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Arduino Based Assistance Model for Paralysed Patients Using Blink Detection

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ABSTRACT: The main aim of this project is, generally most of the people can read, write, listen, and do anything because their body is able to communicate with mind. Basically, mind is the master of the body, mind controls every moment of the body. But some people face obstructions in controlling their body to interact and to receive and transmit messages and impulses from the brain due to their disability. In other words, the brain is active and the body is in-active. This makes their daily life and daily life activities difficult, one among them is communication which is an inevitable function of the body to communicate with others verbally or by other means of action. This kind of people can think but not implement their thoughts. We have designed and implemented a device for the disabled or the vegetated to communicate through their eyes, it is called "An Eye Writer". By using eye writer, they can carry out their thoughts and convey it to others.

KEYWORDS: Eye tracking, Arduino Uno, Blink sensor, ZigBee

I. INTRODUCTION

In the 21st century many people are suffering from paralysis. So, a device must be constructed for helping them to communicate with others, eye writer is such a device. It uses eye tracking camera and open source software. It allows people suffering from any kind of neuromuscular syndrome to write and draw by tracking their eye movement and position. Then the required result's picture is shown on the screen provided. Eye tracking is the technology involved in it. The input will be blinking of patient. Many medical sensors such as EOG and EEG were used earlier for the detecting eye blink. Now in this system, the detection of eyes is through photodiode and IR LED. Eye blinking through camera is already invented. But the new concept is that, if the patient wants any help or he has any emergency or if he wants to send any type of message to his caretaker then such messages will be detected or selected by eyes blinking of patient by selecting any particular LED from the keypad and that message will be displayed on the notification system or on the alert side system. For a person who is suffering from speech disorder, his only way to communicate is through the movement of eyes. The communication with the help of eyes blinking is possible. The present work is only for this motivation that patient can easily interact. If this system is applying for the handicapped person will definitely be helpful for him and the quality of life of the paralysed patient will improve.

II. RELATED WORK

Michael Chau and Margret Betke, [1] Developed a human-computer interface (HCI) system designed for use by people with severe disabilities is presented. People who are suffering from diseases like ALS and multiple sclerosis are unable to communicate or move with any part of their body except for their eyes. So this system detects the user's eye blink and analyses it for particular duration and uses this as input to the computer. The system overcomes the problem of automatic initialization based on involuntary eye movement or blinking by tracking pattern matching and

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correlation and the get reinitialized by tracking and recording head and eye movements, which include focus and blinking.

There are neither lighting requirements nor offline templates needed for the proper functioning of the system. The system uses USB camera, which is comparatively inexpensive and runs at frame rate of 30 frames per second. Extensive experiments were conducted to determine both the system's accuracy in classifying voluntary and involuntary blinks, as well as the system's fitness in varying environment conditions, such as alternative camera placements and different lighting conditions. These experiments in eight test subjects yielded an overall detection accuracy of 95.3%.

Assist. Prof. Aree A. Mohammed, [2] Developed a real time method based on some video and image processing algorithms for eye blink detection. The purpose of this research is to provide assistance to people who cannot control the calls with human mobile interaction directly. A Haar Cascade Classifier is applied for face and eye detection for obtaining eye and facial axis data. In addition, the same classifier is used based on Haar- like features to find out the relationship between the eyes and therefore the facial axis for positioning the eyes. An economical eye pursuit technique is projected that uses the position of detected face. Finally, an eye fixed blinking detection supported eyelids state (close or open) is employed for dominant humanoid mobile phones.

The method is employed with and while not smoothing filter to point out the advance of detection accuracy. The application is used in real time for learning the impact of sunshine and distance between the eyes and also the mobile device so as to judge the accuracy detection and overall accuracy of the system. Test results show that our proposed method provides a 98% overall accuracy and 100% detection accuracy for a distance of 35 cm and an artificial light.

Xuebai Zhang, Xiao long Liu, Shyan-Ming Yuan, and Shu-Fan Lin [3] Developed a method as, eye movement is really having a vital role in human communication, especially for people who has physical disabilities. A novel eye control system with integrating both mouse and keyboard functions is purposed in this paper, to improve the reliability, mobility, and usability of eye tracking technique in user-computer dialogue. A simple and convenient interactive mode by only using user's eye is followed by the proposed system. The proposed systems usage flow is designed to perfectly follow human natural habits. Here to follow the accurate system perfectly, a manager module is extra added. Two interactive tasks with different difficulty were added to compare the existing eye control tool with the purposed system. To evaluate the perceived effectiveness of our system, TAM (the technology acceptance model) is used. TAN demonstrates that purposed system is very effective in case of usability and interface design.

Dr.rer.nat.ThiesPfeiffer, [4] developed technical interfaces that make use of their versatility can bring significant improvements to those, who are unable to speak or to handle selection tasks else wise, e.g. with their hands, feet, noses or tools handled with the mouth. Gaze-typing, is the most prominent gaze-based assistive technology, using this the eyes to enter texts in to a computer system. The article reviews the principles of eye movements, it discussed several approaches to gaze-typing and presents an overview of current eye-tracking systems. With the advancement in mobile eye-tracking systems, gaze-based assistive technology is no longer restricted to interactions with desktop computers. Gaze-based assistive technology is ready to expand its application into other areas of everyday life. The second part of the article thus discusses the use of gaze-based assistive technology in the household or "the wild", outside one's own four walls.

III. METHODOLOGY

The proposed system is an eye tracking device that works by blink detection. Many medical sensors such as EEG or EOG sensors are used for blink detection previously. The system consists of an IR sensor which is interfaced with the microcontroller. This sensor detects eye blink of the patient. And the input to the device is the eye blink of the patient. The system makes the paralyzed patient more active in their activities by enabling a communication with others merely by blinking their eyes. The patient can blink at the desired message that is stored in each LED, in the LED matrix. An added feature of the device is that the message can be transferred to other devices in the receiver side wirelessly via ZigBee module.

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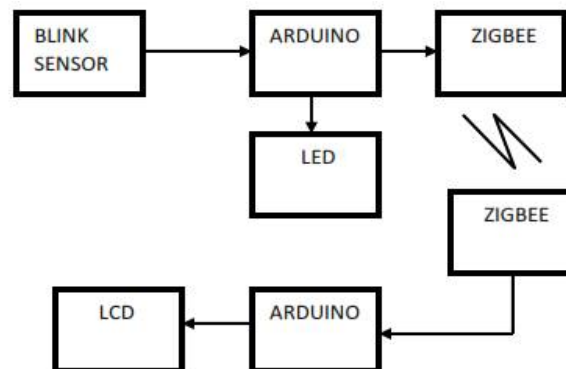


Fig.1 Block diagram of the system

ARDUINO UNO: This communication system uses an Arduino Uno which has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. We have used a microcontroller known as the ATmega328 which provides UART TTL (5V) serial communication, this is available on digital pins 0 (RX) and 1 (TX). Arduino has both hardware and software. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer. The ATmega328 also supports I2C (TWI) and SPI communication.

The proposed system makes use of two Arduino boards one in the transmitter side and other in the receiver side. In transmitter, Arduino controls the blink sensor, LED grid and the ZigBee module. Arduino controls the blink sensor when it is interfaced with it. The action of sensor is in such a way that when an obstacle is placed in front of it, it will give logic high output i.e., +5v and when there is no obstacle sensor gives logic 0. Obstacle in the sense, eyes blink of the patient. These logic changes can be read from arduino using digital Read command. Arduino controls the LED matrix according to the value returned by IR sensor. In the receiver side the arduino based is interfaced with LCD. With the help of ZigBee module, the messages from transmitter side reaches the notification system and is displayed on the LCD.

IR SENSOR: This eye writer uses a photodiode and IR illuminators to scan the movements of the eye and calibrate the motion and bring out the desired movements, With the help of a photodiode and IR illuminators and specified software the proposed system can be better implemented. TCRT5000 is the IR sensor used in the proposed system. This is a reflective sensor with inbuilt transmitter and receiver. Here IR LED act as the IR transmitter. Whereas photodiode act as the IR receiver. The photodiodes can be powered through a current limiting resistor of value 220k and transistor is grounded through 10k resistor. The biasing of transistor is controlled by the amount of IR high if receives so it has no base pin. Thus IR light from photodiode hits the human eye and return back to the phototransistor to bias it. These sensors are highly susceptible to ambient light and must be used after providing a suitable covering. IR sensor is a multipurpose sensor which can be used for obstacle censoring, color detection, fire detection, blink detection etc. dual arrangement of both the emitting light source and the detector in the same direction makes the sensor compact and sense the presence of the object. Infrared Obstacle Sensor module has an in built IR transmitter and IR receiver that sends IR energy and wait for reflected IR energy in order to detect presence of any obstacle in front of the sensor module. There is a potentiometer on the module that lets user adjust detection range. The sensor operation is appreciable and shows a stable response even in ambient light or in complete darkness.

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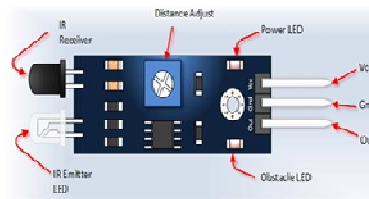


Fig.2 TCRT5000 (IR SENSOR)

LCD DISPLAY: A liquid-crystal display is a flat-panel display used to present textual information to the user. The 16x2 LCD is used to display various status of the system. This display module uses liquid crystal to produce visible image. It can display 16 characters in two rows and each character is displayed in a 5x7 pixel matrix. The proposed system uses LCD in the receiver side to display the message received via ZigBee module. When the system is turned on, "EYEWITER" is displayed. Whenever an eye blink is detected particular message is displayed. Operating voltage of LCD is 4.7V to 5.3V.

ZIGBEE MODULE: The message that is selected in the transmitter section is to be transferred to any other devices wirelessly here we make use of ZigBee module for achieving this wireless transmission. ZigBee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small low power digital radios. It is designed for small projects which need wireless connection. The technology outlined by the ZigBee specification is meant to be less complicated and less expensive than alternative wireless personal area networks (WPANs), such as Bluetooth or more general wireless networking such as Wi-Fi. Applications embody wireless light-weight switches, home energy monitors, traffic management systems, and other consumer and industrial instrumentation that needs short-range low-rate wireless data transfer. For interfacing ZigBee module with Arduino, the supply voltage of ZigBee is regulated to 5V and 3.3V. The VCC of ZigBee module is connected to 3.3V of Arduino. The ground pin of ZigBee is connected to ground pin of Arduino. The transmitting and receiving pin of ZigBee is connected to receiver and transmitter pin of Arduino module.

LED MATRIX: Here we are using a LED grid with 9 LEDs. Each LED stores preprogrammed messages needed for that patient. When the scanning process starts, each LED starts to blink one by one for a particular time duration of about 4 or 5 seconds and thus scanning occurs. When an eye blink is detected, scanning will stop and that particular LED only glows for some time. At that time the message stored behind that LED is ready to be transmitted to any other devices.

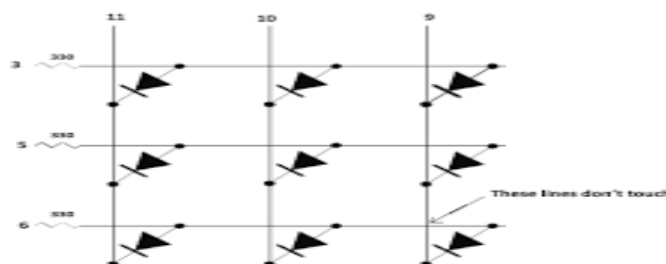


Fig.3 LED grid

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IV. SYSTEM OPERATION

System consists of two Arduino boards which acts as the center of the system. System operates in two steps, sending a message and receiving that particular message in any other device. The transmitter section there is a 3*3 LED matrix, in which each LED is used to represent particular messages. To detect the eye blink of patient we are making use of an IR sensor. The IR sensor will sense any obstacle reaching near to it. When light falls on white part of eye called sclera, IR sensor will sense this, and hence scanning happens according to it. Initially each LED in the LED matrix will blink one by one. When blink detection take place at a particular LED in any row, the message stored behind that LED will be displayed on LCD module in the receiver side. Each LED stores a particular type of emergency message that the patient wants to communicate with others. This message is transmitted from transmitter section and received at the receiver section by a ZigBee module.

V. EXPERIMENTAL RESULTS

In this section the results of the study are presented and discussed with reference to the aim of the study, which was to design and implement an eye tracking device for paralysed persons. The project mainly provides a medium of communication for the one whose brain is active but their body isn't. With the help of this device the patient is able to satisfy their needs merely by blinking their eyes. The device requires eye blink as the input and on receiving the input the blink sensor detect those blink. LED grid is programmed in such a way that on detecting a blink only one LED will be in high state and then the message stored is received on the LCD. We attached the sensor on a pair of glasses so that the patient can wear it.

The IR sensor worked well for blink detection. And a message is selected at the transmitter side properly according to blink and transmitted wirelessly. In the receiver side the message is displayed. The main difficulty faced in this project is the configuration of ZigBee module that enable wireless communication. Here we used eye as a medium for communication after a detailed study. A study on the group of patients with similar disorder show that many of them have the ability to control their own eye movement. And also it is found that many work were previously done by making use of the eyes of these kind of patient.

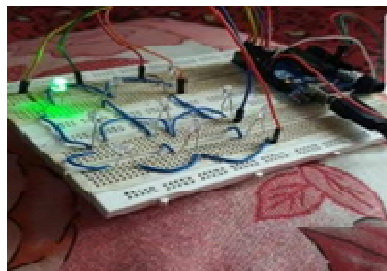


Fig.4 LED grid working

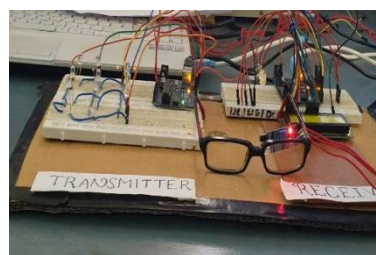


Fig.5 System view

VI. CONCLUSION

We have implemented the eye writer for the disabled to contact their care taker or their loved ones for attention or care during emergencies by using eye tracking and transmitting infrared signals from the eye. System is simple functional and user friendly. The patients can easily satisfy their needs. Cost effective than the existing one. Less complex architecture. Does not require any additional training for the usage. Independent of power supply and computer and also can use a battery to power it. It is easy to develop and enhance or upgrade the current device by implementing new software which allows to communicate freely by using speech text technique used in Computers and mobile devices, and also install operating systems that can restore the function of eye writer or its method and include new features such as calling, texting, browsing the internet just like mobile devices.

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