

User Interest Visualizing and Analysing System using Eye Gaze

Injae Lee*, Jihun Cha*, Jeongil Seo*, Ohseok Kwon**

*Broadcasting & Telecommunications Convergence Media Research Department, ETRI, Korea

**Department of Computer Science & Engineering, Chungnam National University, Korea

ninja@etri.re.kr, jihun@etri.re.kr, seoji@etri.re.kr, oskwon@cnu.ac.kr

Abstract— Eye tracking technology is useful to provide faster and more intuitive control interface. Thus, eye tracking is popular in evaluating contents such as advertisements. It have helped researchers to analyse the user's attention and it finally makes more contents better. This paper introduced the system for visualizing and analysing user's gaze information. Detailed implementation of the proposed system and its capabilities are presented along with usage examples. This system can be applied to various fields such as analysis of driver attention, web page layout, advertisement effectiveness, product sales, and so on.

Keywords— User interfaces, Eye Gaze, Data visualization, Data Analysis, User interest

I. INTRODUCTION

As various smart devices such as Smart TV, IPTV, tablets, mobile phones have emerged, UI/UX technologies for efficient content consumption started getting popular. Recently, gesture, gaze tracking, EEG, facial expression techniques have attracted the attention.

Eye gaze information has a fast response speed compared to other senses as to occupy more than 80% of the obtained five senses information. Therefore, gaze tracking is considered as an effective method of interaction between the user and the information equipment [1]. In particular, it has emerged as the best alternative technology for increased media access so that disabled people can access a variety of media consumption [2] [3]. In addition, it have been used for some time to monitor user's behaviour. Therefore, it has been highlighted as a core technology of psychoanalysis for measuring advertising effectiveness, product/menu layout and monitoring the driver state [4-6].

Current eye tracking systems can be categorized into two types to track eye movements: the head-mounted gaze tracking method and the remote camera based method [7].



Figure 1. Example s of eye trackers

The former technique uses an attachment to the eye such as special contact lenses or headsets. Many commercial trackers are attached to a head mount as shown in Fig. 1(a). Next, the remote camera based method is more comfortable because they do not need to wear any equipment as shown in Fig. 1(b). Therefore, we use the remote camera based eye tracker in the proposed system.

This paper is organized as follows. In section 2, the proposed eye gaze visualization & analysis system is described, and section 3 presents the implementation results. Finally section 4 presents our conclusions and a discussion of future works.

II. PROPOSED EYE GAZE VISUALIZATION & ANALYSIS SYSTEM

Eye tracking technology is useful to monitor user's behaviour. Through this technology, it is possible to improve contents and the user experience. The proposed system consists of the remote eye tracker and eye gaze visualization & analysis tool.

A. Overview

In this system, we use the remote eye tracker which can detect gaze information on a large-screen TV at a distance without wearable device. Because it can get more natural gaze data than wearable device. It can detect and track a user's eye at a distance. It measures eye positions. Then, it send the eye gaze data to the eye gaze visualization & analysis tool. The received gaze data is stored. And it can be visualized and analysed on a screen according to the user's request. Eye gaze data can be used to determine where on the screen a user's attention is directed. Thus the user interest can be analysed through eye gaze analyser using user's gaze data.

The eye gaze visualization & analysis tool consists of menu, tool bar, user list, ROI list, display window as shown in Fig. 2. The menu and tool bars provides fundamental functions for visualizing and analysing the user's gaze data as scan-path, heatmap, etc. The user list is a list of the user to provide gaze data. And ROI list is a list of the region of interest which requires analysis of user attention. Red boxes are the ROI

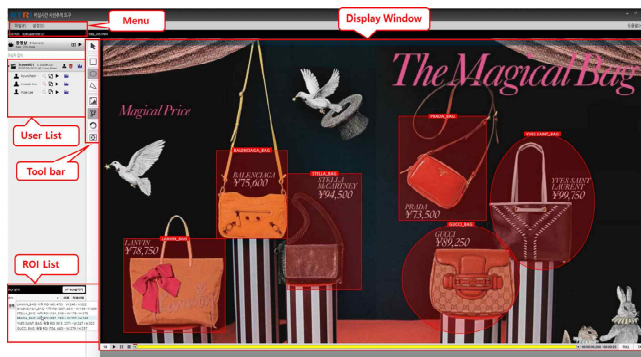


Figure 2. GUI of the proposed eye gaze visualization & analysis tool

areas in figure 2. In the display window, user gaze information is visualized.

The main feature of the proposed tool is the visualization and analysis. The detailed information is introduced in the next section.

B. Eye Gaze Visualization

The presented tool can capture the eye gaze data and visualize the user's gaze data according to the time. It supports the scan path mode and the heat map mode for eye gaze data playback.

The scan path mode shows the exact spatial sequence of eye-movements performed by a user. It reflects the eye gaze data over time. Figure 3(a) shows the scan-path mode. The heatmap mode shows where the largest concentrations of a user's fixations were as a color. It is a graphical representation of gaze data, where the values taken by a variable (fixation time) in a 2D map are represented as colors as shown in figure 3(b).

These modes can be displayed the eye tracking data as meaningful graphs.

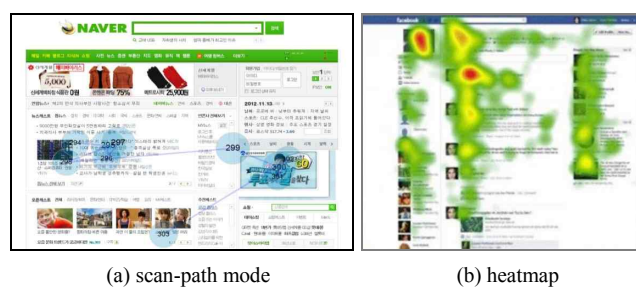


Figure 3. Eye gaze visualization

C. Eye Gaze Analysis

This presented tool supports the ability to analyse the user's gaze data. Thus, it can set the region of interest using rectangle/circle/polygon. It provides a variety of measures for particular areas defined. For single participant, it gives the total time spent in that region, the percentage of time spent in that region, the time until the first fixation in the region. And it analyses what is the longest staring region according to a

user. For multiple participant, it also gives the total time spent in that region, the percentage of time spent in that region, the time until the first fixation in the region. And it shows the ROI where most users have interest.

It can be useful for video analysis, reading analysis, observational studies etc.

III. IMPLEMENTATION

The proposed system consists of the gaze tracker and eye gaze visualization & analysis tool. The presented system includes the VT2XL for gaze tracking. Figure 4 shows the experimental environment for gaze data acquisition.

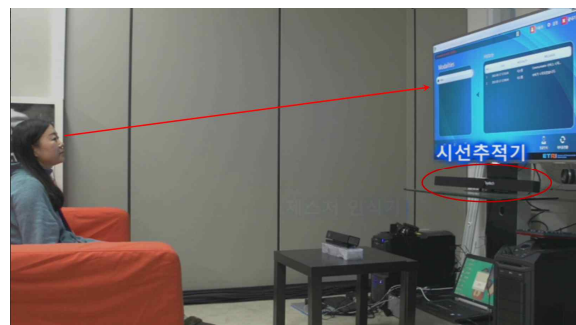
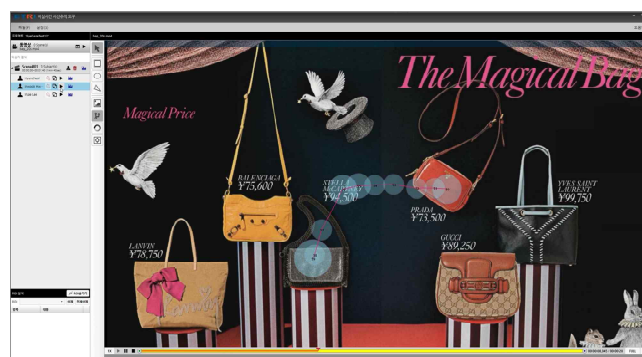


Figure 4. Experimental Environment for gaze data acquisition



(a) Scan-path mode



(b) heatmap

Figure 5. Result of eye gaze visualization

The scan-path mode is a method for displaying a movement path of the gaze on the screen and it displays the position of the eyes in a circle as shown in Figure 5(a). Depending on the degree of focus attention, the radius of the circle is getting larger. Gaze position and a moving route is represented by the movement sequence and line. When a gaze information was displayed on the screen, the heatmap mode displayed the amount of attention focused step by step from blue to red depending on the degree of concentration of attention as shown in Figure 5(b). The red color indicates the highest interest areas.



분석결과

Injae Lee
(시청장면: Bag_Analysis)

시선 점유율 (%)

Brand	시선 점유율 (%)
LANVIN_BAG	34.6
PRADA_BAG	20.9
GUCCI_BAG	9.3
STELLA_BAG	7.5
YVES SAINT_BAG	5.6
BALenciaga_BAG	4.0

발색	내용
ID#	000
레이블	YVES SAINT_BAG
시각위치	(913, 227)
ROI크기	W:247, H:322
사용자	Injae Lee
분석장면	Scene#001
경관시간	00:00:00-00:01:40
ROI인입최초시간	00:00:02
ROI시간	4.0초
시선점유율	4.05%

분석결과

Hyuncheol Kim
(시할장면 Bag_Analysis2)

시할 장면 점유율 (%)	브랜드	비율 (%)
30.1	GUCCI_BAG	30.1
18.9	LANVIN_BAG	18.9
14.6	YVES SAINT_BAG	14.6
9.6	PRADA_BAG	9.6
8.4	BALENCIAGA_BAG	8.4
6.2	STELLA_BAG	6.2

Figure 6. Single user information

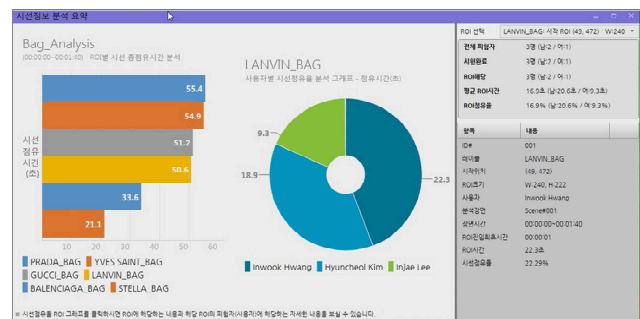


Figure 7. Eye gaze analysis : multiple user information

The proposed system supports the ability to analyse the user's gaze data. A user can select a rectangle/circle/polygon menu from Toolbar, he can set the region of interest with geometry such as rectangle/circle/polygon. Defined ROI is shown as the red boxes in Figure 6(a). This system can provide a variety of information based on gaze data for particular areas defined. For single participant, it gives the total time spent in specific region, the percentage of time spent in that region, the first fixation time in the region as shown in Figure 6(b)(c). And it displays what is the longest staring region according to a user as a list. Thus, we can know what is the most interesting bag according to the user. For multiple participant, it also gives the total time spent in that region, the percentage of time spent in that region, the time until the first fixation in the region. And it shows the ROI where most users have interest as shown in Figure 7. So we can know the bag information which users are most interested in. Besides, we can know who is most interested in a particular bag. These analytics will be useful to psychological analysis such as user's consumption pattern.

IV. CONCLUSIONS

This paper presented the user interest visualizing and analysing system using eye gaze. Gaze tracking technology is used to determine where on the screen a user's attention is directed. So it is useful to monitor user's behaviour. Thus, the proposed system tracked and recorded the user's gaze data. It is also provided by visualizing and analyzing the gaze information. Through the analysis gaze information, we can find out what the user is interested. Furthermore, it is possible to improve contents and the user experience using these information.

Eye tracking interface has fast responsible time compared to the other senses, so it can be used as an effective means of interaction. Through this interface, it is possible to improve the user experience. Therefore, eye tracking technology can be applied to various fields such as impaired eye mouse, driver attention analysis, advertisement effectiveness monitoring, and next generation games.

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Injae Lee received her BS and MS degrees in Electrical and Computer Engineering from Sungkyunkwan University, Suwon, S. Korea in 1999 and 2001 respectively. Since 2001, she has been a senior member of research staff in Broadcasting & Telecommunications Media Research Division, Electronics and Telecommunications Research Institute (ETRI), S.

Korea. Currently, he participates in the development of interactive rich media service technologies. Her research interests include interactive multimedia broadcasting system, interactive rich media system, 3D image processing and computer graphics.



Jihun Cha received his BS degree in Computer Science in 1993 from Myongji University, Yongin, Korea and MS and Ph.D. in Computer Science from Florida Institute of Technology, Melbourne, USA in 1996 and 2002 respectively. He joined Electronics and Telecommunications Research Institute (ETRI) of Korea in 2003. He has been participated in a project on the development of T-DMB interactive multimedia service

technologies. His research interests include multimedia streaming, interactive broadcasting system, and feature extraction/tracking in motion pictures.



Jeongil Seo was born in Goryoung, Korea, in 1971. He received the Ph.D. degree in electronics from Kyungpook National University (KNU), Daegu, Korea, in 2005 for his work on audio signal processing systems. He was worked as a member of engineering staff at the Laboratory of Semiconductor, LG-semicon, Cheongju, Korea, from 1998 until 2000. He has worked as a director at the Immersive Media Research Section, Electronics

and Telecommunications Research Institute (ETRI), Daejeon, Korea, since 2000. His research activities include image processing, audio processing, multi-modal user interface, and realistic broadcasting systems.



Ohseok Kwon received his BS degree in Electronics Engineering from Seoul National University, Seoul, Korea in 1977 and the MS in Electrical Engineering from Korea Advanced Institute of Science Technology, Daejeon, Korea in 1980. Since 1980, he has been a professor in the Department of Computer Engineering at Chungnam National University, Daejeon, Korea. His

research interests include embed system, pattern recognition and intelligent information system.