"EYE GAZE TECHNOLOGY"

Submitted By

Mr. Shivhari Eknathrao Lokhande
Final Year Information Technology,
Anuradha Engineering College Chikhli.
Contact No. :- 9763694499
Email ID :- shivharilokhande@gmail.com

Sagar D. Dharkar
Final Year Information Technology ,
Anuradha Engineering College Chikhli.
Contact No. :- 9404532754
Email ID:-sagardharkar237@gmail.com

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Abstract

As the number of computer devices increases around   us, and the increasing time we spend for interacting with such devices, peoples are strongly interested in finding new interaction methods which ease the use of computers or increase interaction efficiency. Eye tracking seems to be a promising technology to achieve this goal. The Eye gaze System is a communication and control system for people with complex physical disabilities. You run the system with your eyes. By looking at control keys displayed on a screen, a person can synthesize speech, control his environment (lights, appliances, etc.), type, operate a telephone, run computer software, operate a computer mouse, and access the Internet and e-mail. Eye gaze Systems are being used to write books, attend school and enhance the quality of life of people with disabilities all over the world.

Keywords:

Eye gaze, Blurred vision, adequate vision, Automatic Eye Acquisition.

I.   INTRODUCTION

With the invention of the computer in the middle of the last century there was also the need of an interface for users. In the beginning experts used teletype to interface with the computer. Due to the tremendous progress in computer technology in the last decades, the capabilities of computers increased enormously and working with a computer became a normal activity for nearly everybody. With all the possibilities a computer can offer, humans and their interaction with computers are now a limiting factor. This gave rise to a lot of research in   the field of HCI (human computer interaction) aiming to make

interaction easier, more intuitive, and more efficient. Interaction with computers is not limited to keyboards and printers anymore. Different kinds of pointing devices, touch-sensitive surfaces, high-resolution displays, microphones, and speakers are normal devices for computer interaction now a days. There are new modalities for computer interaction like speech interaction, input by gestures or   by tangible objects with sensors. A further input modality is eye gaze which nowadays finds its application in

accessibility systems. Such systems typically use eye gaze as the sole input, but outside the field of accessibility eye gaze can be combined with any other input modality.

Therefore, eye gaze could serve as an interaction method beyond the field of accessibility. The aim of this work is to find new forms   of   interactions utilizing eye gaze and suitable for standard users. The Eye gaze, a communication & control system you run with your eyes. The Eye gaze System is a direct-selectvision-controlled communication and control system. It was developed in Fairfax, Virginia, by LC Technologies, Inc.[1]

FIGURE 1 : DIRECT-SELECTVISION-CONTROLLED
COMMUNICATION AND CONTROL SYSTEM

This system is mainly developed for those who lack the use of their hands or voice. Only requirements to operate the Eye gaze are control of at least one eye with good vision & ability to keep head fairly still. Eye gaze Systems are in use around the world. Its users are adults and children with cerebral palsy, spinal cord injuries, brain injuries, ALS, multiple sclerosis, brainstem strokes, muscular dystrophy, and Werdnig Hoffman syndrome. Eye gaze Systems are being used in homes, offices, schools, hospitals, and long term care facilities. By looking at control keys displayed on a screen, a person can synthesize speech, control his environment (lights, appliances, etc.), type, operate a telephone, run computer software, operate a computer mouse, and access the Internet and e-mail. Eye gaze Systems are being used to write books, attend school and enhance the quality of life of people with disabilities all over the world. In 2008 LC Technologies Introduced the new technique called Eye Gaze Communication System. LC Technologies is leader in research and development of Eye tracking Technologies. [1]

II.   WHO'S USING THE EYE GAZE SYSTEM?

A. *The skills needed by the user*

a. *Good control of one eye*

The user must be able to look up, down, left and right. He must be able to fix his gaze on all areas of a 15-inch screen that is about 24 inches in front of his face. He must be able to focus on one spot for at least 1/2 second. Several common eye movement problems may interfere with Eye gaze use. [2]

These include**s,**

- **Nystagmus** (constant, involuntary movement of the eyeball)

The user may not be able to fix his gaze long enough to make eye gaze selections.

- **Alternating strabismus** (eyes cannot be directed to the same object, either one deviates)

The Eye gaze System is constantly tracking the same single eye. If, for example, a user with alternating strabismus is operating the Eye gaze System with the right eye, and that eye begins to deviate, the left eye will take over and focus on the screen. The Eye gaze camera, however, will continue to take pictures of the right eye, and the System will not be able to determine where the user's left eye is focused. When the left eye deviates and the right eye is again fixed on the screen the Eye gaze System will resume predicting the gaze point. Putting a partial eye patch over the nasal side of the eye not being observed by the camera often solves this tracking problem. Since only the unpatched eye can the screen, it will continuously focus on the screen. By applying only a nasal-side patch to the other eye, the user will retain peripheral vision on that side.[3]

b. *Adequate vision*

Several common vision problems may affect a user's ability to see text clearly on the Eye gaze monitor. These include the following:

B. *Inadequate Visual acuity*

The user must be able to see text on the screen clearly. If, prior to his injury or the onset of his illness he wore glasses, he may need corrective lenses to operate the Eye gaze System. If he's over 40 years old and has   not had his vision checked recently, he might need reading glasses in order to see the screen clearly. In most cases,

eye tracking   works   well   with   glasses. The calibration
lens boundary splits the image of the pupil, making it difficult for the system's image processing software to determine the pupil center accurately. Graded

bifocals, however, typically do not interfere with eye tracking. Soft contact lenses that cover all or most of the cornea generally work well with the Eye gaze System. The corneal reflection is obtained from the contact lens surface rather than the cornea itself. Small, hard contacts can interfere, if the lens moves around considerably on the cornea and causes the corneal reflection to move across the discontinuity between the contact lens and the cornea.[2]

C. *Diplopia (double vision)*

Diplopia may be the result of an injury to the brain, or a side effect of many commonly prescribed medications, and may make it difficult for the user to fix his gaze on a given point..[3]

D. *Blurred vision*

Another occurrence associated with some brain injuries, as well as a side effect of medications, a blurred image on the screen decreases the accuracy of eye fixations.[1]

E. *Cataracts (clouding of the lens of the eye)*

If a cataract has formed on the portion of the lens that covers the pupil, it may prevent light from passing through the pupil to reflect off the retina. Without a good retinal reflection the Eye gaze System cannot accurately predict the user's eye fixations. The clouded lens may also make it difficult for a user to see text on the screen clearly. Surgical removal of the cataracts will normally solve the problem and make Eye gaze use possible.[3]

F. *Homonymous   hemianopsia*   (blindness   or defective vision in the right or left halves of the visual fields of both eyes)

This may make calibration almost impossible if the user cannot see calibration points on one side of the screen.

G. *Ability to maintain a position in front of the Eye gaze monitor*

It is generally easiest to run the System from an upright, seated position, with the head centered in front of the Eye gaze monitor. However the Eye gaze System can be operated from a semi-reclined position if necessary.

Continuous, uncontrolled head movement can make Eye gaze operation difficult, since the Eye gaze System must relocate the eye each time the user moves away from the camera's field of view and then returns. Even though the System's eye search is completed in just a second or two, it will be more tiring for a user with constant head movement to operate the System.[4]

H. *Mental abilities that improve the probability for successful Eye gaze use*

a. *Cognition*

Cognitive level may be difficult to assess in someone who is locked in, especially if a rudimentary communication system has not been established. In general, a user with average intelligence will best maximize the capabilities of an Eye gaze System.[3]

b. *Ability to read*

At present, the Eye gaze System is configured for users who are literate. The System is text-based. A young child
with average intelligence may not be reading yet, but
probably has the capability to learn to read at an average age. He may be able to recognize words, and may be moving his eyes in a left to right pattern in preparation for reading. As an interim solution many teachers and parents stick pictures directly onto the screen. When the child looks at the picture activates the Eye gaze key that is located directly underneath it.[3]

c. *Memory*

Memory deficits are a particular concern in considering the Eye gaze System for someone with a brain injury. A user who can't remember from one day to the next how to operate the system may find it too difficult to use effectively. [4]

III.   HOW DOES THE EYE GAZE SYSTEM WORK?

As a user sits in front of the Eye gaze monitor, a specialized video camera mounted below the monitor observes one of the user's eyes. Sophisticated image-processing software in the Eye gaze System's computer continually analyzes the video image of the eye and determines where the user is looking on the screen. Nothing is attached to the user's head or body.
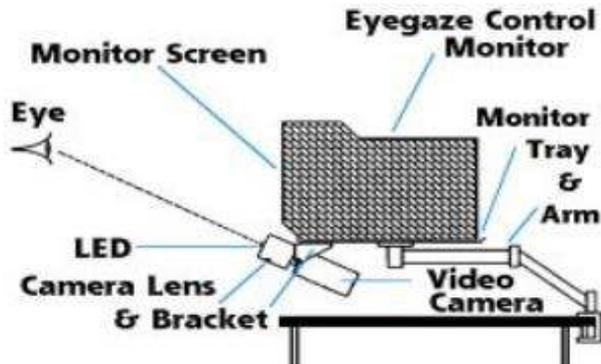
FIGURE 2 : STRUCTURE OF SYSTEM

In detail the procedure can be described as follows: The Eye gaze System uses the pupil-center/corneal reflection method to determine where the user is looking on the screen. An infrared-sensitive video camera, mounted beneath the System's monitor, takes 60 pictures per second of the user's eye. A low power, infrared light emitting diode (LED), mounted in the center of the camera's lens illuminates the eye. The LED reflects a small bit of light off the surface of the eye's cornea. The light also shines through the pupil and reflects off of the retina, the back surface of the eye, and causes the pupil to appear white. The bright-pupil effect enhances the camera's image of the pupil and makes it easier for the image processing functions to locate the center of the pupil. The computer calculates the person's gaze point, i.e., the coordinates of where he is looking on the screen, based on the relative positions of the pupil center and corneal reflection within the video image of the eye. Typically the Eye gaze System predicts the gaze point with an average accuracy of a quarter inch or better. Prior to operating the eye tracking applications, the Eye gaze System must learn several physiological properties of a user's eye in order to be able to project his gaze point accurately. The system learns these properties by performing a calibration procedure. The user calibrates the system by fixing his gaze on a small yellow circle displayed on the screen, and following it as it moves around the screen. The calibration procedure usually takes about 15 seconds, and the user does not need to recalibrate if he moves away from the Eye gaze System and returns later.[8]

IV.   HOW   TO   RUN   THE   EYEGAZE SYSTEM?

A user operates the Eye gaze System by looking at rectangular keys that are displayed on the control screen. To "press" an Eye gaze key, the user looks at the key for a

specified period of time. The gaze duration required to visually activate a key, typically a fraction of a second, is adjustable. An array of menu keys and exit keys allow the user to navigate around the Eye gaze programs independently. The image processing functions in the Edge Analysis System are all implemented in software. The eye tracking functions compute the raw gaze point coordinates each 60th of a second in synchronization with the field rate of the video camera. At each sampling iteration, the eye tracking software places the measured eye gaze data into data structures where it is readily available to the application program.[10]
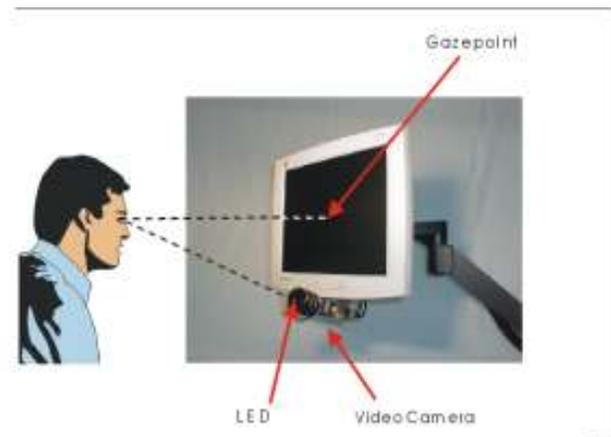

FIGURE 3 : WORKING OF SYSTEM

V. ENVIRONMENT REQUIRED FOR AN EYE GAZE SYSTEM

Eye gaze system must take care of light sources in the room in order to ensure the best accuracy, because eye tracking is done using infrared light. The Eye gaze System
 must be operated in an environment where there is limited of ambient infrared light. Common sources of infrared light are sunlight and incandescent light bulbs. The System makes its predictions based on the assumption that the only source of infrared light shining on the user's eye is coming from the center of the camera. Therefore, stray sources of infrared may degrade the accuracy or prevent Eye gaze operation altogether. The System works best away from windows, and in a room lit with fluorescent or mercury-vapor lights, which are low in infrared.[3]

FIGURE 4 : ENVIRONMENT REQUIRED

VI.   APPLICATIONS

A.   *MENUS OF EYEGAZE SYSTEM*

The main menu: The Main Menu appears on the screen as soon as the user completes a 15-second calibration procedure. The Main Menu presents a list of available Eye gaze programs. The user calls up a desired program by looking at the Eye gaze key next to his program choice.[10]
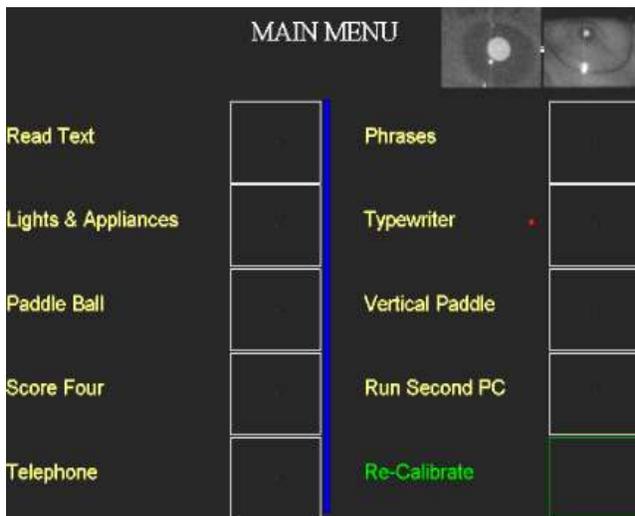

FIGURE 5 : MAIN MENU

B.   *Main Menu options:*

a.   *The Phrase Program*

The Phrases program, along with the speech synthesizer, provides quick communications for non-verbal users. Looking at a key causes a preprogrammed message to be spoken. The Phrases program stores up to 126 messages, which can be composed and easily changed to suit the user.[11]
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b.   *Type writer Program*

Simple word processing can be done using the Typewriter Program. The user types by looking at keys on visual keyboards. Four keyboard configurations, simple to complex, are available. Typed text appears on the screen above the keyboard display. The user may "speak" or print what he has typed. He may also store typed text in a file to be retrieved at a later time. The retrieved text may be verbalized, edited or printed. [10]
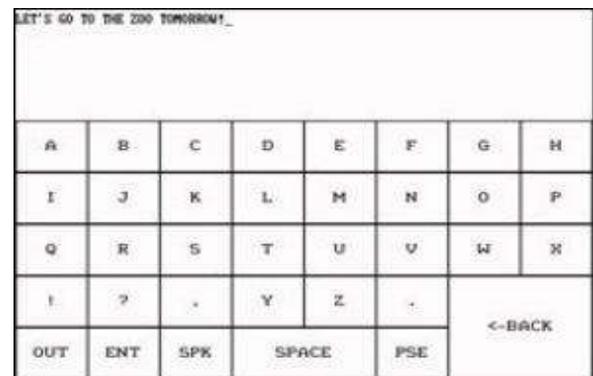

FIGURE 6 : TYPE WRITER

c.   *The telephone program*

The telephone program allows the user to place and receive calls. Frequently used numbers are stored in a telephone "book". Non-verbal users may access the speech synthesizer to talk on the phone.
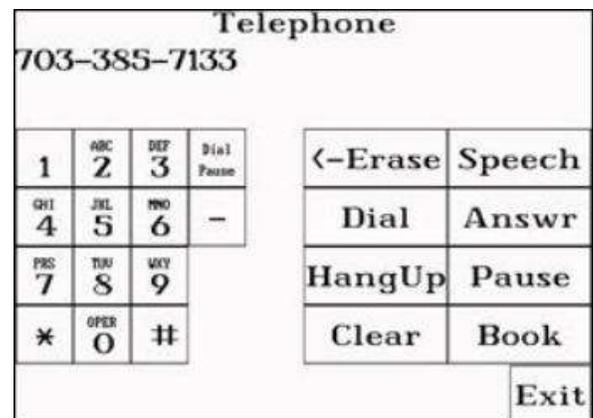

FIGURE 7 : TELEPHONE

d. *Run Second PC*

The Run Second PC program permits the Eye gaze Communication System to act as a peripheral keyboard and
Mouse interface to a Windows computer. The user can run any off-the-shelf software he chooses on the second computer. He can access the Internet, and send e-mail by looking at keyboard and mouse control screens on the Eye gaze monitor. The programs being run are displayed on the second computer's monitor. Typed text appears simultaneously on the Eye gaze and second pc's screens. For children, two new Eye gaze programs have been added to the Eye gaze System. Both run with the Second PC option. **Eye Switch** is a big, basic on-screen switch to run "cause & effect" software programs on a Second PC. **Simple Mouse** is an easy mouse control program to provide simplified access to educational software on a Second PC.[10]

FIGURE 8 : FREQUENCY KEYBOARD

e. *The Lights & appliances Program*

The Lights & appliances Program which includes computer-controlled switching equipment, provides Eye gaze control of lights and appliances anywhere in the home or office. No Special house wiring is necessary. The user turns appliances on and off by looking at a bank of switches displayed on the screen.[10]

f. *Paddle games & Score Four*

These are the visually controlled Games.

g. *Read Text Program*

The Read Text Program allows the user to select text for display and to "turn pages" with his eyes. Any ASCII format text can be loaded for the user to access. Books on floppy disk are available from Services for the Blind.[11]

h. *Television*

Television programs can be displayed directly on the desktop Eye gaze System screen. On-screen volume and channel controls provide independent operation. (Not available on the Portable Eye gaze System.)

VII.   NEW PORTABLE EYEGAZE SYSTEM

The Portable Eye gaze System can be mounted on a weighs wheelchair and run from a 12-volt battery or wall
outlet. It only 6 lbs (2.7 kg) and its dimensions are 2.5"x8"x9" (6.5cm x20cm x23cm). The Portable Eye gaze System comes with a flat screen monitor and a table mounts for its monitor. The monitor can be lifted off the table mount and slipped into a wheelchair mount.[11]

FIGURE 9 : THE PORTABLE EYE GAZE SYSTEM
MOUNTED ON A WEIGHS WHEELCHAIR

VIII. UPCOMING TECHNOLOGY

A. *Totally Free Head Motion*

This new technology solves eye tracking's tolerance-to-head-motion challenge once and for all. The Eye gaze System's Eyefollower™2.0 accommodates all natural head motions during normal computer operation. The user can sit back, sit

up, slouch down, move side to side, reach over to the mouse, operate the keyboard, and move close to the screen to examine a display at close rang.

B.   *Automatic Eye Acquisition*

The Eyefollower™2.0 automatically acquires the eyes when the user enters the workspace, and it rapidly re-acquires the eyes when he returns his attention to the screen after turning his head away.

C.   *Binocular Eye tracking*

The Eyefollower™2.0 tracks both eyes over the full range of head motion. The gaze point sampling rate is 120 Hz.

D.   *High Gaze point Tracking Accuracy*

The Eye gaze System achieves its highly accurate 0.45 degree gaze point tracking accuracy throughout the operational head range.

E.   *Easy User Calibration*

The user calibration employs the same, easy procedure used with the fixed-camera Eye gaze System.

IX. CONCLUSION

Today, the human Eye-gaze can be recorded by relatively unremarkable techniques. This thesis argues that it is possible to use the Eye-gaze of a computer user in the interface to aid the control of the application. Care must be taken, though, that Eye-gaze tracking data is used in a sensible way, since the nature of human eye-movements is a combination of several voluntary and involuntary cognitive processes.

The main reason for Eye-gaze based user interfaces being attractive is that the direction of the Eye-gaze can express the interests of the user-it is a potential porthole into the current cognitive processes-and communication through the direction of the eyes is faster than any other mode of human communication.

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Eye Gaze â€" control any PC with your eyes! For many people who have difficulty physically using a computer, eye gaze technology can offer a quick and easy to understand way of accessing your favourite software. All in One EyeGaze. Inclusive EyeGaze Education. Irisbond Duo Eye Tracker. Inclusive EyeGaze Learning Curve. Tobii Dynavox. Eye Gaze Mounting Solutions. Contribute to iitmcvg/eye-gaze development by creating an account on GitHub.Â Repositiory for Eye Gaze Detection and Tracking. We have implemented an Eye Gaze tracking system (currently in Beta version) using a series of algorithms. It computes the following : Pupil detection. Facial Normal. Gaze direction. To have a look into how we did it, just clone the repository and checkout v1.0. $ cd eye-gaze $ git checkout tags/v1.0 $ make. Or you can download eye-gaze v1.0 directly from releases. For a trial Eye tracking is the process of measuring either the point of gaze (where one is looking) or the motion of an eye relative to the head. An eye tracker is a device for measuring eye positions and eye movement. Eye trackers are used in research on the visual system, in psychology, in psycholinguistics, marketing, as an input device for human-computer interaction, and in product design.