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# Easymeeting – Prototyping Ubiquitous Computing in Offices

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**Abstract.** This paper presents an intuitive, easy-to-use prototype system that supports users in booking and managing meeting rooms based on Near Field Communication (NFC) technology. The prototype was designed to evaluate an NFC application for smart office solutions. We used our prototype to conduct a study with 37 participants in two organizations. The evaluation was based on structured interviews and included a qualitative and quantitative part. The overall impression of the users was positive and NFC regarded as easy to use. The system was also considered useful for unobtrusively fulfilling tasks that arise during meetings. Based on this early prototype we extract findings for smart office applications.

**Keywords:** Near Field Communication, Office solutions, Ubiquitous Computing

## 1 Introduction

Ubiquitous Computing (UbiComp) started back in 1988 in an office of Xerox PARC [1]. From this point early prototypes focused on office settings such as the 1992 active badge location system by Want et al. [2, 3]. Further work concentrated on location tracking [4-6] of workers, visual support [7, 8], and human-computer interaction [9, 10]. UbiComp is not about desktop-computing but about computers in everyday life - in order to facilitate life [11]. Clearly office work is part of everyday life for many people and therefore a relevant field to continue working on the original UbiComp vision. This paper describes a recently conducted and evaluated prototype for a “smart” office solution, based on existing UbiComp technologies such as Near Field Communication.

## **2 Offices and Ubicomp Technology**

An office infrastructure is packed with technology anyway, e.g. desktop pc, video conferencing, telephones, time management systems, etc. Therefore, the introduction of Ubicomp applications needs to a) support workers daily processes and everyday tasks, b) bring additional benefit to the worker and c) avoid unnecessary training courses to use yet another new tool. Being in a competitive setting, the benefit of an installation should justify the implementation and deployment costs as well as show additional savings if possible.

One technology that combines low deployment costs and high usability is Near Field Communication (NFC), a standardized interface technology for the exchange of data between electronic devices such as PCs, mobile telephones and RFID tags. NFC is standardized in ISO 18092 (ECMA 340) [12]. NFC works on the 13.56 MHz frequency. A NFC device can have various shapes; for example a mobile phone such as the Nokia 3220i or 6131 NFC. As people are accustomed to use mobile phones almost automatically [13], the use of NFC should be easy and understandable in everyday situations. The Nokia 3220i provides built in haptic feedback with vibration and lights as soon as a NFC tag is read by the phone. NFC uses the touch paradigm. In order to use services, a “touch” is considered the initial action. Touching is considered a natural action. The notion of touch is important because if the user deliberately chooses to use an RFID/NFC application then the user has full control. This is a positive aspect for the profitableness of perceived control in Ubicomp environments [14].

The next section describes the everyday application and case study “Easymeeting”.

## **3 Easymeeting – a Smart Office Prototype**

Easymeeting is a prototype and case study that was conducted in 2006/2007 and evaluated in two different organizations (O1 and O2). It is a NFC meeting room management system for supporting attendees and organizers with easy-to-use functions. Our emphasis was placed on an unobtrusive use of technology since meetings have a personal and social character.

### **3.1 Prototype Description**

Figure 1 show the prototype with functions applied on tags attached to the wall in a meeting room. The NFC tags included ID numbers and were surrounded by colored labels and a descriptive short text. Touching the tag with the NFC mobile phone started the process. For the prototype a Nokia 3220i with NFC shell was used.



**Figure 1: Prototype on wall in meeting room**



**Figure 2: Ordering coffee with prototype**

In both organizations, we used the same prototype. In organization 1 (O1), the prototype was integrated into the Microsoft Exchange mail system.

The applied functions were defined based on a requirement elicitation in O1 of most-wanted functions in meeting rooms. Among frequently mentioned tasks was the need to refill coffee during a meeting, calling the technical help desk, extending duration of meetings (especially in sales situations), and call a taxi for the client after the meeting was finished. Based on these first ideas on wanted functions, the following functions were used in the prototype setup: Refill coffee, Tech support, 15 Min late (to indicate that the room is blocked for a longer period of time), 30 min, 45 min, Taxi (to call a cab when leaving the conference room), Undo button (to undo the last process, if possible).

Furthermore we added the real-time function of

- Check in (to indicate the room is now occupied)

- Check out (to facilitate communication with adjacent meetings and their organizers using the functionality of shared calendars)

Every tag triggers a pre-defined process by a text message that is sent to a main server and processed based on a rule system. The "refill coffee" tag sends a short message transformed into an email to the assistant with the adequate message and meeting room location. During the prototype evaluation the taxi tag was not connected to the taxi call centre. All other tags used internal processes and an Microsoft Exchange server. The use cases are very simple and focus on mainly small and medium sized companies with less sophisticated conference management systems.

### 3.2 Evaluation and Results

The case study was evaluated with 37 personal interviews with voluntary participants in the two organisations. Each interview took between 20 minutes up to an hour; the average duration was 30 minutes. For the interviews we used a questionnaire with three parts: in part one, the actual knowledge on RFID/NFC was questioned, in part two, the prototype was shown (using a Nokia 3220i handset) and the participants could test and play with the prototype. They were given a common task in a meeting situation ("Please order coffee"). Part three used items out of the technology acceptance framework of Venkatesh [15]. This paper describes the qualitative results in three segments: questions asked while using the prototype, opinion on the prototype and thoughts about the touch paradigm:

*Questions while using the prototype:* During the talking-out-loud session, most participants described the system as useful and interesting. Almost no questions were asked about the system itself. Using the prototype, 10 participants struggled with the OK button of the mobile phone, as it was no easy to make it work correctly. A majority of users got confused by the internal mobile phone screensaver as it went on if a participant wasn't touching the tag fast enough and locked the NFC function. For some people the location of the antenna was unclear, therefore they didn't touch the tag with the right area of the phone. After a short explanation, everyone got the concept and was able to use the prototype correctly. Only two participants mentioned security concerns and asked what happens if the tags were misplaced or misused. Privacy was of no concern to the people in this specific case, because of the consideration that a work place is no private sphere anyway.

*Opinion on prototype:* In O1, the prototype was attached to a wall. Some participants said it would be better to place the tags on the table instead of the wall, because it is less obtrusive. Placing it on the table avoids unnecessary walking around during meetings. In O2, the prototype was placed on the table. In O2 almost nobody recommended to attach it to the wall. Therefore placing the tags on the table is one solution, another recommended idea was to split functions to door and table, for example the check-in/check-out process. One participant mentioned that it could be unclear for a user which process happens after the tag was touched; a more explicit feedback would be recommended. The meeting time extension function should also provide a suggestion for another room, in case the actual meeting room is blocked.

Most people said, if available they would use the system. Interestingly in O2 the main argument against future usage, were the shortly before the interviews took place, introduced Blackberry handsets without NFC. Participants of O2 stated that they use the Blackberry also as a private phone and would not want to use another handset. One participant thought of a stationary device to use the system. This learning is very important for the design of future Ubicomp applications. If the infrastructure currently in use, is preset by the company or other constitutive entities, applications need to either build upon those with usable interfaces or increase benefit also for the constitutive party to force changes.

*Touch paradigm:* The 3220i phone was considered slow and a faster response time after the touch was recommended. Newer phones, such as the Nokia 6131 NFC are capable of fast responses. The reading range of less than 2 cm was clear, although few participants suggested a longer reading range.

## 4 Conclusion

The Easymeeting prototype showed various aspects:

- a) Easymeeting was considered an easy to use and interesting smart office app. Such lightweight solutions for smart office applications can deliver significant value to users
- b) NFC technology is an already available Ubicomp technology and can help to realize smart office apps. Especially the use of mobile phones, clearly everyday objects and know to most users, facilitated understanding of the application
- c) The technical implementation was based on internal MS Exchange and scripts. It cannot be applied easily to a larger scale implementation with needed interfaces to attach existing conference management systems. For a future implementation we consider this development process as very important. A need for a customizable lightweight development framework is given. Then the system could be easily extended to further scenarios in and around office buildings, such as vehicle fleet management, time recording and cafeteria systems. Despite the low implementation costs due to a tag-only infrastructure, the main problem of previously set large-scale mobile phone contracts is imminent as well as the need of handset manufacturers to incorporate another antenna for NFC usage. If this will be the case, we might see another rise of Ubicomp in the office solutions.

We think that according the interviews conducted during the evaluation of the case study, smart office solutions can have a future. Referring to the aforementioned criteria of Ubicomp office solution, Easymeeting a) supported processes that are part of a day to day office life, it brought b) an additional benefit to meeting organizers as well as to clients, because it facilitated some common processes; c) using the NFC phone and a tag infrastructure with clearly labeled functions proved to need no extra training course or further introductions. People regarded the solution as very helpful

and unobtrusive, thus supporting their everyday interaction. Another requirement of Ubicomp systems was low implementation cost. The NFC solution needs an underlying tag infrastructure, which is rather cheap in manufacturing. No additional wires need to be placed and it can be incorporated easily in every room. A benefit to other approaches using readers in every room to read RFID badges and tags.

We see several challenges emerging from this research: How to further improve design processes for smart office applications? What frameworks and what tool support needs to be developed in order to allow more fast and easy to use smart office applications? Which use cases are really needed most by the workers and how to quickly implement those?

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