DESIGN AND IMPLEMETATION OF LOW COST BLOOD PRESSURE & BODY TEMPERATURE MONITORING SYSTEM USING WIRELESS TECHNOLOGY

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Abstract
The objective of this research work is to design and implementation of a non-invasive, accurate, and low cost biomedical sensor interface for processing and monitoring blood pressure and body temperature using wireless technology. In present development, the real time blood pressure biomedical signal is measured using an optical measurement circuit based plethysmography technique(PPG) continuously monitor the systolic and diastolic blood pressure for a long period of time & Body temperature is dealt with a LM35 sensor. The detected measured signal amplified using an operational amplifier circuit and interface with the microcontroller. The numerical reading values of systolic and diastolic blood pressure remotely recorded and displayed with the help of LCD and stationary computer.

Key Words: Blood Pressure ,Body temperature, Wireless, Non-invasive, monitoring system etc.

I. INTRODUCTION

"Health is Wealth", is true not only for an individual, but is perhaps equally important for society in large. A Health care is one of the fast emerging fields today. With the average age of general population increasing each year the credit goes to cutting edge of medical research. New methods are developed almost every month to as a solution to numerous health problems for which accurate diagnosis is the need of the day. The Biomedical equipment providing accurate reproduction of body signals and automated diagnosis and patient monitoring systems. The field of biomedical instrumentation is an integral part of medical research.

Knowing the physical status of a person is very important for understanding the body condition of a person. Vital signs that play an important role for understanding the condition of human system are heart rate, temperature and blood pressure of a person. In this method we had made use of three sensors LM35,, blood pressure sensor which has the sensing element as SPD100G.

A. Blood Pressure:

Blood pressure is the most often measured and most intensively studied parameter in medical and physiological practice. Pressure measurements are a vital indication in the sucessful treatment and management of critically ill patients in an intensive cardiac care unit or the patients undergoing cardiac catheterisation.

The meaurement of BP are of great importance because it is used for detection of hypertension (high blood pressure). Hypertension is a continuous, consistent, and independent risk factor for developing cardiovascular disease. Hypotension can cause the blood supply to the brain, heart and other tissues to be too low, and hypertension is strongly correlated with higher risk for cerebral stroke and heart infarct. Blood pressure measurement is also important for particular disease patients, such as hemodialysis patients. Hence, in the daily life, blood pressure measurement and management is very useful

for handling health situation and plays a preventive function.

B. **Temperature:** Temperature is measured using LM35 sensor. The human body temperature is measured by placing hand on the sensor LM 35 it reads the value and gives an ADC value which is converted to the Celsius degrees

II. METHODOLOGY

A. Photoplethysmography Unit (PPG):-

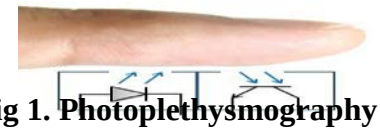

Fig 1. Photoplethysmography Technique

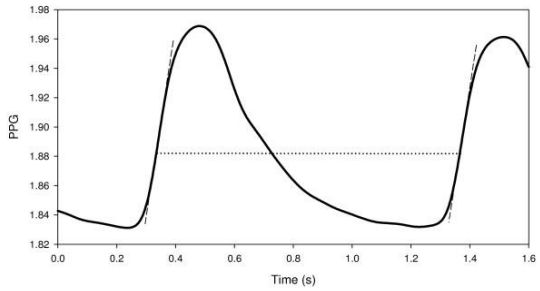

Fig 2. PPG Waves

pressure monitors are based on oscillometric method accepted and widely used mobility, they require suitable for home-care and long-term monitoring of BP for homecare inexpensive method that is and does not require These requirements can be which will be designed using technique. method used to measure volume in the tissues. It utilizes contains an infrared light a part of the tissue photo-detector receives the obtained from this technique which can be used to is shown in fig. 1 where used as the source and a phototransistor is used as the detector.

More to the point, a developed technique based on a noninvasive continuous blood pressure measurement using volume oscillometric method and photoplethysmograph technique has been investigated , and the study uses high intensity LED and a LDR (Light Dependent Resistor) and placed them at the edge of a finger. The concept is that the resistance of the LDR changes according to the light intensity received by the LDR. The change in resistance is proportional to the change of blood volume and as well as blood pressure in the finger. The result showed the systolic and diastolic blood pressure on a mini LCD. In addition, a non-invasive blood pressure monitor was developed using photoplethysmograph method.

B. Body Temperature

The body temperature is measured by LM35, a precision integrated-circuit temperature sensor whose output value is proportional to the Celsius temperature. It's a three pin IC where we have supply output and ground connections

Temperature is a measure of the degree of heat intensity. The temperature of a body is an expression of its molecular excitation. The temperature difference between two points indicates a potential for heat to move from the warmer to the colder point. The human body's core temperature varies from day to day, and from time to time, but these fluctuations are small, usually no more than 1.0ºC. Humans are homoeothermic and body temperature is regulated at about 37ºC ±1ºC. The thermoregulatory center in the hypothalamus plays a very active role in keeping body temperature in the normal range. External and internal heat sources influence body temperature.

LM35 generates higher output voltage than thermocouples and may not require that the output voltage be amplified. The scale factor is 0.01V/**OC.**LM35 does not require any external calibration or trimming and maintains an accuracy of 0.4C at room temperature and 0.8c over a range of 0 to 100.

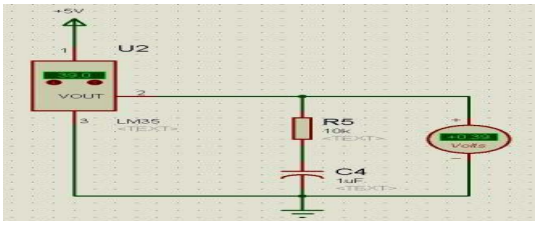

Fig 3. Temperature sensor circuit

III. EXPERIMENTAL WORK

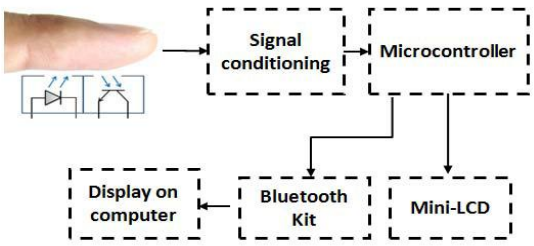

Fig 4. Circuit diagram of system.

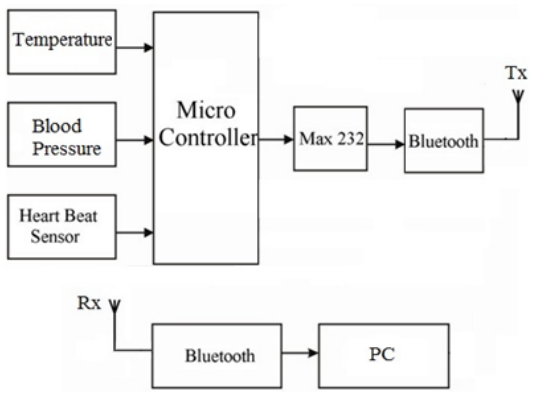

Fig 5. Blood Pressure and Body temperature monitoring

A. Sensing Stage

The detection of the blood pressure signal is based on using optical measurement technique called photoelectric plethysmography (PPG). This technique has the ability to detect the volume of blood pressures in the arteries. The PPG basic form utilizes two components: a light source to illuminates a part of the tissue (e.g. fingertip) and a photo detector to receive the light. Transparency of living tissue to light makes it possible for some part of the light from the source to pass through the tissue to the photo-detector.

However, some part of the light is absorbed by the blood, bone, muscle and skin in the tissue. The volume of the blood in the vessel varies while the volume of other part remains constant. Therefore the light absorption is varied only by the change of volume of blood (increases or decreases) and the returning light to the photo-detector changes according to the change of blood volume. The electrical resistivity of the photo-detector changes depending on the amount of light falling on it. This change of resistivity results is the change of electrical current flowing in the detector which is converted into PPG signal.

Fig 6. Optical Sensor

The LM35 temperature sensor is proposed in this work for measuring the human body temperature. It is a precision integrated circuit Temperature Sensor which is small and can be placed anywhere on the body.

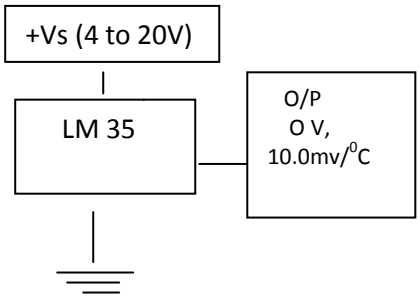

Fig 7. Temperature sensor

The LM35 output voltage is linearly scalable to the measured temperature, which is 10 mV per 1 degree Celsius as shown in fig 8. So if Vout = 0.37V then the measured temperature is 37°C. It does not require external calibration and maintains an accuracy of ±0.4°C at room temperature and ±0.8°C over a range of 0°C to +100°C [26,

A. Signal Conditioning Stage:

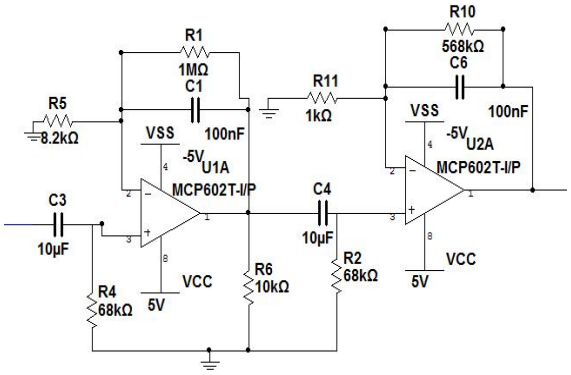

Fig 8 . Circuit Diagram

After the sensor detected the changes in the volume of blood pressures, a low frequency and low magnitude biopotential signal is received by the photodiode. As the detected PPG signal is so weak, it must undergo some signal conditioning (e.g. amplifying and filtering) so that it can be used for further processing. Since the output voltage of the photo-detector has a large amount of dc component which requires a filter to suppress out the dc component. A good filter choice will be the use of an active bandpass filter because its first cut off frequency can be used to remove direct current (DC) and its second cutoff frequency can be used to remove unwanted high frequency components in the signal like power line interference (50 Hz). In addition, the filter is also used with a very high gain for amplifying the signal. Two stage bandpass filter are used and each stage has different gain.

B. Microcontroller Stage:

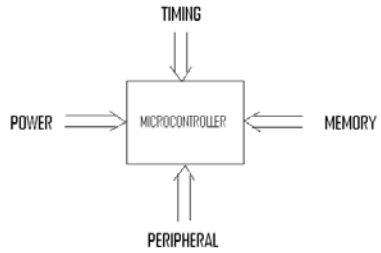

Fig.9 Essential block of microcontroller requirement (PIC18F252)

PIC18F252 is the 28 pin IC, having 10 bit inbuilt A/D converter with five input channels. Operating frequency is DC-40MHz, 32k bytes program memory and data memory is of 1536 bytes. The output of the signal conditioning stage is fed into a microcontroller where it is processed (sampling and quantizing). The PIC18F252 microcontroller is used in this system where it has a built-in ADC. The PIC18F252 device family can operate at speeds up to 12MIPS and has a hardware multiplier for faster calculation of control algorithms. The microcontroller finds out the smallest (represents DBP) and the largest (represents SBP) value form the output voltage using a program written in MPLAB X IDE.

The microcontroller then displays the measured blood pressure information in mini LCD and transmits them through a Bluetooth device to any stationary enabled computer device. Buzzer alert of the system helps the patient itself to be aware of his/her condition and can take necessary steps towards medication. At the same time, physician can also diagnose the patient from a remote location as system provides SMS alert at critical situations. The Bluetooth interface provides a convenient and low power consumption method for data transmission. This system provides users an easy-to-interface interface and simple blood pressure management environment.

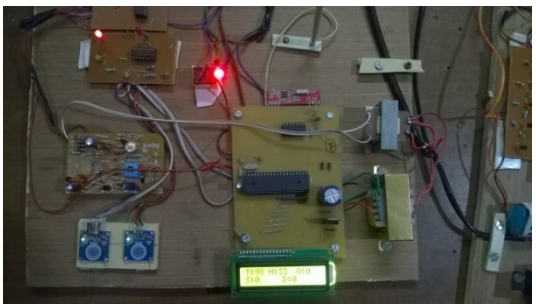

Fig . 10 Experimental Work

D. LCD (Liquid Crystal Display) with Driver.

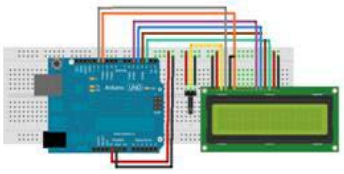

Fig 11 . LCD (Liquid Crystal Display)

A liquid crystal display is a type of display used in digital watches and many portable computers. LCD displays utilize two sheets of polarizing material with a liquid crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them.

E. Bluetooth Technology

By using Bluetooth (SKKCA-21) Remote Control. SKKCA-21 module offers simple yet compact Bluetooth platform for embedded applications. It has a surface mount layout which makes the process of development and application easier. The Bluetooth transmits the reading to the PC equipped with Bluetooth. The display on computer is acquired using special software called Parallax-Serial-Terminal. It is simple terminal software which allows users to display results through predefined serial ports.

F. RF Transceiver Module.

Fig.12 RF Module

An **RF module** (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through Radio Frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and/or receiver.

IV. RESULT AND DISCUSSION

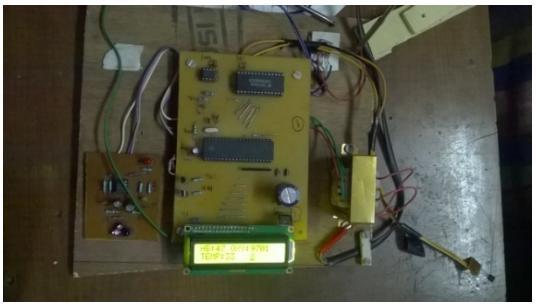

Fig 13. Circuit Result

This system monitors the blood pressure and the temperature in the PC screen by using the Bluetooth technology. This entire system requires less power which can even implemented in remote (mobile) patients too. We can add some another parameters as per our necessary.

When the power is turned on, all the LEDs on PCBs starts glowing, indicating that circuit is working properly. 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.

Age	Gender	PPG(reading)
20	Female	79
26	Female	78
38	Male	84
56	Male	65
60	Male	70

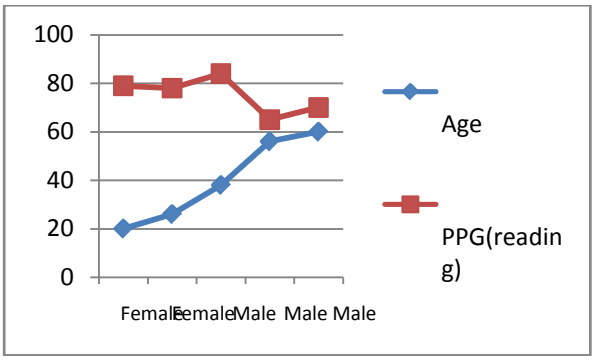

Fig. 14 Graph in between Age, Gender and PPG readings.

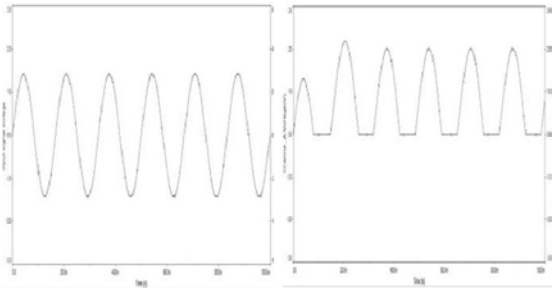

Fig. 15 Input and output waveform of amplifier in Multisim

V. CONCLUSION

With this proposed system the blood pressure can be measured continuously for a long period of time and also remotely monitored. The small embedded system can display the systolic and diastolic blood pressure on a mini LCD as well stationary computer which is a Bluetooth enabled device though Bluetooth wireless technology. In case of any abnormal changes in the blood pressure readings, the system alerts using a buzzer and it also send a message to the predefined number(i.e. a physician number) using GSM. Furthermore, the obtained results will be compared with existing devices data like a sphygmomanometer to verify the accuracy of the developed instrument. This system provides users an easy-to-use interface and simple BP management environment. The Bluetooth interface provides a convenient and low-power consumption method for data transmission. This work may further be extended in future to include more number of physiological parameters like heart rate, oxygen saturation, respiration rate etc. to be monitored for a long period of time. GPS system can be used to spot the exact position of the patient and thus can provide immediate help if required.

V. FUTURE SCOPE

The Scope of research work intended to design and construct an blood pressure and body temperature measurement using Wireless Technology which has the low cost, reliable, and portable and it is used in many medical laboratories and industries where we can get better and more accurate result as compared to other devices.

The device can be connected to PC by using serial output so that measured heartbeat and temperature can be sent to PC for further online or offline analysis.

Warning for abnormalities of health condition can be displayed.

Sound can be added to the device so that the device makes a sound each time a pulse is received and alarm is started for abnormal health condition.

The output can be sent to mobile phones by using GSM module or Bluetooth module for further analysis.

More parameters (like blood pressure) can be added to

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