

The Energy Table – Augmenting the Exhibition Space at The Danish Electricity Museum

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ABSTRACT

This paper explores the use of digital technologies to create interactive museum experiences through a design case. Based on field studies at The Danish Electricity Museum and research into related work we present the concepts of the Energy Table. The vision of the Energy Table is to let people actively appropriate the physical exhibition space by exploring and uncovering the dynamics of electricity on a digitally augmented table. From our design case we discuss focal points in creating interactive installations for museum settings.

Categories and Subject Descriptors

H.5.1 [Multimedia Information Systems] Artificial, augmented, and virtual realities .K.3.1 [Computer Uses in Education]: Collaborative learning, Computer-assisted instruction.

General Terms

Design.

Keywords

Museums, experience design, Mixed Realities

1. INTRODUCTION

One of the grand challenges to the field of HCI is to expand to meet the requirements of designing for other contexts than that of the workplace, such as the home and other parts of our everyday lives [15],[16]. Notions such as pleasure, reflection and engaged interest now exist side by side with the traditional HCI icons of ease of use and efficiency as a way of measuring the usability or usefulness of new digital environment [1], [3], [16].

At the same time, the work done in the fields of pervasive and ubiquitous computing is rapidly dissolving the idea of the desktop computer as the primary object of interest in HCI. Computers are becoming computing and merge with our physical and social environment [9], [2]. This demands consideration from a new range of disciplines – architecture and aesthetics to mention a few - to broaden the perspective of HCI and how our interaction with these new hybrid environments or Mixed Realities should be [1], [13], [17].

This paper addresses the challenge of designing interactive environments for a non-work related context, the museum. We present our design case, which we are currently carrying out at the Danish Electricity Museum. We then describe the Energy Table, a concept proposal for using digital technologies to activate and augment the existing physical space and installations at the museum to enhance the interactivity of the exhibition. We discuss how the Energy Table uses the technology at hand to give the visitors at the museum the possibility to appropriate the exhibition environment while exploring and learning about electricity, thus enhancing their active participation in the museum visit. In doing so, we outline some pertinent themes and problems working with the concept and how we wish to meet these challenges in the remainder of the project.

2. DESIGN CASE: THE DANISH ELECTRICITY MUSEUM

Our design case is part of an ongoing research project called “Experience-oriented Applications of Digital Technology in Knowledge Dissemination and Marketing”¹ carried out at the Centre for Advanced Visualization and Interaction (CAVI), Aarhus University. We have been working with the Danish Electricity Museum for the last seven months. In this section we describe our design setting and process and how they have led to the development of the Energy Table.

2.1 Context

The Danish Electricity Museum is a so-called “living museum” with a cultural historical and scientific focus. The museum is a place of exhibition as well as a place for learning, inviting both contemplation and active, hands-on participation from the visitors. It exhibits electricity in various forms, from the history of the

¹ www.cavi.dk

production of electricity through time, to hands-on experiences of different electrical installations and several other activities. The visitors consist of school classes (1/3 of the visitors), mainly carrying out different projects at the museum, and private visitors, mostly families. One of the cardinal points of the museum are the docents, who give guided tours. The oral communication is as such an important part of the museum's way of presenting their exhibition.

2.2 The Design Process

We started out by carrying out empirical field studies at the museum, observing and analyzing different prototypical situations such as guided tours, demonstrations of various installations, school classes visiting etc. Concurrently we held several meetings with both the museum director and the curators at the museum, to discuss possible points of interest when designing for that particular context. During this preliminary phase, we identified a number of challenges for the museum. In this paper we focus on two of these challenges, namely *activating objects on display in exhibitions* (the museum has a vast number of electrical artifacts, however many of these artifacts are passive props in exhibitions), and *creating engagement among visitors and encourage them to actively explore exhibitions* (rather than passively pass through and observe exhibitions).

Based on these challenges, we analyzed the empirical data gathered at the museum (photos and video from field observations, interviews with museum staff, and various documents such as pamphlets, visitor guides etc.) and used this data as input into a product visioning phase in which we developed design concepts through an inspiration card workshop [11] with the museum staff. In this workshop, empirical findings from the museum and examples of cutting-edge applications of digital technology were represented on inspiration cards that were combined to form design concepts. We developed these concepts and arranged a second workshop at the museum to present, discuss and refine our concepts and knowledge of the museum context. As a consequence of this workshop, we focused on two design proposals, the Electric Floor and the Energy Table. In this paper we elaborate on the Energy Table.

3. THE ENERGY TABLE

The Energy Table uses tangible and digital features as a control center for handling nearby installations in the museum environment (see fig. 1). From the table it is possible to control and explore the exhibition objects available in the room. A map showing the room is projected onto the table. When a person approaches the table, an energy source emits on the table where the person is standing. This energy can be directed to the different objects represented on the table. Directing the energy is done by arranging an array of different physical object on the table surface which works like a playing field. The objects on the table function as *phicons*, physical icons that serve as interfaces in Mixed Reality systems, as presented in the metaDESK design by Ishii & Ullmer [9]. Some of the phicons represent the exhibited objects in the room, they are called *Exhicons*. Other objects work as conductors of energy, some provide resistance and some serve as power transformers, and they are called *Electricons*. When current is conducted through the Electricons to an Exhicon on the table the exhibited object in the room starts to react. Depending on the amount of energy directed to a given installation it may run faster or slower. It is possible to direct all the energy to one installation, or to distribute it more evenly among all the installations. On the

table each of the Exhicons are monitored with respect to power consumption, temperature and other values. Through the interaction with the phicons on the table, the visitors control the activity features of the physical exhibition room.

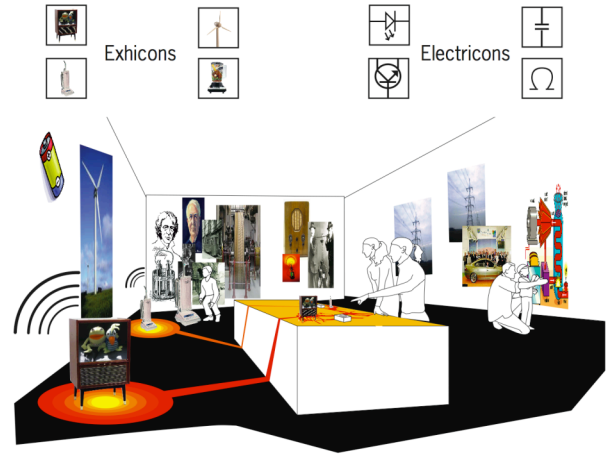


Figure 1. An illustration of the Energy Table and its physical surroundings at the Danish Electricity Museum.

The Energy Table takes its departure in existing artefacts in the Electricity Museum and makes it possible to interact with them in novel ways. Instead of replacing the physical surroundings with a digital universe, the Energy Table adds a digital layer that augments and further enhances the ways to activate the objects on display in the exhibition.

The Energy Table also encourages collaboration among visitors in that a high level of coordination is required for more electric devices in the room to be activated. The installation can be construed as a game of emergence [10] in that it defines a playing field (the table and the physical objects on top of it) and a set of rules (the ways in which the physical objects can be combined and the possible outcomes) but leaves it up to the players (the visitors) to decide how the game unfolds. The Energy Table thus lets people appropriate both the playing field and the physical surroundings through their interaction with it.

The Energy Table makes it possible to experiment with electricity in ways that would otherwise be dangerous or downright fatal. It furthermore introduces a playful element that actively engages the visitors in shaping their own experience of the museum exhibition.

4. DISCUSSION

After presenting the general concepts underlying the Energy Table, we will now move on to a more elaborated reflection on what we find to be pertinent issues considering the future design of the concept on a theoretical and practical level.

4.1 Augmenting and appropriating the existing museum setting

In line with [6] our design proposal strives to make the museum a place for practical and social engagement. We look to support the visitor in actively creating and appropriating the museum installations and technology as is the case in both [5], [19], and [18]. [5] deals with how altering the physical exhibition space

alters how the entire exhibition is perceived as a place; an environment invested by values, attitudes and cultural influences which all shape and set up rules for the museum experience. [18] and [19] focus on how augmenting the existing physical environment using embedded technologies creates an explorative and reflective museum experience, where the visitors take active part in the categorization of the objects on display. Following these ideas, we work to **create a Mixed Reality environment** where the technology augments the existing museum artefacts. The artefacts already present in the electricity museum hold significant value in the goal of the museum as a conveyer of culture. Thus in our design proposal we make these artefacts present in the environment to give visitors the possibility of exploring them in detail. Our installation is designed to be an appendix to the existing exhibition at the museum, and not to form the whole basis of the exhibition. As such, the Energy Table is an example of how technology can be actively used to augment and give new value to an existing physical environment. The Energy Table is part of an “Interspace” [20] where the virtual world of the digital representations merges with and co-constructs the physical reality in which it is placed.

4.2 Socialization and shared exploration

The Energy Table also encourages socialization by facilitating shared exploration. From our studies of the electricity museum we see a high degree of diversity in regards to the people visiting the museum. Some of them are open to exploring the installations in collaboration with strangers while others prefer to do it on their own. Our proposed solution is to allow visitors to explore the installation individually and leave the social interaction as an opportunity. Therefore it is possible to use the Energy Table individually. However, when more than one person is using the Energy Table, coordination of the efforts will most likely be necessary. As the amount of energy on the table and consequently the potential for activating the physical surroundings depends on the number of people around the table, the Energy Table also encourages people to come together to share and enhance the exploration.

Following [11], the Energy Table enables the visitors at the museum to engage in various degrees of interaction with each other through the technological setup in the museum seen as a public and social place.

4.3 Representation and visualization

One of the great challenges when working with the Energy Table is how to represent the physical installations and the various electric currents and transformers on the table. We are working with a direct mapping between the exhibited objects and the Exhicons, simply by using miniature models of the installations on the table. Each model has its own unique tag, so it can be recognized on the table. The Electricons on the Energy Table that work as conductors or transformers of energy are to be mapped onto traditional electric symbols. Finally, we are working on a way to make the digital visualizations of the energy on the table represent the way an electric current might actually behave. This last mapping between the representation of currents on the table and electricity and energy in the real world poses the biggest problems. It needs to be realistic in its behavior, but at the same it should be represented in a way, people can actually work with, without it being too complex. We are planning a workshop with the staff at the museum to find the optimal solution to this challenge. We also wish to further involve the museum visitors in

this process, to ensure that we end up with a usable and comprehensible installation.

In addition to making the existing exhibition at the museum more visible, the Energy Table also strives to uncover the invisible but real world of electric currents that are an integral part of our everyday lives. The playing field and the phicons constitute a real, tangible space for exploring the otherwise invisible dynamics of electricity. As such, the invisible, electric currents are digitally visualized and projected on the table. In doing so, we make it possible for people to explore the links between the material world and immaterial but physical electric space. This is inspired by Anthony Dunne and his work on “Hertzian Space” understood as the invisible but real radio space of electromagnetic environments [5]. In our case, the visualizations of the otherwise hidden electric currents can inform people of their nature, and let them experiment with them while keeping a safe distance.

4.4 Learning and experience

As many other museums, the Electricity Museum lies in the borderland between a cultural centre communicating knowledge about electricity and a place where people come for relaxation, entertainment and being with family or friends. In this sense the museum holds a mixture of learning, leisure and entertainment. As also voiced by [18] one of the key issues when designing for this setting is the balance between learning and leisure. In our conception however the issue does not translate into a choice of either designing for learning or for leisure. We pursue the idea of designing an installation that is sufficiently open to allow the visitors to appropriate it for their needs and desires. For some visitors our installation may only be used for having fun with the projection on the table. Others may be inspired to learn more about energy or electricity.

Our preliminary findings from our work with the Danish Electricity Museum leads us to believe that there is a potential in actively letting people experience new technology as a part of the integral museum context – the interface and the values it supports as part of the experience. In this sense the Energy Table addresses both the level of creating an open context for exploring the production, consumption and control of energy and electricity as well as it gives people the opportunity to interact with and experience the digital installation in itself as a novel aspect of the museum trip. Creating an optimal symbiosis and balance between these aspects remains an unresolved issue that we will address in collaboration with groups of museum visitors in the design and evaluation of a working prototype.

5. FUTURE WORK

Working with and elaborating the Energy Table has forced us to consider various interdisciplinary issues concerning the technology involved (engineering and programming) and the physical space into which we are designing (architecture). We continuously strive to create an aesthetically pleasing and challenging environment for both mind and body, where you can actually learn something about new interactive technologies and the production and consumption of energy and electricity by engaging in interactive and playful activities. In the near future, we would like to involve practitioners from the mentioned disciplines to elaborate the possibilities for the concept. We would also like to elaborate on our understanding of the museum visitors through more engaged observations, interviews and involvement in the design of the working prototype.

We are currently working on a Virtual Video Prototype to further visualise the elements of the concept, focusing on developing the physical design of the room and table, and the various forms of interaction in which people may engage. We are also working with the museum staff to further develop the learning aspects and content of the concrete exhibition in which the Energy Table might be a future part.

Lastly, we believe that our work with the Energy Table and the themes surrounding its design and possible implementation in the Danish Electricity Museum might inform general concerns when designing the museum exhibition spaces of the future. We especially find the mutual reconfigurations of the existing physical environment and the digital augmentation of it inherent in the concept of the Energy Table worth exploring in an attempt to create a unique, flexible and interactive museum space of tomorrow.

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