Issue 9 vol 3 ISSN: 2321-8134

IJFEAT

INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

EYE GAZE TECHNOLOGY

Shamali Jaiswal[1]

[1]*Final year student, Electronics and Telecommunication, Prof. Ram Meghe Institute Of Technology and Research, Maharashtra, India,* ***shamalijaiswa71997@gmail.com***

Abstract

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 in use around the world. Its users are adults and children with physical disabilities. Not only the paralyzed people but eye gaze system can also be used by normal people as well at the workplaces where the speed matters the most.The sole aim of this article is to develop the same system using affordable means, so that more people should know about the system and should be able to take the benefits in low costs. Gaze-based interfaces have proven especially useful for physically-disabled users, for whom gaze control is the only, or easiest, available method of input. Such interfaces cover a wide range of applications, including typing and word processing and locomotion and control. While gaze-based interfaces have also shown promise for able-bodied users in specific contexts they have yet to make a significant impact on the design and development of today's most common user interfaces.

Index Terms: *Tracking, locating, fixating, I.R. rays and the method in eye gazing technique, Science of eye tracking, Skills, Numerous applications with less constraint.*

---------- *** ----------

1. INTRODUCTION

The eye gaze technology is the communication and control system technology for people with complex physical disabilities. Eye gaze systems allow people with severe physical disabilities to access a computer. These high-tech systems have an inbuilt camera which tracks where your eyes are looking, enabling you to move the mouse pointer around. You can 'click' by blinking, dwelling (staring at the screen for a certain length of time) or using a switch.
Eyes are the fastest moving parts of the body and are often not impacted by paralysis or extraneous movements. As a result, eye gaze has long offered people with severe motoric limitations important non-electronic (low-tech and no-tech) face-to-face communication options. These systems enable individuals to use eye gaze to indicate "yes/no" (*e.g.*, eyes up for "yes"), as well as to select or construct messages from displays using letters, symbols, words or phrases. 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.

Imagine yourself being a intelligent, motivated, and working person in the fiercely competitive market of information technology, but just one problem. You can't use your hands. Or you can't speak. How do you do your job? How do you stay employed? You can, because of a very good gift from computer-electronics Industry: The Eye gaze, a communication & control system you run with your eyes. The Eye gaze System is a direct-select vision- controlled communication and control system. It was developed in Fairfax, Virginia, by LC Technologies, Inc.,The results show that, for a simple task, it takes 60% less time to select an object with our eye gaze technique than with a mouse.Eye gaze selection technique is shown to produce a low slope, more like pure eye movement, which suggests that the technique preserves the inherent speed advantage of the eye over the hand. We find that eye gaze interaction is at least as fast as the mouse; and it is convenient in situations where it is important to use the hands for other tasks.

It is particularly beneficial for the larger screens, workspaces, and virtual environments of the future; and

will become increasingly practical as eye tracker technology matures.

2. HISTORY

The science of eye tracking/gazing has been around as early as the 1800s. Although the technology wasn't where it is today, people conducted eye movement studies for centuries using direct observations. In 1879, a French ophthalmologist named Louis ÉmileJaval made an observation when reading. He realized reading didn't involve smooth sweeping across the text, but rather the reader's eyes would have a series of short stops throughout with rapid eye movement.

These short stops are referred to as eye fixations. From the time he made these observations and through the 1900s, people continued to conduct eye tracking studies to make more sense of these eye fixations. Even today, people ask themselves why do a test subject's eyes stop on certain areas and why do they fixate on certain areas more than others. In the early 1900s, an educational psychologist named Edmund Burke Huey built an early eye tracker. He used contact lens with holes for the pupils. After Huey's early eye tracking technology, an experimental education psychologist named Guy Thomas Buswell from Chicago built the first non-intrusive eye tracker. Unlike Huey, Buswell used beams of light that were reflected on the test subject's eyes, and then recorded on film. It was still an early form of eye tracking technology, but again it was much less intrusive compared to Huey's eye tracking methods.

In the 1950s, a Russian psychologist named Alfred LukyanovichYarbus conducted several eye tracking studies that resulted in important eye tracking research. His 1967 book is still referenced today, as it showed that the task given to the eye tracking test subject has a very large influence on the individual's eye movement and fixation.

Simply put, his research showed the relation between eye fixations and the test subject's interest. Moving into the 1970s, eye tracking studies and research continued to rapidly grow. Just like in the 1800s and early 1900s-1950s, the eye tracking research focused mainly on studying how people read. In the 1980s, Just and Carpenter came up with the Strong eye- mind hypothesis. This hypothesis states that when a subject is viewing a word or object, he or she is also processing it cognitively (thinking about it) for exactly the same amount of time he or she is fixating on it. During this time, the Strong eye-mind hypothesis was questioned because of the idea of covert attention, which is the attention to something that one is not looking at. The 1980s also saw the first use of eye tracking technology to help answer questions related to human- computer interaction.

Researchers analyzed how users navigated through and interacted with computer command windows. These researchers also made advancements in the technology by using real time eye tracking results to help disabled people. Today, eye tracking technology and research is continuing to grow and is getting implemented in eye gaze technology.

We see how these users fixate on specific areas to improve their designs and digital media. The eye tracking technology is continuing to advance, resulting in data to be increasingly more accurate.

3. WORKING OF EYE GAZE SYSTEM

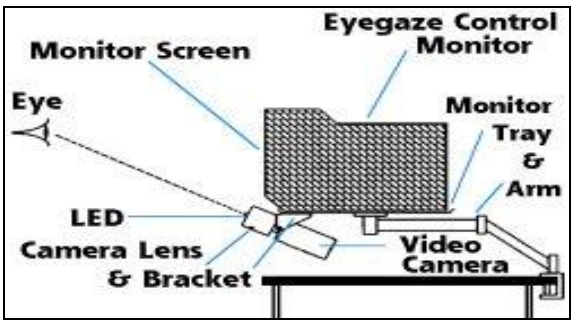


Figure1: EYE GAZE SYSTEM

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.

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. The system learns physiological 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.
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.After the calibration, the configuration between the camera and the monitor is fixed during the eye tracking.

Eye tracking data is collected using either a remote or head-mounted 'eye tracker' connected to a computer. While there are many different types of non-intrusive eye trackers, they generally include two common components: a light source and a camera. The light source (usually infrared) is directed toward the eye.

The camera tracks the reflection of the light source along with visible ocular features such as the pupil.

This data is used to extrapolate the rotation of the eye and ultimately the direction of gaze. Additional information such as blink frequency and changes in pupil diameter are also detected by the eye tracker.

The aggregated data is written to a file that is compatible with eye-tracking analysis software such as Eye Works.

There are many different methods of exploring eye data. The most common is to analyse the visual path of one or more participants across an interface such as a computer screen.

Each eye data observation is translated into a set of pixel coordinates. From there, the presence or absence of eye data points in different screen areas can be examined. This type of analysis is used to determine which features are seen, when a particular feature captures attention, how quickly the eye moves, what content is overlooked and virtually any other gaze-related question.

Graphics such as Gaze-Spots and Gaze-Traces are often generated to visualize such findings. Beyond the analysis of visual attention, eye data can be examined to measure the cognitive state and workload of a participant. Eye Tracking's patented Index of Cognitive Activity (ICA) is among the most widely used of these metrics. It has been validated in multiple contexts as a reliable indicator of mental effort. Revolutionary tools such as the ICA have effectively demonstrated the wealth of information attainable through careful study of the eye.

.

4. WHO IS USING EYE GAZE TECHNOLOGY

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.

Eye gaze/eye tracking technologies can offer individuals with motor neuron disease (ALS), traumatic brain injury, muscular dystrophy, locked-in syndrome, aphasia, cerebral palsy (both spastic and athetoid), high spinal cord injuries and other types of severe physical disabilities a reliable way to communicate and control technology applications.

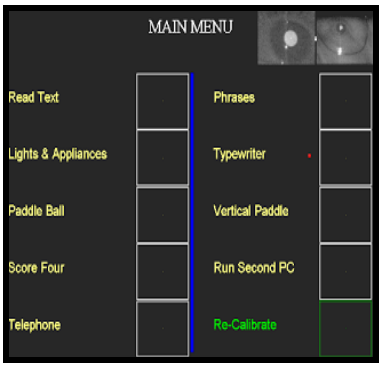
For some, eye gaze may serve as a primary access method; for others, it may be one of several input methods.

People who currently use head pointers or head pointing technologies and those who rely on scanning may find eye gaze less fatiguing and more efficient at certain times during the day.

5. 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.



5.1 Main Menu options :

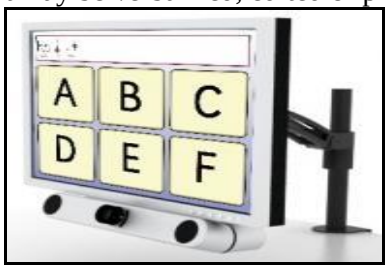
The Phrase Program :

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.

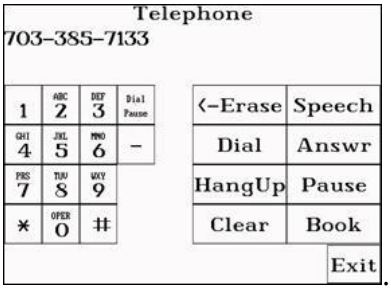
Typewriter Program :

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.



The telephone program :

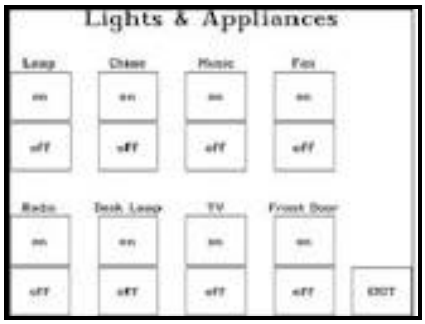
The telephone program allows the user to place and receive calls. Frequently used numbers ae stored in a telephone "book". Non-verbal users may access the speech synthesizer to talk on the phone.



The Lights & appliances Program :

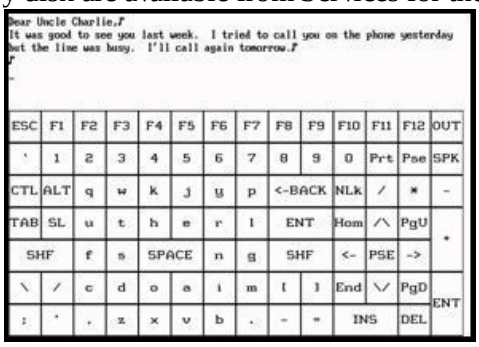
The Lights & appliances Program which includes computer-controlled switching equipment, provides Eyegaze control of lights and appliances anywhere in the home or office.

No special house wiring is necessary. The user turns appliances on and off by looking at a bank of switches displayed on the screen.



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.



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.)

6. THE SKILLS NECESSARY FOR USING EYE GAZE TECHNOLOGY

- Good control of one eye
- Ability to maintain a position in front of the Eye gaze monitor
- Mental abilities that improve the probability for successful Eye gaze use

- Cognition
- Ability to read
- Memory

Some factors that may affect eye gaze and eye tracking:

- Nystagmus (constant, involuntary movement of the eyeball)
- Inadequate Visual acuity
- Diplopia (double vision)
- Blurred vision
- Cataracts (clouding of the lens of the eye)
- Homonymous hemianopia (blindness or defective vision in the right or left halves of the visual fields of both eyes)

7. DEVELOPMENTS IN EYE GAZE TECHNOLOGY

LC technologies have recently developed a portable eye gaze system. The portable eye gaze system can be mounted on the wheelchair and run on the 12 volt battery or wall outlet. It weighs only 6lbs (2.7 kg)and its dimensions are 6.5 cm*20cm*23cm.

The portable eye gaze system comes with the flat screen monitor and a table mount for its monitor. The monitor can be lifted of the table mount and slipped into a wheel chair mount.

Developers:

TOBII, COGAIN, SMI Eye Tracking Technology For Leading OEMS,
ALS Assistive Technology,
Eye Tech Digital Technologies.

Nowadays this whole configuration is embedded in simple flat laptops and the gaze tracking mechanisms are fitted in a flat strip that is already attached beneath the eye gaze display.

8. APPLICATIONS OF EYE GAZE TECHNOLOGY

The automotive, medical and defence industries have applied eye tracking technology to make us safer. The fields of advertising, entertainment, packaging and web design have all benefited significantly from studying the visual behaviour of the consumer. Research with special populations has generated exciting breakthroughs in psychology and physiology. Every day, as eye tracking is used in creative new ways, the list of applications grows.

Eye gaze technologies have been used in medical fields, educational fields, defence and military applications too.

These can also be used in enhancing the infrastructure of virtual classrooms mainly subjected for physically challenged students, to support their intellectual and explore their talents. The technology helps in putting forward the ideas of such challenged students and also helps them to interact with the society.

9. CONCLUSION

Eye gaze interaction techniques are a useful source of additional input and should be
considered when designing advanced interfaces. Moving the eyes is natural, requires little conscious effort, and frees the hands for other tasks. People easily gaze at the world while performing other tasks so eye combined with other input techniques requires little additional effort.

An important side benefit is that eye position implicitly indicates the focus of the user's attention. Today, the human eye gaze can be recorded by relatively unremarkable techniques.

This thesis argues that it is possible to use 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 should be used in a sensible way, since the nature of the human movements of the human are combination of several voluntary and involuntary cognitive processes.

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

It is argued that eye gaze tracking data is best used in multimodal interfaces where the user interacts with the data instead of the interface, is so called non command user interfaces.

References:

[1]. GAZE ENHANCED USER INTERFACE DESIGN by Manu Kumar (May 2007)
[2]. SEEING HOW YOU'RE LOOKING - Using Real-Time Eye Gaze Data for User-Adaptive Visualization.
[3]. HUMAN COMMUNICATION RESEARCH / October 2005