From movement to mechanism : exploring expressive movement qualities in shape-change

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From Movement to Mechanism: exploring expressive movement qualities in shape-change

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Abstract

This one-day studio revolves around the exploration of expressive movement qualities in shape-change by means of physical sketching and prototyping. It is a hands-on studio where participants first explore expressive movement qualities and interaction scenarios with a generic shape-changing platform and then abstract the explored movement qualities to model them in detail using cardboard modeling techniques combined with an Arduino controlled actuator (the advanced cardboard modeling platform). We recognize and want to zoom in on the potential of the expressiveness of shape-change in the context of human-product interaction as an emerging field in HCI research. In this studio we aim to both acquaint participants with new, low threshold platforms for exploration and give them insight in and a vocabulary of expressive movement qualities in shape-change.

Author Keywords

Prototyping, Design, Expressive movement qualities, Tangible interaction, Rich interaction.

ACM Classification Keywords

H.5.2 User Interfaces: Prototyping.

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Introduction

Shape-changing interfaces are set to revolutionize human-product interaction but while technologies for shape-changing interfaces are rapidly evolving, our understanding of the design space of such interfaces is still limited [1].

Central to this studio is the exploration and synthesis of expressive movement qualities in shape-change by physical sketching and prototyping [2]. More specifically, it revolves around gaining insight in and developing a vocabulary of such movement qualities to be able to work towards an understanding of how to design for them. To this end the studio has two aims: (1) it presents low-threshold tools for the exploration of shape-changing interfaces and (2) it presents the notion of expressive movement qualities in shape-change and explores the subtleties required in form, interaction, function and resulting behavior. First we introduce the notion of expressive movement qualities in shape-change, then we present the advanced cardboard modeling tools for the exploration of interactivity and lastly we present the studio itself.

Expressive movement qualities in shape-change

We describe shape-changing interfaces as interfaces that use “*physical change of shape as input or output. We follow earlier work that has used self-actuated change as a defining characteristic [...]. Additionally, we require that the self-actuation must be controllable so that the object can return to its initial state and repeat the shape-change*” [p1, 1].

In an earlier publication we explored the design space of shape-changing interfaces [3] and found that people

describe their experience with shape-changing interfaces in expressive terms that are similar to personal characteristics (or ‘qualities’) that we use to describe ourselves or (our interaction with) other people [4]. These expressive movement qualities are the result of a complex interplay between form, interaction, function and resulting behavior in which subtle differences can have a big impact on the user experience.

We see a potential in making use of the apparent expressiveness of shape-changing interfaces to further the field of human-product interaction. Expressive movements add a new layer of communication that can be used for non-iconic, non-anthropomorphic expressions of affect [5] and thereby invite for novel ways of interaction between humans and computers [6] and thus novel ways of interaction between humans and products; addressing perceptual-motor, cognitive, emotional and social skills. In the short term this can lead to compelling continuous interaction rather than discrete interaction through, for example, buttons. In the long term this can lead to more engaging interfaces as behavior can adapt to use, new functionality or trends.

A growing concern we have is that the behavior of shape-changing interfaces and other dynamic interactive products and systems is designed as an afterthought and as such misses out on the potential expressive movement qualities offer in terms of user experience. We would like to encourage people working with shape-change to explore these expressive movement qualities and attune themselves to the subtleties in form, interaction, function and resulting

behavior by offering them low-threshold platforms and accompanying methods.

Advanced Cardboard modeling tools

The advanced cardboard modeling platform combines advanced foam-core and cardboard modeling techniques with Arduino controlled sensors and actuators. It emphasizes the mechanical and physical aspects of interaction and offers the possibility to experientially explore interactivity and synthesize interactive prototypes in the early phase of the design process.

The advanced cardboard modeling tools were introduced in a studio at TEI'14 in Munich [7] in response to two points of criticism on existing tools: (1) sensing has priority over actuating and (2) the integration of form, interaction and function [8] is not recognized as a carrier of meaning and expressivity [7].

In this studio we go further and chart new territory for the use of early phase exploration tools and aim for the exploration of shape-changing interfaces that are capable of integrating form, interaction, function and resulting behavior. We introduce a generic shape-changing platform that requires no programming skills and allows to quickly sketch expressive movements using a technique similar to programming by example. To go from a generic to a unique design this platform is complemented with the advanced cardboard modeling tools as a means to elaborate, fine-tune and synthesize movement. Under the guidance of the studio organizers participants will abstract expressive movement qualities from the generic sketches and translate these from a generic to a unique design using advanced cardboard modeling; building on more than eight years of

teaching and numerous workshops on cardboard modeling [9].

Detailed studio setup

The studio has place for sixteen participants and presents a generic shape-changing platform and advanced cardboard modeling tools for the exploration of expressive movement qualities. It builds on cardboard modeling skills and on Arduino programming skills. While we do not require previous knowledge and skills it would be helpful if participants have some prior experience, particularly with programming the Arduino microcontroller.

The one-day program of the studio is as follows:

- (1) The studio starts with an introduction of our generic shape-changing platform as a tool to explore expressive movement qualities.
- (2) A range of explorations is made using the shape-changing platform, exploring expressive movement qualities. To guide this step, participants are given a list of expressive qualities from which one is chosen as a starting point to create 'Wizard of Oz' interaction scenarios.
- (3) An introduction to cardboard modeling is given. We focus on integrating actuators into foam-core models and using mechanisms to decrease the number of servos required to create specific expressive movements.
- (4) A quick introduction to the Arduino platform is given together with example code.

(5) A range of explorations is made, exploring a chosen 'expressive movement quality' in detail. One of the explorations is chosen and elaborated into a 'museum quality' prototype having both qualities in the physical and in the digital.

(6) The explorations are presented.

Please note: the participants work in pairs. The participants need to bring a laptop computer with the latest Arduino software pre-installed (www.arduino.cc).

Next to this we bring the generic shape-changing platforms, Arduino boards, motor shields and other electronics that are not covered in the studio fee. These need to be returned after the studio. An open-source building plan for the generic shape-changing platform will be made available after the studio.

Learning goals

1. Explore the concept of expressive movement qualities in shape-change and gain a vocabulary to discuss it.
2. Discover the advanced cardboard modeling tools as a platform for exploration of interactivity: Acquire new exploration skills.

Studio Supporting Web Documents

<http://www.cardboardmodeling.com>.

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