Cross-disciplinary approaches to multimodal user interfaces

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The integration of models, theories, and scientific approaches from several different disciplines is a key factor for scientific research on novel multimodal user interfaces. Research on multimodal interfaces strongly contributed to push for the nowadays consolidated shift of focus from strictly technological aspects to the need of a deep understanding of the mechanisms underlying human perception, cognition, and communication. Cross-fertilisation between computer science and engineering with other domains such as psychology, biomechanics, neurosciences, cognitive sciences, social sciences, musicology, music and dance theory and practice becomes of paramount importance.

Recent initiatives bear further witness of the significance of such a cross-fertilisation. Consider, for example, the Network of Excellence HUMAINE, funded by the European Union in the Sixth Framework Program, that gathered psychologists and computer scientists around the topic of affective multimodal interfaces and that generated the HUMAINE Association, fostering research in this area. In the Seventh Framework Program, the EU-FET Project SIEMPRE aims at investigating and analysing multimodal interfaces for social interaction taking music as both source for theories and models and experimental test-bed. Institutions

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such as the Casa Paganini - InfoMus international centre of excellence, investigating the relationships between science, technology, art, and new media, or the Numediart Institute for New Media Art Technology are grounded on a strong interaction and integration between scientific and technological research and artistic research and production.

In this framework, the eNTERFACE summer workshops on multimodal interfaces are a clear example of effective implementation of such a cross-disciplinary approach. Originating from the EU 6FP ICT Network of Excellence SIMILAR, the workshops promote collaborative, localised research and development work by gathering, in a single place, leading researchers in multimodal interfaces and students to work on specific projects for 4 complete weeks. eNTERFACE is an opportunity for students and experts all over the world to meet and effectively work together, so as to foster the development of tomorrow's multimodal research community.

This special issue presents some concrete examples of effective cross-fertilisation between different disciplines in the development of multimodal interfaces. The examples are the consolidated outcomes of the research works started as projects at the eNTERFACE'09 workshop held in July 2009 at Casa Paganini—InfoMus, Genova, Italy (see Fig. 1).

A first paper presents a system for content-based browsing of a dance video database. A set of features describing dance is proposed to quantify local gestures of a dancer as well as global stage usage. These features are used to compute similarities between recorded dance improvisations, which in turn serve to guide visual exploration and browsing. The features used for characterising dance performances are grounded on the Effort's Theory of choreographer Rudolf Laban and are a clear example of how a qualitative model coming from performing arts can be implemented in a set of quantitative measures having their bases on such humanistic studies.

Fig. 1 Project groups of participants at the eNTERFACE'09 EU Workshop at Casa Paganini—InfoMus, University of Genoa

A second paper addresses Brain-Computer Interfaces (BCI), a recent frontier of Human-Computer Interaction where HCI studies and research in neuroscience converge towards a novel generation of interfaces. The paper introduces Bacteria Hunt, a multimodal, multi-paradigm BCI game, used to evaluate two aspects of BCI interactions in a gaming context: the effect of feedback on the ability of the user to manipulate his mental state of relaxation and the interactions between different BCI paradigms used in the game.

The use of laughter as an important cue to reinforce engagement in human-computer interactions is the subject of another paper, discussing the development of an audiovisual laughing machine, able to detect and respond to user's laughs. A system capable of recording the laugh of a user and responding to it with a similar laugh is presented. The output laugh is automatically selected from an audiovisual laughter database by analysing acoustic similarities with the input laugh and is displayed by an Embodied Conversational Agent (ECA). The aim in this case is to develop novel ECAs as interfaces capable to empathise with users in future application scenarios. This is a topic where interaction of computer science and engineering with psychology, cognitive, and social sciences is of paramount importance for the development of effective multimodal interfaces.

Music is the application scenario of a further paper, describing the interaction paradigms and the software platform, developed in the framework of the 7FP EU-ICT "Networked Media" SAME project, for networked context-aware, experience-centric active listening to pre-recorded music content with mobile devices. The concept of active listening and the interaction paradigms implementing it are grounded on models and theories from performing arts and music practice.

Whereas being only a partial demonstration of the benefits cross-fertilisation brings to research on multimodal interfaces, we think that these works are exemplary case studies of a paradigm of scientific and technological research (and related research centres) that, specifically in the framework of multimodal interfaces, grounds, on the one hand, on high-level specialised professionals, but on the other hand, benefits from the richness of experience that only a cross-disciplinary approach can bring in.