Workshop on Full-Body and Multisensory Experience in Ubiquitous Interaction

Assunta Matassa, Luca Console
University of Torino
Torino, Italy
{matassa,lconsole}@di.unito.it

Leonardo Angelini, Maurizio Caon, Omar Abou Khaled
University of Applied Sciences and Arts Western Switzerland
Fribourg, Switzerland
{name.surname}@hes-so.ch

ABSTRACT
The ubiquitous computing era is bringing to the human the possibility to interact always and everywhere with digital information. However, the interaction means used to access this information exploit only few of the human sensorimotor abilities. Most of these interactions happen through traditional desktop or mobile interfaces, which often involve just vision and hearing senses and require the movement of only one finger. The aim of this workshop is rediscovering the role of human body and senses, focusing on abilities that are often forgotten by the HCI designers, in order to provide new body experiences through the design of novel interactions in smart environments. The focus of this workshop will go beyond the mere design of multimodal interfaces and will exploit theories of embodied cognition to design new full-body experiences to explore ambient space and, more in general, the environment.

Author Keywords
Full-Body interaction; Multisensory experiences; Embodied Cognition; Olfactory interactions; Gustatory interactions; Tactile interactions; Spatial audio interactions.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous;

INTRODUCTION AND WORKSHOP RATIONALE
Since the roman architect Vitruvius, human beings are using the body as a referent to construct adapted spaces and buildings [6]. The importance of using the human body to define and measure reality is nowadays particularly famous thanks to Leonardo da Vinci: designing the Vitruvian Man, he suggested to put the human body in the center of everything, bracing Vitruvius' proportions designed to make spaces better suited for humans in architectural perspective. Moreover, the anatomical studies of Leonardo da Vinci were important not only for his artistic production, but also for his mechanical inventions designed around the human body. Therefore, the human body becomes not only something able to occupy the space, but it represents the more relevant element to define the environment around us.
The body represents also a main component in the process to describe and organize the surrounding environment: people define coordinates and orientation completely related to their body.
While the human body is often used as a measurement unit for the surrounding space (e.g., inch and feet units in the imperial system), at the same time, it offers also the main tools for measuring the environment: the human senses [36]. Since their birth, most living beings start exploring their environment with their senses, building knowledge about it. Human beings do it through the five traditional senses: sight, hearing, taste, smell and touch. Besides sensing the external world, an important part of human senses focuses on the internal status. Proprioception is also fundamental to discover the external world through our body. Indeed, theories of embodied cognition suggest that knowledge is generated by coupling action and perception, through continuous body interactions with the environment [1].
The ubiquitous computing era is embedding several computational capabilities and digital information all around in the human living environment, allowing to the users continuous and seamless access to them [16]. Nevertheless, most of these interactions with digital information are characterized by a poor usage of our sensorimotor abilities [8]. The transition from desktop to mobile interfaces improved consistently the user experience, but did not improve much the user's body experience. Indeed, mobile interfaces still rely mostly on sight and hearing, with basic tactile feedback and simple body movements, such as one-finger swipe gestures and taps. Users are getting acquainted to these gestures and when asked for which gesture they would like to perform to interact with different objects, they often propose the same basic gestures performed on the smartphones [9][10].
Going beyond the traditional interaction model, we intend to focus on physical interactions that make more use of the richness of the body, of the senses and of the movements and actions as the most relevant parts of cognition [1].
Full-body interaction represents an unusual way to interact because in this process body covers a double role: it is a

UbiComp/ISWC '15 Adjunct, September 7–11, 2015, Osaka, Japan.
Copyright 2015 © ACM 978-1-4503-3575-1/15/09...$15.00.
http://dx.doi.org/10.1145/2800835.2806201

controller able to move with several degrees of freedom and it becomes also an interface to exchange information with the surrounding environment.

We propose to apply a critical design method in order to provoke a reflection about the values and the role of body in interaction. The critical design approach is receiving much attention in the Human Computer as an instrument able to push reflection and rethinking with critical attention life attitude. Following these insights, we choose a critical design method to stimulate a “critical sensibility” in users [5]. We exploit this approach as “a form of social research” [17] to understand the relations between body, five senses and the environment, eliciting these relations in a more natural and spontaneous form.

RELATED WORK AND WORKSHOP TOPICS

The exploration of *body-in-action* and *enactments* is popular in embodied cognition theory and in its applications [34]. Van Dijk et al.’s Floor-It system [34] surrounded the body of the participants to a brainstorming with projected insights of their thoughts, such as sticky-notes or mock-up photos, which could be manipulated through foot gestures and connected to the insights of other participants to foster discussions. Mora-Guiard et al. [6] designed an interactive installation where children could explore on projected surface small objects on different scales and compare them with their body, using body as a measurement unit. The Skinput system [35] demonstrated that the body can be used also as an interface, both for input, through gestures on the skin, and output, through light projected on the arm.

While the exploration of multisensory digital experiences dates back to 1962 with Helig’s Sensorama [33], few common applications for the exploitation of the whole spectrum of human senses exist. In the research field, much has been investigated under the term of multimodal interaction, which exploits the human ability to process more than one interaction modality at a time [12]. However, typical interaction modalities exploited in multimodal interfaces are gesture and speech: unconventional senses such as smell and taste are generally ignored. Indeed, in the ubiquitous computing era, the senses used for digital interaction purposes are still limited [13]. Following this insight [14], Obrist recently investigated the design space of three interaction modalities still mostly unexplored for HCI, smell [26], taste [31], and touch [32]. Besides vision and hearing, touch is probably the most used sense to interact with technology and a lot of research has been done in the field of haptic interfaces [15]. Haptic devices use several different techniques to stimulate the different mechanoreceptors that are present in our skin (e.g., for vibration, pressure, touch, stretch), but also the internal kinesthetic receptors that are used to assess the joint positions and movements, forces, weights and muscle activities [7]. New technologies in this field open new perspectives for the design of ubiquitous interaction. For instance, tactile displays [29] promise a revolution in the mobile interfaces, while muscle actuation techniques can introduce kinesthetic affordances for the interaction with everyday objects [30]. Touch can be used to explore the surrounding environment and its living inhabitants. In this latter case, touch is an important carrier of emotions, [37].

Since the human olfactory sense is composed by a much more complex system with hundreds of different receptors, sensing and recreating smells for digital interaction purposes is a difficult task from a technological point of view [26]. Generally, existing systems exploit different types of scent diffusors; electrical brain stimulation for digital smell generation is also currently under investigation [27]. The sense of a taste relies on much more simpler receptors that can be stimulated digitally, although only with invasive systems [31]. Similarly to scent diffusors, flavored cartridges could be used to coat surfaces for recreating digital tastes [28], although clear limitations arise from the user acceptance point of view.

While exploiting the different senses enriches the user experience, combining the same stimuli across different senses can lead to interesting cross-modal effects: Hogan et al. [19] demonstrated that coupling of visual, tactile and audio senses improve the performance of people to act on a system. Also, Matusz et al. [18] exploited the values of multimodal interaction to reduce disease in children with attention problems. In Meta Cookie [21], the system was able to change the perceived taste of a cookie by changing its visual appearance with augmented reality technology and the smell through scents.

Another branch in HCI is exploiting the possibility to combine different and unexpected senses to surprise the users by offering them new products: for instance, Ishii with Music Bottle [20] proposed to rethink Weiser's transparent computer using an innovative metaphor: bottle becomes a container and a controller of digital information. Instead to smell a perfume, when the users open the bottle, they perceive a sound combined with changing colors. Sound Perfume [22] and Scented Pebbles [24] enrich the face-to-face conversation adding smell and sound to improve the exchange of emotions. Taste+ [23] is a proof to digitally enhance the taste sensations of food and beverages without additional flavoring ingredients. Finally, SensaBubble [25] is a chrono-sensory mid-air display that produces smelling bubbles to exchange information to the user via using different sensorial modalities.

WORKSHOP PROPOSAL

The workshop aims at gathering around 15-20 participants. We encourage the participation of young practitioners but also more experienced researchers from different backgrounds (design, engineering, computing, arts, social sciences, neurosciences, ergonomics, etc.), with previous experience in multisensory interaction, full-body interaction or embodied cognition. Workshop participants are invited to submit 4 to 6 page papers that cover one or more topics suggested in the call for papers. First, the participants will briefly present and discuss their contributions. Second, they will benefit to be engaged in hands-on sessions to reason about unexplored body abilities. Using a critical design approach, we will stimulate the combination of different senses and perceptions in order to achieve new ideas of interaction and experience the capabilities offered by the human body and senses in interacting with the surrounding environment. The critical design method should be able to promote reflection about body's natural abilities and how to better exploit them in the ubiquitous computing era. The main goal would be to provide a hands-on exploration using digital technology and the body. In order to achieve a more practical knowledge, the participants, divided into small groups, will be able to experiment directly through their body, benefiting also of the material provided by the workshop organizers such as scents, sounding objects, tasty food, textiles and objects with rough and soft surfaces for different tactile feedback and stiffness, light projectors. In the following phase, participants will discuss ideas for an original interaction installation and will materialize those ideas with the support of paper prototyping materials. Finally, participants will present the results of the design session to the other workshop participants and they will discuss the qualities of the designed interactions.

WORKSHOP TOPIC

According to the related topics, 8 papers have been selected and will be presented during the workshop.

(i) Concerning the view about the body contains the particular condition of being simultaneously subject and object of interaction, Pacheco [37] discusses about the current need for technology that takes into account the experiential and smart body that expands its semiotic world, providing new channels for self- expression and learning. (ii) Matassa and Cena [42] propose a study for the design of an innovative gestural corpus to allow a natural, simple interaction and communication in social smart space through the body. (iii) Mitchell [40] proposes an approach to leverage human sensorimotor abilities going beyond the traditional five senses. It introduces the sense of ownership to tell about how senses are influenced by our perceptions as to who something belongs to. (iv) Using the theory of image schemata and the concept of embodied metaphor, Gumtau [44] introduces the importance of the body as a fundamental partner in action, interaction, communication and therefore meaning making. It is argued that there are mental concepts that cross sensory modes, and which can be harvested as affordances for embodied interaction design. (v) Rapp et al. [41] propose to investigate the smart objects embed computational capabilities in everyday objects opening opportunities for designing new forms of interaction based on the user's bodily experience. (vi) Following calm Ubiquitous Computing approach, Peterson et al. [39] present a way for pushing the frontier of mobile context-aware systems design in a direction where the services that are used by human agents can potentially blend more gracefully with ongoing activities by taking the load on human senses and mind into account at all times. (vii) Brayda et al. [43] introduce how to build a wearable multichannel binaural hearing aid, which hosts an effective beamforming algorithm able to improve speech intelligibility. (viii) Angelini et al. [45] present a concept of a Multisensory Interactive Window, which aims at improving older adults' life with an intuitive system for communicate with distant people and visit distant places.

EXPECTED WORKSHOP RESULTS

This workshop aims at building a community interested in exploring full-body and multisensory experiences for ubiquitous interaction. The workshop will allow participants to see different points of view about the field from people with different backgrounds, enriching not only their personal experience but also the community's knowledge as a whole. We expect that at the end of the workshop participants will have collected a new understanding about the importance of the body in the design of an immersive and natural experience in the environment. We expect also that they will learn the fundamental skills for designing new body-focused services in the future. Indeed, the insights generated during the workshop will support the advancement of multisensory and full-body interaction research fields and the results of the workshop will be shared with the scientific community. The insights of the workshop will be shared also on the workshop web site, which will be used by the newly formed community to share new insights from the field, with the help of a forum section to support long-term discussions among the workshop participants, the organization of joint research studies and the writing of papers.

BIO OF THE ORGANIZERS

Assunta Matassa is a PhD Student at the Department of Computer Science at the University of Torino (Italy). She is working on wearable computing, body experience, tangible interaction, urban interaction design, urban informatics and Human-Computer Interaction in general. Last year, she mainly devoted in studying the implications of Internet of Things in designing and developing of Smart Objects.

Luca Console (PhD in Computer Science). Full professor in Computer Science and Head of the Computer Science Department. He has a long research experience in different areas of intelligent systems and applications and recently on intelligent objects and applications. He has a relevant experience in project coordination. He published more than 100 papers in international journals and conferences.

Leonardo Angelini is currently a PhD student in cooperation between the University of Applied Sciences and Arts Western Switzerland (CH), and the University of Fribourg (CH). He is member of the HumanTech Research Institute and holds a MSc in Computer Science and Telecommunications Engineering from the University of Perugia, Italy. His research domains are in the area of computer science: Tangible Interaction, Gestural Interaction, Multimodal Interaction, Wearable Computing and Affective Computing.

Maurizio Caon is currently a postdoctoral researcher at the University of Applied Sciences and Arts Western Switzerland (CH) as member of the HumanTech Institute. He holds a PhD in Human-Computer Interaction issued by the University of Bedfordshire (UK). His research domains are in the area of human-computer interaction: gestural interfaces, activity recognition, persuasive technology, context-aware ambient intelligence and wearable computing.

Omar Abou Khaled is Professor at the Information and Communication Department of the University of Applied Sciences and Arts Western Switzerland. He is member of the HumanTech institute (former MISG research group). He is responsible of several projects in the field of Document Engineering, Multimodal Interfaces, Context Awareness, Ambient Intelligence, Blended Learning, and Content-Based Multimedia Retrieval.

REFERENCES

1. Paul Dourish. (2004). Where the action is: the foundations of embodied interaction. MIT press.
2. Hansen, M. B. (2002). Wearable space. Configurations, 10.
3. Sadamis, M., (2013), The emergence of a wearable space: A review and research implication, In Proc. CHI'13
4. Dunne, A. (2006). Hertzian Tales: Electronic Products, Aesthetic Experience, and Critical Design. MIT Press.
5. Dunne, A. and Raby, F. (2007). Critical Design FAQ. Retrieved September 1, 2012.
6. MoraGuiard, J., et al. (2014). Child as the measure of all things: the body as a referent in designing a museum exhibit to understand the nanoscale. In Proc. IDC'14.
7. Hale, K., et al. (2004) Deriving haptic design guidelines from human physiological, psychophysical, and neurological foundations. Comput. Graph.
8. O'Sullivan, D., et al. (2004). Physical computing: sensing and controlling the physical world with computers. Course Technology Press.
9. Valdes, C., et al. (2014). Exploring the design space of gestural interaction with active tokens through user-defined gestures. In Proc. CHI '14.
10. Angelini, L., et al. (2014). Gesturing on the steering wheel: a user-elicited taxonomy. In Proc. AutoUI'14.
11. Lee, H., (2008), Mobile Networks, Urban Places and Emotional Spaces, in Augmented Urban Spaces, Aurigi (ed.), Ashgate Press, London, pp.40-59.
12. Dumas, B., et al. (2009). Multimodal interfaces: A survey of principles, models and frameworks. Human Machine Interaction . Springer Berlin Heidelberg.
13. Obrist, M., et al. (2014). .Opportunities for Odor: Experiences with Smell and Implications for Technology. In Proc. CHI'14.
14. Shilling, R. et al. (2002). Virtual auditory displays. Handbook of virtual environment technology.
15. Hayward, V., et al. (2004). Haptic interfaces and devices. Sensor Review, 24(1), 16-29.
16. Matassa, A., et al. (2014). Using the critical design approach for rethinking citizens' emotional bond with urban spaces. In Proc. Urb-IoT'14.
17. Matassa, A., et al. (2014). Eliciting Affordances for Smart Objects in IoT Era. In Press In Proc. COIOTE'14.
18. Matusz, P. J., et al. (2015). Multi-modal distraction: Insights from children's limited attention. Cognition, 136, 156-165.
19. Hoggan, E., & Brewster, S. (2007). Designing audio and tactile crossmodal icons for mobile devices. In Proc. ICMI'07.
20. Ishii, H. (2004). Bottles: A transparent interface as a tribute to Mark Weiser. IEICE Transactions on information and systems, 87(6), 1299-1311.
21. Narumi, T., et al. (2010). Meta cookie In Proc. CHI'10.
22. Choi, Y., et al. (2011). Sound perfume: designing a wearable sound and fragrance media for face-to-face interpersonal interaction. In Proc. ACE'11.
23. Ranasinghe, N., et al. (2014). The sensation of taste in the future of immersive media. In Proc. ImmersivME'14.
24. Cao, Y., et al. (2015). Scented Pebbles: Interactive Ambient Experience with Smell and Lighting. In Proc. TEI'15.
25. Seah, S. A., et al. (2014). SensaBubble: a chrono-sensory mid-air display of sight and smell. In Proc. CHI'14.
26. Obrist, M., Tuch, A. N., & Hornbæk, K. (2014). Opportunities for odor: experiences with smell and implications for technology. In Proc. CHI'14.
27. Ranasinghe, N., et al. (2011). Digital taste and smell communication. In Proc. BodyNets'11.
28. Maynes-Aminzade, D. (2005). Edible bits: Seamless interfaces between people, data and food. In Proc. CHI'05.
29. Jones, L. A., et al. (2008). Tactile displays: Guidance for their design and application. Human Factors, 50(1), 90-111.
30. Lopes, P., et al. (2015). Affordance++: allowing objects to communicate dynamic use. In Proc. of CHI'15.
31. Obrist, M., et al. (2014). Temporal, affective, and embodied characteristics of taste experiences: A framework for design. In Proc. CHI'14.
32. Obrist, M., et al. (2013). Talking about tactile experiences. In Proc. CHI'13.
33. Sensorama simulator. U.S. Patent No 3,050,870, 1962.
34. van Dijk, J., et al. (2014). Beyond distributed representation: embodied cognition design supporting socio-sensorimotor couplings. In Proc. TEI'14.
35. Harrison, C., et al. (2010). Skinput: appropriating the body as an input surface. In Proc CHI'10.
36. Merleau-Ponty, M. (1996). Phenomenology of perception. Motilal Banarsidass Publishe.
37. Angelini, L., et al. (2014). Hugginess: encouraging interpersonal touch through smart clothes. In Proc. UbiComp'14.
38. Pacheco, C., (2015). Expanding our Perceptual World Through Technology: A Subjective Bodily Perspective. In Proc. UbiComp15.
39. Pederson, T., et al. (2015). An Egocentric Approach Towards Ubiquitous Multimodal Interaction. In Proc. UbiComp15.
40. Mitchell, R., (2015). Sensing Mine, Yours, Theirs and Ours: Interpersonal Ubiquitous Interactions. In Proc. Adjunct UbiComp15.
41. Rapp, A., et al. (2015). Human body and smart object. In Proc. UbiComp15.
42. Matassa, A., et al. (2015). Body Experience in the Ubiquitous era: towards a new Gestural Corpus for Smart Spaces. In Proc. UbiComp15.
43. Brayda, L., et al. (2015). Spatially selective binaural hearing aids. In Proc. UbiComp15.
44. Gumtau, S., (2015). Embodied Metaphors and Image Schemata in Interaction Design. In Proc. UbiComp15.
45. Angelini, L., et al. (2015). The Multisensory Interactive Window: Immersive Experiences for the Elderly. In Proc. UbiComp15 (in publishing).