29 June – 1 July 2006, Sofia, Bulgaria

Wireless Technology in Body Area Networks for Multiplex Sclerosis Patient Monitoring

A. Peulic[1], S. Randjic[2], A. Dostanic[3], M. Acovic[4]

Abstract – **In this moment, measuring of physiological data is performed at hospitals or laboratories where patients are trapped with many electrodes attached on the body. Wireless networking will liberate people from such confinement and enable continuous real time monitoring of physiological data, which is vital for medical care. To achieve this goal, it is necessary research and development wireless body area network for signal processing, wireless transmission, and databases for these vital data. This paper presents arm moving wireless monitoring by accelerate sensors for patients with sclerosis multiplex**

Keywords – **Wireless Technology, Body Area Network, Intelligent Sensors, Health Care Information System, sclerosis multiplex**

I. INTRODUCTION

To provide human healthcare support with a better quality, we should be able to collect a very large amount of people's vital signs and monitor it efficiently. Current welfare system is based on medical doctor regular consultation, on behalf of our own feeling. The idea is not to replace the current system, but to augment it by an environment using wireless networking, to provide continuous monitoring of one's physiological information, perform simple diagnosis and communicate all that with medical institutions.

The interest for wearable systems originates from the need for monitoring patients over extensive periods of time. This case arises when physicians want to monitor individuals whose chronic condition includes risk of sudden acute events or individuals for whom interventions need to be assessed in the home and outdoor environment. If observations over one or two days are satisfactory, ambulatory systems can be utilized to gather physiological data. An obvious example is the use of ambulatory systems for ECG monitoring, which has been part of the routine evaluation of cardiovascular patients for almost three decades. However, ambulatory systems are not suitable when monitoring has to be accomplished over periods of several weeks or months, as is desirable in a number of clinical applications.

Wearable systems are devices that allow physicians to overcome the limitations of ambulatory technology and provide a response to the need for monitoring individuals over weeks or even months. They typically rely on wireless, miniature sensors enclosed in patches or bandages, or in items that can be worn, such as a ring or a shirt.

[1]Aleksandar Peulic is with the Tehnical Faculty, Svetog Save 65, 32000 Cacak, Serbia, E-mail: apeulic@tfc.kg.ac.yu

[2]Sinisa Randjic is with the Tehnical Faculty, Svetog Save 65, 32000 Cacak, Serbia, E-mail: rasin@tfc.kg.ac.yu

[3]Adam Dostanic is with the Tehnical Faculty, Svetog Save 65, 32000 Cacak, Serbia, E-mail: adamdostanic@tfc.kg.ac.yu

[4]Marko Acovic is with the Tehnical Faculty, Svetog Save 65, 32000 Cacak, Serbia, E-mail: markoacovic@tfc.kg.ac.yu

We propose a system using wearable micro sensors, to monitor patient's physiological information such as blood-flow, pulse, temperature, EKG, EMG, EEG, etc. On a wearable controller, a software environment allows accumulating data from physiological sensors, recording them into a local database, operating basic data manipulations, and communicating data with the database at medical institutions. These elements compose health remote control systems, which concept is shown on Fig. 1.

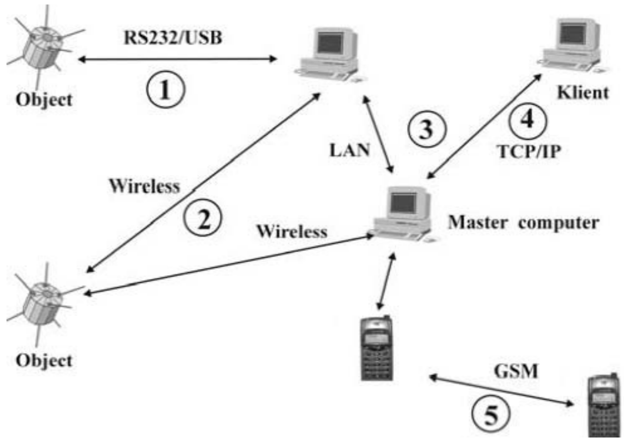

Fig. 1. Health remote control system

It consists of several measurement modules, a local wireless body area network, a local wire network and GSM network.

II. METHODS

Slave board Fig. 2 is based on 868 MHz RF TI TRF6900 Transceiver. The RF transceiver data and controls lines are connected to low-power Texas Instruments microcontroller MPS430F149. The output of signal conditions circuit is connected to microcontroller's 12-bit AD converter. The proposed communication algorithm is implemented in microcontroler memory.

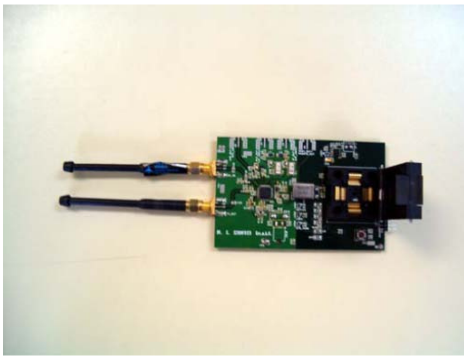

Fig. 2. Wireless module

Wireless Body Area Network is realized like cyclic network, Fig. 3.

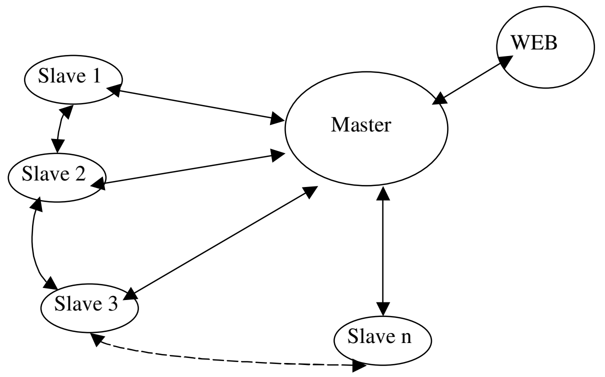

Fig. 3. Wireless Body Area Network

Proposed system is designed for up to 256 modules. Any slave sends own address, two bytes, measured signals information, up to 16 bytes, 8 measured signals, and two bytes of next slave address. Last slave expect first if there is any new slave at network, and if there is not new slave, sends address of the first slave. In master module is implemented agent algorithm. It is programs procedure for case that there is not answer from any slave. Agent scans slaves and reprograms network. One byte is transmitted for 8*13.02μs and for whole slave information there is need 2187.36μs. For all slaves with 8-channel need is about 600ms. USB 2 connects the master module to server PC. 0.

III. DISCUSSION

Wireless intelligent sensors have made possible a new generation of non-invasive, unobtrusive personal medical monitors applicable during normal activity. Sensor intelligence allows implementation of real-time processing and sophisticated encryption algorithms. On sensor data processing decreases the amount of energy spent on communication and allows implementation of power-efficient communication protocols. Decreased power consumption will significantly increase battery life and even enable externally powered intelligent sensors. The current technological trend will allow wider use of wireless intelligent sensors, lower power consumption, and smaller sensor sizes.

In case of medical emergency master module can send an SMS message to the centre medical doctor.

Daily monitoring of patient's vital signals will make possible a broad range of healthcare application services. It allows enhancing accuracy of diagnosis, networked system allows several doctors to monitor the same patient and detect pathological change in its early stage, evaluate behaviour of elderly people with dementia, quantitatively estimate human physiological condition in daily life, and support interactive home care.

Developed system is based on wearable sensors to enable continuous monitoring of patient's physiological information. A wearable controller collects wirelessly sensor data, integrate it into a database, which allow the exchange with medical institutions where a system manages the database for each patient's vital data. Improvements of the physiological information integration system concern simultaneous sensor communication management method, and algorithm evaluation to detect simple abnormalities. Simultaneous use of several wearable sensors allowed performing correlation analysis, which is the source of sensor system simplification (information redundancy). The determination of minimum sensing environment, size and energy consumption improvements are critical to adapt the system to practical use.

Acceleration sensor is placed at patients arm or leg and connected to RF transmitter, Fig. 4.

Fig. 4. The sensor place at the patient arm

The ADXL311 is a low cost, low power, complete dual-axis accelerometer with signal conditioned voltage outputs, all on a single monolithic IC. The ADXL311 is built using the same proven iMEMS® process used in over 100 million Analog Devices accelerometers shipped to date, with demonstrated 1 FIT reliability (1 failure per 1 billion device operating hours). The ADXL311 will measure acceleration with a full-scale range of ±2 g. The ADXL311 can measure both dynamic acceleration (e.g., vibration) and static acceleration (e.g., gravity). The outputs are analog voltages proportional to acceleration.

The typical noise floor is 300 μ g/$\sqrt{Hz}$ allowing signals below 2 m g (0.1° of inclination) to be resolved in tilt sensing applications using narrow bandwidths (10 Hz). The user selects the bandwidth of the accelerometer using capacitors CX and CY at the XFILT and YFILT pins. Bandwidths of 1 Hz to 2 kHz may be selected to suit the application.

IV. EXPERIMENTAL RESULTS

Measured and transmitted accelerate signals are presented at Figure 5, X axis and Figure 6, Y axis.

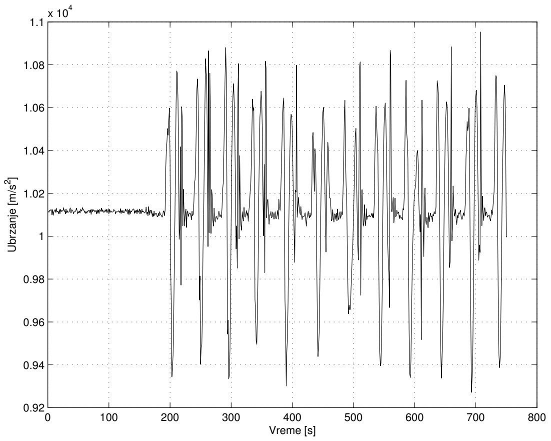

Fig. 5. The transmitted accelerate signal X axis

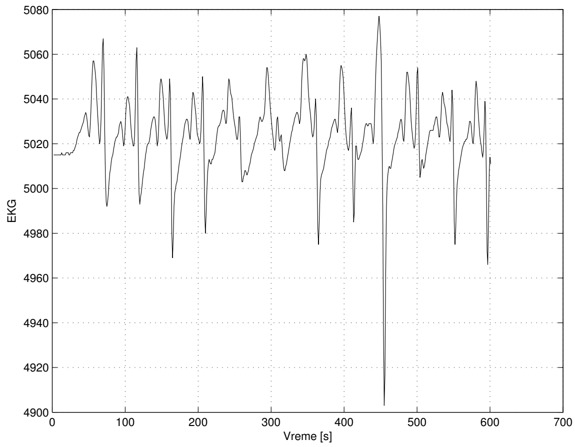

Fig. 6. The transmitted accelerate signal Y axis

When the accelerometer is oriented so both its X-axis and Y-axis are parallel to the earth's surface, it can be used as a two axis tilt sensor with a roll axis and a pitch axis. Once the output signal from the accelerometer has been converted to an acceleration that varies between –1 g and +1 g, the output tilt in degrees is calculated as follows:

$$tilt = a\sin(X/1g) \qquad (1)$$

$$rool = a\sin(Y/1g) \qquad (2)$$

Figure 7 represents right arm moving angle in XY plane measured in scale of about 300 sec, and figure 8 left arm moving angle.

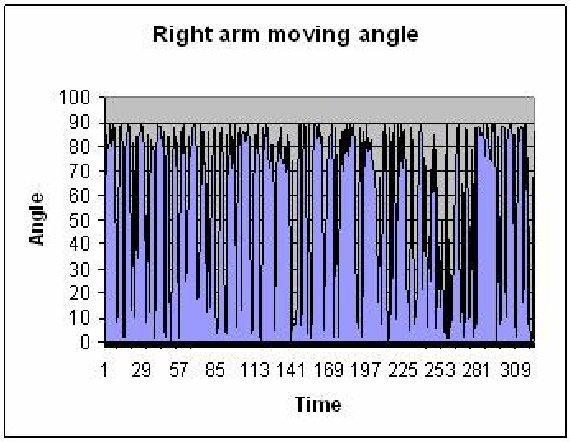

Fig. 7. Right arm moving angle

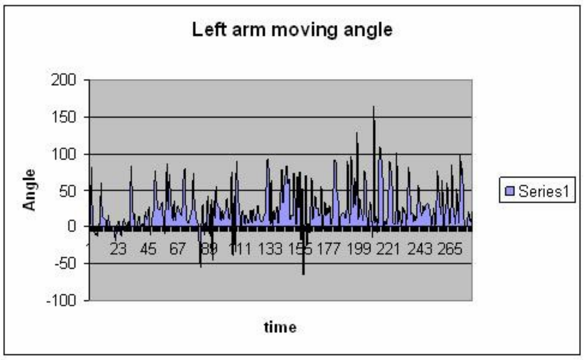

Fig. 8. Left arm moving angle

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