The Lega: A Device for Leaving and Finding Tactile Traces

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ABSTRACT

This paper describes experiences from development and deployment of the Lega, a hand held device for physical sharing of experiences during an art exhibition. Touching and moving the device in different ways creates a tactile trace that can be experienced by others through their own device. The system was successfully deployed at an art exhibition for two months where user studies were performed. Here we present some general observations regarding the systems performance and discuss issues that we encountered.

Author Keywords

Tactile interaction, gestural interaction, individual and social use

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms

Design

INTRODUCTION

This paper presents the Lega, a hand held device that lets visitors to an art hall share their experiences via physical traces that are created through bodily means of interaction. The Lega has an ovoid form that fits into the palm of your hand and has a soft surface that encourages tactile and gestural interaction. By touching and moving their device in various ways users create expressions of their experience that are left at their approximate location. There they can be discovered and experienced as vibration and light patterns by others in the group. Our intention was to create an experience reminiscent of someone drawing in your palm.

The design draws on experience oriented HCI research where there has been an increasing number of attempts to map out interaction qualities such as pliability [4] and suppleness [3] and the challenges related to designing for them. They all recognize the fact that experiences arise in use and depend on a combination of hardware, software and design elements. This holistic view makes the task of designing a system challenging as you constantly have to juggle several interdependent factors. Matters become even more complex when taking the view that representative use experiences are not likely to arise, and are therefore difficult to evaluate, until there is a sufficiently polished prototype available. When working with novel hardware and form factors this could in essence mean having to develop several more or less completed devices before design goals are reached.

There is a substantial body of work on the use of tactile information for non-visual information display [see e.g., 1] and input [see e.g., 5]. Our own work has been less focused on the use of tactile input/output for information transfer purposes but has rather focused on the experiential qualities afforded by tactile interaction. In that sense it bears greater resemblance to tactile messaging systems such as Share2Talk [2] which supports sharing of sensations between users.

While having a strong identity of its own, the Lega concept builds on experiences from *eMoto* [7] and *FriendSense* [6], two earlier prototypes developed within our group. In particular it shares the focus on communication and interaction within groups of friends, but also its focus on bodily interaction, with those earlier prototypes.

Here we discuss how hardware, software and infrastructure constraints together with ethnographic findings contributed in forming the design space out of which the Lega evolved.

DESIGNING THE LEGA

The Lega, named after the Swedish word for a place in the woods where you can see that an animal has slept, was developed in an iterative process that continued throughout the deployment at the art hall. Early users during the two months of the deployment at the art exhibition thus used a slightly different system compared to later users.

The annual Vårsalongen event at Liljevalchs exhibits professional and amateur art selected by a jury from anonymously submitted pieces. Each year around 250 pieces are exhibited for a period of two months. The event is visited by ~ 40.000 visitors each year and has a long-standing tradition of stirring up emotion and engagement from both visitors and media. The ethnographic study we made on-site during Vårsalongen 2009, as well as the art halls own statistics, showed that most visitors visit the

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exhibition in small groups of 2-5 people, with some larger organized tours taking place during evenings and weekends. For our purposes this was a perfect match between our interest in emotional and bodily communication of experiences among friends, and an emotionally evocative event visited mainly by small groups of friends.

The starting point for the design of the system was an ethnographically inspired study of art exhibition visitors and the way they experience and communicate about art through their bodily gestures. As an outcome of that study, we developed an approach to more explicitly taking bodily experiences as inspiration for design. In order to allow for creative linking between ethnographic findings of bodily practices and design, we developed a set of *body act* cards that were used in idea generation and prototyping. The cards are developed to carry experiential qualities from ethnography to design, providing details about movement, touch, gesture, spatiality and so forth, while still opening up for the creativity and interpretation necessary in productive design work.

Much of the design work was conducted within the premises of the art hall allowing ideas and concepts to be tried out in-situ. The design team, of about 15 people, consisted of interaction designers, industrial designers, hardware, sensor and software engineers, as well as HCI-specialists. In using the body cards in design we started out by giving the design team a presentation of the situations in the video material out of which they were derived and collaboratively analysed short snippets of video. This gave the team a first understanding of the setting and the phenomena of specific interest that had been identified. We presented the body cards and how these related to our studies. The design process consisted of a number of design exercises, lo-fi prototyping, and efforts to imagine the experience of users. The key inspiration for the idea that led up to the Lega was the *dancing eyes, fingers, and bodies* and *urge-to-touch* cards. The first card builds on observations of how visitors used the physical space to split up, re-gather, and invite each other to share experiences. The second card builds on observation on the substantial interactional work visitors did to experience the physical and material qualities of the art and the role this played in sharing, seeing, feeling, and imagining the art together with other visitors.

The design process itself started on site at Liljevalchs with a five day workshop that resulted in early implementations of several different concepts. Later several of those were merged to form the Lega concept. Over the course of the following months we involved art hall staff in testing and discussing prototypes as the concept was gradually refined. We also held weekly “build fests” for the design team where features and ideas that we had been working on during the week were tested and discussed, and where we decided what to focus on until the next build fest.

We also returned to Liljevalchs for testing prototypes with art hall staff on two occasions before the Vårsalongen event and received valuable feedback. Finally for three weeks before the event we gained free access to the art hall for testing and deploying the system while the exhibition was being set up.

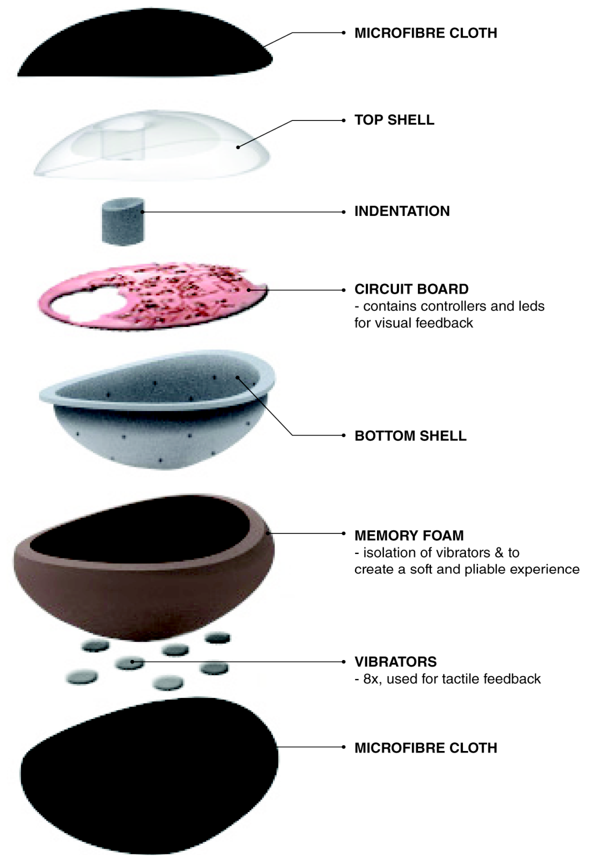

Figure 1. Exploded view of a Lega showing it's layers

Construction

Throughout the design process careful attention was paid to the visual and tactile qualities of the device. We wanted its shape and visual appearance to invite users to pick it up and touch it. The Lega has an ovoid shape that is designed to fit comfortably into a users palm. Users can carry it in one or both hands while walking through the exhibition or let it hang by its strap. The ovoid shape also makes the device orient itself naturally in a users palm although it is possible to hold it comfortably in a variety of ways (see Figure 2, top left).

The device consists of two pieces, a top and a bottom part. The bottom part is a four layer structure (see Figure 1) consisting of a hard inner shell made from plastic, housing and protecting most of the electronics, covered by two layers of 4mm memory foam, and topped with cloth. The foam layers make the surface soft and pliable so that users to some extent can “squeeze” the device, while the cloth layer affords a soft silky surface that invites tactile interaction.

In between the foam layers eight vibrators catering for tactile feedback are embedded (see Figure 2, bottom left and right). Vibrators can be turned on and off – and their intensity can be set – individually to create various patterns of vibration. Vibrators fill a second function as electrodes for the non-contact capacitive touch sensor circuit that provides the means for tactile input. In addition a thin metallic foil to improve the sensitivity of the touch sensor also covers each vibrator used in this capacity. The foil is thin enough to not interfere with the overall tactile quality of the device.

The top part houses a servo-powered button that is used to alter the depth of the indentation on top of the device. Through a simple modification we were able to read the state of the servo's internal potentiometer thereby enabling it to also function as a sensor, telling us when the button was pushed. A single layer of cloth to create a seamless appearance covers the whole top, including the button. In addition the thin cloth layer allows light from the multi colored LEDs inside the device to shine through.

Figure 2. An assembled Lega, the inner shell, vibrator placement, and touch sensor placement.

Infrastructure

Positioning in the system relied on an infrastructure consisting of small, networked, sensor nodes placed around the art hall (See Figure 3). Each node corresponded to a rough location that usually covered more than one art piece. At regular intervals each node would broadcast its ID using a low transmission power to limit the range of the signal. Measuring the signal strength of all ID transmissions that their Lega could pick up and choosing the strongest one would then determine a visitor's position in the art hall. When a visitor left a trace it was uploaded to the infrastructure node "closest" to their position where it could be picked up by others. The art hall consists of 12 rooms and a lobby that are used for exhibiting art works. Each room was covered by 2-3 beacons creating an equal amount of "places" in the room.

Figure 3. Deployment of infrastructure beacons at the exhibition.

Usage

Lega devices are used in groups of 2-5 people. Each person gets their own Lega and moves around the exhibition freely. To make it possible to identify the source of a trace each device is associated with a color that is shown when a trace is found. The Lega constantly records signals from touch sensors and accelerometers. When the indentation on top of the Lega is pressed a trace based on how the Lega has been moved and touched for the past five seconds is transmitted to the infrastructure. This causes the servo-powered button to move down increasing the depth of the indentation, symbolically creating a "lega". Once the trace has been transmitted to the infrastructure the button resumes its original position. By changing how they move and touch their device different expressions can be created. Currently traces are based on how energetic the movement of the Lega has been and the rate of change in touch sensor activation.

Figure 4. Lega devices being used at the art exhibition

When a trace is found by another user the button again moves down to indicate that there is a trace present. At the same time LED patterns light up to show which of the other users left the trace (see Figure 4). When found, traces are experienced as vibration patterns that attempt to capture the characteristics of actions taken to create a trace. Note that traces have no inherent meaning. They are ambiguous by design to allow for a wide range of interpretations. Instead users make sense of them based on their knowledge about the person that left them, e.g. their likes and dislikes and ways of expressing themselves.

DISCUSSION

Over the two months that the exhibition lasted we performed extensive user studies using a wide range of methods. Here we present early findings along two themes that were crucial for users experiences and future technical development: the individual experience of traces, and how positioning of traces in the art hall played out in the practical circumstances of daily visits.

Experiencing vibrations. Our intention with the Lega was to create an experience reminiscent of someone drawing in your palm using a grid of vibrators. While developing the Lega we made interaction tests that convinced us that this would be possible. However, as we later found out users sometimes had difficulty distinguishing between characteristics of patterns other than their intensity of vibration. Due to the construction of the device vibrations easily propagate through the hard inner shell like vibrations that travel through human bone [1]. This makes it difficult to distinguish exactly where vibrations are coming from. A solution to the problem is to take advantage of this “flaw” and make vibration patterns more distinct by basing them more on intensity and rhythm rather than individual vibrator activations. Another is to find a transducer technology more suited for the intended experience as suggested by reviewers of this paper.

Positioning and people. The positioning scheme that was used is quite coarse. Due to the nature of radio communication this would on occasion result in more distant nodes being selected as the closest one For our design an approximate location was sufficient but when a trace was, as happened sometimes, left in a different room it was of course confusing for users.

On the other hand something we believed could be an issue actually turned out to work in our favor. As the exhibition would at times be quite crowded we worried that transmissions from the infrastructure would be absorbed by the mass of visitors. However, in the end this turned out to be an advantage instead as it further localized the range of broadcasts thereby making positioning more consistent.

Another issue became apparent when group size became larger or when users were very active in leaving traces. In such situations the exhibition would be flooded with traces causing the Legas to constantly find traces and replay them. As an effect it diminished the sense users had of finding something valuable left behind for them. One workaround for this would be to instead let users scan for traces when they want them, or to notify them in some more unobtrusive way that there are traces to be experienced.

CONCLUDING REMARKS

In many respects the Lega design was successful. It successfully merged hardware, software and design elements to create a system that is evocative of the type of experiences that were sought. However, it also emphasized the need for thorough exploration of the qualities of the components that go into the design at an early stage in the design process. For instance, although the vibrator grid was tried out at an early stage, the way in which vibrations were experienced changed dramatically once it was mounted on the hard shell of the Lega device. The challenge in designing systems such as the Lega involves not only exploring experiences provided by different technologies, but also finding ways of keeping those experiences intact throughout the development process.

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