

# *Eyetrack* – Developing eyegaze analysis visualization software for designers' use

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**Abstract:** Eye tracking methodology is now very widely used for usability testing and product development. Especially for improving website usability, it's very useful and providing effective visual data. But analyzing eye tracking data which includes just numeric data format with position moving and time is not so simple for designers. 'Eyetrack' software is developed for designers who want to analyze many users' eye tracking data at once. The purpose of this software is providing qualitative analysis data extracting various gaze analysis images of gaze data of many users. 'Eyetrack' software includes 2 main functions. One is 'Replay' function which can replay user's eyegaze data visually. It provides 'Fixation Mark' option which can show 3 different fixation mark visualization. Eye Fixation refers to maintaining the gaze in a constant direction. 'Color Variation' option which can visualize changing color of dots red to green through time spending. The other function named 'Analysis' has 5 different options for analyzing visually effective eyegaze data. First, 'Shadow' and 'Frequent Area' option is for distinguishing user's frequently seen area. If amount of the gaze is large enough, this part is drawn brightly. 'EyeTrack' defines "large enough" to 20% of the most amount of the gaze. Next, 'Selected Area' option supports user can draw and select any area. When user decides an area, and click "Show result" button, 'EyeTrack' calculates quantity of points and gazing time. And 'Priority Order' option supports drawing user's eye movement with lines and fixation marks which is differentiated their size with time which how long user saw that area. The last 'Hotspot' option show an images about amount of the gaze, an image is drawn gradually from red to green. The part of image, which is not seen, is drawn dark.

**Key words:** eye tracking, gaze analysis, emotional quality, industrial design, user-centered design

## 1. Background

Eyegaze analysis is a research methodology which examines human's eye movement patterns using eye tracking technology. In eye tracking technology, video-based eye trackers are now most widely used. Most video-based eye trackers use infrared or near-infrared light and infrared camera to track pupil. Eye trackers make researchers know where people look at and eye scan path.

Recently, eyegaze analysis and eye tracking technology are used in many areas. Like cognitive science, usability research and marketing, they are applicable for various research disciplines. Also it has a big interest that even commercial area; input device for

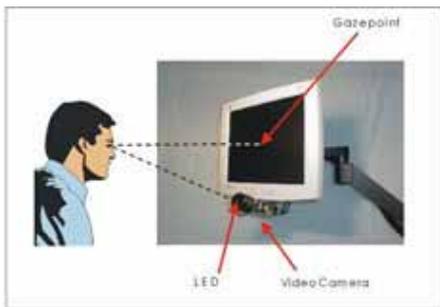
disabled people, measuring effects of advertising media.

Otherwise, eyegaze analysis is difficult to use individual researchers because of analysis methodologies. Eye tracking data needs to be statistically analyzed. This process makes researchers feel complicated and difficult to use.

## 2. Purpose

'Eyetrack' is an eyegaze analysis software developed for using eye tracking data easily. It takes a role of visual processing and organizing eye movement data. After eyegaze experiment for any usage, designers or researchers can handle eye tracking data without statistical analyzing process. Also it provides many

one-click features for diverse usages.



**Fig.1 LC technology 'Eyegaze Analysis System'**

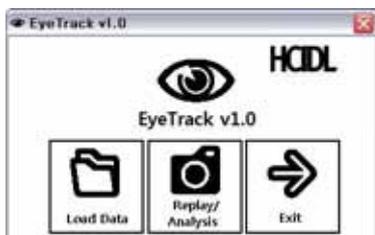
'Eyetrack' uses eye tracking data from LC Technologies 'Eyegaze Analysis System'(Fig.1). It cannot analyze data from 3D eye tracking device (head-mount type) or any trackers from other companies because of different tracking methodologies. And the software development environment is Microsoft Visual Studio 2005(VC8.0), using MFC (Microsoft Foundation Class Library) programming.

### 3. 'Eyetrack' main window

'Eyetrack' software starts with the main window. It contains 3 buttons(Fig.2). First, when user clicks the 'Load Data' button, he can choose eye tracking result data files (.dat) in any folders on his desktop. 'Eyetrack' can load multi data files to compare and synthesize many participants' eye movement patterns.

After the software has done the loading flies, user can push the 'Replay/Analysis' button to start analyze. Before eyegaze data displaying, he will select the background image file which used in eyegaze experiment.

'Exit' button can help user shut down or finish the software safely.



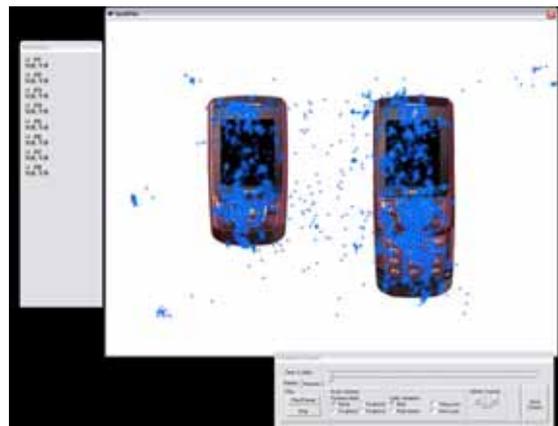
**Fig.2 'Eyetrack' software main window**

### 4. 'Eyetrack' data displaying

After loading participants' eye tracking data files and the background image file, 'Eyetrack' displays 3 windows(Fig.3). The background image is placed in the background with fixation map.

Floating 'Userbox' panel shows every participant's id number whose eye tracking data included. User can see or hide any participant's data freely with checkbox.

Through whole features in the software, this panel helps analyzing individual data or integrated multi data.



**Fig.3 Running 'Eyetrack' software**

Another floating 'control' panel contains main feature control(Fig.4). Above two tabs, there is a timeline for adjusting data by time. It also includes play/pause, stop functions.



**Fig.4 'Eyetrack' control panel**

One tab named 'Replay' mainly roles showing eye tracking data with timeline. Using diverse display options, user can get the appropriate fixation map. Display options will be explained in next chapter.

The other 'Analysis' tab is mainly for analyzing many eye tracking data. It includes 5 different analysis methodologies which supply effective visualization.

When user will get sufficient analysis images, he can click 'Save Screen' button to save fixation map with the background image.

### 5. 'Eyetrack' Features : 'Replay'

The 'Replay' feature consists of four display options for adjusting fixation map. Fixation map will be animated sequentially by time to click 'play' button. Options can be controlled in any time. Except 'Offset Control' option, all options are applied to every participant's eye tracking data at once.

#### 5.1 'Offset Control' option

'Offset Control' option is for calibrating eye tracking data. This function is needed to the eye tracking data of participant who moves his head after calibration phase. If

4-directional button be clicked, all gaze points of one fixation map would move one pixel to each direction.

### 5.2 'Fixation Mark' option

This function finds fixation points due to 'LC Technologies' libraries. Libraries calculate three kinds of gaze points; moving, fixating, and fixation\_completed.

- a) MOVING: It means that a participant looks at this point only 1/60 second, and see other points.
- b) FIXATING: Fixating point is that a participant looks around this point.
- c) FIXATION\_COMPLETED: The point which a participant maintains the gaze in this point.

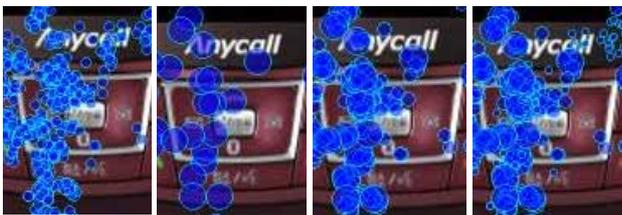


Fig.5 'Fixation Mark' option (none/1/2/3)

'EyeTrack' has four options to show fixation marks(Fig.5).

- a) None: Without any fixation, map is drawn with only gaze points of eye tracking data.
- b) Fixation1: Only shown FIXATION\_COMPLETED points.
- c) Fixation2: Software draws fixation map with FIXATION\_COMPLETED and FIXATING points.
- d) Fixation3: FIXATION\_COMPLETED, FIXATING, and MOVING points.

In case of option c&d, 'EyeTrack' visualize a fixation map with FIXATION\_COMPLETE points as big circles, FIXATING points as middle-size circles, and a MOVING points as small circles.

### 5.3 Color Variation

'Color Variation' option helps recognize where participants look first and later. In 'red-green' option,

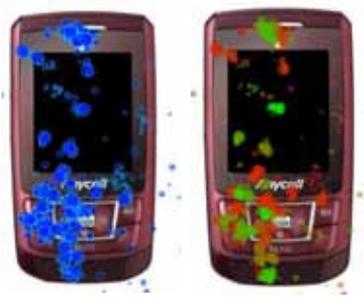


Fig.6 'Color Variation' option (blue/red-green)

software draws the first point of eye tracking data with red color and the last point with green(Fig.6).

### 6. 'EyeTrack' Features : 'Analysis'

'Analysis' feature is developed for recognizing eye movement pattern easily. It has five different options for visualizing eye tracking data. Each option supports specific purpose.

#### 6.1 'Shadow', 'Frequent Area', 'Hotspot' option

These options are designed to distinguish area where participants mainly look at. These are calculated with a same algorithm. User can adjust 'circle radius' option.

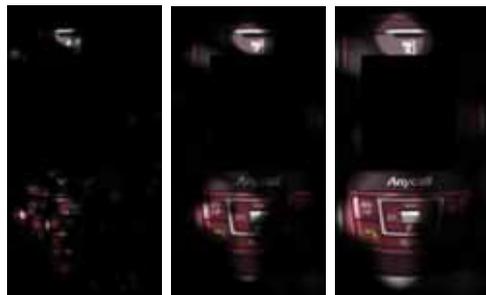


Fig.7 'Shadow' analysis option (radius:5/15/25)

'Shadow' and 'Frequent Area' option hide area where barely seen. If amount of the gaze is large enough, the area is drawn visible. 'EyeTrack' defines "large enough" means 20% of whole amount of gaze points. 'Shadow' option draws a boundary gradually dark, 'Frequent Area' option shows a distinguishable boundary line (Fig.6,7)

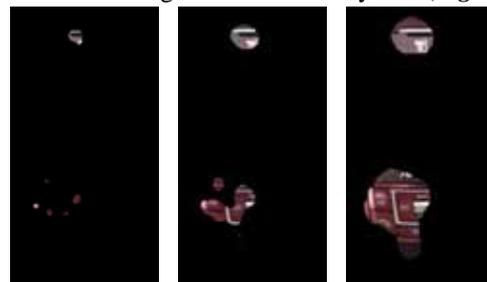


Fig.8 'Frequent Area' analysis option (radius:5/15/25)

'Hotspot' option helps to compare amount of gaze. It shows the analysis image gradually from red to green

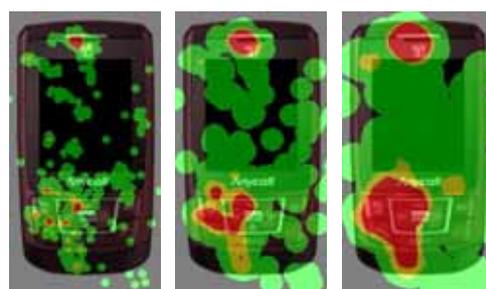


Fig.9 'Hotspot' analysis option (radius:5/15/25)

color due to amount of the gazepoints(**Fig.9**).

### 6.2 'Selected Area' option

This option supports a user can select specific area with drawing a polygon. Drawing polygons with any number of points is available. After drawing a polygon, user can click 'Show result' button to know amount of gaze in that area. Immediately, calculated quantity of points and gazing time is shown on the image(**Fig.10**).



**Fig.10** 'Selected Area' analysis option (2 polygon)

### 6.3 'Priority Order' option

'Priority Order' option visualizes eye movement pattern with lines and fixation marks which is differentiated size to gazing time(**Fig.11**). User can easily recognize mainly seen areas and movement pattern at once. This option supports animation like 'Replay' feature.



**Fig.11** 'Priority Order' analysis option (1 user)

## 7. Conclusion

'Eyetrack' software is developed for designers or researchers who want to analyze many participants' eye tracking data easily. Using this software, researchers can get simple insights how participants look images. It also provides intuitive control to extract various gaze analysis images of eye tracking data.

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