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Review: Health Monitoring System

Mrunali M. Lambat[1], Santosh C. Wagaj[2]

[1]Department of Electronics and Telecommunication, JSPM"s RSCOE, Pune, India

[2]Department of Electronics and Telecommunication, JSPM"s RSCOE, Pune, India

Abstract: ***Design of the health monitoring system for the researchers is the hot topic. Health monitoring system is used every field such as hospital, home care unit, sports. This health monitoring system use for chronicle diseases patients who have daily checkup. So, researchers design a system as portable device. Researcher designed different health monitoring system based on requirement. Different platform like Microcontroller, ASIC, FPGA, PIC microcontroller are used to design the system based on this performance. The integration of different medical instrument on the single system on-chip is main achievement for researcher by using different biomedical sensor. Different biomedical sensors like temperature sensor, heart rate sensor, blood pressure sensor are used to monitor the health condition which is integrated on single system on-chip.***

Keywords: System on-chip (SOC), FPGA, ASIC, PIC microcontroller, Microcontroller, Temperature sensor, Heart rate sensor, Blood pressure sensor

1. Introduction

In today"s life, health problems are occur more than last 25-30 years ago because of modernization, industrialization. Suddenly, changes in environment are directly effect to health condition. So, more health related problems are occurring day by day, require to daily checkup health condition. Researchers design health monitoring system by considering the health condition of patients. Therefore, make device as portable which can handle by any one person and also have ability to provide more flexibility. Normally occur health related problems are Temperature, Heart related problems, stomach problem and so on.

Researchers design health monitoring system using different hardware platform provide integration of different biomedical sensor on single system on-chip such as temperature sensor, heart rate sensor and so on. This technique gives more flexibility, reliability and portability for user. Here temperature sensor use for measuring body temperature, heart rate sensor use to measure heart rate of patient body. So, integration of different biomedical sensors is depending upon researchers design which meets to their needs. Different health monitoring systems are designed with different specification are discussed. In section 2, different techniques are explained to design health monitoring system. In this section, designing of health monitoring system defined into two categories: Conventional System and Advance System. In section 3, based on the system designed different conclusions are derived.

2. Different Techniques Used to Design Health Monitoring System

Researchers design different health monitoring system as per requirements of customer. So, different health monitoring system is now available in market. Design of new techniques based on to overcome previous system drawback and gives more flexibility. Hence, different health monitoring systems are design and differentiate based on the different hardware and software platform. Based on the different hardware and software platform, monitoring system divide into two systems given as follows:

2.1 Conventional System

2.1.1 Body Temperature Measurement System

Thermometer was first invented by Daniel Gabriel Fahrenheit in 1714 also called as „thermo-scope". Its unit is Fahrenheit. First he invented thermometer in 1709 using alcohol and then mercury thermometer in 1714. He introduced in 1724 the standard temperature scale that called Fahrenheit Scale which is used to measure deflection in body temperature. For body temperature, keep thermometer the under arm or into mouth to measure the exact body temperature. Depending of body temperature, the mercury expands and contract shows the result on the standard thermometer scale. For getting exact result thermometer must insert in mouth or in under arm more than 1 minute.

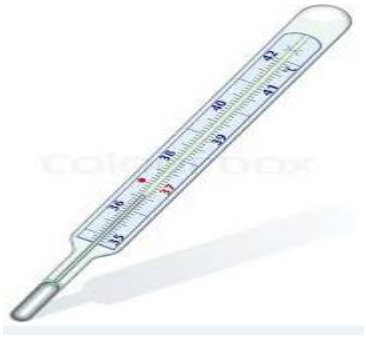

Figure 1: Thermometer

2.1.2 Blood Pressure Measurement

Blood pressure instrument also called as sphygmomanometer. A sphygmomanometer consists of measuring unit, inflatable cuff and mechanism for blowing air which can be manually operated by pump. Cuff wounded around the arm, pressure created in cuff with help of pump. This helps to measure exact blood pressure of the patient easily. There are two types of sphygmomanometer:

(a) Manual sphygmomanometer needs a stethoscope for measuring the pulse rate for blood pressure. They are

used by specially Doctors. It is possible to obtain basic readings of systolic and diastolic pressure.

(b) Mercury sphygmomanometer is considered as best instrument for measuring blood pressure. Without recalibration, it measures blood pressure by noting difference in the height of a column of mercury. Due to its accuracy, it is regularly used in clinical trials and for clinical treatment for determining blood pressure of high-risk patients including pregnant women.

Figure 2: Blood Pressure instrument with Cuff

2.2 Advanced System

In conventional method, each instrument is defined separately. It takes more time for the getting results of health condition and it is difficult to handle separately. For different disease doctors must handle different instrument when he go for checkup of patient‟s. Therefore, researcher designed a device, gave more reliability and flexibility to the user and also provides facility of different instruments connecting on same hardware platform. So, it is very easy to handle and there is need to keep each instrument separately.

New techniques are used by the researcher to design portable device using different hardware platform as per the requirement that is there is integration of large separately designed instruments into single one. Researchers design the health monitoring system using different hardware platform such as ATmega, Atmel, Microcontroller, FPGA and so on. By using different sensor to monitor the health condition instead of large instrument it reduces size and cost of the devices which are defined as follows:

2.2.1 Health Monitoring System using ATmega8

(a) First System

Here, researcher designed health monitoring system using ATmega8 microcontroller with Wireless Body Area Sensor Network (WBASN) [1]. In this work, the sensors are used here Temperature sensor, Blood pressure sensor, Heart beat sensor. These sensors are placed on human body which are helps to monitor the health condition without disturbing the daily routine of the patient‟s and these health related parameters are then communicated to physician‟s server using long range wireless technology GSM.

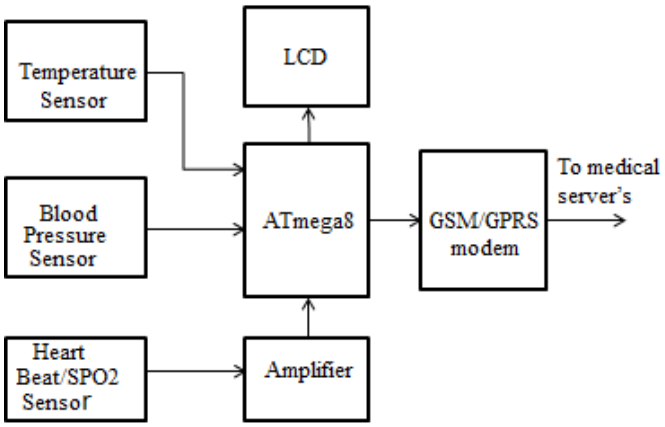

Figure3: Block diagram of Hardware Architecture of health monitoring system at patient‟s terminal [1]

Health monitoring system consists of sensors, microcontroller, LCD display and GSM modem to transmit or receive health related data to or from the doctor. Similarly, at hospital same GSM modem is used. Hence, GSM modem helps to accomplished network between patient‟s server and doctor‟s server. LCD display is providing to show the instant result to the patient. Here researcher used LM34 as temperature sensor, IR LED and red LED [6] is used for heart rate monitoring and Pressure transducer or the sensor based on piezo-electrical material is used to measure the systolic BP and diastolic BP.

Microcontroller reads data from the temperature sensor, blood pressure sensor and heart rate sensor and processing it gives the output in the form of digital and it directly display on LCD or it transmit to the doctor‟s server through GSM modem.

This system gives appropriate and instant result which directly display on LCD. It takes max 4-5 sec to monitor the health parameter. Also, these health parameters directly send to the doctor‟s server using GSM wireless technology.This system takes very less time to know the health condition of patient to doctor.

(b) Second System

Using same system, health parameter sends by using RFID reader, Bluetooth, GSM and UTMS. In this system, gives facility to monitor the blood pressure of patient. The health parameter directly sends to the doctor using GSM and UTMS. Here, video guide is used. This video guide feature serve the patient‟s aged and his blood pressure correctly.

This system consists of three parts: Touchpad, remote server and reading of the Tag ID and BPM [6]. For reading the Tag ID and BPM, use a microcontroller unit (MCU) as a kernel. The client touchpad receive the blood pressure measurement (BPM) data a RFID through Bluetooth. Client touchpad send the data to the remote data center and remote data center to the doctor using GSM and UTMS wireless technology. Data is transmitted in the form of the packet. This system helps to store previous data. Similarly, it takes less time to monitor the blood pressure of the patient.

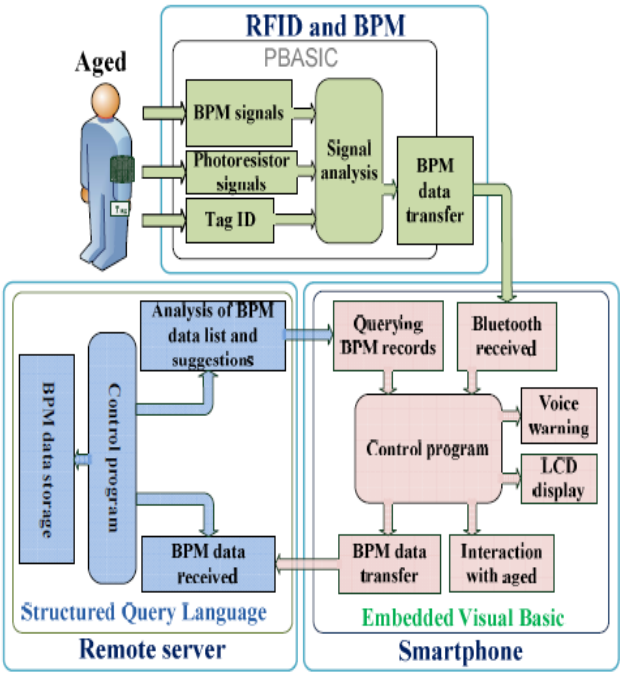

Figure 4: Blood Pressure Monitoring System [6]

(c) Third System

Below figure 4 shows the blood pressure monitoring system using microcontroller. This system includes motor control unit, Microcontroller MCF51QE128, LCD display. The pressure sensor is directly connected to the cuff, which is inflated or deflated via a motor and valve [3]. ON and OFF of motor is controlled by the microcontroller at correct time. Due to ON and OFF the motor, the wrist cuff is inflated and deflated, this pressure is measured by pressure sensor. Pressure sensor generates the health parameter in the analog sensor.

The processing of analog sensor is done through the microcontroller and gives digital output which is display on the LCD or on the Personal computer using RS232. Magneto resistive RAM (MRAM) stores the value of systolic and diastolic blood pressure values and directly connected to the microcontroller.

Similarly, here no need of pump the cuff by hand, all the system is controlled by the microcontroller. There is no need to calculate or observe blood pressure manually. Time consumption is very less compared to old system.

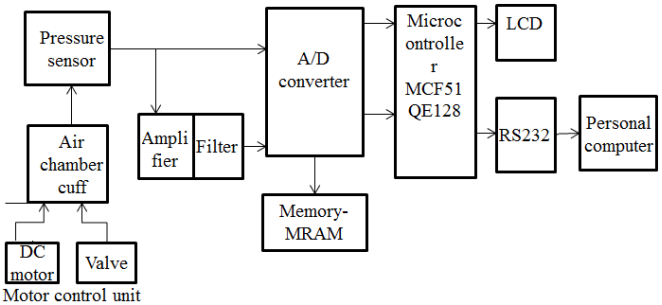

Figure5: Blood Pressure Monitoring System Using Microcontroller [3]

(1) Health Monitoring System using Wearable Sensor

Wearable sensors are developed 10-15 years ago, but sensors are wired for data processing, data stored in data recording unit. Wired networks are robust, but for user it difficult to handle large sensor network with wired and also difficult to long data transmission.

Wireless transmission becomes available to overcome the wired network. For short wireless data transmission, some protocols are used like Zigbee, Bluetooth. Wearable sensors are help to collect the data and transmit to require location.

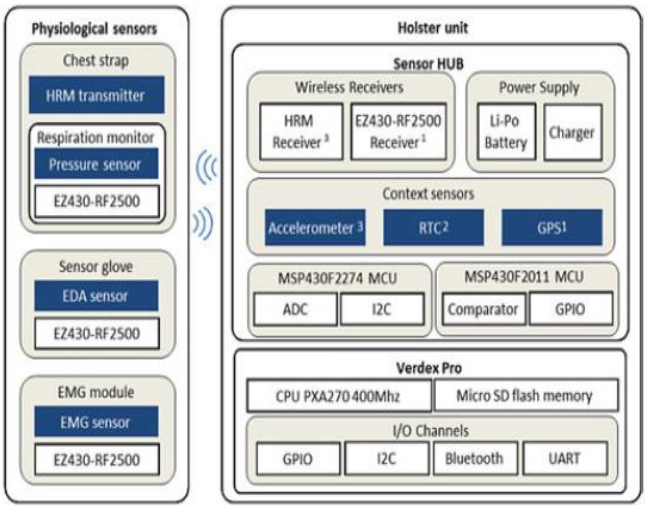

Figure 6: Architecture of Wearable Sensor [8]

Each wireless sensor network has transceiver. In this wearable sensors consist of respiration, EDA and EMG sensor, used as wireless sensor nodes. Data transmissions are in the form of single packet. The packet length and size are configurable. Features are extracted from sensors outputted data. After the features extraction exact results of health relates are occurred. USB transducer is used to display sensor data in real-time on a PC monitor during sensor calibration. Below figure shows snapshot of wearable sensor to monitor the health condition.

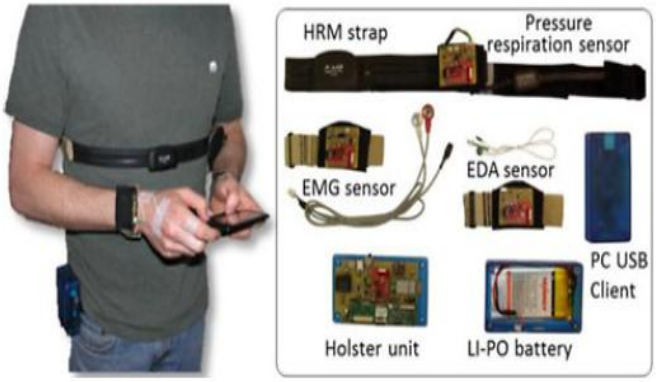

Figure 7: Snapshot of wearable sensors [8]

(2) Health Monitoring System Using FPGA

Health monitoring system is design with the help of FPGA. In this system, temperature measurement instrument is designed. Low cost ADC is used for digitization of analog signal that helps to connect the digital system such as FPGA.

Design of smart wearable sensor using FPGA as hardware platform and LabVIEW as software platform shown below:

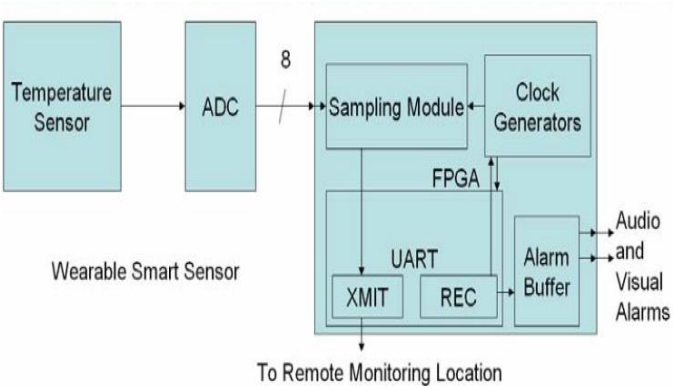

Figure 8: Wearable smart sensor system [9]

FPGA sends the data serially transmitted to the fixed monitoring station consist of PC with LabVIEW GUI (Graphical User Interface) [9]. FPGA is programmed with Verilog files. So, data transmission is depending upon clock oscillator and length of desired clock period.

3. Conclusion

As per paper work, health monitoring system design is based on researcher idea that meets to the patients need. As per consideration of conventional system, this system still in use from their manufacturing but it is very bulky to handle individually and size and cost are also more compared to the advance system and also it take more than 1minute for getting the exact result.

As per consideration of advance system, each system has its own advantage. Each health monitoring system has different specification as per patient‟s requirement. This system provides more medical instrument facility on single system on-chip compare to conventional system. This system takes less than 1 minute to calculate result related to health condition. Size also reduces compared to the conventional system because of integration of number of medical instrument on single chip. So, size, cost and complexity also reduce.

As consideration of microcontroller like ATmega, PIC controller there is need to connect external peripheral for signal conditioning. Therefore size, cost and flexibility are more. But as per consideration of Microcontroller (MCF51QE128) and FPGA there is need of extra ADC circuitry for digitization of analog signal. Hence, as external peripheral increases cost and size also increases. Researchers designed health monitoring system as per patient‟s requirement.

Because of wireless data transmission, health related data will be send to doctor‟s personal computer or on his mobile. So, need to go hospital every time and sending massage to the doctor gets immediate remedy related to the health condition.

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Author Profile

Ms. Mrunali M. Lambat is doing Master‟s in Engineering (VLSI and Embedded system). Previously, she did her Electronics Engineering from SMT. BCCE, Nagpur. Her area of interests is Embedded system and Telecommunication.

Mr. S. C. Wagaj is Assistant Professor at JSPM‟s RSCOE, Pune. He is doing PHD in Nano-technology. He did B.E. in Electronics Engineering. His area of interest is VLSI and Embedded system.