POSITIVE EMOTION RECOGNITION THROUGH EYE TRACKING TECHNOLOGY

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ABSTRACT: Currently, modern eye tracking technology has been utilized to examine the gazing behavior as human visual perception is very much linked to the psychological knowledge of mental processes. Hence, eye tracking technology is potential to reveal hidden cognitive processes of human behaviour. However, eye tracking understanding can be crucial to investigate as the analysis involved the nature feeling of positive stimuli affects subjects' emotions and soul through the eye tracking device. This experiment therefore attempt to investigate and identify the feeling utilizing the eye tracking sensor. Audio-visual setup of media containing positive emotions attributes were exhibited to participants to gauge the feeling of valence and excitement. The experiment used Tobii TX300 eye tracker with 10 subjects participated. The positive emotions that apply in this experiment are Love, Joy, Inspiration and Serenity. The results showed that both "Joy" and "Inspiration" stimuli fixation duration peaks the longest at 7000ms among the ten subjects tested. The experiment further found that the pupil dilated strongly to "Joy" and "Inspiration". These fixation metrics results confirmed that the participants visual attention toward salient image content were differently processed which concluded the positive emotion recognition. The results sum up that eye tracking metrics is useful to implicitly uncover the feelings insight of human behavior.

KEYWORDS: *Eye Tracking; Fixation; Positive Emotion; Pupil Dilation*

1.0 INTRODUCTION

Emotions are known as an important psychological condition that represent several human mental state, such as pleasant or unpleasant feelings, relationship with humans, process and results of an action. Understanding feelings is a key component in social interactions since it empowers people to precisely recognize the intentions of others and cultivates proper reactions. Hence, identifying mutual feelings is essential in establishing relationships and in creating enthusiastic correspondence. Human live with transient feelings such as gratitude, anger, happiness, and sadness. Essentially, emotions provide us with essential feedback about how we live in the world.

This study particularly, intended to explore the positive emotions as it help promotes positive feedback in daily undertakings. Positive psychology applies the logical strategy to questions that involve ideas, for example, happiness, satisfaction, qualities and excellences, versatility, hopefulness, and self- empathy [1-3]. These modern psychology and traditional psychology findings gave a more entire picture of human functioning. It further interest many field of studies and work to apply its advantages [4] such as automatic emotion recognition in various engineering fields [5-7], neuroscience [8-9] and new emerging field of neuro-marketing [1, 10] , the newly evolved field of emotion engineering [11-12] and many others.

Despites all these progresses, applications of positive emotion have yet showing remarkable outcomes and major breakthrough in which many spaces of research and developments opportunities and challenges are still exist. The study presented here thus, aimed to investigate these attributes with another very popular technology called eye tracking. As eyes are the main focus of human in Human Computer interaction (HCI), quantifying and tracking its gaze behaviour may bring a closer understanding of the emotions attributes. Previous study in [13] has shown promising results when the gaze visual attention reflects the consuming behaviour which relates the insight of eyes and emotions communication.

Primarily, the concern of this research is to study how the eye tracking technology contributes in analysing the activity of human eye and the relationship of its responses to emotional stimuli. The emotion were detected using the Tobii TX 300 eye tracking sensor when audio and video stimuli were presented to participants to measure the emotion valence and arousal. The fixation duration, fixation count and pupil dilation were analysed to study the eye activities. Positive emotions

videos of joy, inspiration, love and serenity theme were used as the stimuli. The study hypothesized that different emotions theme may captured different visual attention from the participants which indicate their emotions.

2.0 METHODOLOGY

2.1 Stimuli

The first video clip displayed is "Joy" where it is a comedy video which a hippo will be singing a song and a dog will be dancing for the music and it happens in a clear background area which triggers happy feeling. The second video in the list is "Inspiration" where the video shows how a good act be transfers to other just by looking at them doing it where it inspires the good vibe. The third video displayed is "Love" where it shows two-person shows love to each other about their feelings. The fourth video displayed is "Serenity" where it emphasizes on color mixing demonstration where the color been mixed in an aquarium filled with water and the slow motion of the art work. The video static segment is as shown in Figure 1.

Figure 1: Four static positive stimuli video

2.2 Software and Hardware

Eye gaze data was recorded while performing the task by using a Tobii TX300 eye tracker. Tobii TX 300 is a standalone eye tracker. The sampling rate was set at 300 Hz. Figure 2 shows the Tobii TX300 hardware. Tobii TX300 is synchronized to a main a computer that controls the Tobii TX300 software. In another word, this additional computer is the master system that provides the stimuli to be displayed in the eye tracker equipment. This computer was installed with Tobii Studio 3.4.1 for data collection and analysis. This computer is responsible for recording the gaze date recorded by the eye tracker as

well as showing the live recording of the subject that is being studied. Figure 3 shows the setup of Tobii TX300 with the secondary computer. The eye tracker collects and records all the data in its system. The data used for this study is the fixation index (the order of fixation), fixation duration (duration of each fixation in milliseconds), and pupil dilation (estimated size of the pupil in millimeters).

Figure 2: Tobii TX300

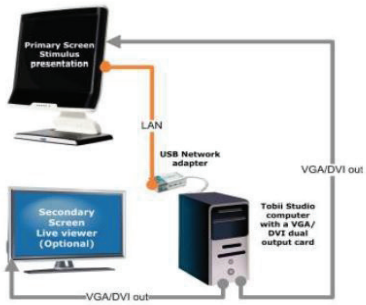

Figure 3: Tobii TX300 S

2.3 Experimental Design and Flow

Figure 4 depicts the summary flow chart of the whole experiment.

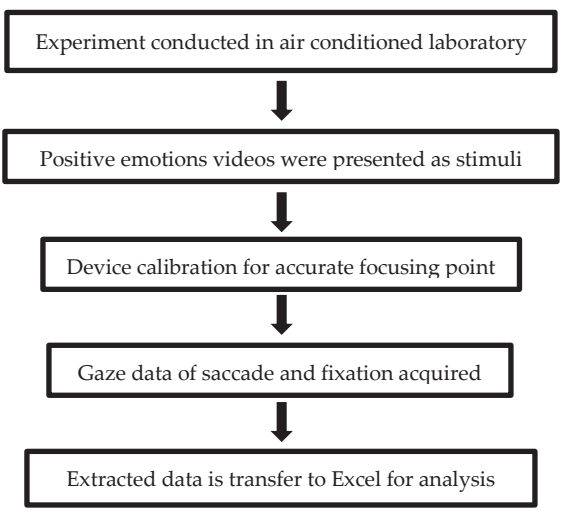

Figure 4: A flow chart of the experimental procedure

2.4 Subject

Random healthy 10 healthy students from the Malaysia-Japan International Institute of Technology were chosen as the subjects in the study. Six of them were female and the other four subjects are male. All of them are free from any disease and medication.

3.0 RESULTS AND DISCUSSION

3.1 Fixation Count versus Fixation Duration

A total of ten charts were produced for this analysis. Each chart represents the data from different subject. Each of the chart contains the data from four videos stimuli. These is to ease the process of comparing between the four video stimuli. Figures 5-14 show the graphs that are produced.

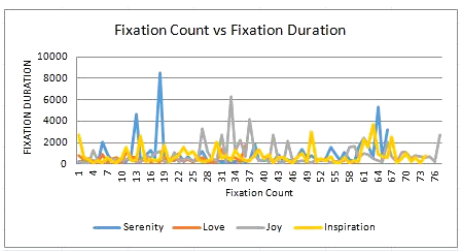

Figure 5: Fixation Count vs Fixation Duration for Subject 1

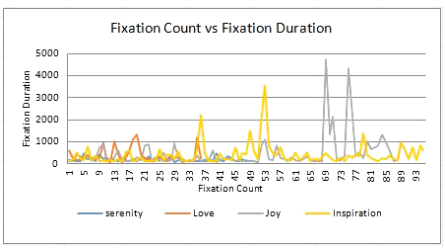

Figure 6: Fixation Count vs Fixation Duration for Subject 2

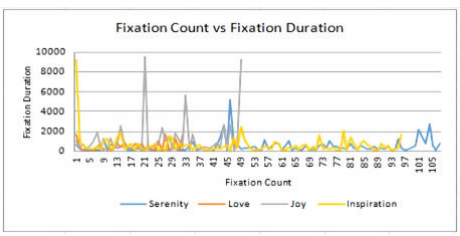

Figure 7: Fixation Count vs Fixation Duration for Subject 3

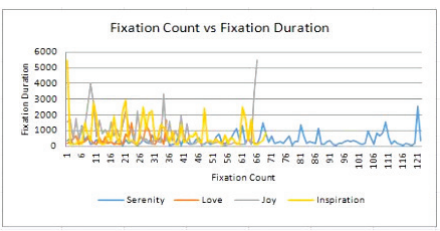

Figure 8: Fixation Count vs Fixation Duration for Subject 4

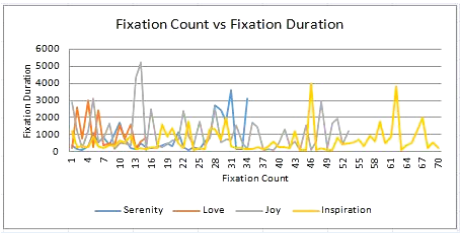

Figure 9: Fixation Count vs Fixation Duration for Subject 5

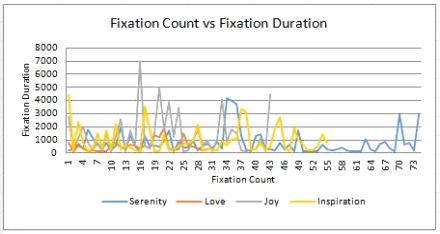

Figure 10: Fixation Count vs Fixation Duration for Subject 6

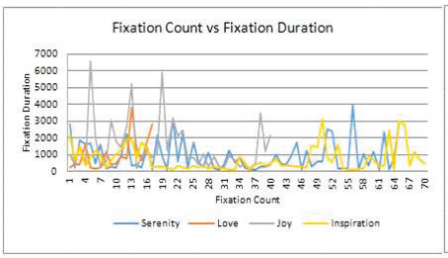

Figure 11: Fixation Count vs Fixation Duration for Subject 7

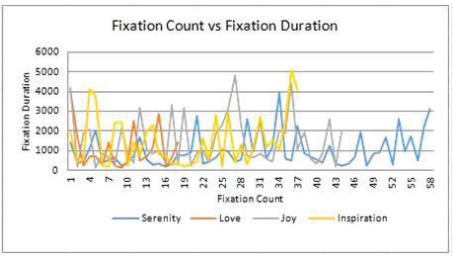

Figure 12: Fixation Count vs Fixation Duration for Subject 8

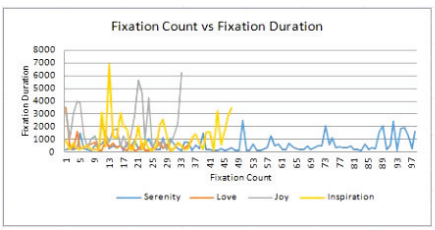

Figure 13: Fixation Count vs Fixation Duration for Subject 9

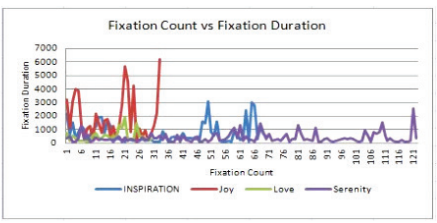

Figure 14: Fixation Count vs Fixation Duration for Subject 10

The results based on the chart from Figure 5 until Figure 14 show that the "Joy" video stimuli recorded the longest fixation duration for subject 2,3,5,7 and 10 at 4800 milliseconds, 5200 milliseconds, 7000 milliseconds, 6700 milliseconds and 6100 milliseconds respectively. "Interesting" video stimuli records the second longest fixation duration for subjects 2, 3, 5 and 10 whereas "Serenity" video stimuli records the second longest fixation duration for subject 7. The "Love" video stimuli recorded indistinguishable value at a low fixation duration for these five subjects

The fixation duration recorded for "Inspiration" video stimuli is the longest for subject 8 and 9 at 5000 milliseconds and 7000 milliseconds

respectively. "Joy" video stimuli records the second longest fixation duration for subject 8 and 9. "Inspiration" and "Joy" video stimuli records the same longest fixation duration for subject 4 and 6. The difference between the fixation duration of "Joy" and "Interesting" video stimuli and the other three video stimuli shows that these nine particular subject's eyes are focusing more on the clips in "Joy" and "Interesting" video stimuli.

3.2 Fixation Count versus Pupil Dilation

The pupil dilation of the right eye was chosen to be analyzed. This is because the pupil dilation for left eye and right is almost alike. A total of six charts produced for this analysis where each chart represents the data from the different subject. Each of the charts contains the data from four videos stimuli. This is to ease the process of comparing the four video stimuli. Figures 15-24 show the scatter plot produced for fixation count versus pupil dilation.

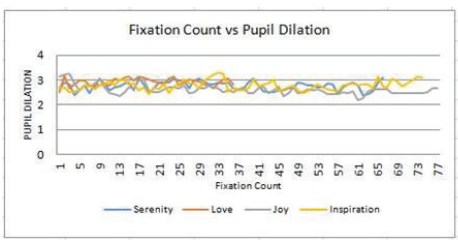

Figure 15: Fixation Count vs Pupil Dilation for Subject 1

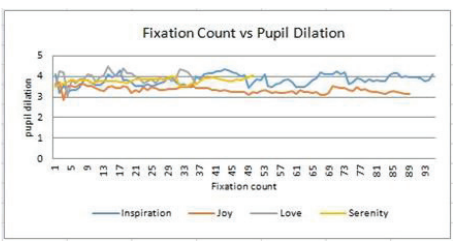

Figure 16: Fixation Count vs Pupil Duration for Subject 2

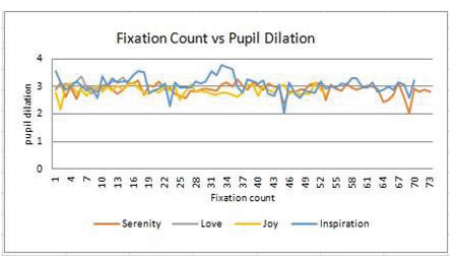

Figure 17: Fixation Count vs Pupil Dilation for Subject 3

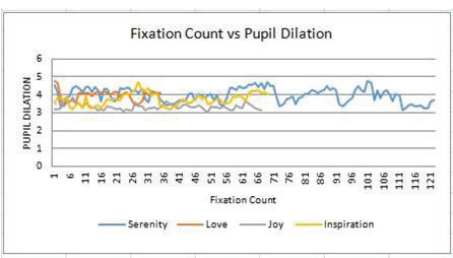

Figure 18: Fixation Count vs Pupil Duration for Subject 4

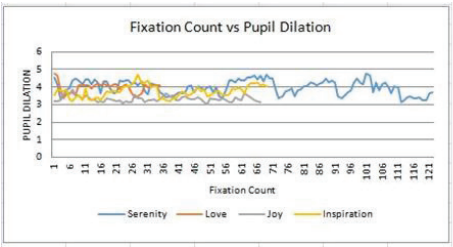

Figure 19: Fixation Count vs Pupil Dilation for Subject 5

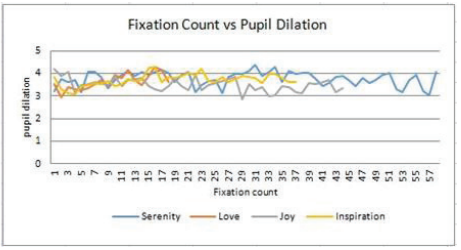

Figure 20: Fixation Count vs Pupil Duration for Subject 6

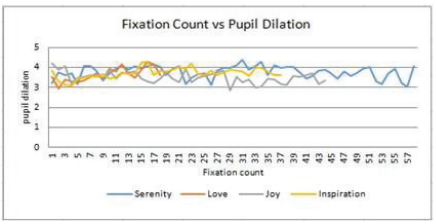

Figure 21: Fixation Count vs Pupil Dilation for Subject 7

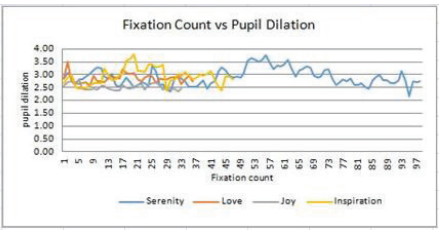

Figure 22: Fixation Count vs Pupil Duration for Subject 8

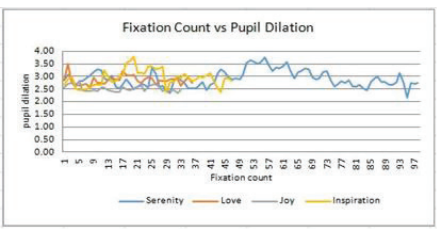

Figure 23: Fixation Count vs Pupil Dilation for Subject 9

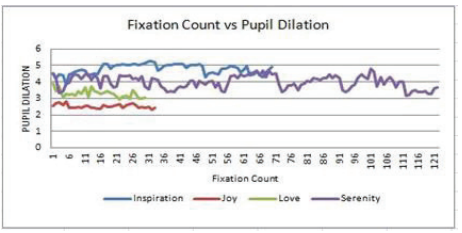

Figure 24: Fixation Count vs Pupil Duration for Subject 10

Based on the analysis made as mentioned above, it was found that the pupil dilated to some extent in time course particularly during the "Joy" and "Inspiration" stimuli. This is in line with previous studies in [14-15] indicated that pupil dilated to various kind of emotion stimuli.

4.0 CONCLUSION

An experimental investigation has approved the fact that the emotional state is individual and it depends on the persons cognitive perceptions. From this analysis, we found out that "Joy" and "Inspiration" stimulus has a greater positive impact on the participants. It has been concluded that these two emotional stimuli are the most reliable in terms of attentional capture. Hence, these two types of positive emotional

stimuli can be used in the psychological field as a stress relief medication. The results of the experiments have shown that the "Joy" and "Inspiration" best fixation duration is at peak 7000 milliseconds and this goes to most of the subjects tested. These fixation metrics results confirmed that the participants visual attention toward salient image content were differently processed which concluded the positive emotion recognition. The results sum up that eye tracking metrics is useful to implicitly uncover the feelings insight of human behavior. Future work will involve the application involving more subjects to get more numbers of gaze point and more detail research of the pupil dilation relation to eyes fixation.

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