BodyPresent: Social Coordination of Embodied Stillness

CSRP 583

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SUMMARY

We are proposing a small-scale demonstrator, BodyPresent, which is an installation constructed out of five stands, arranged in a circle around a physical display. Each stand holds one person, whose swaying movement animates the shared physical display made from ferromagnetic fluid. The five persons who are taking part in the installation coordinate their movements to simultaneously interact, changing the shape of the fluid. Embodied interaction occurs in the physical world and in social context, thus involving the body, others, and objects. Ubiquitous computing often centres on one of the mentioned elements in embodied interaction. We are investigating a proof of concept by implementing all three elements, tying them together with the participants' swaying movements so that these can create a unified and coordinated representation. Our approach is iterative and incremental, using in-situ user studies that rough out user responses in regards to content conception. Technically, we are building on existing tools from the Equator device catalogue with the potential to incorporate, as an addition, a novel form of tangible interfaces.

CASE FOR SUPPORT

Research Context

Embodied interaction as an approach to design technologies in ubiquitous computing takes the notion of embodiment, the acting, physical manifestation in the here and now, as the central idea. Tangible computing draws on the concept of embodied interaction in its analogy by utilizing skill sets that are inherent to the physical world. Similarly, social computing takes into account the situated perspective in which social action is performed [1].

Until now, the study of embodied interaction within the framework of ubiquitous computing has centred on the development of environments that are reactive to a user's presence, as well as interactive through the expression of the user's gesture-based interaction with technology. In other cases the approach has been product-based [2], where existing artefacts or concepts thereof have been augmented with ubiquitous technology. In both cases, the engagement through embodied interaction is relatively superficial, relying either on sensing the context of use or interpreting tangible manipulation of objects. The integration of body, mind, and technology is rarely fully exhausted.

Embodied interaction as it has been understood in ubiquitous computing can be divided into levels of integration of body, object, and social engagement:

a) Centres on the object to be manipulated e.g. tangible interfaces such as Equator's Pin&Play

b) Centres on other people's input into the system e.g. games such as Equator's Seamful games

c) Centres on one's own body e.g. gesture recognition, predictive, reactive systems such as Equator's Headracer wearable

Embodied interaction has the potential of providing a richer understanding of the relationship between body, the physical world and the social context. We propose to investigate this potential by using technology tying these different concerns together in such a way that the participant's involvement incorporates the movement of their own body, the movement of other's around them, and the physical manifestation of the digital interpretation. In kinesiology research, the human sway [3] has been well researched and identified as an unconscious movement that occurs when humans stand still. However, the human sway can also be subtly controlled and hence rendered conscious. For our research the human sway is an ideal bodily motion to investigate the above-mentioned concerns.

This research programme proposes to bring together the necessary technologies and techniques to develop a proof of concept and platform for further research. As a research platform, the result of this work would be suitable for ongoing, efficient investigation of embodied experiences with different groups of people in a variety of social settings. As an innovative approach, the platform fully supports Equator's concept of Experience-Project by creating unique experiences for the participants that are new to the context of ubiquitous computing and embodied interaction. Experiences such as self-reflection and internal states on the one hand, and social engagement and coordination on the other can feed into conceptual research from which could be abstracted and generalized.

Building on Equator's Curious Home, we are designing an activity that follows the path of non-utilitarian, playful access, an invitation for the participants to explore technology without precepts. Equally practice-based as research conducted under the umbrella of Curious Home, our approach moves from embodiment in the context of the living environment to a tightly focused, more immediate embodied experience within a group setting where the body is at the centre of the inquiry. Openness and ambiguity throughout the mediated experience will help define the scope of embodied interaction pertinent to inform other applications.

The technical requirements of the small scale demonstrator, BodyPresent, will necessitate the use of a wide range of technologies including distributed sensors, embedded computing and tangible interfaces, all of which will be built on existing tools adapted from the Equator device catalogue. In particular, we are looking at using the Smart-Its platform, Weight-Table technology and ECT toolkit. Furthermore, the project will explore the possibilities in a novel form of physical display, which has the potential to be a useful addition to the catalogue in itself.

By the term physical display we refer to a device that allows the visualization of information in a form other than graphical rendering or projection. In some sense, work such as the Actuated Workbench [4] or POUTS [5] can be included in this definition, since the interfaces have the ability to convey information through the alteration of constituent physical elements. Another important exemplar is Daniel Rozin's Wooden Mirror[1], which mechanically controls a matrix of wooden 'pixels' to display graphical information.

Ferromagnetic fluid (see Annex 3) has the potential to be used as a physical display medium in a unique way, distinct from other physical interfaces. The material can be shaped into interesting patterns by the application of electromagnetic forces. It is not only experienced as a shape-shifting, three-dimensional object, but can also be tangibly manipulated. The fluid has been used in experimental sculpture, for example by Sachiko Kodama[2]. We propose to develop it into a more generic device, which could be appropriated into a number of future works.

Our strategy has two main components that require interdisciplinary collaboration across multiple Equator sites, Sussex, Lancaster and Bristol. We are looking at Sussex for content creation derived from user studies, including the main time allocation. For re-appropriated and further developed Equator weight sensing technology from Lancaster and week-long time allocation, as well as support from Bristol for possible hardware development.

RESEARCH PROGRAMME

Goal

The goal for BodyPresent as an installation is to effectively converge physicality with digital technology. This includes artistic concerns towards aesthetic value and the participatory experience. With this outlook, it is important that BodyPresent goes beyond the current horizon of expectation that a computer driven installation might evoke. Screen or projection displays would immediately reduce the visual display into a two-dimensional surface. Thereby loosing the rich texture caused by the play of light in three dimensions, and thus the ability to process the visual information as an object, which is closely tied to the efficient control of body movements [6]. Ferromagnetic fluid can be appropriated in this context. Because the fluid can be animated to create three-dimensional shapes it would permit the person to sway with it, and thus promote an advantageous condition to engage physically with the pattern being created.

The stand, which is a slightly raised surface, measures the swaying movements of the person [3] by deploying four attached weight sensors . It can hold one person and is large enough for someone to stand on comfortably. Partaking in this installation is a collaborative endeavour, in that each member of the group tunes into the same physical display, which is in the container in the centre holding the ferromagnetic fluid. The complete set-up (see Annex 2) places the container of ferromagnetic fluid into the centre and from there five stands are placed around it in a circle. Through the controlled sway of the persons standing on the stands the fluid is animated and shaped three-dimensionally.

BodyPresent constitutes a spatial system by aligning people closely with one another in a circle to arrange a group that is closed inwardly and has the potential to focus together on a singular object. If the group chooses to interact as a group, people have to organize their movements to create a unified representation. This is not to say that the only possibility is to be in synch with each other. Depending on what kinds of patterns are possible to create, the group's degrees of freedom will vary. The sensors measure the continuously fluctuating centre of pressure (COP) of each person. In creating the pattern there are two main options, either each person engages with their own COP "feed-back" in the fluid, or there is one common COP that is animated by interpreting the movement of each individual.

Objectives

The proposed small-scale demonstrator is conceived as a development taking several weeks over a 10-12 month period. It encompasses the following objectives:

1. Capturing the sway
    a. Measure how people are moving by tracking the COP of their body as people stand still.
2. Analysis of captured information
    a. Analyse raw data and interpret as movement information.

[1] http://www.smoothware.com/danny/woodenmirror.html

[2] http://www.kodama.hc.uec.ac.jp/index-e.html

   b. Create digital representation of the communal sway in order to extract patterns.

3. Investigate potential treatment of the visual display using ferromagnetic fluid
   a. Understand the characteristics in terms of material possibilities and limitations.
   b. Devise a way to convey the digital representation as a meaningful physical manifestation, using the ferrofluid as a display medium.

Methodology

Our research approach is iterative and incremental, interweaving the results of the in-situ conducted studies with the step-by-step constructed installation. During the first phase, in-situ studies will focus on a one-person experiment and evaluation, using a prototype to test the concept of measuring a person's COP through the sensed load distribution of their body.

With the second phase, a second prototype and user study will include additional persons interacting. These user studies might be conducted with a screen display, rather than the physical ferromagnetic fluid display, to rough out specific questions regarding the appropriateness of different visualization techniques at an early stage.

In parallel during the second phase, the installation will be constructed and small tests performed to understand the possibilities of ferromagnetic fluid as a visualization medium. Initial tests will focus on how the shape of the fluid can be altered and controlled via electro-magnetic actuators. Further experiments will determine how arrays of actuators can be arranged and individually controlled to provide fine-grained manipulation of the fluid as a display material.

The final step will be one of integration from the previous phases - applying the sway-sensing techniques and understanding of how they can be represented to the new physical display medium.

Schedule and Milestones

See Annex 1.

Description of Principal Investigators and Partners

Creating BodyPresent involves research expertise from various disciplines therefore we take advantage of Equator's support for interdisciplinary collaboration by leveraging of the strengths of University of Sussex's user-centred design techniques with Lancaster University's expertise in embedded systems and sensor integration.

BodyPresent Partners:

Manuela Jungmann has a background in art and real-time multi-media applications. She is currently a PhD candidate in her 2nd year at the University of Sussex and the Equator programme. Her PhD work focuses on representation through bodily movements.

Nicolas Villar is a research associate at Lancaster University and the Equator programme, with several years of experience developing physical interactive systems. He has collaborated with the Royal College of Art team integrating the technology behind the Furniture for the Curious Home, as well as the development of the Pin&Play [7] as a platform for tangible interaction.

Expected results

BodyPresent's physical display creates an innovative approach towards tangible computing. In the process of creation, specific questions have to be researched and resolved.

During content development results to questions like these need to be obtained:

- *Aspects of feedback and reaction times*

How long will it take a person to understand that their sway is animating a pattern? - How much feedback is needed for the person to understand that patterns can be made?

- *Group dynamic through group COP or individual COP's*

How do people recognize that they are feeding into one COP? -How do people recognize that they can make a pattern together when each person is animating their own COP?

- *Complexity of pattern, including aspects of evolution*

What is a feasible level of complexity for a pattern to be made?- If people reach a certain threshold collectively, such as a pattern that has been animated for a certain time or build up to a certain complexity, what has to be done to the pattern to keep people engaged?

On the technical side, we are looking for answers to some of the following questions:

- *Tracking the COP*

Can we successfully track a person's sway or COP by using a load-sensing stand?

Can the existing weight-sensing hardware- originally developed to track the position of objects on surfaces- be appropriated and its sensor data be reinterpreted to detect the subtle swaying movements of a person?

What mechanism between feedback and pattern needs to be established so that the person understands uses very subtle, swaying movements?

- *Ferromagnetic fluid as physical display*

Can ferromagnetic fluid be a useful material in the development of a generic physical display technology? - Sway motion changes every few seconds; is the fluid responsive enough at the same fast timescale?

How can we develop a flexible mapping mechanism between sensed sway and displayed pattern to quickly experiment with different strategies to visualize the same data?

Work towards publications and dissemination will start in the second phase as indicated under Schedule and Milestones. We are also planning to present BodyPresent at various academic and public venues, e.g. Blip, ECAL2007.

Tackling interaction in ubiquitous computing has often meant research towards explicit bodily movements. With BodyPresent we are aiming to convey that less outwardly expressed interaction can be a valid advance towards the broadening of the range of possible embodied interactions with technology. We are expecting to create a platform that has given way to interaction, simultaneously combining the body (the self), others, and the collective and coordinated manipulation of a physical object. BodyPresent draws from multidisciplinary influences which come together creating a platform where future studies could be conducted that open up new areas to be embraced by ubiquitous computing. An applicable field would be embodied cognition, specifically research in adaptive systems and social coordination. The flexibility that such a platform puts forth can influence a variety of applications in the public and academic arena, and therefore work towards an Equator legacy contribution.

REFERENCES

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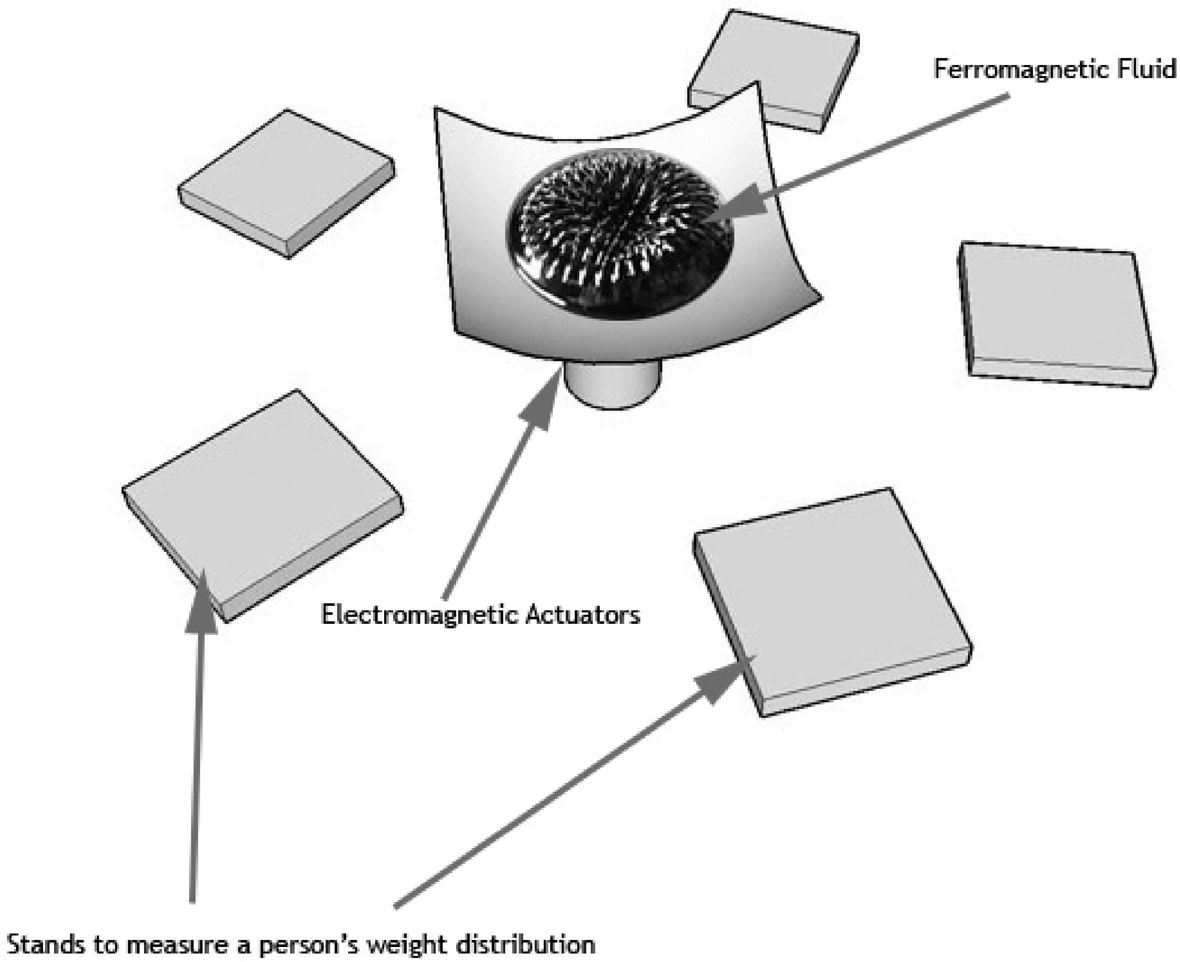
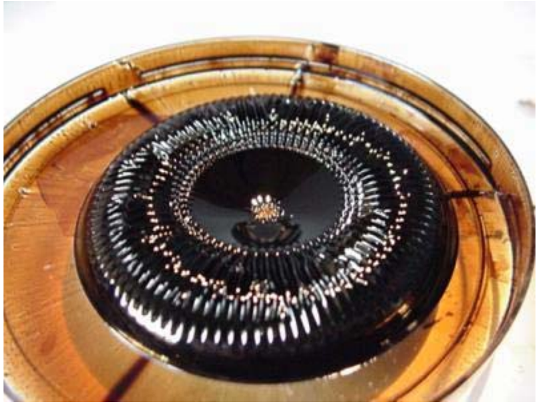
Annex 1: Schedule and Milestones

Activity	Phase 1	Phase 2	Phase 3
Milestones: -small scale experiment with fluid and magnetic actuator -experiment with actuator shape, quantity, arrangement, fluid, and container form. - Set up for in-situ user studies including one sensing stand	3 weeks- by June 06		
Milestones: -developing software –sensor data to COP - perfecting load stands with multiple users -development of hardware for computer-controlled actuator array -Running of in-situ user studies ▲ Demonstration of operational single use sensing stand with the physical display		3-4 weeks – by Sept 06 ▲ Demo	
Milestones: -Integration between COP data and ferrofluid display -Exploring mapping strategies COP-fluid visualization -Testing and refinement, final version		4 weeks – by Jan 07 3 week – by Apr 07	
Design and implementation			
Writing and dissemination			

Annex 2: Installation Set-up



Annex 3: Examples of animated ferromagnetic fluid



Images from http://www.wondermagnet.com/ferro.html