Physiological Computing

Jennifer Allanson

Department of Computer Science
Lancaster University
Lancaster
LA1 4YR
allanson@comp.lancs.ac.uk

Gillian M. Wilson

Department of Computer Science
University College London
Gower Street, London
WC1E 6BT
g.wilson@cs.ucl.ac.uk

ABSTRACT
Applications involving the measurement of human physiological responses are becoming increasingly popular in Human Computer Interaction (HCI). This is partly due to the increased availability of low-cost, high-specification sensing technologies. Areas such as brain-computer interaction, evaluation and affective computing are all benefiting from the rich data source such sensing technologies make available. However, guidelines on the gathering and analysis of these measurements are virtually non-existent, which makes it difficult for new researchers to practise in this area. This timely workshop will bring together both practising and potential researchers using this methodto gather knowledge on the techniques, technologies and applications of physiological computing.

KEYWORDS: Physiological computing, HCI evaluation, affective computing, biofeedback, brain-computer interaction.

INTRODUCTION
Increasingly, interactive applications are taking advantage of advanced sensing capabilities in order to free users from the constraints imposed by physical machines. The field of ubiquitous computing is breaking the machine itself down and dispersing it into the fabric of the users' changing world, a world where work and leisure activities are no longer distinct.

Far from severing the ties between user and machine, the reduced physical presence of 'the computer' is actually forging a more intimate relationship between people and technology. One striking effect of this is the increasing exploration of specialized sensors for gathering personal user data. Of particular interest are those sensors that allow us access to detectable human physiology - data relating heart and respiration rate, the changing level of tension in a user's muscles, the level of excitation in the sweat glands as well as peripheral body temperature. We can even use these non-intrusive sensing technologies to listen to the gross electrical output of an individual's brain.

Work on direct brain-computer interaction (BCI), for example, is being carried out in dozens of labs across the globe. This work is carried out acoss a number of disciplines, but for a variety of reasons, has yet to be gathered together for scrutiny.

Related, in technological terms, is research into the field of intelligent, affective computers. Affective computing aims to enrich the human-machine relationship by creating machines that interpret and respond to a user in an emotionally intelligent manner. Physiological data gathered through specialized sensors provide important indications of arousal. When considered alongside other personal user information, (e.g. vocal intonation, facial expression) this data can be used to ascertain the changing emotional state of a user.

WORKSHOP GOALS
This workshop will bring together researchers and practitioners who are interested in the utility of physiology within the human-machine interface. The main goals of the workshop are:

1. To provide participants with an overview of the state of the art
2. To develop an understanding of how the availability of physiological will effect the future of HCI
3. To formulate a set of practical guidelines for the measuring and analysis of physiological data.

RESEARCH ISSUES
In order to achieve these goals, we need to gather researchers with knowledge and experience from a variety of fields of inquiry and applied use.

Physiological Sensing Technologies
The first area we need to establish an understanding of is that of the sensing technologies underlying physiologically-based HCI. Such technologies are commercially available and in order to encourage their uptake by the HCI community we need to demystify the technology – what is it, how does it work and what quality of information can researchers expect to receive from such technologies?

Development Support for Interactive Applications
Commerical physiological sensing devices are often developed with specific applications in mind. This means that software available with these devices is often closed to further development. Thus we need to consider the development of suitable tool support for those

wishing to develop applications which utilise physiological information.

Physiology as a Usability Metric
Detectable physiology has been used as a usability metric in the design of interactive systems since the mid 1980's. In order to make progress in this field, we need to establish from practitioners the utility of the information source, its reliability and experimental methodology issues.

Affective Computing
Affective computing is one of the emerging computing paradigms that has already found a role for physiology in the human-machine interface. What can the experiences of researchers in this area tell us about inferring emotional state from this data?

Bio-cybernetic or Biofeedback Systems
Biofeedback training, where users physiological state is presented back to them in real time to allow them to learn to exert conscious influences over their physiology, is an established field and is used in areas like stress reduction.

Healthcare Applications
From critical monitoring of physiology through a plethora of clinical biofeedback applications, the physiologically-enhanced computer is a workhorse within the medical field. The interactive concerns of these systems will be shared by those researchers exploring brain-computer interaction as well as those working in the area of affective computing.

These applications share the requirement to detect, process and suitably present human physiological information. Currently each field covers the same evolutionary development ground in order to make advances in its respective field. Thus, a gathering of together of this knowledge will assist our understanding of the relationship between physiologically-enhanced computer systems and users.

ORGANIZERS' BACKGROUND

Jennifer Allanson
Dr Jennifer Allanson is a lecturer within the Computing Department at Lancaster University. She began work on Physiological Computing in 1998 as part of her doctoral studies and has publishing several key papers on this subject. Her work involved the design of tools aimed at facilitating the prototyping and subsequent implementation of physiologically-interactive computer systems. The toolkit that resulted from this work was arguably the first of its kind.

Dr Allanson is principle investigator of an EPSRC-funded project to develop support for sentient computer systems. In addition she is heading an interdisciplinary team currently designing a project to explore brain-computer biofeedback control interfaces.

Gillian M. Wilson
Gillian Wilson is a completing doctoral student and Research Fellow in the department of Computer Science at University College London. She graduated in Psychology from York University (1998). She is conducting research in the area of multimedia quality assessment, where the application of interest is Multimedia Conferencing.

As the number of networked multimedia applications increases constantly, users audio/video quality requirements need to be clearly specified. Subjective assessment is currently used to do this, however it has drawbacks. Gillian's research is utilising an objective method to assess the impact of media quality on users: physiological indicators of arousal are being taken as an indicator of user cost. Findings so far indicate that physiological responses to media quality degradations can be detected and that they do not always correlate with subjective results. Thus, to rely solely on subjective assessment is unwise. A three-dimensional approach to multimedia quality evaluation is proposed by this research, incorporating measures of task performance, user satisfaction and user cost.