Development of Low Cost Heart Beat Monitoring Device using Arduino uno.

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ABSTRACT— the aim of this project is to develop a low cost heart beat monitoring device. The system consists of three main parts: 1) the optical sensor: consisting of the optical transmitter and receiver for emitting the light and receiving it; 2) the Arduino Uno section: which receives and processes the signal to display the heart rate and will be obtained by measuring the time between signal peaks and then calculating the frequency of the peaks in units of beats per minute. 3) The LCD section which show the reading of heart beat and the implementation of the heart monitor.

KEYWORDS – LCD, Optical Sensor, Low Cost, Heart Beat

INTRODUCTION

Heart beat rate measurement could show the condition of the heart. Heart rate is varying according to age, person physical and activity condition. Human heart rate of healthy adult is around 60 to 100 beats per minute (BPM). While for an athlete, his/her heart rate is slower than an active adult, for baby is on the other hand, the heart rate is higher which is around 120 to 160 BPM and for children's heart rate is around 75 to 110 BPM. Abnormal heart rate such as lower heart rate than the normal rate is called bradycardia whereas for a higher heart rate, which is higher than the normal, is called tachycardia. The traditional method of heart rate is measurable by putting finger above pulse artery and count pulse rate within 30 second and heart rate (BPM) can be found with multiplying with 2. This way is easy but inaccurate especially when artery pulse state in high rate. The most accurate method to measure heart rate is by using electrocardiogram machine (ECG) but this equipment is expensive and not affordable by individuals

HEART BEAT RATE

The heart is the organ that is responsible for pumping blood throughout the body. It is located slightly offset to the left and surrounded by the lungs, the human heart is composed of four chambers which are two atriums and two ventricles. The right atrium receives blood returning to the heart from the whole body. That blood passes through the right ventricle and is pumped to the lungs where it is oxygenated and goes back to the heart through the left atrium, and then the blood passes through the left ventricle and is pumped again to be distributed to the entire body through the arteries.

Heart rate is the number of heartbeats per unit of time, typically expressed as beats per minute (BPM). Heart rate can vary as the body's need to absorb oxygen and excrete carbon dioxide changes during exercise or sleep. The heart rate of a healthy adult at rest is around 72 beats per minute (bpm). Athletes normally have lower heart rates than less active people. Babies have a much higher heart rate at around 120 bpm, while older children have heart rates at around 90 bpm. Lower than normal heart rates are usually an indication of a condition known as bradycardia, while higher than normal heart rates are known as tachycardia. The measurement of heart rate is used by medical professionals to assist in the diagnosis and tracking of medical conditions. It is also used by individuals.

HEART RATE MEASUREMENT METHOD

The heart rate can be measure at any spot on the body at which an artery is close to the surface and a pulse can be felt. The most common places to measure heart rate using the palpation method is at the wrist (radial artery) and the neck (carotid artery). There are several others places that can measure heart rate such as elbow (brachial artery) and groin (femoral artery). The methods of measuring heart rate can be divided into two:
1: manual method, 2: monitor method.

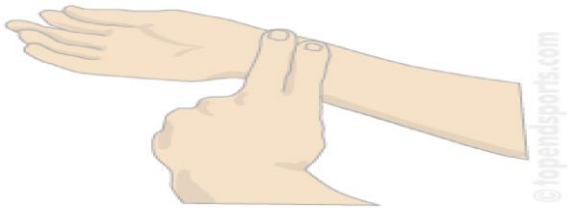

Fig. 1 Manual Method

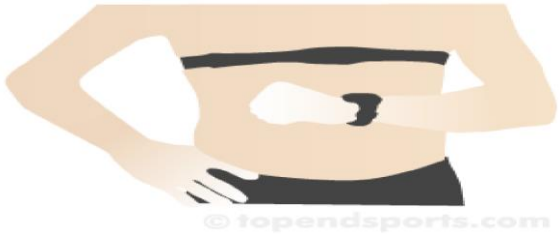

Fig. 2: Monitor Method

The monitor method can be perform by using electrocardiogram (ECG) machines. The standard Electrocardiogram (ECG) machine normally found in big hospitals, due to the high cost and requires a specialist to handle the machine. The ECG concept also applied on several gadgets such as watch and Smartphone but the demand is not good due to the high price.

FINGERTIP SENSOR

Heart beat sensor is a device designed to give digital output of heart beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each

heartbeat. It works on the principle of light modulation by blood flow.

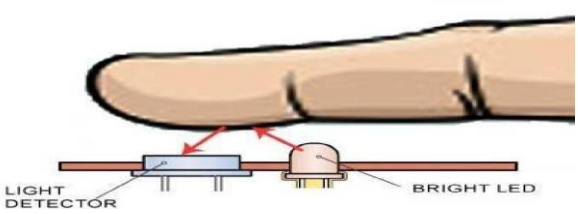

Fig. 5 Fingertip Sensor

Fingertip sensor has been done in two methods: transmittance and reflectance of light. In transmittance fingertip sensor, light is shone through the tissue using an LED and is detected on the other end using a photo detector. In contrast, reflectance fingertip sensor uses a photo detector on the same side as the LED to detect the light reflected by the tissue.

V. ARDUINO UNO

Arduino Uno is a widely used open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino-cc.The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.The board features 14 Digital pins and 6 Analog pins. It is programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable.It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts.

Figure 6: Arduino Uno

VI LCD (Liquid Crystal Display)

A Liquid-Crystal Display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. It does not emit light directly, instead it uses a backlight or reflector to produce images in color or monochrome.LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and seven-segment displays.

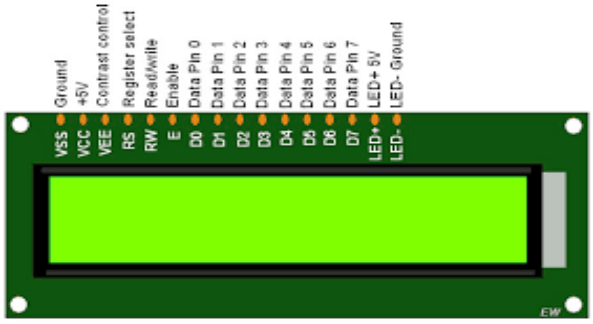

Figure 7: LCD (Liquid Crystal Display).

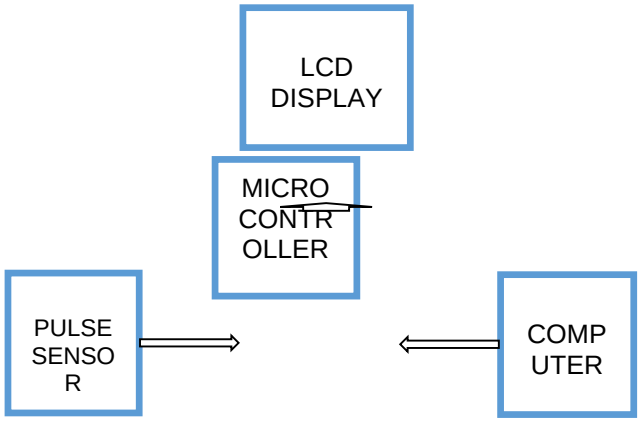

Figure 8: Heartbeat Monitor Device Block Diagram

VII. MATERIAL AND METHOD

The component used was selected based on the design which would provide optimistic low cost, and availability. The components are coupled in the design to complete the circuit of heart beat monitoring device where by the circuit were run to ensure it services.

A. List of Material Used

The materials used for this work are listed below.

1 Atmega328.
2 Resistors.
3 Capacitors.
4 Push button.
5 Jumper wires.
6 National instrumentation (NI) multism.
7 Arduino Uno (Integrated Development Environment (IDE))
8 Soldering iron.
9 Soldering lead.
10 LCD.
11 Fingertip sensor.
12 Bread board.
13 Casing.
14 IC socket.

B. pulse sensor circuit.

Heart beat sensor is designed to give digital output of heart beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heartbeat

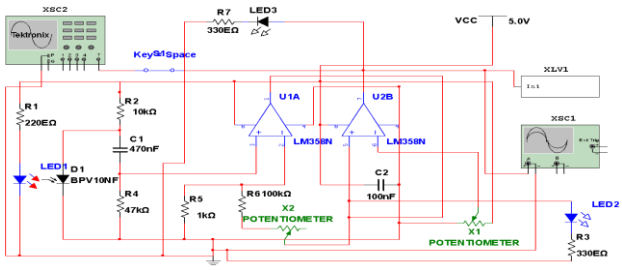

Figure 9: Heartbeat Sensor Circuit

VIII. RESULTS

Through various test procedures and techniques, many parts of this project were improved. Initially, basic features were tested to ensure that each component or block worked, as testing progressed, modifications or adjustments were made to the circuits so they functioned well practically.

Figure 10: shows the result obtained at 10 kHz sampling rate and linear interpolation at time domain.

Figure 11: shows the result obtained for spline interpolation at time domain

Figure 12: shows the result obtained at 10 kHz sampling rate for spline interpolation at time domain.

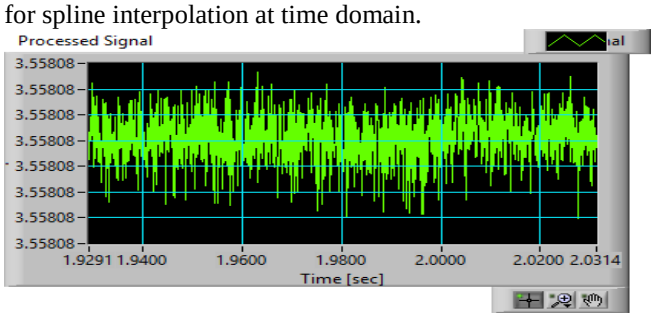

Figure 10: Linear Interpolation at Time Domain for 10 kHz Sampling Rate.

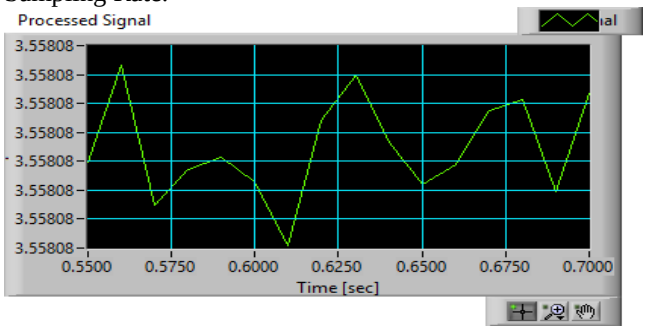

Figure11: Spline Interpolation at Time Domain for 100 Hz sampling rate.

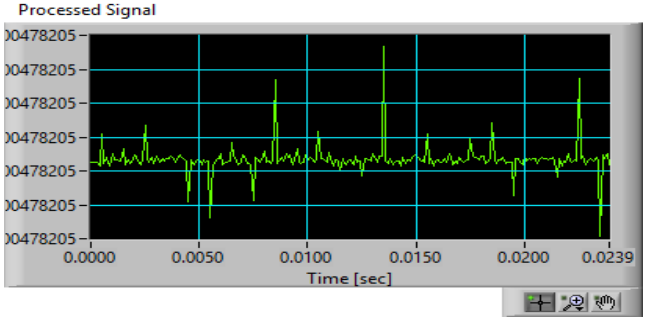

Figure12: Result at 10 kHz sampling rate, spline interpolation at time domain

IX. cost of hardwares (components)

The costs for all the parts used in the design and implementation of the heartbeat monitor device sensors are listed below. The costs outlined below are for only the parts used to build the actual circuits. Additional costs related to other parts used in older models of these circuits are not attached

Table 1: Bill of Quantity (BOQ)

PARTS	QUANTITY	PRICE
Microcontroller	1	#1000
LCD	1	#700
(male to male)/male to female jumper	1 dozens each	#700
Thumb sensor(pulse sensor)	1	#1800
Casing	1	#200
Chip socket	1	#1200
Female connector	1	#100
Total cost		#5700

X. CONCLUSION

This implementation of a heart monitor involves low cost components coupled with a sophisticated microcontroller and LCD screen. The device is useful as it is portable, it was designed with use of 5volt. In doing this the output voltage was found to be strongly related to the quality of contact between the sensor and the thumb and was observed to be highly variable. This project was successfully implemented as digital heart rate monitoring device.

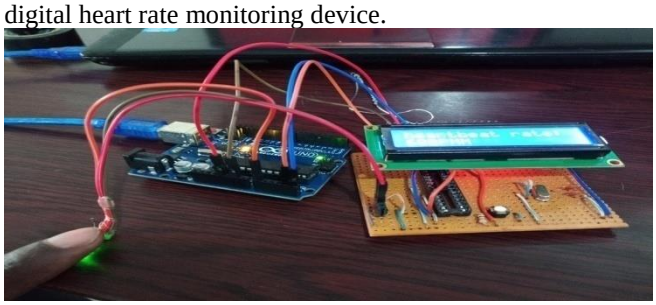

Figure 13: Constructed Project

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