Mobile Interaction with an NFC-based Billboard

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ABSTRACT

With the advancement of Ubicomp technologies, physical objects can be tagged, support the interaction with associated information and services and finally serve as physical interfaces. This paper investigates mobile interaction with a dynamic NFC-display that uses interaction with a grid of NFC-tags to manipulate a projected application interface. It presents a prototype that adopts this technology to implement an advertisement billboard and show how the physical interaction between mobile devices and physical interfaces can increase its interactivity. The paper describes the design of the NFC-based advertisement billboard, a first prototype and its preliminary evaluation.

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation**]: User Interfaces – graphical user interface (GUI), input devices and strategies, interaction styles

General Terms

Design, Human Factors

Keywords

Physical Mobile Interaction, NFC, physical interfaces

1. INTRODUCTION

In recent years, the advancements of Ubicomp technologies and applications have increased the possibilities for mobile interaction with physical objects. Technologies like NFC, RFID, visual markers or Bluetooth make it possible to tag everyday objects in order to advertise associated information and services, facilitate their discovery and enable the interaction with them. Complementary, Physical Mobile Interaction [1] uses mobile devices to interact with tagged objects and thus facilitate the interaction with associated information and services.

As everyday objects are augmented with (multiple) tags, they become physical interfaces that complement mobile interfaces and adopt some of their features: In [1], the authors present smart posters as physical interfaces for mobile ticketing. Users can compose their order from different options by selection their tags through NFC, visual markers and numeric identifiers. Reilly et al. [3] have augmented a map with a grid of NFC-tags, thus turning it

into an interactive surface. Hardy et al. [2] have extended this static physical interface and presented a dynamic NFC-display that projects an application interface onto a grid of NFC-tags. Users can interact with the projected interface by touching the NFC-tags of the underlying grid with their mobile devices.

This paper investigates the application of this novel technique for mobile interaction with physical interfaces as it builds upon the technology of the dynamic NFC-display to implement an advertisement billboard. In the prototype, the interface of the billboard with its different advertisement snippets is projected onto a grid of 20x15 NFC-tags. Figure 1 shows how users can interact with adverts by touching the tags of the NFC-grid with their NFC-enabled mobile devices. That way, they can also download and store adverts from the NFC-display, create new adverts on the mobile device and upload them to the display.

Figure 1. Interacting with an advert on the NFC- billboard

The prototype uses the dynamic NFC-display to show how traditional interfaces (e.g. billboard with paper adverts) can become more interactive and provide additional features: The NFC-display makes it easy to add and remove adverts through physical interaction. Mobile devices add more features to the interaction with billboard information, e.g. by storing it for later usage, calling its creator or opening an associated website. The separation between the NFC-display and the mobile display is also useful for the interaction with privacy-sensitive information (e.g. contact details or payment information) that should not be shown on the public display but on the private one. The next section provides more details about the implementation of the prototype, section 3 summarizes its preliminary evaluation and section 4 concludes the paper.

2. PROTOTYPE

The prototype of the dynamic NFC-billboard consists of 3 main parts to provide the features of a traditional billboard and to add some new ones, using the dynamic display as physical interface and mobile phones as input devices (Figure 2): The server manages the application logic, stores advertisements in an XML-format and controls the communication between the mobile device and the dynamic NFC-billboard as they interact with each other. The GUI of the billboard application on the server is projected onto the 20x15 grid of NFC-tags of the dynamic display, providing a physical interface for touch-based interaction. Users can interact with this interface by touching the underlying NFC-tags with an NFC-enabled mobile device (e.g. Nokia 6131 NFC). The mobile application reads the information on the tag - its position within the grid - and sends it to the server via Bluetooth. The client application on the mobile device has its own interface and action handling for creating, downloading and deleting adverts.
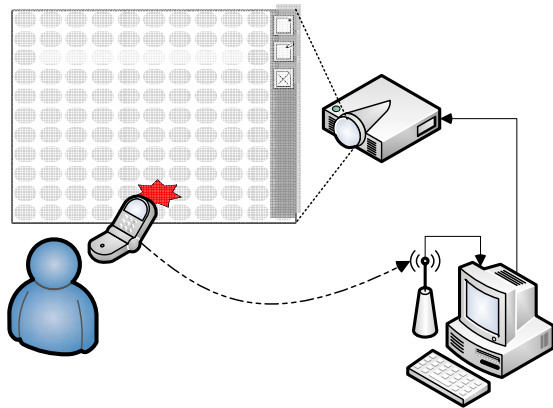

Figure 2. Overview of the dynamic NFC-billboard system

In order to create new adverts, users fill a form on the mobile device with the content of the advert, e.g. title, description, photo and contact information. Privacy-sensitive content like contact information can be set to be only visible on the mobile device. In order to place the advert on the display, users only have to select two NFC-tags to span the area for the advert. In order to download or delete adverts from the billboard, users have to select the appropriate command from the phone's menu and touch a tag of the advert they want to download or delete. Users can only delete adverts they have created by themselves.

3. USER STUDY

In order to assess the usability of the dynamic NFC-billboard, a qualitative user study with 10 subjects (9 male, 1 female, average age 23.5) was conducted. All of them were students of technical subjects. On a Likert-Scale from 1 ("no experience at all") to 5 ("very experienced"), they rated their expertise with mobile devices with an average of 3.6, but only with 1.0 for experiences with NFC and 1.5 with Bluetooth. After a general introduction to the employed technology, the subjects had to carry out 3 tasks to evaluate the usability of interacting with a dynamic NFC-display and the prototype in particular. They had to a) download an advert, save it and call its creator, b) create a new advert and

place it on the billboard and c) delete the previously created advert again. The subjects did not get a detailed introduction to the prototype on purpose in order to evaluate their behavior the first time they use this novel interaction.

All subject managed to solve the three tasks and 70% of them said that they managed to get along with the application well or very well. The subjects liked the idea of having the possibility to store the adverts on their phones and thus be able to "quickly take away" interesting ones together with all their information. The possibility to open a website or call the contact directly from the advert was also appreciated.

Some subjects remarked that the little slips of paper with e.g. the creator's telephone number are often out of stock on regular paper-based billboards. In the prototype, this shortage inherently expires, as the contact details would always be available in a digital format. Furthermore the fact that an advertisement can only be removed by its creator was seen as a benefit. Interestingly other subject considered this as a disadvantage, as they appreciate the chance to be able to pull off adverts.

When the subjects were asked if they could imagine other useful features, they proposed to display the age of an advertisement, so that users would immediately see how up-to-date the adverts are. They also suggested inventing life-spans or time-outs so that users could decide how long their adverts should be displayed.

A negative point of the application was the establishment of the connection with the server, which was tedious and took too much time. The second negative aspect was the fact that users need to have the application installed on the mobile device, in order to be able to use the billboard system at all. Still, altogether 40% of the subjects concurred that they would prefer the NFC-billboard to a traditional one.

4. CONCLUSION AND OUTLOOK

This paper presented the design, implementation and evaluation of an interactive billboard based on mobile interaction with a dynamic NFC-display. The purpose of this prototype was to find out how traditional interfaces like a billboard with its paper adverts can benefit from new technologies for mobile interaction with physical interfaces. The results of the preliminary evaluation are promising and show the potential of both the interaction with dynamic NFC-displays as well as its application to everyday use-cases.

5. REFERENCES

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