Towards Personalized Adaptive User Interfaces

Vlaho KOSTOV, Shuichi FUKUDA, Hideyoshi YANAGISAWA
Department of Production, Information and Systems Engineering,
Tokyo Metropolitan Institute of Technology,
6-6 Asahigaoka, Hino-shi, Tokyo, Japan

Abstract. An approach towards standardization of the general rules for synthesis and design of man machine interfaces that include dynamic adaptive behavior is presented. The link between the personality type (Myers-Briggs or Kersey Temperament sorter) and the personal preferences of the users (Kansei) for the purpose of building Graphical User Interface (GUI) was investigated. The rules for a personalized emotional GUI based on the subjective preferences of the users were defined. The results were tested on a modified TETRIS game that displayed background characters capable of emotional response. When the system responded to a user in a manner that is customized to his or her preferences, the reaction time was smaller and the information transfer was faster. Usability testing methods were used and it was shown that development of pleasant cartoon face GUI based on the users inborn personality tendencies was feasible.

1. Introduction

The penetration of digital devices is reaching the point where novelty is no longer the chief attraction: adaptation and efficiency are. Most of us want to be convinced that we need something and then, when we have it, we don't want to waste time getting it to do what it is supposed to do. When we have to accommodate the technology, then priorities are backward and something is wrong.

Over the past decade, user interface design has been focused primarily on capability. However, current Graphics User Interface (GUI) research suggests a future trend where greater attention is paid to the subjective user experience, including an adoption and emotional response. Few researchers are already exploring new ways to sense and interpret the affective state of users, and others are challenging the problem of creating synthetic creatures in which affect and emotion are expressively communicated in behavior. It has been reported that actually humans do not need complex artificial agents or Virtual Reality (VR) characters on the computer screen in order to invoke social response [1].

Our work is an approach towards personalized adaptive user interfaces that are able to recognize or predict specific group of users according to their temperament and personality and predict their preferences and emotional response to what they see, hear, touch or even smell. Our goal is to define the general rules and guidelines for a design and a synthesis of man machine interfaces by possibly including a dynamic adaptive behavior to the conventional GUI. By this paper we attack the problem of defining an appropriate emotional response based on the personal preferences of the users. We also investigated the ways to recognize the quantities and the links between the personality type and the personal preferences of the users. Our ultimate goal is to build future human interfaces able to optimally adapt to the user without any effort from the user itself.

2. PERSONALITY TYPES AND TESTS

Many models look at personality differences for the purposes of career decisions, life planning, job assignment, and team building [2]. Most personality assessment is done through self-report with individual response to items varying according to mindset, vocabulary, life experience, culture, and so on. The usefulness of the model is determined by the accuracy of both the model and the instrument [3]. Most commonly used tests are Myers-Briggs Type Indicator (MBTI) [4] and Keirsey Temperament Sorter [5]. Since MBTI and the Keirsey Sorter are based on theories that address the innate nature of the personality, it is very important to help individuals to get at what we call "true type." This is the inborn pattern or potential, the source of our identity. However, the expression of our individual personalities is not always synchronized with this pattern. Quite often people are so influenced by their environment that they adapt or alter their inborn personality tendencies almost beyond recognition.

According to understandings and researches on personality [3], obtaining the true personality type is very important and we have to recognize that to behave in a way that is not consistent with one's inborn pattern takes a tremendous amount of energy. In fact, it is highly related to stress, unpleasantness and dislikes.

Both the MBTI and the Keirsey Sorter reflect trustworthy theories. MBTI, based on the Jung's theory of psychological types, was proved through the time by multitude of users. Keirsey's temperament theory reflects patterns of behavior that have been described by many great thinkers for over 25 centuries. Both instruments work fairly well with both theories. Temperament and type dynamics reflects the integration of both theories.

3. USABILITY TESTING METHODS AND KANSEI ENGINEERING

Subjective measures are always used, in some way, in usability testing as questions in a pilot survey or post-survey analysis of various products. The aim is to access the users opinion of the usability of the products they have just used. Most common methods are Likert rating scales [6] and Semantic Differential (SD) [7]. The former is a method of measuring attitudes by asking people to indicate their agreement or disagreement with the written statements where SD is interested in understanding the connotative meaning people attach to object or events. The levels of agreement to the statements at Likert's method are averaged by assigning the numbers 1 to 5 to each levels of agreement, while the participants during SD are asked to rate objects (people or events) on a number of bipolar adjective scales. The rating is obtained by putting a check on one of the seven lines or boxes between each pair of adjectives.

Kansei Engineering comes from Japanese term (image, impression, feeling) and tries to define the guidelines to design new objects or products, by including the personal preferences and psychological feeling (image or impression) the users or customers have regarding the new product. The most commonly used technique for grasping or extracting the users' "kansei" is the SD method developed by Osgood et al. [7].

4. METHOD

Our aim was to develop and test a system that is able to adapt to the user emotional preferences and will also enable pleasant interaction while keeping or boosting the performance. It is based on the idea that if a system responds to a user in a manner that is customized to his or her preferences, the reaction time becomes smaller and information transfer becomes faster than the one in a generalized response manner.

4.1. Personality adoptive method

In this section an adoptive user interface is introduced using a TETRIS game. The modified TETRIS game, which was able to display emotional cartoon faces in the background, was used. During the course of the game, which in our case we assume is an interaction process, the background faces change their expression in real time according to the player's performance. If the player is a bad one, the background face becomes negative i.e. angry, disappointed, etc. If the player is a good one, the background face displays positive ones. The main difference from the other adoptive user interfaces is that the cartoon face expressions at a same stage (level) of the game are different for each player even if the results of their performance are the same. This is due to our personality adoption method, which displays the faces in an order that is customized according to the players' inborn preferences towards such cartoon faces.

Our first approach towards adoptive interaction was accomplished by displaying the faces that change according to the emotional flow as shown in Fig. 1 Each face was assigned to a certain emotional group according to the previously developed methods and surveys [8]. For example, if the subject was a bad player the background faces would change in the range from normal to depressed. It was designed such that the current state could "jump" up to one half of the maximum Emotional flow. It could change directly from depressed to normal, but it could not directly change from depressed to thrilled without going through at least one state in between.

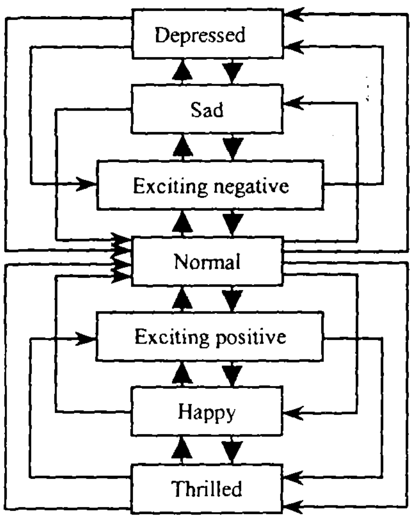


Figure 1: Emotional Flow

However, such a design did not obtain any significant results and we had to look for a new approach and different criteria for display of the adoptive faces.

The whole process of our new approach and the flow of the research are shown in Fig. 2.

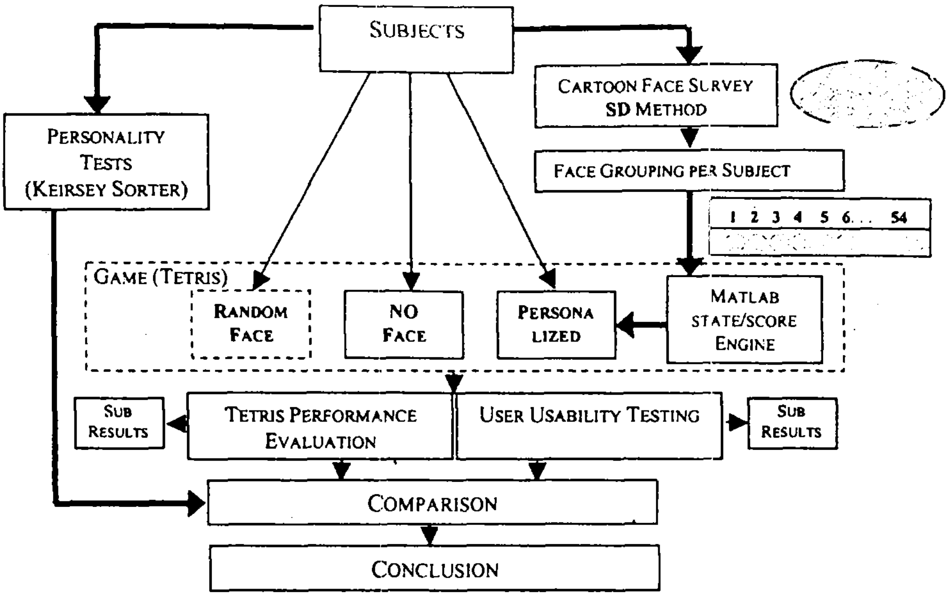


Figure 2: Flow of the research

1. Happy – Sad
2. Cute – Not Cute
3. Cheerful – Gloomy
4. Funny – Not funny
5. Warm – Cold
6. Lively – Dull
7. Casual – Formal
8. Thrilled – Depressed
9. Usual – Unusual (Artificial / Strange)
10. Excited (Positive) - Excited (Negative)
11. Relaxed – Worried
12. Satisfied – Unsatisfied
13. Surprised (Positive)– Surprised (Negative)
14. Calm – Angry
15. Smiling – Crying (Complaining)

Figure 3: SD survey, 15 pairs of adjectives

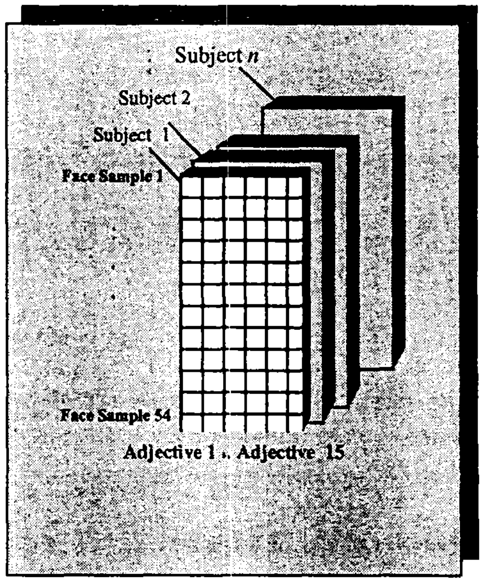


Figure 4: (SD Aadjective Pairs) x (54 Faces) x (*n* Subject)

In order to determine the emotional group they belong to, the cartoon faces were analyzed by a Web survey with SD technique of 15 pairs of adjectives (Fig. 3). 54 cartoon faces were analyzed and the evaluation SD data per each subject was obtained

(Fig. 4). The relevant adjectives for the Likert ratings and the SD bipolar scales were defined in a separate survey and later analyzed by multivariate techniques such as Cluster Analysis. Each subject' SD data was standardized by a Zscore and PCA (Principal Component Analysis) was performed. By looking at the Variance explained by the PCA components, it is obvious that the first three components substitute for more than 78% of the variance of the original data (Fig. 5). The complete absolute correlation between PCA score and the 15 adjective pairs for one subject is shown in Fig. 6. By looking into the non absolute bar representation of the correlation of the first three PCA components and the 15 adjectives (Fig. 7), we conclude that the first component has the biggest number of high correlated adjectives. This result was expected. Therefore we used the first PCA score as a subjective criterion to order the cartoon faces according to the evaluation of each subject (Fig. 8). As the first PCA component is highly correlated to most of the adjectives, for a particular subject, the higher the score, the more expressive in a positive direction the cartoon face becomes. By looking at the second, third and further components and the corresponding correlation coefficients, we could easily develop selective criteria for categorization (ordering) of each face. For example, if we take the second component as shown in Fig. 7 as ordering criteria, the faces would be ordered in a manner from the most

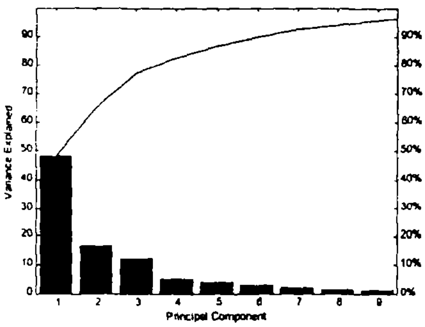


Figure 5: PCA components of typical SD data

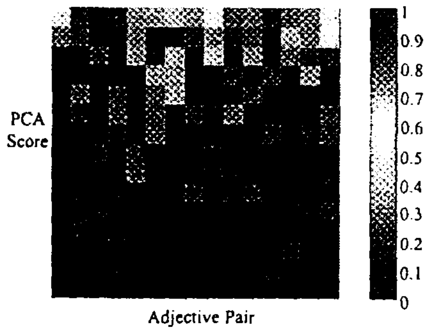


Figure 6: Absolute correlation between the PCA components and the 15 adjective pairs

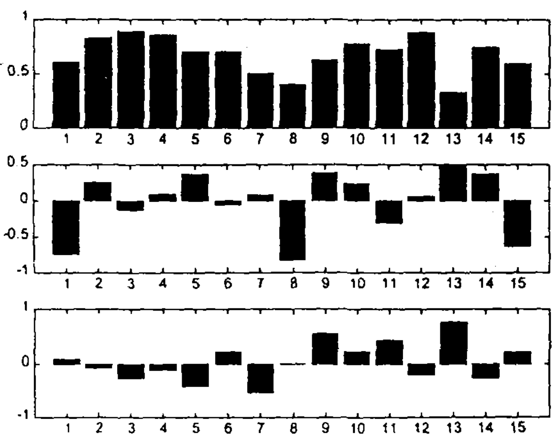


Figure 7: Correlation between the first 3 PCA components and the 15 adjective pairs

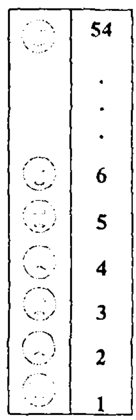


Figure 8: Personalized face order

negatively correlated face with the adjective pairs 1 (Warm – Cold), 8 (Thrilled – Depressed) and 15 (Smiling – Crying), to the least negatively correlated.

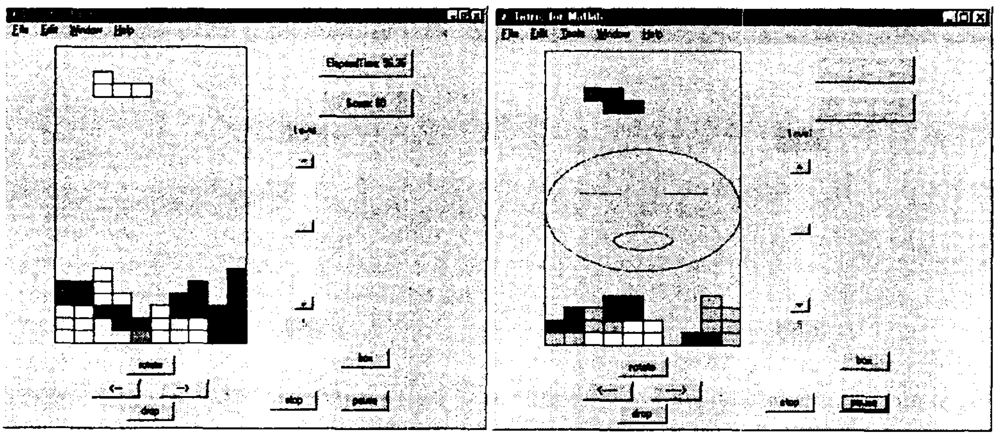
Subjects were asked to play the modified TETRIS game. Each subject played the game in an "Exercise mode" 120-240 sec depending of the subjects' skills. After that each subject played the game in two different modes:

Mode 1: The game was played without background characters at all (normal mode), Fig. 9 (a);

Mode 2: Based on the results of the cartoon faces Web-survey and the personality test for each subject the cartoon faces were changing according to the performance i.e. the game score, Fig. 9, (b);

One play session in each mode consisted of 3 rounds. After each play session, usability-testing methods were applied in order to measure the likeness and the pleasantness of TETRIS in both modes (Fig. 10). A record of the actual total performance of the subjects measured by the length of the time they played and the score they achieved was obtained.

The real time player's performance during the game was evaluated by the maximum height of the cubes (h_{max}) and the used space, i.e. the number of cubes (N_c)in the TETRIS field. For example for Fig. 9 (b), h_{max}= 4, N_c= 26. The faces became more negative as the height increased and as the total number of cubes increased



(a) (b)

Figure 9: TETRIS game, normal mode and Modified TETRIS game with cartoon faces

For the personality test the publicly available web site for the Keirsey sorter (http://www.keirsey.com) was used. The subjects were not informed about the purpose or the conditions of the experiments. Nor were they familiar with the differences or conditions between the different play modes as they played (performed).

5. Results and Discussion

Usability-testing questionnaires were used in order to measure the likeness and the pleasantness of the TETRIS game. More than 80% of the subjects evaluated 10 out of

15 adjective pairs with 18% higher rating towards positive direction for Mode 02 (Tetris with faces). It is a strong proof for the achieved pleasantness.

Looking at the total actual (objective) performance according to the score, it was in average 15% better in Mode 02 due to the faster information transfer. The actual duration of the game (playing time) was not taken into consideration as an objective performance indicator as the subjects at this stage were not completely familiar in

Impression Degree

[0=Neutral, 1=Little, 2=Very, 3=Completely]

	3	2	1	0	1	2	3	
Interesting								Uninteresting
Contemporary								Old fashioned
Fair								Unfair
Friendly								Unfriendly
Pleasant								Unpleasant
Funny								Not funny
Competent								Not competent
Stressful								Relaxed
Interactive								Un interactive
Helpful								Unhelpful
Frustrating								Fulfilling
Exiting								Boring
Attractive								Not attractive
Cool								Not Cool
Like								Dislike
Natural								Artificial
Easy								Difficult

Figure 10: Tetris Usability test (SD Method)

advance with this particular TETRIS game (controls are with PC mouse) or they could not exercise long enough so we would be certain that they are in the saturation part of the game learning curve.

It was shown that development of GUI with pleasant cartoon faces based on the users' inborn personality tendencies was feasible. Users seem to like the user interfaces that display emotional faces more, especially the ones that were developed to suit their own personality and personal preferences.

References

[1] B. Reeves and C. Nass, The Media Equation, Cambridge Univ. Press, 1998.

[2] D. J. Wilde, "Design Team Roles", in Proc. of ASME DECT99, Las Vegas, Sept. 1999.

[3] L. Berens, "Type & Temperament", Bulletin of Psychological Type, Vol. 19, No. 2, pp. 8-9, Spring 1996.

[4] B. I. Myers and H. M. McCauley, Manual: A Guide to the Development and Use of the Myers-Briggs Type Indicator (2nd Edition), Consulting Psychologist Press, Palo Alto, 1985.

[5] D. Keirsey, http://www.keirsey.com.

[6] R. Likert, "A Technique for the measurement of Attitude", Archives of Psychology, 140, pp. 1-55, 1932.

[7] C. Osgood, G. Suci and P. Tannenbaum, The measurement of Meaning, Urbana, University of Illionis Press, 1957.

[8] S. Fukuda, V. Kostov, H. Yanagisawa and M. Johansson, "Development of Simple Method for Extraction of Emotion from Face Using Cartoon Emotional Expression Approach", in Proc. 5th IIM, Intelligent Information Media Symposium (in Japanese), pp.125-132, Tokyo, Dec. 1999.

NUMERICAL METHODS II