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Design and Development of Virtual Instrumentation System for Disabled using LabVIEW

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Abstract— **Hospitals need several measurement systems that can measure physiological parameters of the patients. The increased performance of personal computers and their reduced cost has made it possible for development of PC based measurement systems. This paper describes an eye-control method based on Electrooculography (EOG) to develop a virtual instrument for acquiring and processing Electrooculogram signal which can be used to detect eye movement for disabled people. Also there is too much dependency on hardware devices like keyboard and mouse to operate a computer. An alternative way to access various computer applications without the keyboard and mouse is Hand gesture recognition system which is a feasible solution to interface with the computer to control. This system helps the dumb and deaf people to input their data using hand gestures and serves as communication aid. It aims to identify the hand gestures by an individual, map them on to alphabets and then map them in voice using LabVIEW. Hence this work aims at designing a virtual instrumentation system which can be used to detect eye movement of a person in an unconscious state and also provide communication aid for deaf and dumb.**

***Index Terms*— Disabled people, Electrooculography, hand recognition, Virtual Instrument.**

I. INTRODUCTION

In the last years, there has been a significant increase in the development of assistive technology for people with disabilities leading to improvement in the traditional systems. Also, the growing use of the computer in work and leisure has led to the development of PC-associated handling applications, mainly using graphic interfaces. The increased performance of personal computers and their reduced cost has made PC based measurement systems achievable. [1] Combining virtual instrument technology to achieve the purpose of physiological measurement has several advantages. These systems are resourceful and cost-effective for acquiring and analyzing biomedical signals.

In the European Union (EU), it was estimated that10–15% of the total population was disabled and the population aged 60 years and older had a ratio at nearly 1 person in 10.

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This means that in EU there were about 80 million elderly or disabled people [2]. Aware of the scarcity of applications for this sector of the population, public institutions and governments have been promoting research in this line in the recent years [3]. Designing a virtual instrument for acquiring and processing of Electrooculogram signal which can be used to detect eye movement is desirable. This information should be readily available to the doctors for diagnosis and proper treatment. Electric potentials are generated as a result of movement of the eyeballs within the conductive environment of the skull. Electrodes placed on either side of the eyes or above and below them pick up the potentials generated by the motion of the eyeball. Several methods have been proposed in literature that use Electrooculograms (EOGs) occurring as a result of eye movements. Electrooculography (EOG) is a technique for measuring the resting potential of the retina.

Hand gesture recognition system is a feasible solution to interfacing with the computer to control various domestic, industrial and biomedical applications. This system helps the dumb and deaf people to input their data using hand gestures and the input data is converted into the respective alphabet. It is not hard to train any user because of the simplicity of operation and the fact that hand gestures come out naturally. Gestures are expressive, significant body motions i.e. physical movements of the hands, arms, fingers, head, face, or body used for communication. [4]

The PC based measurement system mentioned above lacks in accuracy and additional features. Hand gesture recognition system can be modified for such people who are illiterate and need to communicate using basic commands such as yes, no, eat, sleep etc.

II. LITERATURE REVIEW

The main objective of this work was to develop PC based systems using LabVIEW in which EOG amplifier was designed. The data acquired was amplified, filtered and observed on the front panel. Both the horizontal and vertical movement of the eyes and eye blinks were visualized. The system developed had certain limitations in terms of accuracy and features. [1]

An electric wheelchair controlled by eye movements using EOG had been developed as a movement support device. An eye model based on EOG was proposed and a study was made of its ability to determine the eye position within the socket.

Several human-machine interfaces (HMI) based on EOG were commented focusing on guiding and controlling a wheelchair for disabled people, where the control was actually affected by eye movements within the socket. [3]
In this work author described a methodology for designing a complete hand gesture recognition system to identify and display 26 English language alphabets and 4 Navigation Gestures and also map them into voice. The system was developed in MATLAB using Image Processing on Windows XP Operating System. [4]
This system used the electronic nose technology and LabVIEW technology, realized the dairy harmful gas concentration of automatic control, with sensitivity and safety associated with adjustable, reliable, simple structure, long service life, low cost and easy to use. The system used graphical programming language and control for the harmful gas concentration intelligently. [5]
In this research, new hand geometry based biometric technique for verification using LabVIEW had been proposed. A prototype hand geometry-based verification system was developed and an application that uses hand geometry as opposed to password for restricting access to a web site was designed. [6]

III. JUSTIFICATION FOT THE RESEARCH

This research is different from the related literature because Hospital measurement systems should be able to compute accurately the vitals of patient like heart conditions, body temperature, electrical activity of the heart, electrical activity of the brain etc. PC based signal acquisition, and analysis is an efficient and cost effective method for biomedical signal acquisition and monitoring.

Secondly, Hand gesture recognition becomes important because it gives interactive human-machine interface and virtual environment. Also there is too much dependency on hardware devices like keyboard and mouse to operate a computer. It is better to have an alternative way to access various computer applications without the keyboard and mouse.

IV. OBJECTIVES

- To design a Virtual Instrument (VI) for measuring the resting potential of the retina.
- To design VI for hand gesture movement.
- To design hardware setup for above two systems.
- Interfacing the hardware system with the software system using DAQ card and Digital Camera.

V. PROPOSED APPROACH

The proposed system which is to be designed using LabVIEW requires to be interfaced with the hardware for EOG system and Digital camera for acquiring real time images for hand gesture using national instruments USB Data acquisition (DAQ) card.

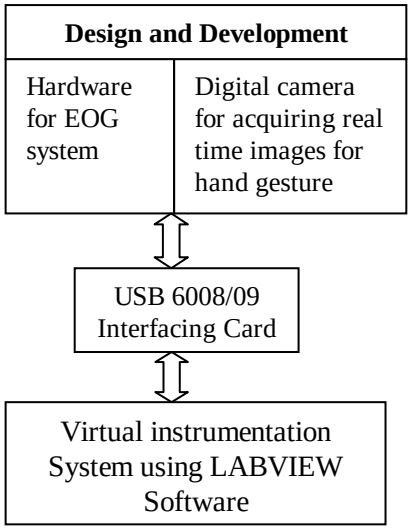

Fig 1. Block Diagram

A. System Organization for EOG System

EOG is a method for sensing eye movement and is based on recording the standing corneal-retinal potential arising from hyperpolarizations and depolarizations existing between the cornea and the retina which is commonly known as an Electrooculogram. This potential can be measured as a steady electrical dipole with a negative pole at the fundus and a positive pole at the cornea Fig. (a). The standing potential in the eye can thus be estimated by measuring the voltage induced across a system of electrodes placed around the eyes as the eye gaze changes, thus obtaining the EOG (measurement of the electric signal of the ocular dipole). The EOG is captured by five electrodes placed around the eyes as revealed in the figure below.

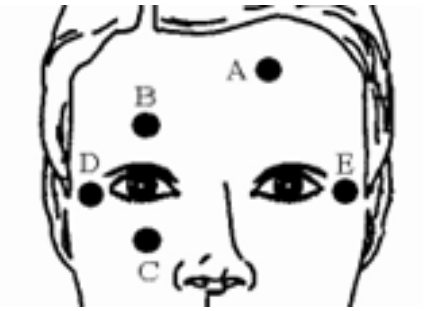

Fig 2. Electrode placement

The EOG signals are obtained by placing two electrodes to the left and right of the outer canthi (D-E) to detect horizontal movement and another pair below and above the eye (B-C) to detect vertical movement. A reference electrode is placed on the forehead at position (A).
The EOG signal is a result of a number of factors including eyelid movement, different sources of artifact such as EEG, eyeball rotation and movement, electrode placement, head movements, influence of the illumination, etc. [3]

The main purpose of the current work carried on is to develop a virtual instrument which can do the following things:

- Acquire the EOG signal.
- Perform noise elimination and amplification.
- Designing the suitable low cost amplifier for amplification.
- Designing of low pass and high pass filters.
- Acquiring the signal using NI DAQ.
- The acquired signal to be displayed using LabVIEW front panel.

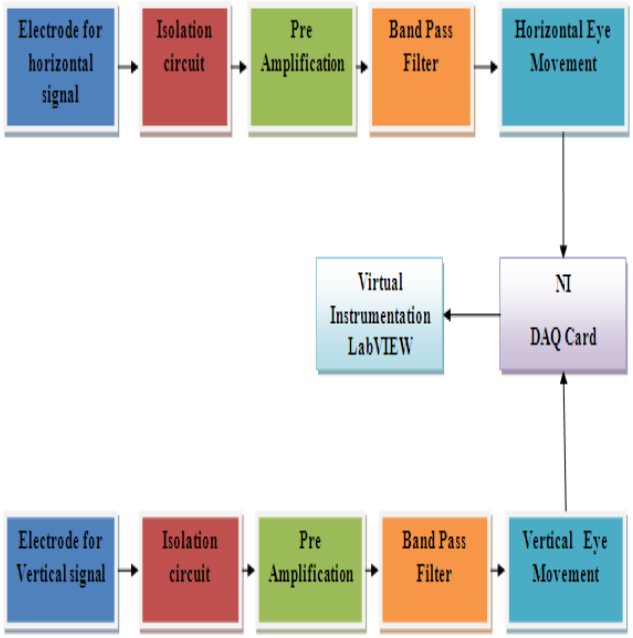

Fig 3. Block Diagram for EOG system

B. *Hand Recognition System*

The first step is to generate a Test and Trainer database of Navigation gestures which are to be interpreted using digital camera. The images in both the databases (Test and Trainer) will be stored using.bmp format. These images will be then pre-processed using a normal noise removal method which is Gaussian low pass filter.

These pre-processed images will be then used to obtain feature vectors of each database image. The test database image will be compared with the trainer database images using methods desired such as Thresholding, Magnitude and Phase Gradient Method, Zero Crossing Detection and Principle Component Analysis (PCA).

The appropriate image i.e. the closest match will be selected and the corresponding alphabet/navigation gesture will be displayed on the screen. Simultaneously voice output will also be played for the respective image. The Fig.4 shows the flow diagram denoting the steps to be followed for hand recognition System.

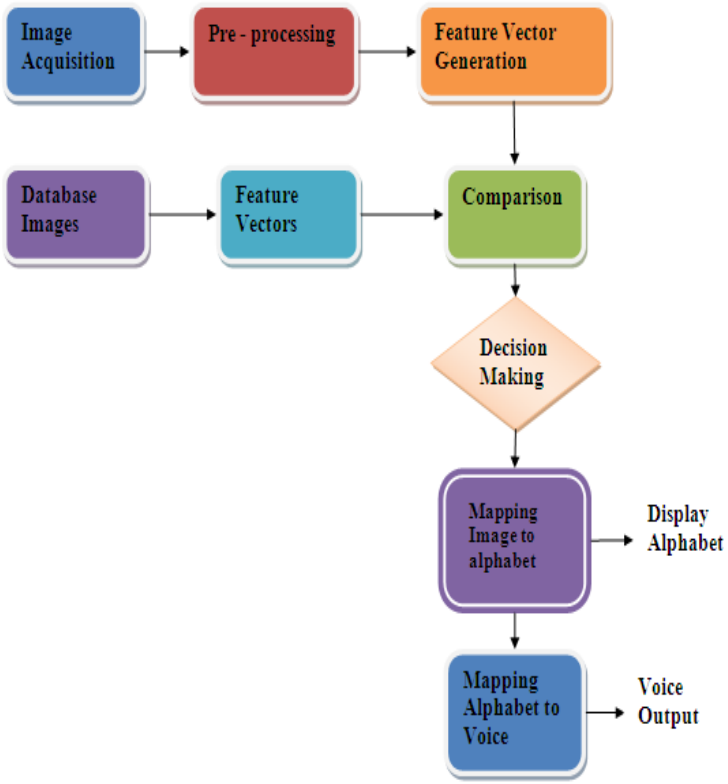

Fig 4. Block Diagram for Hand Recognition System

VI. APPLICATIONS

- Hospitals that need several measurement systems which can measure physiological parameters of the patients.
- Communication aid for deaf and dumb.
- Detection of eye movement of a person in an unconscious state.
- Hand gesture recognition system with basic commands can also be used by uneducated people.

VII. FUTURE SCOPE

a) Man-machine interface can be made which uses hand gestures to control the computer mouse and keyboard functions. It serves as an interface for man to interact with the machines using gestures alone.

b) Control of mechanical systems such as robotics can be done using the hand to remotely control them.

c) Such a system can be made for security and authorization by keeping any particular hand gesture as the password.

d) The hardware implementation of this system can be done using micro-controller for various applications.

e) New systems can be developed which can allow disabled handle a computer by means of an eye-operated mouse based on Electrooculography, and on videooculography using a Web cam to reduce costs.

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