other.

EXISTING SYSTEM

In the paper "The Optical-Type Eye Tracking System to Control Powered Wheel Chair" submitted by Gunda Gautam et.al. In this system [10]-[12], Client's eye movements are converted into screen position using the optical type eye tracking system [13]-[16]. When client looks at appropriate angle, then input system will transmit command to the software based on the angle of rotation of pupil i.e., when client moves his/her eye ball up, down, left or right which indicates move forward, move backward, move left, move right respectively and in all other cases wheel chair will be idle. Once the image has been processed it passes the message to the microprocessor. The microprocessor will use a USB output from the laptop and translate the signal into signals that will be transmitted to the wheelchair's wheels for movement. The pressure and object detection sensors will be attached to the microprocessor to provide necessary feedback for proper operation of the wheelchair system. All four wheels will be attached to the microprocessor that will transmit signals to control the wheels and thus the overall movement. But this has a drawback it's difficult to use over long periods of time because the eyes tend to become dry and fatigued.

In the paper "The Automatic Wheelchair Using Eyeball Sensor" proposed by Luis A. Rivera et.al. In this system [17], it uses an eye ball movement tracking system to detect the motion of electronic wheel chair [18]-[21]. When it is detected it is send to the microcontroller. The microcontroller depends upon the feed coding and the output is then given to the driver circuit. The obstacle detection sensor will be connected to receive necessary feedback for proper operation of the wheelchair. All the four wheels will be connected to driving circuit that will move the wheelchair which is based on eye ball movement. The control of the wheelchair depends on the eye ball sensor, which will do the operations such as right, left, forward and reverse directions. The wheel chair is designed to move freely without any external support. This system provides the patients to move their wheelchair as per their desire. The eye ball sensor senses the position of the eye and sends to the microcontroller. It will then convert the input signal to digital signal and send to the driver circuit. The output of the controller is digital signal. It uses L293D IC for converting digital signal to 12V analog signal. The obstacle sensor is connected to the controller. The motor will move according to the eye ball movements.

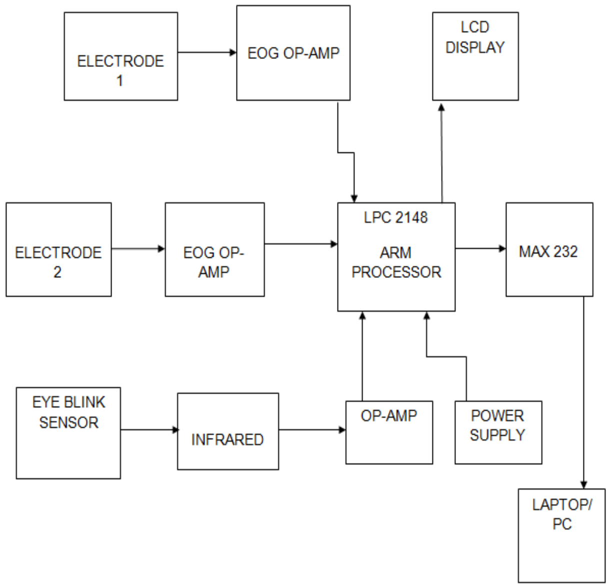
In the paper "An Eyeball Motion Controlled Wheelchair Using IR Sensors" developed by Hitesh Joshi et.al. In this model [22]-[24], three Infrared (IR) sensor modules are mounted on an eye glass to trace the movement of the iris. The IR sensors detects only the white objects therefore, a unique sequence of digital bits is generated in accordance with each eye movement. These signals are then send to the microcontroller IC (PIC18F452) to control the motors of the wheelchair. In this system, spectacles are drilled with three pairs of IR sensors. A single eye can command a wheelchair. IR sensor modules produce a continuous beam of IR rays. Whenever an obstacle (white object) comes in front of the receiver, these rays are reflected back and captured. When there is no obstacle (black object) the IR rays are absorbed by the surface and cannot be captured. The sclera is acts as an obstacle since it is a white object while the iris acts as the reflecting object. A user has to look extreme left and extreme right to move the wheelchair in either direction. When the user looks straight, the motion of the wheelchair is forward. The signals received by the IR sensors are then send to the PIC micro-controller. This system has a drawback, when it is used for a long time the eyes get spoiled because of too many IR sensors.

In the paper "A Biologically Inspired Controller for Fast Eye Movements" submitted by Martin Lesmana et.al. This system [25]-[27] is used to describe and test a non-linear control algorithm controlled by the behaviour of motor neurons in humans and other animals during extremely fast and simultaneous movement of both eyes between two or more phases of fixation in the same direction. The algorithm [28]-[32] is developed on a robotic eye, which consist of a stiff camera cable, similar to the optic nerve, which includes a complicated non-linear stiffness to the plant. For high speed movement, pulse-step controller controls open loop using an internal model of the eye plant implemented from earlier measurements. This system implements that the controller controls the performance seen in the human eye, which produces fast movements with little overshoot. The controller also reproduces the main sequence relationship observed in animal eye movements. But its less efficient as it doesn't give accurate output, therefore it's a drawback.

METHODOLOGY

The goal of the proposed project is to develop an innovative communication system which can give voice to voiceless people through EOG technology. In this project the user uses eye blink sensor to communicate a sentence or word through EOG technology their by communication occurs. User uses an eye blink sensor which is used to detect the movement of eyes. The eye blink sensor is based on tracking system and this system detects four directional eye movements and also detects blink using EOG (Electrooculography) signal acquired by means of band filtering of five electrode input signal. The user sits in front of the system or PC in which a keyboard will be displayed. Using EOG technology the user will move the cursor which is shown on the PC. By double blinking the eyes each alphabet present on the visual keyboard is selected. The selected word or a sentence will be displayed on the PC and a speaker is also connected on the PC for announcing the word or sentence. Thereby communication is complete.

PROPOSED MODEL



MATERIALS AND METHODS

The Basic hardware's used in EOG Technology for Communication between Deaf and Dumb People Using Eye Blink Sensor are:

A. ARM 7-LPC 2148 Processor
B. Electrode
C. Infrared Sensor
D. LCD Display
E. MAX 232

ARM 7-LPC 2148 PROCESSOR

ARM is a family of instruction set architectures for computer processors constructed on a Reduced Instruction Set Computing (RISC) architecture elaborated by British company ARM Holdings. ARM, is expanded as Acorn RISC Machine, later Advanced RISC Machine and arranged for various environments. A RISC-based computer design deals with ARM processors requiring significantly fewer transistors than typical processors in average computers. This deals with reduction in cost, heat and power use. These are desirable qualities for light, portable, battery-powered devices which includes in smart phones, laptops, tablet and notepad computers and other embedded systems. A simpler design makes an action more efficient multi-core CPUs and higher core counts deals with lower cost, providing higher processing power and ameliorated energy efficiency for servers and supercomputers. ARM provides license to the processor to various semiconductor companies, which sketches the full chips based on the ARM processor architecture.

ARM7 is one among the micro-controller family in embedded system application which is widely used. ARM7 is a category of former 32-bit RISC ARM processor cores licensed by ARM Holdings for microcontroller use.

The most extensively used ARM7 designs execute the ARMv4T architecture, but some execute ARMv3 or ARMv5TEJ. ARM7TDMI has 37 registers (31 GPR and 6 SPR). All these delineation use Von Neumann architecture, thus the few versions encompass a cache which do not separate data and instruction caches. LPC2148 is extensively used IC from ARM-7 family.

It is fabricated by Philips and it is pre-loaded with various inbuilt peripherals making it more systematic and a reliable for the novice as well as high end application developer.

Features of LPC214x Series Controller

i. 8 to 40 Kb of on-chip static RAM and 32 to 512 Kb of on-chip flash program memory. 128 bit wide interface/accelerator permits high speed 60 MHz operation.
ii. USB 2.0 Full Speed compliant Device Controller which includes 2 Kb of endpoint RAM. The LPC2146/8 dispenses 8 Kb of on-chip RAM accessible to USB by DMA.
iii. One or two 10-bit A/D converters allocate a total of 6/14analog inputs, with conversion times as low as 2.44 us per channel.
iv. Single 10-bit D/A converter provide variable analog output.
v. Multiple serial interfaces which includes, two I2C-bus, two UARTs, SPI and SSP with buffering and variable data length capabilities.
vi. On-chip integrated oscillator control with an external crystal which span from 1 MHz to30 MHz and with an external oscillator up to 50 MHz
vii. Power saving modes comprises of Idle mode and Power-down mode.
viii. Individual enable/disable of peripheral functions in addition to peripheral clock scaling for additional power optimization.
ix. Single power supply chip which includes Power-On Reset (POR) and BOD circuits:
x. CPU operating voltage ranges from 3.0 V to 3.6 V (3.3 V ± 10 %) with 5 V tolerant I/O pads.

ELECTRODE

An electrode is an electrical conductor pre-owned to make connection with a non metallic part of a circuit (e.g. a semiconductor, an electrolyte, a vacuum or air). Electro-oculography (EOG) diagnoses the eye-movement by indicating the corneal–retinal potential difference from hyperpolarizations and de-polarizations prevailing between the cornea and the retina. The potential difference can be observed as the electrical dipole with a negative pole at the fundus and positive pole at the cornea. By calculating the voltage induced across a set of electrode coils pasted around the eyes it computes the electric signal of the eye's dipole as the eye-movement alters. EOG is the most extensively used expertise in measuring the bio-potential.

The electrical signal that can be measured by this technique is called the Electrooculogram (EOG). The signal is dignified between two pairs of surface electrodes placed in relating to positions around the eye with respect to a reference electrode (placed on the forehead). If the eyes move from the centre position towards the direction of one of these electrodes, the retina accessions this electrode, while the cornea accessions the opposing one. This change in dipole orientation causes an alteration in the electric potential field, which in turn can be observed to track eye movements.

In the proposed system, the electrodes are connected to the forehead which is used to detect the movement of the curser on the PC. In this system, they are two electrodes namely, electrode 1 and electrode 2. Electrode 1 detects Right and Left direction and Electrode 2 detects Up and Down directions.

Expressions for the Electrodes

- Right→X=X-30, Electrode 1
- Left→X=X+30, Electrode 1
- Up→Y=Y+30, Electrode 2
- Down→Y=Y-20, Electrode 2

ISSN: 0975-8585

INFRARED SENSOR

Infrared radiation is an EM Radiation having larger wavelengths than those of visible light, and is therefore invisible, while it is sometimes called Infrared light. It ranges from the nominal red edge of the visible spectrum at 700 nm (frequency 430 THz), to 1000000 nm (300 GHz). Most of the thermal radiation released by objects is near to room temperature in infrared. Like all EMR, IR emits radiant energy, and acts both like a wave and like its quantum particle, the photon. The infrared sensors are the sensor that detects infrared radiation or alteration in the radiation from outer source or inbuilt source. Also sensors that have the property of infrared radiations to measure the changes in surrounding are defined as infrared sensors.

Working process of IR Sensor

INFRARED SOURCE	• The source of Infrared is either inbuilt or from outside environment. • Range of detection and wavelength of infrared radiation to be detected can be configured.
TRANSMISSION MEDIUM	• Vacuum, Air or Optical Fibres
OPTICAL SYSTEM	• To converge the infrared radiation into the detector. • Optical lenses or mirrors • The materials for optical system are chosen according to their transmittance/ reflectance for desired wavelength of IR.
DETECTOR	• Two types • Thermal and quantum detector • Thermal detector has thermal material and is independent to wavelength. • Quantum detector is dependent wavelength
SIGNAL PROCESSING	• The signals produced by the detector are small so an amplifier is required.

LCD DISPLAY

A liquid-crystal display (LCD) is a flat-panel display which has the ability to establish the light-modulating properties of liquid crystals. Liquid crystals do not discharge light directly; instead it uses a backlight or reflector to originate images in colour or monochrome. LCDs are accessible to exhibit arbitrary images or fixed images with less information content, which can be flourished or hidden, such as preset words, digits, and 7-segment displays, as in a digital clock. It uses the same basic technology, except that arbitrary images are formed by a large number of small pixels, while other displays have larger elements.

A 16x2 LCD describes that it can display 16 characters per line and there are 2 such lines. In this LCD each character is exhibited in 5x7 pixel matrix. This LCD has two registers named as Command and Data.

The command register stores the command instructions which are given to the LCD. A command is an instruction such as initializing, clearing its screen, setting the cursor position, controlling display etc which is send to the LCD to do a predefined task. The data register is used to store the data to be displayed on the LCD. The data is the ASCII value of the character to be viewed on the LCD.

MAX 232

The MAX232 is an integrated circuit which is first developed in 1987 by Maxim Integrated Products that transforms signals from RS-232 serial port to signals available for TTL-compatible digital logic circuits. The MAX232 is a binary transmitter / binary receiver that typically are available to convert the RX, TX, CTS, and RTS signals. The drivers impart Rs-232 voltage level outputs from one 5-volt supply by on-chip charge pumps and external capacitors. This fabricates it for implementing RS-232 in devices that contrary do not need any other voltages.

The MAX232 (A) has two receivers that transforms from RS-232 to TTL voltage levels and two drivers that transform from TTL logic to RS-232 voltage levels. As an outcome, only two out of all RS-232 signals can be transformed in each direction. Generally, the first driver/receiver pair of the MAX232 is available for TX and RX signals, and the subsequent one for CTS and RTS signals.

SOFTWARE DESCRIPTION

The Software's used in EOG Technology for Communication between Deaf and Dumb People Using Eye Blink Sensor are:

A. Visual Basic
B. On Screen Keyboard

VISUAL BASIC

Visual Basic is more advanced technology, event-driven programming language and integrated development environment which is developed from Microsoft for its Component Object Model (COM). This programming model was first released in 1991 and declared its legacy during 2008. Microsoft intended Visual Basic to be comparatively easy to learn and utilize. Visual Basic was obtained from basic user-friendly programming language available for beginners, and it permits the rapid application development (RAD) of graphical user interface (GUI) applications, approaches to databases using Data Access Objects, Remote Data Objects, or ActiveX Data Objects, and development of ActiveX controls and objects.

Visual Basic .NET (VB.NET) is a multi-paradigm, object- oriented programming language, executed on the .NET Framework. Microsoft introduced VB.NET in 2002 as the beneficiary to its original Visual Basic Language. Visual Basic.Net refers to all Visual Basic languages released since 2002, in order to discriminate between VB and VB.NET.

ON SCREEN KEYBOARD

An On Screen keyboard is a software constituent that permits a user to enter characters. An On-Screen Keyboard is an approach utilising a virtual keyboard to be displayed on the computer screen that permits people with physical disability to type characters by using a pointing device or joystick. On-Screen Keyboard can also be pre-owned as a typing tutor.

A virtual keyboard can customarily be employed with multiple input devices, which may consist of a touch screen, a computer keyboard and a curser.

RESULTS

With the help of ARM7 processor the eyeball is tracked and successfully designed using EOG Technology. Hardware setup of the module is developed and experimentally proved. The proposed model is more reliable, user independent and portable system which is developed to convert the sign language to voice message in which the system consumes less power.

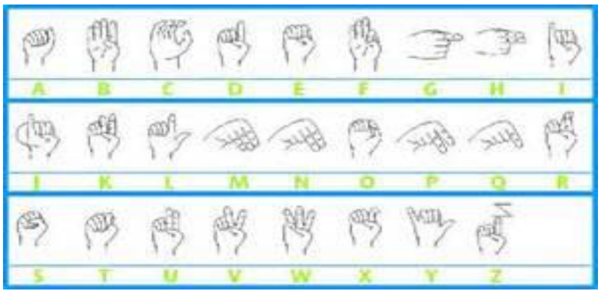


Fig.1: Sign Language for communication

ISSN: 0975-8585

Fig. 2: Communication using Sign language

Fig. 3: Electronic Wheel Chair

Fig. 4: Eye gear with three IR sensors

Fig. 5: User Wearing Eye Blink Sensor Tracking the Movement of Eye

Fig. 6: ARM7 Board

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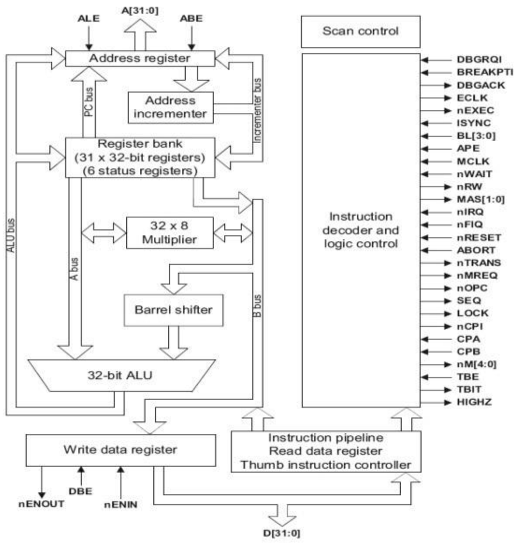

Fig. 7: Block Diagram of ARM7

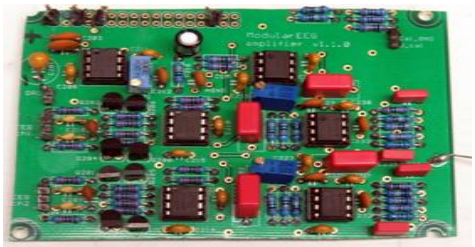

Fig. 8: Electrode Board

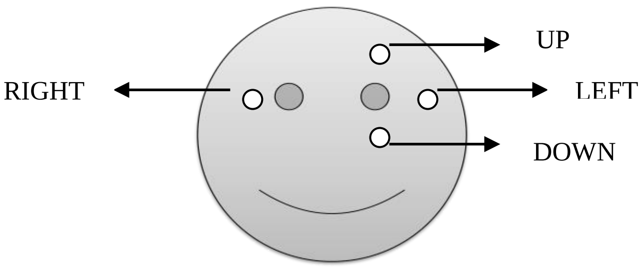

Fig. 9: User Wearing Eye Glass Connected With Electrodes

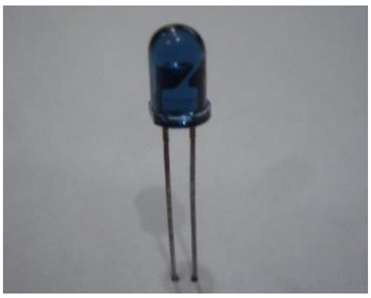

Fig. 10: Infrared LED Sensor

Fig. 11: 16x2 LCD Display

Fig. 12: RS-232 to TTL converters using MAX232

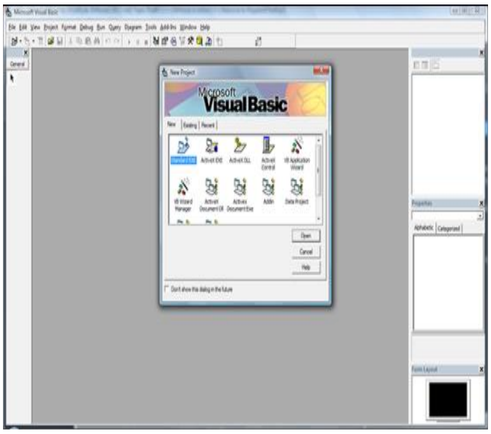

Fig. 13: Visual Basic Software

Fig. 14: On Screen Keyboard

Fig. 15: Output of VB software

CONCLUSION

The problem that our society faces nowadays is that people with disability are finding hard to grapple with the fast growing technology. The opportunity of communication technologies has become essential for the handicapped people. Normally deaf/dumb people use hand gestures for exchanging information and they find hard to deal with people who can't grasp the idea of sign language. And therefore they can't communicate with normal people. The project deals with an advanced communication system which can give the ability to speak in the public domain through EOG technology.

The major objective of this paper is to give voice to voiceless community on the basis of EOG technology for communication between deaf/ dumb with the outside world. The proposed system is more reliable, user independent and portable system which is developed to convert the sign language to voice message in which the system consumes less power. It helps to overcome the communication gap between the deaf/dumb people with the rest of the world. In this system, an EOG communication system is developed and features of eye movement and eye blink were observed. The proposed method will be useful in our practical situations.

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