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Patient Health Monitoring With Android Based Smart Phone

N.Nagarjuna
M.Tech Embedded Systems,
St.Ann's College of Engineering and Technology,
Chirala, Andhra Pradesh.

Mrs.K.N.L.Vamsi Priya, M.Tech
Assistant Professor,
Department of ECE,
St.Ann's College of Engineering and Technology,
Chirala, Andhra Pradesh.

Abstract:

For smart living, interactive applications are increasingly important especially on interaction of people and the environment. The aim of this paper is to develop an android based application which will help the doctor to diagnose the diseases using their smart phone. Wireless technologies are bringing about dramatic improvements in the quality of patient care by allowing unprecedented mobility while providing medical staff with easy and real-time access to patient data. In this research, a new wireless patient monitoring system is developed from concept to a reality. After receiving the raw signal we can use digital filtering for extraction of wanted signal. After filtering it is processed for detecting diseases and thus output is display on the screen. The web module also connects the microcontroller and android OS together. Since this application is made on android platform which is an open source and independent of any platform, it can be installed on any smart phone. Using this new system, medical staff can track patients' vital signs from any place, allowing them to monitor more patients. The accessibility of this application is simple and easy. By developing this application, we can say that, it can be cost effective, compact and user friendly.

Index Terms:

Multi parameter, Monitor System, Smart Phone, Web server, Web database.

I.Introduction:

Patient monitoring system is a process where a surgeon can continuously monitor more than one patient, for more than one parameter at a time in a remote place [1]. With the development of Smartphone, it has performed a Smartphone based body monitoring system with a combination of the advantages of network technology and multiple sensor fusion technology.

Body monitoring system greatly improves the operational capability of health care, such as remote operations, wireless health care so on [2]. There has been a growing concern with technology of medical care which has developed rapidly and plays an increasingly important role in our life [2].The advances in information and communication technologies enable technically, the continuous monitoring of health related parameters with wireless sensor, wherever the user happens to be. They provide valuable real time information enabling the physicians to monitor and analyze a patient's current and previous state of health. Now days there are several efforts towards the development of system that carry out remote monitoring of patients [1].

Traditional healthcare technologies mostly are confined to hospitals and other specific place, which is not convenient for the user's movement. It may also take lots of money. At present, several proposals, have been used to concentrate to this issue. But they also suffer from some limitations mainly. Concerning single function of equipment and the potential radiation hazards by mobile phone direct contacting with the body. In order to solve the purpose of mobile medical care, we can use android Smartphone as a component of this system. Android mobile phone can not only receive the data collected by our hardware device but also can transmit these data to remote server in time [2].

This method not only simplifies and speeds up the process of information acquisition, processing and analysis, but also declines costs of equipment; therefore, researchers have become more interested in wireless health care [2]. The main aim the project is to design a system which is used to monitor the patient condition using Bluetooth and Wi-Fi technology which is called "Remote Health monitoring for elderly persons by using android based mobile data acquisition system". The Data Acquisition (DAQ) solution, which collects personalized health information of the end-user, store analyze and visualize it on the Smart mobile Phone and optionally sends it towards to the data center for further processing.

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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: user location, acceleration, temperature, etc.). The user interface of our software solution is suitable for different skilled users and highly configurable which provides a better and more effective health monitoring system.

This Project is based on monitoring of patients. I have designed and developed a reliable, energy efficient patient monitoring system. It is able to send parameters of patient in real time. It enables the doctors to monitor patient's health parameters (temp, heartbeat, position) in real time. Here the parameters of patient are measured continuously (temp, heartbeat, position) and wirelessly transmitted using Wi-Fi or Bluetooth. This project provides a solution for enhancing the reliability and flexibility by improving the performance and power management of the patient monitoring system.

Along with patient monitoring, it is possible to monitor remotely not only the patient's status, but also some mobile hardware and software specific parameters (such as: battery level of sensors), and we also to redesigned the whole user interface of the handheld device to support elderly persons with low IT skills. Based on the received result both PC and Android based DAQ solutions are capable to provide seamless remote monitoring of elderly persons not only at home, but with Mobile Hub also abroad. The developed system provides important feedbacks about health status to the patient and to the medical experts.

II.Related work:

The ultimate goal of the project is to provide a unified solution for the seniors in the home, enabling them to closely participate in disease detection and health management by themselves. A similar type of project named AHRI (Aware Home Research Initiative) [6] is going on at GeorgiaTech University. MobiHealth project [7] [8] [9] is going on to build a system for collecting vital body signals and manipulating those in distant health care institutes. The Terva [10] monitoring system had been introduced to collect data related to health condition like blood pressure, temperature, sleep conditions, weight, etc., over quite a long time. Here data has been collected four times a day (morning, noon, evening and night) and saved in the form a TOD (time-of-day) matrix and analyzed later. The whole system has been housed in a suitcase that includes a laptop, blood pressure monitor and several other monitoring devices. As a result, this system loses its mobility and becomes feasible to be used in a static manner in the home. A feedback-based self monitoring system for managing obesity named Wireless Wellness Monitor [11] has been devised using Bluetooth and Jini network to supports Java dynamic networking. The system consists of measuring devices, a home server as the base station, mobile terminals (e.g. PDA or smart phone) and databases which are connected through the internet. The measuring devices collect data and place that in the home server. Mobile terminals can access information wirelessly from the home server or can collect data from the external databases through the home server.

This Project work shows the development of remote patient monitoring environment using a client side software and Health care provider. Later on we present how this software environment has been used to do patient's location/sudden event monitoring, Pulse, and Patient's temperature in living room. 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.In the current proposed system the patient health is continuously monitored and the acquired data is analyzed at a centralized ARM [12] microcontroller. If a particular patient's health parameter falls below the threshold value, an automated SMS is sent to the pre-configured Doctor's mobile number using a standard GSM module interfaced to the ARM microcontroller. The Doctor can get a record of a particular patient's information by just accessing the database of the patient on his PC which is continuously updated through Wi-Fi or Bluetooth module.

The Mobile Hub [13] has many attractive features such as cheaper price, portable, location awareness, inbuilt touch screen. The Mobile Hub is targeting different functionalities, and it can extend the usability with additional special features, such as mobility, location awareness and small size. Bluetooth [14] enabled smart phone can collect data from different Sensors. Temperature sensing technique RTD [15] is used to collect patient's Temperature which will be transferred to the Android based Mobile device for further processing.

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Liquid Crystal Displays [16] are required to display the data collected from sensors. Keil [17] performs a very detailed simulation of a micro controller along with external signals and interfaces all the modules with LPC2148 board.

III.OVERVIEW OF THE HEALTH MONITORING SYSTEM:

Mainly the block diagram of the project consists of microcontroller, sensors, Bluetooth, Wi-Fi module, power supply and Liquid Crystal Display which is shown in Figure 1. In case of emergency and dangerous situations we have to alert the doctor immediately. For this we are using a Wireless network for doctor to patient communication in the hospital and also through SMS. This way of communication is actually done with Wi-Fi and with the GPS. Each patient will be given this module and with the help of this module the patient health condition is monitored and if there is any change in the condition of the health then immediately an alarm alerts the doctor by sending a message. The same information is transferred as message to the corresponding or relevant person.

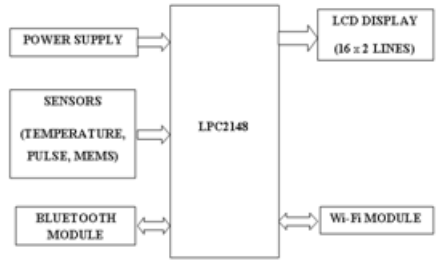

Figure: 1 Block Diagram of the Project

The project will use ARM7 TDMI-S based NXP's (National Semiconductors and Philips) LPC 2148 microcontroller in LQFP (Liquid Quad Flat Package) with 64 pins. The Power requirement of LPC2148 Microcontroller is 3.3VDC and VSS ground. The power supply for the LPC2148 is produced by using available 1 Φ 230VAC with the help of conversion AC to DC supply which includes four most basic steps of step down the available power to required level of power supply, Rectification of 1Φ supply to the pulsated DC supply, filtering of Pulsated DC supply to non regulated DC supply and then through regulator a pure regulated DC supply is produced. The Mobile Hub has many attractive features cheaper price, portable, location awareness, inbuilt touch screen , however on the other side it has also significant limitations compared to a full PC hardware like limited CPU power, memory, storage size and external interface connection support, The Mobile Hub is targeting different functionalities compared to the Home Hub solution due to the smaller screen size and fewer hardware interfaces, and it can extend the usability with additional special features, such as mobility, location awareness and small size. Mobile Hub software is capable to run almost all Bluetooth enabled and Android based Smartphone. In a sudden panic situation an alarm can be activated manually (by the patient) or automatically (by e.g. the accelerometer) with the mobile device. When an alarm signal initiated the central dispatcher is able to acquire location information (based on GSM/GPRS cell information) immediately (see Figure 2 shown below).

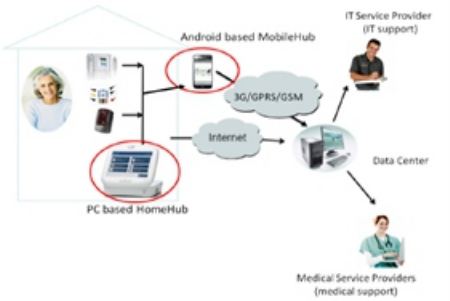

Figure: 2 Overview of the Health Monitoring System

LPC2148 ARM7 PROCESSOR:

The LPC2148 (Low Pin Count) microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support. They will combine the microcontroller with embedded high-speed flash memory ranging from 32kB to 512kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. It is used to interface all the modules.

16×2 LCD

Liquid Crystal Displays (LCDs) have materials, which combine the properties of both liquids and crystals. These are used in a wide range of applications, including palmtop, computers, word processors, photocopiers, point of sale terminals, medical instruments, cellular phones, etc.

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The 16 x 2 intelligent alphanumeric dot matrix displays is capable of displaying 224 different characters and symbols. They have the temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal.LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed. Two polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle.

TEMPERATURE SENSOR:

Several temperature sensing techniques are widely using now a days. The most common sensing techniques are RTDs, thermocouples, thermistors, and sensor ICs. The right sensor for your application depends on the required temperature range, linearity, accuracy, cost, features, and ease of designing circuitry. In this section, I will discuss the characteristics of the most common temperature sensing technique RTD (about LM35 Temperature Sensor). But the cost of real time temperature sensor is not affordable. Hence in this project I used a potentiometer to display body temperature. By using this I am showing a prototype how it works when we use an LM35 sensor.

PULSE SENSOR:

Pulse Sensor is a well-designed plug-and-play heart-rate sensor. Pulse sensor is also called as Heart Beat Sensor. This heart beat sensor is designed to give digital output of heat beat when a finger is placed inside it. This digital output can be connected to microcontroller directly to measure the Beats Per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse. Heart beat measurement is one of the very important parameters of the human cardiovascular system.

The heart rate of a healthy adult at rest is around 72 Beats Per Minute (BPM). Athletes normally have lower heart rates than less active people. Babies have a much higher heart rate at around 120bpm, while older children have heart rates at around 90bpm. The heart rate rises gradually during exercises and returns slowly to the rest value after exercise. The rate when the pulse returns to normal is an indication of the fitness of the person.

IV.Results & Discussion:

The developed system is verified at different conditions with different temperatures. The Temperature, Pulse, and Movement of different Persons are collected using the developed equipment which is shown below. The Person's behavior can also estimated with collected Pulse measurement, whether the Person is angry or normal. The screen shots of Health Monitoring Android App and Measurement of Pulse, Temperature, Movement of Persons are displayed below.This system presents an upgrade to the existing health monitoring systems in the hospitals by providing monitoring capability and a thus a better cure. This system is based upon wireless technology Wi-Fi or Bluetooth low cost effective solution. As it is wireless device, the cost of cables is reduced here. It provides continuous monitoring of the vital signs of the patient over long periods of time until an abnormal condition is captured and hence critical situations can be overcome. This Health monitoring system provides long term monitoring capability useful for the staff in the hospitals and reduces their work load. Future work may include more number of sensors in a single system to provide flexibility.

Increase efficiency

The number of nurses required for keeping a check on patients in ICU can be reduced to a large extent.

More Accurate

Chances of human error in checking different health parameters is also reduced, also the database can be updated time to time.When we power on the circuit shown in the Figure 3, all the LEDs on PCBs are glowing, indicating that circuit is working properly shown in Figure 3. Here there is a use of the industrial temperature sensor i.e. LM 35 which gives us room temperature in ˚C. That temperature is displayed on the LCD as shown in Figure 3. All the Sensors are interfaced to the LPC2148 Microcontroller.

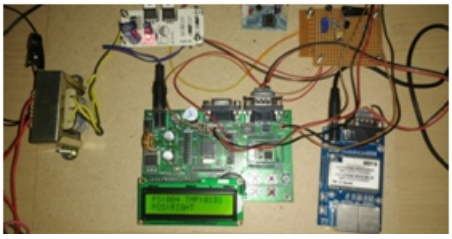

Figure 3 PCB development of Health Monitoring System

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Sensor Measurement :

As shown in Figure 4 there is a cavity for measurement of the heartbeat, which consist of a arrangement of LED and LDR. By placing your finger in between a LED and LDR, we can detect the pulses of heart. Result is displayed on the LCD. This collected data is transmitted using Wi-Fi module (see Figure 4).

Figure 4 Wi-Fi Module

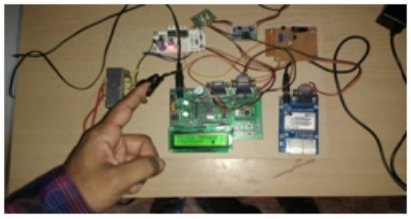

Figure 5 Measurement of Pulse

Use of Smart Phone:

Android based Smart Phone is used to show the results. An Android App called Connection Terminal is configured and connected to the Health Monitoring System. The Figures 6 and 7 shows the Connection Terminal (circled in red) and its configuration respectively.

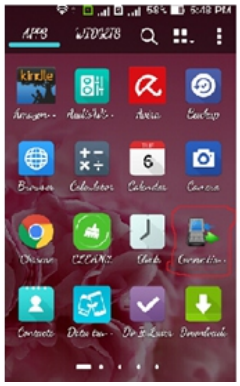

Figure 6 Screen Shot of Android App

Figure 7 Screen Shot of Connection Terminal

The measured parameters such as Temperature, Position and Pulse Rate of the Person are updated every time. When we place our finger in between the clips of the Pulse Sensor, the measured

Pulse Rate is transferred to the Wi-Fi or Bluetooth enabled Smart Phone which is already configured. Screen Shots of Measurement of Pulse, Temperature, and Movement of different Persons are shown below.

The Figure 8 has high Pulse indicates that the person is in angry or hurry with his work. The Figure 9 indicates that the person is in normal condition. The measured information using the system can be transferred to the Doctor or care givers.

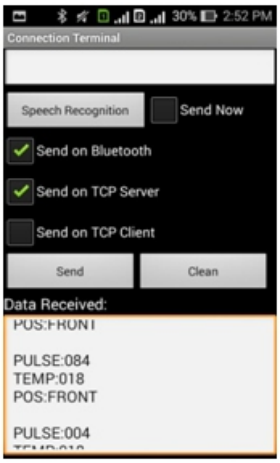

Figure 8 Screen Shot1

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Figure 9 Screen Shot2

V.CONCLUSION :

The project Health Monitoring System has been rigorously tested in the Lab environment. Beside patient monitoring mobile hardware and software specific parameters (such as: battery level of sensors) also redesigned and modified the device to support elderly persons with low IT skills. According to the received results the Monitoring solutions are capable to provide seamless remote monitoring of elderly persons at home. The developed solutions provide important feedbacks about health status to the patient and to the medical experts. The project "patient health monitoring with android based smart phone" has been successfully designed and tested. It has been developed by integrating features of all the hardware components used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit.The developed Android App is configured to only one Person, but we can also provide DAQ solutions to multiple numbers of Patients. According to the availability of sensors or development in biomedical trend more parameter can be sense and monitor which will drastically improve the efficiency of the Health monitoring system in the society.

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