Multi Propose Biomedical Circuit

Prof Abhijit G Kalbande
Assistant Professor
Department of Electronics & Telecommunication Engineering
P.R.M.C.E.A.M. Badnera, Amravati, M.S., India

Ms. Bhavan B. Malode
UG Student
Department of Electronics & Telecommunication Engineering
P.R.M.C.E.A.M. Badnera, Amravati, M.S., India

Ms. Swati B Nale
UG Student
Department of Electronics & Telecommunication Engineering
P.R.M.C.E.A.M. Badnera, Amravati, M.S., India

Ms. Pooja A. Kshirsagr
UG Student
Department of Electronics & Telecommunication Engineering
P.R.M.C.E.A.M. Badnera, Amravati, M.S., India

Ms. Pratiksha Deshmukh
UG Student
Department of Electronics & Telecommunication Engineering
P.R.M.C.E.A.M. Badnera, Amravati, M.S., India

Abstract

In this paper we describe the design process of a low cost and portable microcontroller based heart-rate counting and temperature measurement system for monitoring health condition. The raw heart-rate signals were collected from finger using IR TX-RX (Infrared Transmitter and Receiver pair) module which was amplified in order to convert them to an observable scale. The inherent noise signal was then eliminated using a low pass filter. These signals were counted by a microcontroller and displayed on the LCD panel. As well as the LM35 measure the temperature in the form of voltage and it convert into digital form using ADC 0804 and display on LCD. The project is applicable for family, hospital, clinic, community medical treatment, sports healthcare and other medical purposes. Also, fit for the adults and the pediatrics. However, presented method in the developed system needs further investigation and need more functionality, which may be useful to consider advance in future research.

Keywords: Heart Rate, Microcontroller finger trip, Sensor

I. INTRODUCTION

The advances in the technologies related to biomedical engineering as let to the emergence of several engineering designs to aid the human requirements. Seniors have to make frequent visits to their doctor to get their vital signs measured. Regular monitoring of vital signs is essential as they are primary indicators of an individual's physical well-being. These vital signs include:

1) Body temperature
2) Heart pulse rate

Our project on based on "biomedical technology" used for to detect temperature and heart pulse of human being. The design portion involves temperature sensor and heartbeat module circuitry with microcontroller. We use certain software like circuit wizard, mini pro and keil.

Nowadays, the use of a vital sign's monitor is very common and not merely used at the hospitals as a monitoring system for patients. Generally, pulse rate monitor was used by a person who cares about their heart to ensure that they have a normal heart pulse rate. The early detection of the abnormal pulse rate can help to prevent from the serious disease. The pulse rate monitor is needed to determine the range of pulse rate. This range of pulse rate should be compatible with the normal rate to prevent from serious injury. Such digital display of target pulse rate did not provide for ease of reading the display under the most conditions. This project proposed an innovation to respond to these problems by providing novel wearable biomedical signal sensor devices for monitoring heart pulse and temperature at home easily, which displays the pulse rate by LDR Sensor and also temperature monitored [1]. The proposed innovation will be programmed to automatically suggest the user about their health conditions. We developed a group of sensors for measuring pulse rate and temperature.

Heart pulse rate measurement is one of the very important parameters of the human cardiovascular system. The pulse rate of a healthy adult at rest [3] is around 72 beats per minute (bpm). Athletes normally have lower pulse rates than less active people. Babies have a much higher pulse rate at around 120 bpm, while older children have pulse rates at around 90 bpm. The pulse rate rises gradually during exercises [4] and returns slowly to the rest value after exercise. The rate when the pulse returns to normal is an indication of the fitness of the person. Lower than normal heart pulse rates are usually an indication of a condition known as bradycardia, while higher than normal pulse rates are known as tachycardia.

Pulse rate is simply and traditionally measured by placing the thumb over the subject's arterial pulsation, and feeling, timing and counting the pulses usually in a 30 second period. Pulse rate (bpm) of the subject is then found by multiplying the obtained number by 2. This method although simple, is not accurate and can give errors when the rate is high. More sophisticated methods to measure the pulse rate utilize electronic techniques. Electro-cardiogram (ECG) is [5,6] one of frequently used and accurate methods for measuring the pulse rate. ECG is an expensive device and its use for the measurement of the pulse rate only is not economical. Low-cost devices in the form of wrist watches are also available for the instantaneous measurement of the pulse rate. Such devices can give accurate measurements but their cost is usually in excess of several hundred dollars, making them uneconomical. Most hospitals and clinics in the UK use integrated devices designed to measure the pulse rate and temperature of the subject. Although such devices are useful, their cost is usually high and beyond the reach of individuals.

II. LITERATURE REVIEW

Initial research was conducted to determine the types of vital signs that are routinely measured during a visit to a doctor. These vital signs are: body temperature, pulse rate and respiration rate (rate of breathing). As part of our project, we decided to design and build sensors that measured two of these vital signs. Then, the market demand for this type of device was determined and research on similar monitoring devices that are currently sold was performed. According to a report from Berg Insight, the market for home health monitoring was worth about $11 billion in 2008 [2] found some current devices sold that offer similar monitoring capabilities as our main project.

Some examples of such devices are: i) "Lifeguard – A Wearable Vital Signs Monitoring System" developed by NASA AMES Astrobionics, ii) Spot Vital Signs LXi developed by Welchallyn, and iii) CASMED's 740 Vital Signs Monitor. These devices are compared in Appendix in Table 1. Major disadvantages with these devices are that they are not very easy to use, somewhat intrusive, and, of course, very expensive. After considering these factors, a key goal of this project became to design sensors that would not only efficiently and accurately monitor the vital signs, but also be cost-effective. Next, various technologies that were currently used to monitor these vital signs were examined and the most effective sensing techniques for this project was determined. Next, different types of temperature sensors were compared. It was determined that the most effective way of measuring body temperature is by using a LM35.

III. SYSTEAM DEVLOPMENT

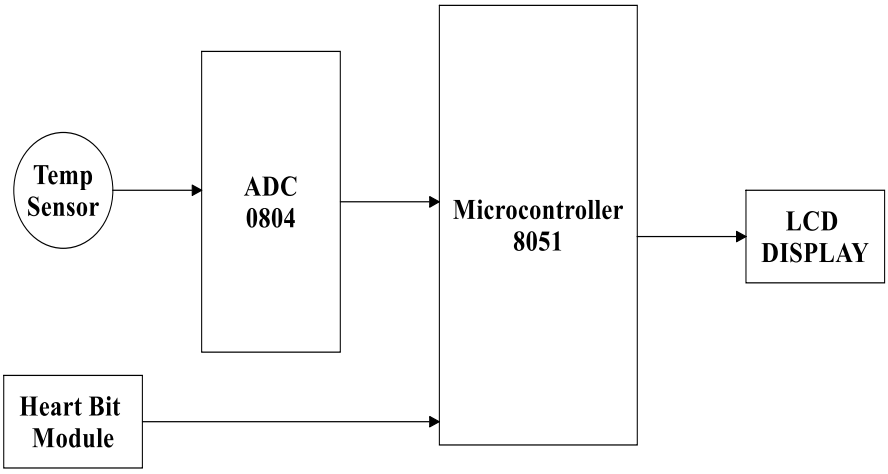

Fig. 1: Block diagram of multitasking biomedical kit

A. Sensor One:

This is first sensor which uses to sense parameter one. This can be temperature sensor, say LM35. The sensor will be placed on the front panel. One can use LCD display to read the temperature. Temperature sensor sense the body temperature and gives the output as a voltage to the amplifier which amplifies the voltage and gives the output to the voltage comparator and output of comparator output given to the ADC which convert analog value to digital ,microcontroller display the temperature on LCD display.

B. Heart beat module:

Heart beat sensor is directly given to the microcontroller because its output is digital in form so need to given to the ADC. A heart rate monitor is a personal monitoring device which allows one to measure his/her heart rate. It is largely used by performers of various types of physical exercise

C. *ADC:*

Analog to digital converters find huge application as an intermediate device to convert the signals from analog to digital form. These digital signals are used for further processing by the digital processors. Various sensors like temperature, pressure, force etc. convert the physical characteristics into electrical signals that are analog in nature. We are going to use ADC 0804 which is 8 bit and 8 ADC channel. Since we have one input for ADC, we have used this ADC.

D. *Microcontroller:*

Microcontroller is the major component of the system also called as a computer on chip which has features of a Microprocessor like CPU, ALU, PC, SP and Registers. It also had added the other features needed to make complete computer like ROM, RAM, Serial and Parallel I/O, counters and Clock circuit. Like the Microprocessor, a Microcontroller is a general-purpose device, but one that is mean to read data, performs limited calculation on that data, and control its environment based on those calculations. The prime use of Microcontroller is to control the operation of a machine using a fixed program that is stored on ROM and that does not change over the life time of the system.

E. *LCD Display:*

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

F. *Power Supply:*

The Power supply circuit are built using Transformer, Rectifiers, Filters and then Voltage regulators starting with a AC voltage, a steady DC voltage is obtained by rectifying the AC voltage, then filtering to DC level, and finally regulating to obtain a desired fixed DC voltage. The Regulation is usually obtained from an IC voltage regulator unit, which takes a DC. voltage and provides a somewhat lower DC voltage, which remains the same even if the input DC voltage varies, or output load connected to DC voltage changes.

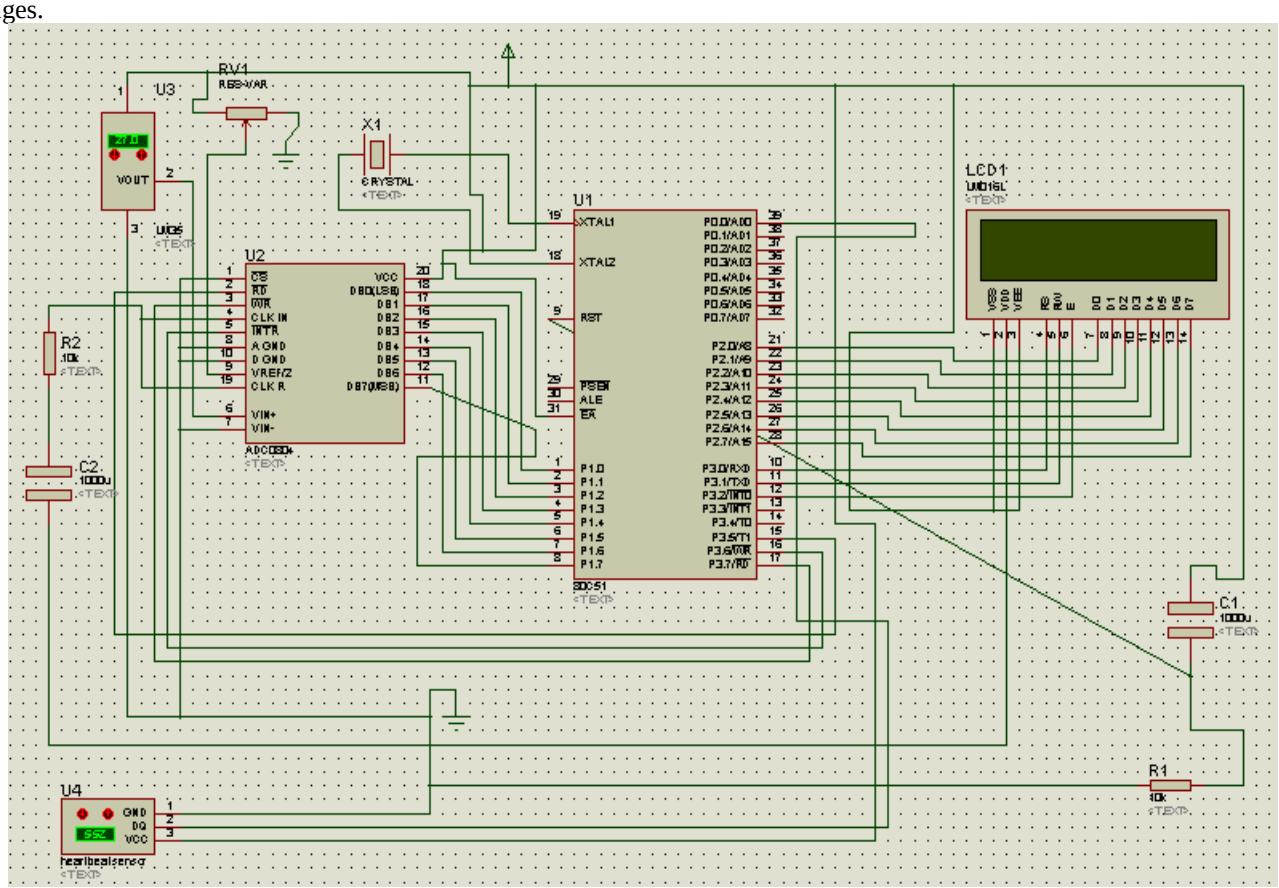

Fig. 3.2: Circuit diagram of multipurpose biomedical kit

1) Body Temperature Measuring Using Lm35:

Human body temperature varies within a narrow range of values. Body temperature can be measured from different parts of the body, but for this project, temperature will be measured from the ear as it is one of the most accurate types of body temperature measurement. Temperature depends on many things, including level of activity, time of day, and psychological factors. It also depends on whether the person is eating [7]. This article is about a simple 0-100°C digital thermometer with 1°C resolution using 8051. The circuit is based on LM35 analog temperature sensor, ADC0804 and AT89c51 microcontroller. LM35 is an analogue temperature sensor IC which can measure a temperature range of -55 to 150°C. Its output voltage varies 10mV per °C change in temperature.

For example, if the temperature is 32°C, the output voltage will be 32 x 10mV = 320mV. ADC 0804 is used to convert the analogue output voltage of the LM35 to a proportional 8 bit digital value suitable for the microcontroller. The microcontroller accepts the output of ADC performs necessary manipulations on it and displays it numerically on a 2 digit seven segment LED display. Output of the LM35 is connected to the +Vin (pin 6) of the ADC0804. Resistor R13 and preset R14 is used to provide an external reference voltage of 1.28V to the Vref/2 pin (Pin 9) of the ADC0804 and with this reference voltage, the step size of the ADC will be 10mV and span will be 0-1 V. This means that for a 10mV input the digital out of ADC will be 1 (1 in decimal also), for 20mV it will be 10 (2 in decimal), for 30mV it will be 11 (3 in decimal) and so on. The microcontroller accepts this data and puts it on the LCD display.

Digital out of the ADC (D0 to D7) are connected to P1 (P1.0 to P1.7) of the microcontroller. This is the line through which the microcontroller accepts data from the ADC. The control pins CS, RD, WR and INTR are connected to P3.7, P3.6, P3.5 and P3.4 of the microcontroller. The output of temperature sensor is connected to pin number 9 of ADC. This is the data path through which the microcontroller sends chip selects (CS), read (RD) write (WR) signals to the ADC and receives INTR signal from the ADC. Data lines (D0 to D7) of the LCD display are interfaced to P2 (P2.0 to P2.7) of the microcontroller. The control pin of RS, R/W AND Enable is connected to P3.0, P3.1 and P3.2.

2) Pulse Rate Using Heart Beat Sensor Module:

Pulse Rate, determined by the number of times heart beats in a minute, is substantial, as it gives information on the overall physical condition of the body. In case of patients suffering from diseases, continuous or routine measurement of pulse rate is very important. Analysis of pulse rate would help maintain health, diagnose and detect coronary diseases. The project is designed in such a way to monitor the pulse rate measurement using a microcontroller with the help of a heartbeat sensor. In models of pulse rate counter have been designed and implemented based on analyzing infrared light reflection from body parts. In a LCD display shows a change of pulse rate over a time period. Microcontroller based heart rate measuring device that integrates most of the key features of the aforementioned devices and models. The device is compact in size, energy efficient, and portable, capable of data storage.

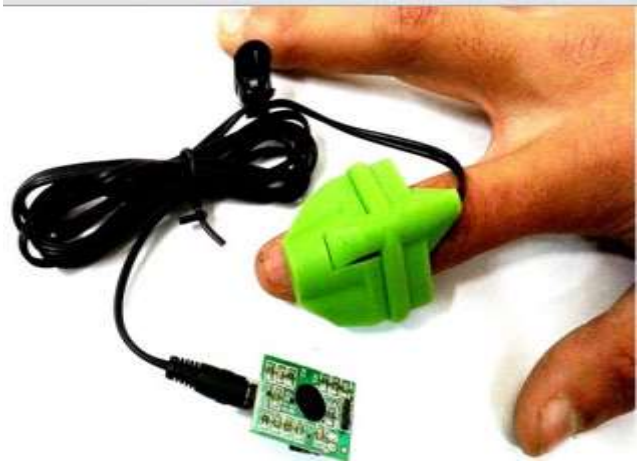

Fig 3.4.1: Heart beat module

IV. ADVANTAGE & APPLICATION

A. Advantage:

1) It is very easy to use.
2) Cost is very less.
3) It gives accurate reading
4) Because of small size it is portable.
5) It gives accurate reading so that it is noise free
6) Circuit is very simple.

B. Application:

1) It has become a widely used training aid for a variety of sports.

2) Hospitals/dispensaries.
3) Better and accurate method of measuring heartbeat.
4) At homes.
5) A set point can help to determining whether a person is healthy or not by Checking his/her heart beat, BP & Temperature & comparing with set point.

V. FUTURE SCOPE

Sound can be added to the device so that a sound is output each time a pulse is received. The maximum and minimum heart rates over a period of time can be displayed Serial output can be attached to the device so that the heart rates can be sent to a PC for further online or offline analysis.

VI. CONCLUSION

A Low Cost Professional Heart Rate Measuring Kit has been developed with significant operational conformity with its commercial counterparts. In this project, the design and development of a low-cost microcontroller based device for measuring the heart pulse rate has been described. The device has the advantage that it can be used by non-professional people at home to measure the heart rate easily and safely. The device is ergonomic, portable, durable, and cost effective. The device is efficient and easy to use. This device could be used in clinical and nonclinical environments. It can also be easily used by individual users, e.g. athletes during sporting activities.

REFERENCES

[1] 1D.Chandana, 2B.Hema Latha/ A Tele-medicine System for Measuring Heart Rate, Blood pressure, And Drug Level Detection/ 2014 IJEDR | Volume 2, Issue 1 | ISSN: 2321-9939
[2] Brian Dolan /Home health monitoring was 11b market in 2008 Berg Insight/September 2009.
[3] S. Edwards/ "Heart rate Monitor Book"/ Leisure systems international/ Dec.1993.
[4] M. Malik and A. J. Camm. / "Heart Rate Variability"/ Futura Publishing Co. Inc./sept. 1995.
[5] J. R. Hampton/ "The ECG In Practice"/ Churchill Livingstone./ Mar. 2003
[6] A. R. Houghton and D. Gray/ "making sense of the ECG"/ Hodder Arnold Publishing.m 2003.
[7] Dhvani Parekh/ Designing Heart Rate, Blood Pressure and Body Temperature Sensors for Mobile On-Call System/ 0543318 April 22, 2010
[8] 1 Mamun, A. L., 2 Ahmed, N.,/ A Microcontroller-Based Automatic Heart Rate Counting System From Fingertip / 30th April 2014. Vol. 62 No.3.
[9] Mohammad Nasim Imtiaz Khan/A Low Cost Optical Sensor Based Heart Rate Monitoring System.
[10] Nusrat Hossain/Heart Rate Measurement Project/February 2, 2014.