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Implementation of Heart Rate Measurement Device using Wireless System

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***Abstract*—** This paper describes an approach to design a cheap, accurate and reliable device which can easily measure the heart rate of a human body. In this project heart rate signal can be found using the fingertip sensor .After getting the signal, it is amplified, because the signal amplitude is very low. This is done using amplifier circuit. Then the amplified signal is counted by the counter using microcontroller. Finally, the signal is transmitted by the RF transmitter. After transmitting the heart beat signal, it is received by the RF receiver. Then this signal will be displayed on 16 X 2 LCD.

Keywords- *Pulse sensor, microcontroller, RF module.*

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I. INTRODUCTION

Heart rate indicates the soundness of our heart and helps assessing the condition of cardiovascular system. In clinical environment, heart rate is measured under controlled conditions like blood measurement, heart voice measurement, and Electrocardiogram (ECG) but it can be measured in home environment also. Our heart pounds to pump oxygen-rich blood to our muscles and to carry cell waste products away from our muscles. The more we use our muscles, the harder our heart works to perform these tasks- means our heart must beat faster to deliver more blood.

The design of a very cheap device which measures the heart rate of subject by keeping the fingertip on fingertip sensor and then text based LCD displays the result on itself is described by this paper. The device has the benefit that it is microcontroller based and thus can be programmed to display various quantities, such as the average, maximum and minimum rates over a period of time and so on. Another advantage of such a design is that it can be expanded and can easily be connected to a recording device or a PC to collect and analyses the data for over a period of time.

II. BLOCK DIAGRAM

Heart rate signal is found using a fingertip sensor. After getting the signal, it is amplified, because the signal amplitude is very low. This is done using amplifier circuit. Then the amplified signal is counted using microcontroller. Finally, the signal is transmitted by the RF transmitter. Figure 1 shows the block diagram of heart rate measurement device.

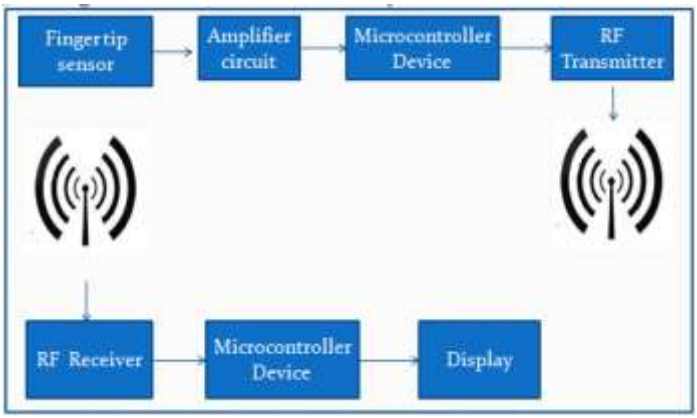

Figure 1: Block diagram of Heart rate measurement System

After transmitting the heart beat signal, it is received by the RF receiver. This signal will be displayed on 16X2 LCD.

III. CIRCUIT DESIGN

The heart rate measurement circuit is having two parts. Those are the transmitting circuit and receiving circuit.

A. Transmitting Part

In Fig 2 you can see at the top of the circuit there is power supply circuit. Generally we use adapter is of 9V or 12V here we are using 12V adaptor for the supply. Since IC runs at 5V power supply. Hence first of all we have to convert 12V into 5V. In the circuit of the power supply you can see there is 7805 regulator IC which is 3Pin IC. And the pins are input, ground and output. There are two capacitor on input, ground

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and output. There are two capacitor on input and output side of power supply which is of 1000µf and 470µf respectively. These are the filtering capacitors 5V supply is used on whole kit.

Pulse sensor is connected to one of the pin of microcontroller the signal obtained from the sensor is weak which is amplified using amplifier. Obtained signal is counted using counter RF transmitter consists of encoder IC. There is a crystal of 8MHz. Crystal is called heart of the controller. The counted signal is transmitted using RF transmitter.

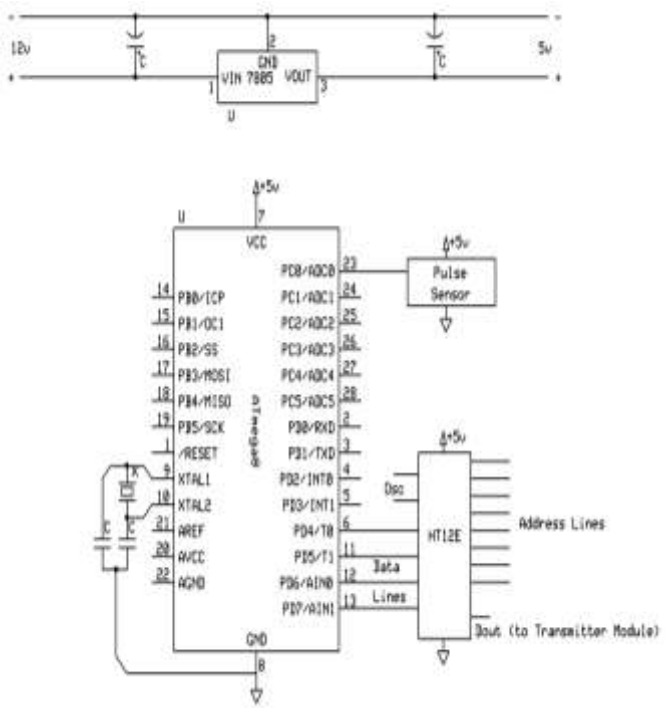

Figure 2: Schematic of heart rate measurement and transmitting circuit

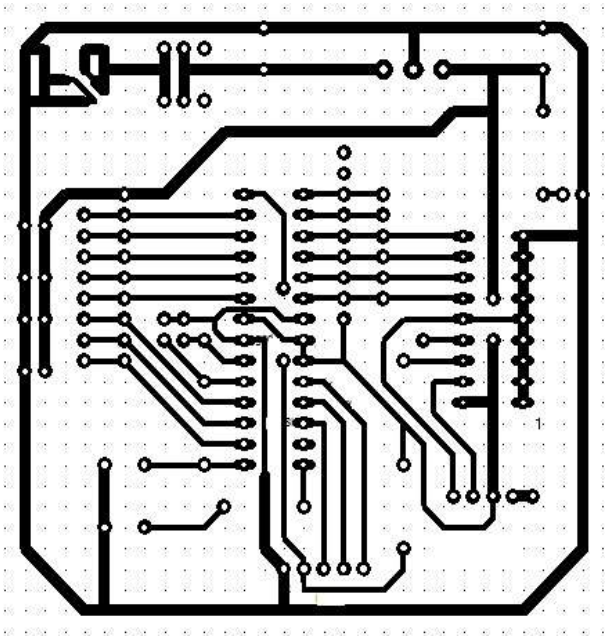

Figure 3: PCB layout (Transmitting Circuit)

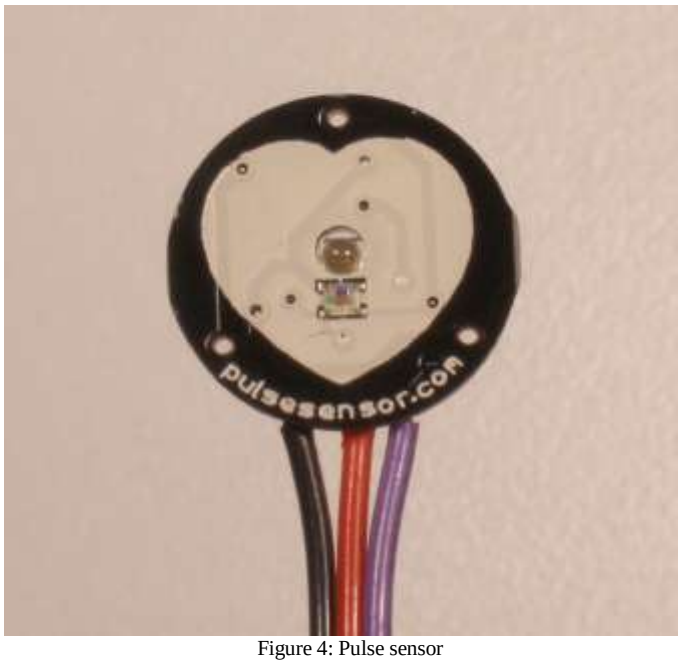

Figure 4: Pulse sensor

Consider figure 4, The Heart logo is on the front side of the sensor. contact with the skin is made by front side. On the front you see a small round hole, which is where the LED shines through from the back, and there is also a little square just under the LED. The square is an ambient light sensor, exactly like the one used in cell phones, tablets, and laptops, to adjust the screen brightness in different light conditions. The LED shines light into the fingertip or earlobe, or other capillary tissue, and sensor reads the light that bounces back. The back of the sensor is where the rest of the parts are mounted. We put them there so they would not get in the way of the of the sensor on the front. Even the LED we are using is a reverse mount LED.

The cable is a 24" flat color coded ribbon cable with 3 male header connectors.
RED wire = +3V to +5V, BLACK wire = GND
PURPLE wire = Signal..

B. Receiving Part

In Fig 5 you can see at the top of the circuit there is power supply circuit generally we use adapter is of 9V or 12V here we are using 12V adaptor for the supply similar to the transmitter circuit. HT12D IC is used on the RF receiver side. The communication is possible if and only if data sent by the transmitted is same as the data received by the receiver. If data is same then communication process will be continued. The signal received is displayed on LCD which is interfaced with microcontroller.

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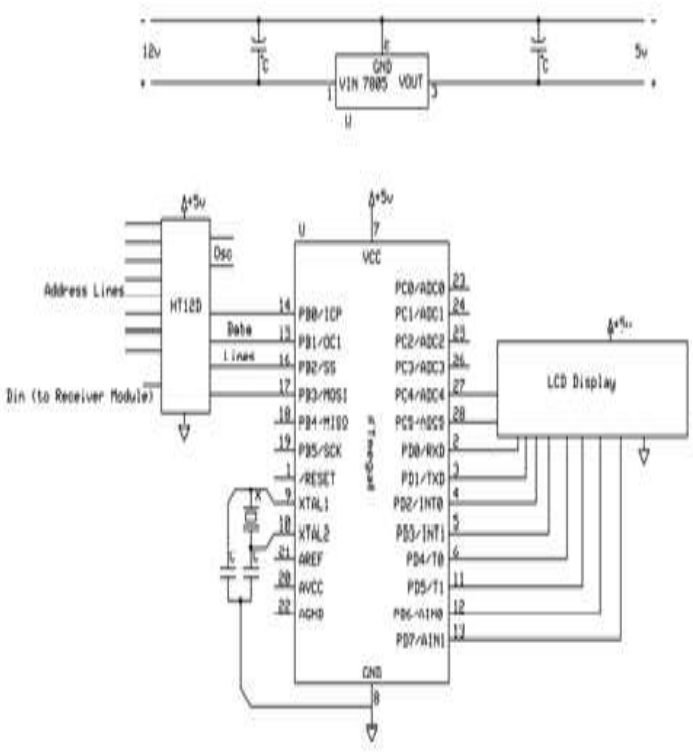

Figure 5: Schematic of the signal receiving circuit

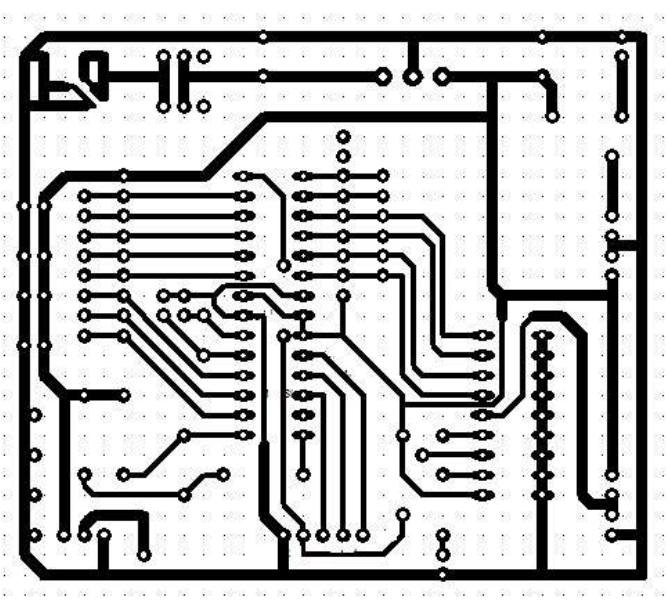

Figure 6: PCB layout (Receiving Circuit)

IV. HARDWARE IMPLEMENTATION OF HEART RATE MEASUREMENT SYSTEM

Printed Circuit Board (PCB) fabricates the microcontroller based wireless heart bit rate measurement device.

By using the fingertip sensor the heart rate signal can be found. Amplifier is used to amplify the signal amplitude since signal amplitude is very low. Then the amplified signal is counted by the counter using microcontroller. Finally, the signal is transmitted by the RF transmitter. The steps taken for measuring the heart beat and transmitting the data using the RF transmitter:

1. Device powered up and waited for 3 seconds so that in the meantime Display unit also turned on and showed blinking message in LED
2. Controller will start measuring the beats continuously
3. After one minute controller stops measuring and will be having the pulse rate.
4. Controller then checks whether the second person's button is pressed or not.
5. If pressed then controller sends pulse count and '2' using RF.
6. This same data is received by the receiver side and is displayed on LCD.
7. If button is not pressed controller sends the pulse count and '1' to the receiver side.
8. After sending data controller restarts counting the new pulse rate.

A. Hardware design of transmitting Part

Consider the figure 7; Power supply is obtained by on-off switch above the microcontroller.

The users are having push to on switches. The microcontroller we are using is on the left side of the PCB. In this PCB it is ATMEGA8. Transmitter and antenna are on the left side.

Figure 7: Hardware implementation of heart rate measurement device (Transmitting part)

B. Hardware design of receiving Part

Another ATMEGA8 microcontroller is used on the left side of PCB.LCD where the output result will be shown is in the below of figure .

Figure 8: Hardware implementation of heart rate measurement device (Receiving part)

The Heart Rate Measurement Device Using Wireless System is the part of Patient Monitoring System, can be extended to measure other parameters of patient like temperature etc.

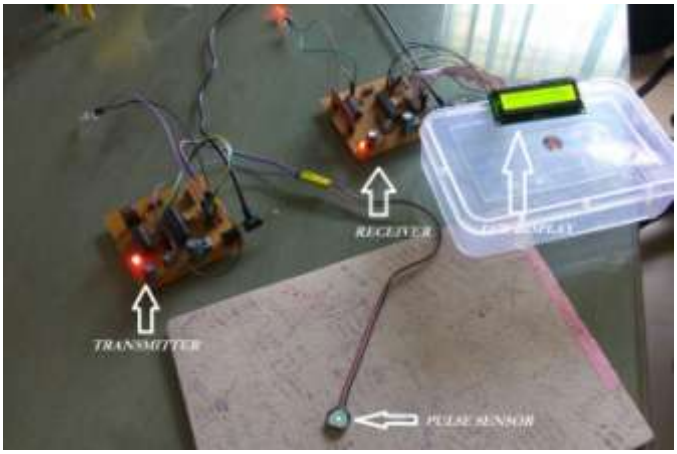

Fig: 9 Heart Rate Measurement Devices

In above Fig 9 there is a pulse sensor. The pulse sensor is based on the principle of photo phlethysmography. It measures the changes in volume of blood through any organ of the body which causes a change in the light intensity through that organ (a vascular region).In case of applications where heart pulse rate is to be monitored, the timing of the pulses is more important. The flow of blood volume is decided by the rate of the heart pulses and since light is absorbed by blood, the signal pulses are equivalent to heart beat pulses. The front of the sensor is the pretty side with the Heart logo. This is the side that makes contact with the skin. On the front you see a small round hole, which is where the LED shines through from the back, and there is also a little square just under the LED. The square is an ambient light sensor, exactly like the one used in cellphones, tablets, and laptops, to adjust the screen brightness in different light conditions. The LED shines light into the fingertip or earlobe, or other capillary tissue, and sensor reads the light that bounces back. The signal obtained through pulse sensor is heart rate signal.

Person keeps his fingertip on the pulse sensor for 1 minute and the data obtained in 1minute is split into 3 digits and transmitted by the RF transmitter and received by the receiver. The received data is the heart rate of the person which is displayed on LCD display. On receiving the readings and current status of patient, the doctor can take necessary actions or suggest his sub-ordinates for the same.

Fig:10 Measured heart rate of person 1 & 2

The above figure shows the heart rate of the 1st person & 2nd person simultaneously. For adults 18 and older, a normal resting heart rate is between 60 and 100 beats per minute (bpm), depending on the person's physical condition and age. For children ages 6 to 15, the normal resting heart rate is between 70 and 100 bpm, according to the AHA (American Heart Association).

V. CONCLUSION

This microcontroller based heart beat monitoring system is portable device. This type of technology can be used by doctor from any remote place like villages. Any non professional educated person can also operate this type of device. So the heart rate device which is being designed is cheap in terms of cost also easier to understand.

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