Guidelines to Develop Emotional Awareness Devices from a Cultural-Perspective: A Latin American Example

Cesar A. Collazos[1,2], María Paula González[1,3], Andrés Neyem[4], and Christian Sturm[5]

[1] Group GRIHO – University of Lleida – Jaume II 69, 25001 – Lleida, Spain
mpg@diei.udl.es, mpg@cs.uns.edu.ar
[2] Department of Systems, Universidad del Cauca – FIET-Sector Tulcan, Popayán, Colombia
ccollazo@unicauca.edu.co
[3] VyGLab Laboratory – Computer Science Department – Universidad Nacional del Sur
Av. Alerm 1253, 8000- Bahia Blanca, Argentina
[4] Department of Computer Science, Universidad de Chile
Av. Blanco Encalada 2120 – Santiago, Chile
aneyem@dcc.uchile.cl
[5] Instituto de Electrónica y Computación - Universidad Tecnológica de la Mixteca
Huajuapan de León, 69000 - Oaxaca, México
csturm@mixteco.utm.mx

Abstract. Interpersonal communication involves more than just words; it involves emotional issues that can be roughly seen as complex organized internal states. Awareness of those states allows human beings to evaluate social information and develop strategic social intelligence. In this setting, developing emotional awareness devices can be successfully achieved under a Cultural Centred Design perspective, as social and cultural features are crucial to ensure an adequate level of emotional awareness. However, cultural-oriented recommendations are not always included to lead the promoting of an adequate emotional awareness in digital and physical devices. To cope with this problem, this paper presents a minimal set of cultural guidelines that should be taken into account to develop emotional awareness devices under Cultural Centred Design. To illustrate the proposal, the development of an extended virtual portrait is discussed by highlighting a cultural viewpoint form a Latin-American perspective.

1 Introduction

In the last decades, the importance of social and cultural aspects in the HCI field increased significantly. Applying Cultural Centred Design (CCD) [11], Ethnographic Observation [17], ethnographically-informed systems design [2] and localization methods that go beyond simple language translation shifted the focus from the individual human-computer interaction to contextual and social-cultural issues. This enhance the importance of systems supporting interpersonal interactions where nonverbal clues are closely connected to the emotional state of a person (like body

language and gestures). However, part of these non-verbal information seem to be missing when communication is mediated by technology. While the new developments in information technology lead to new ways of interpersonal computer-mediated communication, facilitating international and intercultural communication, the human basics of how trust and sociability is developed haven't changed [5].

In the above scenario, alternative ways have been proposed ranging from basic features such as the "emoticons" up to more sophisticated tools such as specialized emotional awareness devices based on Phidgets [9]. Note that in general the communication of emotional states has to be brought from an unconscious to a conscious level for both the sender and the receiver of the message, leading to evolve a common ground of emotional context in which the message can be interpreted correctly. Consequently, the support of emotional awareness is identified as one central issue that need to be developed further within the field of interpersonal computer-mediated communication [13, 16]. To address this problem, this paper discuss a minimal set of cultural guidelines that should be taken into account to develop emotional awareness devices under CCD. Taking as stared point the building of an emotional awareness device called *Emoti-Picture Frame*, the existing guidelines of User-Centered Design (UCD) associated with the production of social-oriented interactive systems are extended to include emotional awareness as a core function.

This paper is structured as follows. First, Section 2 discussed the most relevant characteristics of emotional awareness devices. Next, Section 3 describes the proposed guidelines. Section 4 presents the device *Emoti-Picture Frame* as an example wich illustrated the use of the settled guidelines within a Latinoamerican context. Finally, Section 5 concludes and depicts some further work.

2   Emotional Awareness Devices

Human emotions are valuable sources of information wich help us make decisions and communicate with others [4]. They play a major role in human interaction [4]. In particular, facial expressions can convey a wide range of emotions (as hapinness, nervousness or fear). Therefore, recently many areas of HCI research have been converging on the important implications of emotions and emotional awareness in software development, where emotional awareness is measured in terms of levels of awareness. As a consequence, novel types of software-based devices are emerging, including physical user interfaces augmented by computing power [9]. These new gadgets are called emotional awareness devices (EADs).

EADs enables new types of communication (e.g. tangible interfaces) and novel ways of emotional interactions, as the one-bit communication artefact described on [19]. Further on, existing products are often enriched by adding new communication functions to promote emotional awareness. Researchers have also addressed the "glancing" metaphor with the exploration of MediaSpaces, Portals, and awareness devices [6]. Various physical interfaces have enabled remote individuals to arm

wrestle,[1] blow kisses,[2] exchange simple touching [3], and send gestures [7]. Similarly, there has been a tremendous amount of sociological studies of mobile phone usage.

In this setting, and according with UCD and CCD, cultural-based issues and restrictions comming from the final user's context of use should be strongly taken into account during all the development process of EADs. However, even some researches have investigated how to represent emotional characteristics using colors [16], most EADs are designed without considering the cultural characteristics of the people who use them as crucial requirements to achieve. In our opinion, a set of multicultural elements as those proposed in the next section needed to be more strongly considered for achieving an appropriate level of emotional awareness in a final EAD product.

3   Cultural-Based Guidelines for Emotional Awareness Devices Development Our Proposal

In this section a set of guidelines to better support a cultural-based development of EADs devices are presented. The proposal is based on the premise that final user's emotions are strongly related to their cultural context. Even we are aware of the great amount of discussions dealing with inborn universals and cultural induced characteristics of man, these issues are not addressed here. A review of cross-cultural differences in emotions can be found in [1]. The definition of culture proposed by [8] (culture is "a system of meanings", a direct connection between both cultural context and emotions can be drawn) is assumed as a theoretical underlying framework. Also the four-factor theory described by [12] are taken into account. In fact, while [12] defines the appraisal of external stimuli or situations as a starting point for an emotional experience (where facial expressions, action tendencies and body reactions are involved), [8] pointed out that stimulus can be seen as a central aspects of culture.

Based on [8] and [12], the author of [18] defined four levels that need to be taken into account when developing and adapting systems for different user groups: *technology*, *language*, *culture* and *cognition*. The first level deals with all the technical aspects of a system and is shaped by norms and given characteristics (e.g. the power supply). The second level deals with the translation of the words used in the user interface. The cultural level includes basically the context in which the technical system will be used and which assigns a meaning to it as well as meanings of user interface elements (such as icons, colours, music and metaphors). The fourth level describes the concrete human-interaction and the cognitive processes involved. According to this approach, the model described in this paper is related to both the cultural and the cognitive level because user interface elements as well as the overall cultural context are addressed.

---

[1] See Telephonic Arm Wrestling Report (1986) at http://www.bmts.com/~normill/artpage.html
[2] See more information at http://www.we-make-money-not-art.com/archives/007274.php

Putting into practice all the above ideas while developing EADs is neither a clear nor easily achieved task. Consequently, our goal is to propose a set of cultural-oriented guidelines which should be taken into account to ensure an appropriate emotional awareness level in a final EAD product. In what follows we will assume the existence of a current EAD E that is being constructed for the context of use C by means of a prototyping-based development process under a CCD perspective. This development process involves a number of intermediate stages that are performed cyclically on the basis of active user participation.[3]

First, according to CCD participants belonging to the context of use C should be included in the development team of E. This way, cultural behavior of end-user can be perceived more clearly when analyzing controversial information (e.g. when processing unclear information comming from ethnographic studies, or when taking design decisions influenced by cultural issues). Respecting to the Requirement Analysis Stage, a cultural-based elicitation procedure is recommended in order to achieve a satisfactory set of minimal requisites for E. End-user studies guided by Ethnography or other similar methodology should highlight the next issues when analyzing the context of use C under consideration:

− significance of colors and their relation with emotions [16]
− cultural premises associated with the use of technology and gender [14]
− grade of face expressiveness and spontaneity to transmit emotions [20]
− significance of emotional feedback and expected frequency [10]
− basic rules in C for relationships [15]

When performing the Design Stage for E, Participatory Design [17] is highly recommended. Besides, the development team needs to be focused on the elements which enhance final user's communication, since emotional awareness is directly related with messages transmission. Cultural variables of C related to communication as style, grade of contextualization and implicit communication rules in C (individualism, competitiveness, etc) should be reflected in the design of E. With respect to the Implementation Stage, it is desirable to make the functionality core of E independent from cultural-based features and to follow a localization procedure to promote the scalability of E. Finally, when considering the Evaluation Stage, adopting a cross-cultural usability viewpoint will ensure an appropriate evaluation of E.

4   The Emoti-Picture Frame: A Latinoamerican Example

This section describes the application of the cultural guidelines proposed on Section 3 when developing an EAD portrait called "Emoti-Picture Frame" (EPF).

---

[3] We are aware that in actual software development projects some parts of the above stages might overlap, as system lifecycle is not always characterized in a uniform and linear manner within the existing models in HCI.

4.1   Brief Description of the "Emoti-Picture Frame"

The EPF is an emotional awareness device constructed for the Latinoamerican context of use. It allows anyone with Internet access to transmit their feelings by displaying them on a TUI or a GUI interface (see Figure 1, left). By means of this kind of device, a user can send (sending-user) and receive (receiving-user) emotional awareness. The EPF interface is composed by two main parts (Figure 1, left): a picture area storing a picture of the sending-user, and a feeling area which allows the perception of the sending-user current emotional state. The feeling area is composed by different features as colored emotional buttons, a Heart-Emotional Indicator and a set of history-emotional buttons.
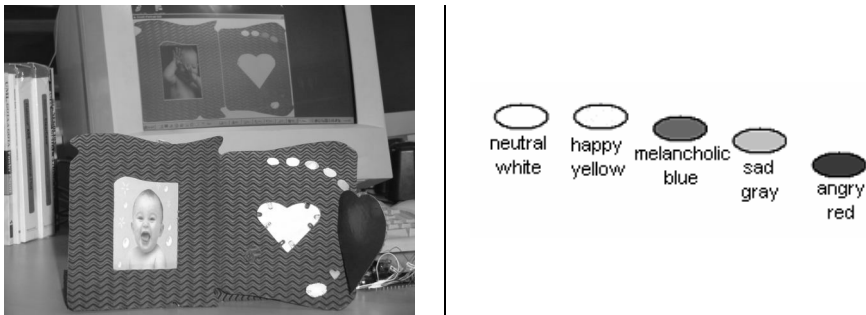

Fig. 1. Physical prototype of the Emoti-Picture Frame Device. Left: TUI and GUI versions. Right: colors associated with emotions.

Table 1. The emotional that users can communicate

Emotion			Emotional Buttons Pressed	Touch the picture
I am thinking about you			None	Yes
I am neuter			white color	No
I am happy			yellow color	No
I am melancholic			blue color	No
I am sad			gray color	No
I am angry			red color	No
I am neuter with you			white color	Yes
I am angry with you			red color	Yes
	happy	Because	yellow color	Yes
I am	melancholic	I am thinking	blue color	Yes
	sad	about	gray color	Yes

As shown in Figure 1 (right), each emotional button is linked to some emotional state of the sending-user: white color represents a neutral emotional state, yellow color represents a happy emotional state, blue color represents a melancholic emotional state, gray color represents a sad emotional state, and red color represents an

angry emotional state. Moreover, each possible emotional state is intended to transmit a particular user feeling according to the correspondence summarized in Table 1.

When a sending-user wants to transmit a particular emotional state form the available range in Figure 1 (right), he/she has to press the correspondent emotional button in order to set a particular value in the EPF interface of the receiving-user. Then, this setting is captured by the EPF system which stored it in an historical database in order to allow the receiving-user to replay it later on by pressing the heart-like shape button in the set of history-emotional buttons. Indeed, pressing the heart-like shape button lead to the automatically painting of the Heart-Emotional Indicator with the color corresponding to the last emotional state sent by the sending-user. Besides, any time a novel emotional state arrives to the EPF interface of the receiving-user, some leds located around the Heart-Emotional Indicator blink, indicating that a new emotion sent by the sending-user has been received.

The EPF device also provides mechanism to send a special message to indicate the receiving-user that the sending-user is currently remembering him/her. To perform this action, the sending-user has to touch the picture of the receiving-user currently stored in the emotional picture zone of his/her EPF interface. When this action is carried out, some green leds blink on the Heart-Emotional Indicator of the receiving-user device. To stop this blinking the receiving-user has to touch the surface of the Heart-Emotional Indicator. Additionally, the receiving-user can block the reception of emotions by closing the portal of the Heart-Emotional Indicator. It must be stressed that this action is never informed to the sending-user, as the emotional state sending by him/her after the receiving-user blockage is received by the end EPF device and stored in the history database for a later optional recovery. If the receiving-user wants to erase the lasts recorded sending-user emotional states (which are stored in the historical database), he/she has to press the ellipse-like shape button in the historic-emotional buttons area.

4.2   Applying the Proposed Model to Develop the "Emoti-Picture Frame"

As suggested in the proposal of this paper, the EPF development team included people belonging to the context of use under consideration. In fact, the development team was formed by two Computer Engineers (both PhD students in HCI and Computer Supported Collaborative Work), and one specialist in HCI. One of the PhD students was Chilean, the other PhD student was Argentinean and the HCI specialist was Colombian. Besides, the development team was

Following the guidelines of Section 3, the Requirement Analysis for EPF was focused on understanding portrait manipulation in the Latinoamerican context of use. Indeed, a questionnaire including the items shown in Table 2 was performed in two different Latinoamerican scenarios (Chilean and Colombian scenarios) with the participation of a group of 15 Latoniamerican people. The analysis of the answers in Table 2 and the personal experiences of the EPF development team suggested that photos are an important part of many people's life in Latinoamerica, as they are symbols of a personal bond and provide a constant reminder of the feelings and emotions associated to that particular time frame or circumstance. However, this type of casual but personal communication can be very difficult at a distance, because it imposes restrictions on physical access to the personal space and artifacts of others.

Table 2. Questionnaire for the Requirement Analisys of the Emoti-Picture Frame

Question	Answer (Portrait)
When is a portrait used?	When I want to see a picture. / When I want to show a picture to other people. /When I want to remember "loved beings" or "unforgettable moments".
When do you need to put attention on the portrait?	Only when I want to see the picture.
How do you handle a portrait?	Putting the photograph in the portrait. / Locating the portrait on a visible place facing towards me.
How do you know it is working well?	Putting the photograph in the portrait. /Locating the portrait on a visible place facing towards me.
How do you know it is working well?	Because the photograph fits to the portrait and I can see the picture
What is the direct consequence of using a portrait?	It remains in the last place I put it on. /It shows the last picture placed there.
What do you do with a portrait?	Hold the portrait. /Put pictures on it
Who can use the portrait?	Anyone who faces the portrait or can grab it when it is on a visible place.
What is the cost of a portrait?	The economical cost is cheap. / The time spend in setting up is short.
Can you notice it was used?	Yes, when the picture or location has changed.
What is the user intention when have a portrait?	Providing a constant reminder of the feelings and emotions associated with this person or moment.
What do you do with a portrait?	Watch the picture hold by the portrait. Get close to the picture and grab it
How do you know if a portrait was used?	When the picture or location has changed. When my emotions distort the picture.
What is the relevance with a portrait?	Emotional. It maintains bonds with people, animals, places, etc.
What kind of value has a portrait for me?	Emotional, personal.
Who can use the portrait?	Close people (friends and family).
Who can watch you when you are using a portrait?	Sometimes it should be private, sometimes it could be public.
How many times you need to put attention on the portrait?	When I am thinking about someone. / When I am melancholic because I am distanced of people pictured on the portrait. / When I am happy and I need to bond with someone. / When I need emotional support.

The analysis of the answers in Table 2 and the personal experiences of the EPF development team were compiled in the information shown in Table 2. This analysis suggested that photos are an important part of many people's life in Latinoamerica as relevant symbols of personal bond, providing a constant reminder of the feelings and emotions associated to that particular time frame or circumstance. However, this type of casual but personal communication can be very difficult at a distance, because it

imposes restrictions on physical access to the personal space and artifacts of others. In addition, the development team also studied different media and devices for remote affective communication. On the basis of these activities, the EPF development team decided to create a physical augmented portrait keeping some Latinoamerican cultural features. In consequence, and to cope with the proposal of this paper, during the Design Stage of EPF the development team focused on elements which enhance final Latinoamerican user's communication, such as:

− Represent emotional state of only one person per portrait using the guidelines depicted in Table 1
− Communicate the feelings and emotions of the sender-user depicting his/her photo in the portrait in order to reinforce the information received by the receiving-user
− Communicate several tokens of affection in a semi-transparent way
− Provide an interpersonal communication though an emotional awareness device.

Then, a first physical prototype of EPF was constructed, as one shown in Figure 1. Following the suggestions of Section 3, the technical core of the EPF was completely independized from the more high-level code corresponding the implementation of the information in Table 1. This way, the localization for the EPF for the Latinoamerican context was encapsulated in the interface level, thus promoting a simple future adecuating of EPF to others contexts of use.

Finally, the Evaluation Stage of EPF was carried out by applying the recommendations given in Section 3. The evaluation team was stated with the participation of the three EPF developers plus three teams of final-user comming from the Latinoamerican context. Whith the active participation of the six final user, the evaluation team pursed three case studies in order to cope with the usability evaluation of EPF stressing cultural associated issues: Case 1: Mother (GUI) and son (GUI and TUI), Case 2: Brother (GUI and TUI) and sister (GUI), Case 3: Boyfriends (GUI and TUI). The first two cases involved people living in distant cities which do not visit eachother frequently. In these cases the EPF was tested in the final users' homes during free time. The third case involucred a couple of boyfriends who were separated for work reason. In this case the EPF was tested at the final users' workplace during working time. More relevant results of the performed evaluation highlighted:

− No problems were detected associated with the chosen values for the cultural-biased elements of the EPF interface (those based on the information shown in Table 1). All users reported that the EPF system presented a useful and enjoyable way of transmitting emotions. They described EPF as a simple physical device that remains common everyday object often associated to emotional attachment such as a portrait. Users emphasized the EPF functionality which allows them to control which pictures are the appropriate to convey a particular emotion.
− Users declared that in their opinion, EPF stimulated other types of communication among people (as phone calls or e-mails interchange) due to the strengthening of people bonds through the increase of affective communication In addition, users reported that the increase in these communications does not affected the normal flow of their working day or free time.
− At the beginning, the EPF was perceived as a disrupting element for the activities in the workplace, since a lot of attention was given to the emotional interaction.

Later on, the EPF was assimilated and incorporated in a natural way. This evaluation result provided evidence of a usability problem. Therefore, it will be necessary to improve EPF GUI in order to make it less intrusive (for instance, instead of being a physical window, next version of EPF prototype could be embedded as a notification icon in the operative system task bar). Similarly, the TUI interface could be replaced by a touch screen, flattening the device so that it can resemble more closely to a regular portrait.

− Several problems were presented regarding the configuration and synchronization of the remote connection within the physical device EPF. As the evaluation of EPF was carried out in the real final users' environment (in opposition to a controlled laboratory circumstances) no conclusion about accessibility problems related to EPF could be established. However, the evaluation demonstrated that in a naturalistic environment everyday restrictions and heterogeneity make difficult to set up the device. Consequently, a transparent way for configuring EPF needed to be developed for next prototype version.

In addition to the case studies described above, the EPF evaluation team also experiented the use of alternative media and devices for remote affective communication as part of the EPF usability evaluation. Even some EPF features needed to be improved, note that the Evaluation Stage of the current EPF version concluded satisfactorily.

5   Conclusions and Further Work

As communication technologies increase their presence in the whole World, cultural issues and CCD are becoming important in HCI. Many cultural-biased features should be considered when developing interactive systems. Thus, taking into account these features during the whole system development process persist as a crucial challenge to achieve. Understanding how cultures vary and how to address this diversity within the design of the interface is becoming critical to ensure the quality of any final product, in particular EADs. However, few cultural-based guidelines or recommendations were founded related to the development of EADs.

To cope with the above problem this paper presents a set of cultural-based recommendations (guidelines) related to [18]. These guidelines can be used during the EDAs development processes in order to ensure EDAs quality related to culture. To illustrate de proposal, the development of a physical EDA prototype called "Emoti-Picture Frame" (EPF) for the particular cultural context of Latinoamerica is discussed. Future work includes the use of the proposed guidelines to conduct the development of the next EPF version with the inclusion of people comming from different cultural environments. More evidence is required to assure the impact of the proposed guidelines in EADs development. Work in this direction is being pursued.

References

1. Altarriba, J., Basnight, D.M., Canary, T.M.: Emotion representation and perception across cultures. In: Lonner, W.J., Dinnel, D.L., Hayes, S.A., Sattler, D.N. (eds.) Center for Cross-Cultural Research, Western Washington University, USA (2003)
2. Bentley, R., et al.: Ethnographically-informed systems design for air-traffic control. In: Proc. of the Fourth ACM CSCW '92, pp. 123–129. ACM Press, New York (1992)
3. Brave, S., Dahley, A.: InTouch. In: Proc SIGCHI Conference, ACM Press, New York (1997)
4. Buck, R.: The communication of emotion. Guilford Press (1984)
5. De Souza, C.S., Preece, J.: A framework for analyzing and understanding online communities. In: Interacting with Computers, The Interdisciplinary Journal of HCI (2004)
6. Dourish, P., Adler, A., Bellotti, V., Henderson, A.: Your place or mine? In: Proc. of the ACM CSCW'96, ACM Press, New York (1996)
7. Fogg, B., Cutler, L.D., Arnold, P., Eisbach, C.: HandJive: a device for interper-sonal haptic entertainment. In: Proc. of ACM SIGCHI'98 Conference, ACM Press, New York (1998)
8. Geertz, C.: The Interpretation of Cultures. Basic Books ed. New York, USA (1975)
9. Greenberg, S., Fitchett, C.: Phidgets: Easy development of physical interfaces through physical widgets. In: Proc. of the ACM UIST'01 Conference, ACM Press, New York (2001)
10. Gelfand, M.: The Handbook of Negotiation and Culture. Stanford Univ. Press (2004)
11. Marcus, A., West Gould, E.: Crosscurrent. ACM Interactions, nro. 7 4, 32–46 (2000)
12. Parkinson, B.: Emotion. In: Colman, A.M. (ed.) Companion encyclopedia of psy-chology, vol. 2, Routledge Press, UK (1994)
13. Picard, R.W.: Affective Computing. MIT Press, Cambridge, MA (2000)
14. Primo, N.: Gender Issues in the Information Society. UNESCO WSIS Pub. Series (2003)
15. Saarni, C.: The Development of Emotional Competence. Guilford Press (1999)
16. Scheirer, J., Picard, R.: Affective Objects. In: MIT Media Lab Report N 524 (2000)
17. Schneiderman, B., Plainsant, C.: Designing the user interface: Strategies for effec-tive human-computer interaction. Addison-Wesley, Reading (2004)
18. Sturm, C.: TLCC Towards a framework for systematic and successful product internationalization. In: Proc. of IWIPS'02. Product & Systems Internationalisation, Inc (2002)
19. Tollmar, K., Junestrand, S., Torgny, O.: Virtually living together. In: Proc. of the Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques, pp. 83–91. ACM Press, New York (2000)
20. Weiten, W.: Psychology: Themes and Variations. Thomson Wadsworth 6th edn (2005)