



Eye Gaze Communication

Ms S. V. Kamble¹, Mr S. S. Naitam², Mr A. N. Shire³, Mr A. P. Shingade⁴

Student, Department Of Electronics & Telecommunication Engg., JDIET, Yavatmal, India^{1,2}

Assistant Professor, Department Of Electronics & Telecommunication Engg., JDIET, Yavatmal, India^{3,4}

Abstract: The term Eye gaze communication refers to operating computer system by tracking the eye gaze of the human. Eye tracking is the process of tracking the moment of eye and determining where the user is looking on the screen. Eye gaze technology is hand free or voice free technology i.e. without using hand or voice we can operate the computer. Persons with cerebral palsy, spinal cord injury, brain injury, brainstem stroke, muscular dystrophy etc. can use this system. This system is also called as vision-controlled communication system. In this type of communication system control keys are displayed on the screen. By looking at the control keys user can operate computer, type, access internet, send email etc. The system is useful to enhance the life of disabled person. Firstly we are presenting what actually the eye gaze communication system is and the key elements. We are evaluating the behaviour of user when they are using the eye gaze interfacing. Used different methods of eye tracking such as electro-oculography, scleral search coil, infrared oculography, video oculography, and different approaches i.e. feature based approach and appearance based approach etc. We have tried to compare surveys based on some parameters such as input, tracking type, sensing technology etc.

Keywords: Eye gaze communication, eye tracking, vision controlled communication, voice free technology.

I. INTRODUCTION

Average computer user spend most of their time looking at the computer screen. A number of researcher found that detection of eye gaze is fruitful for operating the computer system. For human computer interaction natural user handles the computer system or perform their daily work with natural behaviour. But the disabled person cannot perform their daily work naturally. So eye gaze communication system helps them live their life independently. It is also called as hand free communication. Eye gaze communication is based on the eye gaze of the human. User can operate this system by looking at computer screen and the eye tracker device conclude that where the user is looking. Eye tracking is the process of measuring either the point of gaze or the motion of the eye relative to the head.

Eyes are normally used for observation not for control. Eye moments are natural and extraordinarily fast. Direction of the gaze implicitly indicate main target of attention. Eye gaze tacking in eye gaze communication system enables the users through movement of eye to guide a system. There are number of methods for measuring eye movement. The eye gaze system is a communication control system that you can run with your eyes. The eye gaze system is a direct-select vision controlled communication and control system. To operate eye gaze communication system user should have one eye with good vision and ability to keep head fairly stable. The main aim of the paper clearly deals with the various aspects of eye gaze communication and different methodology such as electro-oculography, video oculography etc. used for the eye gaze communication.

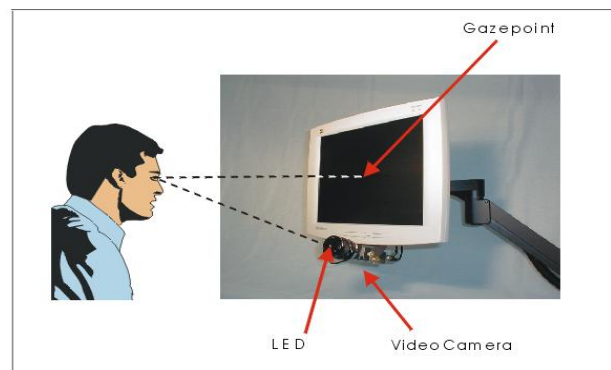


Fig.1. Basic concept of eye gaze communication

A. ELECTRO-OCCULOGRAPHY

In this method, sensors are attached at the skin near the eye to measure an electric field exist when eyes rotate. By recording the small differences in the skin potential around the eye, the position of eye can calculated. By placing electrodes carefully, it is possible to record horizontal and vertical movements. This technique is not so appropriate for daily life, since it require close contact of electrodes. It is a cheap, easy and invasive method.

B. SCELERAL SEARCH COILS

In this method, small coils of wire are embedded in a modified contact lens. When a coil of wire moves in a magnetic field, voltage is generated in coil. If this coil is Attached to the eye, then a signal of eye position will produced. An integrated mirror is fixed in the lens allows measuring of reflected light. An integrated coil in a lens allows detecting the coil's orientation in magnetic field.



This lenses can be applied after local anaesthetics has been introduced. It is highly accurate method of eye tracking.

C. INFRARED OCULOGRAPHY

The infrared oculoigraphy measures the intensity of reflected infrared light. In this method, eye is illuminated by the reflected infrared light. The difference between the incident infrared light and reflected infrared light from the surface of eye carries the information about the position of eye. It can measure eye movement in darkness.

D. VIDEO OCULOGRAPHY

In video oculoigraphy, to determine the movement of, eye single or multiple cameras are used by using the information obtain from the images captured. Video oculoigraphy is widely use eye tracking technique. Video oculoigraphy grouped into single-camera eye tracker and multi-camera eye tracker. Different approaches used are featured based gaze estimation approach appearance based gaze estimation approach. The main aim of featured based gaze estimation is to identify informative local features of eye. In feature based approach the characteristics of human eye are explored to identify set of different feature of eye like contours, eye corners and corneal reflection (most commonly used feature for gaze estimation). In appearance based technique image contains are used to estimate direction of gaze by mapping image data to screen coordinates. Appearance based gaze estimation approach detect and track eyes directly based on photometric effect.

II. LITERATURE REVIEW

Kyung-Nam et al [1] discussed the variety of technique for estimation and eye movement tracking. These techniques are longest line scanning (LLS), occluded circular edge matching (OCEM), eye lid tracking etc. For measuring eye gaze computer vision techniques and image processing techniques are used. There are two type of approach to estimate eye gaze they are estimation based on geometry and estimation based on adaptive. Estimation based on geometry is than estimation based on adaptive approach. Find out the relation between face model and camera image point to obtain eye gaze. Non-intrusive tracking type is used. The eye gaze tracking techniques estimate gazing point at 3x3, 4x5, and 8x10 screen resolution by adaptive base and geometry base estimation method. But eye gaze tracking method are seen to be quite successful at 8x10 screen resolution. Author investigated the non-intrusive vision-based eye movement tracking and gaze estimation.

Manu Kumar [2] Author discussed variety of techniques that use gaze information for daily life task. Main purpose of this research is not to replace the existing techniques but to give variable alternatives which user can use according to their physical ability or preference. Also this author arguing existing interaction technique with eye gaze. The major contributions of this author are Gaze-

based interaction techniques, technologies for gaze input, and guidelines for gaze based interaction. Various gaze enhanced scrolling techniques such as manual scrolling, automatic scrolling, etc. are discussed. Also introduced the use of off-screen gaze actuated buttons or hotspots. Gaze enhanced scrolling techniques reduce the efforts of the user in order to surf the web or collecting other information. Different applications are used that gives the evaluation and design of eye gaze based techniques for switching between different applications. The research of this author present use of eye gaze based password entry technique which reduce the threat of shoulder surfing, keyboard acoustic, and screen electromagnetic emanation and how gaze can be used for zooming. Author works on techniques for improving gaze point they are saccade detection and fixation smoothing, eye- hand coordination, and focus point. This technique provide more accuracy. Introduce low cost eye tracking techniques.

Linda sibert et al [3] Comparison is done between the performances of eye gaze interaction with widely used, general-purpose device i.e. mouse. Input device is computer demonstrates advantages of eye gaze of human. For this purpose two experiments are described that compare the eye gaze interaction technique with widely used device: mouse. In this experiments time required for performing simple computer task is measured for both eye gaze and mouse. The first experiment is circle task which required the subject to select highlighted circle from a three by four grid of circle as fast as possible.

Jowers Iestyn et al [4] worked on evaluation on eye tracking interface for a two dimensional (2D) sketch editor and computer aided design tracking interfaces. Author gives different models that are used for collecting gaze information for supporting dynamic shape study of two dimensional sketch editor. Various purpose of eye tracking interfaces are discussed. Totally different eye tracking methodology is introduced. 3D model based methodology and shape based methodology are described by author. Pupil corneal reflection tracking technique and non-intrusive tracking approach is used. Tracking algorithm is image screen mapping and sensing technology is graphical display. Results are positive.

Susanna Nilsson et al [5] tell in the paper that how the interaction based on gaze are implemented are used in an augmented reality system. Main aim was to check gaze control's functionality of application. In AR-system eye-gaze control tool is designed for developing designing interfaces and interaction approaches of the system and to develop augmented reality with joined eye tracker system. Screen resolution is 640x480 pixels, 800x600 pixels and a field of view 37x28 degrees. Gaze tracker technologies used are displays, optic device, image sensor, real time signal processing.

Anjana Sharma et al [6] Describes the research issue in designing improved eye gaze based human computer interaction (HCI) for argumentative and alternative



communication (AAC). Argumentative and alternative communication is the domain of communicating methods or techniques that provide improved human-human or human-system interaction. AAC technique help user with certain communication disability to perform everyday conversation without helper. The paper of this author gives main idea of Augmentative and alternative communication (AAC) for developing main AAC.

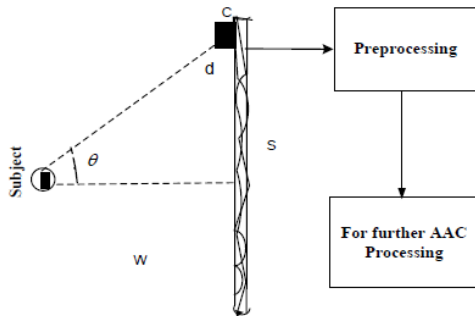


Fig. 4. Specified set up for eye gaze processing

Here, in this diagram W is workspace giving setup for placement of the subject and image capturing. Image is captured by the capturing device C . d is the distance between the subject and the screen S . Image is then given for processing. The processed image is then given to further processing phase. The result image after processing can be used for several HCI and AAC application. Some issues related to the AAC and HCI designing such as capable to work in narrow lightning situation, real time detection, interactivity limitation, price, performance issue, sound resistance, orientation etc. have been discussed by the author.

Dan Witzner et al [7] worked on detection of eye and tracking of gaze in video based gaze tracker. Different methods and techniques for eye detection and tracking and

eye model are discussed in this paper. Survey are done for gaze estimation and compare them on their geometrical based properties and described correctness. In short, that type of system should be build which are easy to use and Low cost, negligible, normal movement of head and under illumination changing conditions, estimation accuracy for gaze should be good. There is problem that some experiments are conflicting such as low number of calibration and flexibility.

Alex Poole [8] tells the main concept of eye tracking technology in human-computer interaction (HCI). Explained the technical issue in eye tracking research. This paper of author helps many researcher to give an applied guide. Different methodologies such as electro oculography and video based eye tracker etc. are explained.

Robert Lupu et al [9] Describes some related past studies for eye tracking. This paper covers the various types of devices and well known applications, different software algorithm for pupil detection, data filtering, recording eye moment, image processing etc. Eye tracking application cover human computer interaction (HCI), brain computer interaction, e-learning, virtual reality etc. By using eye tracking method in e-learning it is possible to capture learner behaviour.

Chennamma et al [10] worked on the development of non-contacting based on video gaze tracking. This paper of the author include terminologies and definition, improvement in this field and development of this field in future. Several methods are used in the paper for tracking the motion of the eye such as infrared oculography, electro-oculography, video oculography, scleral search coil etc. Gaze estimation method for gaze tracking are feature based gaze estimation, appearance based gaze estimation. The gaze tracking system needs to become low in cost and accuracy of data capture needs to improve in order make them useful tools.

III. COMPARISION TABLE

Reference	Author	Input	Tracking type	Sensing technology	Measurin g eye gaze	Result
[1]	Kyung-Nam Kim et al	Eye image	Image data	Video camera, microphone	Image processing , computer vision	Proposed eye gaze tracking method which are seen to be successful at 8x10 resolution. Geometry based estimation better than adaptive estimation.
[2]	Manu Kumar	Eye image, hand, keyboard, mouse	Eye data, image data	N/A	Pointing and selection	Discussed the variable alternative technique, low cost technique for the disabled persons.
[3]	Linda Sibert et al	Hand, mouse	Vision based	Audio	Eye gaze selection technique	Result show that, for a simple task, it takes 60% less time to select an object with our eye gaze technique than with a mouse. Beneficial for the larger screen.



[4]	Jowers Iestyn et al	Mouse, keyboard	Image data	Graphical displays	Eye-gaze selection	The result are positive and gives the eye tracking interface for 2D sketch editor.
[5]	Susanna Nilsson et al	Eye typing	Vision based	Black/white gaze tracker camera, micro displays	Computer vision	Gaze-controlled AR system's results shows that system does work, but it needs considerable development and further user studies before it can be a realistic option in real end user setting.
[6]	Anjana Sharma et al	Eye input	Image data	N/A	Image processing	Explain the importance of eye gaze based method for designing better AAC system. Result shows that the system recovers from tracking errors due to sudden head movement or slow blinking.
[7]	Dan Witzner Hansen et al	Eye image	Image data, eye data	Video camera, graphical display	Computer vision	Future gaze tracking system should be low cost, easy to setup, accuracy, good gaze estimation and natural head movement.
[8]	Alex Poole et al	Eye image	Image data, vision based	Video based	Image processing	Continued growth in the use of the eye tracking method in HCI studies look likely continue as a technology becomes increasingly more affordable and easy to use.
[9]	Robert Gabriel Lupu et al	Mouse based	Image data	Video and stereo camera, video glasses	Image processing, computer vision	Solutions are focused on commercial remote camera based eye tracker system for which the light source and camera are permanently affixed to a monitor. Because these commercial systems including software and support are expensive, some low cost mobile devices for eye tracking were developed.
[10]	Chenna mma H.R. et al	Eye	Vision based	Stereo and video camera	Computer vision	Future development in eye tracking need to focus on standardizing what eye movement metric is used. No standard yet exist for the minimum duration of a fixation. The contrast of the equipment should be decreased for making user comfortable. The gaze tracking system should be low in cost and accurate

IV. CONCLUSION

From the research of various paper we conclude that using eye gaze as pointing tool to operate system is very useful. This paper argue that it is achievable to use eye gaze of computer user within interface to help management of

application. As eye tracking system improve in quality and accuracy and reduce in value, it will grab attention of the user. Human eye movement is a combination several voluntary and involuntary cognitive process therefore eye movement should use carefully. In future the eye gaze tracking communication systems should be



- Low in cost
- Easy to use
- Use with normal movement of head.

REFERENCES

- [1] Kyung-Nam Kim, R.S. Ramakrishna, "Vision Base Eye Gaze Tracking For Human Computer Interaction", Department Of Information And Communication, Kwangju Institute Of Science And Technology, Kwangju, 300-712, Korea (ROK).
- [2] Manu Kumar, "Gaze-Enhanced User Interface Design, A Dissertation Submitted To The Department of Computer Science And The Committee on Graduate Studies, Stanford University, 2007.
- [3] Linda E. Sibert And James N. Temple man, Robert J. K. Jacob, "Evaluation and Analysis of Eye Gaze Interaction", Human Computer Interaction Laboratory, Naval Research Laboratory Washington, Dc 20375, Department Of Electrical Engineering And Computer Science, Tufts University Medford, Ma 02155.
- [5] Jowers Iestyn, Prats Miquel, Mckay Alison, Steve Garner, "Evaluating An Eye Tracking Interface For A Two Dimensional Sketch Editor", University of Leeds, Leeds And The Open University, Walton Hall, Milton Keynes, Mk7 6aa, Ls2 9jt, UK.
- [6] Susanna Nilsson, Torbjorn Gustafson and Per Carlsberg, "Hands Free Interaction with Virtual Information in A Real Environment: Eye Gaze as an Interaction Tool in an Augmented Reality System", Linköping University, Sweden, 28th April, 2009.
- [7] Anjana Sharma, Pawanesh Abrol, "Research Issues In Designing Improved Eye Gaze Based HCI Techniques For Augmentative And Alternative Communication", Department of Computer Science & IT, University of Jammu, J & K-180006 INDIA, At IJETCAS, 2013.
- [8] Dan Witzner Hansen, IEEE Member and Qiangji, IEEE Senior Member, "In the Eye of the Beholder: A Survey of Models for Eyes and Gaze".
- [9] Alex Poole And Linden J. Ball, "Eye Tracking In Human-Computer Interaction And Usability Research: Current Status And Future Prospects", Psychology Department, Lancaster University, UK.
- [10] Robert Gabriel Lupu And Florina Ungureanu, "A Survey Of Eye Tracking Methods And Applications", Gheorghe Asachi, Technical University of Iași, Faculty of Automatic Control and Computer Engineering, August, 2013.
- [11] Chennamma H.R., Department of Mca, Sri Jayachamarajendra College of Engineering, Mysore, Karnataka, India, Xiaohui Yuan, University of North Texas, Denton, Texas, USA, "A Survey on Eye-Gaze Tracking Techniques".

BIOGRAPHIES



Miss. Sayali V. Kamble Pursing engineering in SGBAU Amravati University



Mr. Shirish S. Naitam pursuing engineering in SGBAU Amravati University



Prof. A. N. Shire received M. Tech degree in Electronics from G. H. raisoni, Nagpur, Indian 2010. He has all experience of 09 years in teaching and industry. He also

served as Head Of Department for 03 years in DBNCOE in electronics and telecommunication, Yavatmal, Maharashtra. Till date he has published 05 research papers in various International Journals. His area of interest is signal/ image processing. He is also Life members of ISTE & IETE.



Mr .Atul P. Shingade has completed his Master from SGBAU Amravati. He has more than Six years of experience in teaching and industria l area. He has interest In Digital Image Processing and VLSI Design.