

# Identifying patients and visualize their vitality data through Augmented Reality

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**Abstract**—Hospitals aim at an extensive continuous monitoring of patients. This enables the personal to check the conditions of a patient anywhere at any given time and allows them to immediately react to anomalies and emergencies. The same technology can be used to instantaneously visualize available patient data using augmented reality techniques.

**Keywords**—augmented reality; patient monitoring; sensor networks; situation awareness; visualization

## I. INTRODUCTION

Hospitals would like to monitor changes of vitality data of patients like body temperature, blood pressure, pulse rate, and many other extensively and continuously. This would not only enable hospitals to record those data for analysis and other long term uses but also allow swift reactions to potential emergencies. This kind of monitoring has to allow timely and purposeful usage of the gathered data. However patients should not be restricted unnecessarily, since the ability to move around freely has positive effects on recovery [5]. To avoid restricting patients the applied sensors have to be as small as possible to enable pervasive use. Furthermore they have to be energy efficient and available in large quantities. This means that the sensors used are cheap, embedded nodes that are severely constrained concerning available resources like processing and storing capacities. Which in turn means that software for these nodes has to be efficient and in most cases specifically designed. Beyond being as non restrictive as possible monitoring solutions gain if the data is instantaneously available for emergency alerts and local inspections (*for instance during the round of the physicians*). An interesting aspect would be, if up-to-date sensor data was not only available but could also be visualized in a simple manner enabling any physician to asses the condition of patients easily.

The demonstration setup described in the following section illustrates how continuous pervasive monitoring of patients can be implemented applying a wireless sensor network and how the data gathered can be visualized via augmented reality providing immediate access to a patients vitality data.

## II. DEMONSTRATION

Current technologies already allow mobile access to centrally managed patient information using available communication infrastructures. If hospitals were to upgrade their infrastructure with additional wireless sensor networks to acquire vitality data of patients, the desire to use this data immediately instead of just logging it for long term use will arise soon.

- 1) A stationary device that is hooked into a backbone enables central monitoring of vitality data of many patients including triggering alarms in case of emergencies. Alarms can either be triggered by a sensor node or another device that uses a variety of data such as blood pressure, pulse rate, body temperature or oxygen saturation to assess a patients condition.
- 2) A mobile device that is able to collect data directly from the wireless sensor network as well as request additional information using the backbone can be used to monitor or inspect a patient locally. To be able to visualize vitality data of patients, augmented reality techniques will be required additionally.

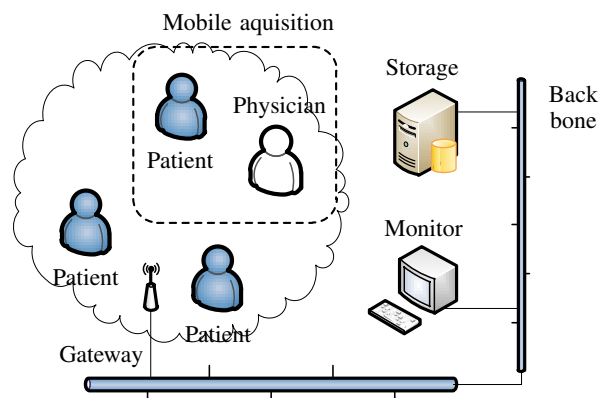


Figure 1. Schematic infrastructure of monitoring scenario

Figure 1 schematically depicts an infrastructure able to satisfy demands for both stationary and mobile use. The infrastructure itself consists of patients wearing several sensors connected by an IEEE 802.15.4 [3] sensor network,

a backbone that can be a wired or wireless network and several mobile and stationary devices connected to the backbone. Gateways connect the wireless sensor network with the backbone. The sensor network is used to gather and disseminate vitality data of patients. Once this data is received by a gateway it is transferred to a central data storage or a stationary device, requesting this particular data. If a physician carrying a mobile device wants to inspect the data of a particular patient, he normally has to first identify the patient, then use the identification to discover what sensors are available for this patient and finally use these information to request the data. However this process is slow and error prone due to the fact that every step has to be executed manually.

Our demonstration aims at automatizing this process by employing techniques of augmented reality. We use visual markers to identify patients unambiguously. Hence, for the visualization it does not matter if a marker is attached to a patient or contained in his file. The patient's ID is then used to request the patients current vitality data.

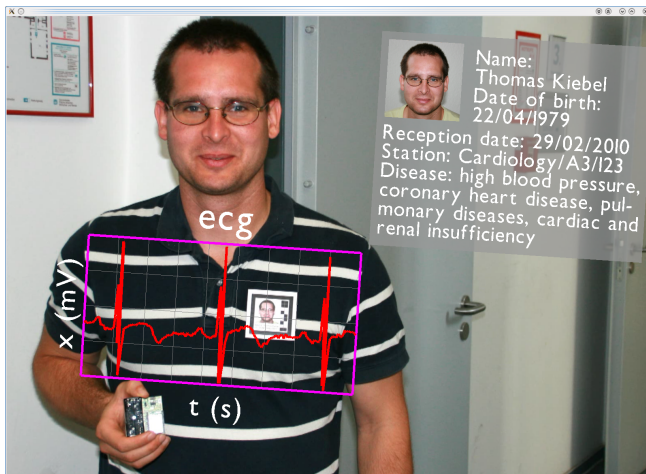


Figure 2. Patient and a visualization of his vital data

Figure 2 depicts a patient as seen by a physician during his round or an emergency. This situation is marked by the dashed box in the schematic of the infrastructure in figure 1. The marker used to identify the patient is recognizable on the chest of the patient. A visualization of the patients information including his cardiac data is shown in the upper right corner and one of our wireless sensor nodes is depicted in the lower left. It should be noted that currently we only use cardiac data and while the data used is real it is not provided by a live measurement.

For our demonstration we use a wired backbone (*Ethernet*) and a wireless sensor network. The wireless sensor nodes consist of 8-Bit AVR Atmel micro-controllers for processing and IEEE 802.15.4 based radio controllers for communication. To be independent from the underlying

networks our event-based publish/subscribe middleware FAMOUSO (*Family of Adaptive Middleware for autonomOUS Sentient Objects* [6], [7]) is used for data dissemination in both the sensor network and the backbone. For the radio communication in the wireless sensor network FAMOUSO uses the ARMARoW (*Architecture for Medium Access control and Routing protocols in Wireless sensor networks* [4]) radio stack which is based on the IEEE 802.15.4 physical layer. Recognition of patients, visualization of information, and vitality data is done with the help of the Augmented Reality ToolKit [1]. Additional information like diagrams and textual elements may be easily integrated as well.

### III. CONCLUSION

The described demonstration and its underlying technology is easily applicable to medical applications and other fields of operation. Thus, it is conceivable to use it for automation engineering applications [2] for instance to visualize abnormal situations during processes and parameters of devices and goods.

### ACKNOWLEDGMENT

This work is partly funded by the Ministry of Education and Science (BMBF) within the project "Virtual and Augmented Reality for Highly Safety and Reliable Embedded Systems" (ViERforES - no. 01IM08003C).

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