Influence of Culture in Multimodal Interfaces

Gesture behavior between Anglo-Celtic and Latin Americans

Karime Nasser Alvarez
Department of Computing
Macquarie University
Sydney, Australia
Karime.nasser-alvarez@mq.edu.au

Manolya Kavakli
Department of Computing
Macquarie University
Sydney, Australia
manolya.kavakli@mq.edu.au

***Abstract*— In multimodal interfaces, hand gestures often help convey meaning to the spoken word; therefore, the cultural background of the gesturing person might be an influential factor in the interaction with these interfaces. This paper presents an empirical study aimed at singling out basic cultural differences in hand gesture performance between two cultures: Anglo-Celtics and Latin Americans. The focus in this paper is given to the video analysis of the two cultures describing two objects with their hands. The purpose is to use gesture segmentation to define predominant hand gestures by culture. Conclusions are drawn from the experiment and are linked to cultural attributes proposed by theorists like Hall and Hofstede. The findings state that cultural differences exist in the description of the object, which might have implications for the development of gesture-based multimodal interfaces. As Anglo-Celtics are low context cultures, they used more words and gestures in longer time. On the other hand, Latin Americans, which represent the high context culture, had more frequent gestures, but performed fewer ones, in shorter time. We also found that as the complexity of a task increases, so does the use and type of gestures. The performance of a multimodal interface will not only be affected by the task being performed, but by the cultural background and language skills of the user.**

Keywords- Gesture recognition; HCI; culture; Anglo-Celtics; Latin Americans; gesture based interaction; performance; frequency.

I. INTRODUCTION

The aim of Human Computer Interaction (HCI) is making the interactions as natural as possible, as if communicating with another human [1]. Gestures, such as pointing, are where language, culture and cognition meet [2]. Humans have an innate need to use gestures; since they complement our ideas, to such an extent that humans are known to gesture even when talking on the phone [3].

The significance of this study relies on the intention of defining the gesture variances from one culture to another and relating them to cultural traits. Culture has been studied by anthropologists all over the world, and these have arrived to the science behind stereotypes. Our intention is to identify, if any, the cultural influences that may possibly affect the representations of hand gestures. Our approach follows the experiment conducted by Bischel et al. where a designer is required to describe a mechanical device to another designer [4]. In this case, the participants of each sample were recorded depicting two different chairs with their hands. These videos were recorded for later segmentation and used timestamps to assess the cultural influence via metrics such as frequency and the quantity of certain gesture types.

The paper is structured as follows. First, there is a summary of related works. Second, we describe the experiments conducted. Third, we analyze the data collected and conclude with a discussion of the findings.

II. LITERATURE REVIEW

The means to communicate with computers has evolved from classic mouse input, to rich multimodal data [5]. Multimodal interfaces have combined various user input modes beyond the known keyboard and mouse input/output [6], and now include a wide range of possibilities; such as hand gestures, both static and dynamic, speech, head and eye tracking. Apart from usual voice interaction, advances like sensory output have also been developed in videogames.

Games and infotainment are not, however, the only use for gesture based interfaces. The Intuitive Surgical da Vinci surgical system, for instance, is an example of a system for the capture of subtle motions of the surgeon, to teach complex procedures [7]. One may assume that in tasks such as the manipulation of objects, cultural implications might not be of considerable importance, but in the context of cultural and physical differences between surgeons, the subject calls for more attention [8].

Gesture-based interfaces enable freer, more intuitive, and richer digital interactions, than conventional user interfaces [9], leading to better idea generation [10]. When developing multimodal interfaces and applications, developers and designers work together to understand what types of gestures are used for what tasks, as well as the frequency, the importance, and ease of use of the interface. Therefore, there have been many attempts to design an appropriate gesture classification and segmentation "dictionaries".

A. Gesture classification and segmentation

Gesture offers versatility when representing objects, or qualities of these in the scientific field. The main problem

 ISBN: 978-1-61208-195-3

here is that there is no common database of gestures used between developers and scientists. The most recognized gesture classification, and the one referred to from now on, is the one established by McNeill in 1992 [11]. McNeill classifies 4 types of gestures; iconic (resemble what is being talked about, e.g., flapping arms when mentioning a bird), metaphoric (abstractedly pictorial, e.g., drawing a box shape when referring to a room), beat (gestures that index a word of phrase e.g., rhythmic arm movement used to add emphasis), and deictic (gestures pointing to something, e.g., while giving directions).

The iconic ones are of particular interest to HCI and developing technologies as they allow accurate depiction of objects encountered by the user. The cultural background might be an influential factor in the design of gesture-based interfaces. Metrically, culture could be reflected in the interactivity, symbol variety, re-hearsability and pre-processability of gestures.

B. Culture

As defined by Hofstede [12] "Culture is the collective programming of the mind that distinguishes the members of one group or category of people from another". Through the appropriate design of support-focused interfaces how we obtain maximum usability. Technology has been conceived in 'prosthetic' terms, as an extension to the body, or support for tasks [13] and given the global diversity, cultures will perceive these tasks differently. Language and representation are critical elements in the study of culture, because we are locked into our cultural perspectives and mindsets [14].

1) Culture and Interfaces

We communicate and exchange information with a system or a device through interfaces. The more familiar or intuitive an interface is, the higher its usability.

Cultural preferences determine the type of layout, texture, pattern and color [15] in website portals. Certain colors are offensive or uncomfortable for certain cultures, for instance, red is bad luck for Koreans, therefore, Korean websites might avoid the use of red. These examples illustrate the need to adapt interfaces to attract the targeted market, or in this case, culture. Culture does not exist as a computational term in HCI, even though there are efforts like tailored interfaces to a targeted culture. With every use of the technology, the success depends on the capabilities embedded in a persona who is "programmed" in a specific way. The mental "coding" of this persona will affect the usability.

The cultural behavior is visual, but it is not always evident until there is an interaction. One instance is Rehm, Bee, and André [16] try to identify the culture of the user so that the behavior of an interactive system can be adapted to culture-dependent patterns of interaction. This was achieved via a Bayesian network model that based itself on gesture expressivity via speed, power or spatial extent.

In our globalised reality, there is also the implication of remote international collaboration. Here, each participant has their own symbolic, iconic and metaphoric influence on their gestures [16]. As Hofstede concludes in writing about the influence of communication technologies, the software of the machines may be globalized, but the software of the minds that use them is not [12]. Therefore, the dominance of technology over culture is an illusion, and differences between cultures exist.

2) Hofstedes Cultural Dimensions

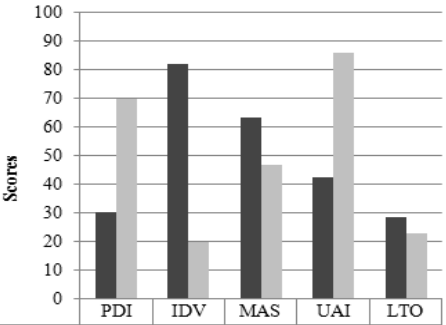
The most renowned cultural study involving the identification of common attributes is the work done by Gert Hofstede [12]. Hofstede developed a set of culture build-ups that describe the way in which national societies are built and the rules by which people think, feel and act. These differences are defined as five dimensions and are measured as indexes. The higher or lower the index, more or less the culture portrays this feature.

The Hofstede's model of dimensions of national culture has been applied predominantly in international business; marketing and consumer behavior works [18]. Now we briefly describe the dimensions by Hofstede.

- Power Distance (PDI): is the acceptance and expectation of power to be distributed unequally.
- Uncertainty Avoidance (UAI) indicates the extent to which the members of society feel uncomfortable or comfortable in an ambiguous or abnormal situation.
- Individualism (IDV) is the extent to which individuals are merged into groups.
- Masculinity (MAS) refers to the distribution of emotional roles between the genders, and also serves to classify a culture as assertive/ competitive (masculine) or modest/caring (feminine).
- Countries with high Long- Term Orientation (LTO), foster pragmatic virtues oriented towards future rewards, in particular saving money, persistence, and adapting to changing circumstances.

Now we present the cultures used in our experiments: Anglo-Celtic (Australian, British, Irish, New Zealanders) and Latin Americans (American countries where Spanish is primarily spoken: Argentina, Chile, Colombia, Costa Rica, Ecuador, Salvador, Guatemala, Mexico, Panama, Peru, Uruguay, and Venezuela).

 ISBN: 978-1-61208-195-3



	PDI	IDV	MAS	UAI	LTO
Anglo-celtic	30	82	63	43	29
Latin American	70	20	47	86	23

Figure 1. Hostedes 5D Model comparing Anglo-Celtic and Latin American countries.

In Fig. 1, we can see a comparison of both samples; an average was taken of the indexes of the countries mentioned above. As we can see in Fig. 1, the Anglo-Celtic culture had a lower PDI (30, 70), and UA (43, 86). On the other hand, they have higher IDV (82, 20), MAS (63, 47) and LTO (29, 23) than the Latin American countries.

Therefore, we assume that due to the greater equality (Low PDI) Anglo-Celtics feel, they are more individualistic (High IDV) and can master new challenges (Low UAI) better than their fellow Latin American colleagues. Hosftede developed a solid foundation for identifying the possible complication of cross-cultural interactions, what makes cultural differences, and how they would act upon this [12].

Even though Hosftede is cited by an extensive amount of sociologists and anthropologists, for the analysis taken in this paper, it is also beneficial to analyze the context classification made by the anthropologist Edward T Hall [19]. Hall identifies a culture's use context in routine communication and classifies them as High or Low. In a high context culture (including much of the Middle East, Asia, Africa, and South America), many things are left unsaid, letting the culture explain. There is more non-verbal communication, a higher use of metaphors, and more reading between the lines. In a lower context culture (including North America and much of Western Europe), the emphasis is on the spoken or written word. They have explicit messages, focused on verbal communication, and their reactions could be visible, external and outward [19].

We can say that Anglo-Celtic cultures (e.g. Australian, British, Irish, and New Zealanders) categorize as low context cultures and Latin Americans (American countries where Spanish and Portuguese are primarily spoken) correspond to the high context cultures. This classification lets us make certain assumptions, like the Anglo-Celtic may predominantly use words, while the Latin Americans would use gestures.

These characteristics identified for each of the samples will be later referred to in order to understand possible influence of these in the gesture performance after the experimentation.

III. EXPERIMENT

In order to explore the influence of culture in gesture performance, an experiment was carried out. As following up on Bischels' experiment the participants will be required to describe two chairs to the camera. They were sat in front of the camera and told to act as if having a video conference with someone. This experiment was chosen because it is not of interest to determine the types of gestures used to draw an object as these may be standardized worldwide, it was of interest to know what the user himself would bring to the table. Bischels' experiment also brings together language and gesture; both of these being important in defining a culture (as stated in Section 2.B). Throughout this study, the observational task analysis method will be used. The observational technique, via the video footage, will permit a careful analysis of gestures occurring at certain timestamps during the interaction. This will be helpful in identifying individual gesture differences in task performance.

A. Hypothesis

The hypothesis taken as a base for the analysis is as follows:

"Designers' culture may affect gesture recognition in multimodal interfaces because of variations in gesture type, gesture frequency, and gesture occurrence".

This hypothesis brings together the subjects of gesture, multimodal interfaces, gesture segmentation and culture based theories. The three metrics stated in the hypothesis are gesture type, frequency and occurrence.

- Gesture Type. The gesture type is based on McNeill's classification. It is believed that certain types of gestures could be attributed to different cultures; therefore, it is important to analyze the type of gesture that is mostly performed.
- Frequency. The frequency is measured as the number of gestures performed by a participant divided by the period of the gesture of the same participant. This way we obtain the gestures per second which will help assess speed of gesture performance and point out what gestures are most significant for a gesture recognition system.
- Occurrence. Occurrence measures the appearance of the gestures. This once again tries to identify if certain gestures are culture-oriented or task-oriented (i.e., related to the task being performed).

B. Experiment Guidelines

The task to be performed consists of describing two chairs (See Figure 2). Participants were encouraged to use as many gestures as possible, just as in [21]. The analysis methodology is via video analysis using a video annotation tool called Anvil.

 ISBN: 978-1-61208-195-3

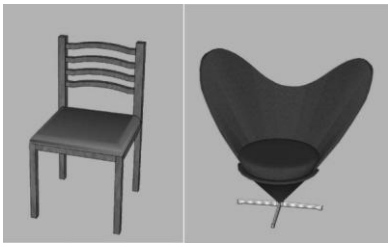


Figure 2. Classical chair (left) , Abstract chair (right)

1) Procedure

There were a total of 8 Latin American participants and 11 Anglo-Celtics videotaped, but only the ones with clearer hand gestures and comprehension of the task were chosen. A criterion for deselecting a video footage for analysis was either the lack of gestures, or the lack of iconic gestures which are the focus of this study.

The final selection was 5 participants from each sample group, totaling 10 participants. For the purpose of the experiment two samples were needed, one with English as a first language (Anglo-Celtics, and one with English as a second language (Latin Americans). For the second sample, it was important that they were sufficiently proficient and immersed in an English speaking country (Australia) for the past 6 months.

2) Gesture coding

In gesture analysis, we first analyzed the videos and segmented the video footages. For each occurrence, what was recorded was the name of the gesture type (repetition, beat, iconic, metaphoric, deictic junk) that was performed by the participant. These correspond to McNeill's classification, but the repetition gesture (which is a type of deictic gesture) was coded separately because of the difference in language. Repetition was considered to be a potential factor that reflects culture, as uncertainty in the language, or description, could be characterized this way. Junk gestures were identified as gestures without a particular meaning. This could be a gesture that the user takes the gesture back (which is a "mistake") or made some transition movements.

Gestures are separated by pauses, and a pause is defined as a temporary stop in action or speech [22]. The purpose of this pause was to eliminate the period of inactivity at the beginning of a video, when the participant explains what he or she might do, or when the participant states that he or she has ended.

TABLE 1. WORDS DERIVED FROM VIDEOS FOR CHAIR 1 AND CHAIR 2

Words	**Samples**			
	Anglo-Celtic	***Latin American***	***Both***	***Total***
Chair 1	9	13	6	28
Chair 2	13	10	5	30

3) Speech Coding

Words were not a requirement, yet the participants talked through their depictions. As a result, the "verbal descriptions more significantly used were coded. These were classified as adjectives, parts of the chair, verbs, order and shapes (See Table 1). It was found that each iconic and metaphoric gesture is related to at least one word, reflecting the participant's cognition.

Finally, we obtained close to 10 minutes of monologue object descriptions in a video footage. Seconds were used as the time measuring unit.

IV. RESULTS

Numerically, Anglo-Celtics did not display too much variation (SD) between chair descriptions, regardless of the second ones unordinary structure (See Table 2).

The Anglo-Celtic participants used more gestures on average to describe Chair 2. On the contrary, the Latin Americans used less number of gestures to describe the same chair. The reason behind this could be the degree of comfort in using a language when describing the abstract. This reflects how the language and increase of the complication of the task have an influence in cognition. Given that the features found in the abstract chair are not as common as the features found in the classic chair, this sample may have had more trouble in finding a way to explain words or shapes in the abstract chair.

The SD was again higher with the Anglo-Celtics, which made it hard to identify a pattern. On the other hand, the Latin Americans had a smaller SD and more frequent gestures, meaning shorter, concise, and common gestures by most of the participants. Their gesture frequency is higher in Chair 1, and increases in Chair 2. This could be because Latin Americans scored higher results in junk gestures in the second Chair.

Latin Americans had more frequent gestures in both chairs meaning that they performed more gestures per

TABLE 2. VIDEO ANALYSIS FOR CHAIR 1 AND CHAIR 2

Chair	**Metrics**						
	Sample	***Avg gesture duration***	***Total no of gestures***	***Avg gestures***	***SD***	***Avg gesture Time***	***Frequency***
Chair 1	Anglo-Celtic	1.84	65	12.8	5.63	22.74	0.56
Chair 1	Latin American	1.49	59	11.8	2.16	17.81	0.66
Chair 2	Anglo-Celtic	1.73	65	13	7.17	23	0.56
Chair 2	Latin American	1.67	43	8.6	2.88	14.22	0.60

 ISBN: 978-1-61208-195-3

second, even though they had fewer gestures in total. The smaller count of gestures by Latin Americans is justified by the lesser time in which they performed the gestures.

Given the distribution of gestures, we can see that in general, iconic gestures decrease with Chair 2, in contrast, junk and deictic gestures appear more.

The Latin Americans used more words for Chair 1 and less in Chair 2 (See Table 1). Less gestures and words in Chair 2 could probably mean a better selection of words and gestures, or the lack of vocabulary. The higher words count for Chair 1 must mean a higher degree of confidence, or more predictable and structured ideas on behalf of the Latin Americans.

A. Findings

After analyzing the performance of both samples, in this section we reveal the results of the metrics stated in the hypothesis: gesture type, frequency and occurrence.

1) Frequency

Gesture frequency indicates that overall the Latin American sample performed more gestures per second; however, this evidence is not enough to say that a certain sample was more expressive than the other. The use of gestures involves various factors, such as the comfort of a person had in front of the camera, or the confidence with the object being described, as well as the language. Chair 1 had Iconic and repetition gestures with higher frequency in both samples. Chair 2 on the other hand had an increase in junk and metaphoric gestures. The most significant gestures for the gesture recognition were the iconic ones as well as repetitions, and subsequently they are the ones that convey the representation of the chair.

2) Occurrence

There are no junk and deictic gestures in the description of Chair 1 for the Anglo-Celtic sample, but they do appear in Chair 2. We can see that number of gestures increases in Chair 2. This means that the occurrence of gestures was related to the task, not to the culture. Since Chair 2 was more complex and there was a need for more explanation by the user.

3) Gesture Type.

The results for gesture types show that in Chair 1, the iconic gestures were close to 50% in both sample groups. In Chair 2, the iconic gestures diminish and metaphoric gestures increase for the Latin American sample group. Again, this may be related to the complexity of the chairs.

V. DISCUSSION

Now we may relate the gesture metrics to the cultural attributions made by both Hofstede and Hall (Section 2.2). As Anglo-Celtics are low context cultures, they used more words and gestures in longer time, since they took time to explain the chair in detail. On the other hand, Latin Americans, which represent the high context culture, performed fewer gestures, in shorter time and used fewer words. The element that calls for attention is the higher use of metaphoric gestures, as this is a characteristic of a society that relies on reading between the lines and letting nonverbal cues explain the meaning.

Continuing with the culture analysis, we will now state the relation of the gesture performance with Hofstede's cultural dimensions. The connection between these dimension (experiment, cultural aspects, participants, results) are displayed in Table 3. As mentioned before, the traits that are mostly reflected are IDV, UAI, and MAS.

- IDV. This trait could be related in fact that the SD between samples is higher with the Anglo-Celtic cultures reflecting the societies high individualism index (IDV, 82). On the other hand, the low SD with the Latin Americans shows the low individualism index (IDV, 20).
- UAI. This trait could be reflected in the overall impression of Chair 2. The Anglo-Celtic sample did not vary too much in gesture means and time from one chair to another, showing greater comfort with adverse situations (UAI, 43). It is possible to say that Latin Americans showed their high uncertainty avoidance (UAI, 86) since they use less time and limited gestures, possibly sticking to "what they knew" instead of managing the abstract.
- MAS. This trait could be related to the fact that the Anglo-Celtics as a low context culture are more assertive (MAS, 63), in comparison to the Latin Americans that are more human-oriented and therefore there is a higher use of metaphors (MAS, 47) in their descriptions.

The Latin Americans in this sample have more of an advantage with the language as they have been immersed in the culture and language for the past 6 months. Regardless,

TABLE 3. INTEGRATION OF EXPERIMENT AND CULTURE

Sample	**Metrics**			
	Context	***Predominant culture trait***	***Metric Evidence***	***Predominant Gesture Type***
Anglo-Celtic	Low context (assertive, rely con words)	Individualism Masculinity	High SD Constant gestures beween chairs More gestures and more time	Iconic
Latin American	High context (rely heavily on non verbal communication)	High Uncertainty Avoidance Collectivism	Low SD Fewer Gestures in the second Chair Fewer gestures in less time	Metaphoric Repetition

they still performed fewer gestures and chose different words.

VI. CONCLUSION AND FUTURE WORKS

A. How these affect multimodal interfaces?

We started this paper in order to prove if multimodal interfaces could be affected by a user's culture. After the literature review, we have seen that any interaction is a result of user, task and input. Apart from performance or stability issues, multimodal interfaces are subject to a context problem. In the international scene, depending on where participants are from, their style of communication will vary. This analysis arrived to the conclusion that as the complexity of a task increases, so does the use and type of gestures. The metrics stated in the hypothesis influence multimodal interfaces and their performance in the following ways:

- Frequency may affect the recognition rate because of the need for faster, more efficient algorithms.
- Occurrence also affects interaction due to the possibility of absence (zero occurrences) of certain gestures that may convey functionality (i.e. iconic).
- Gesture type, as well as occurrence, also affects the goal that the user wishes to attain. Identifying and classifying certain gestures due to their use during trials would permit the identification of type tendencies and will help embed differences in the development of the gesture recognition tool.

Due to the "freedom" that hand gestures provide, gesture based interfaces gain popularity. The aim of HCI is to have users strongly prefer to adopt the new technologies for interaction because of the usability opportunities they provide. Culture influences a user's openness and a more conservative or traditional culture, like the Latin American, could take more time to adapt, this was visible with the frequency rate difference between the academic and abstract chair. The performance of a multimodal interface will not only be affected by the task being performed, but by the cultural background and language skills of the user. Therefore, the design of gesture-based interfaces not only requires a multidisciplinary approach, but also a culturally sensitive one.

We acknowledge that future studies need a larger sample size. Similarly, future studies may also work on the consistency of the annotations by having more than one person in charge of coding the gestures. Also, the results could have significant variations if the experiment is carried out in Spanish, the native language of the second sample. Further research studies can also attempt to investigate the effects of gender on performance.

ACKNOWLEDGMENT

This research is supported by the Australian Research Council Discovery grant DP0988088 to Kavakli, titled "A Gesture-Based Interface for Designing in Virtual Reality". Also, the experiment on which this project was based is inspired by Jing Liu's previous work "Temporal Relation between speech and co-verbal iconic gestures in multimodal interface design". Authors are grateful to her for her support in sharing data.

REFERENCES

[1] Wachs, P., Kölsch, M., Stern H., Edan Y. (2011) Vision-Based Hand-Gesture Applications. Communications of the ACM. vol. 54. no. 2., pp. 60-71 DOI:10.1145/1897816.1897838

[2] Kita, S. (ed.) (2003). Pointing and Placing. Pointing: Where Language, Culture and Cognition Meet. Retrieved April 2012 from http://www-psych.stanford.edu/~herb/2000s/Clark.Pointing.placing.03.pdf

[3] Bavelas J., Gerwing J., Sutton Ch., and Prevost D. (2008) Gesturing on the telephone: Independent effects of dialogue and visibility Journal of Memory and Language Volume: 58, Issue: 2, pp. 495-520 ISSN: 0749596X DOI: 10.1016/j.jml.2007.02.004

[4] Visser, W., and Maher, M.L. (2011).The Role of gesture in designing. Artificial Intelligence for Engineering Design, Analysis and Manufacturing Vol 25, pp. 213-220. Cambridge University Press DOI: 10.1017/S08900604/11

[5] Gullberg, M., (2010) Methodological reflections on gesture analysis in second language acquisition and bilingualism research. Second Language Research 26,1 ; pp. 75–102. DOI: 10.1177/0267658309337639

[6] Karray, F., Alemzadeh, M., Saleh, J., and Arab, N. (2008) Human-Computer Interaction: Overview on State of the Art. International journal on smart sensing and intelligent systems, 1,1 Retrieved April 2012 from http://www.s2is.org/Issues/v1/n1/papers/paper9.pdf

[7] Lanfranco, A., Castellanos, A., Desai, J., Meyers, W. (2004) Robotic Surgery. A Current Perspective Ann Surg. 2004 January; 239(1): pp. 14–21. DOI: 10.1097/01.sla.0000103020.19595.7d

[8] Purdue University (2011, February 3). Future surgeons may use robotic nurse, 'gesture recognition'. ScienceDaily. Retrieved April 2012, from http://www.sciencedaily.com-/releases/2011/02/110203152548.htm

[9] Van den Hoven, E., and Mazealek, A. (2010). Grasping Gestures: Gesturing with physical artifacts. Artificial Intelligence for Engineering Design, Analysis and Manufacturing, 25, pp. 255-271. DOI: 10.1017/S0890060411000072

[10] Kim, M.J., and Maher, M.L. (2008). The impact of tangible user interfaces on spatial cognition during collaborative design. Design Studies 29(3), pp. 222–253 DOI: 10.1016/j.bbr.2011.03.031

[11] Berry, M. (2009) The Importance of Bodily Gesture Example 1. McNeill's classification of gesture types Retrieved April 2012 from http://www.mtosmt.org/issues/mto.09.15.5/berry_ex1.html

[12] Hofstede, G. H., Hofstede G. J. ,and Minkov, M. (2010) Cultures and organizations: software of the mind : intercultural cooperation and its importance for survival. (3rd ed) McGraw-Hill Professional ISBN 0071664181, 9780071664189

[13] Murphie, A. , and Potts, J. (2003) Culture and Technology. N.Y: Palgrave Mcmillan

[14] Hall, S. (2007) Review: Representation: Cultural Representations and Signifying Practices (Culture, Media and Identities Series) London, SAGE Publications Limited

[15] Aaron Marcus and Associates, Inc (2010) Cross-Cultural User-Interface Design for Work, Home, and On the Way: Accounting for

Cultural Preferences, Acceptance, and Constraints. ACM SIGGRAPH ASIA 2010 Courses. DOI 10.1145/1900520.1900525

[16] Rehm, M., Bee, N., and André, E. (2008) Wave like an Egyptian — Acceleration based gesture recognition for culture-specific interactions. In Proceedings of HCI 2008 Culture, Creativity, Interaction, pp. 13–22, 2008.

[17] Yammiyavar, P., Clemmensen, T., and Kumar, J. (2008). Influence of cultural background on non-verbal communication in a usability testing situation. International Journal of Design, 2(2), 31-40. Retrieved April 2012 from http://www.ijdesign.org/ojs/index.php/IJDesign/article/view/313/164

[18] Hofstede, G. (2011) Dimensions of national Cultures Retrieved April 2012 from http://www.geerthofstede.nl/culture/dimensions-of-national-cultures.aspx

[19] Hall, E.T. (1976) Beyond Culture. Anchor Books

[20] Changing Minds (2011) Hall's cultural factors. Retrieved April 2012 from http://changingminds.org/explanations/culture/hall_culture.htm

[21] Liu J., and Kavakli, M. (2011) Temporal Relation between speech and co-verbal iconic gestures in multimodal interface design. Retrieved April 2012 from http://coral2.spectrum.uni-bielefeld.de/gespin2011/final/Liu.pdf

[22] Pause (2011) In Oxford Dictionaries. Retrieved April 2012 from http://oxforddictionaries.com/definition/pause

 ISBN: 978-1-61208-195-3