Electronic Identification and Patient Parameters Monitoring

Siniša Ranđić[1], Aleksandar Peulić[2], Adam Dostanić[3] and Marko Acović[4]

Abstract **- In this paper has shown different method for wireless monitoring biomedical patient data and safety modes. Our system consists of mobility sensors devices and using wireless transfer for sending measured biomedical data to central computer/data base server in hospital. The proposed health remote control system supports a few levels, a first, level with sensors for monitoring biomedical data, second central level for wireless transfer measured data, third central system for acquisition data and last , fourth level, corresponding application for automatic analysis same, user interface for data access and very important part is hardware protection of data access. Barcode reader and patient's identification card realize hardware protection. This system is convenient for continuous patient monitoring as enhance care of patient's health.**

Keywords **– Monitoring biomedical patient data, Mobility sensor devices, Wireless transfer measured data**

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 information technologies (IT) and wireless networking, to provide continuous monitoring of one's physiological information, perform simple diagnosis and communicate all that with medical institutions. 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 totally no obtrusive 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. They take advantage of hand-held units to temporarily store physiological data and then periodically upload that data to a database server via a wireless LAN or a cradle that allow Internet connection.

II. SYSTEM DESIGN

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 shown on Fig 1.

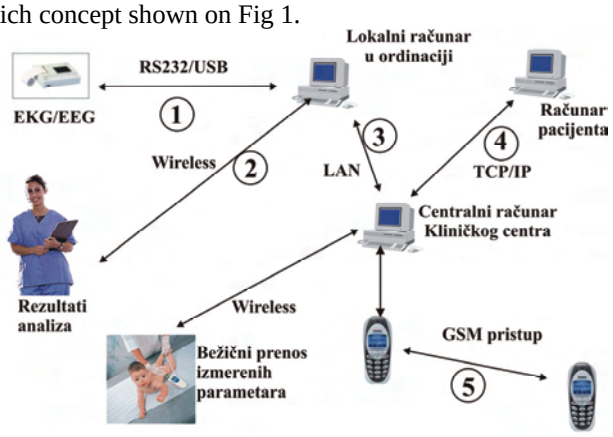

Fig. 1. Health remote control system

The whole system can operate as standalone as well as PC controlled. It can be divided into four parts, radio frequency data transmission network, analogue measurement modules, PC-based base station (including data processing) and programmable, portable recording modules with feedback options. The main goals of the design are lightweight, minimal power consumption, modular design and robust circuitry. The Network in between the measuring modules and the base station is realized as a bi-directional multi-point, single master RF-link, operating in the LPD-frequency range (868MHz) on a single channel. The RF measuring network consists of several measuring (slave) modules (a maximum of 31 slaves is possible) and of one master module. The structure of the network is fully dynamic and in operation reconfigurable and scaleable. The configuration process of the RF-network is fully automatic in conjunction with the control program, running on the PC or the Base station. The

[1]Siniša Ranđić is with the Technical Faculty, Sv. Save 65, 32000 Čačak, Serbia, Email: rasin@tfc.kg.ac.yu.
[2]Aleksandar Peulić is with the Technical Faculty, Sv. Save 65, 32000 Čačak, Serbia, Email: peulic@tfc.kg.ac.yu.
[3]Adam Dostanić is with the Technical Faculty, Sv. Save 65, 32000 Čačak, Serbia, Email: adamdostanic@tfc.kg.ac.yu.
[4]Marko Acović is with the Technical Faculty, Sv. Save 65, 32000 Čačak, Serbia, Email: markoacovic@tfc.kg.ac.yu.

initializations process and the required communication in between the master and the module's give the possibility to control the network dynamically. It is therefore necessary to initialize a slave module to a dedicated master. The function of master is slave polling and acquisition of data. The function of slave is recognition of control package and sending data to master. The master acts in direct conjunction with PC by USB or RS232, collecting information from RF link and sending to database by PC application. User action by PC application master translates to slaves by RF link. It is possible to operate several masters in parallel using different channels. The base station collects the data stream of the modules operating in parallel and feed them together. The bandwidth of the whole system is 19200 Baud. The bandwidth of each slave is dynamically controllable by the master. For each slave is also given a back directional configuration channel. Its purpose is to configure the slave and to control hardware functions of measuring device. The channel selection by the master is managed by a collision detection algorithm to ensure the usage of the channel with the minimum radio strength signal. Individual slave (measuring) modules) are controlled by, and communicate with, the master module (PC) using a custom wireless protocol. We use standard 868 MHz RF modules (RF Transceiver TRF6900) because the available Bluetooth technology requires three to five times greater power consumption. In addition, we reduce power consumption by using a custom, power-efficient communication protocol. The core of our wireless modules consists of a low-power Texas Instruments microcontroller MPS430F149. The controller features a 16-bit architecture, ultra-low power consumption (less than 1 mA in active mode and ~1 µA in standby mode), 60-KB on-chip flash memory, 2-KB RAM, 12-bit A/D converter, and dual UART. Internal microcontroller analogy channels monitor battery voltage and temperature. Therefore, slave module is capable of reporting the battery status and temperature to the upper level in the system hierarchy. Master and slave modules form a personal area network, which communication system is wireless, mid-range (up to 40 meters) and consume little energy, for practical usability. Under these requirements, it is constructed transmission circuits using weak radio frequency. On vital data reception, master module automatically records it in a local database. It is designed database architecture centered on measurement sessions and time-based classification. The environment also provides functionalities to display multiple physiological data on graphs, carry out graph manipulation (zoom, slide), and access information about sensors (maker, serial number, picture...). After the data have been saved, it is coupled with sensor information (sensor id number, name) and saved into PC database. It is designed to manage patients' daily monitoring individual data, provide tools to support medical doctor diagnosis process, and a meta-data framework to make easier processes like correlation analysis and data-mining.

WEB Internet service is data transfer is the system extension. Long distances patients monitoring are available and doctors have a possibilities to produce actions from house from example. There is and mobile phone services and figure 2 shoves a system design based at Internet and mobile phone services.

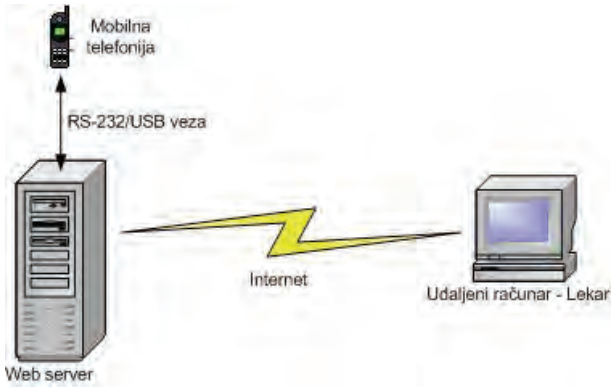

Fig. 2. Internet based patients monitoring system

The hospital web server station has IP (Internet Protocol) address. The symbolic web address is need for directly locations patients data form WEB server.

A mobile phone module is need for Small Message System conectd directly to WEB server by a standard RS232 ar USB interface.

III. BAR CODE READER SYSTEM PROTECTION

The realized health remote control system supports a three security levels, a first, lowest patient security level, second a doctor level involved at doctor personal computer and top level at data base server. This chapter describes first security level, realized bar code card reader. Every patient has own identification number and own password implemented in identification card. The identification card has intention to protect external access to health remote control system by unauthorized persons. Second convenience is storage an array of medical date concerning card owner. The Card reader is realized like external device and connected to PC by serial or USB port or wireless, Blue Tooth for example, Figure 3.

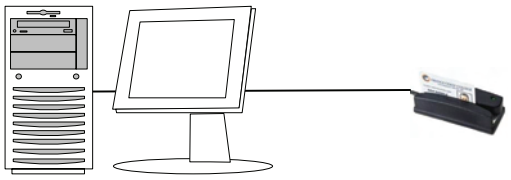

Fig. 3. Bar code reader PC connections

The bar code reader reads personal identification number and password from card memory and sends it to PC. The PC application is realized by Microsoft Visual C++ with intention to establish communication check accepted data form card and permit or deny access to system.

CONCLUSION

Developed system is based to enable continuous monitoring of patient's physiological information. A wearable controller collects measured 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. Intelligent medical monitors can significantly decrease the number of hospitalizations and nursing visits. In case of medical emergency master module can send an SMS message

to the personal medical doctor. A three security levels are involved in aim to prevent and limit access. A first security level is a bar code reader based realized, and our future work will be focused to improve security capabilities of system.

REFERENCES

[1] Jovanov, E., Price, J., Raskovic, D., Kavi K, Martin, T., Adhami R.: "Wireless Personal Area Networks in Telemedical Environment" Proceedings of Third International Conference on Information technology in Biomedicine, (ITAB-ITIS2000), pp. 22-27, 2000.

[2] Jovanov, E., Price J., Raskovic, D, Moore, A., Chapman, J., Krishnamurthy A.: "Patient Monitoring Using Personal Area Networks of Wireless Intelligent Sensors", Biomedical Sciences Instrumentation Vol. 37, in Proc. 38th Annual Rocky Mountain Bioengineering Symposium, RMBS 2001, April 2001, Copper Mountain Conference Center, pp. 373-378.

[3] Jovanov, E., O'Donnel, A., Morgan A., Priddy,B., Hormigo, R.: "Prolonged Telemetric Monitoring Of Heart Rate Variability Using Wireless Intelligent Sensors And A Mobile Gateway", 2nd Joint EMBS-BMES, Houston,Texas, October 2002.

[4] Jovanov, E., Price J., Raskovic, D, Moore, A., Chapman, J., Krishnamurthy A.: "Patient Monitoring Using Personal Area Networks of Wireless Intelligent Sensors", Biomedical Sciences Instrumentation Vol. 37, in Proc. 38th Annual Rocky Mountain Bioengineering Symposium, RMBS 2001, April 2001, Copper Mountain Conference Center, pp. 373-378

[5] Peulic, A., Randjic, S.: "Radio Frequency Measured Data Transmit", ICEST 01.-04. Oct. 2002, Nis, Yugoslavia, CD zbornik, Measurement Technique

[6] Peulic, A., Randjic, S.: "Computer Based High Radio Frequency Systems Contro", TELSIKS 01.-03. October 2003 , Nis, Yugoslavia, Proceedings is on CD

[7] Peulic, A., Randjic, S.: "Computer Based Remote Measuring and Acquisition of Dynamic Data", ICEST 16.-18. October 2003, Sofia, Bulgaria