# Eye Tracking Technology

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As technology advances it is important for people to be able to keep up with the progress or the technology becomes obsolete. Once the computer became a household item, companies began researching how to make it more user-friendly. Manufacturers of personal devices like computers, phones, and tablets all compete to create the most convenient product so they can stay on top of the market. This means they have to stay one step ahead of new technologies. Once the touch control system used for the iPhone became popular, it quickly spread to other devices. Voice control is also becoming popular in phones and has already been used on computers for disabled people to communicate. Companies are looking for the next best, and easiest method of control for personal devices. Eye control looks like the most promising new technology that can eventually be used commercially for many personal purposes.

Eye control is the technology that allows computers to know where a user is looking (Tobii in Brief). Eye tracking devices detect and track the features of the eyes and their movements. Gaze tracking software then calculates the eye gaze from the features in a process called gaze estimation (Research). There are four functions that are key to most eye tracking devices: connection, calibration, synchronization, and data streaming (Duchowski). Connection establishes a link with the eye tracker device, then calibration determines where the user's eyes are located and synchs the computer's display with eye movement by displaying calibration points. An example of calibration would be a dot moving around the screen and the user's eye following it to let the device know how the specific eye moves. Synchronization informs the application of the eye tracker device's state, which is necessary for the final function, data streaming, which allows the user to see what is happening in real time.

Eye tracking is a useful device for many areas of study. "We may presume that if we can track someone's eye movements, we can follow along the path of attention deployed by the

observer" (Duchowski) which will provide insight into what the user was drawn to and how the user perceived and interpreted whatever he or she saw. This kind of data can be useful for web designers or advertisers because they can place text or graphics in certain places of the webpage where the computer screen would be most likely to be viewed. Not only does eye-tracking assist in research, but it also makes it possible for disabled people to communicate if they cannot speak or use a conventional keyboard. Eye tracking typing interfaces use on-screen keyboards that track the observer's gaze to determine the letter they are focusing on (Research). Feedback can be given to the user through highlighting the letter or giving an audio response. Some interfaces use predictive text to offer likely word suggestions that the user can choose.

Swedish firm, Tobii, is the world leader in eye tracking technology. Founded in 2001 and currently employing 300 people in six different countries, Tobii strives to provide their technology to many industries including hospitals, gaming, computer manufacturing, diagnostics, and vehicle safety (Tobii in Brief). In his book Eye Tracking Methodology: Theory and Practice, Andrew Duchowski explains that while Tobii's table mounted eye trackers look like a simple flat panel display, a camera and infra-red LED optics are actually embedded underneath the LCD screen. The camera and infra-red light are the hardware tools needed for the eye tracking device to "read" the user's eyes. Tobii typically requires two computers that can share a keyboard, display, and mouse through a switch and are connected to a 1 gigabyte Ethernet local area network (LAN). Tobii itself is considered the server and the interactive application is considered the client (Duchowski). The application controls the modes of eye tracking: idle, calibrating, and running. This easy transfer of control allows for unproblematic advances and development of the program.

In 2011, Tobii teamed up with Lenovo, a Chinese technology company that develops notebook and desktop computers. Together they created twenty Windows 7 prototype laptops with a built-in eye tracking device (Ziegler). This project further advanced Tobii's technology by attempting to make it more marketable and commercial. Many people were able to test out the eye control software and found it worked "extraordinarily well" (Ziegler). Users participated in a game in which the player could blow up asteroids just by looking at them. A convenient feature of the laptop is the appearance of a side menu bar whenever the user looks beyond the left of the computer screen. A participant stated, "It also worked very well and never came up when we didn't want it to" (Ziegler). In March 2012, Tobii announced their new version of the eye control technology called the IS-2 Eye Tracker, which they advertise as "the smallest and most reliable eye-tracking system on the market" (Levine). Not only has the size been reduced by seventy-five percent, but the power consumption decreased by forty percent in this new model (Levine). This is a clear example of how far the eye control industry is coming because just a few years ago some of the main complaints about eye control technology were that it was too bulky, too expensive, and used too much power. Calibration takes less time, at only ten seconds, and users claim that within a short time the eye control interaction becomes natural. This is probably due to the improvement in the eye tracking software, which can now get past previous issues such as contact lenses, eye color, eye wear, and external light. Tobii's Chief Technology Officer, John Elvesjo, said the new eye tracker "allows for accurate eye tracking of almost everyone within varying environments" (Levine).

Tobii has clearly achieved great success in its advancements, but it is still not completely available to the public and remains rather expensive. The Gaze Group from the IT University of Cogenhagen, Denmark "focuses on gaze tracking technology using low-cost and off-the-shelf

components, such as webcams and video cameras" (Research). In April 2009 The Gaze Group launched an open source eye tracker called the ITU Gaze Tracker (Research). The goal of this project was to create an easy starting point for people who want to develop eye tracking software or applications and to provide an inexpensive alternative for people who wish to try using eye gazing interaction technology. This is especially helpful for disabled people who cannot afford the more expensive options of eye tracking technology they need for communication. ITU Gaze Tracker is the only open source eye control software compatible with windows (Reasearch). All a person needs to do it download the software for free off of the Internet and purchase a webcam and an infrared light. By focusing on the software and not hardware adjustments, The Gaze Group ensures users don't have to worry about possible expensive hardware changes and upgrades.

The Gaze Group has recently been working on a new project called Senseye, which allows users to control aspects of cell phones with their eyes by using front-facing cameras on the phones to track the movement of the user's eyes (Bryant). Currently, Senseye works for ninety percent of people who have tested it and the phone can be held naturally in a person's hand due to the allowance for small head movements. The Gaze Group is looking to partner up with third-parties and provide them with data useful to manufacturing applications for phones and eventually have the technology produced directly into the phones (Bryant). They anticipate prototyping a device that can fit in the USB port of smartphones, enabling people to use eye tracking whenever they want (Bryant).

Tobii is also broadening their presence and plan to use their new IS-2 Eye Tracker on computer monitors, slot machines, arcade games, and many other devices in the near future. They also hope to achieve full commercialization within two years (Levine). While Tobii's

advancements are significant, ITU's Gaze Group's work is equally, if not more, important because it allows for open source. Eye tracking can be expensive and The Gaze Group ensures that everyone who wants and needs to use the technology has access to it. The open source technology also allows for other developers to make even more advances and progress. The Gaze Group avoids hardware modifications, which would make it harder for the public to access and update the technology (Research) and they emphasizes off-the-shelf products that can easily be used with the open source software available publically. Open source software can truly help the progress of a new technology because it lets others share their ideas and designs. Advancements such as eye tracking technology show how closely linked humans are becoming to their technology. Soon people may be able to control an entire machine with the blink of an eye.

Works Cited

Bryant, Martin. “Senseye Will Let You Control Your Mobile Phone With Your Eyes.” The Next Web. 2 Dec. 2011. 6 March 2012. <http://thenextweb.com/mobile/2011/12/02/senseye-will-let-you-control-your-mobile-phone-with-your-eyes/>.

Duchowski, Andrew. Eye Tracking Methodology: Theory and Practice. 2nd ed. London: Springer-Verlag London Limited, 2007. *Google Books*. Web. 7 March 2012.

Levine, Barry. “Here Comes the Next Generation of Eye-Tracking.” Newsfactor. 6 March 2012. 8 March 2012. <http://www.newsfactor.com/news/Everywhere-I-Look--I-See-a-Cursor/story.xhtml?story_id=012001D1A0GO>.

“Research.” ITU Gaze Group. n.d. 6 March 2012. <http://www.gazegroup.org/research>.

“Tobii in Brief.” Tobii: Looking Forward. 2011. 7 March 2012. <http://www.tobii.com/en/group/about-tobii/tobii-in-brief/>.

Ziegler, Chris. “Tobii and Lenovo Show Off Prototype Eye-Controlled Laptop, We Go Eyes-On.” Engadget. 1 March 2011. 5 March 2012. <http://www.engadget.com/2011/03/01/tobii-and-lenovo-show-off-prototype-eye-controlled-laptop-we-go/>.