Personal Health Monitoring with Android Based Mobile Devices

K. Avinash¹, M. Venkateshwarlu²

¹PG Scholar, Sri KS Raju Institute of Technology and Sciences, Hyderabad, Telangana, India.
²Asst Prof & HOD, Sri KS Raju Institute of Technology and Sciences, Hyderabad, Telangana, India.

Abstract: As the healthcare industry has evolved, technology provides readily accessible health data that may facilitate people to deal with health concerns. We have developed an Android based mobile data acquisition (DAQ) solution, which collects personalized health information of the end-user, store analyze and visualize it on the smart device and optionally sends it towards to the datacenter for further processing. The smart mobile device is capable to collect information from a large set of various wireless (Bluetooth, and Wi-Fi) and wired (USB) sensors. Embedded sensors of the mobile device provide additional useful status information (such as: heart beat, temperature, etc.). The user interface of our software solution is suitable for different skilled users, highly configurable and provides diary functionality to store information (about pulse and body temperature). The software enables correlation analysis between the various sensor data sets. The developed system is tested successfully within our Living Lab facility. Sensor data acquisition on the personal mobile device enables both end-users and care givers to provide better and more effective health monitoring and facilitate prevention which can be easily observed by using application in android mobiles. The paper describes the internal architecture of the software solution and its main functionalities. By supplying real time health information, a sensor primarily based health care information infrastructure that's based on relatively static based sparsely collected information can be used to maintain the patient medical records effectively. The solution projected for this method combines environmental and wearable sensors so as to monitor both the surrounding space of the patient and the patient’s health status at the same time. This would allow a comprehensive understanding of the patient’s condition by both the specialist caring for the subject and the patient themselves.

Keywords: Remote Health Monitoring, Portable Sensor Data Acquisition, Mobile Device, Android Application.

I. INTRODUCTION

“Prevention is better than cure.” The system proposed in this chapter aims to achieve this. According to the bulletin report of Indian Ministry of Interior, the elder population in India at the end of 2008 was 2.4 million, about 10.4% of the total Indian population. This percentage has already exceeded the standard for aging society set by the World Health Organization (WHO). Furthermore, it is estimated that in 2025 the elder population in India will reach more than 20% of the total population; therefore, the “long-distance home health care service” has become one of the key emerging businesses in India. It was estimated that the market revenue of home health care for these elders reached 300 million dollars in 2010. In recent years, several studies integrating communication and sensor technologies for home health monitoring system have been discussed (Chang, 2004; Chen, 2008; Lee, 2006a, 2006b, 2007a, 2007b; J.L. Lin, 2005; T.H. Lin, 2004, Shu, 2005; Wu, 2004; Ye, 2006; Yu et al., 2005), such as monitoring long-term health data to find out the abnormal signs and monitoring the medical record regularly for chronic patients to cut down their treatment frequency, to save doctor’s treatment time, and to reduce medical expenses. Based on the sensor and communication technologies used, these systems can be categorized into two systems: immobile and mobile long-distance health monitoring systems. Our previous works all focused on mobile long-distance physiological signal measuring based on either a single-chip microprocessor or a smart phone.

Figure 1. Overview of the personal health monitoring infrastructure (with Android based handheld Mobile Hub collecting sensor data).

The physiological sensor used was a RFID ring-type pulse/temperature sensor. The measured data can be transmitted via different communication protocols, such as Bluetooth, ZigBee, HSDPA, GPRS, and TCP/IP. In order to meet the requirement for mobile health monitoring system (MHMS),...
the system design needs to adopt light modular sensors for data collection and wireless communication technology for mobility. The popular smart phones used in people’s daily life are the best devices for MHMS. With the popularity and mobility of smart phones, this system effectively provides the needs for mobile health management. This paper shows how we have built up our remote patient monitoring environment (DAQit)[8] using a client side software and the DrHealth portal. Later on we present how this software environment has been used to do patient’s location/sudden event monitoring, remote diabetes and hypertension monitoring in our Living Lab. Through the co-operation of commercial companies, universities and other non-profit organizations the direct goal of the AALAMSRK project was to develop an integrated, standardized dementia and health monitoring system supported by innovative, modern measurement and info-communication technologies. By the integration of medical expertise and developing assisted living patterns (ALPs), the realized system offers personalized monitoring solution for monitoring and prevention of elderly people, particularly who suffer from stroke, neurological diseases such as dementia or depression. Our two DAQ solutions (HomeHub and MobileHub) are able to serve overlapping patient categories.

A. Motivation

Considering the real social and market demands and the needs of the health care service provider segment [5], the general project aim is to improve the quality and cost effectiveness of health care services by developing service models, methods, tools, products and services. We are doing research and development of a full scale remote telemonitoring system that monitor both activity levels and vital signs such as blood pressure, blood sugar level and heart rate, alerting caregivers about potential health problems or emergency situations. Service categories of a generic home-based care/remote patient monitoring solution. Remote patient monitoring builds up from the following five evitable service pillars:

- Data acquisition services: DAQ services collect physiological information of a person’s condition from deployed sensor infrastructure or from the person directly.
- Store/forward and visualize services: Services to store, process and visualize locally the captured physiological information of a person’s condition at the patient’s device and to forward these information using ICT towards the central data collector node for further data processing, storing, visualization.
- Activity recognition services: Recognition of psycho-physical performance of patients or elderly people for effective therapy intervention (quantitative and qualitative measurement of high level living patterns).
- Lifestyle guidance services (knowledge transfer): Feedback from medical experts/physicians based on the acquired real-time or historical data enables lifestyle guidance, therapy adjustment, early warning/prevention, personalized health care & rehabilitation.
- Recognition of psychophysical performance of patients or elderly people for effective therapy intervention (quantitative and qualitative measurement of body movement).

- Behavior monitoring services.

II. METHODOLOGY

To implement a remote healthcare monitoring system. In these sensors to monitor the medical parameters such as Heart Rate and Temperature are designed and interfaced to the microcontroller ARM7 (LPC 2148). This microcontroller having inbuilt ADC which converts the sensors input analog signals to digital signals. These days, wearable sensors such as heart rate monitors and pedometers are in common use. Several products are already on the market, such as the Lifeshirt, developed by Vivometrics, the body monitoring system developed by BodyMedia and the Nike-Apple iPod Sports kit which facilitates individualized feedback control of performance during exercise periods. The Heart Beat Sensor provides a simple way to study the heart's function. This sensor monitors the flow of blood through Finger. As the heart forces blood through the blood vessels in the, the amount of blood in the Finger changes with time. Heart beat sensor is designed to give digital output of heart beat when a finger is placed on it. It consists of a super bright red LED and light detector.

The LED needs to be super bright as the maximum light must pass spread in finger and detected by detector. When the heart pumps a pulse of blood through the blood vessels, the finger becomes slightly more opaque and so less light reached the detector. With each heart pulse the detector signal varies. This variation is converted to electrical pulse. This digital output can be connected to microcontroller directly to measure the Beats per Minute (BPM) rate. This signal is amplified and triggered through an amplifier which outputs +5V logic level signal. The output signal is also indicated by a LED which blinks on each heartbeat. The proposed design has a significant advantage: introducing environmental sensors that collect context information will help in analysis of the medical data. When, e.g., a patient is doing sports, medical parameters like heart rate or O2 saturation have to be interpreted differently compared to the same person sleeping in bed. It is estimated that 70% of all illnesses are preventable, and if suitable screening measurements were introduced, this could produce dramatic reductions in costs for treatments and medication.

The environmental sensors mainly include temperature sensors, humidity sensors, and in case of emergency, an alarm signal from smoke detectors. It happens to be very important that the inclusion of special circumstances sensors such as smoke detectors be included so that the attending physician may communicate the appropriate course preventive diagnosis even when the patient is remotely stranded. The processed signals from the respective medical sensors and the environmental sensors are now sent to ATmega16 Microcontroller that process the received signal and displays on the development kit, but more importantly now proceeds to the next phase of the monitoring system, that is to communicate the received results to the patient and physician. The received data is communicated by simple means of Bluetooth via UART serial communication. In the
proposed system we use two RF Bluetooth that are Transceivers and may act as either a transmitter or a receiver. We should note that communication is possible only when one Bluetooth acts as a transistor and the other as a receiver. Communication is not possible for a pair of transmitters or a pair of receivers. The received information is sent to the respective Smart Phones via UART. The Smart Phone is capable of displaying, monitoring, recording and sharing the received information, thus saving cost on display, and recording devices. This solution not only gives patient more freedom, but also provides early diagnosis of cardiac diseases with its alarming properties.

III. DESCRIPTION OF HARDWARE COMPONENTS

A. LPC 2148

Increasingly, embedded systems developers and system-on-chip designers select a specific micro processor cores and a family of tools, libraries, and off-the-shelf components to quickly develop new microprocessor-based products and applications. ARM is one of the major options available for embedded system developer. Over the last few years, the ARM architecture has become the most pervasive 32-bit architecture in the world, with wide range of ICs available from various IC manufacturers. ARM processors are embedded in products ranging from cell/mobile phones to automotive braking systems. A worldwide community of ARM partners and third-party vendors has developed among semiconductor and product design companies, including hardware engineers, system designers, and software developers.

ARM7 is one of the widely used micro-controller family in embedded system application. This section is humble effort for explaining basic features of ARM-7. ARM is a family of instruction set architectures for computer processors based on a reduced instruction set computing (RISC) architecture developed by British company ARM Holdings. A RISC-based computer design approach means ARM processors require significantly fewer transistors than typical processors in average computers. This approach reduces costs, heat and power use. These are desirable traits for light, portable, battery-powered devices—including smartphones, laptops, tablet and notepad computers), and other embedded systems.

B. Temperature sensor

The Thermistor is another type of temperature sensor, whose name is a combination of the words THERM-all sensitive res-ISTOR. A thermistor is a special type of resistor which changes its physical resistance when exposed to changes in temperature. Thermistors are generally made from ceramic materials such as oxides of nickel, manganese or cobalt coated in glass which makes them easily damaged. Their main advantage over snap-action types is their speed of response to any changes in temperature, accuracy and repeatability.

Fig 2 LPC 2148 Pin package.

Most types of thermistor’s have a Negative Temperature Coefficient of resistance or (NTC), that is their resistance value goes DOWN with an increase in the temperature, and of course there are some which have a Positive Temperature Coefficient, (PTC), in that their resistance value goes UP with an increase in temperature. Thermistors are constructed from a ceramic type semiconductor material using metal oxide technology such as manganese, cobalt and nickel, etc. The semiconductor material is generally formed into small pressed discs or balls which are hermetically sealed to give a relatively fast response to any changes in temperature. Thermistors are rated by their resistive value at room temperature (usually at 25°C), their time constant (the time to react to the temperature change) and their power rating with respect to the current flowing through them. Like resistors, thermistors are available with resistance values at room temperature from 10’s of MΩ down to just a few Ohms, but for sensing purposes those types with values in the kilo-ohms are generally used.

C. Heart Beat Sensor

Heart rate is a very vital health parameter that is directly related to the soundness of the human cardiovascular system. This project describes a technique of measuring the heart rate through a fingertip using a PIC microcontroller. While the heart is beating, it is actually pumping blood throughout the body, and that makes the blood volume inside the finger artery to change too. This fluctuation of blood can be detected through an optical sensing mechanism placed around the fingertip. The signal can be amplified further for the microcontroller to count the rate of fluctuation, which is actually the heart rate.
Fig4. Heart rate sensor.

IV. CONCLUSION

A lot of research and effort has gone into the making of a better and well improved healthcare monitoring system, even for remotely located patients. Only a few of these researches have taken into consideration of the environmental factors that affect the human health state. Thus, this paper puts forth the necessity, method and various trends in using both medical and environmental sensors. Further, taking advantage of the advanced technology available to the general public, a remote healthcare monitoring system that is capable of providing health parameters by wireless means to Smart Phones of both patient and physician, it is possible to provide immediate diagnosis simply through the click of a button.

V. FUTURE SCOPE

In order to implement future improvements to the health monitoring network we can introduce new sensors such as cameras, ECG sensors as well as location tracking capabilities. We can also plan to integrate alarm triggering algorithms and advanced security techniques in Wireless Sensor Networks which would be essential in a health monitoring environment. Another aspect to consider is involving wearable sensors or wearable sensors that may well be cheaper and more diverse in utility which can lend a hand in improving the already existing systems.

VI. REFERENCES


