Tangible Interfaces to Digital Connections, Centralized versus Decentralized

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Abstract. In the era of distributed digital media, technology is moving to the background and interoperability between devices increases. The handles for users to explore, make and break connections between devices seem to disappear in overly complex menu structures displayed on small screens. Two prototypes have been developed that introduce a tangible approach towards exploring, making and breaking connections between devices in a home environment. Findings suggest that users are better able to project their mental model of how the system works on decentralized representations and that a tangible solution is not necessarily a better one.

Keywords: Ontology, semantic connections, tangible user interface, internet of things.

1 Introduction

In the era of distributed digital media, especially in a home environment, devices are connected to one another to create preferred experiences. A home theatre system is one example of how multiple devices can create one joint experience when interoperating [5,6,3,7]. With the introduction of portable media players, possibilities and needs for content sharing are even bigger. Currently these devices are connected wirelessly or with all kinds of cables, and users are currently occupied with finding the right cables to connect devices and have to deal with cables that physically allow for connections that are not possible. Even more, some possible connections never get explored, simply because physical cables do not allow for it. Wireless technologies such as Bluetooth solve part of the problem, but introduce overly complex menu structures and devices without proper interfaces. A single task like sharing music from the one device to another currently involves multiple steps on both devices, while one single high-level effort would be desirable.

In ‘The Internet of Things’ [8] and ‘Shaping Things’ [14] a world is sketched in which each everyday object has an unique identity and is connected to the internet. In this world, technology has moved to the background and interoperability between devices has been achieved. Provided that these devices are able to communicate with each other and with the user, this could mean the end of
compatibility problems and the hassle of using cables, and that users will have less physical and visual handles to make sense of their environments and the devices therein. Design can play an important role in this sense-making with paradigms like Tangible User Interfaces [4], that believe that physical handles for digital information provide users with more freedom and control.

The SOFIA project is a European research project that targets to “make ‘information’ in the physical world available for smart services - connecting the physical world with the information world” [13]. Within this project a “Semantic Connections” demonstrator was developed named Interaction Tile. This demonstrator allows users to tangibly explore, make and break connections between devices in a smart home environment [11,16,17].

A second demonstrator, named Interaction Tabs, was developed to explore alternative possibilities of Tunis. Where the Interaction Tile provides users with a centralized way of exploring, making and breaking connections, the Interaction Tabs provides users with a decentralized way to perform the same tasks.

In order to see which demonstrator would be the easiest to use and allow for a better projection of the users’ mental model, a user experiment was set up to answer the following questions:

- Are the demonstrators a better alternative, compared to the conventional method?
- Will the users be able to work equally well with both demonstrators?

In the first question, “better” is in the sense that exploring, making and breaking connections are easier (more efficient) and more satisfactory (positive user experience). An important aspect is the mental model that the participants have and how it compares to the actual architecture of the system.

2 Background

2.1 SOFIA Project and the Interaction Tile

SOFIA (Smart Objects for Intelligent Applications) is a European research project addressing the challenge of Artemis sub-programme 3 on Smart Environments. The overall goal of this project is to connect the physical world with the information world, by enabling and maintaining interoperability between electronic systems and devices. Our contribution to the project is to develop smart applications for the smart home environment, and to develop novel ways of user interaction. For users to truly benefit from smart environments, it is necessary that users are able to make sense of such an environment. One way of facilitating this “sense making” is through design. Our contribution to the SOFIA project aims at developing theories and demonstrators, and investigating novel ways of user interaction with the smart environment, through interaction with smart objects in the space.

To illustrate the concepts and ideas developed in the project, a demonstrator was developed. The demonstrator is a tile-like interactive object that allows for both exploration of a smart space in terms of connections, and manipulation of