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Tele Monitoring System for Heart Rate Measurement

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Abstract

If a particular patient is suffering from heart disease then there is utmost need required for monitoring their health. There should be a better system that ease patient to monitor sharply and make the trace of abnormalities obtained. In this system the heart rate of the subject is measured from the finger and displayed on a text based LCD and GSM bases network is used to send information on mobile phone.

Keywords: *- Heart beat pulse, Finger pulse rate, GSM Module, Microcontroller*

1. Introduction

Heart rate measurement is one of the very necessary frameworks of the human cardiovascular system. The heart rate of healthy adult [1] at rest is around 72 beats per minute (bpm). The model developed here is useful in medical applications for monitoring of heart rate and it offers less cost and compact size than ECG (Electro Cardiogram). [3][4]. The heart rate rises gradually during hypertension activity [2] and for a normal person it returns slowly to the rest value, but in case of people with critical heart problem as well as for old people who are suffering with heart diseases the situation may not be the same. For such patients continuous monitoring is required which is sometimes not possible in the remote area where hospital is not available or when person is alone at home, or the patient location is far away from the hospital. In such cases this proposed model is useful to measure the heart rate of the person and the information is transmitted to the medical consultive for the preparatory precautions so that patient can be under control, prevented from serious situation before reaching to the hospital .

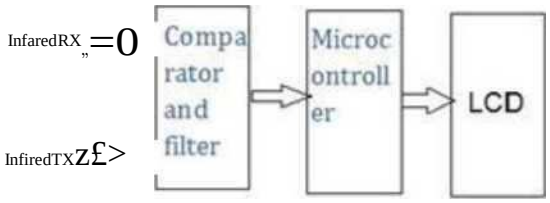

Figure 1. Block diagram of the measuring device

One critical inference drawn from epidemiological data is that deployment of assets for early revelation and therapy of heart disease has a higher based care potential of reducing fatality correlated with heart disorder than enhanced care after hospitalization. Hence new

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strategies are needed in order to cut down time before any remedy. Observing patients is one possible solution. Also, the trend towards an independent personalized non-hospital based care this model measures heartbeat of patient and uses GSM technology for transferring information that can be used in hospitals and also for patients who need to be under continues monitoring whiletraveling from places to places. Since the system is continuously monitoring the patient and in case of any abnormality in the pulse rate of the patient, the arrangement will instantly send a text message to the concerned doctors and relatives about the condition of the patient and about the abnormal details of heart rate. To perform these operations the system handles heart beat sensor, GSM modem, and to handle these equipments the heart of the system microcontroller (ATMEGA328P) is used. Figure 1 as shown is the block diagram of the proposed device. In the development stage the design is only focused with one critical parameters ie. Heart rate but other parameters such as body temperature, blood pressure etc. can be added in proposed design [5].

The test can be performed on a person during his activities which includes their walking,

Running and rest time. While the person is running the heart beat gradually increases above the normal value i.e., 82 and above and after running if the value comes to rest within 2 to 3 minutes the person is normal and healthy[8].

The same test is performed on the other person and if the heartbeat during his rest time does

not comes below 82, the test is again performed till 5 non-repeating values and if the value is continuously rises above threshold value which is above 82 then the message is sent automatically to the doctor’s mobile about the critical condition of patient.

2. Proposed model

The device consists of an infrared transmitter LED and an infrared sensor photo-transistor. The LED emits infrared light to the index finger of the subject whose heartbeat is being measured. The photo-transistor detects this light beam and measures the change in blood volume through the finger artery.

The transmitter-sensor pair is clipped on one of the fingers of the subject (see Figure 2). The calculated heart rate is displayed on an LCD in beats-per-minute in the following format:

Heart Rate = yyybpm
Where yyy is an integer between 1 and 999

Figure 2. Infrared transmitter and received sensor pair clipped to the finger

The second part of the figure 1 shows the comparator and filter. Heartbeat in this system is sensed by heartbeat sensor and a comparator produces an amplified square wave output by comparing the values given by the sensor .The comparator output is given to the filter.

Filters are used in electronic systems to emphasize in certain frequency ranges and rejectssignal in other frequency ranges. Therefore, the low pass filter is proposed to filter low frequency signals in this circuit design from the PPG (Photoplethysmogram) signal to cut off frequency of 0.18Hz and thus high frequency noise also get filtered. The values after being amplified and filtered is pass through a microcontroller which is ATMEGA8 microcontroller. [7] A microchip is used to collect and process the data and then stores it in a 32KB ISP flash memory. It is a modified Harvard architecture 8 bit RISC single chip microcontroller. The two stage amplifier/filter feed satisfactory gain to hike the faint signal which is 3-4 mV and coming from the IR sensor unit, and convert it into a pulse.

The pulse signal of heart extract from finger is fed to the port PD-4 which is pin number 4 of ATmega8 microcontroller. The counter of microcontroller is used to measure the pulse rate per minute. [6] This pulse is counted by the microcontroller. Microcontroller initiates command for the LCD display. LCD is initialized by using command cmd lcd ( ).On LCD message is displayed as “CHECK HEARTBEAT”.

After pressing the reset switch the heart beat calculation takes place. Heartbeat sensor gets the count of 15 second and converts it beat per minute (bpm).Thus the value is displayed on LCD.

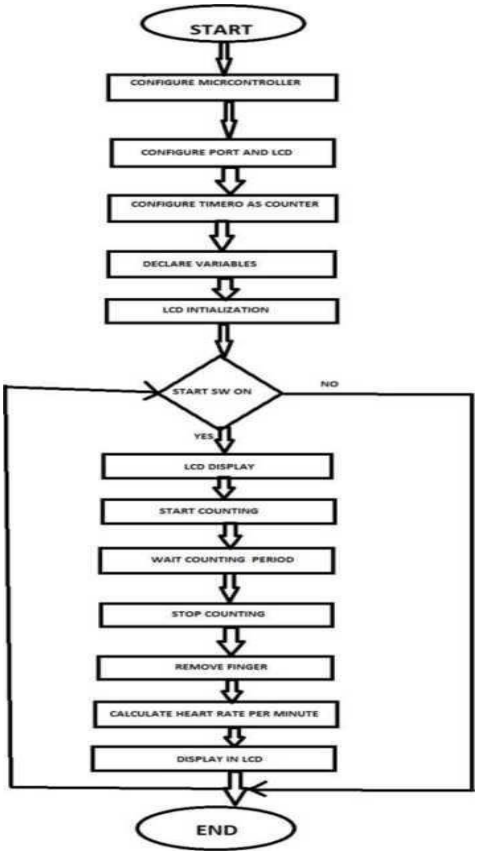

Figure 3. Flow chart

The GSM module has a slot where the SIM (Subscriber identity module) is inserted .This module is used to establish communication between the mobile and the GSM system. It is used to send SMS to the mobile wirelessly to give data about a patient. It also has an IMEI (International mobile equipment identity) which is similar to mobile phones for its recognition GSM has a small size, light weight[9] with very small energy consumption.MAX232 is connected to GSM module for the serial data communication. Figure 3 show the GSM module.

Figure 4. Proposed device system

Minutes and their heartbeat rate were subsequently measured. The readings of the device were correlated in opposition to the standard measurement. The standard measuring data were taken by counting the pulse from the wrist. Overall, the results are in an acceptable agreement with the actual readings.

Table 1 shows the ten subject's heart rate with the both approaches. Now another analysis was performed with two subjects (presented in Table 2) where two person including one male and one female was participated.

3. PCB layout of proposed system

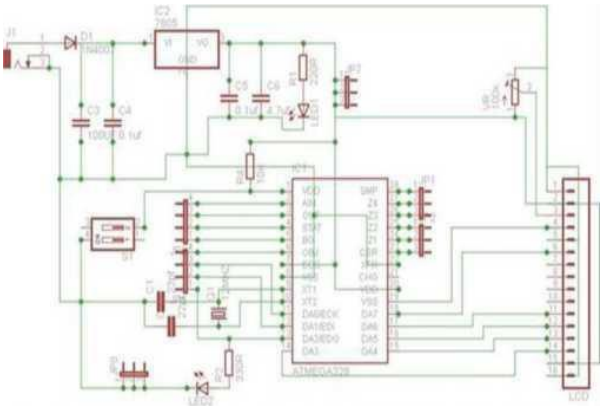

Figure 5. PCB Layout of system

4. Result

Analogue signals of heart rate obtained by the sensor through index finger and input to pin number 4 or port 4 of the microcontroller. The system was used to measure the pulse rate of a countable number of male and female participants. The results of the developed system correlated in contrast to prevailing calibrating techniques. These outputs show acceptable range compare to standard measurement methods. Another experiment was conducted where we measured the pulse rate of two male volunteers at rest. The volunteers then performed some exercise (jogging) for five.

Table 1. Results of measurement of people heart rate per minute

SUBJECT	GENDER	AGE	\HEART BEATBY DEVELOPED SYSTEM	HEARTBEAT MEASURED MANUALLY	ERROR %
SUBJECT1	MALE	20	77	77	0%
SUBJECT2	MALE	22	89	86	3.33%
SUBJECT3	MALE	32	101	103	2%
SUBJECT4	FEMALE	20	74	72	1.47%
SUBJECT5	FEMALE	22	85	86	1.19%
SUBJECT6	FEMALE	40	103	102	0.96%

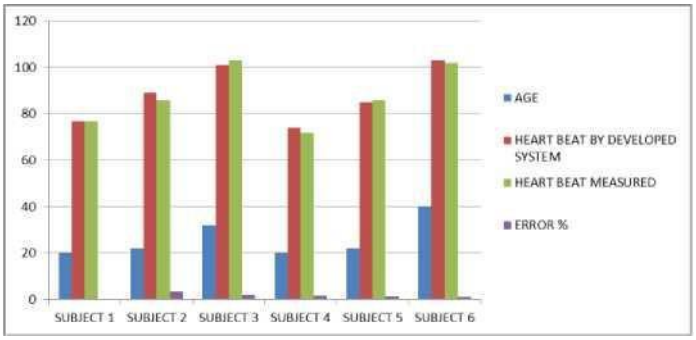

Figure 6. Graphical presentation of table 1

Table 2. Results of measurement of people heart rate per minute

	EXERCISE	80	6MINUTESLATER
		75	8MINUTESLATER
	AT REST	76	
FEMALE		99	AFTER RUNNING

	AFTER EXERCISE	92	2MINUTESLATER
		85	4MINUTESLATER
		80	6MINUTESLATER
		74	8MINUTESLATER

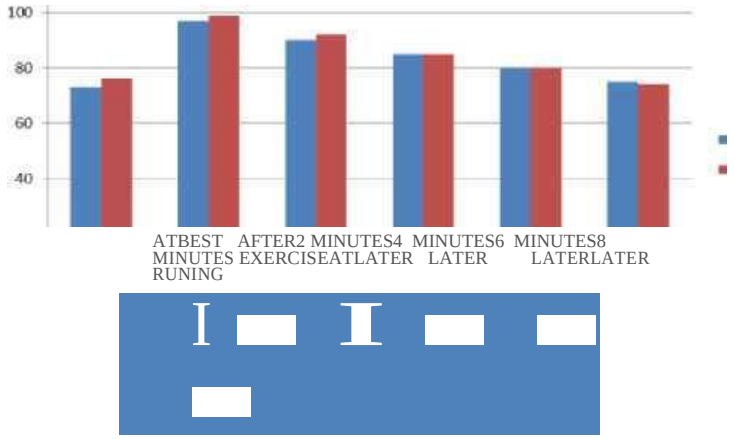

Figure 7. Graphical presentation of table 2

5. Conclusion and future Scope

The design and development of a microcontroller-based real-time processing heart rate counting system [10] has been presented here. The device is movable, stable, adaptable, undeviating and cost effective. Also, it is efficient, easily valuable inputs and can be simply used by the end user. Analytical results have shown acceptable range with actual heartbeat rates. Finally, this hand held system has proven to be an excellent heart rate counting system for the end user. However it can be enhanced further by adding some more critical parameters such as blood pressure, body temperature etc. that will help to record and sample display the heart rate, blood pressure, temperature etc easily on a display system. Serial result can be linked to the device so that the heart or pulse rates can be sent for further online and offline analysis.

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