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Health Monitoring System Using PSoC

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ABSTRACT *: Different way are used for determining the way of health condition of person. Researchers design different type of health monitoring system as per requirement using different hardware platform. Here, design of body temperature measurement device using PSoC3 as new hardware platform with low cost and low power consumption rate. Here, for body temperature measurement temperature sensor is used. PSoC3 is design by the Cypress Semiconductor. PSoC consist of 8–bit microcontroller processor with analog peripheral and digital peripheral. Traditional MCU- based system component is replaced by PSoC.*
Keywords: *Temperature sensor, PSoC.*

I. INTRODUCTION

As in our daily life, we have a lot of work, tension, happiness, etc. But at this moment we don't care about our health because all these moments are directly effect on our body. Due to these reasons so many problems are arises. To recognize that health related problem researcher worked and designed health monitoring system. Therefore health monitoring system is hot topic in our daily life.

Health monitoring systems consider in field like in military, home care unit, hospital, sports training and emergency monitoring system. Developing wearable portable devices for untrained and uneducated people and for those people who have chronicle illness. In this work, a portable real-time wireless health monitoring system is implementing using Programmable System on Chip (PSoC) [1].

The acquisition system is used for remote monitoring of patients who are normally occurred in human body temperature, heart rate and oxygen saturation in blood i.e. pulse oximetry, pH level of blood, ECG. Pulse oximetry is used to check oxygenated blood present in circulatory system. If the brain does not receive enough oxygen called Cerebral hypoxia, it is very dangerous for patient's health. Such type of patient must check each and every time. similarly in case of ECG is used to monitor the heart condition. Since this portable device is very helpful for such patient who required regular checkup.

PSoc (Programmable system on chip) [11] gives the facility to reprogram the device as per requirements. So, it provides reliability and flexibility to user. In this work, reduce the use of wireless sensor network for data transmission to show the result on another device, designing of such device to show the result on the device not on other devices. So, it reduces the wireless sensor network due to this as compared to previous PSoC based health monitoring system method power consumption, cost and size. The rest of the paper organized as follows: section2 described different technique used for designing the health monitoring system. Section3 described what problem definition and objective of project. Section4 described the comparisons between different hardware platform based health monitoring system in terms of cost, size and power consumption. Section5 described implementation of Temperature sensor. Section6 described experimental result from device was shown. The last section is discussion and conclusion.

II. COMPARISION OF DIFFERENT HEALTH MONITORING SYSTEM

In early year, different techniques were used to design different medical devices for checking different body parameter. The conventional method used to design takes more time to design and also take more time to show the results. Example, blood pressure take more time to read the exact result [9], wound the cuff around arm and it pressurized by pump, cuff inflated and deflated show the result on BP apparatus. But it takes more time show the result. To overcome the problem, these medical instruments are designed by new hardware platform with multiple access medical instruments at a time. Especially hardware used for this type of applications is FPGA based hardware platform and Microcontroller based hardware platform.

Microcontroller based hardware platform provides complex, powerful and extremely efficient. It allows designers to incorporate many hardware functions on single on chip and also improve overall the performance and reduce the cost of system. The selection of specific Microcontroller depends on performance, complexity and flexibility of the system. The below figure1 shows example of Microcontroller based blood pressure apparatus [9].

The language used either assembly language or high level language such as c for designing the application on it. So, reprogramming can easily do by changing the program as per application requirements. But reconfiguration or rebuilding of hardware part cannot be done. It does not provide flexibility to hardware, but provide flexibility to software.

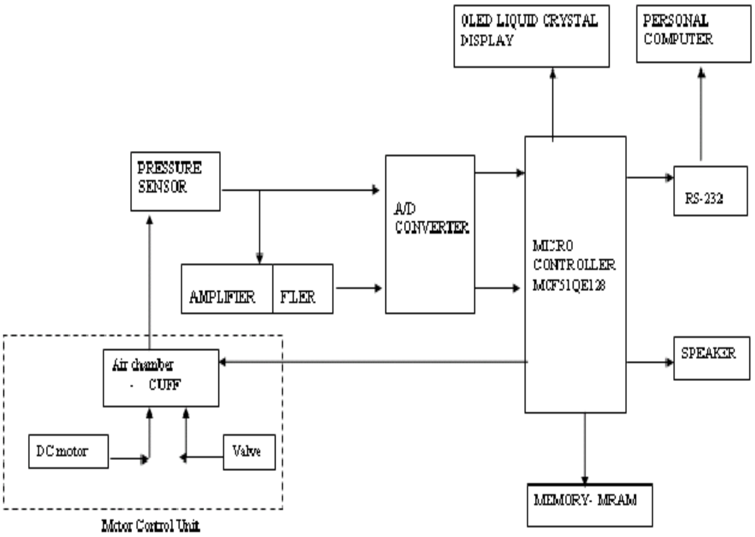


Fig.1. Block Diagram of Design and Development of Microcontroller based system for the measurement of Blood Pressure [9].

Similarly, as we consider the FPGA based hardware platform to design medical instruments it provide customized hardware platform having reconfigurable PEs (Processing Elements). Also, give more flexible by providing the parallel operation using VLIW instructions. Increasing density of FPGA and decreased in low cost allows for integration of embedded system in single FPGA device. This reduces system development time for hardware. FPGA has more advantages than Microcontroller for industrial and medical based applications.

Software language used for designing different application is (VHSIC)HDL hardware description language. Below figure shows block diagram of multi-parameter monitoring device using FPGA.

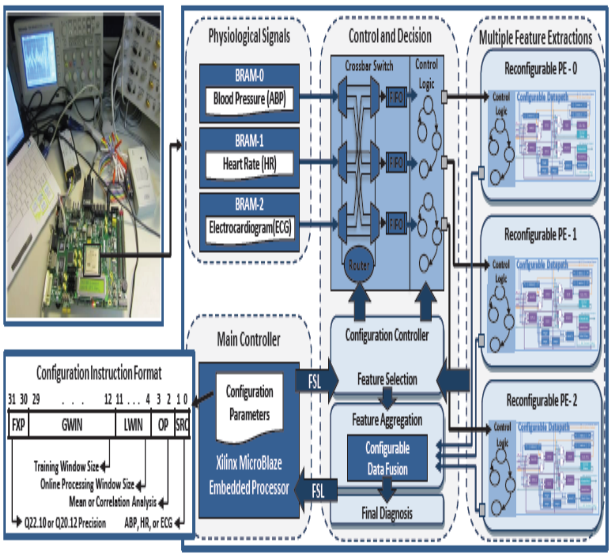


Fig.2. Reconfigurable Architecture with Configurable PEs for Patient-Specific Multi-Parameter Monitoring, prototyped on an FPGA platform [10].

But as we consider in terms of software language, FPGA used VHDL and Microcontroller used either assembly language or high-level language such as 'C'. As we design for specific application complexity is low so too easy to write the program for particular application in C as well as in VHDL language. But as we consider complexity of hardware increases, it difficult to write a program in VHDL language.

As we consider in term of Hardware complexity, Microcontroller gives more complexity than FPGA as external peripheral or complexity of hardware increases. Similarly both don't have analog part. For signal conditioning we require externally connected analog part, therefore size of hardware increases.

As per seen above drawback, new technology is invented provide both analog and digital blocks on system on chip called as PSoC (Programmable System on Chip). For signal conditioning does not require connecting external peripheral and supports more features as compare to FPGA and Microcontroller. The description of PSoC shown below.

III. THEORETICAL BACKGROUND

The hardware use for designing of Health monitoring system is PSoC (CY8C3866), family of PSoC3xxx. PSoC3 [7] is a true programmable embedded system-on-chip, integrating configurable analog and digital peripherals, memory, and a microcontroller on a single chip. PSoC categories into three parts:

CPU(M8 microcontroller)
Analog programmable block
Digital programmable block

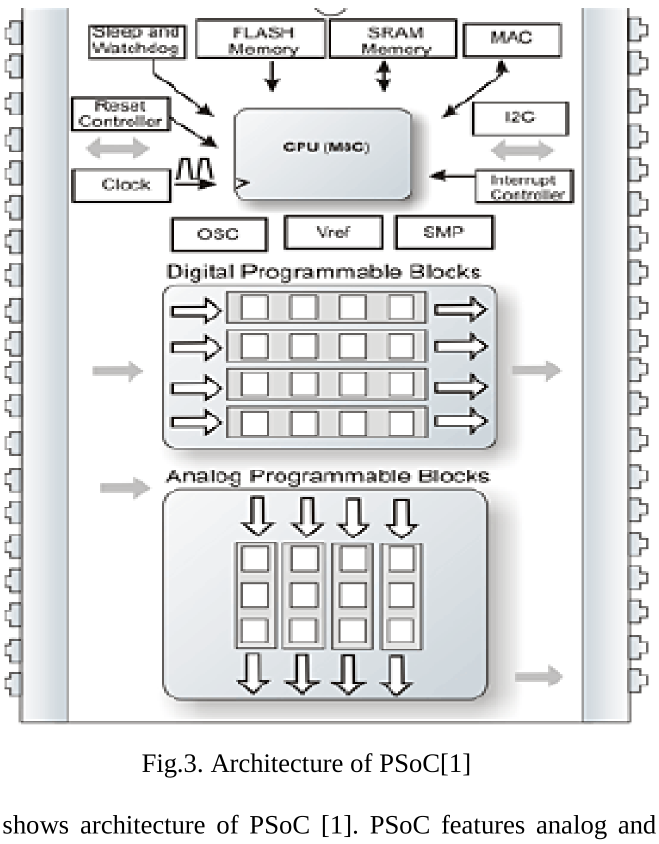


Fig.3. Architecture of PSoC[1]

Above block diagram shows architecture of PSoC [1]. PSoC features analog and Digital programmable block, allows large number of peripheral. CPU used, 8- bit 8051 microcontroller core having ten times faster than 8051 microcontroller. Analog programmable block divide into two categories, the continuous time block (CT) are composed of an op-amp circuit. The other type is switch capacitance (SC) block, which allows complex analog signal flow such as filter, ADC, Operational amplifier, Timer [11]. Similarly Digital programmable block divide into two category, Digital building blocks (DBBxx) and Digital communication block (DCBxx) such as SPI, UART etc. Some more features are like as follows:

- Operating characteristics-

a) Voltage range: 1.71 to 5.5V

b) Temperature range (ambient) –40 to 85 °C

- Performance-

a) 8-bit 8051 CPU, 32 interrupt inputs
b) 24-channel direct memory access (DMA) controller

- Memories-

a) Up to 64 KB program flash, with cache and security features
b) Up to 8 KB additional flash for error correcting code (ECC)
c) Up to 8 KB RAM
d) Up to 2 KB EEPROM

- Digital peripherals-

a) Four 16-bit timer, counter, and PWM blocks
b) I2C, 1 Mbps bus speed
c) USB 2.0 certified Full-Speed (FS)
d) 12 Mbps Full CAN 2.0b
e) Full CAN 2.0b, 16 Rx, 8 Tx buffers
f) 16 to 24 universal digital blocks (UDB), programmable to Create any number of functions:

i. 8-, 16-, 24-, and 32-bit timers, counters, and PWMs
ii. I2C, UART, SPI, I2S, LIN 2.0 interfaces
iii. Cyclic redundancy check (CRC)
iv. Pseudo random sequence (PRS) generators

- Analog peripherals-

a) Configurable 8- to 20-bit delta-sigma ADC
b) Up to four 8-bit DACs
c) Up to four comparators
d) Up to four op-amps
e) Up to four programmable analog blocks, to create:

- Programmable gain amplifier (PGA)
- Trans-impedance amplifier (TIA)
- Mixer
- Sample and hold circuit.

IV. IMPLEMENTATION OF BODY TEMPERATURE MEASUREMENT DEVICE

As we consider the conventional temperature measurement device such as thermometer, measurement of body temperature take place by keep thermometer inside the mouth or under arm for 1-2 min, the mercury arises as per the body temperature and show the reading to doctor and related treatment is done. But all this process takes 3-4 min to get the result. To overcome this problem here designing of PSoC based body temperature measurement device based on real time system show the instant result to doctor or colleague and get immediate treatment on it.

For measuring body temperature here use sensor (LM34) as temperature sensor show the output voltage is linearly proportional to the Fahrenheit temperature [12]. The LM34 thus has an advantage over linear temperature sensors calibrated in degrees Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Fahrenheit scaling. LM34 having some features as follows:

a) Calibrated directly in degrees Fahrenheit
b) Linear +10.0 mV/°F scale factor
c) 1.0°F accuracy guaranteed (at +77°F)
d) Rated for full .50° to +300°F range
e) Suitable for remote applications
f) Operates from 5 to 30 volts
g) Less than 90 uA current drain
h) Low self-heating, 0.18°F in still air
i) Low-impedance output, 0.4W for 1 mA load

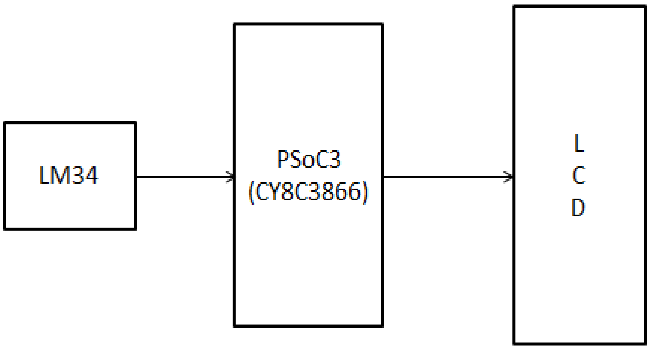


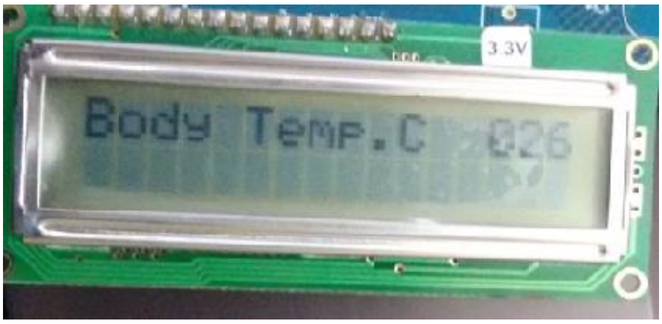
Fig.5. Block Diagram of Design and Development of Body Temperature measurement device using PSoC3.

Above figure4 shows block diagram of Body Temperature Measurement Device. Input taken from temperature sensor (LM34) which analog input taken from patient body. The output of LM34 sensor given to the PSoC (CY3C3866) in which analog signals are given to the sigma-delta ADC, output of ADC give to the Digital Filter Block(DFB) in which unwanted signals are filtered out using FIR or IIR filter and display the output in digital form on LCD.

In PSoC, for debugging the program here used software PSoC Creator 2.0 by designing software circuit using predefined software component and burn the program through PSoC programmer3.22.0 on hardware kit and display the result on LCD screen.

V. EXPERIMENTAL RESULT

Output1



Output2

VI. CONCLUSION

This paper presents implementation and design of the Body Temperature measurement device using PSoC3(CY3C3866)for real-time health monitoring system. It is very useful for remote patients. The intelligence of this device is due to the processor itself, which could handle simple pre-processing tasks. The output of A/D conversion is on 16*2 LCD display. Further advantage of this device is its low-power consumption, which is attractive for portable applications

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