Volume 4, Issue 4, April 2014 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Development of Embedded web Server for Medical Application

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Abstract— Traditionally, the medical measurement system can be expensive and a medical measurement system can be difficult to access for a needed patient. Moreover such a system is neither compatible with the PC and communication standards nor is it easily upgraded. In addition, a special patient may need a medical measurement system to monitor one's body condition even if that individual is located in home or in the hospital. Based on these requirements and available technology, design provides a convenient operational procedure utilizing an embedded circuit board and Web server to provide a remote patient parameters measurement.

The embedded circuit board uses client-server network programming for transmitting this digital medical signal to the remote database by wireless networks.

Keywords— ARM 11 (raspberry pi) board, msp430 development board, linux os, medical measurement sensors, TCP/IP protocol suite .

I. INTRODUCTION

In recent years health related issues are becoming more and more important. Also the emergency of a patients cannot be handled immediately so the solution to this is real time patient monitoring as well as remote patient monitoring .

Remote patient monitoring is an alternative for a doctor to continuously know the status of a patient who is in a hospital, in a ICU, or at home who is physically challenged and the elder persons who are unable to regularly visit healthcare facility. This paper also includes the web part. The patient database is monitored through embedded web server. The monitoring center receives the information from the patient and maintains the database, based on it the doctor can judge the patient and then diagnose.

II. EMBEDDED WEB SERVER FOR MEDICAL FIELD

The general block diagram of realtime remote data acquisition using msp430 processor and ARM11 board as a server base station (fig1).

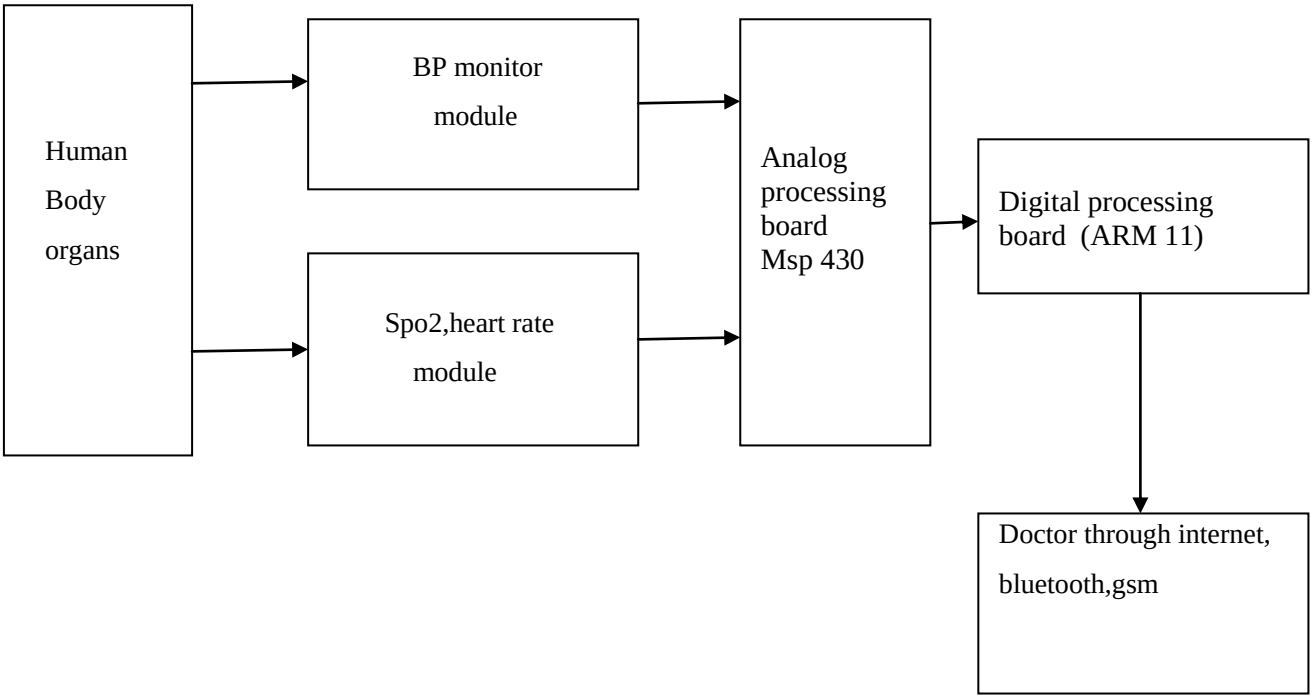

Fig.1 Block diagram of embedded web server for medical field

Individual modules used in the blockdiagram :

A. **BP monitor module**

- BP is one of the vital signs in human body.
- This paper demonstrates how to build noninvasive BP monitor using mpx 2050 (fig.2) blood pressure sensor and msp430 board.

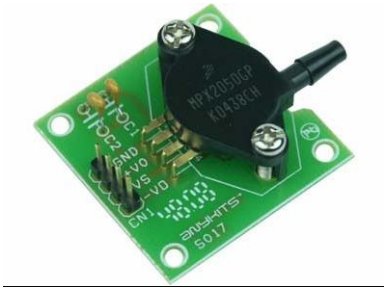

Fig.2 Msp430 sensor

- Noninvasive method measures arterial systolic and diastolic pressure of human body .
- Noninvasive method of monitoring BP used is oscillometric method.

B. **pulse oximeter module**

- pulse oximeter measures the amount of oxygen in blood.
- As oxygen is integral for countless biological processes.
- This paper discuss the design of non-invasive optical plethysmography using msp430 microcontroller
- The pulseoximeter consists of probe called nellcor probe (fig.3) which is to be placed on a body such as fingertip, nose, ear lobe.

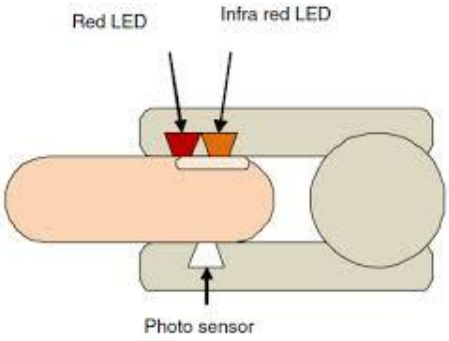

Fig.3 finger inserted in nellcor probe

- This probe consists of two led, red led(660nm), infrared led(940nm).
- The percentage of oxygen in the body is found out by measuring the intensity from each frequency of light after it transmits through the finger and then calculating the ratio between this two intensities

C. **Analog processing board (Msp 430) :**

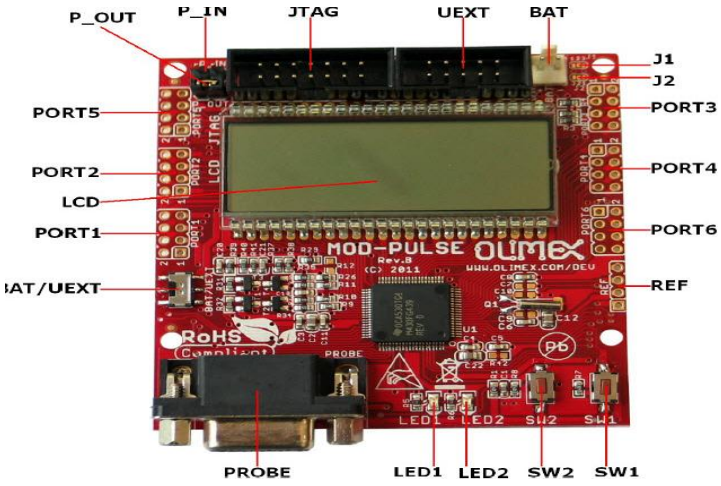

Fig.4 Msp 430 Development board

- Ultra low power performance:

All MSP430 devices are built for ULP. This means MSP430 can give your portable medical devices longer battery life.

- Integrated devices :

MSP430 provides high-performance, high-resolution analog and digital peripherals ideal for blood pressure monitor, heart-rate monitors, spo2 measurement.

D. **ARM 11**

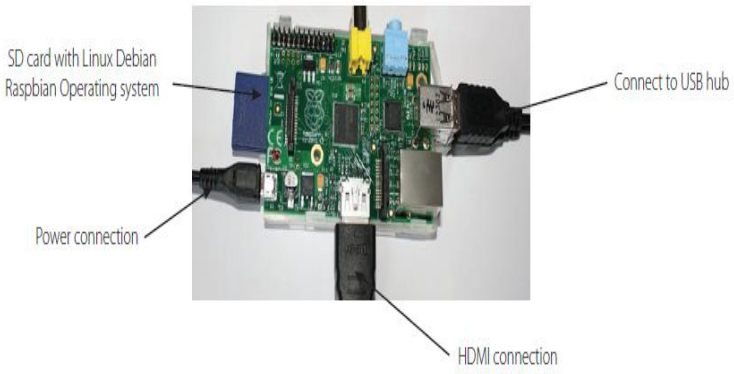

Fig.5 ARM11

- HDMI (High Definition Multimedia Interface) supports high-quality digital video and audio through a single cable.
- Touchscreens and smaller LCD displays will be supported via the DSI (Display Serial Interface) header connection.
- Sd card is ported with linux OS, application specific software, tcp/ip protocol which will act as embedded web server.
- Usb wireless for wifi connection,wired Ethernet, usb Bluetooth adapter, Usb sound cards, camera serial interface.

III. SOFTWARE

A. **IAR Embedded Workbench for TI MSP430**

- Integrated development environment and optimizing c compiler for msp430.
- Integrated development environment with project management tools and editor.
- Highly optimizing C and C++ compiler for MSP430.

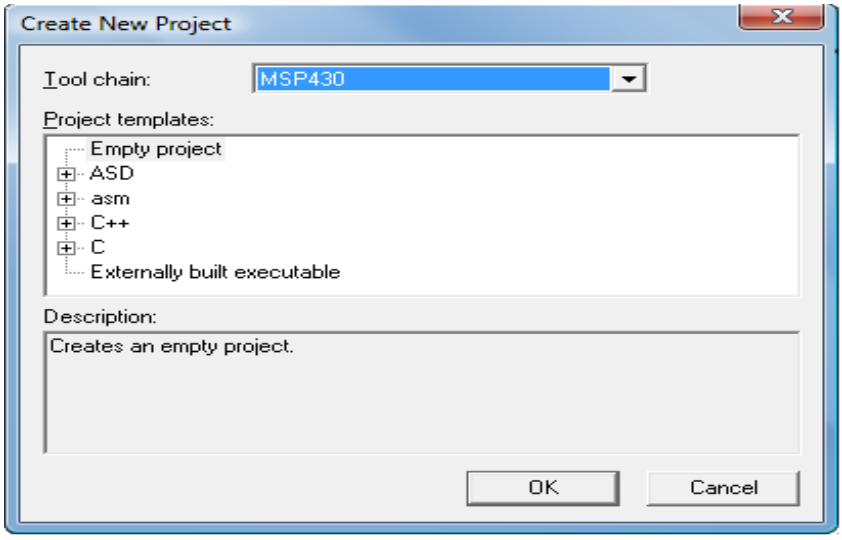

Fig.6 New project page on screen

B. **QT linux GUI design :**

QT designer :

- Qt Designer is a tool that let's you design visually and code user interfaces using the 'Qt' Library.
- The Designer is capable of generating the entire source for the GUI at any time for you to enhance further.

IV. ALGORITHM

A. Pulse oximeter measurent :

pulse oximeter measures oxygen saturation.oxygen saturation refers to percentage of available haemoglobin that carries oxygen.

1) Oxygen enters the lungs and is passed on to blood.The main way the oxygen is carried in our blood is by haemoglobin
2) Haemoglobin without oxygen is deoxygenated hb. and oxygen with haemoglobin is called as oxygenated hb.
3) Oxyhaemoglobin absorbs more infrared light then red light. Deoxyhaemoglobin absorbs more red light then infrared light.
4) Haemoglobin absorbs light. The amount of light absorbed is proportional to the concentration of hb.
5) The pulse oximeter works out the oxygen saturation by comparing how much red light and infrared light is absorbed by blood.

B. Blood pressure :

1) Run the air pump until ptressure in the cuff is greater than the typical systolic pressure.
2) It is then deflated. The pressure starts decreasing, resulting in blood flow through the artery, this make the artery to pulsate.
3) The pressure measured on the device during onset of pulsation defines the systolic blood pressure.
4) Then the cuff pressure is reduced further.The oscillations becomes increasingly significant fig(7), until they reach maximum amplitude.
5) The pressure at the maximum amplitude of these oscillations define the average blood pressure.

The oscillations start decreasing as the cuff pressure reduces. The pressure at this point defines the diastolic blood pressure.

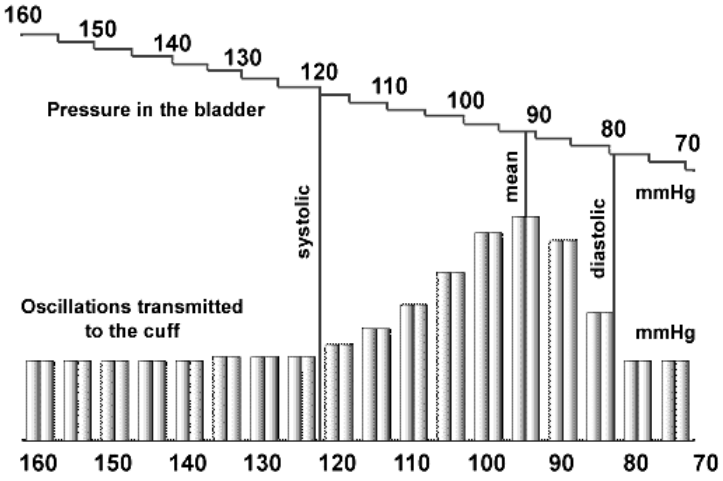

Fig. 7 graph showing principle of systolic vs diastolic BP

V. RESULT AND DISCUSSION

The captured ADC counts of pressure signal is calibrated for the range of 0-250 mmHG
Blood pressure readings :

ADC Counts	Pressure measured in Pressure meter (Omega HHP240) in mmHG
1323	150
1288	145
1081	120
924	100
845	90
805	85
765	80
727	75
645	65
530	50

Blood pressure is derived from adc counts by following equation :
Y= 0.128(x)-19.59
Where x= adc counts
Therefore for ADC count 1323,

1) Y= 0.128(1323) -19.59
   = 169.4 – 19.59
   = 150 mmHG
2) For ADC count 530,

Y = 0.128(530) – 19.59
  = 68 – 19.59
  = 50 mmHG

Thus by using this equation for adc counts blood pressure can be determined.

Pulse oximeter signal output :

Figure.8 shows the captured pulse oximeter signal from the board.This signal represents pulsatile arterial blood absorption. The beats per minute can be calculated from this signal.

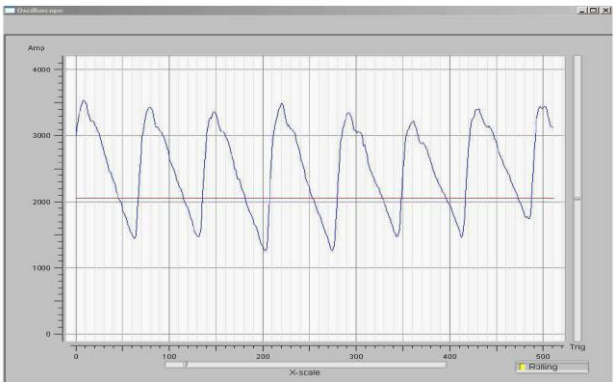

Fig.8 pulse oximeter signal

As this is a medical application, reliability is needed in first place. so to achieve the reliability the main attention were given to following points:

1) Accurate collaboration
2) Maintaining low noise floor
3) Getting data in real time and processing it.
4) Reliability of communication infrastructure
5) Patient security

Total integrated circuit:

Display with readings of systolic diastolic BP, oxygen saturation, pulse, interfaced to arm 11 board :

Fig.9 total integrated circuit

VI. CONCLUSION

This project allows real time continuous monitoring of patient by medical expert from anywhere in the world and handle emergencies.

With the approach and studying of different developing platforms like cypress, freescale, texas instrument, and according to requirements and by calibration most suitable elements were chosen and the final design was created, and to work out with this design various suitable hardware and software tools were used.

VII. FUTURE SCOPE

Project can be extended for monitoring of other parameters like respiration rate, ECG, EEG. Also camera can be interfaced to ARM 11 and the moments of the patients can be visualized. gps system can also be used to track the patients position may be in hospital, in home etc.

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