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System for Mobile Monitoring of Vital Functions and Environmental Context

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Abstract

The use of ICT in the health care system is aimed to increase efficacy and decrease costs. We have designed a system and services for mobile monitoring of vital physiological parameters and environmental context. The system is based on a small multi-functional wireless body sensor for simultaneous measurement of ECG, temperature, heart rate, respiration rate, and movement. The sensor is wirelessly connected through Bluetooth Smart to a Smartphone. When necessary, the measurements are transferred to a server and can be accessed by authorized personnel. The contribution of the system to improved quality and efficiency of medical care is validated and estimated through several pilot studies.

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Keywords: body sensor, health care, mobile, monitoring, telemonitoring, eHealth, multi-functional, wireless; ECG;

1. Introduction

The development of information technology and telecommunications (ICT) has reached a level where its usefulness can be applied for health care needs towards Telemedicine and Telecare, which represent a promising alternative for today's traditional hospital admission. This basic premise is included in all strategic plans of the EU and the rest of the world. Research efforts are focused on the development of devices and instruments which are

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small, simple to use and reliable. Our latest contribution to this topic is an open source system for mobile monitoring of vital physiological parameters and environmental context. The system has been registered as a technology innovation at the Jožef Stefan Institute since April 15th, 2015.

2. System description

The proposed platform for mobile monitoring of patients is schematically shown with the diagram in Figure 1. The core of the system is a small and light **wireless multifunctional** body sensor, fixed to the skin of the user by two standard self-adhesive electrodes. The body sensor (dimensions: 2x9cm, weight: 22 g) measures vital physiological and environmental parameters, with two electrodes at the distance of 8 cm [1]. It primarily measures differential surface potential (ECG) between the electrodes. The body sensor has a long autonomy (up to 7 days) and low-power wireless connection (BLE) to a Smartphone or other portable personal unit (PPU). The PPU runs programs for: communication with the sensor; storage, processing, analysis and visualization of measurements; user interface; and interface, accessible via the Internet, to a safe storage server. When necessary, the measurements are stored on the server and can be accessed by authorized personnel.

The moderate resolution ECG obtained by the body sensor is suitable for long-term personal cardiac activity monitoring, as well as for clinical use. Its exceptionally **lightweight** design allows for **unobstructed** use also during sports activities or during exhaustive physical work. Besides ECG, other features can be extracted from the measured potential difference, such as muscle activity and respiration [2]. The sensor can also detect information about the measurement conditions such as movement and ambient temperature, thus providing information that allows for **ambient intelligence** [3]. The device can support solutions to every-day problems of the medical personnel in hospitals, health clinics, homes for the elderly and health resorts.

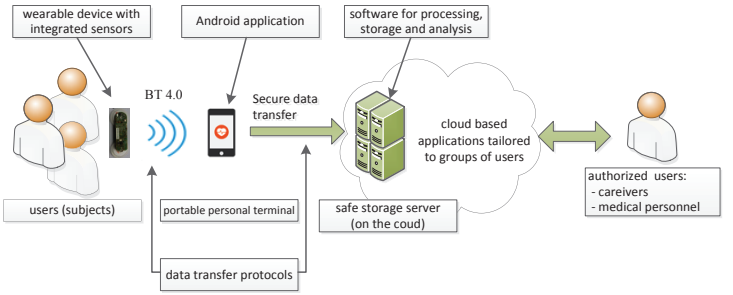

Fig. 1. Technology platform for the follow-up of patients.

3. Pilot studies

In order to assess the usability of the proposed system, four pilot studies were designed [4]: (1) postoperative atrial fibrillation recognition at the University Medical Center Ljubljana; (2) palpitation detection at the Community Health Centre Ljubljana; (3) short or long term health assessment at Terme Dobrna; and (4) short or long term heart condition assessment at the Muscular Dystrophy Association (MDS) rehabilitation center Izola.

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