International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 01
January 2017

An Efficient Microcontroller Based Heart Rate Monitoring

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Abstract: The main aim of this project is to monitor the heartrate using fingertip sensor. The device uses the optical technology to detect the flow of blood through the finger and offers the advantage of portability over tape-based recording systems.The main components used in this project are Microcontroller, power supply unit, heart rate sensor and LCD to Display the heart rate.In this project the heart rate sensor senses the heart pulse and gives the values to the microcontroller and which is further processed by microcontroller to display the count of the heart pulses on the LCD.In medical termminology, the technique used here for sensing heart rate is called photoplethysmography.

Key Words: Heartbeat, Fingertip pulse rate, Microcontroller, Heart rate monitor.

I. INTRODUCTION

Science and technology by way of inventions and innovations has made life easier for everybody in all spheres of life. One of such is in medical sciences where medical personnel are now able to acquire vital medical data from patients. Two of the most important are the measurement of heartbeat rate and temperature. The Human Heart Rate Monitors (HRM) are devices that allow the user to gain a real time measurement of their heart beat. They consist of a transmitter which detects the heartbeat by measuring the number of times the heart beats per minute and a receiver that determines the heart rate on receiving signals from the transmitter. The first wireless Electro-cardiography (ECG or EKG) heart rate monitor was invented in 1977 by Polar Electro. It was invented for the Finnish National Cross Country Ski Team to aid them in training. The concepts of "Intensity Training" became a buzz throughout the athletic world in the eighties, and in 1983 which lead to the introduction of the first wireless heart monitor.

By the 1990's, attention shifted from heart rate monitors for intensify and quality training needs to normal individual everyday fitness needs. The measurement of heart rate is used by medical professionals to assist in the diagnosis and tracking of medical conditions. It is also used by individuals, such as athletes, who are interested in monitoring their heart rate to acquire maximum efficiency. Accordingly, there is a dramatic increase in incidents of heart and vascular diseases as a result of the lifestyle and unhealthy eating habits. Consequently, heart problems are on the increase on younger patients. Statistics shows that coronary heart disease is now the leading cause of death. Thus, any improvements in the diagnosis and treatment tools are welcomed by the medical community. In a clinical environment, heart rate is measured under controlled conditions like blood measurement, heart beat measurement, listening to heartbeats using Stethoscope and Electrocardiogram (ECG), but these methods are expensive and need to be carry out by an experience medical personnel. Drawbacks with ECG method are too many sensors and cables connections, fluctuations in the ECG signal baseline, power line noise, and interference due to muscular activities and high cost of procurement. More so, ECG is not suitable for continuous monitoring on burnt victims and the conduction gel used may cause discomfort and inflammation on the skin.

Therefore, there is a great need that patients are able to measure the heart rate in the home environment as well. This project is design to use in medical applications and it is low cost and smaller in size than ECG (Electro Cardiogram)

sometime in any emergency cases for people who are suffering from heart diseases continuous monitoring of the patient is required it is not possible in some cases where the hospital is far away from the patient location. In such cases this prototype model is useful to measure the heartrate and the information is send to the medical advisory for preliminary precautions so that patient can be under control and prevented from serious situation before reaching to the hospital.

II. PROPOSED METHOD

This system basically consists of three components like Heart rate sensor, display and Microcontroller, the explanation of this circuit component is as shown below:

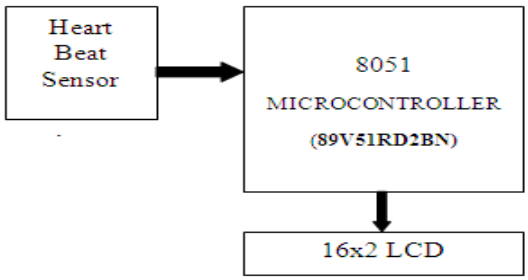

Figure.1 Block Diagram of Microcontroller Based Herat Beat Monitor

A. Microcontroller(89V51RD2BN):

The P89V51RD2BN is an 80C51microcontroller with 64K Flash and 1024 bytes of data RAM. A key feature of the P89V51RD2BN is its X2mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (6 clocks per machine cycle) to achieve twice the throughput at the same clock frequency. Another way to benefit from this feature is to keep the same performance by reducing the clock frequency by half, thus dramatically reducing the EMI. The flash Program memory supports both parallel programming and in serial. In-system programming (ISP) parallel programming mode offers gang programming at high speed, reducing programming costs and time to market. ISP allows a device to be reprogrammed in the end product user software control. The capability to field/update the application firmware makes a wide range of applications possible. The P89V51RD2BN is also In-Application Programmable (IAP), allowing the flash program memory to be reconfigured even while the application is running.

B. Finger Clip Heart Rate Sensor:

The Heart Rate Sensor basically consists of a Photodiode and an Infrared LED (IR LED) which are wrapped in clip.The Photodiode and an IR LED acts as transmitter and a detector which is used to measure the heart rate by passing the IR light through the finger tip depending upon the blood flow in the finger some of the IR light is penetrates through it and it is detected by the photodiode and gives the heart rate.

Figure.2 Heart Rate Sensor

C. Technique used by Heart rate sensor:

Photoplethysmography: Photoplethysmography is the process of optically estimating the volumetric measurement of an organ. Pulse oximetry, cardiovascular monitoring, heart rate monitoring etc are few common applications of photoplethysmography. When the heart expands (diastole) the volume of blood inside the finger tip increases and when the heart contracts (systole) the volume of blood inside the finger tip decreases. The resultant pulsing of blood volume inside the finger tip is directly proportional to the heart rate and if you could somehow count the number of pulses in one minute, that's the heart rate in beats per minute (bpm). For this an IR transmitter/receiver pair placed in close contact with the finger tip which is wrapped up in the heart rate sensor clip in this prototype model. When the heart beats, the volume of blood cells under the sensor increases and this reflects more IR waves to sensor and when there is no beat the intensity of the reflected beam decreases. The pulsating reflection is converted to a suitable current or voltage pulse by the sensor. The sensor output is processed by a

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comparator circuits in this prototype model to obtain a well-defined pulse which is finally given as input to microcontroller and microcontroller processed this pulse and give a visible indication on digital display.

D. LCD display:

A Liquid Crystal Display is a flat panel display, electronic visual display, or a video display that uses the light modulating properties of liquid. The purpose of using this LCD display in this prototype model is to display the heart rate in decimal value. Here we are using 16*2 LCD display which is connected to port1 of microcontroller. The following are the basic commands used for LCD are shown in Table.1.

Table.1

S.NO	COMMANDS	FUNCTION
1.	01H	Clear screen
2.	38H	Select 5*7 matrix
3.	0EH	Turn ON display, Turn ON Cursor
4.	80H	Select Top row
5.	C0H	Select bottom row

III. PROJECT METHODOLOGY AND DISCCUSSION

When we placed our finger in the heart rate sensor clip it will generate pulses which is analog in nature and it converts to digital form with the help of comparator circuitry available with the heart rate sensor module and give it as input to the microcontroller. The Microcontroller will detect the sensor output when the start button is pressed which is connected to the microcontroller.The microcontroller will start counting the pulses and calculate the count for 1 minute and display it on the LCD.

A. Software Used:

1. KEIL µ Vision IDE: KEIL µ Vision is an IDE (Integrated Development Environment) which is used to develop an application program compile and run it even the code can be debugged.It is a simulator where we can check the application code even in the absence of the hardware board.

2. Flash Magic: Flash Magic is used for burning the developed code on KEIL in to the microcontroller Chip. the serial port of PC is connected to the port of microcontroller through MAX232 to burn the program into the microcontroller.

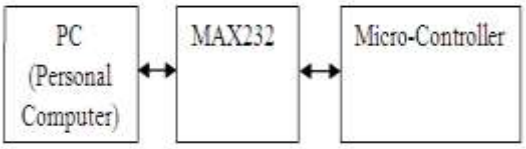

Figure 3. Programmimg process

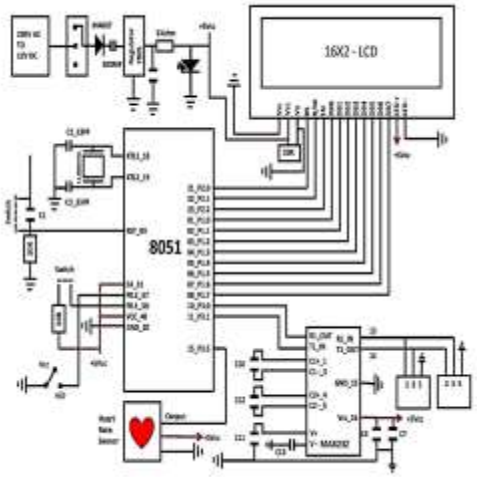

Figure 4. Schematic Diagram

Algorithm steps:

In order to count the number of pulses given by Heart beat sensor,timer-0 of 8051 is used. It is used as a 10 millisecond counter. The programming of timer is interrupt based.

The monitoring of heart beat is done by two methods

1) Fixed monitoring method

2) Continuous monitoring method

The selection of the method is done by a switch provided on the PCB. One more switch is used to indicate the start/stop operation. Both the switches are connected to the port-0.2. The switch readings are debounced using software delay technique.

Fixed method: During the start/stop duration counter counts the pulses which are recorded in the memory. At the end of time period, memory will give you the counter value,using which heart rate i.e.: Heart Beats per minute are calculated. This values is displayed on LCD.

Second method: The continuous method is similar to the fixed method. The basic difference is that in continuous method Heart beat is monitored continuously and the values are displayed for active heart beat pulse.

Practical model:

Figure.5 Lcd Displaying Welcome On Power

Figure.6 LCD Displaying 3 Digit Count = 080

Applications:

1. This project can be used to measure the heartbeat of different persons.
2. Project will display the variable and fixed heart rate.

Advantage:

1. Easy to use
2. Low cost
3. Easy to construct
4.

Disadvantages:

It is a low range circuit and cannot be implemented in critical condition.

IV. CONCLUSION

The project entitled "Microcontroller Based Heart Rate Monitor" helps to measure the heart rate of the Human Beings. The design and development of a heart rate monitoring device is presented that measures the heart rate efficiently in a short time and with less expense without using time consuming and expensive clinical pulse detection systems. Both analog and digital processing techniques are combined to keep the device simple and to efficiently suppress the disturbance in signals.Simulation showed that the heart rate can be detected from changes of blood flow through fingers.Experimental results showed that the heart rate can be filtered and digitized so that it can be counted to calculate an accurate pulse rate.

V. FUTURE SCOPE:

With the advent of fitness tracking devices and wearable technology, instruments like portable heart rate monitors will draw a huge market share, and technology like this can be implemented with more accurate sensors which will track not only a person's heart rate but also other physical parameters like calories burnt and steps taken etc.

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