

THE STUDY OF GAZE MOVEMENT PATTERNS IN IDENTIFYING TOILET SIGN PICTORIAL FORMS USING EYE TRACKING

Gunanda Tiara Maharany

gunandatiara@gmail.com

Martinus Pasaribu

ergolib@gmail.com

Andar Bagus Sriwarno

andarbugs@itb.ac.id

Faculty of Visual Arts and Design – Bandung Institute of Technology
Jalan Ganesha No.10, Bandung 40132

ABSTRACT

People's confusion in interpreting the gender of the toilet sign has caused a hesitation to the people in determining the toilet's cubicle. In this study, the toilet's pictorial sign were examined and depicted as stylized forms of men and women. The aim of this research is to collect the data of the people's eye gaze movement in order to identify the toilet's sign system. Other related data were also collected through literature to obtain the theories that support the study. Three volunteers were participated in this study. In the first experiment, they had to identify 6 signs with different shapes presented at the same location with their central visual field using an "Eye-tracking" device without being told in advance. In the second experiment, they had to mention the type of gender in the three pairs of 6 toilet signs displayed. The result of the study indicated a difference between the pattern of human's eyes movements in observing the sign unconsciously and the zoning at the middle represented as the "body" was the most viewed part. This research is expected to provide informations and references for academics, designers and governments in order to create sign system and universal design services.

Keywords: Eye gaze movement; Eye tracking; Sign; Toilet.

INTRODUCTION

In Indonesia, many toilets are not regulated by sex because of the limited facilities. But in some public places such as malls and offices, the grouping in developed countries has become common. In the contemporary period toilet signs are almost universally indicated by images of men and women, and the segregation of the sexes seems to occur in most cultures.

Observations was held by Jawa Pos at the Juanda Airport 1st Terminal's public toilet in Surabaya in January 2018 where 20 people mistakenly entered the toilet every hour. The reason is because visitors are in a hurry and not aware of seeing the toilet's sign system.

Sign systems in public places facility are sometimes confusing for some people which can cause misinterpretation and incorrect use of the facility. Toilet signage is one example of a sign system and is considered one of the most common signage, which exists in the contemporary era. It is often found that toilet signage is difficult to understand. Some studies showed that in some cases toilet signage is often confusing and unclear because of several reasons, for example, the signage contains too much information and the elements of the signage illustrates shape, colour, line, tone, and pattern which are not easy to understand. As the result is many people get wrong in entering the toilet.

In this paper, we focus our attention on recognizing toilet signs by people with normal vision. Eye tracking is one of the latest technologies that has shown potential application in several areas including human-computer interaction for people with and without disabilities, and for noninvasive monitoring, detection, and even diagnosis of physiological and neurological problems in individuals. Eye tracking facilitates the measurement of unconscious movements in gaze and provides objective data that cannot be obtained via interviews. Yamamoto et al. reported that individuals focused their gaze on sites that strongly interested them [6]. Previous studies using eye tracking mainly concern with the role of the eye in reading, and so they are oriented only to the sighted. We believe that this technology can be utilized to identify an individual's unconscious gaze movement in the pictorial forms of toilet sign.

The introduction of an eye-tracking system (eye tracker) is to find out the eyes' movements when looking at the toilet's pictorial forms with reflexes, so they will know which parts are seen first, most often seen, and attract attention. The present study aimed to investigate the relationship between an individual's recognition and gaze movement for pictorial forms of toilet sign while using an eye tracker. As a result, we think it will be a

great help to clear the important issues of "wrong entry to the toilet" with the recommendation of effectiveness in toilet sign's designs.

METHODS

1. Study of Participant

Participants were taken from ITB's Arts and Design students. Three individuals with the criteria of young-healthy vision group (21–35 years old) were recruited. All the participants could see normally without visual aids and never had a history of eye defects confirmed by interview. Individuals were given verbal guidelines ahead of commencing the experiment using an explanation until the participants were sufficiently understood the content of the study. Tests are carried out in a controlled environment. There was only one respondent and one observer in a room, so the respondent could concentrate on completing the task.

2. Eye Tracking system

In this study, an eye tracker device (Argus Science Eye Tracking Mobile) was used to track the eye's movement. With this system, several cameras were applied by infrared rays to the eyeball and recorded video of the real-time situation. Infrared rays were used to sense light and dark areas in the pupils. Images reflected in the cornea were obtained via a video camera to create reflection points (i.e., the Purkinje effect) on the cornea. The pupil and reflection points were subsequently detected in real-time. Gaze points were measured using the corneal-reflex method which detects eyeball movement based on the positional relationship between the central point of the pupil and the Purkinje effect. The corneal reflex method facilitates the measurement of gaze while placing minimal burden on an individual and causing no health damage. The gaze point shifts rapidly due to saccadic movements. Therefore, it is difficult to quantify gaze points. Martinez-Conde et al. reported that the gaze point stops when the angular velocity of eyeball movement decreased to 100/s. Therefore, they defined a gaze point as motionless when its sampling rate was 50 Hz and the angular velocity of eyeball movement was decreased to 100/s. Measured gaze points were recorded using the recording unit. The unit consisted of a computer and DTU (Display Transmit Unit). Gaze's data were stored in the recording unit and were analyzed using ETA-analysis software version 1.0.4.4.

3. Gaze measurements method

The measurements were obtained from the participant in product design's ergonomic laboratory chamber. We used 6 toilet sign pictorials (Fig.1) and they all were displayed on a 42-inch monitor. All participants were standing in front of monitor screen

about 60-70cm apart. Three pairs or 6 toilet sign pictorials were taken from several public places in Indonesia. We divided the area of interests in each image into 3, named as head area, body area and leg area (fig.1). The participants fitted the eye tracker in front of monitor screen. Before starting data collection, calibration was done first. Calibration used the eye tracking device was done manually by showing visual stimulus in the form of dots that must be seen by the participant until the gaze movement was accurate. After that data retrieval began, they were asked to freely state as quickly as possible the gender types of 6 toilet pictures that were randomly assigned. Analysis software (ETAnalysis by Argus Science) was used to analyze the gaze points. We measured the average of gaze's fixation-point duration and, time to first's fixation recorded, gaze point and heatmap at the analysis sites.

Head Body Leg

Fig.1 Toilet sign pictorial zone division

RESULTS

1. Average Fixation duration in each area of interest

Average Fixation duration in each area of interests showed how long the average fixation occurred in the area within the AOI. Body area in toilet pictogram D was the longest seen area, followed by the body area of pictogram C and F. In the other hand, there were several areas that were not seen, such as the head area of pictogram B, C, D, E and F. The design on "head" in toilet pictogram B, C, D, E and F were have same form (oval and circular), so it was not enough to attract the respondent's attention to see them.(Fig.2)

Fig.2 The result of average fixation duration

2. Time to First Fixation

Time to first fixation matrix can assess the effectiveness of the toilet's sign system by looking at the number of respondents who looked at each area for the first time. From the results obtained, the respondents most often looked at the body area first and then headed to the leg area on the sign system image. From this study it was found out that respondents were more interested in the body area instead of leg area.(Fig.3)

Fig.3 The result of time to first fixation

3. Gaze Point and Heatmap

This study found out that the area of the body had quite a lot of fixation and density. This indicates that the respondent saw repeatedly into the area. The body area contains many elements of gender markers such as shoulder, waist-sized, and other marker attributes. Whereas the lowest fixation is in the head area. (Fig.4)

Participant 1

Participant 2

Participant 3

Fig.4 Gaze point by all participant

Fig.5 Heatmap by all participant

From the results, obtained the heatmap which can be seen in the figure 5 above. The color in the heatmap shows a number of fixations that occurred. The redder color in a particular area shows the more fixation that occurred in that area.

Heatmap shows reddish marks on the body area of all toilet pictogram. When respondents were interviewed, everyone stated body parts as a marker for parameters mentioning gender. So that, to interpret “male or female” in toilet pictogram, respondent tend to look dominant towards the body area.

DISCUSSION

1. Eye tracking recording

In the present study, we used a glasses-type eye tracker, which offered a wide measurement range, obtained two and three dimensional data, and could record in a setting that more closely resembled how toilet sign pictorial were seen.

Pictorial used was a public toilet’s sign system that was in a public facility. To prevent participants' views moving towards other things than the picture being tested, we focused on giving a white background. We eliminated the color factors by turning the stimulus into black and white. Besides, we used the same lux lighting level in the same place

2. Total number of gaze point fixations and gaze point fixation time.

The preferential looking method involves the phenomenon of an individual’s unconscious comparisons and selections while looking for a longer time at the item that they prefer. Our purpose was to investigate the extent to which participants focused their gaze on toilet pictorial with a high preference level.

3. Issues for future investigation

We can use an eye tracking system to measure views and objectively evaluated the behavior of eye movements when viewing a toilet sign. In order to continue the research, the following problems needs investigating. We will individually investigate participants who need gaze analysis and evaluation items. Gaze analysis depends on a higher order of brain function (eg, attention, memory, thought, and decision making). In addition, the number of fixation points of view and time of fixation of points of view could be assessed in this individual. So that it could see the pattern of the direction of eye movement and which part is the most interesting of a toilet image. The question is “Will the results of this vision pattern be the same, if the participant is a person who has eye disorders?”.

CONCLUSION

We observed an increase in the frequency of fixation time and first fixation for each field of interests and the gaze plots on the stimulus visual toilet pictogram. The results found out that the whole leads to the body part followed by the leg area and head area. Three respondents also had similarities in preferences for interpreting women's or men's toilets by paying attention to the body area of a toilet image. The results of this study are appropriate and proven to be the most interesting and the most important part in designing a toilet sign system is the body area.

BIBLIOGRAPHY

- Afacan, Y., & Gurel, M., O. (2015). Public toilets: An exploratory study on the demands, needs and expectations in Turkey. *Environment and Planning B: Planning and Design*, 42, 242– 262. doi:10.1068/b130020p.
- Barton JJ. (2011). Disorder of higher visual function. *Curr Opin Neurol*, 24, 1–5.
- Ciochetto, L. (2003). Toilet signage as effective communication. *Visible Language*, 37(2), 208–221.
- Ebisawa, Y., Fukumoto, K. (2003). Head-free, remote eye-gaze detection system based on pupil- corneal reflection method with easy calibration using two stereocalibrated video cameras. *IEEE Trans Biomed Eng*, 60.
- Findlay JM. Global visual processing for saccadic eye movements. *Vision Res* 1982.
- Martinez-Conde, S., Macknik, S., L., & Hubel D., H. (2004). The role of fixation eye movements in visual perception. *Nat Rev Neurosci*. 5, 229–40.
- Jacob, R., J., .K., Kam, KS. (2003). Eye tracking in human-computer interaction and usability research. In: Hyona, J., Radach, R., and Deubel, H. (eds.) *The Mind's Eye: Cognitive and Applied Aspects of Eye Movement Research*, 573-605.
- Talukder, A., Morookian, J-M., Monacos, S., Lam, R., Lebow, C., Bond, A. (2004). Real-time non-invasive eye tracking and gaze-point determination for human-computer interaction and biomedicine, *SPIE Defense and Security Symposium, Optical Patter Recognition XV*, Orlando, FL. <http://hdl.handle.net/2014/38027>.
- Tobii Technology. (2011). Accuracy and precision test method for remote eye trackers. Stockholm, Sweden: Tobii Technology, 5–25.
- Trisnawati & Sriwarno. (2018). *Cogent Arts & Humanities*. 5: 1553325
<https://doi.org/10.1080/23311983.2018.1553325>.
- Yamamoto, M., Torii, K., Sato, M., Tanaka, J., Tanaka, M. (2017). Analysis of gaze points for mouth images using an eye tracking system. *J Prosthodont Res*, 61, 379–86.