Chapter 7
A Review on Eye Tracking Technology

Pavneet Bhatia
Dr. B. R. Ambedkar National Institute of Technology, Jalandhar, India

Arun Khosla
Dr. B. R. Ambedkar National Institute of Technology, Jalandhar, India

Gajendra Singh
Dr. B. R. Ambedkar National Institute of Technology, Jalandhar, India

ABSTRACT

In past few decades, eye tracking has evolved as an emerging technology with wide areas of applications in gaming, human-computer interaction, business research, assistive technology, automatic safety research, and many more. Eye-gaze tracking is a provocative idea in computer-vision technology. This chapter includes the recent researches, expansion, and development in the technology, techniques, and its wide-ranging applications. It gives a detailed background of technology with all the efforts done in the direction to improve the tracking system.

INTRODUCTION

Eye tracking is a process of measuring the eye movements. It is a sensor technology which enables a device to track eye activity. Psychological studies consider eye movements as a strong penetration into one's perception framing a mental picture of its' line of thinking. Gaze patterns provides an idea about how we discern what we see and visualize. Eye Tracking is a process of estimation of eye development/action whereas tracking gaze pattern is the analysis of eye following information in accordance with the head/visual scene. Generally, the incorporation of head and eye position is utilized to process the area of the look in the visual scene. Basic eye trackers report just the bearing of the look in respect to the head with head-mounted framework, cathodes, scleral coils or for a settled position of the eyeball (frameworks which require a head obsession). Such eye following frameworks are alluded as meddlesome or obtrusive

DOI: 10.4018/978-1-7998-3069-6.ch007

frameworks since some uncommon reaching gadgets are connected to the skin near the eye to get the client's look (Duchowski, 2007). Such frameworks are also called as invasive or intrusive systems. There are few frameworks which don't have any physical contact with the client. Such systems are alluded as non-meddling frameworks or remote frameworks or non- intrusive or non- invasive systems (Morimoto & Mimica, 2005). Such methods generally illuminate eye with IR light instead of using any instruments in direct contact with eye or body of the subject.

BACKGROUND

The potential and importance of eye tracking was recognized by researchers, investigators and analysts in the early 18th century. The development in the field and technology of eye tracking have been through many phases and efforts in the past many years. An attempt to track eye developments while reading was depicted by Hering and by Lamare in 1879; both utilized comparative strategies of tuning in to sounds made by withdrawals of the extraocular muscles (Wade, 2010). Photographic records and light reflections from the eyes during reading task was used by Dodge and Cline to estimate horizontal eye movements (Drewes, 2010). An idea to measure both horizontal and vertical eye developments was conceived by Jung in 1939 placing electrodes close to the eye which measure changing electric field of the eye-ball due to its movement. Such a method involving electrodes relating electric properties of eye with its movements is called Electro-Oculography (EOG). Even the magnetic properties of human eye were cashed to retrace eye developments using principle of electromagnetic induction. Scleral search coils were placed into the eye in form of a lens to monitor eye movements (Bates et al., 2005). With advancement in technology, real-time computation of eye movements was made possible using video-based frameworks known as Video-Oculography. Improvement in the innovation, compact designs, enhanced algorithms, high precision and falling prices of the systems has encouraged the usage of the technology in many fields like business research (Koller et al., 2012),marketing and advertising (Rayner, Rotello, Stewart, Keir, & Duffy, 2001), human-computer interaction(HCI) (Drewes, 2010; Goldberg, Stimson, Lewenstein, Scott, & Wichansky, 2002; Jacob, 1990; Lee & Tsai, 2010), assistive technology as if eye typing for physically disabled (Balan, Moldoveanu, Morar, & Asavei, 2013; Lupu & Ungureanu, 2013; Majaranta & Raiha, 2002) automated safety systems, drowsiness detection (Picot, Charbonnier, & Caplier, 2010), as a clinical support for iris acknowledgment (Xu, Zhang, & Ma, 2006), visual search (Greene & Rayner, 2001), psychology and neuroscience (Rayner, 1998; Snodderly, Kagan, & Gur, 2001; Vidal, Turner, Bulling, & Gellersen, 2012), evaluation of e-learning systems (Hend & Remya, 2010), Cognitive and behavioral therapy (Grillon, Riquier, Herbelin, & Thalmann, 2006).

ANATOMY OF HUMAN EYE

Human eye is a natural optical instrument used to see objects by human beings. An eye is a photosensitive organ which responds to light and pressure. In an improved view, the anatomy of eye can be perceived like a camera with picture adjustment having lens and screen system (Drewes, 2010) that helps to give a 3-D moving picture, typically hued in light. Rod and cone cells in the retina permit cognizant light recognition and vision including shading separation and the impression of profundity (Judd, 1975).