Eye Tracking Hardware & Software

How It Works Explained in Nearly Plain English

Eyes move in short bursts known as saccades and usually move in tandem. Commercial systems are generally noninvasive (i.e., nothing attached to the eyes or the head). In a noninvasive system, a camera tracks one eye or both eyes using infrared light to create a contrast between the pupil and the rest of the eye. This allows the camera to execute commands when the eye stops to fixate on a particular point for a few milliseconds.

Designers assume that no information is processed during saccades and that the reader is interested in what the eye fixates on. Noninvasive systems generally restrict head movement (often with a headrest) to reduce the need for calibration and recalibration of the systems. Despite the restriction on head movement, noninvasive systems are generally considered too inaccurate to be useful in eye tracking research.

Noncommercial eye tracking systems used for academic research attach wires and other hardware to the head. This can be either basic research (e.g., learning more about eye movement) or applied research (e.g., Google funding research into how people are using its search engine).

Inherent Limitations

Eyes are one of five major "input devices" (i.e., sight, hearing, smell, touch, taste) that are part of the human body. Their function as a human input device can create conflicts with their function as a computer input device because the vast majority of the time the user does not want to execute commands. In addition, because eyes are not completely still during fixations, eye input is less precise than using one's hand and fingers to control the mouse (if one does not have a disability preventing ordinary use of hands and fingers).

Improving It for Current Users

Hardware and software improvements are needed to improve device tolerance of imprecise eye movements and to allow for increased head movement. While incremental improvements are possible, robust solutions will require increased processing power that may not be available in the immediate future.
Historical Dates Relevant to Current Commercial Products

1879 -- Eye movements are measured for the first time.¹

1988 -- LC Technologies introduces the noninvasive Eyegaze eye tracking system.² It is intended to provide computer-based control of various devices rather than merely reading a computer screen.³

2001 -- Tobii Technologies introduces its ET-17 eye tracking system.⁴

2011– The IT University of Copenhagen has an open-source eye tracker and eye movement has its own academic journal.

Selected Bibliography (in chronological order)


¹ Edmund Burke Huey, The Psychology and Pedagogy of Reading 18 (1907). (Crediting Emile Javal). Nicholas J. Wade and Benjamin W. Tatler, Did Javal Measure Eye Movements During Reading?, 2 J. of Eye Move. Res. no. 1, 2009, at 1, 5. (Suggesting that Javal himself credited his coworker M. Lamare and also that Ewald Hering measured eye movements in the same year).