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Services in AmI-NFC Environment

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ABSTRACT

The Ambient Intelligence (AmI) concept has emerged to "describe interactions between a multitude of network-enabled devices, services and artifacts. The technology will be almost invisible, embedded in all kinds of objects and everyday environments, such as the home, office, car and train. Users' access to applications and services – many of which will be delivered within mobile environments – will be simple and effortless" [1]. The origin of the AmI concept lies in the conjunction of Ubiquitous Computing, Ubiquitous Communications and Intelligent User Friendly Interfaces [2]; some of their many characteristics are as follows: context awareness, embedding device, an unobtrusive, proactive, implicit and natural interaction, access data and communications anywhere, etc.

An AmI environment must be context awareness and sensor technology is the key for this. Radiofrequency identification (RFID) can be used to implicitly receive information about contextual information but it has two problems: the cost and the fact that it cannot pinpoint users (i.e. perceive users in an area). The new Near Field Communications (NFC) technology overcomes these problems and, although there are other problems (e.g. the antenna range), we considered this a sufficiently good option to explore its use in an AmI environment.

The information necessary for the AmI environment using context awareness comes from two main elements: people (location and needs) and devices (location and services that are offered). Tagging users, places and devices enables a system to obtain sufficient data to be able to provide services to the user.

Keywords— Ambient Intelligence, NFC, Touch Services, Ubiquitous Computing.

I. INTRODUCTION

There are different methodologies that provide services to the users based on their location, from devices embedded in the clothes they wear regularly to new devices designed specifically with this objective in mind. The obstacle to the success of these devices will be the users' ability to adapt to them and their cost. We will now talk about some of these systems.

In [6], we presented a framework for the service delivery to mobile entities (users and objects). Each mobile entity carries: one passive RFID tag and one or more sensor nodes. The context of each entity is associated with other ones: for example, the temperature and humidity will be captured from the different sensors in the users' shirts, and will combine with the location provided by the phone's GPS and their identity from their ID card, which will turn on the user's home AC. In this system, the RFID cost and the difficulty in installing sensors in all the user's entities are an obstacle to its widespread use.

The Korea Advanced Institute of Science and Technology [7] has developed the ubiquitous fashionable computer (UFC), which is a wearable computer with embedded WLAN, Bluetooth and ZigBee devices, GPS, camera, hard disk, battery, hub and main module, as well as a ring-like device which is a wireless gesture recognition. Again, the obstacles will be the cost plus the difficulty in making all our clothes into a UFC, as well as the problem of extending the application.

Küpper and Treu [8] propose offering the service by proactive proximity and separation detection, equipping users with a cell phone with integrated GPS receiver, where the position obtained by the GPS area is passed on to the server according to a certain position update method.

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II. AMBIENT INTELLIGENCE

Ambient Intelligence represents a vision of the future in which we are surrounded by environments with devices equipped with certain capacities intelligent and sensitive people who react to them

Technologies relating to Ambient Intelligence combine concepts of ubiquitous computing and intelligent systems of ambient intelligence emphasize three characteristics: Ubiquity, which will accompany the user wherever you are (home, school, transportation, hospital, moving down the street, etc.), Invisibility by the ability to pass unnoticed in the physical environment and Intelligence for its ability to adapt to the preferences of the individual.

Although Weiser mentioned the importance of knowing who is in the surroundings of the computer, it was not until the mid-nineties that the concept of "context aware" arose [4] [5].

Dey defines this as “any information that can be used to characterize the situation of an entity. An entity is a person, place, or object; that is considered relevant to the interaction; between a user and an application, including the user and applications themselves” [6].

A fundamental characteristic of context aware systems is not only that they react to the user input, but that they also respond to contextual events that happen in the user's environment [7] [8].

It is important to find new ways of approaching natural interaction as much as possible to an implicit interaction, which is unnecessary explicit dialogue with the computer.

III. NFC TECHNOLOGY

Nowadays, we live surrounded with an enormous amount of devices and their multiple functions, thus generating a need to interconnect with one another. The Near Field Communications (NFC) technology was developed to meet this need. NFC is a short-range wireless connectivity technology that combines RFID and interconnection technologies, and was presented in 2002 by Philips and Sony. It works on a high frequency band of up to 13.56 MHz, with a data transmission speed of 424 kbits/s and a range of 10 cm. Although the NFC protocol can be installed in any electronic device, our interest will focus on NFC enabled cell phones (cell-NFC).

During the design process, Philips and Sony decided that NFC would be compatible with ISO 14443, but incompatible with the EPC global standards [9]. The first NFC specifications were published by ECMA International in open standard 340 “NFC Interface and Protocol”; one year later, they were adopted by ISO/IEC with number 18092.

Any communication or link in the NFC technology must be made between two devices: the Initiator, which, as its name suggests, initiates and controls the information exchange (called a reader in RFID); and the Target, which is the device that responds to the initiator’s request (called a tag in RFID).

In an NFC system, there are two methods of operation: Active and Passive. In the active one, both devices generate their own radio frequency field to transmit data (peer to peer). In the passive one, only one of these devices generates the radiofrequency field, while the other is used to load modulation for data transfers. In other words, the tag-NFC can only work like a target. Any other NFC-enabled electronic devices can work like the initiator or target (e.g. the cell-NFC or reader). The tag NFC can be read by the cell-NFC or reader-NFC. The cell-NFC can communicate with the reader-NFC or other cell-NFC.

At present, NFC technology is not yet common, but there are three reasons why it has a promising future: the connection between two NFC devices is established at once; the large companies (Philips, Sony, Nokia, HP, Microsoft, etc.) are supporting its development and widespread use; and it can be integrated into cell phones. The enormous penetration of cell phones among the population makes this an ideal device that will help to provide a seamless adaptation to NFC technology.

IV. AMI-NFC ENVIRONMENT

The two essential elements of any NFC system are the initiator (reader) and target (tag); both will be new devices when implementing an AmI-NFC environment in a computer infrastructure environment (although could be situations in which they are not needed). This infrastructure must have LAN (with internet connection), and each area must have at least one Bluetooth server, a services server, a file server and a database server (the latter three could be in the www if AmI has internet connection). The elements in AmI-NFC environment can be grouped as follow:

- NFC devices. Any NFC-enabled device: cell phone, reader and tag.
- Computer devices. Printer, display, desktop computer and laptop.
- Computer/Communications Infrastructure. LAN, internet connection and servers (services, Bluetooth, databases and files).
- Software. Specific software is installed in each NFC cell and computer in the environment (in the servers - Bluetooth, services, and files-).

When users touch a tagged device with their NFC cell, a preinstalled application is executed automatically, reading necessary information from the NFC tag and sending necessary information context to management system via Bluetooth bridge to request service. The application may obtain data from data bases and satisfy the service directly to NFC cell o service device, regarding this type of service, that are required by the AmI-NFC environment infrastructure which we call “services in the AmI area”. Sometimes, the users will touch another NFC cell with their NFC cell; in this case, the service is satisfied merely with their interaction, and does not require the AmI-NFC

environment infrastructure. We call these services "services in the AmI point".

V. AMI ENVIRONMENT THROUGH NFC: OUR PROPOSAL

In our previous work, we developed systems that capture the context using different options: RFID, the RFID-infrared combination and the RFID-NFC combination. The use of RFID technology is a good solution for offering implicit services to the user but it has some "limitations", i.e. cost. Although RFID technology allows us to offer implicit services, it does not have the capacity to confirm if those services are accepted there and then by the user. RFID does not enable us to know the user's exact position in order to consider this at the time of offering a service. In tests performed with the users, we observed that the use of infrared sensors was not natural for the users. The option of combining NFC and RFID is a good solution for offering implicit and explicit services to the user but there is a big problem: the cost of RFID. We expect RFID costs to decrease considerably in the near future; in the meantime, we have decided to develop an AmI environment using only NFC. When we stop using RFID technology, we also lose its advantages: implicit location and services. Although we have moved away from the effortless services only, we have added some effort: the touch.

Touching interaction is "the deliberate bringing together of two devices, for the purpose of obtaining services" [10]. Touching Interaction will be the user's interactive efforts to request and accept services. When users bring their NFC device close to each other, it will be for the purpose of obtaining services. Each touch will allow the AmI environment system to identify and locate the users and to manage their requests as well as customize the services.

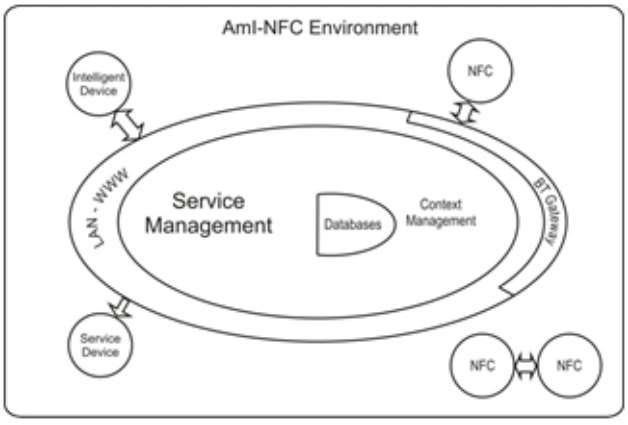

Figure 1: Element interactions in AmI-NFC Environment.

Context awareness is any information about an entity's features, while an entity is any user, place, object, device or application relevant to the users at any time [11]; to obtain this information, we will put a tag-NFC on each one, which we will call the "Tagging Context". In the tagging context, a tag-NFC is placed on any entity which, at some point, can interact with the user so that this interaction can be easily perceived by the AmI-NFC environment system.

In our proposal, we provided the user with one NFC-enabled cell phone (cell-NFC) or tag-NFC. In an ideal AmI NFC environment, all users have cell-NFC but we decided to develop these two options for two reasons: to anticipate when the user does not bring his cell-NFC, and to give services to temporary users who bring a tag instead of cell-NFC.

The users will access the services available in the AmI-NFC environment when their cell-NFC touches the tag-NFC that will be inside the device from where it wants the service. For example, if they want to unlock the door, they will simply have to touch it with their cell-NFC, in order to print the file stored in the cell-NFC, they will have to touch the printer, and in order to show the file to them, they will have to touch the display.

VI. SERVICES IN AMI-NFC ENVIRONMENT

A service is provided when users' needs are met. The proposed system manages the need from the moment that it arises, as well as the elements that are related to it. For example, the system will know when the user generates a "note to comment", it will be notified when the users who generate it and to whom it is addressed are in the same area, and it will show the "note to comment" in a nearby display if necessary.

The services in the AmI-NFC are classified based on whether or not they require the AmI-NFC environment infrastructure (table 1). The "services in the AmI point" are delivered only with the interaction of both NFC-enabled devices. The "services in the AmI area" require the use of the AmI-NFC environment infrastructure.

TABLE I
SERVICES IN AMI-NFC ENVIRONMENT FOR MAGNETIC

Service Name	Description
Services in AmI-NFC environment Area	
Enter/Exit	When user touch this NFC tag, the AmI management will consider or let consider it within the AmI
Store File	Copy file to file server. The user will set up who can access to the file
Associated file	When a file is stored in the server the owner can modify the allowed users
Load File	Save file in NFC device
Show file	Show file stored (in NFC device or server) in display
Visualization	The public display in area are customize to users.
Note to Comment	The user carries out notes in NFC devices, which want to comment on with somebody next time that meet. The system detects them in the same area
Post-it NFC	User equipped with NFC-device (not tag) can leave a note in any NFC tag. To specify user or any user touch the tag
Synchronize	Process so that is equal the information of the device and the desktop computer
Services in AmI-NFC environment Point	
Scheduling date	The user selects an option of looking for a meeting with another people. By just putting the cell phones close to each other, the system looks for and selects a suitable meeting arrangement
Business card	Bringing cell phone near each other in order to exchange the presentation card
Serving File	Send file from NFC device to service device

V. CONCLUSION

The use of NFC technology in the AmI environment is a step further in achieving the ideal vision of ubiquitous computing or ambient intelligence environment. Although it is not a totally proactive system, touching interaction is a somewhat explicit task that generates savings in terms of effort, compared to the traditional way of interacting with devices. Moreover, the fact that the system is embedded in a cell phone will facilitate its widespread use.

We have developed the first phase of an AmI-NFC environment at the AmI research group - AmIReG (Ambient Intelligent Research Group). This is an intelligent environment that can provide services, with minimum efforts, to a group of users who have common interests working in collaboration with each other. These users may have schedules that are frequently intertwined so that there will be a constant information flow among them. AmIReG will be able to manage a number of areas and points of service on different floors in one or more buildings. [9].

The use of AmIReG in our research group, show it that use of Bluetooth to connect the NFC-cell with the service servers, represents a saving compared with the data transferring through GPRS-connection, but require computational infrastructure.

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