

EYETRACKER AS A NEW RESEARCH TOOL

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Abstract. Why do you need to know where I am looking? Eye contact is one of the most fundamental kinds of communication. You may obtain a basic picture of where and who someone is gazing at by observing their eyes. My eyes are constantly moving, but can computers? Naturally, they act in the same way. Computers can monitor users' facial and eye movements while allowing for real-time interaction. Computers may gather this data and give it to us in the required format. What eye tracking is, how it functions, and specifics on eye tracking projects are all covered in this article.

Keywords: Eye tracking, communication, neuromarketing.

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1 Introduction

Do you realize how frequently your eyes move? Even if you don't see it, feel it, or even want it to, this activity nevertheless takes place. This article examines how eye movements can be included in user interfaces. By examining interfaces and evaluating their usability, we can learn more about how people behave and how they interact with computers. As you are aware, a sizable portion of the global populace makes use of the Internet. The amount has now surpassed 5.03 billion. This represents approximately 63.1% of the total population (<https://datareportal.com/global-digital-overview>). Users of the internet are growing daily. A huge portion of the population can benefit from the use of eye tracking equipment. Currently, eye tracking technology is used in many places. One of them is medicine.

Autism is a condition that some young people are dealing with nowadays. Additionally, once this illness is discovered, there is no cure. One of the issues that families consider the most is this one. Young children blood cannot be taken from them, and therefore cannot have their autism diagnosed. Only in the second half of life may someone be diagnosed with autism. It will be too late to treat the illness when this time comes. We are unable to do a blood test or brain study since we do not currently have a biological marker for autism. Therefore, we must undertake a behavioral examination in order to diagnose a child. The inability to follow the faces of their interacting partners is one of the hallmarks of autism in babies (<https://www.youtube.com/watch?v=r-mGwSG2KDs>). When someone tries to speak to them or establish eye contact with them, they don't even watch out at them. As a result, they don't learn much because children learn the majority of what they know by watching what others do.

Using eye tracking equipment, we can discover this. For instance, it enables you to show a child a video while using specialized cameras to record their perspective with incredible accuracy. Most babies these days spend their days on the phone, watching cartoons, and visiting websites.

Eye tracking technology allows for early diagnosis and treatment of children at this time. This is not a treatment or anything. You will use just telephone like in every time and it will diagnose your treatment. In such illness, early intervention is crucial. Eye-tracking technology plays a significant role not just in medicine but also in neuromarketing, education, and security. This technology can be used on any device, anyplace. Where we use it is up to us (Porta & Ravarelli, 2010; Fini et al., 2011).

2 What is eye tracking and how does it work

Eye tracking is a type of sensor technology that gives a computer or mobile device the tools to understand and delineate where a person is looking. An eye tracker can identify a user's presence, focus, and attention while they interact with a particular app, touchpoint, or website. These measurements are performed using an eye tracker, which monitors the movements and positions of the eyes and they can present them in the format we want.

Even though we can't see it, can't feel it, and even don't want to, our pupil is always moving. The pupil's movement is referred to as a saccade. The pupil must be focused on a single object in order to see color, faces, writing, or any other object. We refer to this as fixation. By measuring pupil velocity, eye tracking can determine when fixation occurs. Attention and fixations are related. Instead of saying "your pupil moving" we can say "your attention moving". This does not mean that if a person looks at something, pays attention, he understands it. However, something has a better chance of being perceived if it is visually appealing. The cornea of our eyes reflects infrared light. You can also see it in some old pictures. The people in the picture have red eyes. It is regarding to using the infrared light of cameras. This light is also used in eye tracking so that your eyes can shine and the pupil can be seen. The pupil and cornea show distinct reflections when near-infrared light is focused on the center of the eyes. These reflections, which represent the cornea and pupil's vector, are monitored by an infrared camera.

The precision of measuring the gaze direction depends on being able to clearly distinguish (and identify) the pupil and identify corneal reflection, which necessitates the use of an infrared light source (and corresponding detection technology).

Regarding the location of the corneal reflection, the center of the eye is tracked. The determination of the gaze direction is made possible by the relative distance between the two locations. Visible light is more likely to cause uncontrolled specular reflection, whereas infrared light can distinguish precisely between the pupil and the iris because it enters the pupil directly but "bounces off" the iris. Furthermore, because infrared light is invisible to humans, it doesn't interfere with the tracking of the eyes. We can determine the direction of the gaze by comparing the relative positions of the corneal reflection and pupil center.

3 Two types of eye tracking

There are numerous variations of eye trackers, but there are two main categories: screen-based and glasses. They are utilized in a wide range of fields and research areas, although their use and the data that arise from them can vary.

A. Screen-based

Screen-based technologies are frequently employed when tracking eye activity at a distance in a controlled setting. The participant is seated in front of a laptop or computer monitor with a panel or standalone device situated beneath or in close proximity to the screen. Following that, the participant is shown multimedia stimuli to initiate, record, and analyze eye movements, such as images, webpages, movies, or games.

In general, screen-based eye trackers collect high-quality eye-related data in a static test environment, providing visual attention insights for developers or academics.

B. Glasses & VR HeadSets

For behavioral research in real-world settings, wearable eye tracking devices are advised. They allow for movement that is not restricted by the “headbox” that stationary eye trackers impose. Eye movements can be closely observed with head-mounted eye trackers. Nevertheless, in some test scenarios, particularly those involving athletes, mobile trackers like eyewear may become unstable. The respondent may be able to manage features in VR applications by simply focusing on a particular virtual button thanks to eye tracking technology.

You can use a VR headset with gaze tracking for:

- industrial areas’ professional training;
- involving entertainment;
- testing visual perception in retail, among other things.

In conclusion, wearable eye tracker devices are the ideal option whenever studies call for subjects to respond in real-world situations that are dynamic and natural.

4 Applications of eye tracking technology

Eye tracking is employed in a variety of scientific domains as well as in a wide range of commercial contexts. In a variety of scenarios, including psychological research, medical diagnosis, neuromarketing applications, and more, learning in-depth information about where a person or group of individuals glance is helpful.

A. In medicine

In all medical specialties, advancements are being made in the use of eye-tracking technologies to assist in medical diagnostics. For instance, 2010 study’s findings indicated promise for employing eye tracking to identify autism spectrum diseases. Eye trackers are simple to use and put into practice for patients of any age, and this study discovered that they are a useful approach to systematically tracking a marker of autism: focusing on geometric objects rather than human beings. Eye trackers can be useful in identifying medical conditions that affect the patient’s eye or their eye movement. According to studies, those who have glaucoma, for example, have noticeably different eye movements from people who do not. Another issue that might benefit from new technology is strabismus because the existing technique of diagnosis is frequently irrational and challenging to use in settings like schools where there are many people. Eye trackers, such as the one produced by Gazepoint, can provide objective data on a person’s pupillary position, eye gaze motions, and other information that can help in strabismus diagnosis.

Eye-tracking technology can be helpful for treating illnesses as well as making diagnoses in the medical field. Eye tracking can be used to track eye movement and gaze during exercises provided to patients as part of some treatments. For people with communication problems, eye trackers also provide a straightforward and natural means of communication. In reality, systems for augmentative and alternative communication (AAC-Augmentative and Alternative Communications) are already in use. For people with motor neuron illnesses, who frequently still have some eye movement and can use an eye tracker to communicate, they can be very helpful. Currently, it is possible to construct an interface for a human computer and eye tracking technologies. People who are unable to operate a mouse due to a disability or for any other

reason may particularly benefit from this. The pupil of the user's eye is tracked by the camera in front of them using a custom algorithm. When a user looks in that direction, the mouse cursor travels there in real-time. Using this interface, people with disabilities can effortlessly operate computers and phones.

B. In neuromarketing

In recent years, marketing and sales strategies for commercial products have advanced significantly, and neuromarketing is one of the strategies that has had the biggest impact on this development. In order to understand how consumers' brains function and which areas need to be stimulated to persuade them to make a purchase, the field of neuroscience known as neuromarketing has been applied to the field of marketing. This is accomplished by conducting investigations in tightly regulated laboratories using the scientific approach. Through this scientific research, along with the observation of customer behavior and the gathering of increasing amounts of scientific data about what people actually believe, this discipline aids in the discovery of the formula to increase the conversion of a brand's products and services. Eye tracking is one of the main neuromarketing strategies. Eye tracking allows for the collection of information on the elements that consumers find most compelling. One of the underlying assumptions of neuromarketing is that 80% of customer purchasing choices are done unconsciously.

Currently, by collecting the user's data, it is possible to determine which product is more suitable for him. Even this data is used for the user. As with this data, the user's likes and dislikes are distinguished. The next time he goes web, he will be presented with products that his loved ones are more likely to like. Through this, both the seller is satisfied by selling his goods and the user is satisfied by finding what he is looking for faster. This is a great marketing trick used today. This is more convenient than asking the people because explicitly questioning someone about their objectives will only produce less information. They can be shy and likely to lie but eyes never lie. Therefore, the use of eye-tracking technology is currently considered. The objective assessment of unconscious decision-making processes is the goal of neuromarketing approaches, on the other hand.

In order to get insights into how customers interact with advertisements and products, eye tracking involves observing the eye movement patterns of research participants. Because modern eye-tracking equipment is so portable and light, research participants may use them in a variety of settings (for instance, while looking at telephone advertising or visiting a commercial place). Currently, neuromarketing is used in a variety of industries, including web design, training, and the enormous video game business, while ignoring all other industries save for the one in issue, the point of sale, and market research.

C. Safety

Security makes eye tracking especially essential. One could prepare such a project, for instance. Cameras can be mounted on cars' windows, allowing for real-time observation of the driver's actions. There are a lot of car accidents that happen when the driver is asleep. The driver can be awakened with a specific signal when asleep using eye tracking technology. By gathering data on driver behavior, this technology can also significantly contribute to the development of self-driving automobiles.

Eye tracking technology has a significant impact on security. In addition to such a project, in my opinion, eye tracking can help raise the security standards even higher. Where and how? As you are aware, locks are installed through the eye in banks, cash registers, telephones, and other locations that require security. A person's eyes are first scanned and stored in memory. Following that, this lock can only be opened with this person's eyes. You are aware of this technology, no doubt, but it is not secure enough. Only the person who set the password will be able to access such locks under my proposed project. As you are aware, eye tracking makes

it possible to ascertain which point a person's eyes are fixed on for how long at a time. Imagine, for instance, that while you are looking at a picture, the people next to you can see that you are doing so, but they are unable to tell what part of the picture you are looking at or when. Consider using this technology to improve security. Ten or even one hundred times more security is provided. Your password is secret-not even the person standing next to you can figure it out. The identity of the eye will be scanned using this technology, and the person will be verified at what time and for how long. We're doing research on this project right now. The project's interface will look like this: A picture of your choice will then appear on the screen after the eye identity has been verified. At predetermined intervals of time, which you can set in advance, you will look a portion of the image or several portions of the image. The lock will be open if the image's viewing points and duration match the predetermined points.

D. Exam

Online exams are being used more recently. Especially after the COVID-19 pandemic, online examination have become a mandatory situation for every institution. Of course, this is very nice, but we cannot be sure that integrity is maintained here. During face-to-face exams, teachers monitored students and prevented them from transferring. In online exams, this is not so possible. As the number of students increases, it becomes impossible to prevent it. For this, they were proposed to record the voice and videos of all students. These would then be monitored by human experts and a decision would be made about the student. But it was not possible to do this because there were many students in large institutions. Now, smart exam programs are being developed for this through eye tracking technology. These programs can monitor the student's eyes and face in real-time. This program collects the students' data and displays the graphs of all the students. By looking at these graphs, the teacher can know which student is copying and which student is looking at which side more.

5 Conclusion

We can conclude by saying that eye tracking technology has a lot of benefits and it is also helpful to people. Many tasks can be carried out automatically using this technology, which minimizes the need for human labor.

Several studies on eye movements during human-computer interaction were reviewed in this article. The potential of this field has been obvious from the start, but development has been gradual so far. Does this imply that the field is now worthless? Of course not, as evidenced by the work being done with this technology at the moment. Eye tracking in human-computer interaction is still a very promising field of study. Its market and technological barriers are finally being lowered. Studies, works, and articles in this field indicate that it has only recently begun to flourish. Over the past 30 years, eye tracking technology has been used to make a lot of claims. However, we think the technology has advanced and is already producing encouraging outcomes. We are optimistic that the current generation of experts in this field will eventually end the boom-and-bust cycle of the past and make the use of eye movements in human-computer interaction (HCI) an integral part of contemporary information technology.

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