Enactive sketches for designing enactive interactions

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ABSTRACT

The role of sketching for designing enactive interactions is reviewed, a conceptual framework is described and an exploratory case study is analyzed and discussed. The framework is organized as a map with two dimensions: the first one expresses the interactivity embodied in the different representations used by designers. The other dimension organizes the user experience expressiveness achieved by the different sketches. The sketch categories are linked through the attributes of interactivity sought by the designer. The case study supports the need to include some form of interactive sketching for designing of enactive interactions..

CCS Concepts

- **Human-centered computing ~ Interface design prototyping**

Keywords

Sketching; enactive interaction; design

1. INTRODUCTION

Designers are used to sketch a lot during the ideation stages and many of intermediate products of design activity are sketch like models[7]. The object of interaction design is dynamic, experiential Designers need to represent how people interact with products. So, their sketching differs from other domains: models and representations has to be both static and dynamic, they have to focus on kinesthetic experience, temporal aspects, tangibility, etc.

Enaction involves expressing and getting knowledge through the act of performing physical activities tightly coupled to perception[4]. Enactive interfaces are human computer interfaces based on enactive knowledge.

This paper presents a conceptual framework to organize sketching for enactive interactions design and a case study about sketching enactive interactions in hardware.

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2. FOUNDATIONS AND RELATED WORK

2.1 Enactive interactions

Theories of embodied cognition and enactive action-perception offer new foundations for the current stage of tangible, embedded, embodied interaction [3, 4, 9]. The "cognitivist" approach [4] put on the user side some type of reasoning between perception and action. The user is forced to change the focus of his attention from the abstract output of the device to make sense to that output in order to decide the appropriate course of action. Instead, the enactive approach considers that sensory perception (input) and motor performance (output) are two sides of the same process of construction of meaning. A enactive interface can be defined "as a technological interface designed with the purpose of increasing the construction of meaning"[4]. The sense making process begins by an immediate understanding of the situation and only after it reaches an interpretation mediated by language or reflection. This embodied activity can be defined as a state of mixing action and awareness to achieve complete integration of the agent and the context where the interaction takes place, kind of a "transparent", fluent interaction.

2.2 Sketching and interaction design

Interaction design is the process organized to create, shape and decide all the qualities of a digital artifact oriented to use[11]. Interaction designers often use sketches and models to support the process. These sketches don't follow any particular order. Sketches are made to learn, to understand a situation, the design space boundaries, the possibilities of usage scenarios: they are not only an externalization of ideas in the designer's mind but vehicle to reach new ideas[1, 13]. This demands sketches being quick and easy to make, to record, to review, to discard.

Sketching for designing interactions post-WIMP includes a combination of a particularly low-fidelity prototyping and sketching in hardware [1, 8]. Sketching in hardware involves an attitude of tinkering with technological components in an exploratory and open way, almost a kind of "do-it-yourself". The key is the condition of ephemeral or circumstantial, since the work is aimed to easy the process of discovery and learning, not to getting a perfect model. These "ad hoc interactive prototypes" are also "conduits for a design conversation, not accessories"[7]. Another important aspect of physical modeling is that it helps to activate the spatial and kinesthetic awareness and become enactive representations. These objects help in participatory design processes and facilitate communication with the user[8]. However, physical models restrict the design space more than the sketching on paper. Sketches in hardware are richer in information about UX possibilities but at the same time they lose ambiguity or limit the emergence of ideas and reinterpretation allowed by paper sketches on paper. So, they complement each other as design tools.

2.3 Supporting interaction sketching

Different tools have been developed to support sketching in design. From the electronic versions of 2D sketching (like Balsamiq[1]) to more process oriented tools[12]. Also frameworks, platforms and tools have been presented to integrate sketching in hardware to design process[5, 6].

Closer to the design of interaction shape itself, there are conceptual frameworks or taxonomies that provide a kind of map or route guide for the sketching process. For example, Lim[10] organizes an "Anatomy of Prototypes" along two set of dimensions: design aspect manifested by the sketch (material, scope, resolution) and idea attributes filtered (appearance, functionality, interactivity) . Based on this anatomy, they have built a tool to help designer focus on the shape of interaction qualities, without coupling to a concrete product[14]. Our work is closer to this approach than the former. But we aim to provide tools to sketch interactivity as part of product design ideas rather to just being explored in isolation.

3. A FRAMEWORK FOR SKETCHING ENACTIVE INTERACTIONS

During early stages of interaction design process a flow between different forms of representation takes place. Without any predefined order, an idea is plotted on paper, the sketch extends to the storyboard format, some mockups are built with any object at hand and the imagined interaction is enacted with them. In each step, concepts are tested and new ideas or corrections emerge [7].

As long as the embodiment is central in enactive interactions, the designer has to combine simulation in his mind with simulations in the world to fully understand the interaction in play [9]. Simulations "in his mind" are supported by externalizations like sketches or storyboards, but 3D objects manipulation or body performances allow him to discover and understand some issues otherwise would remain hidden. In 2D sketching, an interaction walkthrough can be implemented through a series of gestures and supported by the designer's imagination. This is a process that the sketch is part of, but that is external to it. In interactive, hardware sketch is the sketch itself which allows this exploration.

The interactivity, as the filtering dimension in the anatomy of prototypes[10], can be used as the thread connecting different sketching levels or views of the same design idea.

The representations can be organized according to two dimensions (see Figure 1). The first dimension is defined as a continuous growing of information regarding the desired interactivity, from sketches on paper or any other 2D surface objects with capacities up to embody the desired interactivity: 2D freehand sketching, 3D model making, sketching in hardware. The design process doesn't follow any predefined order among these levels. Some mechanism to trace interactivity through them should be provided.

There is another dimension which we can call the user experience (UX[2]). At some time exploring the experience required to study only one of its parts and others, together with a higher level of abstraction. So, it appears a fourth type of sketching, the UX sketching is any kind of representation, in any medium that is designed to understand, explore and communicate how could be the use of the product is designed so that you can use any of the other representations with the addition of context relevant to the situation of use.

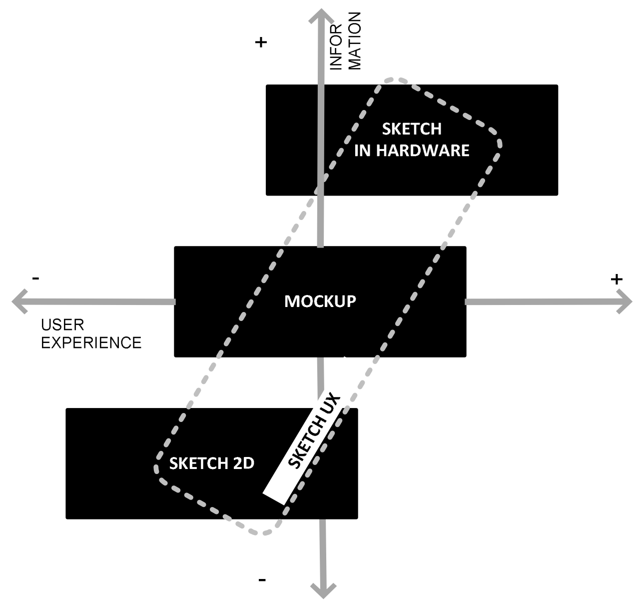

Figure 1. Framework for sketching enactive interactions

As we move up the scale of information, interactivity becomes more specified and embodied. In 2D sketching, it can be expressed with some labels or using a storyboard like sequence. However, in a sketch in hardware the designer have to decide whether the desired experience is achieved by an immediate or deferred response, fluent or stepwise, etc. So, some mechanisms to get traceability of ideas among the different representations could be necessary. We use the interactivity filtering dimension in the form of a attribute vocabulary, each defined within a range (i.e. slow-fast; stepwise-fluent, instant-delayed) as proposed by Diefenbach[2].

4. A CASE STUDY

4.1 Design

To explore the sketching of enactive interactions in the light of the proposed framework we run a case study. We proposed a group of interaction designers to develop ideas for a device based on sensory substitution (haptic feedback to replace or augment the visual feedback). As a triggering example we presented the designers the Enactive Torch [4].

No specific form of representation was suggested for the design process, either for the final presentation. The exercise was conducted during a Master in Technology for the Electronic Arts. Nine participants took part (5 males, 4 females). They have backgrounds in design, art and programming, all of them with experience in their fields and practical knowledge about building hardware models. Along 3 meetings, each of 4 hours, they developed ideas organized in three groups. Data collection was done by recording sessions on audio and video from one fixed point.

4.2 Results

After gathered the data an analysis was made by authors on the recorded audio and video. All graphic material and software code was kept after sessions to support video analysis. The focus was

[1]http://balsamiq.com

[2] UX stands for User eXperience

put on the different types of representation used by designers and the traceability that could be found among those models.

As base schema we used the anatomy of prototypes by Lim[10]. Each verbal utterance was transcribed with identification of actions made by designers, material and filtering dimension involved, traceability to other actions.

The first group developed a playful version of the enactive torch, as a guiding puppet for visually impaired children. The second group worked with a version of a "dreamcatcher[3]" (they called it "interactive nightmare catcher"). And the third group proposed a haptic mouse allowing visually impaired users to haptically navigate over the "texture" of an image displayed on screen.

Here we describe some of relevant results found.

4.2.1 Sketches as UX enacted representations

All groups started with improvised enactments of hypothetical use scenarios followed by talking about design alternatives. Most of them commented the need to feel the haptic feedback on their own skin in order to imagine a design proposal with sensory substitution. They referred the difficulty to imagine the notion to convert haptic feedback to space awareness.

So, designers decided to build almost immediately some very limited models, just to feel the sensation, using them to simulate a desired UX. They took some ad hoc objects and enacted a performance of a tour by the room using a “guiding puppet” in a hand. Also when designers started to combine electronics with other materials (as fabric for dresses in the puppet case), they found out the need to test the interaction in terms of haptic feedback with models that combine all parts of the model.

In order to validate the attributes of the response curves they were analyzed "in the abstract" only electronic, need to include the whole to experience differences between placing the engine in a wrist or in the palm, etc.

4.2.2 Opportunistic decisions based on sketching materials

The three groups made some decisions after discovering some feature on the sketching materials at hand. For example, the puppet group started using an IR[4] sensor (as in the original torch) but preferred an US[5] one, after discovered that its visual appearance resembled the puppet’s eyes.

4.2.3 Interactivity as filtering dimension preferred

All groups worked directly on the shape of the interaction. They left for the final tests considering the other four schema filtering dimensions (appearance, data, functionality and spatial structure. Keeping the focus on the interaction itself involves a posture of exploration and discovery that make the product shape emerge as an embodiment of the interactivity sought, as implied by the enactive approach.

4.2.4 Tinkering approach to speed up ideas testing

The three groups employed a “do-it-yourself”, "tinkering" approach to build physical, interactive models. For example, they first made a simple circuit model on a protoboard and programmed the interactivity control with Arduino[6] board, with an iterative process of trial and error. Only after they were satisfied with the answers provided by the model, they refined the circuit or replaced adhoc elements with designed ones.

4.2.5 Need for speeding up building interactive sketches

The adjustment of interactivity (i.e., the motor response curve as feedback to the measured distance) was made on the Arduino code with iterative processes of re-coding, compiling and uploading to the card. Here designers claimed for tools enabling them to keep their focus on the ideas flow, as paper sketching does. They regretted not having a tool easing to implement the UX they were looking for (pleasure, leisure, and containment) without so much trial and error.

4.2.6 Interaction attributes are expressed on every sketch type

Designers registered the interaction attributes sought in every model. On 2D sketches or storyboards, they did many textual annotations. But also on the mockups or sketches in hardware they tried to register how to achieve an imagined interactivity (they used post-it notes on mockups and some comments within the code).

5. DISCUSSION

The case study has supported our assumptions for proposing the framework: the relevance of sketching in hardware for enactive interactions design, the focus of the designers on interactivity and UX, the need to low the threshold for getting interactive sketches with no interruptions to the designer thinking. The workshop has shown that to create new interfaces to interact with gestures, body movements, manipulations, etc. designers complement paper sketching with enactments in the real world, using their own body and 3D models.

The design of interactions with sensory substitution seems to imply a complexity that cannot be supported only with static sketches and dynamic, interactive sketches come into help. Static sketches can be seen as elements of a state transition diagram. So they complement the ephemera nature of enactments. These have no stable traces stable and, at different stages of the design process it is necessary to have a documented specification of an idea. So, making interactive sketches seems a convenient solution. But in sketching in hardware the story of transitions is lost. If the designer wants to recover a previous state, sometimes simply redeploy a previous connections or code. But it is not easy. Especially it get complicated by the nature of the software-hardware relation that allows for changes in the functionality offered just by modifying some internal conditions without touching anything about the physical form of the sketch in hardware. This is a limitation of sketching in hardware that must be taken into account in development of new tools.

Therefore, from these results we propose some requirements for tools aimed to support the design of interactions with enactive approach:

- Integrate all possible forms of representations, from 2D sketching to interactive hardware sketches. Enable the production of 2D sketches as analogy of graphic paper made by interaction designers (free stroke, lack of structure and ambiguity). Support building mock ups and sketches in hardware. All forms of sketching included must be easily integrated and linkable by the designer. Somehow they could be considered different "views" of an idea in design so that a score in any of them should be reflected in the other. Let the

[3] http://en.wikipedia.org/wiki/Dreamcatcher

[4] InfraRed sensor

[5] UltraSonic sensor

[6] http://arduino.cc

designers to replay the story of transitions in the design process whenever they want.

- Allow to express interactivity attributes and trace them among different sketching levels.
- Keep the access threshold to the sketching technology, as low as possible and “interaction designers oriented”.

6. CONCLUSION AND FURTHER WORKS

In this paper we have reviewed some characteristics of sketching activity for enactive interactions design, especially as a way of embodying the thought of the designer. We have seen that the challenges of new embodied, embedded interactions demand tools that exceed the 2D sketching and 3D mockups. We have presented an exploratory case study and proposed a framework to integrate sketches in hardware along with other representations in the ideation process.

Future work will include a deeper analysis of interactive sketching for the enactive approach and refining the framework.

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