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Wireless RF Based Heart Beat Monitoring System

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ABSTRACT—
This article describes the design process of a low cost and portable microcontroller based heart-rate counting system for monitoring heart condition. The raw heart-rate signals were collected from finger using RF TX-RX (Radio Frequency Transmitter and Receiver pair) module which was amplified in order to convert them to desired scale. The inherent noise signal was then eliminated using a low pass filter. These signals were counted by a microcontroller module (PIC16F877A) and displayed on the screen. An algorithm has been developed which was programmed into the microcontroller to run the heart rate counting system. The results obtained using the developed device when compared to those obtained from the manual test involving counting of heart rate was found satisfactory. The proposed system is applicable for family, hospital, clinic, community medical treatment, sports healthcare and other medical purposes. Also, fit for the adults. 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: Microsystems, microcontroller, real-time, heart rate monitoring

1. INTRODUCTION

A heart rate monitor is a personal monitoring device which allows one to measure his or her heart rate in real time or record the heart rate for later study. It is largely used by performers of various types of physical exercise.Widely used in hospitals for checking the health of patient(s). Diagnosis of heart disease using ECG signals may be achieved by either correlating the pattern of the ECG signal with a typical healthy signal, characterizing the typical signal using basic logical decisions, or more complicated algorithms to process in depth the heart disease. The first approach requires complicated mathematical analysis to obtain the required diagnosis, while the second one involves only simple analysis in most cases. The system connected to the parallel port of a microcomputer is able to transmit the information or the collected data to the cardiologist by e-mail every end of the day. Further on, provision for storing a number of ECG signals assists the cardiologist to formulate his personal analysis and to be more confident of system performance.

More than 2 million people are at high risk of having heart attack. It would be helpful if there was a way for these people to monitor their heart. So we have a problem. That is the way our project focuses on how we can utilize this problem and find a solution.

2. BLOCK DIAGRAM OF MODEL

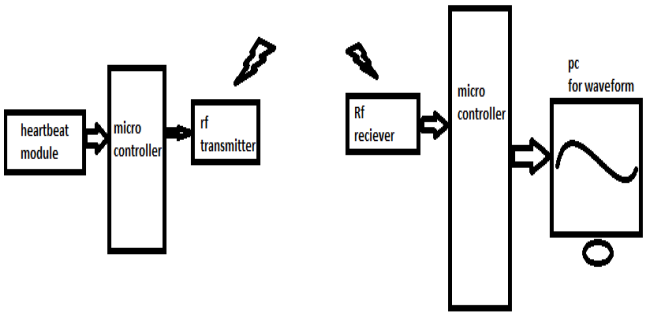


Fig.1 Block diagram

3. COMPONENTS IN OUR SYSTEM

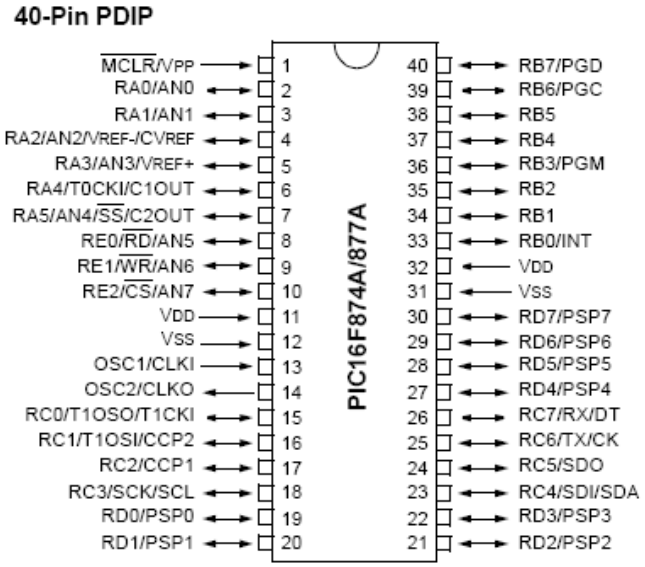
- MICROCONTROLLER PIC16F877A
- CRYSTAL OSCILLATOR
- 7805 VOLTAGE REGULATOR
- RESISTOR
- TRANSISTOR
- LM324
- CAPACITOR
- CONNECTORS
- BUZZER
- LED+LDR USED AS SENSORS
- RELAYS
- LCD 16X2(CAN BE LAPTOPS OR PC)

4. HARDWARE SYSTEM

The hardware design is based on an embedded system Implementation using the PIC16F877A microcontroller from microchip. The microcontroller working is taking the input signal and storing it and processing it by sampling the signal by smaller unit and sending the same to the java programming as an input.
The java program uses those sampling input and plot the graph on x-y axis by joining the sample points.

4.1. The Microcontroller

A Microchip microcontroller PIC16F877A is used to collect and process data and then stores it in a serial ROM. This microcontroller had been used before at the laboratory and gave good results. The PIC16F877A is an 8k instructions program ROM; 256 bytes data references ROM, 368 bytes of RAM, three timers. It has RISC architecture and can use oscillators for frequency up to 20 MHz Its power consumption is about 25 maws (at 4 MHz). The sampling rate of the system is 1 KHz which means 1000 simples were acquired in a second and then processed in order to detect zero crossings. The internal timer is used to emulate real-time clock.
In this case, the ECG Signal is processed, if six consecutive zero crossing were detected and separated by at least 40 ms (40 simples). Memory requirements are 1k of program memory for storing the system operation program, and 256 bytes of data EEPROM for storing up to 80 different heart diagnosis conditions. Only three bytes are required for each diagnosis (two bytes for the time and one byte for the heart condition). The number of samples of ECG signals stored depends on the available memory.



PIN Diagram

4.2. Sensors

Even if they are not called ECG-sensors, ECG-similar sensors exist. They use less number of measuring points on the body but they still give heart rate according to the same principles as ECG. The market leader is the Finnish company 'Polar Electro OY'. Their heart rate monitoring system consists of a belt Worn around the chest and a receiving unit.

4.3. Display

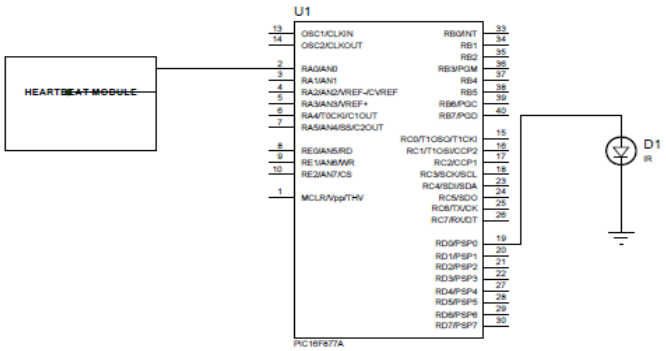
The heart beat graph is displayed on the computer screen on GUI developed by java program. This java application will be connecting all the sample points given by the micro controller as an input. The sample given will be the y-axis coordinate and x- coordinate will be increased accordingly. The simple java code will join all the sampling points and in the end the heart beat graph is plotted on the computer screen.

4.4. RF-Transmitter/Receiver

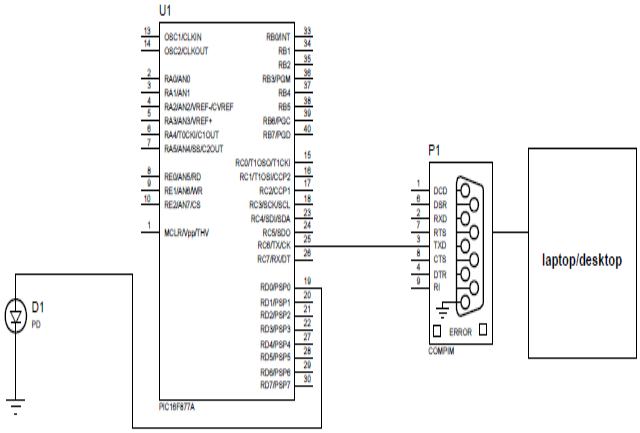
In this case, the radio frequency transmitter and receiver is used to established wireless connection between the input module (at the sender end) and the receiver module. The receiver module contains the micro-controller which will process the received signals.

5. CIRCUIT DIAGRAM

5.1. Transmitter End



5.2. Receiver End



6. SOFTWARE SYSTEM

The software is based on two parts design. One forgetting and processing signal which is implemented within the PIC16F877A. The other one is a Graphic Unit Interface easy to use by the patient. It is developed by using the Java language under Windows as operating system.

6.1. Microcontroller Software

In this case, the method consists of computing a cardiovascular rate of the person each minute. A pre-Processing step is needed to perform an amplification of the Signal and a hardware filtering to eliminate noise. The adult normal heart rate is in the range of 70 and 90 beats, while that of an infant is in the range of 100 and 170 beats per minute at rest [16]. If the heart rate counter is different from references then a LED indicator is lightened and an audio signal is generated. After a minute, the rate count is stored in the ROM, if it is different from the previous count. This is followed by an internal clock time which should be synchronized with real-time clock. Thus, at every sensitive variation of the pulse rate, three bytes would be stored. These bytes represent the rate count, the hour and the minute of the internal clock.

6.2. PC Software

The software consists of java code that will implement the logic of plotting the graph of the heart rate. An interface is generated that is user friendly and any one can use that interface for checking his/her heart beat graph.

7. FUTURE SCOPE AND CONCLUSION:

In future to this system can either introduce as Heart beat monitoring or heart beat scanning system. Even can connect the system with the database of the patient's records for archive purpose or for the future use. Hence the heart beat monitoring system provides good solution to the health problem. Our proposed system is designed in such a way that it overcomes the defects of previously available systems. User friendliness is given much importance in our system which makes it more comfortable to use than any other existing systems. Also it is built with open source hardware which makes it cheaper. Many additional features can be implemented within this system as counting of heart rate and working with that date for taking out some conclusions. This system can be used even in houses for daily check-up of heart rate condition as it is user friendly.

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