Towards NFC Services

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Abstract— One of main objectives of Ambient Intelligence is the reduction to a minimum of the user's interactive effort, the diversity and quantity of devices with which people are surrounded with, in existing environments, increase the level of difficulty to achieve this goal. The mobile phones and their amazing global penetration, makes it an excellent device for delivering new services to the user, without requiring a learning effort. An NFC-enabled mobile phone will allow the user to demand and obtain services, by touching its different elements in the environment. In this paper we present a proposal where we analyze the scope associated with touch interaction, and where a model to perceive touch interaction through the tagging context is designed.

Keywords*-component; Touching Services, NFC, Ambient Intelligence*

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I. INTRODUCTION

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].

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 three problems: the cost, the fact that it cannot pinpoint users (i.e. perceive users in an area) and memory capacity of the tags. The new Near Field Communications (NFC) technology overcomes these problems: an NFC initiator device can move to any place, the localization will be on a point because of the need to bring the target and the initiator very close together, and the initiator/objective can use the memory device. 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.

In our previous work, we used RFID to identify the users as implicit inputs in the system and offer them services as implicit outputs. The particular contexts studied here are the classroom, the research laboratory and the lecturer's office [3]. We used an RFID-Infrared sensor combination to perceive users' locations and movements in front of a projector, commence a presentation automatically and control it with a hand movement [4]. In another phase of our research work, we used an RFID-NFC combination [5] to implicitly capture the user's presence in the working area of intelligent environment, offer implicit services, and request and accept certain services using touching interaction through an NFC-enabled cell phone. The advantage of RFID and NFC technologies is that the communication channel between the antenna and receiver begins automatically when the tags are detected. Unfortunately, the cost of disseminating the RFID technology is an obstacle for its widespread use.

This work explores the single use of NFC technology to get context information in an AmI environment. In addition, the development of NFC tag structure to obtain maximum advantage from its memory is studied. In our proposed AmI-NFC environment, we will use touching interaction to enter the environment, request and accept services, and place context information in the AmI-NFC environment management system.

II. RELATED WORK

There are different approaches that provide services to the users based on NFC technology. The user ability to adaptation and the technology costs are core difficulties when it comes to introduce these technological approaches. We will now talk about some of these systems.

In REACHEeS [6] using a cell phone equipped with NFC compliant RFID reader as a remote control for all kind of the multimedia content shown on an external display. In this framework each tag contains sufficient information, and may contain some extra parameters associated to that event, to start a one service. The communication between user interface gateway and the cell phone is implemented by means of HTTP

request and responses. Data bearer for the communication channel is GPRS/EGPRS.

In [7] NFC enabled cell phone was used as a user interface element so as to enable home-dwelling elderly people to choose their meals to be delivered be means of a home care service. They using a NFC tag stand with three tag where user can select one of two options of meal and third if user don't need meal. The application is based on Nokia Field Force Solution where the tags only have an instruction to execute the application in the cell phone after information about meal can be transferred through GPRS-connection to a middleware server and onwards to the back-end system.

The Mobile Sales Assistant [8] uses a NFC enabled cell phone to helps retailers and customer to check availability of articles at the point of sales. When a customer need information about an article she is interested in touch the NFC touch the NFC enabled label of the wanted articled, information about availability is taken from the ERP system and directly shown on the cell phone The tag over items have saved the electronic product code (EPC), the connection between the cell phone and the Web server (connected to the ERP) is made over GPRS.

The previous approaches they have two aspects that we improved in our proposal: The memory tag completely it is not used (only for a service) and the use of the GPRS as data bearer can be expensive.

III. User Scenario

In the following scenario, we describe some activities at a research group; in these the users obtain services through "touching interaction". This scenario is the support for the application we are developing and testing.

John arrives at the building door, where his office and other workspaces (laboratory, other members' offices, and meeting room) of his research group are located. With his NFC-enabled mobile phone he touches the tag at the side of the main door of the building and the NFC-enabled mobile phone reminds him that he has an important comment for George who is already working at his desk. For this reason John decides to go to the laboratory (where George is). At the moment John touched the tag, all the members of the re-search group, who are working in a computer, receive a message indicating that John has entered the building.

In a corridor, John can observe (on a public display) a summary of the research group's current work, such as deadlines of the congresses in which they will participate, the last versions of the papers being written, the identity and location of each person working in the building, etc.

When John arrives at the door of the laboratory he can observe who is in inside by looking at a little display. He can also see the degree of progress of the different activities (along with notes on projects, programs, articles, etc.) that the members of the group are developing. Before entering he touches the tag of the next door. Inside the laboratory he can observe a reminder of all "notes to comment on", on a public display at the laboratory, which has been stored in his mobile phone. Meanwhile, all users who have "notes to comment on" to John, can see a reminder indicating that John entered the laboratory on their computers.

While John talks to George, John places his mobile phone near the tag on the display of George´s computer to show a file. After commenting on it, they decide to show it to everyone in the laboratory. To this end, John touches the public display with his mobile phone.

Before John leaves the laboratory, George decides to send him a paper for checking, but, due to its large size, it does not fit in the mobile phone's memory. He therefore, decides to send the file to John so that it can be checked from any computer in the AmI environment.

When John leaves the laboratory, he runs the exit service in his mobile phone to aware the AmI environment that he is coming out of the laboratory. When John arrives at his office and touches the tag in the door, his mobile phone shows the list of people who came to see him while he was out, as well as the messages left for him

IV. 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. 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 (NFC cell).

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 (similar to a reader in RFID); and the Target, which is the device that responds to the initiator's request (called tag in RFID). In other words, the NFC tag can only work like a target and, any other NFC-enabled electronic devices can work like the initiator or target (e.g. NFC-enabled cell phone). The NFC tag can be read by the NFC cell or NFC reader (figs. 1.a and 1.b). The NFC cell can communicate with the reader-NFC or other NFC cell (figs. 1.c and 1.d).

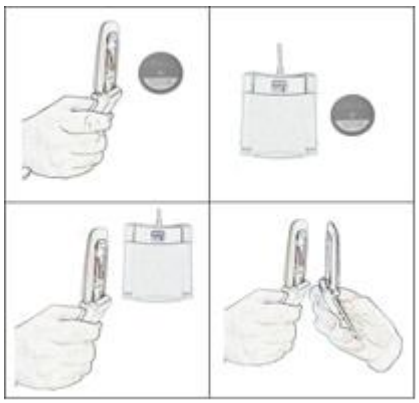

Figure 1. (a) Cell-Tag (b) Reader-Tag (c) Cell-Reader (d) Cell-Cell.

V. AMI-NFC ENVIRONMENT

The two essential elements of any NFC system are the initiator and target; 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 (fig. 2) 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".

A. AmI-E 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 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 interaction.

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.

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 NFC tag on each one. In our proposal, we provided the user with one NFC-enabled cell phone (NFC cell). When the user, carrying his NFC cell, touches one NFC tag, the application obtains answers to basic questions (Who, What, Where and When) generating context information. This information along with the obtained data from the data bases or from the user it will allow delivery of the services to the user.

The users will access the services available in the AmI-NFC environment when their NFC cell touches the NFC tag that will be on 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 NFC cell, in order to print the file stored in the NFC cell; they will have to touch the printer, and in order to show the file to them, they will have to touch the display.

B. 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.

VI. CONCLUSIONS

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. [12].

The use of AmIReG in our research group it show to use that of Bluetooth to connect the NFC-cell with the service servers it represents a saving compared with the data transferring through GPRS-connection but required computational infrastructure, and the use of the complete memory of the NFC-tag allows to offer a greater amount of services in a place. All users think the application was very simple to use and reduction in interaction effort.

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