

Design of ECG's Web Services with Low Power RF Module for MSMC

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ABSTRACT

This paper describes the design of a remote monitoring system for ECG signals. The system provides remote monitoring of several patients wearing a portable device equipped with 802.15.4 low power RF module connective based on wireless sensor networks for MSMC (Princess Maha Chakri Sirindhorn Medical Center). We have designed to record on-line database, server computer used to analyze ECG signals and detect serious heart anomalies in time sent alarm to authorized medical staffs or physician through telecommunication network. The system has a decision support on web based methods that can detect with high precision. Then the ECG signals are sent by a patient's equipped through wireless to the server of the ECG receiver used in hospital. The physicians can have an easy access to that patient's information and ECG with software on PDA, and in the web browser on PDA or PC computer.

Keywords: MSMC, 802.15.4 RF module, ECG signals, remote monitoring, PDA

I. INTRODUCTION

At present, heart disease is one of serious diseases that may threaten human life. The electrocardiogram (ECG) is important role in the prevention, diagnosis the abnormality of patients and rescue of heart disease. In progress has been made in the development of a remote monitoring system for ECG signals, the deployment of packet data services over telecommunication network with new applications.

The tele-transmitting and receiving of ECG signal is the key-problem to realize the tele-diagnosis and monitoring of ECG signals. This system is provided remote monitoring of one or

several patients wearing portable devices equipped with a PDA-based portable wireless ECG monitoring for physician personal area networks wireless connectivity based on different technologies[1]. In approach, the fast and effective compression scheme, designed for the tele-monitoring system, the mobile phone based intelligent tele-monitoring platform supports background bio-signal abnormality surveillances using data mining agent[2]. A dynamic ECG system with tele-transmitting and receiving function it consists of the ECG recorder carried by patients. The ECG receiver used in hospital and the PC computer used to analyze ECG signals it is possible for hospital to offer the service of heart health with long-distance [3]. An innovating on-line monitoring system, which has been developed by applying new advances in biosensors, the mobile devices and wireless technologies. On the effectively implemented and deployed into a system that makes use of PDA, and wireless communications Bluetooth and GPRS[4].

We present the possibility of accessing PDA data through the web server. In order to do that we have defined a set of interesting web services, use for monitors ECG signal from the patients send-receiving and analyzing of ECG based on conventional dynamic electrocardiogram with interface ECG technology in order to monitor on-line. The proposed system automatically alerts physician service provider with ECG intelligent analysis, when physician assistance is crucial for the user, can detect some anomalies and send alarms to a control center and a physician. A wireless portable is small hardware and supports the unique needs of low-cost, low-power wireless sensor networks, send and receive connective ECG signal to database server. A description of a full-custom design with a similar functionality than the application described in this paper can be found in[5], [6].

II. GLOBAL ARCHITECTURE

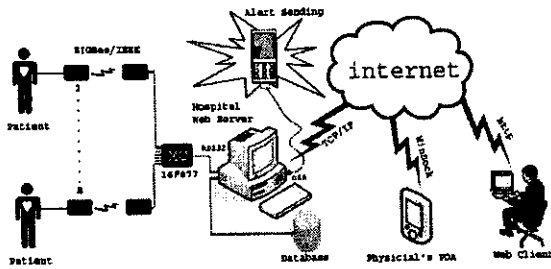


Figure 1. The structure of global system.

The structure of global system is shown in Figure 1. It consists of three parts: Portable ECG Transceiver, Hospital web server, and Personal monitor. Among them, Portable ECG Transceiver check status of the patient and send the bio-signal with IEEE 802.15.4 RF module, Hospital Web Server as receive data send to record database and monitoring analysis system performed multi-user real-time monitoring analysis if it received data to analyze ECG signals and detect serious heart anomalies in time sent SMS to authorized physician staffs or physician and web service client as application interface for user executed by the web browser, and Personal monitor consist application on patient's PDA for monitor information system and analysis data of patient.

II. System Implementation

We implemented program using Embedded Visual Basic (EVB), MySQL database and PHP language for send and receive signal data in web service. In order to provide PDA to remote monitoring clients with socket application and add send data with those systems are implemented as wireless network connection.

III. PORTABLE ECG TRANCEIVER

This unit contains bio-signal transceiver device with ECG amplifier connects via IEEE 802.15.4 technology. Portable monitoring terminal send and receiving the signal voltage, the 802.15.4 OEM RF module standards and support the unique needs of low-cost, low-power wireless sensor networks.

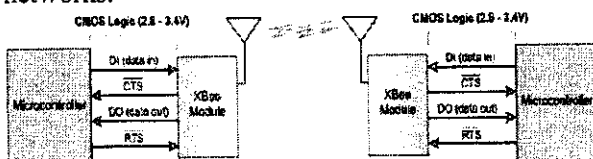


Figure 2. 802.15.4 IEEE technology

The modules require minimal power and provide reliable delivery of data between devices, it operate within the ISM 2.4 GHz frequency band and interface to a host device through a logic-level asynchronous serial port. Through its serial port, the module can communicate with any logic and voltage compatible UART, use through a level translator to serial device as shown in the Figure 3.

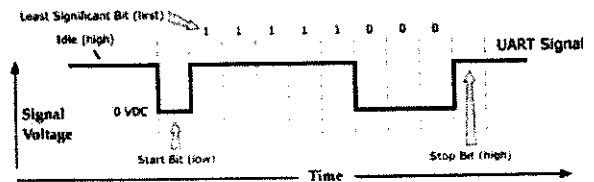


Figure 3. System Data Flow Diagram

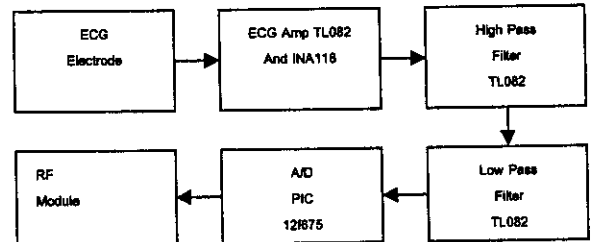


Figure 4. Portable ECG design

Portable ECG Transceiver device transmit signal to database on the computer server during a period of 24 hours, it was used an PIC12F675 microcontroller for analog to digital signal conversion and patient interface controller is shows in Figure 5.



Figure 5. Hardware PCB

IV. HOSPITAL WEB SERVER

The Hospital Web Server is provided receiver device, application, web service and patient's database.



Figure 6. ECG measurement method



Figure 7. Portable ECG Transceiver device

We have designed to record by on-line database, computer server is used to analyze ECG signals and detect serious heart anomalies, in time sent alarm to physician or doctor. Then the ECG signals are sent by a patient's equipped to the hospital server, the remote to patient monitoring to access a specific patient and revise data of all. This module is to efficiently manage the resources in the computer server consists of five parts.

V. REGULAR SIGNAL RECEIVER

During this normal operation mode, patient's unit sends the biological signal acquired from the acquisition device at a regular interval to the web server. Anyhow, this signal acquisition process, the PIC16F875 microcontroller will checks connecting from Portable ECG Transceiver, and the ECG signal acquisition module receives the analog signal and converts to a digital platform, it will be manage the wireless communication among the regular signal

receiver, and user MAX232 interface to computer server with RS232 serial port communication, it has to build signal packages with include multi-patient's ECG signals before send to real-time monitor application.

A. Real-Time Monitoring Application

Hospital web server performed multi-user real-time monitoring receive provides application designed with Visual Basic application as multithreaded application to enable simultaneous connections with multiple clients include multi-patient's ECG signals. There are concentrative recording on MySQL database and displaying wave of signal.

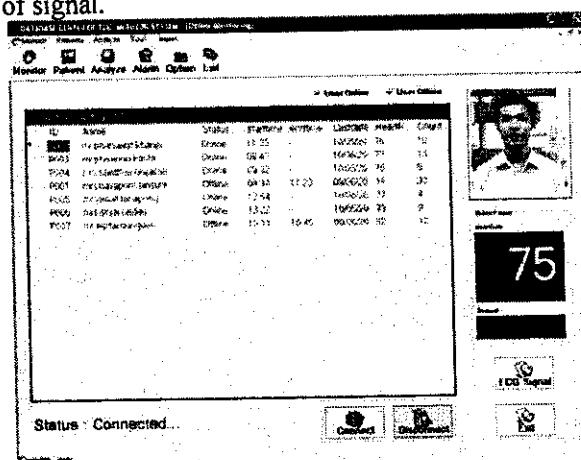


Figure 8. Real-time monitoring on PC

B. Notifying Emergency Situation

The application running in the computer server can distinguish abnormal situations like excessive pulse rate, interval at the ECG signal. The ECG signal is processed detection of the beats, it is significant the identification of the presence or absence of some signal, the points where P, QRS and T waves start, end and their peaks. For the implementation of this module we have used detect number peaks of ECG signal with this application interface to RS232 port and built an automata that divides the signal into a sequence of beats.

In situation is alerted when application detects any abnormality on the signal discovers any pattern requiring urgent physician attention. The system is capable of notifying the appropriate physician via SMS send alarms to physician, we used mobile phone, interface to USB modem port, standard-baud-rate was set to 9,600 bps, and used AT - Command, a usable standard command of modem for almost mobile phone series.

C. Database

All the biological signals from the patient's unit are stored here. For implementation purposes we have chosen MySQL, because of its support of data with online analytical processing module, it require support online web browser and PDA connection.

D. Web service monitoring

The computer server consist Apache web server module and web service as PHP interpreter, it is free software, and connect to internet network with TCP/IP protocol.

This computer consists of information of patient and ECG signal. It unified management model for communication and analysis ECG signal, web service as web application interface for user executed by the web browser with other computer or PDA. The physicians to analyze the data easily with calculate data form compare between data and time domain for check normal ECG and for monitoring signal graph with PHP function, and shows information. The user interface management is accomplished by PHP scripts executed by the web server and connected online database as MySQL show in Figure 8 and 9

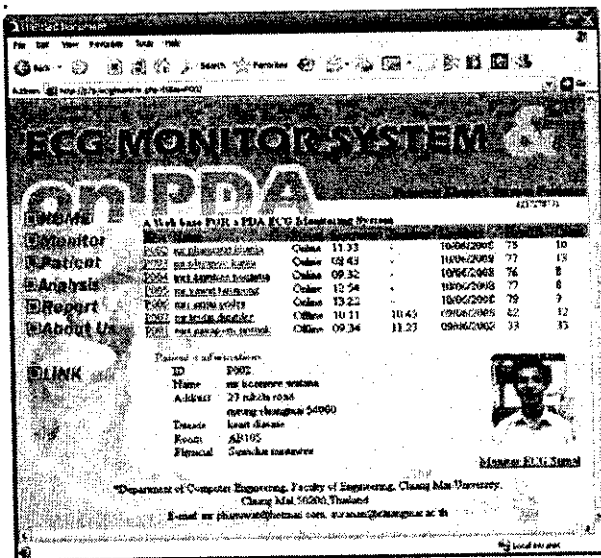


Figure 9. Web service of ECG signal display.

E. Personal monitoring

A physician access by remote monitoring client, and can request patient's information in a HP iPAQ h6365 PDA connected to the server with GPRS, Bluetooth, and wireless or internet cable. PDA client

could receive security services and connect to hospital server, it can getting response from the system with ECG monitor software. This software developed with platform windows mobile 5.0 version, it used Embedded Visual Basic consists of two sub-systems are online and off-line analysis, the other patient information to be displayed show in Figure 10 and 11.

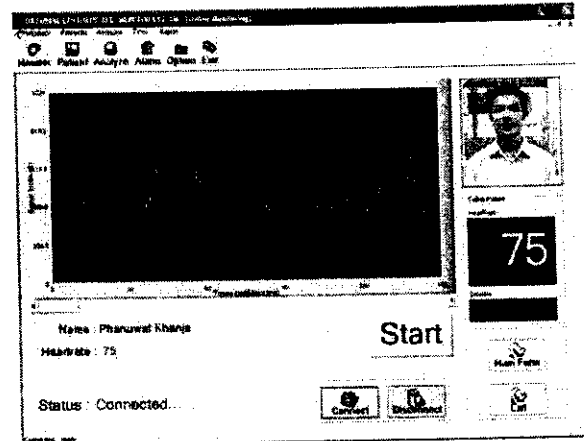


Figure 10. Web Client ECG signal Monitoring.

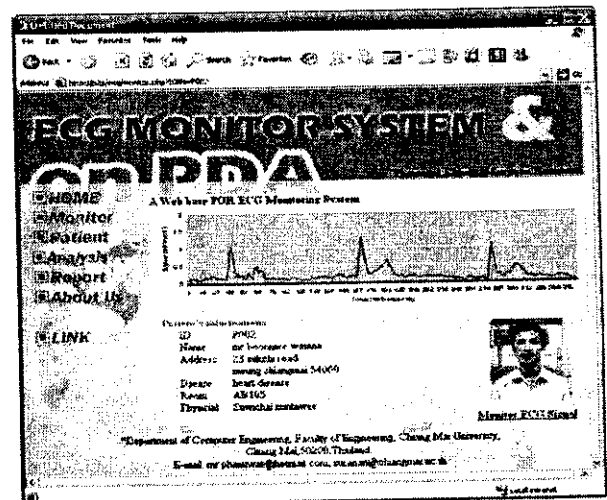


Figure 11. Personal ECG Monitor

The application modules are connected through TCP/IP sockets so that they can run application in the PDA as well. The client uses the socket interface in order to send configuration and acquisition requests to the server running on the PDA, as well as to read the sampled data. The socket based interface, the graphic client can be run either in the same PDA, and the graphical client is also multithreaded.

VI. Results

The main proposed of our system is a web server application based intelligent tele-monitoring, PDA function, and wireless technology. In a remote monitoring the ECG signal from people suffering from heart disease. On the other development projects, working with wireless communication on telecommunication network is more expensive than using wireless sensor networks technology. Therefore, it is interesting to pay special attention to try to not pay of the wireless communications service, at the same time not to delay the notification of serious heart anomalies to the hospital.

In order to validate the concept and experimentally the functions of the real-time server monitoring of the ECG in Figure 6 and 7, an test system using the developed prototype is build and an basically experiment is carried out on a volunteer moving around in hospital. The preliminary test results can receive ECG signal by wireless communication of the volunteer in order to test of system performance as distant at indoor is 100 meter. The Hospital Web Service can receive ECG signals and information. In order to analyze the ECG signals, patient may carry out the ECG recorder to hospital server. Figure 10 is the analysis interface of ECG and shows ECG waveform. The correct operation of the web interface has been checked, verifying the remote access to the system from different browsers.

Finally, Figure 10 and 11 shows the ECG signal and status of patient on screen of computer. When it connects to the web server, provides a link to the patient database. Therefore, the client can get the basic information of Socket communication from the hospital server and the information appears in PDA. On the PDA can select menu on the screen to start and resume the remote patient monitoring, it is start search the data by Socket and MySQL database. We tested the prototype system monitoring clients accessing continuously for 24 hours.

VII. CONCLUSIONS

The design of A Web base System for ECG data transferred using IEEE 802.15.4 RF module is completed following Portable ECG Transceiver, Hospital web server, Personal monitor. In this paper we have presented the global architecture of web based tele-monitoring platform, we have designed and performed some experiments that consisted a web based intelligent tele-monitoring platform with

good extensibility, it is new technologies for ECG monitoring from hospital database, the device IEEE 802.15.4 RF module with special attention has also been paid in not pay of the wireless communications and a wireless interface is a good alternative to other interface, platform makes it easy to use the web browser for data editor and found that the system satisfies all the requirements for remote patient monitoring, and a remote monitoring PDA clients of the physicians to analyze the data easily and quickly and shows information. The design supports the remote monitoring of ECG signal using different user interfaces.

Furthermore, receiver application could include advances ECG analysis with more to automatically detect various high risk heart diseases, get early diagnosis and prediction of care demands.

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