

# Tagging for Nursing Care

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**Abstract**—Today, more and more hospitals manage patient records using computer support. Hospital personnel, however, are complaining increasingly about the complications involved in using healthcare applications. Dealing with complexity is a waste of valuable time that could be better dedicated to patient care. In this work, we present a proposal which seeks to adapt Near Field Communication technology (NFC) for nursing care. This consists of a combination of RFID and mobile phones. We propose that information management problems be solved with a single interaction by contact.

**Keywords**—ubiquitous Computing, Ambient Intelligence, Context-Awareness, RFID, NFC, Healthcare, Visualization.

## I. INTRODUCTION

Today there are greater and greater expectations about technological adaptability in health care scenarios. In addition, applications such as mobile telemedicine, patient monitoring, location-based medical services, emergency response and management, pervasive access to medical data, personalized monitoring and lifestyle incentive management can support physicians and nurses, improving the quality of service. [1]. However, many older staff members do not use computers in their daily activities [2]. Apart from all that, this author argues that despite the fact that computers have clear advantages, they are not well integrated into hospitals and Weiser's vision is not being played out successfully in these scenarios. Finally, staff complain about the difficulty of using healthcare applications; the time they have to spend on those everyday tasks produces certain frustration. These situations are very far off the idea of Ubiquitous Computing [3]. In addition, Favela [5] asserts that a great percentage of a nurse's work corresponds to management of information (22%). This takes up time that could otherwise be used for caring, so technological adaptability seems to be needed towards solving this problem by reducing that percentage.

In this work we present a proposal of technological adaptability for nursing care. We promote the use of an NFC enabled mobile phone for nursing care in a hospital ward. Here, each mobile phone has a contact RFID reader for the interaction with tags containing patient information as well as contextual information. With these, two goals are achieved: access to the Patient Nursing Record, together with the contextual information for interacting with the visualization services. Using NFC, nurses only need to touch the patient's tag with the mobile phone to identify prescribed drugs and

doses, as well as to see the patient's concerns, monitor his or her pulse and blood pressure, and so on. In addition, it is possible to display and manage the Patient Nursing Record with just a simple touch. In the next section we present the NFC technology and the nursing care tasks in a hospital ward through what we have called the "NFC Nursing Care Cycle". The architecture and classification for tasks, collaboration and tags structure can also be seen. Finally, we talk about the conclusions we have drawn and our future work.

## II. NURSING CARE SERVICES: A PROPOSAL FOR THE TAGGING OF CARE

Our proposal consists of placing tags on the patients' wrist, beds, rooms, medication and displays. In addition, nurses use NFC-enabled mobile phones and public displays, aiming to reduce the time taken to manage the patient's nursing record with the simple touch Patient Nursing Record. In our proposal, we study the following tasks for nurses: those related to the prescribed drugs and doses, preparation of medication, blood and urine tests, management of different diets, assorted care tasks and the taking of blood pressure and temperature. The visualization of information completes our proposal for the management of information for nursing in a hospital ward. In the next sections we present an introduction to NFC technology and the corresponding process for controlling nursing tasks.

### A. The NFC technology

NFC is a new short-range wireless connectivity technology developed by Philips and Sony in 2002. It is a combination of RFID and interconnection technologies. In an NFC system, there are two modes of operation: active and passive. In the active one, both devices generate their own field of radio frequency 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 Figure 1 three types of NFC devices and the operation modes can be seen. In our case, we have structured the information in tags according to the needs. The patient's wrist tag contains information about patient identification, along with treatments, diets, dates of blood and/or urine tests, patient monitoring and the contraindications of the medication. In addition, other kinds of information can be stored. For example, it is possible to manage a crisis of high temperature or of high blood pressure produced in the previous shift. Although this information is stored in the nursing server, we believe it is good to duplicate it



Figure 1. NFC devices and operation modes.

in the patient tag. Control of drugs, by matching the patient and drug tags, for instance, is thereby possible at the patient's bedside by means of simple touch.

### B. An NFC nursing care cycle.

Figure 2 shows the cycle for nursing with an NFC-enabled mobile phone. In the top left, the contact between two mobiles is displayed, a contact which makes the shift change possible when a new nurse comes into the hospital ward. The schedule is transmitted from the nurse on duty to the mobile phone of the incoming nurse, along with all the information needed. This consists of a task classification by time. The nurse's mobile phone sounds alarms when patients need particular care tasks. At present, nurses manage this information through forms that have to be prepared for each shift. With the shift schedule, managing the Patient Nursing Record is done with just a touch of the patient's tag. Alongside these provisions, tags in the room or the bed help nurses in task classification in the room. They can also control data if the patient is not in bed and when he or she may be out of the room. The next step, on the right, presents a J2ME application for managing nursing tasks. There are two modes of operation with this application: by task or by schedule (time). In the first one, the nurse chooses the task required from the menu and, in the second one we may observe the shift schedule that was mentioned before, which controls the entire process by the touching of tags. This application tries to avoid the interaction of nurses with the mobile phones. It is thus only necessary to use an option for entering data on a few specific occasions; for example, in the case of temperature or blood pressure. Figure 2 shows five screens. The first one, on the left, is for managing the nursing task. It is seen alongside another giving advice for how to bring the mobile phone close to the tag, as well as screens for controlling diets, monitoring the patient and visualizing blood/urine tests. The third step shows different information that can be stored in tags. There are five types: patients' wrists, rooms (there could be more than one patient), beds, medications and interaction tags. At the bottom of Table 1, a proposal for tag structure is presented. As

we said before, the patient tag contains all the information needed for nursing, which means, drugs prescribed & their doses, blood/urine tests (control of requests for these), diets, wound dressings, data monitoring and the contraindications of the medication. The tag on the bed can contain useful data of a patient such as identification, blood/urine tests pending and their diet. The room tag contains the patient's/patients' identification. This information shows the schedule for the room at that particular time. Awareness is also provided and some other kinds of information, such as instruction for a new patient, can be stored. The tags for medication store specific information for everyone, along with support for the control of their administration and corresponding preparation in the nurse's cabinet. Finally, the interaction tags provide a simple way for visualizing and managing information. The fourth step, below right, shows the nursing server. It is a PC connected by the data base for patients and contains the Nurse Patient Record. All the information managed in the patient room is transmitted by Bluetooth or NFC Reader. The first one can be done by touching the tags next de PC display and, the second one, by touching an NFC reader connected to the PC. We consider this a very appropriate way to manage the Nurse Patient Record, which at the same time avoids complicated interactions and reduces the time nurses spend on managing information.

Finally, a visualization service completes this cycle. In this, nurses manage the information for patients by just the interaction with tags placed on the public display. Collaboration between nurses in the shift change is also possible. We have placed four tags for interaction next to the public display. Another tag for supporting the identification control is also needed. This one allows each nurse to take control of the display. In the bottom left of Figure 2 our "Visualization Mosaic" is presented [6] [7]. It consists of different pieces of a puzzle that show information of each patient: a ward plan with the room number included, a list of patients that the nurse is looking after, general information of a given patient, his/her particular Patient Nursing Record and the graph development of that. These graphs are generated automa-

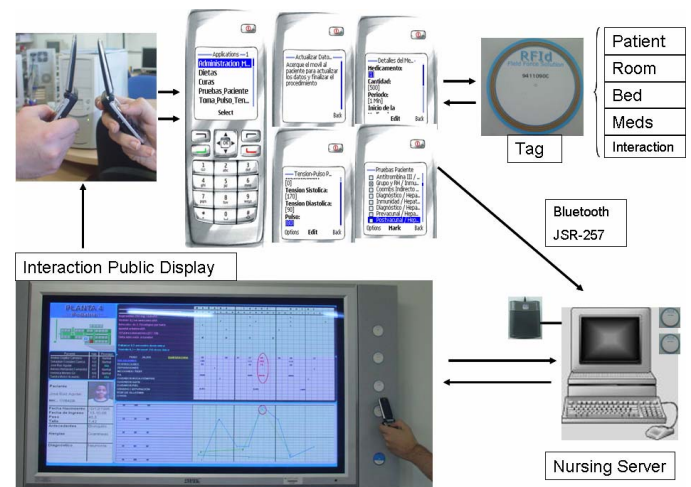


Figure 2. The NFC nursing care cycle.

TABLE I. NURSING TASKS, COLLABORATION AND TAG STRUCTURE

| Task                               | Place   | Tag                                    | Process (Awareness)                                      |
|------------------------------------|---|--|--|
| <i>Patient Monitoring</i>          | Room  | Patient                                | Blood Pressure, Pulse. (A)                               |
| <i>Drugs control</i>               | Room  | Patient                                | Drug checks (A)  |
| <i>Diet</i>                        | Room / Nurse Desk   | Patient / Bed/ Interactive Display Tag | Select & Modify  |
| <i>Cares</i>                       | Room  | Patient                                | Care Protocol (A)  |
| <i>Analyses Control</i>            | Room / Nurse Desk   | Patient / Bed/ Interactive Display Tag | Select (A)   |
| <i>Managing Information Server</i> | Nurse Desk  | Interactive Display Tag                | Storing Information                                      |
| <i>Patient Record for Nursing</i>  | Nurse Desk  | Interactive Display Tag                | Getting Information (A)                                  |
| <i>Preparing drugs &amp; doses</i> | Drugs Cabinet   | Meds                                   | Doses (A)  |
| <b>Collaboration</b>               |   |  |  |
| <i>Nurse &amp; Physicians</i>      | Room / Nurse Desk   | Patient / Bed/ Interactive Display Tag | Control of Blood/Urine Tests/ Drugs / Diet / Monitor (A) |
| <i>Nurse &amp; Nurse</i>           | Nurse Desk  | Interactive Display Tag                | Shift Change (A)   |
| <b>Tag Structure</b>               |   |  |  |
| Tag                                | Content   |  | Awareness  |
| <i>Patient</i>                     | Drugs & Doses (Last, Time) Blood/Urine Tests (Time, Results), Diet, Dressings, Monitoring, Contraindications of medication. |  | Yes  |
| <i>Bed</i>                         | Patient Id., Blood/Urine Tests Pending, Diet.   |  | Yes  |
| <i>Room</i>                        | Patients' Id.   |  | Yes  |
| <i>Meds</i>                        | Active principle, Contraindications, Doses.   |  | No   |
| <i>Interaction</i>                 | Control, Select, Zoom, Back,...   |  | Yes  |

tically when the server receive the information from the caring tasks carried out on the patient. As well as the above, the management of an abnormal state is shown. For instance, in this case, a high temperature and increased blood pressure is marked by a red circle. This fact, along with the visualization of the information itself, supports the collaboration between physicians and nurses while helping nurses in the change in shifts. This functionality can be seen in the middle of the Table 1 (Collaboration). As we commented before, the interaction through the public display tags allows nurses to visualize the information of each patient by touching one of his/her tags. The functionality of each tag can be varied (*take control, select, zoom, back*, etc.). At the top of Table 1, a classification of the

nursing task is shown. Touching the tag on the specified place produces the execution of the application in the mobile phone. A proposal for collaboration and tag structure is presented below

### III. CONCLUSIONS AND FUTURE WORK

We have presented a proposal for nursing care through novel technology, as NFC is. With this and the widespread use of the mobile phone, we have aimed to reduce the time for managing information, by just a simple single touch. This is in line with the idea of Roy Want and other authors about computerizing the daily activities in a hospital context. It is also the case that by implanting this technology, thus saving time in information management, it is possible to improve patient care in a hospital ward. To do all this, it is also important to acquire the complement of awareness for tagging context: this comes from patients, rooms, beds, medications and interactions. Finally, we are looking for other devices such as Bluetooth-enabled blood pressure monitors or thermometers. These will make it possible to transmit the information to the mobile phone, thereby minimizing the interaction.

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