MISSING LINK – DESIGNING FOR DEPENDENCY

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ABSTRACT

In this paper, we investigate aspects of interaction design related to the appearance and context of dual-natured design objects, meaning artefacts with physical form and digital behaviour. In interaction design of today there is a focus on isolated artefacts/objects, but does not involve the context in the sense that it is a vital part of its design and expression. We argue for interaction designers to take respect to the dependency of computational design objects to their context in greater extent. We would like to ask interaction designers to look at their work as part of a whole, where their creations will influence / be influenced by the rest. A workshop method named 'Missing Link' used in teaching is proposed here. The workshop confronts questions on how to give up control of your design and at the same time in a creative way exploit the available rules of the bigger system.

INTRODUCTION

We argue that information technology can be viewed as a material for design (Löwgren & Stolterman 2004, Hallnäs & Redström 2006). This material is both abstract and concrete, both imaginary and material, both software and hardware. It manifests its expressions in the spatial, physical realm through displays of various sorts, but the true nature of this material is primarily temporal, as the dynamic motion of executing program code is its essence. This material allows for precisely controlled dynamic behaviours, communication, as well as adaptation to new or local conditions. This material is central to the field of interaction design. However, it is not sufficient for successful interaction design on its own. Other materials are needed as well, to form and shape the things we will come to use and live with. These "other" materials are primarily physical, such as plastic, metal, glass, wood, textile, even though we also need more abstract things such as ideas, organizations, economy, etc.

In this paper, we focus on designed things, or artefacts, that are made of several materials, but where the central material is information technology. In a way, such things can be said to be made of a *composite* material, in analogy to how carbon threads are used to reinforce Kevlar. Kevlar is much more powerful than its constituents on their own, and the same thing is true for these computational things. Things built with this composite material have a dual nature, they are of course physical, but they also have a computational, or virtual, part to them. This *dual nature* will be central to this paper. We believe that existing approaches to design, engineering or software development tend to focus on only one of these aspects, or perhaps one after the other in a development cycle, but it is rare to consider both physical and computational design simultaneously, equally important, feeding into and depending on one another.

Today, with Weiser's future scenario of ubiquitous computing a reality (Weiser 1991), when the design paradigm has shifted towards a theory and practice of physical interaction with digital materials, it has become time to take the next step, to take respect to the dependency of those design objects to their context. We understand context as the combination of the social fabric and the physical location where the object will be placed. As design object we understand the outcome of the interaction designer's work, a mixture between aesthetically valuable artefact and service, dependant to a certain extent on existing infrastructures. The potential connection among dual-natured artefacts should also be informed by means of spatial aspects (physicality matters) as well as the digital ones, and remain in control by humans. In contrast to automation the human should stay in control, not be controlled. Note that we separate control from autonomy, our design objects are part of a system, and have to be able of relating to it. We – as users – with our devices are dependant on the existence of other users and infrastructures interacting at the same level and with the same tools. We are dependant; therefore we should *design for dependency*.

Our statement will be exemplified through a workshop held with master students in interaction design from two different universities. The intentions, setup and results of this workshop will be discussed based on our idea about the importance of designing for dependency. Artefacts that are dependant on in what way they are connected to the environment and to other artefacts. They have inputs from the users and outputs to the world, inputs from other systems/infrastructures and outputs to those. They act as transceivers, retrieval servers, information sources, or data black holes. They are not simply self-contained things, objects must contain mechanisms allowing them to consider and be able to take advantage of other (nearby) objects to greater extent than today. Our considerations move towards the standardization of means of relationships among devices, meshed strategies of data retrieval that could provide us with alternative, even aesthetically beautiful unexpected representations of flows.

Not just communication standards, such as UPNP, JINI, Bluetooth, IEEE 802.15 (PAN), etc. but also standards that take physical space into account should be developed. It seems that with the introduction of the mentioned standards, the qualities in the potential of properties from the physical world have been forgotten. And this is maybe our main statement; we want to get back to the qualities in property from the physical world inside the interaction design discourse. Our tools, physical computing and architecture, are a cocktail in study at many different places. Our experiment and its results are the first brick of our staircase to the understanding of the dual-natured design object.

SYSTEM DESIGN

Within engineering's work methodology exist mechanisms dedicated to simplify the way how to approach problems. It is the separation of problems into pieces and the establishment of communication protocols what allows teams to work simultaneously in the development of integrated circuits. There are more similarities between the activities of designing a CPU (Central Processing Unit, part in a circuit dedicated to the realization of numeric operations, process control, etc) and the management of an airport than one can imagine. The design of a complex system is based in the assumption that all the other parts will do what they are expected to do and will provide us whatever we expect when making a certain request.

This kind of activity requires the realization of a strong abstraction process where the designers start to look into the objects as if they were a magician's collection of black-boxes. The design activity is then reduced to a small portion of the whole system. Taking again the example of designing an integrated circuit, there we find many different parts: the ALU (Arithmetic-Logical Unit, dedicated to operating pairs of numbers), the BUS (it is the transmission line, or channel over which the information will be transmitted), the registers (memory cells, with direct access from the other parts), the interfaces to different peripherals (examples are USB - Universal Serial BUS - interface, UART - Universal Asynchronous Receiver-Transmitter, etc), ADC/DAC (Analog-Digital Converter/ Digital-Analog Converter), and other parts. Just by mentioning the former parts one can understand that due to the state of the art of technology microchip design is not a one-man activity.

Airports present very similar issues, there are many simultaneous processes happening in parallel that cannot be controlled by a single person. The success of the different operations performed in such an environment is the result of endless additions of operations and actions (Bødker 1991) performed by the distributed intelligence of hundreds of people collaborating at the same time in many different levels. For example, the bus driver waits for a command before he goes out in the landing area to look for the passengers coming in a certain flight. His work is independent from the one done by the luggage carrier, but both are equally relevant for the task of bringing the passenger and his goods to his destination.

The black-box design approach implies that the different actors involved in the design activity agree on a certain set of rules on how their different parts of the total system will interact with each other, but they will not enter to discuss how each one should solve his/her own specific tasks. We cannot say we invented this work methodology, but we would like to apply it to the field of interaction design and ask the designers to look into their work as part of a whole, where their creation will influence/be influenced by the rest. We believe that important aspects within interaction design are to be able to cooperate, admire and respect other solutions that constrain your own design in certain ways, both physically and digitally. To exemplify our theory, we made a workshop, which will be further presented here.

THE MISSING LINK WORKSHOP

The workshop "Missing link – designing for dependency" was a two day set up (Missing Link web). The workshop addressed the concept of bottom-up design where several groups have to work with designing components that will be combined in a number of unforeseen ways, creating an interactive light installation. The workshop participants were Master level students in Interaction Design with various backgrounds from two different universities, and the four workshop leaders represent three different research institutions in interaction design and architecture in Denmark and Sweden. Basically it was a hands-on workshop dealing with the design of interactive light components that are interfacing with other components both hardware- and software wise.

BACKGROUND

The work of an interaction designer is often limited by constrains set up by i.e. a boss, an employer, a budget, a platform or the rest of a system. A common task for an interaction designer is to investigate, improve or design a system of some kind, and very often this is limited to the functionality and interfaces of the rest of a larger system. It is up to the interaction designer to make sure that the different parts have an interface and react, link, communicate to/with each other and to the user.

During the education, interaction designers are pushed to work with projects, from small scale to large scale, and to develop them from concept to implemented prototype. Most often meaning that constrains are quite low, and that each project is a standalone system. As the Missing Link workshop was a part of the education of our students, it aimed to widen their horizon and with this practical exercise bring in new aspects into the minds of the future interaction designers.

COMPONENT VS SYSTEM

The aim of the workshop was to design and develop a component that works within the rules of an overall system interface. Each component is supposed to work on its own and at the same time be able to be a part of a full scale system, in which it reacts to the other and totally different components of the system. Sometimes the larger system is a software system and sometimes it is physical and tangible. In this workshop the total system contains twelve different components that are related and depending to each other. The components are represented by a wooden frame cube, which sets the boundary for the physical design space.

Each component is to be designed as an interactive light/lamp. The component can work as a stand-alone but must be able interact with other cubes, and react and provide feedback to and from other components. As soon as the components are connected they are no longer in control but must obey the rules of the system as a whole. This task confronts questions on how to give up control of your design and at the same time in a creative way exploit the available rules of the system.

Each group was supposed to work within a spatial domain of a cube. In this domain the group has to design a light installation that deals with the challenges of making the cube function both as a stand-alone component and as a component of a larger system, dealing, negotiating and communicating with its unknown neighbours, see concept in Figure 1.

Figure 1. Concept of the Missing Link Workshop

The workshop started with an introduction to the workshop leaders, the students, and different projects framing the idea of the workshop, the technical matters, and a small inspiration to what different qualities light has. The groups were given a space frame cube, a basic electronic kit and code for the communication protocol to start out with. In the workshop space different materials were supplied but groups were welcome and encouraged to explore and buy other materials within the budget. The groups worked hard and intensively during the two days. After each component had been finished the cubes were assembled and connected via the serial protocol that was available on each side of every cube. Not all cubes functioned perfectly but you got the impression that the different components acted and behaved very differently, see Figure 2.

Figure 2. Result from the workshop

LIGHT

Light was chosen as the design medium, to put focus on interaction both through technology and physicality – both contained in the boundary space. Light can be controlled in various ways with technology and as well by creative use of materials. However these two ways of working with and understanding light should be combined and used to create a dual nature component that takes advantage of both physical and digital properties. To exemplify working with light approached from two perspectives, namely a physical and a digital/electronic approach - the light source of each cube could be controlled e.g. by reflecting light in a certain direction with a reflective material; program the microcontroller to switch the light on and off; or by mounting the reflective material on a micro controlled servo motor and by combining the physical and digital properties establish a potential for very varied behaviour that both take the physical boundary space and the digital properties into account.

DISCUSSION

The groups had to document their work by taking pictures and writing an abstract explaining their idea and its background. In this text the students had to define the expression and behaviour of their cube, both physically meaning appearance and reaction to input from sensors, and digitally, meaning if information was sent out or just accepting and reacting to other boxes. This small piece of text, accompanied by pictures, was an important part of the reflection work of the students. The text and the pictures were uploaded on a website during the last hours of the second day, and contributed to the eager of trying to go through and accomplish the task they had set up for themselves. The documentation became their description of their total system, and thereby their goal which they struggled to reach.

The result of the workshop were twelve stand alone boxes that all had an individual expression, and when brought together to one physical unit, they reacted to each other and the expressions of the boxes changed, because digitally the boxes kept their individuality. The cubes were, for instance, a heart beating calm and white on its own, but faster and red when it got neighbours, or an ice cube start melting when people or other cubes approach it, but when it receives digital information it gets angry, cool and shouting.

An interesting and unexpected phenomenon during the workshop was that none of the participants sneaked around the other groups to negotiate around the physical coherence of their pieces. This is relevant to the outcome of the workshop, since it implies that they focused more on the technological coherence of their things than their spatial. The final cubes did respond to communication and to other cubes, but more adjusted to the order of the cubes, how they were gathered, not to which one. This shows the student's ability to negotiate via the digital infrastructure but unfortunately also their missing ability to exploit and use the physical potentials in the cubes as physical boundary spaces. This does not imply that they missed the point of the workshop at all, rather proving our work methodology that the black-box design approach implies that the actors involved in the design activity agree on a set of rules on the interaction of their different parts of the total system, but they will not discuss how the responsible for each unit should solve their own specific tasks.

In this workshop, one explanation to that the negotiation was suppressed is that there was a lack in time, and that the communication protocol was not clear to them, it was too complicated. Another aspect contributing to the result of the workshop is the background of the students. The physical and digital expressions of the boxes varied according to the competences found in the groups. If the students would have been of e.g. pure architect background, then there would probably have been a different result, with more focus and interest in trying to explore the spatial and physical aspects of the boxes relation to each other.

The fact that there were no restrictions or constraints to what material the students were allowed to use probably had an effect on the result. With increased restrictions and budget, one could steer the focus away from the material and into exploring the qualities of the materials at hand, especially to light. More important, added restrictions could lead to deeper focus on the communication and expression of the different parts.

The workshop can be used as an eye opener, a first hands-on exercise, which can open up for the second iteration. The time plan of two days was too short, but even so the workshop participants emphasized the general idea of the workshop – that different designer corporate to create a common design with a life that is somewhat unpredictable and larger than the sum of the components. Deriving from discussions around the results from this workshop, a second creation could be created, which would deepen the focus of the dual nature understanding, and push the students to take advantage of that.

CONCLUSION

The interaction designer needs to be trained in paying attention to both the digital and physical context surrounding the computational object, to have it pay attention to its neighbors in many different levels, to determine its place in the overall system in the real world that it is dependent on and be able to take advantage of other nearby objects in their context to greater extent than today. We suggest a practical workshop method training students in thinking their design as part of a bigger system.

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