HCTL Open Int. J. of Technology Innovations and Research
HCTL Open IJTIR, Volume 4, July 2013
e-ISSN: 2321-1814
ISBN (Print): 978-1-62776-132-1

Eye Based Interaction System

Kanika Tehlan*
kanikatehlan@gmail.com

Abstract

The aim is to introduce a system that can be operated by all users, whether it is a normal user or any physically disabled person who cannot move his hands and operate the system. There are many ways that can be used to operate the system without using hands. One such method can be to use human eye to control the system and provide commands through eyes. There are several obstacles in this but with some level of compromise with cost, this system can be made highly accurate and easily usable. A particular wavelength of light can be used to achieve this objective. The light is thrown to the human eye through a special device. As it falls on the eye it is reflected in the direction in which the user is looking on the screen. All the devices used for this need to be specialized, normal screen cannot be used for the accomplishing our task. The screen needs to be sensitive to the light reflected by the eye. There is requirement of a special lens that can fairly reflect the light falling on it from the light source. The type of lens required will entirely depend on the wavelength of light selected. This type of system will be very useful for the physically disabled people and to some

*Masters of Technology (Information Technology) Student at Banasthali Vidyapith, Rajasthan, India

e-ISSN: 2321-1814
ISBN (Print): 978-1-62776-132-1

extent it may be a possibility to employ the system in a hands busy situation when technology becomes cheaper and easily accessible. It is relatively easy to track the movement of eye rather than recording brain signals because eye involve some physical movement of eye muscles when compared to brain which only include electrical signals.

Keywords

Eye, Lens, Reflection, Tracking, Saccades, Fixation.

Introduction

The system proposed will contain a device to through light on the user's eye, one can call it the light source for the interaction, a special screen that can detect the light rays falling on it and a small lens that will help the human eye to reflect that particular wavelength of light. These are the three key things on which the entire system is based on. After selection of appropriate devices the procedure for controlling the system will be as follows. The light source will throw the light towards human eye. The light source will be a static device that can be placed anywhere as it is convenient to the user but there are two recommended positions, first is to place the device just below the monitor at the place of keyboard and second possibility can be right above the screen. Its direction can be adjusted in such a way that it throws light only in the direction of human eye. The angle can vary depending on the height of the user using the system. Another implementation of the light source is that it can be moulded as a thin line attached on the monitor itself that is continuously emitting light of particular wavelength. It can be viewed as a monitor with integrated light source to reduce the overhead of placement and maintenance of the light source. Here we will consider this type of device only.

Now the next question is what will happen to the light once it is emitted by the source. The light will be made to fall exactly on human eye continuously by varying the angle of the device. The user has to either attach a lens to the eye ball and if it is not convenient then that lens can be embedded in spectacles. The actual reflecting lens will be a small sized dot like part of the lens or spectacle. The choice of lens depends on the wavelength of light emitted by the light source because it is not possible for the ordinary lens to reflect the spectrum of light used for this purpose we will have to select the appropriate properties that truly reflects the band of light falling on it. Wearing a spectacle or even a lens is not so inconvenient for the user as compared to some other

e-ISSN: 2321-1814
ISBN (Print): 978-1-62776-132-1

heavy devices like helmet etc. It is also relatively easy to change the angle of sight while you are wearing a spectacle.

The third integral part of the system is the screen which also includes some special features. The most important point with the monitor used in this system is that it has to be sensitive to the light. It should detect the light falling on the screen and perform actions accordingly. There are different ways in which human eye works, the same can also be used to operate the system. One can just go through the content by taking the overview or one can also select some specific icons to provide a command to the computer. There is different mechanism for selecting an icon by looking at it continuously for a pre-specified time interval through eye gaze [3]. This is derived from two types of eye moments called saccades and fixation that are discussed in detail in subsequent section.

Despite of several limitations with the system proposed there are a number of advantages that make it really profitable to develop this proposed system. Cost is the governing drawback of this system that makes it unrealistic to be used by the common user and limiting its use to the users who can spend a big amount to get access to this technology. The system is really helpful and can become a bane for physically challenged people who want to use the technology by leaving behind there disabilities and its implementation will lead to up gradation of the level of ease with which the new methodology can be used.

Detailed Description

The system to be developed comprises of three main components. These components are named as following:

1. Light source
2. Sensitive screen
3. Reflecting lens

The light source as discussed earlier will be a device which will throw light on the human eye. We can have the source attached with monitor only. This will increase the cost but at the same time it will enhance the ease of maintenance and use. The light can be made to emit out from a thin line attached to the monitor. The angle of emitted light can be varied according to height of the user so that it directly falls on the eye of the user. The screen of such system will

HCTL Open Int. J. of Technology Innovations and Research
HCTL Open IJTIR, Volume 4, July 2013
e-ISSN: 2321-1814
ISBN (Print): 978-1-62776-132-1

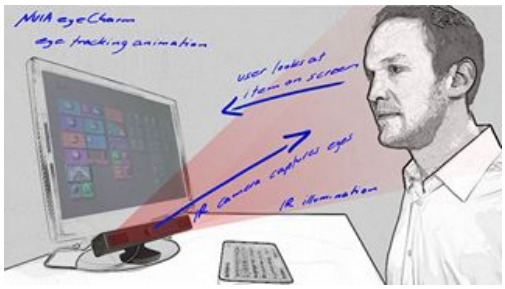

Figure 1: *Process of Tracking*

look like as shown in the figure 1. The light to be emitted will be of relatively lower wavelength for instance a laser with low power can be can be emitted that is reflected by retina directly but due to some health related issues it is recommended to use a lens that can reflect the light in the same way as it is done by the retina of our eye. There is a need to be very careful while choosing the wavelength of light to be used in this whole procedure. Either a sufficiently low bandwidth of light may be used or low power laser. The most appropriate choice taking health issues in consideration will be green laser with 1.5 mW of power and wavelength 532 nm or even lower. The voltage required for operating this type of laser will be 3.0 V and hence it will be convenient to club the light source with the monitor only [1]. This green laser is not harmful for human health and it is also used as highlighting or pointing device in many applications but in slightly high power [2]. The current range for operation of this green laser is between 220-250 mA [1]. The third major component of the proposed system is the specialized screen which has to be sensitive to the low power green laser. The entire screen has to be divided into matrix of pixels. A group of specific number of pixels denotes different icons. As and when light falls on the pixels of a specific group , the icon denoting those pixels is selected and a command is generated to the system that will perform its associated functionality.

Once the light source and reflecting lens is selected next is the process of going through the system and selecting the icons displayed on the screen. There are two ways in which eye moves. These are saccades and fixations. The principal method for moving the fovea to view a different portion of the visual scene is a sudden and rapid motion called a saccade [4]. Saccades take approximately 30-120 milliseconds and traverse a range between 1 and 40 degrees of visual angle (15-20 degrees being most typical) Typically, a saccade is followed by a 200-600 ms. period of relative stability, called a fixation, during which an object can be viewed. During a fixation, the eye does not remain still. Several types of

HCTL Open Int. J. of Technology Innovations and Research
HCTL Open IJTIR, Volume 4, July 2013
e-ISSN: 2321-1814
ISBN (Print): 978-1-62776-132-1

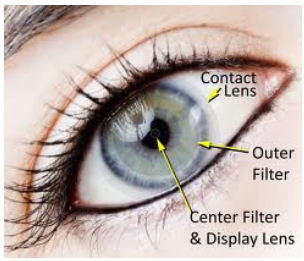

Figure 2: *Lens on Eye*

small, jittery motions occur, generally less than one degree in size [4]. System can recognize a selection command by encountering the fixation. When the user wants to select an icon then an easy eye gaze can be sufficient. The user can continuously look at a desired icon for a particular time interval and that icon will be selected and the command associated with that icon will be performed by the system. In other words the fixation denotes the selection of an icon. The main feature of the screen supporting this system is that it has to be sufficiently large in order to accommodate all the icons required on desktop with some gap between them. This gap is necessary for clear and distinct selection by the reflected beam of light. The icons should also represent a group of large number of pixels or in other words they should be large enough to provide the user the ease of selecting the required icon and minimizing the probability of wrong selection and ambiguity to the system.

Despite of all the obstacles present in the implementation of the proposed

Figure 3: *Fixation*

system and its cost at present it is worth building such a system. There are several advantages of such a system. It will be a faster, more convenient means of interacting with the computer. Moreover it is more natural way of delivering your dialogue to the computer system. This can be the most effective

e-ISSN: 2321-1814
ISBN (Print): 978-1-62776-132-1

method, even better than speech recognition devices which due to limitations in technologies and ambiguity in human languages are not so much perfect. Eye detecting systems may also arrive at ambiguity if they cannot distinguish clearly between saccades and fixations but to make sure that this do not happen the time interval or selection can be made fairly large. It will take time to get your commands executed due to eye gaze of large time interval leading to selection but it will ensure that an icon is selected only when the user wants to select it. There is another issue related to this system and that is accuracy. To provide accuracy the icons should be sufficiently large and should have as much gap from its neighbours as it is possible. If all the issues are dealt appropriately then this system will have the capability of shifting the direction of dialogue to user-to-computer direction which at present is in computer-to-user direction. Another major advantage of this system is that there is no need of any training for the users to make use of the system it is self intuitive.

Figure 4: *Eye Trackers*

References

[1] http://odicforce.com/shop/article_OFL199/1-2mW-Green-Laser-Module-(APC).html?pse=apq

[2] Laser Pointers, Wikipedia - http://en.wikipedia.org/wiki/Laser_pointer

[3] R.M. Pritchard, Stabilized Images on the Retina, Scientific American 204 pp. 72-78 (June 1961).

e-ISSN: 2321-1814
ISBN (Print): 978-1-62776-132-1 *References*

[4] Robert J.K. Jacob, `Eye Based Human Computer Interaction Techniques: Towards Non Command Interfaces`, Naval Research Laboratory Washington, D.C.