MICROCONTROLLER BASED HEART RATE MONITORING SYSTEM

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ABSTRACT

Aim of our work is to monitor the human heart rate of the patient. For a patient who is already diagnosed with fatal heart disease, their heart rate condition has to be monitored continuously. This paper proposed an alert system that is able to monitor the heart beat rate condition of patients. The heart beat rate is detected using photoplethysmograph (PPG) technique. This signal is processed using an ATMEL 89S52 microcontroller to determine the heart beat rate per minute. A desired amount of sensor value is set and if it is exceeded preliminary steps should be taken by the indicated LCD monitor. The HEARTBEAT sensor information will be transmitted from the patient unit to the main controller unit with the help of a data communication system which is connected with the microcontrollers in the both units. Thus, doctors can monitor and diagnose the patient's condition continuously and could suggest earlier precaution for the patients themselves. This will also alert the family members to quickly attend the patient. The design method is developed in Embedded C and simulate in KEIL and implemented on Microcontroller ATMEL 89S52.

***Keywords*:** Heart beat sensor, AT89s52 microcontroller, LCD (16*2), LM358, IR sensor (Photo diode & receiver), Crystal (11.0592 MHz)

INTRODUCTION

Health is one of the global challenges for humanity. According to the constitutions of the World Health Organization (WHO) the highest attainable standard of health is a fundamental right for an individual. Healthy individuals also reduce pressure on the already overwhelmed hospitals, clinics, and medical professionals and reduce workload on the public safety networks, charities, and governmental (or non-governmental) organizations. To keep individuals healthy an effective and readily accessible modern healthcare system is a prerequisite. A modernized healthcare system should provide better healthcare services to people at any time and from anywhere in an economic and patient friendly manner.

The heart rate monitor is a personal monitoring device that allows one to measure his or her heart rate in real time or record the heart rate for later study. It's largely used by performers of various types of physical exercise. It's widely used in hospitals for checking the health of

patients. These monitors are very useful in realizing the health conditions of the person according to the age group. The following table shows the average heart rate of the people from different age groups.

AGE	AVERAGE HEART RATE
Newborn	140
7-years	85-90
14-years	80-85
Adult	70-80

There is no doubt about the usefulness of a heart rate monitor. Every time someone visits a doctor, one of the first things the doctor checks is the patient's heart rate or say pulse rate. In medical terms the heart rate of the patient is useful in determining many of his /her medical conditions.

There are many heart rate monitoring systems already present. But our monitoring system has certain advantages over the already present systems. The stethoscope which is the most basic device used by doctors is not very accurate. Another way is to use an electrocardiogram, but it is supposed to be very costly and not user friendly. The heart rate monitor that we have setup does not need any expert advice, since it directly shows the value of heart rate on LCD. Also, it is portable, so can be carried along to places that one travels to. Its cost effectiveness is also an advantage.

WORKING

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. Let us have a look at the application of photoplethysmography in heart rate monitoring from the fingertip. When the heart expands (diastole) the volume of blood inside the fingertip increases and when the heart contracts (systole) the volume of blood inside the fingertip decreases. The resultant pulsing of blood volume inside the fingertip 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 is placed in close contact with the fingertip. When the heart beats, the volume of blood cells under the sensor increases and this reflects more IR waves to the 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 suitable electronic circuits to obtain a visible indication.

The system majorly consists of three components like heart rate sensor circuit, let us see the brief explanation of circuitry (Ch Subudhi and Sivanandam, 2014).

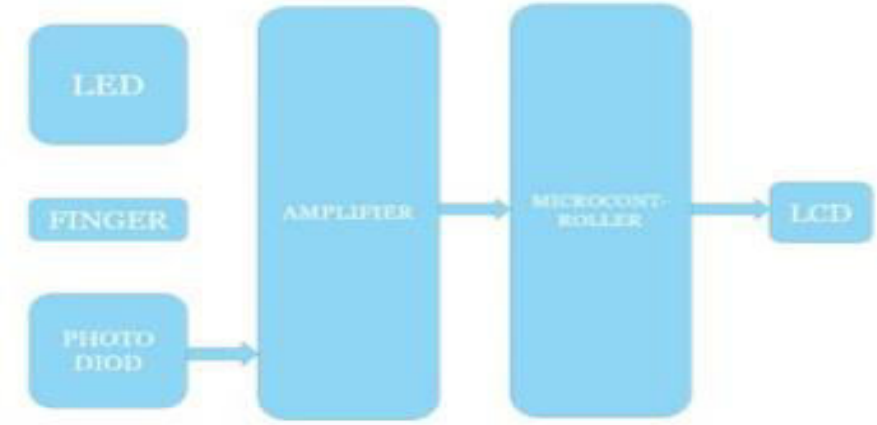

Fig.1 Block diagram

HEART BEAT SENSOR: The Heart Beat signal is obtained by LED & photodiode combination. Pulses form hands interrupt the light reaching the Photodiode and this signal is read by microcontroller, a logical zero is represented by a pulse in the first half of the bit.

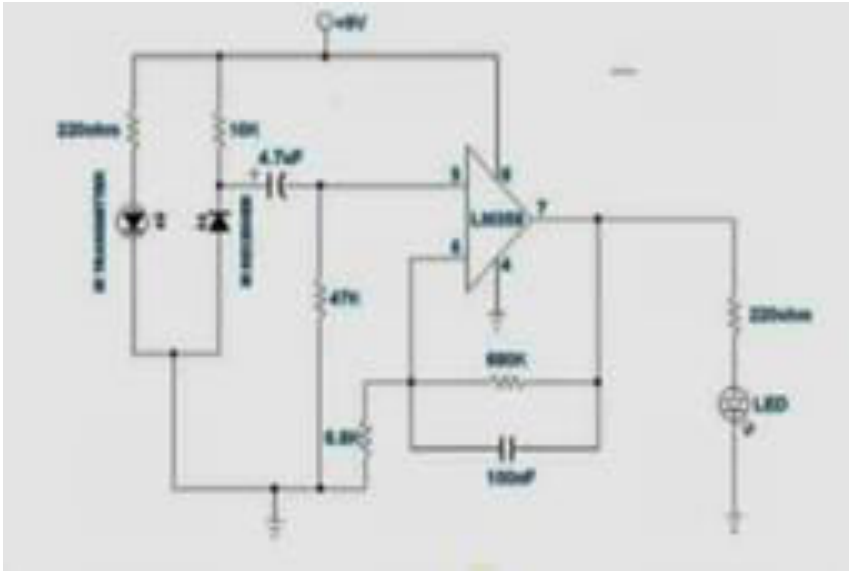

Fig. 2 Heart beat sensor

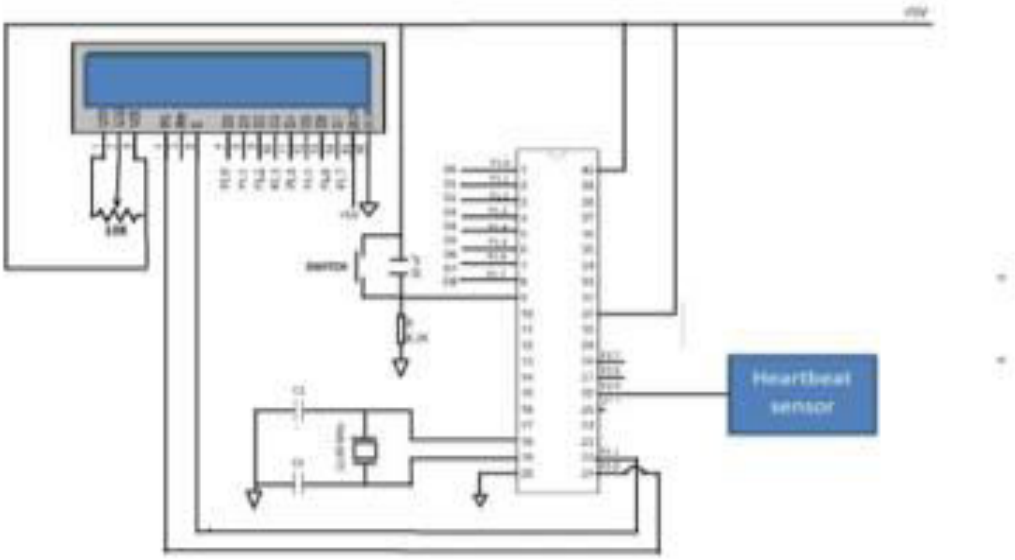

Fig. 3 Circuit diagram

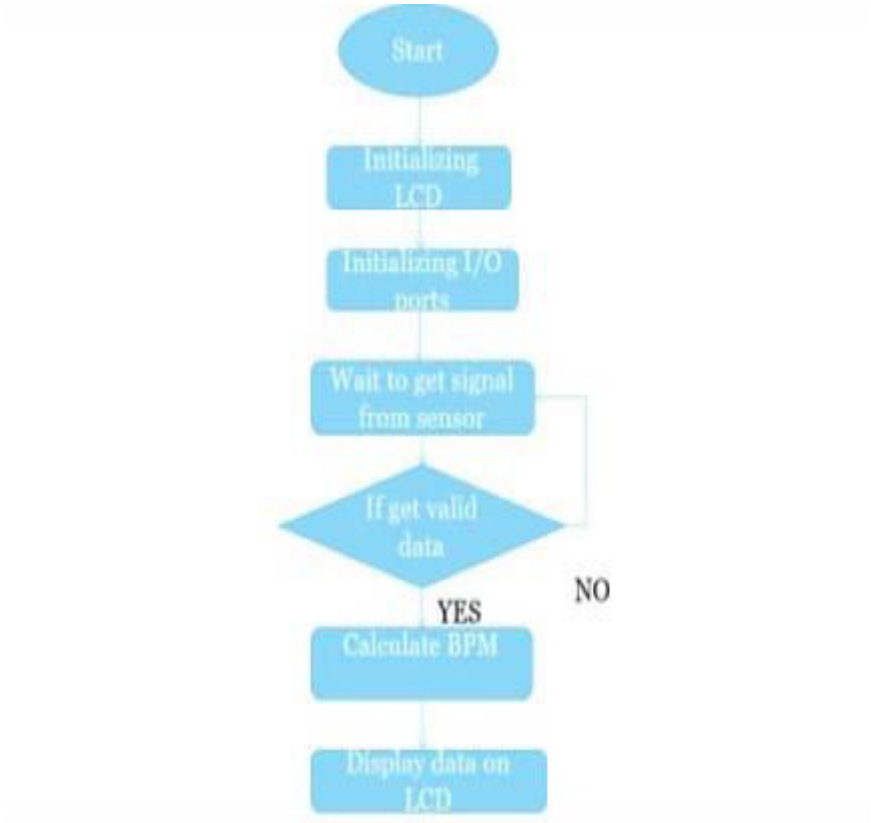

Fig. 4 Flow chart

Heartbeat is measured with the help of fingertip sensor which consists of an infra-red (IR) light emitting diode transmitter and an IR photo detecting receiver. The IR light passes through the tissues and variations in the volume of blood within the finger determine the amount of light that is incident on the IR detector.

The signal produced from photodiodes is very weak and small which is required to be increased in magnitude. This signal is so weak that it cannot be detected by the microcontroller directly. Thus, the signal is amplified using an operational amplifier. The operational amplifier used for this purpose is LM358.

Finally, a red LED is placed at the output of the amplifier stage to show that the device is working for the measurement of heartbeat. The output is connected to a microcontroller that by using the program shows output on LCD (Sali *et al.*, 2016; Parihar, *et al.*, 2017).

CONCLUSION

We introduce the Heartbeat sensor in the embedded C programming to access LM358 & IR sensors. It communicates with ATMEL 89S52. We proposed & experimentally demonstrate the heart rate monitor. The instrument has simple structure, stable and reliable operation, high Accuracy, low power consumption, good portability, full featured function, and extensive application occasion. It can be easily used by patients and keep the patient's moment intact because it is miniature and portable. In future this can be implemented with multiple sensors & communication systems to build it as a wireless health monitoring system.

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