

A Study on the Interaction between Human and Smart Devices Based on Emotion Recognition

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Abstract. In this study we focus on the effect of the interaction between humans and device when emotion recognition smart device is used. We propose that emotion based smart device is the most effective device in interacting with human when it comes to user-centered device. Forty participants watched Smart TV with three different user interfaces; remote controller, gesture recognition, voice recognition system and emotional recognition system. When they used the TV with the remote controller and voice recognition system, gesture recognition, they were given interesting and sad contents and were to choose any contents they want to see within a limited time. With emotion recognition system, Fraunhofer IIS SHORE™ demo software, participants' facial expression was automatically detected and they were provided with contents according to their emotions. This research offers a new concept that emotion-based smart device that can interact with humans will be the most effective user interface in HCI. The study will discuss how people feel and how Smart TV will respond accordingly.

Keywords: Cognitive Smart TV, Emotion recognition in Smart device, Usability in Smart TV, User interface, User-centered design, Smart TV.

1 Introduction

From the early days, user interfaces for products and services have continued evolving. The most important fundamental design principles that will allow successful user experience are: focus on helping the user perform tasks quickly and easily, providing flexibility to allow users to have a seamless visual experience as they switch to different devices, providing effortlessness by keeping the look of the Smart TV simple, clean and consistent, and, finally, emotional engagement.[2] Recently, as research and technologies are going around, it seems that things around us will slowly be replaced by non-touchable interaction. The focus of this paper is mostly on the advances in emotional and social aspect of interaction and shows the effectiveness of this kind of interaction compared to different methods of interactions (remote controller, gesture recognition, voice recognition system). These sensory based interfaces are mostly passive interaction system in which human controls the devices but not vice versa. With respect to the elements of interactivity, emotion recognition based user interface is the most adequate interface in smart devices. Emotion involves

both physical and cognitive actions. Our body responds biologically to external stimulus and we somehow interpret that into a particular emotion. That biological response changes the way we deal with different situations and this has an impact on the way we interact with computer systems. [1] In this paper, we tested the Smart TV usability in four different interfaces; emotion based facial expression recognition interface, the TV remote control unit (RCU) based interface, the voice recognition interface, gesture recognition interface. We found several research papers on our study and extracted important theoretical background from those papers.

2 Theoretical Backgrounds – Motivation

Most of the people watching TV consume contents according to their emotions and characters. Thus, the more complex the user centered interface, the higher the demand for user centered smart devices in HCI.[4] People should not change radically to “fit in with the system”, rather the system should be designed to match their requirements (Brooke et al, 1990).[5] The purpose of watching TV is to get information or get entertained [3], and the latter is especially important in watching TV. Thus, in order to attain the representativeness and universality of contents of different genre, pilot TESTs were taken and programs and genres were set based on the results. We can clearly see that emotion plays a significant role in selecting contents.

Different Methods of User Interface. 1) Remote controller 2) voice recognition 3) Emotional recognition 4) Gesture recognition systems

3 Emotion Based Facial Expression Recognition Interface

People usually use their facial expressions, gestures, verbal pitches, and postures to express their emotional state.[7] Emotions can be divided into two layers: momentary emotion and mood. Momentary emotions are the behaviors that we display briefly when interacting to events (e.g., angry, happy, or sad). Ekman’s six emotional expressions [8] show happiness, sadness, anger, surprise, fear, and disgust/ contempt. Emotions and moods are displayed in our bodily movement more apparently than in personality. The attitude toward other people displays the interpersonal relationship.

Different Emotion of Sadness contents in Gender. Males and females understand, interpret, and regulate the emotion of sadness differently in accordance with gender-specific social norms. Sadness is stereotypically perceived as a Feminine emotion associated with weakness and lack of control (Brody, 1985).

4 Structure of Emotion Recognition Detection

The research focused on improving the accuracy of emotion recognition for accurate measure of tendency of personality. The camera receives a fixed image of a participant’s face which is automatically sent to the software. Then, the software detects the facial expression of the participant. The image is then used to recognize emotion expression. According to the categorization of data, four emotions are displayed.

5 Research Question

Emotion recognition through individualized facial expression on Smart TV

RQ1) Which user interface was more effective to males and females, and in terms of emotion recognition user interface, which gender responded more effectively?

RQ2) What is the most satisfactory user interfaces among emotion recognition interface, remote control, voice recognition interface and gesture recognition interface on Smart TV?

RQ3) Is the user satisfied with the customized contents based on the recognition of the happy & sadness of emotion through individualized facial expression?

6 Method of Experiment

Experiment #1. Emotion recognition from facial expression on Smart TV

Participant. Sample size: 40 people (20 males and 20 females) Age: Between 20 and 30

Procedure. 40 people will randomly experience 4 types of user interfaces, which are emotion recognition interface, remote control, voice recognition interface and gesture recognition interface on Smart TV. With each interface, participants will use Smart TV for 20 seconds. They have to choose and watch the contents they want with remote control, voice recognition and gesture recognition interface. However, with emotion recognition interface, their emotion will be detected automatically by their facial expression, and they will be shown specific contents according to the detected emotion. If the emotion is detected as happy or surprising, the programs of TV will shift to funny or interesting shows (Gangnam style) whereas if sad or angry mode is detected it will change to moving or touching shows(Titanic).[6] After 10minutes, the feeling of response from the user is defined. (The idea is already protected by the patent law at home, and the patent is in process overseas.)

Measure. A questionnaire with a scale of 1-7 was used to measure the level of satisfaction of Smart TV in each user interface.

Statistical Analysis / T-TEST & Correlations Test

DV: UI type 1) remote controller 2) voice recognition 3) emotion recognition 4) gesture recognition systems CV: Contents (Sad Dramas Comedies Game Shows)

IV: Sex (male, Female)

Analyses within Design. Emotion Recognition Interface. Fraunhofer IIS SHORE™ [9] Emotion recognition software base on the tested for cognitive TV models as below.



Fig. 1. Recognition of participants' emotion through the Software

From Ekman's six basic categories of emotion (i.e. happy, sad, angry, fearful, disgusted, and surprised) [8].

7 Results

Remote Controller Unit (RCU) Based Interface. All of the result is not significant.

Voice Recognition Based Interface. All of the result is not significant.

Gesture Recognition Based Interface. Most of the results may not be significant, but the results for expectation is significant ($T(38) = -3.78, P < 0.05$). In addition, the level of perceived (Mmale = 5.45, SE = .35) was the highest for men when experiment with gesture recognition was conducted, and women had the highest expectation (Mfemale = 5.95, SE = .26). Men had the lowest satisfaction level (Mmale = 4.27, SE = .41) using the remote control and usefulness (Mfemale = 4.37, SE = .35) was at the lowest for women.

Emotional Recognition Based Interface. Most of results may not be significant, But evaluation is significant ($T(38) = -2.134, P < 0.05$) and satisfaction is significant ($T(38) = -3.388, P < 0.05$). In addition, perceived level (Mmale = 5.25, SE = .29) was the highest for men when experiment with gesture recognition was conducted, and women had the highest satisfaction (Mfemale = 5.85, SE = .28). Men had the lowest usefulness (Mmale = 3.88, SE = .32) using the remote control and usefulness (Mfemale = 4.53, SE = .26) was also at the lowest for women.

8 Conclusions

In this study, in order to find out the most satisfactory user interface, we experimented with 20 men and 20 women of ages between 19 and 31, average age of 25 and they spend one hour in average, on watching smart TV.

Among the four user interfaces, Gesture recognition interface had the highest level of expectation ($T(38) = -3.78, P < 0.05$). However, the overall satisfactory level of gesture recognition was at the lowest. Especially, the emotion recognition interface had the highest evaluation and satisfaction level (Mean= 4.96) ($T(38) = -3.38, P < 0.05$) when compared to other user interfaces. Overall, the satisfaction level was the highest on emotion based recognition interface and next came voice recognition (Mean = 4.85). The next was the remote control (Mean= 4.82) and the next was gesture recognition (Mean=4.08). Especially, women were very satisfied with emotion recognition interface (Mean=5.85). Men's satisfactory level on emotion recognition interface was (Mean=4.08). In terms of QUIS (Questionnaire for User Interaction Satisfaction) satisfaction, those who were highly satisfied with remote control also had high level of satisfaction of voice recognition, and those who were highly satisfied with voice recognition also had high levels of remote control and gesture recognition. Those who were satisfied with gesture recognition were also satisfied with voice recognition and those who were highly satisfied with emotion recognition interface were also highly satisfied with gesture recognition.

With the experiment on emotion recognition user interface, we also found out that in terms of preferences of contents, those who had negative feelings preferred watching sad dramas. (Mean=5.25). Those who had positive feelings preferred entertaining contents. (Mean=4.28). Since women tend to be more sensitive to emotion when watching the contents, ways to approach women in a different way is needed.

Thus, this paper proposes the most appropriate user centered interface since the way to approach and use contents on Smart TV is very complicated. In terms of approaching media contents, we cannot ignore the mood of the viewers. Thus, it is important to provide the right content according to different moods and it holds significant influence on the satisfactory level of the user. Although emotion recognition may not be applied universally, it may be very effective when applied at the right spot. Thus, recommendation of the user centered interface and appropriate contents will present the future direction of an innovative user interface.

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