Leihwand: Requirements and Conceptualization of a Loan & Sharing System

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Abstract

Loaning items such as tools leads to a high amount of administrative tasks in universities and other non-profit organisations. Nevertheless, commercial automatic tool management systems are not affordable. We therefore propose an interactive low-budget loan system, which is adaptable to various contexts of use, ranging from closed communities like a university to public access. It can also be used as a sharing platform in public spaces and therefore contribute to a more sustainable way of consumption. To understand the requirements of the different contexts of use, we conducted and analysed in-depth interviews with relevant staff members and potential users. Based on these requirements, technical possibilities were considered and a first system concept has been developed. The concept includes affordable commercial-off-the-shelf hardware (e.g. Raspberry Pi), which enables novel interaction concepts, such as face or speech recognition. Additionally, its modular storage system allows a high degree of flexibility and adaptability while still being easy to produce, repair, and maintain.

1 Introduction

Various educational institutions, such as universities of applied sciences, try to give their students an understanding of technological issues by offering to work in studios or workshops. The material and tools they need for their projects there are mostly lent by the institution, often manually. Depending on the number of students, the process of loaning is requiring a lot of time and staff resources. As commercial solutions for tool management vending systems are neither affordable nor feasible for the non-profit sector, we aimed to design a low-budget system, which is adaptable to various contexts of use. Our system's name Leihwand is the German word for "loaning board" but is also pronounced like the Austrian term for "great". While the area of application in educational institutions is comparatively small, the human-centred development of an adaptable loan system offers also the use as a sharing platform for public spaces. By placing the system for example at a town hall, residents could share the usage of seldom needed items such as drilling machines or skis. Sharing products can lead to less wasted materials and resources and therefore contribute to a more sustainable way of consumer behaviour.

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2 Related work

The proposed system Leihwand belongs to the group of self-service systems, like vending machines, automated teller machines (ATMs), information kiosks or equivalent. All these systems have an impersonal nature in common because the users have to perform the necessary tasks by themselves (Walley and Amin, 1994). The literature research was focused on the main aspects of the system to be developed: user interaction with self-service systems and methods for a systematic development of self-service systems.

There have been several experiments concerning user interaction with self-service systems. Johnson and Coventry (2001) describe a voice controlled automated teller machine. Their attempt to create a natural interaction led to increased expectations of the whole interaction. Due to the quality of the speech interaction the participants attributed human-like characteristics to the prototype, but they wanted to adapt the way they were addressed by the voice-based interface (Johnson and Coventry, 2001). According to Saffer (2008), the most common interface of self-service systems is a touch-sensitive display. Most public user interfaces are optimized for wheelchair users, as required by recommendations, standards, or legislature regarding universally designed physical environments. To overcome this exclusive optimization, Hagen and Sandnes (2010) used a digital camera in their kiosk prototype to measure the user's approximate reading distance and adjusted the text size on a display accordingly. Three different assistance levels for the user interface of kiosk systems were tested by Sengpiel (2016) with young and elderly users: normal user interface, user interface with instruction video and user interface with a task-oriented wizard. The interaction performance of the older participants improved by the instruction video, reaching the effectiveness of the younger users. By using the wizard-based interface the age differences in effectiveness and satisfaction were eliminated. Thus, the integration of video- or wizard-based support can enhance the usability of self-service system.

Maguire (1999) described the need for user-centred development and necessary steps to ensure a systematic development of self-service systems: the analysis of the user population, their task goals, typical task scenarios and where the system will be located. These are the main aspects of the user context (Domhardt and Schmidt, 2012). According to Ashford et al. (2002), self-service systems should be developed with the needs of the users in mind, especially regarding the tasks that users are willing to perform. Kules et al. (2004) recommended to utilize characteristics of the target user group like social constraints, trust, and a lack of anonymity to provide interactive capabilities that otherwise would be impractical. Sandnes et al. (2010) suggested a list of sixteen different user interface design heuristics for the design of self-service systems to avoid the most common mistakes in designing a kiosk system. Cinto (2016) described the design process and methods applied to enhance the accessibility of several self-service solutions.

3 Requirements and conceptualization

To understand the requirements of the different contexts of use, we decided to conduct in-depth interviews with relevant staff members of a university on the one hand and potential users on the other hand. Based on the requirements, a first concept was developed in collaboration with

design students: As a matter of principle, it must be possible to identify the user to be able to track him/her down in case of not returning the items. User authentication will be based on an unobtrusive technology like voice or face recognition. After recognizing the user, Leihwand offers the possibility to choose the required item from an graphical overview of all available products. This UI will be based on touchscreen interaction. If necessary, Leihwand proposes hints to attachments like chargers or adapters relevant for the selected item. After the selection of one item by the user, Leihwand has to unlock only the right compartment or drawer. When a user picks up an item, Leihwand communicates clearly its return date, which should be determined by the availability and demand. There is also an automated reminder signal in terms of an e-mail or an text message. In case the user does not return the item in time, he/she can be blocked from the system for a certain time. When an item is returned, Leihwand registers which item has been handed back and indicate the right compartment or drawer to put it back. Return is possible even for non-registered users, so that users can ask a friend or family member to hand their items back. Our system will be available 24/7. In case of failure or problems, students can indicate this to staff via a helping system.

A web-based UI provides the user with an overview of all available items, a reservation functionality, a possibility to extend the loan period and a notification when an item is returned. For the staff, the website offers a administration section, where the users and the stored items are managed. Production, maintenance and repair of Leihwand should be made as easy as possible. This requirement correlates to a design strategy that is called *Design for Repair and Maintenance* (Bakker et al., 2014). According to this strategy, standard tools as well as easily exchangeable components are considered during the design process and materials are chosen considering not only costs, but also availability and handling.
Although the focus of Leihwand was on loaning tools, staff members expressed their wish to include also a vending function for materials such as sandpaper, screws or small electronic parts (diodes, resistors...). We could also imagine this functionality to be relevant in public space, for example for wearing parts such as drill bits. As our first prototypes will be used in universities, payment can be realised through the currently used student cards. Payment methods for public spaces will be considered at a later project stage.

4 Discussion

Our aim was to support a more sustainable way of consumption by a low-budget, but highly novel interactive loan system. Our human-centred process began with interviews to understand the system's contexts of use as well as the user requirements. These insights led to innovative aspects that distinguish Leihwand from existing products:

- user authentication without the need of ID card or token, e. g. biometrically
- web-based availability check and reservation function
- total cost of prototype less than 1000 € (aim: 500 € or less for the final system)

We are now building a prototype to check the feasibility of the proposed technologies and conduct user tests. Possible barriers might be the technological realisation of our concept, but also users' concerns: Some participants of our interviews indicated that they would not want to

share their items with “everybody”, because they might get broken or are not handed carefully. These concerns are with good cause, as leased products are also usually used less carefully than products that are owned (Tukker, 2015). We would therefore start with public systems that are operated by a non-profit organisation, which would also provide the items initially. After a certain period of usage, users might then be more motivated to share their own items. We are aware of the fact that it is still a long way to a functioning system, but we believe that human-centred design could – and should – make a contribution to a more sustainable way of consumption.

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