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"Remote Patient Monitoring System for Rural Population Using Ultra Low Power Embedded System"
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REMOTE PATIENT MONITORING SYSTEM FOR RURAL POPULATION USING ULTRA LOW POWER EMBEDDED SYSTEM

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Abstract - ***This paper proposed a prototype that analyses various Bio-medical parameters like temperature and blood pressure and heartbeat obtained from the sensors used &with the help of a*** **MSP430-** ***microcontroller, all the parameters obtained are displayed on an LCD screen. Based on the parameters obtained the patient is continuously monitored and if in case of any critical mishap when the parameters go out of a particular range then it is prevented by the care system attached to the Patient Monitoring System. The primary function of this system is to sense the temperature and heartbeat of the patient and sensed data is sent to the embedded processor port. The processor is programmed to continue monitor the data and send GSM module is used mobile message display and the actuation signals to patient care system.***

Keywords*:* sensors, MSP-430microcontroller, bio signals, GSM module.

1 Introduction

It has been long recognized in the health care industry that long-term, continuous monitoring is a key element in preventive care for people with chronic conditions such as cardiovascular disease. A typical example of patient monitoring is a home care device, such as an electronic blood pressure or glucose meter. An ambulatory system that allows long-term monitoring of mobile patients is also desirable. The ambulatory electrocardiogram (ECG) Holter device, used since the 1960s, provides a reliable measurement of the wearer's heartbeat but is heavy and cumbersome to wear over an extended period of time. In addition, its substantial power consumption forbids continuous operation using low-capacity batteries.

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In recent years, lightweight devices have emerged as a viable technology for continuous measurement of vital biomedical parameters [7].Wearable, biosensors connected to self-organizing allows physicians to continuously monitor vital signs, and helps in preventing any critical mishap and also helps physicians to record long-term trends and patterns that provide invaluable information about a patient's ongoing condition, ease of Use [1]. The availability of advanced sensing devices combined with sophisticated; self-organizing care system will enable new applications and represents a significant opportunity for remote health monitoring. This system will serve 3 requirements

The first is a portability factor so that these health monitoring devices can fit or attach easily to a wrist or arm band, ring sensor or other wearable or implantable device.

The second requirement is extremely low power so that small batteries can be used for an extended period of time. The third requirement is a highly sophisticated protocol for low latency, high scalability and high responsiveness.

The organization of paper is as follows:
Section II describes the block diagram. Section III gives the detail of component used in proposed system. Section IV and V overviews the software and hardware parts of this proposed work. Finally some conclusion and future scopes are drown from the work done in section VI.

2 Description

Various biometric signals are sensed by the sensors and sensed signals are conditioned through signal conditioning circuits. After getting the appropriate shape and value these bio signals are converted in to digital signals for processing. Embedded processor continues monitors these bio signals and display their values on LCD times to time. Any variation in these signals makes processor to send the actuating signals to patient caring system

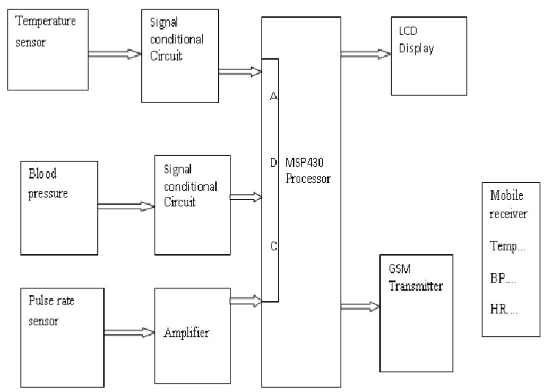


Fig.1 block diagram

3 Components Used

The whole system is composed of three components sensing, processing and actuating. Apart from these components, the signal conditioning circuit, local display system and programmed algorithm are also integrated part of this application specific embedded system. A few components are discussed below

3.1 Microcontroller

The MSP430 MCU clock system has the ability to enable and disable various clocks and oscillators which allow the device to enter several low-power modes (LPMs). The flexible clocking system optimizes overall current consumption by only enabling the required clocks when appropriate. This means that MSP430 MCUs can operate for decades on a single coin cell battery.

1) Used to display Biomedical Parameters on LCD.

2) It is also used to interface the temperature sensor, the heartbeat sensor and blood pressure the LCD.

3.2 Liquid Crystal Display

Display used here is the LCD display. It is an intelligent LCD. It is a 16*2 LCD, which displays 32 characters at a time 16 will be on the 1st line and 16 will be on the 2nd line. There are two lines on the LCD and it works on extended ASCII code i.e. when ASCII code is send it display it on the screen. On the LCD total no of pins are 16 out of which 14 pins are used by the LCD and 2 are used for backlight. LCD is an edge Trigger device i.e. from high to low. The data can also be monitored on mobile devices using DTMF [4].

3.3 Temperature Sensor

In this a precision centigrade temperature sensor LM35 is used. It is a precision integrated-circuit temperature sensor, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature [2]. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. For every ^{0}C change in temperature, it shows a variation of 10mV in the output [3].

3.4 Heart Beat Sensor

A Heart Beat Sensor is implemented with a pair of LED and LDR. (Fig.2). This transducer works with the principle of light reflection, in this case the light is infrared.

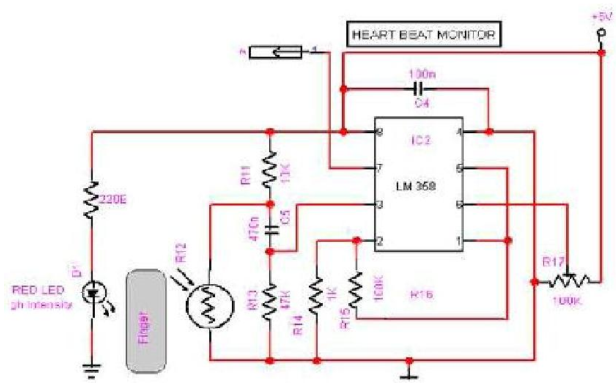


Fig.2. Heart Beat Sensor

3.5 GSM Module System

In this part we have implemented the mobile application for the multiparameter value are display the any rural area to medical care system.

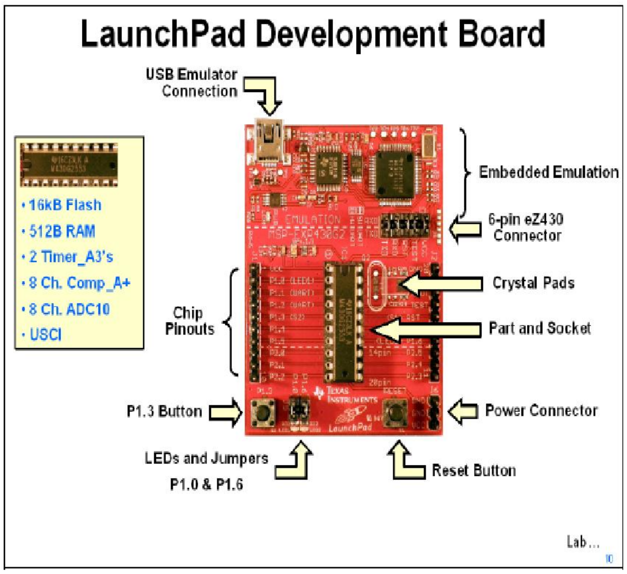
4 Software Implementation

The software design is a key element in the development of a project. For visualization of the different parameter on the LCD display, the microcontroller is burnt in assembly level language. The microcontroller chosen for the development of the system is MSP430. The MSP430 has 8K bytes of Flash programmable and erasable read only memory (EPROM) and has the capability to write to its own memory. The use of a FLASH device for development also provides the option to use FLASH microcontrollers in the final design making the system fully upgradable. This allows modification of the microcontroller software to expand.

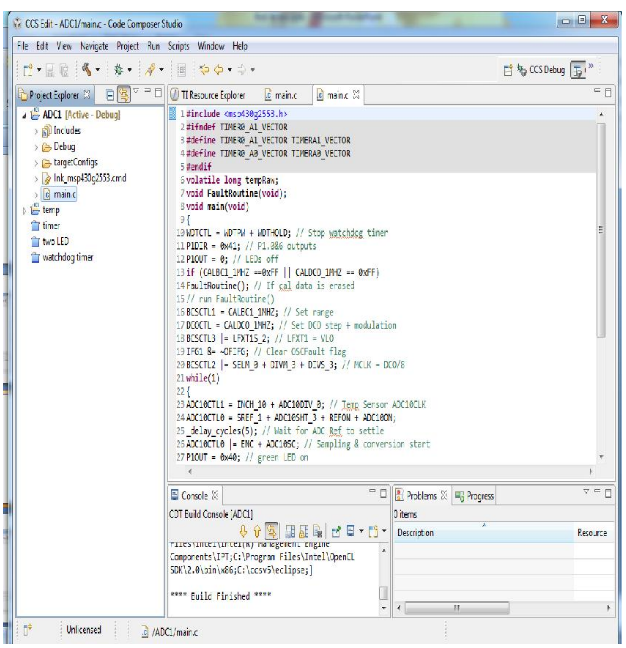
4.1 Software tool:

- **Code Composer studio**
  1.CCS Editor
  2.Debugger

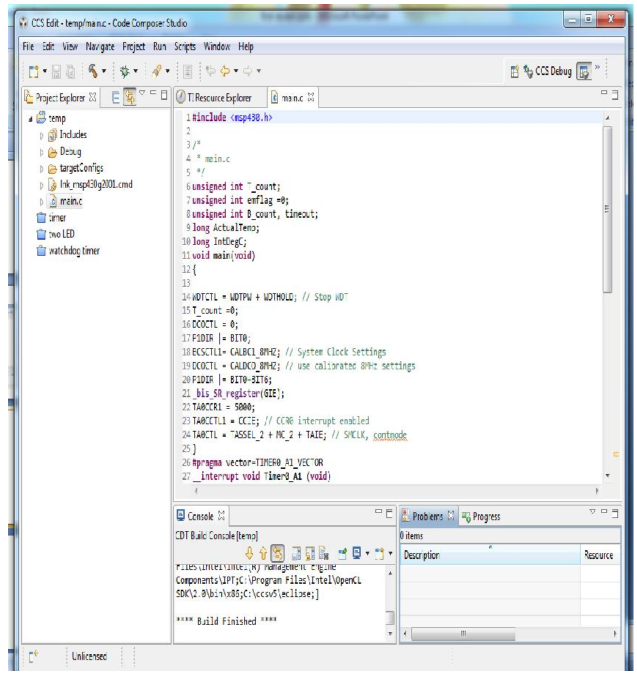
MSP430 Launch pad:



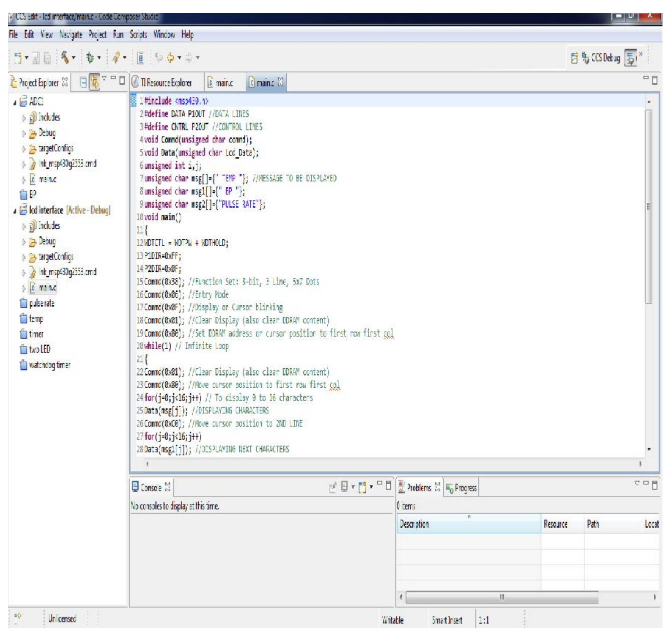
4.2 Software Coding-ADC Program:



4.3 Software Coding-Temperature Sensor:



4.4 Software Coding-LCD interface Program:



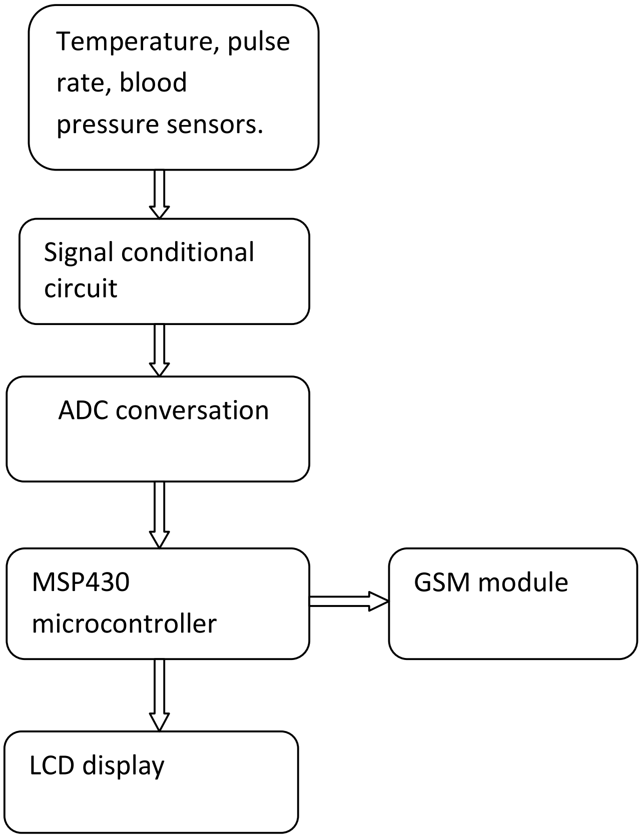


Fig.4. Flow Diagram

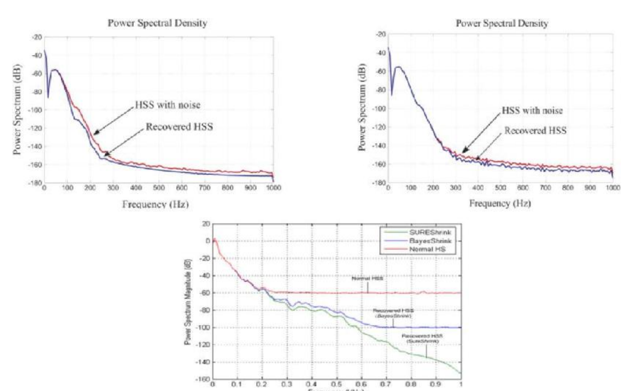
The proposed work is focused on body temperature measurement device and heart rate measurement monitor taking up the analog values using the sensor LM 35 and LDR and LED, these signals were fed into an ADC (Analog to Digital Convertor) The digital value of the temperature measurement and heart rate measurement from the ADC is then fed to the MSP430 microcontroller. The LCD (Liquid Crystal Display) is interfaced with the microcontroller which displays the value of the temperature sensed and the heart beat. In case the values of the temperature and the heart beat goes out of a particular range prescribed by the doctor the relay gets triggered and hence the care system responds to GSM system as shown in fig.4

4.5 Classification And Its Clinical Significance

The system is designed to classify the signals into: 1) abnormal and 2) normal classes at the onset. The abnormal classes once screened are further classified into: 1) valvular heart dis-eases (VHD), 2) ischemic heart disease (IHD), and 3) abnormal undetermined (AbU). The sub classification is based on frequency signatures of the HS and its temporal properties. The valvular disorders can be easily picked up by identifying the murmurs in the segmented HS. we can find the evidence of a trial fibrillation. Ischemic heart diseases can be diagnosed when there is an early or late heart failure, S3 Gallop, or a loud P2 (loud P2 often indicates a pulmonary hypertension); an a trial septal defect is indicated by a split of second HS. Coronary stenosis is generally known to produce sounds due to turbulent flow of blood in the occluded arteries. Normally, the sounds are masked and are not audible clearly during the systolic phase but the same can be picked up by precision sensors during the relatively quiet diastolic phase [5]. The extraction of useful information from the diastolic sounds associated with coronary occlusions using the adaptive signal-processing algorithms and the use of clinical examination variables can yield encouraging results. The signals are highly attenuated and complex so high precision microphones are required to detect the sound signals. The feature vectors extracted from the diastolic sounds analyzed, in addition, other physical examination variables like pulse rate, ambient/body temperature, and patient details are registered us-ing the system that can be used by fuzzy and neural network classifiers located at a remote server to validate the results and minimize false detections. Features were determined with reference to the S1 and S2 peaks determined using the entropy plots (see Fig. 5).

The applicability of the system can further be extended to pediatric heart care and can be used for early detection of ventricular septal defect (VSD), bicuspid aortic valve disorders and patent ductus arteriosus (PDA). As per statistics, 2–5 children are detected with congenital heart defects per 1000 live births. Hence, use of a non-invasive and safe methodology, i.e., auscultations, for identification of these conditions can provide a paradigm shift in paediatric and neonatal healthcare.

Fig.5.ECG parameter graph



5 Hardware implementation

By using various electrical circuits the bio-medical like temperature and heart beat parameters can be found. The output of the circuits is amplified by means of an amplifier and fed into an A/D converter. The digitized signal is then fed into the input port of the microcontroller. The microcontroller displays the parameters in digital value in the display device. And the injector connected to the prototype works accordingly as shown in Fig. 5. Hardware implementation of proposed work is shown in Fig.6.

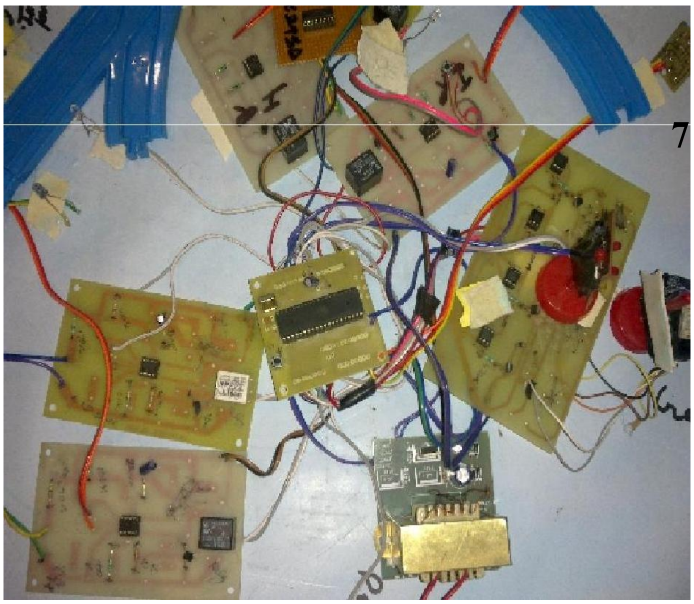


Fig.6. Hardware Implementation

6 Conclusion and Future Scopes

The project has been successfully completed within the stipulated time frame with the prototype displaying bio-medical parameter and the Care System We have achieved the desired outputs of the body temperature and the heartbeat and blood pressure of the patient on the LCD displays and according to which the Care System i.e. the Medicine performs if these parameters go out of a particular set range. Despite lots of research in this field of Monitoring and Care of patient, there has been very little effort in actual implementation of the concept which provides ample scope for the further developments of this project. Over the past few decades, technology has touched lives, literally. While use of technology in healthcare has been made in a hospital environment, a larger scope lies for technology to become simple. The complete system can be condensed in to a SoC by using on-chip network [5][6].

Patient Monitoring and Care today is fast becoming a common reality. From Cardiac Monitoring to Diabetes Management and more, healthcare services that were once restrained within doctors being around the patient 24 hours are now finding patients.

Patient Monitoring and Care makes objective, pertinent information available to caregivers in a timely manner, or as and when the need arises, prevent any kind of critical disaster to occur. This way, the patients are taken care of and the doctors are able to perform their job effectively too. Also, this addresses the issue of ever-less-available resources like healthcare staff and physical presence of the doctor. Additionally, it helps improve patient health, thanks to early diagnosis and preventive care.

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