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Wireless Implementation for Monitoring the Bio-Signal Shape of Blood Vessels

Implementación inalámbrica para monitorear la forma de bio-señales de los vasos sanguíneos

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Abstract

The application of telemetry systems to monitor and send physiological functions raises a number of challenges in project development of modules that can enter the body with minimal intrusion, managing and amplifying the sensitive signals generated by the body, and transmitting them to an external system for data reading. Such devices can be used to monitor and manage the signals from patients and obtain accurate readings in noisy electrical environments (such as operating rooms). The following paper shows an application of wireless communication systems applied to medical measurement and monitoring via Bluetooth.

Keywords:

- blood vessel
- wireless
- bluetooth
- telemetry

Resumen

La aplicación de sistemas telemétricos para vigilar y enviar funciones fisiológicas plantea un gran número de retos en la elaboración de proyectos de módulos que puedan introducirse en el cuerpo con un grado de intrusión mínimo, amplificando y gestionando las minúsculas señales que genera el cuerpo y transmitiéndolas después a un sistema externo de lectura de datos. Este tipo de dispositivos puede utilizarse para vigilar y gestionar las señales que provienen de los pacientes y para obtener lecturas precisas en entornos eléctricos ruidosos (tales como las salas de operaciones). En el siguiente trabajo se muestra una aplicación de un sistemas de comunicación inalámbrica aplicado a la medición y monitoreo medico a través del Bluetooth.

Descriptores:

- *presión arterial*
- *sistema inalámbrico*
- *bluetooth*
- *telemetría*

Introduction

Measurements of arterial and venous pressure have evolved over time, from noninvasive measures performed with the sphygmometer to methods such as the cuff to processes that warrant the placement of intravenous catheters such as cardiac catheterization and placement of Swan-Ganz catheter (SG) (Tortora *et al*., 2001; Pepine *et al*., 1992; Maldonado *et al*., 2008; Chatterjee *et al*, 2009; Córdova *et al*., 2012). Hemodynamic monitoring is essential for medical evaluation of the clinical routine, particularly in critically ill patients and thereof. So, there is a need to find a method capable of performing measurements of the vascular mechanical activity in real time, it should be similar to catheterization evaluation, furthermore they should be noninvasive and with graphical information displayed on a screen. On the other hand, wireless communication between electronic devices and systems is increasingly used in different areas. For example, cell phones, computer networks, industrial sensors and biomedical measurement systems, to name a few examples of these technological advances. Particularly, the portability of the current medical devices could avoid cables that currently are a disadvantage in hospital rooms.

A wireless system can consist of wide-area wireless networks (WWAN), i.e. cellular systems, wireless local area networks (WLAN) (IEEE 802.11a, b, g) and wireless personal area networks (WPAN) Bluetooth, Zigbee (Vijay et al., 2007). In March 1999, the working group was created (IEEE 802.15), which has developed communication standards for wireless personal area networks (WPAN). In July of that year, Bluetooth was chosen as the first standard of the group and served as the basis for the new standard (IEEE 802.15). It was associated with the Bluetooth standard (IEEE 802.15.1) (Chatschik et al., 2001).

Completely wireless scenarios can be achieved due to the nature master-slave Bluetooth technology, where all devices are equal, identified by its own unique address 48 bits, and can be assigned as a teacher, either by function or user intervention. In particular, a teacher can connect up to seven slaves at the same time, forming a piconet point-to-multipoint. A group of piconets, no more than ten, is referred to as scatternet. This feature is what makes it different from other Bluetooth wireless technology advances (Kammer *et al*., 2002).

Wireless communication devices and medical monitoring measurements are increasingly used and accepted by medical staff in hospitals or outside them, as well as other providers of health care around the world (Vijay *et al*., 2007; Amoore *et al*., 2008; Contreras *et al*., 2010).

This work presents a wireless device and its potential to record biosignal of the mechanical activity and hemodynamics for arterial and venous biological systems, their wave shape in healthy volunteers, as well as the implementation of wireless communication of Bluetooth for viewing and registering data.

Transferring of biosignals

There is a device developed in our laboratory (Maldonado *et al*., 2008), called PPC (pulse pressure gauge heart) which bases its operation that uses the sensor magnetometer KMZ10 Philips, of second generation, it was updated in order transfer recorded biomagnetic signals to three potential recipients: *i*) smart phone, *ii*) personal computer and *iii*) portable device developed to measure the implementation. Besides wireless communication the use of Bluetooth technology was implemented. The biomedical signal is transferred from PPC to medical staff according to the diagram shown in Figure 1, and the block diagram in Figure 2.

The protocol of the biomeasurements demand a patient in semi-Fowler position, a magnetic marker is placed just above the blood vessel, as shown in Figure 3. The magnetometer from the PPC, without surface con-