A Somaesthetics Based Approach to the Design of Multisensory Interactive Systems

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Abstract. This paper aims to analyse the state-of-the-art of somaesthetics, describing the scientific and philosophic basis of the discipline, in order to devise how to implement a soma-based design. The goal is to apply the somaesthetics approach to the design of multisensory interactive systems for the purpose of creating novel technology designs for people with disabilities that can foster their participation and improve their daily life and overall well-being. Somatics can be intended as a set of instrumental values to increase bodily awareness. It allows us to get in touch with our own inner states, which can lead to a personal evaluative dimension for the designer, which can be used to integrate existing methods for evaluating experiences. Paying attention to one's own bodily states is key as it can turn such states in desing material. This concept was further developed with Shusterman's somaesthetics, a theoretical framework for aesthetic experiences. In the paper, we present examples of somaesthetics approaches to the design of interfaces (e.g. the SomaMat, that uses heat stimuli to guide the user attention to different parts of his/her body and can be a support for exercising or a tool to increase the body awareness). Moreover, we illustrate existing practices to design such as Embodied Sketching or Moving and Making Strange that are based on the body as the starting point of the design process, usually preceded by techniques such as defamiliarization or Feldenkrais exercises. Then, we move on to our forthcoming research, aimed at applying a somaesthetics approach to create a system for two possible groups of users: (1) children who are patients at the Giannina Gaslini Institute (a pediatric hospital) and (2) visually impaired and blind people members of Unione Italiana Ciechi (an Italian association of blind people). The system will help users move together, to increase interaction between them as well as involve them in educational and creative activities. The work will be carried out under the PNRR RAISE project (*Robotics and AI for Socio-economic Empowerment*; https://www.raiseliguria.it/).

Keywords: Multi-sensory technologies · somaesthetics approach · full-body movement analysis

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1 Introduction

While multisensory interactive systems increasingly find applications in many areas (e.g., education, rehabilitation, and entertainment), these systems are usually conceived as technologies that observe their users, analyze users' behavior (e.g., their motor behavior), and produce a suitable multisensory feedback. An issue with this approach is that analysis is grounded on a collection of features that are similar for every category of users and that do not necessarily reflect the inner state of the user, but rather correspond to what an external observer perceives. An approach that, instead, leverages awareness that users have of their body, by eliciting, identifying, and measuring the features that are most responsible of such awareness (thus reflecting the user's inner state) for each user (or category of users) may make the experience with the interactive system more effective and compelling. Along this direction, in this paper we present a novel methodology for the design of multisensory interactive systems based on: (1) a design approach grounded on theories from *somaesthetics*, and (2) computational techniques for automated analysis of movement and generation of multisensory feedback. Somaesthetics is used to give users awareness of their body so that the design process can identify both (1) the movements that are most suitable for a given task and class of users and (2) the multisensory feedback which is most appropriate to them. Then, automated approaches to movement analysis and feedback generation are applied to actually make the system. These techniques will need to go beyond currently popular mappings based on physical aspects (e.g., positions, distances, and energy) moving towards higher-level expressive qualities (e.g., lightness, fluidity, and fragility). Moreover, finding the most suitable movements/feedback for each class of users and making users aware of that will help overcome physical and cognitive barriers e.g., for users with disabilities. The design of the demonstrators for the PNRR RAISE project (https://www.raiseliguria.it/) will be taken as a test-bed for this novel approach. The RAISE project supports the development of an innovative ecosystem based on the scientific and technological domains of Artifical Intelligence and Robotics, focusing on the needs of a specific regional context, i.e., the Liguria Region. In this framework, we focus on the development of a collection of multisensory interactive systems intended to support inclusion in the classroom and at technology-extended playgrounds. Main objectives of the work will be to investigate somaesthetic designs, methodologies, and their state-of-the-art, to devise a somaesthetics approach to the design of multisensory interactive systems, and to apply and evaluate the proposed approach in the selected use-cases. This paper discusses the state-of-the-art of somaesthetics approaches to the design of the systems and our plan for research in this area.

2 State-of-the-Art and Existing Approaches

Somatic is a set of traditions centered on the body which are historically tied to the treatment of the body such as medicine, physiology, and performance [16].

Somatic gave start to research on how to build, change, and express themselves: it became a research field during the XIX and the XX century in Europe and America. One of its characteristics is to endorse subjective perception of the body [16]. Somatics is defined as the experience from within the lived body [3].

The idea of transformation at a bodily level is key in somatic approaches: the emphasis is on learning and cultivating experiential skills through doing. The checking-in, cross-referencing, and calibration process is continuous and it takes between the self-directed intentions embodied in physical action with an inner focus of attention, and the awareness of one's inner state as a shifting dynamic. For this reason, somatics is also intended as a set of instrumental values: self as a set of states, attention as an operator, experience as a skill, and interconnectedness as empathy. Experienced teachers usually guide novices through techniques of practices, where observation of self and others are key elements [16]. By adjusting our sensorial focus and attention to energies of self and of others, we enter a cyclic process of consciousness, made up by somatic awareness. This phase should not be continuously maintained, as rest and recuperation phases are critical for learning of sensory-motor habits [5].

2.1 Theoretical Basis

Gendlin [6] states the body is on the edge of thinking, because it knows more than our rational mind. His technique for focusing wants to find a way to access implicit information in the body through supposition. By feeling the inner state of the body, it is possible to generate design concepts and qualities. Metaphors are usually used to articulate and describe the inner states, such as "feels like a crumbling rock" [16]. The body can also be described as a set of qualitative states, that can change continuously according to mental events and physiological states. If the focus of our attention is our internal state, we can notice and differentiate internal changes. When we shift the focus on external events without losing the connection with our inner ones, internal changes can be used to evaluate the experience of that interaction. Existing methods for evaluating experiences can be augmented by the evaluative dimension, allowing to acknowledging immediate impressions as well as the lingering effects of interaction [16]. The somatic perspective can contribute to first-person methods for understanding and valuating experience: it can make the designer or researcher feel an higher sense of their own presence [16].

According to Dewey [4], an aesthetic experience "has a unity that gives it its name, that meal, that storm, that rupture of a friendship. The existence of this unity is constituted by a single quality that pervades the entire experience in spite of the variation of its constituent parts". Aesthetic experiences, however, are not something outside the ordinary, because such experiences can be repeated or lived on a daily basis; scary or bad experiences can be considered aesthetic as well [9].

Richard Shusterman further developed Dewey's ideas with somaesthetics, a theoretical framework for aesthetic experiences [21]. The framework emphasizes the importance of bodily movements, sensations, and somatic training, as well as

the aesthetic in these experiences [9]. Hannah defines somatics as the field which studies the soma: this means, the body as perceived from within by first-person perception. When a human being is observed from a third-person viewpoint, the human body is perceived as a phenomenon. When the same human being is observed from the first-person viewpoint of his own proprioceptive senses, a different phenomenon is perceived: the human soma. [23] Shusterman's somaesthetics is based on different body-work traditions and methodologies, such as yoga, tai chi, or more modern methods, such as the Alexander Technique [1] and the Feldenkrais Method [5]. These techniques focus on using touch and movement for learning coordination of the body, by emphasizing skills, which are innate or have already been acquired and are habitual or even unconscious. There is, however, the possibility of adopting bad habits that lead to restricted movements, causing a loss of perception of aesthetics in our own somatics [9]. Self-observation combined with intention gives life to self-agency and it is very important in somatics practice [9] because only when we move, we experience through our own somas [20] and when movements are limited, so are experiences [5].

The approach helps designers by providing them with tools that support mental, physical, and emotional health of users through enhanced perception of the body [16]. It gives designers the opportunity to work explicitly with experiences as material to base projects on: there is a causal nexus between attention and experience, because attention transforms material qualities of the experience. In somatics, through attention experience can become a pliable material [7]. Somatic techniques should be understood to be applied to technologies as well [10], in order to design new experiences. These insights can be considered as a resource for design practices [19]. Technologies require attention and somatic techniques can provide many useful strategies, in order to support greater attentional skills and awareness in users and designers. [19].

2.2 Examples of Soma Based Designs

Some examples of soma based designs follow; all designs have a playful approach, where everyday movements are altered. Another similarity in these examples is the design material, made up by two parts: digital mediated materials and our bodies. Both can be modified by mutual interaction [9]. The first example is BrightHearts, an interactive work of art and biofeedback application, developed to minimize pain and anxiety in children who undergo painful medical procedures. Their hearth-beat is monitored to change diameter and color of concentric circles: the more relaxed they are, less intense and warm are colors [13].

Another example is the SomaMat, that uses heat stimuli to guide the user attention to different parts of his/her body; it can be used alone or as a support to exercises to increase the user's body awareness. It is used together with an app with many pre-recorded audio sessions, with instructions guiding their bodies in very slow movements, while they are focused on different body parts and how these interact with each other [11].

GangKlang is an app that uses the rhythm of a person's walk to generate a soundscape. It emphasizes the physical dimension of who is walking by perceiving the user's movements and inserting them into the context. It translates their peculiarities into characteristics of the sound landscape in real time [8].

Soma based design is not only used for applications, for example Embodied Encounters Studio is a toolbox made up of 3 components: the Embodied Ideation Toolkit, which is a set of non-descriptive magnetic objects; Hexn, a tangible modular notation system composed of transparent hexagons with icons and Inspiration Cards, which are RFID-enabled cards with images related to database content, such as slides and videos that are shown on a stationary iPad [12]. The goal of this toolbox is to allow two or more participants to brainstorm together through playful encounters. This design supports nonverbal communication and social coordination in action, instead of a more dialogue-oriented discussion. [12].

Finally, The Tail and Ears are mechanical extensions of the body to be used in theatrical contexts. The tail moves as the hips do, using accelerometers and gyroscopes; the ears are controlled by sensors on gloves [22].

2.3 How to Implement Soma Based Designs

Before starting to create soma based designs, there are practices to adopt; the main one is defamiliarization, i.e., the disruption of habitual ways of moving, sensing, and feeling to give perception a new perspective or to create new connections by rearranging sensorimotor neural pathways [16]. Another practice is represented by *Feldenkrais*, i.e., exercises to increase awareness of the body, also helping to "slow down the brainstorming" [9]. It is necessary to holistically explore bodily and emotional aspects in the experience of movement to increase awareness [14].

Moreover, the designer has to articulate experiential qualities and strong concepts, in order to generalize from the specific insights gained and testing what has been learned [11]. An experiential quality describes the experience between user and system that the designer wants to achieve. A strong concept must be generative, from more than one application: it has to do with the interactive behavior of an application [11].

One practice involving designing bodily experiences early in the design process is called *Embodied Sketching*. It is based on five principles: (1) an activity-centred approach to ideation, (2) use of a complete setting as a design resource, (3) physical and practical involvement of the designers with an improvised and unplanned activity, (4) use of movement and play both as a method and a goal, and (5) the provision of an awareness-raising and planning space [17]. It is activity centred because the goal is to design enjoyable social and physical activities that are technologically-supported; contextual elements are used as design resources, while in other methods are just used as a backdrop, useful to evaluate ideas. This methodology focuses on initial explorative ideation phases as a way to open up the design space; in order to do so, using a physical and

playful engagement is key, as it allows designers to engage in a mind-set conducive of exploration and creativity [17]. Another approach, called *Moving and Making Strange*, recognizes the central role of body in lived cognition. Making strange is a tactic used for disrupting habitual perceptions and ways of thinking. This methodology provides a set of principles, perspectives, methods, and tools for designing and evaluating movement based interactions with technology. This also provides a general framework for research and for designing technologies, based on an embodied approach that privileges the body as a source of movement and as a place of experience. [15]. A generic and summarized example of approach used to create soma based design is shown in Fig. 1.

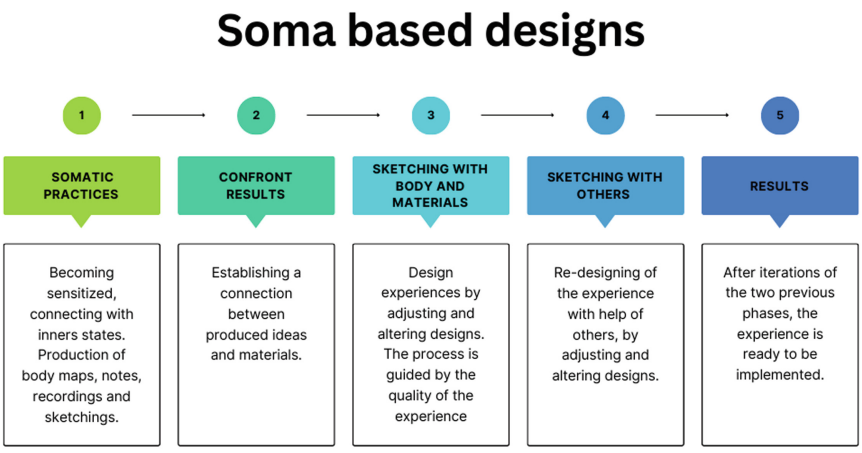

Fig. 1. An example of soma based design timeline.

3 Forthcoming Research

We selected two possible classes of users: (1) children who are patients at the Giannina Gaslini Institute, a pediatric hospital, and who are receiving a rehabilitation treatment at home and (2) visually impaired and blind people members of Unione Italiana Ciechi. Applications developed for these users often rely on different design approaches, such as co-design [18] or participatory design [2]. For this project we will develop a system which allows users to create their own story, starting from preset elements which can be combined in different ways. We will use the same concept seen in the book "Six billions fables by Jean de la Fontaine", written by Nicola Ferrari. This book is structured in a way readers can mix and match sentences, thanks to the pages being cut in a non standard way; however the reader combines the sentences, the final story has the same structure but a different meaning. The goal of this system is to help users move together, for example children who attend frequently the hospital. This would increase a better interaction between patients, as well as the involvement in creative and educational activities. This system could be installed in part of the

common areas of Giannina Gaslini Institute, which are dedicated and accessible to all patients.

For this project, we will first start to create designs mainly based on somaesthetics, develop the identified technology, and finally assess the obtained prototypes.

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