Universidade do Minho
Escola de Engenharia

Semana da Escola de Engenharia
October 24 - 27, 2011

SOCIAL SIGNALS PROCESSING IN HUMAN-COMPUTER INTERACTION

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KEYWORDS
Social Signals Processing, Human-Computer Interaction

ABSTRACT

In human-human interactions we are able to interpret body language and the subtle clues that make us aware about the others' comprehension, agreement, disagreement, interest, empathy, etc. Humans are good at reading these signals, and that ability is intrinsic to the conduciveness of normal social interactions. Computers, however, are completely clueless about those social signals, missing what can constitute very relevant information on the user's state, attitude and perception of a system. Social signals processing has the potential to change the way we interact with computers by making it possible for the computer to observe a user's social signals during an interaction, and reason about them, just as a human would do. This research aims to develop a system with built-in heuristics that has the potential to detect or predict a user's problematic interactions and determine the quality of an interaction just by "watching" the user's reactions, in particular the nonverbal language.

INTRODUCTION

According to Vinciarelli and his colleagues (Vinciarelli, Pantic, & Bourlard, 2009), social signals processing (SSP) is an innovative and multidisciplinary field of research that has the goal of providing computers with the ability to sense and reason about human social signals, in a similar way to the one a human does in appraising another's emotions (Picard & Klein, 2002). Social signals processing has therefore the potential to change the way we interact with computers.

RESEARCH PROBLEM

Recent work in the integration of a variety of sensing modalities in Human-Computer Interaction (HCI) opens an opportunity for the interface to step up and become more aware of the user, his/hers emotions, difficulties and needs. In recent years a particular set of interesting work studying the dynamics of human-human interactions revealed the significance of nonverbal languages to determine the outcome of social interactions in particular contexts (Pentland, 2008). Of relevance to this research are social signals, the subtle patterns of nonverbal language and vocalizations a person display when interacting with other people and that reveal his or hers attitudes toward the others. Our working hypotheses is that the dynamics of social signals can also be applied in revealing important aspects of HCI. This approach relies on the user's natural communication channels that, despite research in recent years, are still underexplored in HCI. We seek to observe behavioral patterns of nonverbal language that are tellers about the user and the user's reactions. This builds on examples of promising research to tackle the challenges of non-intrusive user social signals processing.

In short, the main question driving this research effort is: *What is the relevance of social signals in human-computer interaction contexts, and what is the set of social signals that are most relevant in predicting a user's level of experience, the quality of an interaction, and the outcome (positive or negative) of that interaction?*

EXPECTED RESULTS

A system with built-in heuristics has the potential to be able to detect or predict a user's problematic interactions and determine the quality of an interaction just by "watching" the user's reactions. The ability to interpret the user's behavior, in particular its nonverbal language could provide a mechanism that would allow for the detection of adverse events, a necessary first step to solving them.

Studying if, and how, others can assess or predict about the quality of human-computer interaction from the observation of users' behavior dynamics would allow for the development of systems oriented towards those

behavioral features that are most relevant. Summarizing, the contribution of the proposed work is expected to be:
. Identification of the existing social signals in a HCI context;
. Development of a model based on users' social signals which will assess a user's experience level, quality of interaction and occurrence of critical incidents;
. Implementation of this model into a device that records the user's social signals and qualifies the user interaction;
. Deployment of this device for testing and evaluation.

RESEARCH PLAN

The activities necessary to carry out this research project can be broadly divided into the three following stages:
1. Data collection: An important part of the work proposed will consist of observational sessions which will seek to observe users' social signals and their correlation with the interaction and user experience. Two types of interfaces will be considered: (1) a desktop interface and a system such as a (2) supermarket self-checkout cashier or a similar system to be determined.
2. Data Analysis: Users' video and audio recordings will make it possible to extract features such as level of physical activity, patterns and speed of movement, posture changes and vocal outbursts. These features relate with nonverbal behavioral cues which will be analyzed. Other cues that, throughout the study, reveal themselves to be promising may eventually be included. The main criteria for choosing which features to monitor will be whether their analysis is technically easy. Interaction recordings will be used to classify user interaction and correlated with users' social signals. The scoring of interaction analysis will be used to define a metric to qualify the degree of success of an interaction.
3. Implementation and Testing: Video-based and audio-based monitoring and processing techniques will be developed to identify the most relevant social signals and classification algorithms will be implemented to classify those signals according to the model developed in the previous stage. A device will then be implemented to monitor and classify users' social signals. Implementation should consist of a self-contained system that can be easily deployed. This device will be subjected to tests in real-world interaction contexts to assess the success of both the model and the implementation techniques developed.

PRELIMINARY RESULTS

In a first study, people acting as evaluators determined users' expectations based on non-linguistic social signals in a 20 seconds video clip of volunteers using a photocopier. This experiment aimed to investigate if, even before a user engages in performing the task, there are relevant social signals that can reveal the user's expectation towards the difficulty of a task. Early results suggest that those short seconds of video were enough for most evaluators to make fairly accurate predictions about the level of difficulty the volunteers expected to have. This study, performed in collaboration with other colleagues was submitted and accepted as a "Work-In-Progress" paper at the 2011 Conference on Human Factors in Computing Systems (CHI 2011):

Branco, N., Ferreira, J. P., Noronha e Sousa, M., Branco, P., Otero, N., Zagalo, N., et al. (2011). Blink: observing thin slices of behavior to determine users' expectation towards task difficulty. *Proceedings of the 2011 annual conference extended abstracts on Human factors in computing systems - CHI EA '11* (p. 2299). New York, New York, USA: ACM Press.

FINAL CONSIDERATIONS

Social signals processing has the potential to change the way we interact with computers by making it possible for the computer to observe a user's social signals during an interaction, and reason about them, such as a human would do. It is the goal of this research to develop a system capable of detecting or predicting a user's problematic interactions and determine the quality of an interaction just by "watching" the user's reactions. There is a strong belief that this will provide the ground to allow the computer to deliver better responses, thus providing better interaction quality and becoming more effective and more efficient, important factors for user engagement.

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