HCI and the Face

Michael J. Lyons
ATR Intelligent Robotics and
Communication Labs
2-2-2 Hikaridai, Seika-cho
Soraku-gun, Kyoto 619-0288
Japan
mlyons@atr.jp

Christoph Bartneck
TU/e
Department of Industrial Design
Den Dolech 2, 5600 MB Eindhoven
The Netherlands
christoph@bartneck.de

CHI 2006, April 22–27, 2006, Montreal, Canada.
ACM 1-xxxxxxxxxxxxxxxxx.

Abstract
The workshop aims at a general assessment of facial information processing in HCI. We will discuss why certain areas of face-based HCI, such as facial expression recognition and robotic facial display, have lagged others, such as eye gaze tracking, facial identity recognition, and conversational characters. Our goal is to collectively identify research strategies to bring the more slowly developing areas up to speed.

Keywords
Face, recognition, eye gaze, emotion, expression

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): H.5.2 User Interfaces

Introduction and Motivation
The human face plays an important role in many aspects of verbal and non-verbal communication. The face is involved in speech, the facial expression of emotions, gestures such as nods, winks, and other human communicative acts. Major subfields of neuroscience, cognitive science, and psychology are devoted to study of the information conveyed by the human face. Increasingly, computer scientists and engineers have worked on the face from the viewpoints of graphics, animation, computer vision, and pattern recognition. By contrast, in the past, relatively few

works on human-computer interaction have concerned the human face. This is more likely to reflect technical limitations to the development of practical applications rather than any intrinsic lack of relevance to HCI. Many problems in HCI involve aspects of human identity, affect, and tacit communication, which are all informed by information conveyed by the face. In fact, human-computer interaction is one of the most commonly stated application domains for works reporting basic research into facial information processing.

Eye gaze has occupied the greatest share of the attention of HCI researchers [10]. Eye gaze tracking technology has become sufficiently advanced that several companies offer complete, working systems which are usable even without special technical expertise. Gaze tracking has become a widely used technique in studies of interface usability, machine-mediated human communication, as well as alternative input devices for disabled users. This area can therefore be viewed as a successful, mature sub-field related to face-based HCI.

Research on face classification [6], mostly by the pattern recognition community, is perhaps the only other case of a relatively mature sub-field of facial information processing, with several companies offering access control and security systems to end users.

Compared to the state of the art in screen-based characters, such as Embodied Conversational Agents [3], the field of robot's facial expressions is underdeveloped. Much attention has been paid to robots' motor skills, such as walking and gesturing, but little work has been done on their facial expression. Advanced humanoid robots such as the Honda Asimo or the Sony Quiro have barely any facial features at all. The Phillips iCat and the most realistic android developed to date, Ishiguro's Repliee Q1Expo, represent substantial progress in this respect, but even the Repliee Q1Expo is only able to convince humans of the naturalness of its expressions for at best a few seconds. In summary, natural robotic expressions remain in their infancy [5].

Some fundamental theoretical aspects of facial information processing relevant to HCI applications remain unresolved. The representation of the space of emotional expressions is a prime example [9]. The space of expressions is often modeled either with continuous dimensions, such as valence and arousal [8] or with a categorical approach [4]. This controversial issue has broad implications for all HCI applications involving facial expression [9]. The same can be said for other fundamental aspects of facial information processing, such as the believability of synthetic facial expressions by characters and robots [1].

In this workshop we would like to examine the status of these and other aspects of facial information input and output within the context of HCI. Why have several areas of research, such as facial expression processing, fallen short of usable, practical applications? Are there technical barriers or does the general approach need revision? What is the potential of areas of the face, other than the eyes, for gestural input? What can be learned from ongoing research in pattern recognition, computer graphics, and robotics to aid the progress of face-based HCI?

Topics for the Workshop

The workshop will explore a broad range of topics related to facial information processing and its relevance to HCI. Below we list some of the topics of potential interest.

Facial Output

- Innovative methods for controlling physical models of the face, especially robotic faces.
- Measurement tools for the quality and appropriateness of synthetic facial expressions, gestures, or the visual component of speech in HCI and in social robotics
- Conceptualizations of the expression output space.

Facial Input

- What information in the user's face is actually useful in HCI?
- Is emotion recognition a realistic HCI application of face processing? What are the success stories in this research paradigm?
- Role of context in facial expression processing.
- Use of EMG, GSR and other affective signals in combination with facial input.
- What factors contribute to the success of gaze tracking and face identification technology? Can these factors help to develop other face-based HCI technology?

Theory and Research Paradigms

- How is facial information best measured, represented, stored, and accessed?
- What influence do categorical and dimensional views of affect and expression have upon HCI applications?
- How can the importance of contextual information be assessed?
- Are partial solutions to difficult face processing problems a more realistic and useful goal for HCI?

Application areas

- What special requirements do HCI applications have for facial recognition?
- What privacy and ethical issues must be considered by designers of face-processing applications?
- How can the face be used to build trust amongst users and between users and companies?
- How can face-based technology improve the quality of life for disabled and elderly users?
- How can this area contribute to the emerging fields of entertainment computing and gaming?
- What are the successful applications to date? What are possible breakthrough areas?

Further Research, Dissemination, Education

- How can we encourage further work and progress in this area?
- What funding sources are available to fund research in this area?
- What are appropriate venues for presentation and publication of research in this area?

Goals of the Workshop

Our main purpose in organizing this workshop is to take stock of the current situation with regards to HCI and

human face, by bringing together researchers on several aspects of face processing, who are interested in human-computer interaction, with HCI experts who are interested in the human face and to stimulate exchange with following aims:

1. To review current and recent works in human-computer interaction, as well as important works in the past, which have involved the use of techniques for analysis and display of information in the human face.

2. To summarize the state of the art with regards to currently used techniques, and to identify significant outstanding issues or limitations of these which are relevant to HCI applications.

3. To list domains of HCI which are widely recognized as being application domains of face processing technology and to identify novel potential applications.

4. To pool the collective experience of the workshop participants to develop a strategy to move this field ahead. To plan public presentation of the shared knowledge and wisdom in the form of a special journal issue, co-authored book, and/or future meetings.

Format and organization

The workshop will consist of a day long highly interactive format encouraging small group dialogue and knowledge transfer. The overall goal is to elicit research issues and findings related to the design and implementation of HCI applications involving facial information processing as well as fundamental research which will further progress of this important field.

Industrial partnerships

Tobii Technology and SR Labs, two leading companies developing face related technology, are convinced of this workshop's relevance to the industry and therefore have agreed to sponsor the event. Their interest demonstrates the need for bridging the gap between academic research and its application.

References

[1] Bartneck, C. (2001). How convincing is Mr. Data's smile: Affective expressions of machines. *User Modeling and User-Adapted Interaction*, 11, 279-295.

[2] Bartneck, C., & Suzuki, N. (Eds.) (2004). *Subtle expressivity for characters and robots* (2 ed. Vol. 62). Amsterdam: Elsevier.

[3] Cassell, J., Sullivan, J., Prevost, S., & Churchill, E. (1999). *Embodied Conversational Agents*. Cambridge, MA: MIT Press.

[4] Ekman, P., Friesen, W. V. (1975). *Unmasking the Face*. Englewood Cliffs: Prentice Hall.

[5] Fong, T., Nourbakhsh, I., & Dautenhahn, K. (2003). A survey of socially interactive robots. *Robotics and Autonomous Systems*, 42, 143-166.

[6] Lyons, M.J., Budynek, J., & Akamatsu, S. (1999). *Automatic Classification of Single Facial Images*. IEEE PAMI, 21, 1357-1362.

[7] Lyons, M.J. (2004) *Facial Gesture Interfaces for Expression and Communication*. IEEE International Conference on Systems, Man, and Cybernetics, v.1, 598-603.

[8] Russell, J. A. (2003). Core Affect and the Psychological Construction of Emotion. *Psychological Review*, 110, 145-172.

[9] Schiano, D. J., Ehrlich, S. M., & Sheridan, K. (2004). *Categorical Imperative NOT: facial affect is perceived continuously*. CHI'2004, 49 – 56.

[10] Zhai, S., Morimoto, C., & Ihde, S. Manual And Gaze *Input Cascaded (MAGIC) Pointing*, CHI'99, 246-253