Ubiquitous Computing for Hospital Applications
RFID-Applications to enable research in Real-Life environments

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Abstract

Ubiquitous Computing (UC) has the potential to improve many workflows in Health Care. In hospitals clinicians move around constantly between very different work places and need to have fast access to information. Consequently, classical solutions, bound to a particular location, are often inadequate for optimal support of clinical workflows. In this paper the authors report ongoing work in R&D of UC applications in real life settings within Graz University Hospital, which is one of the largest in Europe.

1. Introduction

New technologies enable a revolutionary development; away from the classical Personal Computing (PC) towards Ubiquitous Computing (UC) [1].

However, *The New Computing* [2] aims to support people, to improve daily workflows – briefly: in order to create a clear, unambiguous and manifest appreciation in value.

Work in hospitals is formed by many cooperating clinicians having a high degree of mobility, parallel activities and no fixed workplace. Existing software solutions often fail to consider these issues [3], [4].

As a result, our research uses the approach of UC to address existing problems including immobility, inefficient medical interfaces and navigation or misidentification within the Hospital. Also we work towards achieving possibilities to support patients in improving the management of their Health Care and medication at home. Our research focuses not only on technological aspects but includes the whole integrated supply chain order. On the basis of working demonstrators, we carry out research in real-life settings. To date, UC has been tested extensively in laboratory settings – but has not been sufficiently researched in real life settings of hospitals [5].

2. RFID Technology

We use two main categories for RFID (Radio Frequency Identification): systems with passive RFID transponders (near field (LF, HF) systems) and far field systems (UHF). In most of our experiments we focused on near field 13.56 MHz RFID technology. It employs inductive coupling of the transponder to the reader antenna and obtains relatively short – but for our requirements sufficient – reading distances.

3. Ubiquitous Communication

Widespread use of the Internet/Intranet in Hospitals, standards in networking, mobile communication (GPRS, UMTS) and wireless infrastructures (WLAN, Bluetooth, Infrared, etc.) provide great opportunities for ubiquitous communication. Bandwidth increases three times faster than power and storage capacity of computers. In addition to the availability of mobile devices, this enables the exchange of large amounts of health care data in low time.

4. Software Architecture

The software we developed for our experiments is based on Infineon Technologies You-R® OPEN software that behaves as an RFID middleware that aggregates, filters and collects data generated by RFID readers. These data are provided by an event based model. The data of the transponders provided include the Unique IDentifier (UID) of the transponder and an abstract data model with key value pairs of different data types. Interfaces of this RFID middleware to Graphical User Interfaces (GUI) and Hospital Information Systems (HIS) are constructed as a facade to hide the internal structure of the RFID system [6].

It is implemented by an extension of the framework via a HTTP/SOAP Web service interface. This interface

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provides exactly those methods that are required for different scenarios in the hospital workflows by the used HIS or other applications. In the following we describe two scenarios which we implemented and tested.

5. Scenario Example 1: Check-In

Patients check in at the Hospital – in addition to an ordinary wristband an RFID transponder is supplied (figure 1). Patient data is entered via our application at the check-in-point, any previous patient data can be retrieved from the HIS. From this information, uncritical but important data (such as name, blood type, allergies, vital medication etc.) is transferred to the wristband’s RFID transponder. The Electronic Patient Record (EPR) is created and stored at the central server. From this time the patient is easily and unmistakably identifiable. All information can be read from the wristband’s transponder or can be easily retrieved from the EPR by identifying the patient with a reader. In contrast to manual identification, automatic processes are less error-prone. Unlike barcodes, RFID transponders can be read without line of sight, through the human body and most other materials. This enables physicians and nurses to retrieve, verify and modify information in the Hospital accurately and instantly. In addition, this system provides patient identification and patient data – even when the network is crashed.

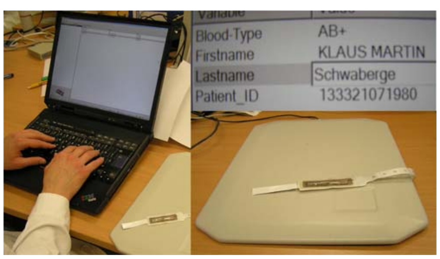

Figure 1 Input of data at patient check-in

6. Scenario Example 2: Ward Round

Physicians are equipped during their ward round with mobile devices (Tablet PCs or PDAs) that have an RFID reader integrated. Tablet PCs have the benefit of a large screen size, handwriting recognition and extended storage space as compared to PDAs – however the costs are higher. Patients are easily identified by reading their RFID wristbands with the integrated RFID module of the Tablet PC. With a special pen the physician is able to enter notes and modify or add medical data. This information is later transferred to the central data storage of the patient records and is retrievable from that moment on.

7. Conclusion & Future Work

To date, our research shows that there is an extremely high potential for optimizing and automating many workflows within the Hospital by the application of UC. Existing problems such as immobility, or time consuming navigation of patient records can be addressed by this approach. Currently we are testing our demonstrators in specific real life hospital settings. In addition, we evaluate new technological approaches including optical and RFID based printing of wristbands, biometric methods to address login, security issues and sensors retrieving medical information of patients. However, a lot of research must still be done and experiences must be gained. In order to provide clear benefits to the end-users of these technologies the application of usability engineering methods is essential [7].

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