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Guessability Study on Considering Cultural Values in Gesture Design for Different User Interfaces

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Abstract. Hand gestures act as computer input seeking faster, more natural, and more convenient means for a user to transmit information from the brain to a computer [8]. In this paper guessability study,- which extends our understanding of gestural interaction both in two dimensions (surface gestures) and in three dimensions (virtual gestures) has been mentioned -in order to gain the benefit of identifying natural gestures and natural mappings whether in 2D or 3D, with prospective of users. Then it has been discussed that like consideration dedicated to cultural values in the creation of icons, creatures, colours, traditional user interface elements, novel gesture recognition user interfaces (like touchscreens and virtual reality interfaces) need bringing into account the role of cultural differences and similarities in generating gestures to interact with such interfaces. A guessability which brings into account the role of cultures should be associated with user-centered approach to help designers produce systems that are not culturally offensive.

Keywords: Cultural values, Gesture, Guessability, User-Centered, User-Interface

1. Introduction

Creating interaction between human and electronic devices is the focus of human computer interface (HCI). Interaction that is similar to human beings communication. Human computer interfaces (HCI) has been developed from text-based interfaces to fully fledged multimodal-based 3D virtual environment (VE) systems. Thus, providing a new sophisticated paradigm for communication, learning, training and entertaining for those innovations is essential. Creating devices that can sense body position and orientation, speech and sound, facial expressions and gestures, haptic feedback and other aspects of human behaviour or state can be a more powerful interaction between human and computers [2].

The first step to achieving powerful interaction is to know how human communicate with each other. Humans communicate with each other verbally and nonverbally. Non-verbal communication is what comprises body movements. Gesture is one form of nonverbal communication that has been presented in a vast amount of research [17] . Hand gesture is a powerful human –to human communication channel, which forms a major part of information transfer in our everyday life. It can be used in wide range of applications as they are less intrusive and more convenient for users to interact with the computer and explore virtual worlds [2]. However, the main thing to be considered is that gestures vary depending on the context and the culture [5].

From the view point of application domain gestural interfaces are those using gestures as input technology [20]. Moreover, keyboard, mouse, and mouse-based widgets considered as traditional input devices are no longer preferable for those application domains; instead, valuable interactive surfaces are now controlled through multi-touch freehand gestures and computer vision hand tracking techniques [23].

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Consequently, this brings about the concern to find types of gestures that can be used to control such surfaces and are consistent among cultures.

2. The functional roles of human gesture

Before generating gestures for HCI applications we should know what hand posture and hand gesture are as well as functional role of human gestures.

- Hand posture: is defined as static hand pose and its current position without any movement involved. For example, making a fist and holding it in a certain position.
- Hand gesture: is defined as a dynamic movement and sequence of hand postures connected by continuous hand or finger movements over a short period of time. For example, waving goodbye [2].

Related to hand posture and hand gesture, gesture recognition can be classified into two categories: static gesture recognition, and dynamic gesture recognition which are not the focus of this paper [17]. Human gesture consists of three functional roles: semiotic, ergotic, and epistemic. Ergotic function of gesture is more commonly used especially in traditional interfaces in comparison to semiotic function that is used in novel interfaces.

- Semiotic function of gesture: to communicate meaningful information and commonly results from shared cultural experience. Like, goodbye gesture, the American Sign Language.
- The Ergotic function of gesture: corresponds with the ability of humans to control the real world or, to demonstrate artefacts. For example, typing on a keyboard, moving a mouse, and clicking buttons.
- Epistemic function of gesture: to help people learn about the real world through tactile experience by moving the hand over an object [2].

2.1. Gestural taxonomy

Several alternative taxonomies have been suggested in the literatures that deal with categorizing of gestures for HCI. Gestures as an interaction mode can be classified in terms of four key elements: gesture styles, the application domains they are applied to, input technologies and output technologies used for implementation. Gestures also can be labeled from a descriptive point of view and a semantic point of view. Descriptive labelling describes the movement of the gesture, while the semantic label refers to what the gestures communicate and their purpose [9].

Kendon [10] divided hand movements into two categories: hand gestures and unintentional movements. Unintentional movements have no intentions to communicate information. Hand gestures are divided into two groups: manipulative gestures and communicative gestures. Manipulative gestures are the ones used to act on objects in an environment. Communicative gestures can be further divided into acts and symbols. Based on the fact that communicative gestures can often be represented by different static hand postures and movements, they are the most commonly used gestures for the applications of HCI. Surface computing gestures [23], motion gestures [19], and cooperative gesture [17] are others taxonomies of gestures in the field of HCI.

3. Attribute of a good gestural interface

The characteristics of a good gestural interface seem similar to the characteristics of any other well-designed interactive system. Terms “useful”, “usable”, and “desirable” are usually used by designers to describe well-designed product. Some researchers say that products should be “intuitive” or “innovative.” What is obvious is that the gestural interfaces should be: discoverable, trustworthy, responsive, appropriate, meaningful, smart, clever, playful, pleasurable, and good. The terms “appropriate” and “good” are the focus of this paper. Gestural systems need to be appropriate to the culture, situation, and context they are in. Certain gestures are offensive in certain cultures. Although an “Okay” gesture is common in North America and Western Europe, it is insulting in Greece, Turkey, the Middle East, and Russia [20].

Designers and developers need to be responsible for the choices they make in their designs by creating a user interface that is good for users, good for those indirectly affected, good for the culture, and good for the

environment. Consequently, usability of such systems regarding to higher learnability, performance, efficiency, memorability, and lower errors and coverage will increase [14].

3.1. The role of culture on human gestures and usability study

One way of transmitting information is using emblematic gestures that constitute more than 10% of the gestures produced by speakers. Although they are culturally specified, most of advanced gestural interfaces are designed to recognize only such gestures [16]. Thus, cultural values of such gestures should be considered either in early stage of design or in usability testing stage. Result showed that when the evaluator and user are from different cultures, the interaction among them may vary from those who are culturally the same [7].

In a 3D gaming VE designed by Chen [2], the user is represented by the avatar. To move the avatar car to different locations forward/backward and turn right /left, a simple and intuitive hand postures shown in the table are used (Fig.1). Combination of these hand postures as hand gestures are used in terms of semaphoric gestures for selecting a traffic sign either from left or right side of the road and for opening the learning styles (Fig.2) [2] [9]. Manipulation of objects in this user interface based on Karam [9] is found in semi-immersed virtual worlds.

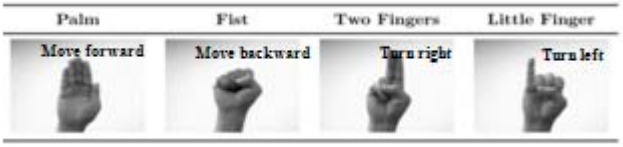

Fig.1- Hand postures [2]

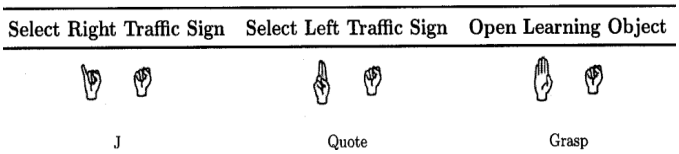

Fig. 2- Hand gestures [2]

The same combination of hand gestures and postures has been utilised in the game “Fly over the city” [4]. Even though those gestures are retrieved from sign language using a single camera to track the user's unadorned hands [4], they are not culturally meaningful in terms of use in real time interactions. Palm hand posture (letter B) in Western countries means number 5, in Greece and Turkey means “go to hell”, and elsewhere it means “stop”. Fist hand posture (letter S) is used in forms of gesture similar in meaning to a “handshake” “high five” and “respect”. Two fingers (letter U) means “go to hell” in Greece and “two” in the West. The little finger (letter 1) symbolises “small penis”, “bad”, “woman”, “thin”, and “you cannot fool me” in the Mediterranean, Bali, Japan, South America, and France respectively [15].

Another example of such gestures is in GestureTek using 3D cameras to let users control the PC using hand gestures. Some gestures are not considered polite in other cultures. For example, thumb down and up gestures for getting back to the desktop[1]. Thumb up gesture means “one”, “sit on this” (upward jerk), “hitchhike- good- ok”, “up yours!” (Thrust forward), and “man five” in Europe, Australia, Greece, and Japan respectively. Thumb down gesture means “bad/ kill him in Gladiators” [15]. Moreover pointing gesture used in many systems by Nickel and Stiefelhagen [13] which is capable of visually detecting pointing gestures and estimating the 3D pointing direction in real-time, is considered rude. In the Philippines people use the lips for pointing. So it is better to use hand for the purpose [15].

4. Gesture generating

For HCI application hand gestures to be effectively expressive, it is necessary to cautiously select the asset of gestural commands. Design space for gestural commands can be demonstrated along three

[1] http://www.gesturetek.com/3ddepth/introduction.php

dimensions [2]. Gestures generated based on these three dimensions would be more appropriate and good if they consider cultural similarities and differences of hand gestures.

- The intuitive aspect (cognitive): selected gestures should be intuitive and comfortable to learn and recall.
- The articulatory aspect: selected gestures should be easily recognised and do not confuse users.
- The technology aspect: properties of employed algorithms and techniques of selected gestures must be considered.

Nielsen *et al.,* [14] proposed a procedure for selection of gestures considering three aspects mentioned above as following: find the functions, collect gestures from user domain, extract gesture vocabulary, and benchmark the chosen gesture vocabulary.

In order to have the best and most natural user interface, gestures selected should match the system as well as behaviour of the users [20]. The best approach for generating a set of gestures that are culturally acceptable and enhance usability of the system is asking several users from different cultures to match a feature to a gesture or, reversely, a gesture to features that they would like to use or employ, in other world execute UCD method [14].

4.1. User-centered not technology-led

There are two approaches in working out the system design: adapt the user to the system or adapt the system to the user [6]. As mentioned earlier, the better effort in generating set of gestures is using USD. The user-centred design approach occasionally brings the users into the design and evaluation process of the product, in order to gain their feedback. Its goal is to adapt system to the users in relation to learning rate, ergonomics, and intuition [14]. The result showed that gestures are designed better by users' behaviour consideration [23].

Until recently, products were mostly created with a 'technology first' approach in which products being created by engineers and technologists rather than user experience or usability experts[2]. Although gestural interactions on various displays vary by culture, little research has been done about preferable gestures by people from different cultures. Unequivocally, designing products only with the intervention of designers may not be acceptable by users of various cultures.

Despite the designer's critical role in generating gestures for products, new approaches need to be considered. One way of determining initial user experience is the guessability of a system. Guessability study is occasionally associated with user-centered approach to enhance immediate usability of the system. In today's computing systems guessability is essential especially for those who wish to design a set gesture with high guessability [22]. Thus, creating a more natural set of user gestures would be easier when user-defined gestures have been agreed upon, and that those gesture vocabularies would be culturally well [18]. Not only engaging end users in the process of design can lead to better design solutions, it provides the researchers with a clear understanding about user' preferences and needs [21].

4.2. Guessability study

Gestures used by users to interact devices can either be in two dimensions or three dimensions. Two-dimensional gestures (surface gestures) are gestures in mobile surface computers with touch screen displays. Three-dimensional gestures (motion gestures) are gestures made by translating or rotating the device, and as in manipulating tasks in virtual and augmented reality. In mobile computing devices, gestures typically involve PDA's with touch sensitive screens to enable the users to focus more attention on their mobility rather than direct visual interaction with their devices. This style of gesture accepts finger gestures or strokes as input [9]. Previous researchers used bottom-up and top down approaches in which users were taking through scenarios that were like users domain and gives researchers opportunity to look for more natural gesturing for different kinds of user interfaces, guessability study is much more focusing on finding sets of gestures for touchscreen displays [14].

Ruiz and Li [18] developed a taxonomy for motion gestures based on a guessability study of 20 end users who inspired motion gesture set for nineteen tasks on a Smartphone device without being given any

[2] http://www.id-book.com/secondedition/casestudy_11-2_paper.htm

feedback during the performance of gestures. Tasks were like navigation of maps or images, text input, and controlling a cursor. Their study acts as guidance in the sensors design and toolkits, and was conducted on the same rationale expressed in Wobbrock *et al*., [23] surface gesture work.

In work examining gestures for single-user interaction Wobbrock et al., [23] showed a guessability study of user-defined gesture set based on mental model of non-technical participants' agreement on over 1,080 gestures. Gestures are conducive to be implemented in tabletop systems because of their ease of recognition, consistency, reversibility, and versatility through aliasing. They also presented a taxonomy of surface gestures along four dimensions: form, nature, binding, and flow. Although the work done by Ruiz and Li [18] and Wobbrock et al., [23] are very critical in assisting designers, they have ignored the role of cultural backgrounds of the users.

More recently Mauney et al., [11] conducted a study in nine different countries, with the aim of identifying similarities and differences in the use of gestures on the small touch-screen user interfaces. They asked participants to define their own gestures for 28 common actions on a recorder that simulated a handheld touchscreen device. Actions were like "zoom" and "copy". They found that there is generally, high level of gesture agreement across cultures for common actions, except for the Chinese who preferred using symbolic gestures. They also noticed gestures that participants created for the actions are influenced by users' previous experience with gesture-enabled devices. Their findings help the engineers who work in multicultural environments by giving them insights into user behaviour in various cultures. It is also noticeable that gestures conducted by users in their study are more reliable to be used because they are culturally sensitive.

5. Discussion

Macintosh Human Interface Guidelines mentioned that it would be easier to develop worldwide software which is compatible with right from the beginning of the development process [1]. Traditional user interfaces with regards to use of colour, graphics, calendars, text, and the representation of time, creatures, plants, and inanimate objects should take in to account cultural values, compared to novel user interfaces like virtual reality, augmented and mixed reality that need further consideration in gesture generation. In order to have a system concerned about multicultural sensitivity of target audience, guessability study in association with user-cantered approach and cultural values can be utilised as a helpful method for designing gestures of different domains.

6. References

[1] C. M. Brown. Human-computer interface design guidelines: *Intellect Books*. 1998, 236 p.

[2] Q. Chen. Real-time vision-based hand tracking and gesture recognition. *University of Ottawa*. 2009, 117 p.

[3] J. Coutaz, and J. L. Crowley. Interpreting human gesture with computer vision. *Position paper for the workshop "Gesture at the User Interface*".CHI'95, Denver. 1995, 8 p.

[4] N. H. Dardas, and M. Alhaj. Hand Gesture Interaction with a 3D Virtual Environment. *International Journal of The Research Bulletin o f Jordan.* ACM. 2011, pp. 86-94.

[5] Y. A. Gonzales, and Z. Jinyu. A study on gesture-based input in multi-touch enabled mobile devices. *Kun Shan University*. Tainan. 2011, 9 p.

[6] M. D. Good, J. A. Whiteside, D. R. Wixon, and S. J. Jones. Building a user-derived interface. *Communications of the ACM.* 1984, 27(10): 1032-1043.

[7] M. Hertzum, and N. E. Jacobsen. The evaluator effect: A chilling fact about usability evaluation methods. *International Journal of Human-Computer Interaction.* 2001, 13(4): 421-443.

[8] R. J. K. Jacob. Human-computer interaction: input devices. *ACM Computing Surveys (CSUR).* 1996, *28*(1): 177-179.

[9] M. Karam. A taxonomy of Gestures in Human Computer Interaction. *ACM Transactions on ComputerHuman Interactions*. 2005, pp. 1-45.

[10] A. Kendon. *Sign languages of Aboriginal Australia: Cultural, semiotic and communicative perspectives*. Cambridge University Press. 1988.

[11] D. Mauney, J. Howarth, A. Wirtanen, and M. Capra. Cultural similarities and differences in user-defined gestures for touchscreen user interfaces. *ACM*. Atlanta, GA, USA. 2010, pp. 416-420.

[12] M. R. Morris, A. Huang, A. Paepcke, and T. Winograd. Cooperative gestures: multi-user gestural interactions for co-located groupware. *Proc. of the SIGCHI conference on Human factors in computing systems*. New York, NY, USA: ACM Press. 2006, pp. 1201-1210.

[13] K. Nickel, and R. Stiefelhagen. Pointing gesture recognition based on 3D-tracking of face, hands and head orientation. *Proc. of the 5th international conference on Multimodal interfaces.* New York, NY, USA: ACM press. 2003, pp. 140-146.

[14] M. Nielsen, M. Storring, T. Moeslund, and E. Granum. A procedure for developing intuitive and ergonomic gesture interfaces for HCI. *Gesture-Based Communication in Human-Computer Interaction*. 2004, pp. 105-106.

[15] A. Pease, and B. Pease. *The definitive book of body language*. London. Orion Books Ltd. 2006, 400 p.

[16] S. A. Rehfeld, F. G. Jentsch, and T. N. Rodriguez. Memory recall for international gestures. *Proc. of the Human Factors and Ergonomics Society*.2004, pp. 2604-2607.

[17] J. W. Roltgen. *AQUA-G:* A universal gesture recognition framework. *Iowa State University*. 2011,159 p.

[18] J. Ruiz, and Y. Li. DoubleFlip*:* a motion gesture delimiter for mobile interaction. Vancouver, BC, Canada: ACM press. 2011, pp. 2717-2720.

[19] J. Ruiz, Y. Li, and E. Lank. User-defined motion gestures for mobile interaction. Vancouver, BC, Canada: ACM press. 2011, 10 p.

[20] D. Saffer. *Designing gestural interfaces: Touchscreens and interactive devices*. Canada. Reilly Media. 2008, 247 p.

[21] D. Schuler, and A. Namioka. Participatory design: Principles and practices. New jersey, USA: CRC. 1993, 319 p.

[22] J. O. Wobbrock, H. H. Aung, B. Rothrock, and B. A. Myers. Maximizing the guessability of symbolic input. *In CHI '05 extended abstracts on Human factors in computing systems.* New York, NY, USA: ACM. 2005, pp. 1869–1872.

[23] J. O. Wobbrock, M. R. Morris, and A. D. Wilson. User-defined gestures for surface computing. *ACM*. Boston, Massachusetts, USA. 2009, 10 p.