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Evaluation of Medical Parameters Using Android Smartphone

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ABSTRACT

The medical field concentrates on the measurement and analysis of crucial parameters, e.g. ECG, heart rate, heart rate variability, Body Temperature, plethysmography. (Wireless) Body Area Network connected to an Android smartphone offers the large functionality. Smart and energy efficient sensor nodes collect physiological parameters, execute signal processing and data analysis and convey evaluation values to a coordinator node. Data are transferred via Bluetooth to an Android based smart phone, which further may be transferred to Doctors, Relatives or Clinical Server as per requirement to facilitate emergency medical help.

Keywords

Telemedical, Body Area Network.

1. INTRODUCTION

Advances in technology were contributed many changes in human daily life as an example mobile phone for this century has become more than a tool for communication. As a born a new generation of mobile phone is known as a Smartphone were support many function such as Internet Browser, Java application, GPS, Bluetooth/infrared and other future functions. These powerful function that supported Smartphone enabled it to use in health monitoring field.

Basically, the existing system is used for health monitoring only available in hospital and huge in size. Monitoring can be done when the patient is on the bed. From that, monitoring and recording of physiological parameters of patients outside the clinical environment is becoming increasingly important in research as well in applied physiology and medicine in general. The idea is to provide the monitoring system even the patient is not in clinical environment. As a result, patient still can be continuously monitoring even had discharged or can be used as personal health monitoring.

In order to provide the health monitoring system when the patients are out of clinical environment many things needs to be considered. The first thing, need to be considered is mobility. The system need to implement in way unobtrusive the daily life of users, also easy to user to use it (user- friendly) and easy to set up the system. Secondly the cost, low cost system is more prefer to be implemented. Last but not least, reliable data transmissions where the data can be transmit everywhere and anytime.

The main idea for the present work is to develop an Android OS based data collection platform that can collect physiological data from multiple sensors, perform signal processing and analyses, store data in an internal memory and transmit data to clinical server. When the medical parameter exceeds specified limits, automatically message shall be sent to Doctor and Relatives of patient through Mobile SMS.

For the present work, by using the existence device (Smartphone) it will make the cost lowest. As a target market, Smartphone will be conquering the mobile phone market and Android OS uses is were increasing from year to year.

2. REALTED WORK

A user wearable breathing recorder was described in [1], This work propose a wireless PAN of intelligent sensors as a system architecture of choice, and present a new design of wireless personal area network with physiological sensors for medical applications.

Improving the safety of diving and increasing knowledge about the adaptation of the human body to underwater and hyperbaric environment require specifically developed underwater instrumentation for physiological measurements [2], technological acquisitions and the development of three dedicated devices: (1) An underwater data logger for recording O2 saturation (reflective pulse oxymetry), Two-channel ECG, depth and temperature; (2) An underwater blood pressure meter based on the oscillometric method; and (3) An underwater echography system.

"A novel wearable apnea dive computer [3] was prepared for continuous plethysmographic monitoring of oxygen saturation and heart rate. The device is able to measure and display transcutaneous oxygen saturation, heart rate, plethysmographic pulse waveform, depth, time and temperature during breathhold dives. All measurements were stored in an external memory chip.

"Multi-stage Real Time Health Monitoring [4] proposes platform operates in two different modes. In the first mode, it measures the raw ECG signal form up to three electrocodes, and locally analyzes heart rate variability. If an arrhythmia risk is detected, an

alert is transferred to the home server over the ZigBee network controller. In the second mode, the

ECG is measured and transmitted to the home server, and the home server an ECG record. In order to completely cover the monitored area, several additional ZigBee routers may be required.

3. PROPOSED SYSTEM

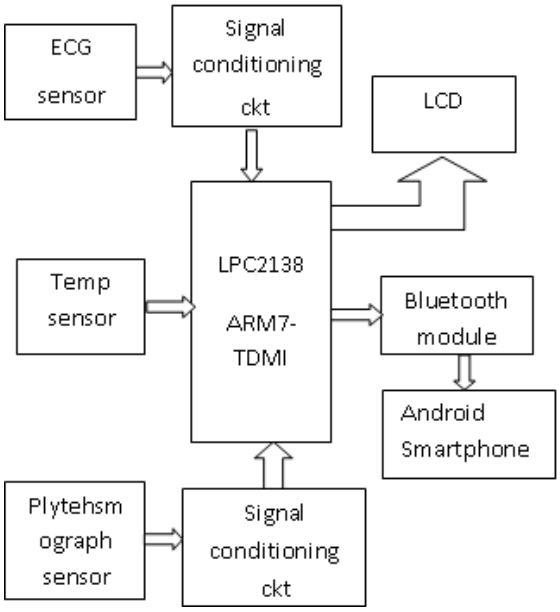

Fig.1.Block Diagram Of Proposed System

System would constantly monitor important body parameters like temperature, heartbeat and would compare it against a predetermined values set and if these values cross a particular limit it would automatically alert the doctor and relatives of the patient via a SMS. In such case the patient will get a very quick medical help and also would save time and energy of the relatives who neither would have to be with them all the time.

Sensors and the smart phone collects/displays the Physiological data and also transmit data to the remote Server through wireless technology Wi-Fi. This can keep record of all the mobiles which are connected to the system.

In present work, three biomedical parameters considered are as: (1) ECG, (2) Plethysmograph, and (3) Body temperature.

4. DESIGN METHODOLOGY

4.1 WBAN Architecture:

Figure 2 shows the WBAN architecture. In this architecture the primary data processing is done by the sensor nodes, including the physiological signal processing in the ARM 7 processor of the nodes. The secondary data processing is performed in the Smartphone. This includes data representation, data filtering, graphical interface and data synchronization. Finally the last and most demanding data processing together with the database management is performed in the medical server. The medical server allows local and remote access for Medical personnel via the internet.

4.2 ARM 7 Processor:

The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers. This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory. The ARM7TDMI-S processor also employs a unique architectural strategy known as THUMB, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue. The key idea behind THUMB is that of a super-reduced instruction set. Essentially, the ARM7TDMI-S processor has two instruction sets: (1) The standard 32-bit ARM instruction set, and (2) A 16-bit THUMB instruction set.

The THUMB set's 16-bit instruction length allows it to approach twice the density of standard ARM code while retaining most of the ARM's performance advantage over a traditional 16-bit processor using 16-bit registers. This is possible because THUMB code operates on the same 32-bit register set as ARM code. THUMB code is able to provide up to 65% of the code size of ARM, and 160% of the performance of an equivalent ARM processor connected to a 16-bit memory system.

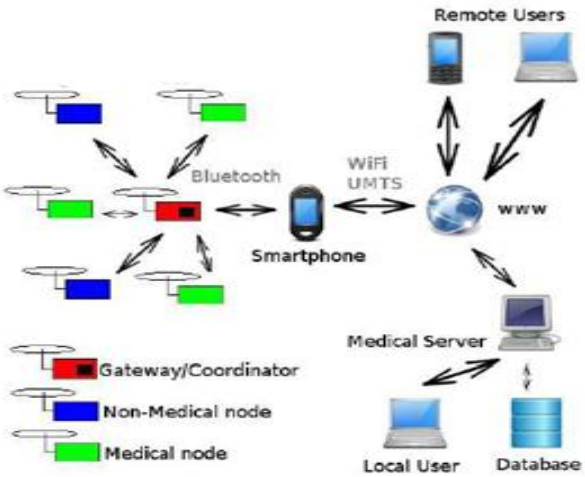

Fig.2. WBAN architecture

4.3 Electrocardiography (ECG)

The electrocardiograph (ECG) is an instrument which records the electrical activity of the heart. ECG provides valuable information about a wide range of

cardiac disorders such as the presence of an inactive part (infarction) or an enlargement (cardiac

hypertrophy) of the heart muscle. Electrocardiographs are used in catheterization laboratory, coronary care units and for routine cardiac diagnostic applications in cardiology.

An ECG is the best way to measure and diagnose abnormal rhythms of the heart, particularly abnormal rhythms caused by damage to the conductive tissue that carries electrical signal, or abnormal rhythms caused by electrolyte imbalances.

4.4 Electroplythesmograph

Electro-plethysmography technologies are widely used in hospitals throughout the world. The electro-plethysmograph or photo-electro-plethysmograph (PEP) is a noninvasive continuous heart monitor. Unlike an EKG, the PEP provides doctors with accurate heart beat reading without needing to "connect" the device to the patience. This electrically open connection is desirable because there is no interference with the patience' electronics devices such as a pace maker.

The PEP is designed to measure the change in blood density flowing through the capillaries of a finger. All photo-electro-plethysmographs emit an infrared light source. Most PEP operates at the 940nm in wavelength range. The infrared light then passes through a medium such as a finger the earlobe. An infrared light detector on the opposite side of the medium will detect the amount of light passing through at that instance.

4.5 Body Temperature

Body temperature is lower in the morning than it is in late afternoon and evening. Temperature can vary with other factors, such as exercise, drinking hot or cold fluids, sitting in a cold room, fighting an infection, and by the accuracy and type of thermometer used. The normal core body temperature of a healthy, resting adult human being is stated to be at 98.6 degrees Fahrenheit or 37.0 degrees Celsius. Temperature is important in an athlete. Heat is generated when a person exercises. The body tries to keep the core temperature the same through sweating. It can also cause dehydration as the body sweats to keep its core temperature in a good range. Temperature affects the time to fatigue in an athlete.

5. ANDROID SMARTPHONE

5.1 Android smart phone:

As mentioned in the System Architecture the smartphone should manage not only data acquisition from the W(BAN), but also synchronization and provide a Graphical User Interface (GUI), among other tasks. In order to do so an Android application is necessary, this application should feature several functions, among these are: Data acquisition from the (W)BAN via Bluetooth; data analysis, i.e. comparison with medical norm values; GUI for configuration, data visualization, and communication; data transfer (synchronization) to a medical server via WiFi or cellular network. Android applications are divided into Activity classes. An Activity is both a unit of user interaction, and a unit of execution which provide reusable, interchangeable parts of the flow of UI components across Android Applications. In essence

the application is responsible to detect the Bluetooth gateway and establish a full duplex communication, including device discovery, pairing, debugging and communication, and to be able to connect to the medical server through the Internet enabling data synchronization between the server and the W(BAN) in soft real-time.

The application features numerical analysis and graphical representation of the captured physiological data, an activity for the patient's profile, physical condition, disease history, etc., and activities for the connection with the medical server. For this project some interesting packages available in the Android SDK are Android Bluetooth, Android database sqlite, Android net, Android webkit, javax net ssl, Android SDK tool . The use of third party libraries is optional keeping the validation effort for a Safety Critical System in mind. The app is also responsible to present a GUI, whose design represents the captured data in an understandable way. Together with the basic requirement of a state-of-the-art Android app, the GUI has therefore three principal modes: Configuration, display for patients, display for medical personnel with restricted access. For the proposed application internal smartphone sensors, e.g. accelerometer, GPS, etc., provide additional opportunities, i.e. patient localization and possible detection of a fall. Based on the evaluation of the acquired data the app starts communication to predefined first responders. Android based on Linux lacks a real-time kernel and cannot support hard real-time requirements.

6. RESULTS & DISCUSSION

Bluetooth hardware connected using android Bluetooth adapter receives the ECG, plethysmograph and body temperature values via Bluetooth, these values gets stored into androids SQLite database which resides in the android phones.

After clicking on the start button, Bluetooth class gets connected to the Bluetooth hardware and starts receiving values of ECG, plethysmography and body temperature. Similarly after clicking on upload button, data from the android SQLite database gets uploaded to the server. Graphs for the ECG, plethysmograph and body temperature values can be viewed on server side.

After exceeding the predefined values of these parameters, message is received by intended Doctors and Relatives.

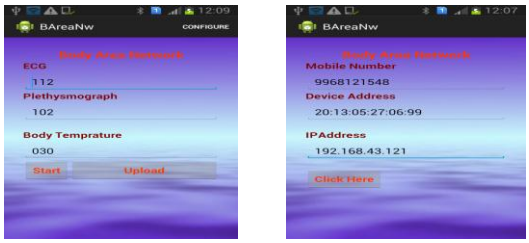

Fig.3. Android prototype Application

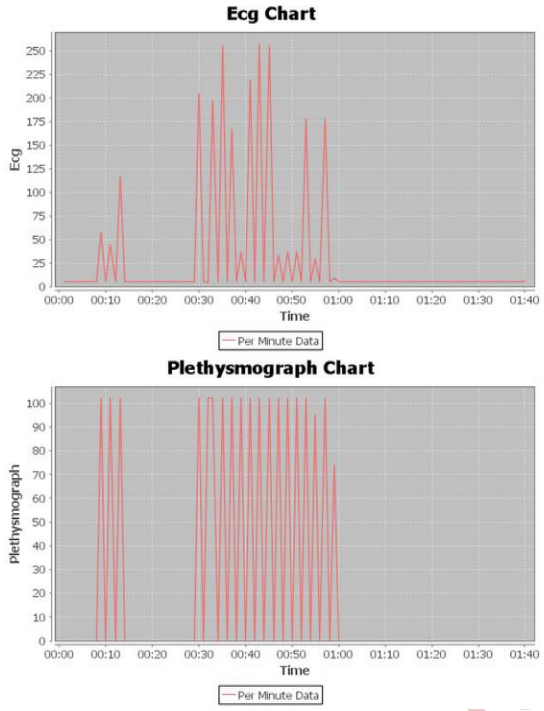

Fig.4. ECG & Phethysmograph Charts

7. CONCLUSION

WBAN design approach fulfills the basic requirements. Reliability and range are sufficient. As a conclusion, the combination of WBAN with an Android smartphone offers a large functionality. Vital parameters can be stored, analyzed and visualized with GUIs.

Implementation of present work will contribute in research in the area of Environment physiology which will form basis for recommendations and draft guidelines on how and to what extent exposures to extreme environments can be tolerated in a safe way with minimized health risks considering short, medium as well as long term effects.

8. ACKNOWLEDGMENTS

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9. REFERENCES

[1] Jovanov, E., Raskovic, D.; Price, J., Krishnamurthy, A., Chapman, J., Moore, A., "Patient Monitoring Using Personal Area Networks of Wireless Intelligent Sensors," in Proc. of 38th Annual Rocky Mountain Bioengineering Symposium, RMBS 2001, Copper Mountain Conference Center, CO Apr. 20-22, 2001.

[2] Arne Sieber, Antonio L'Abbate, Benjamin Kuch, Matthias Wagner, Antonio Benassi, Mirko Passera, Remo Bedini, "Advanced instrumentation for research in diving and hyperbaric medicine," Instrumentation for diving medicine, Vol. 37, No. 5, UHM 2010.

[3] Kuch, B., Koss, B., Butazzo, G., Dujic, Z., Sieber, A., "A novel wearable apnea dive computer for continuous plethysmographic monitoring of oxygen saturation and heart rate," Diving and Hyperbaric Medicine Volume 40, No. 1, March 2010.

[4] S. Dagtas, G. Pekhteryez, Z. sahinoglu, "Multi-stage Time Health Monitoring via Zigbee in Smart Homes;" 21st International Conference ON Advanced Information Networking and Applications Workshop (AINAW'07), 2007.