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RESEARCH ARTICLE

REDUCED INSTRUCTION SET COMPUTING TECHNOLOGY MICROCONTROLLER BASED PROACTIVE HEALTH MONITORING SYSTEM

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ABSTRACT

A Micro-controller-based physiological sensing unit has been designed, prototyped, and field-tested for recording galvanic skin response data and relaying them to a computer for physiological analysis. Focusing on system design issues concerning battery-driven ambulatory applications, this paper presents a special data compression algorithm based on relative encoding to optimize memory utilization and reduce data transfer time. Data flow coordination and timing control are enabled by a PIC micro-controller. The embedded block is connected with the computer through serial port and the patient reaches an abnormal condition, automatically an alert message will given to the doctor.

INTRODUCTION

The organization IEEE had published a paper in the early years of this millennium about a prototype model of recording galvanic skin response data and relaying those data with a microcontroller and sends the data to a PC and analyzes the data. Based on this idea we have endeavored to develop a prototype model which is also based on a microcontroller wherein we monitor a patient's health parameters like heart beat and body temperature and via a microcontroller based system we analyze the data.

Proposed System

In a case of a patient being in physically unsuitable condition (high pulse rate or too low pulse rate and similar cases with regard to body temperature), the critical situation will be at once notified to a few doctors in close vicinity so that the patient can be attended to without any fatal delay. This will help to improve the efficiency of doctors. The doctors are intimated about the critical situation of a patient by means of short message service(SMS).there will be a permanent mobile near the PC and that mobile will act on the coding directions of the PC(coding in VISUAL BASIC). It will send the notification to all concerned doctors on their own mobiles. In this way all patients can be attended to without delay.

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The first module of our paper consists of the patient interface. We place a heart beat sensor called pulse sensor and a temperature sensor LM35 on the patient's body. The sensors will continually read the values of heart beat and temperature. The next module consists of conversion of data from its inherent analog form to digitized form which can be processed by the microcontroller. We use comparator and ADC0809 for that purpose. We did our research and arrived at the conclusion that for consecutive data conversion the most appropriate technique is the successive approximation technique.

The various steps in the conversion were also engraine into us. The most pivotal part of our model, the microcontroller AT89S51 forms the next module of our prototype model. In order to satisfy all aims we set out to achieve through this project the microcontroller is the most essential cog in the system. We made a study about the features of this microcontroller and also of its advantages and arrived at the conclusion that it will suit our model perfectly. The microcontroller is coded using the language called EMBEDDED C. The embedded c is software which is used specifically for coding microcontrollers. The language combines features of C with the features of the microcontrollers so as to provide the widest range of services of the microcontroller. The PC which we use is coded in VISUAL BASIC. A stand alone mobile is connected using data cable to this PC.

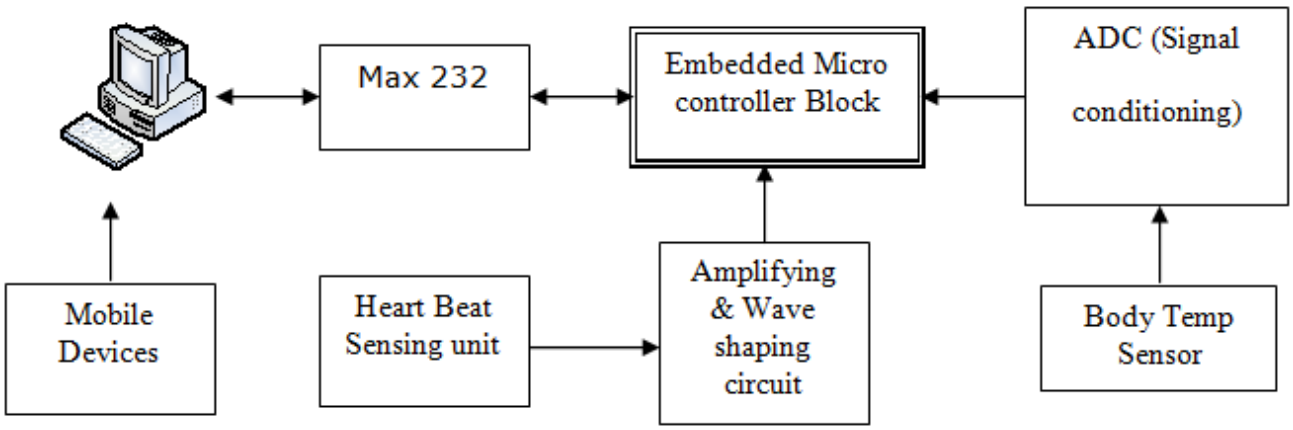


Fig 1. Block Diagram of Proactive Health Monitoring System

Fig. 2. Piezo Film Pulse Sensor

Fig. 3. Piezo film attached to the wrist with athletic tap

PULSE SENSORS

The purpose of the piezo film pulse sensor paper is to identify and build a reliable, low power, low cost blood flow sensor. The sensor is intended for two proposed designs for the ambulatory blood pressure monitor (ABPM). They are: (a) an oscillometric cuff design (as a Korotkoff sound sensor) and (b) the blood flow velocity design. The project includes the following deliverables:

- Selection of the piezo film sensing element(s).
- Design of a sensing circuit, including filtering and amplification stages.
- Layout and fabrication of a small, low noise circuit board.
- Bill of material
- Evaluation of the completed sensor system.
- Public invention disclosure and release.
- A written report.

Piezo Film Sensor Element

The piezo film sensor element selected for this paper was because (a) it is very sensitive to low level mechanical movements, (b) it has an electrostatic shield located on both sides of the element (to minimize 50/60 Hz AC line interference), (c) it is responsive to low frequency movements in the 0.7 - 12 Hz range of interest, (d) the foil size was about right (1 inch / 2.54 cm long) and (e) it has an integral connector and cable for simple connections. The sensor is shown in Figure 2.

Wrist Pulse Response

The piezo film was attached to the wrist with cloth athletic tape. The sensor was placed over the pulse point as shown in Figure 3. The adhesive on this tape is designed to be attached to the skin, and is breathable. It's a fairly weak adhesive which also allows the tape to be removed without damage to the piezo element. Figures 4 and 5 indicate the signal response from the filter/amplifier circuit when the sensor is placed over the wrist. Figure 4 is a single sweep waveform as obtained from an HP 54615B storage oscilloscope. Figure 5 uses the same configuration, except that the output signal is averaged over 64 waveform samples. The vertical and horizontal scales for the two waveforms are identical, with a horizontal sweep of 200 mS/div, and a voltage gain of 100 mV/div.

Waveform averaging is a well known noise reduction technique. It reinforces the waveform of interest by minimizing the effect of any random noise. These pulses were obtained when the arm was motionless. If the arm was moved while capturing the data the waveform did not look nearly as clean. That's because motion of the arm causes the sonic vibrations to enter the piezo film through the arm or by way of the cable. Mid-arm Response. The piezo sensor was moved from the wrist to the mid forearm area.

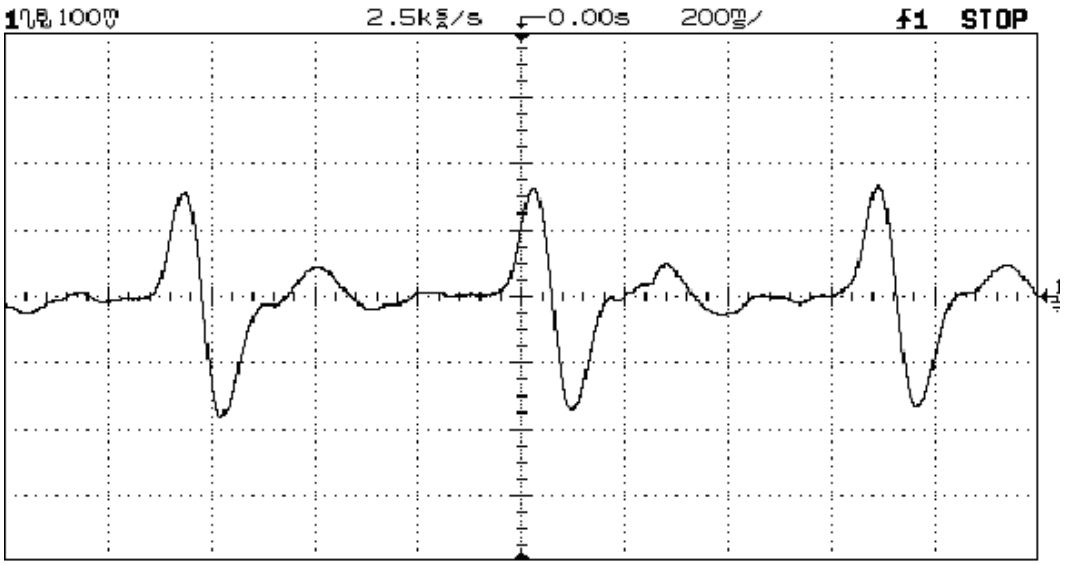


Fig. 4. Wrist pulse single sweep waveform

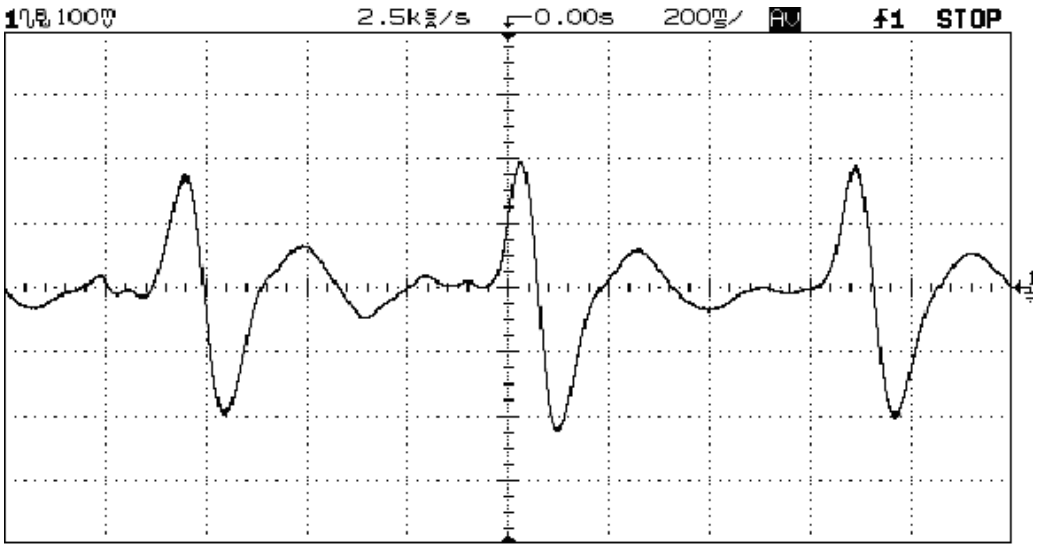


Fig. 5. wrist pulse waveform averaged over 64 samples

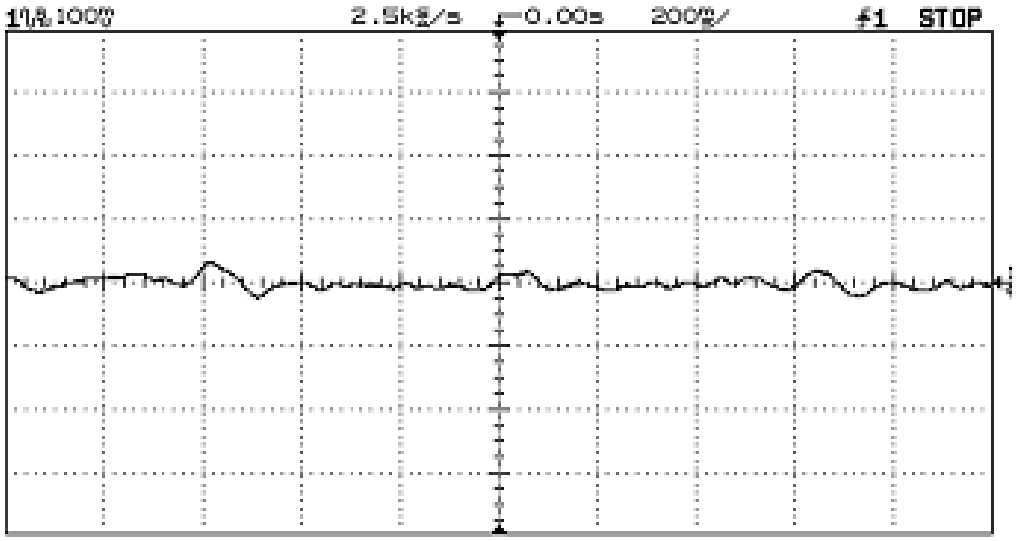
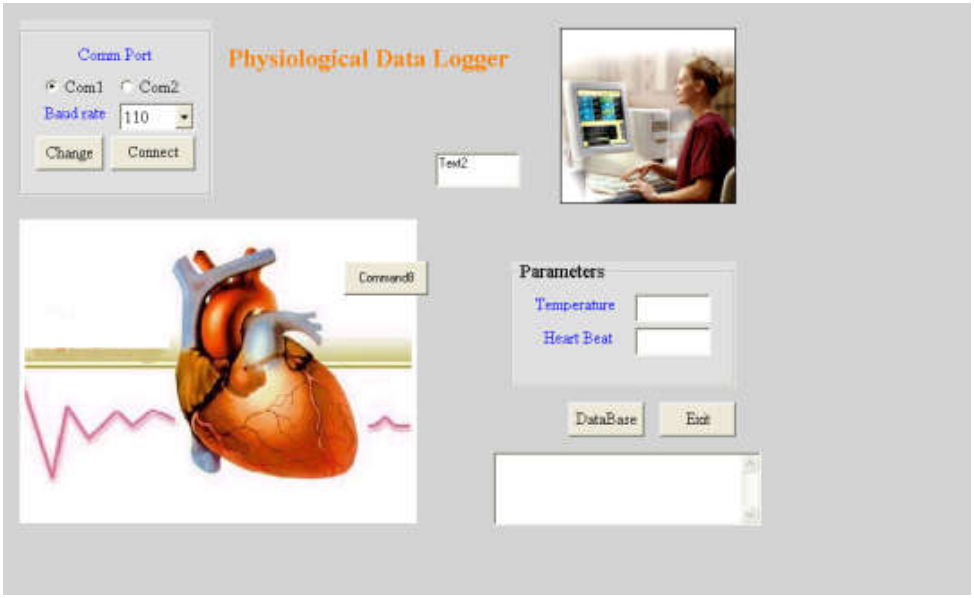


Figure 6. Mid forearm Response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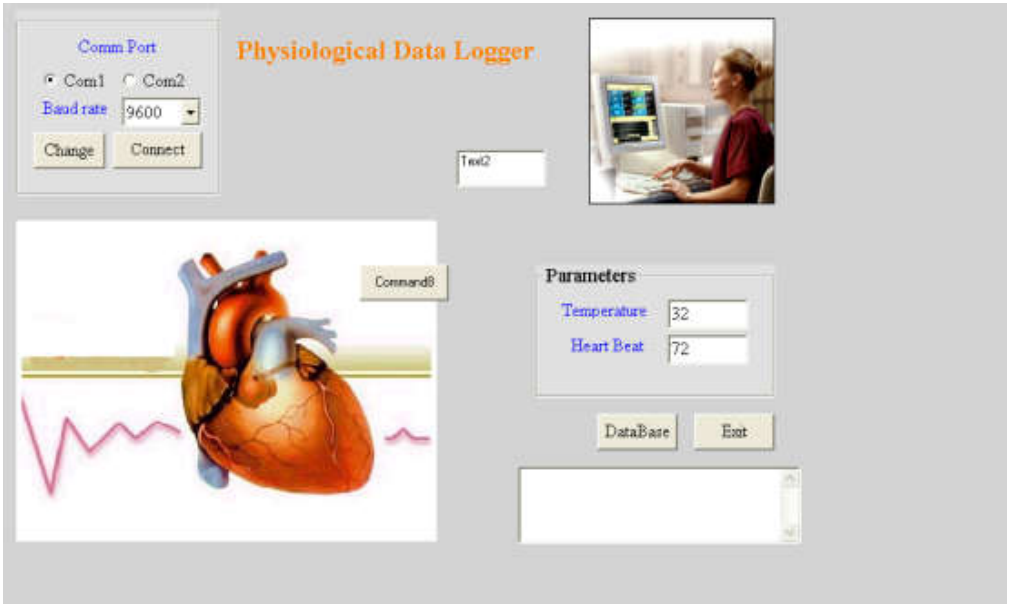
Com1
Com2
Baud rate
110
Change
Connect
Physiological Data Logger
Text2
Command0
Parameters
Temperature
Heart Beat
DataBase
Exit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Com2
Baud rate
9600
Change
Connect
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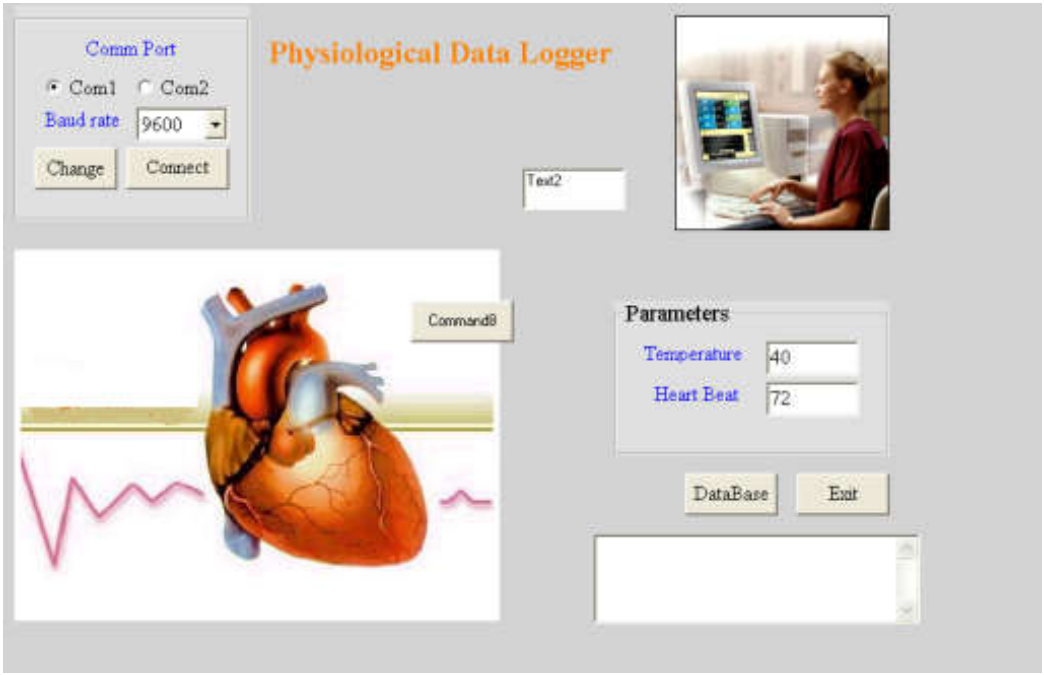
Text2
Command0
Parameters
Temperature
32
Heart Beat
72
DataBase
Exit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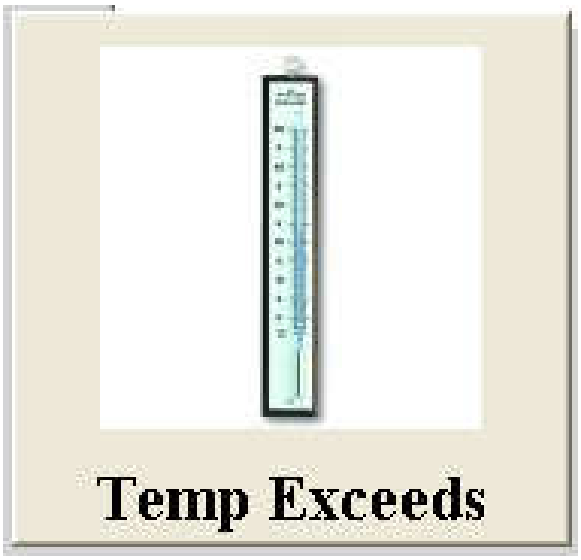
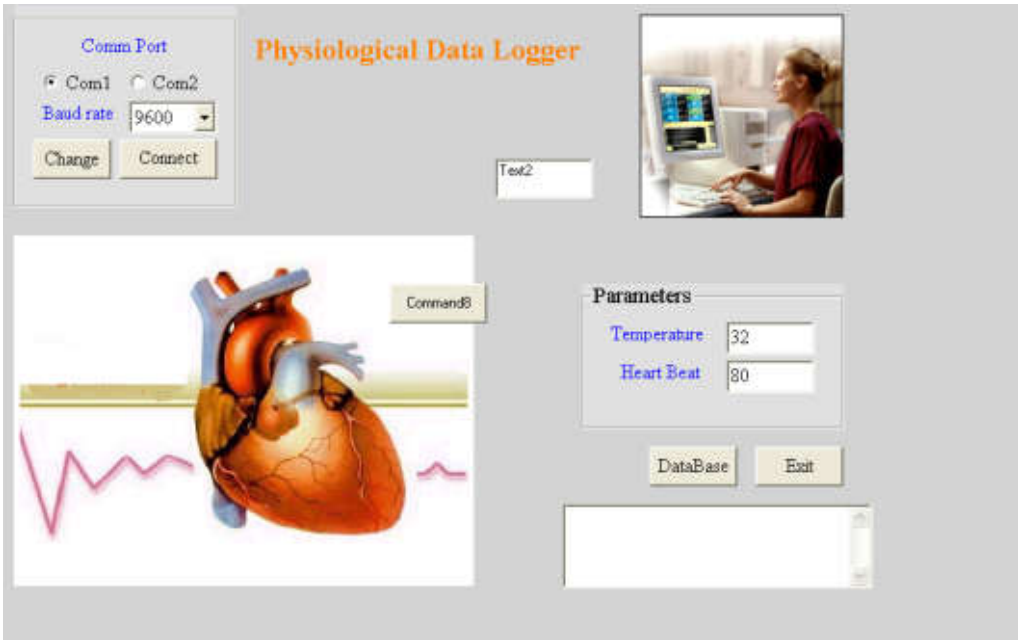
Com2
Baud rate
9600
Change
Connect
Physiological Data Logger
Text2
Command0
Parameters
Temperature
40
Heart Beat
72
DataBase
Exit


Temp Exceeds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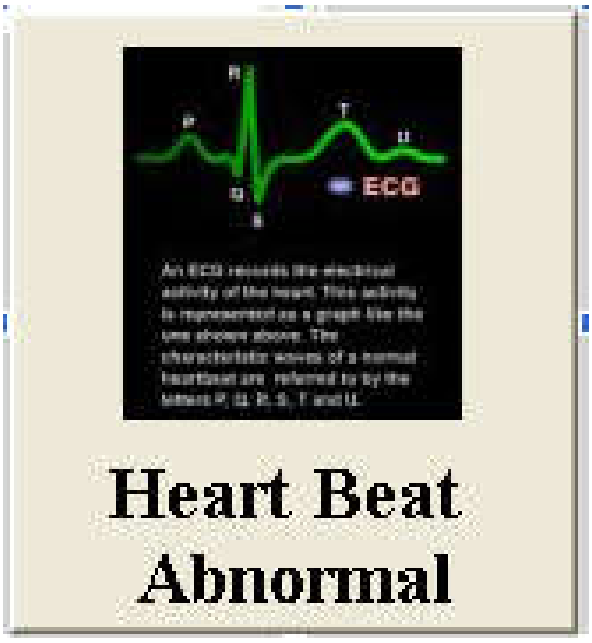
Com1
Com2
Baud rate
9600
Change
Connect
Physiological Data Logger
Text2
Command8
Parameters
Temperature
32
Heart Beat
80
DataBase
Exit


ECG
Heart Beat
Abnormal

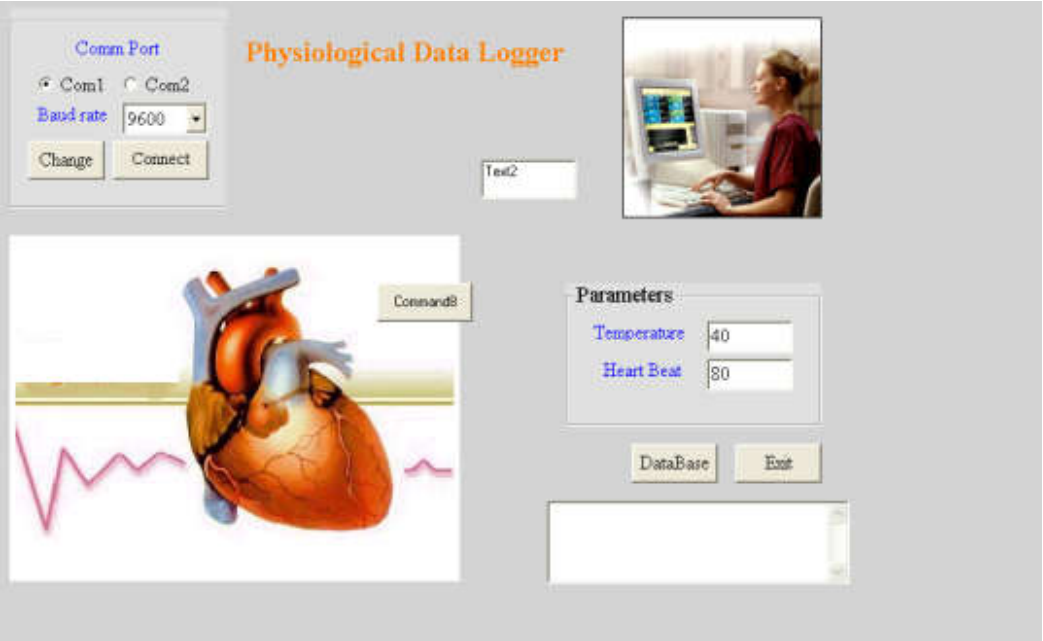


Fig 6. Output of Proactive Health Monitoring System

The response there was less dramatic as shown in Figure 6. In this case the piezo film is probably picking up the acoustic sound wave rather than any physical motion of the skin surface. This is an area that needs improvement because the acoustic sound waves are probably more valuable in the measurement system, because they permit simplified attachment to the skin.

EXPERIMENTAL RESULTS

Given Above is the screen visual when our monitoring system is switched on. We are connecting the mobile in the com port 1 or com port 2.The baud rate is set to 9600. The patient's temperature and pulse rate are being read**.** The next step is that the values are being read and they are displayed in digital format in the corresponding text boxes. As the values which have been read are normal values, no messages will be sent to any doctors. These values correspond to the preset normal and acceptable values set by the person who is in charge of programming the PC using visual basic. The next case is when the patient's temperature exceeds the accepted level. When the temperature reaches an abnormal level this message is displayed and simultaneously a message is sent to all doctors informing about the patient's irregularity. The next case is when the patient's heart-beat exceeds the accepted level. When the heart-beat reaches an abnormal level this message is displayed and simultaneously a message is sent to all doctors informing about the patient's irregularity. The next case is when the patient's heart-beat and temperature both exceed the accepted level at the same time. In this case all doctors are sent a message to their mobiles immediately so that there is no delay in attending to the patient is shown in fig 6. The model that we have designed is a very basic one. In time with more research there can be several advancements and improvements possible. Here is some advancement we think can be possible in near future. The system can be made wireless whereby the data from the patients can be sent via a wireless mode without the need for the sensors to be wired.

Also the message sent to doctors can be made wireless so that a standalone mobile may become redundant and can be disposed of. One more area which needs to be looked at is what happens if ten doctors rush at once to attend a patient. In that case if there is a system to link all relevant doctors mobiles so that they can signal each other as to which doctor is going to attend the patient then it will be less chaotic and even more systematic

Conclusion

The system that we have designed will help medical centers immensely. It will provide them immense value for very less expense. It will help them monitor all patients at all times and attend to each patient within seconds of an abnormality. It will help the nurses to take breaks since them being on the job 24x7 is now not necessary. All this at not high expense is a good bargain for them. The patient parameters are monitored automatically, and if there exists any critical situation it will automatically alert the nursing staff and also the doctor.

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