Early Detection of Cardiological Issues using Mobile Applications

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Abstract

This project proposes a system for early detection of heart attack using a smart device. The device can measure and compute the heart rate, blood pressure and ECG using an ARM processor. The data measured from the controller device are then sent to the mobile application using a Bluetooth Connectivity and displayed to facilitate the end user to check their heart rate, blood pressure and ECG. The displayed data are then compared with default values and questions are raised to diagnose their present health status. If the stated conditions are true then a message or a call will be made to the concerned contact number to prevent heart attack of the patient before it occurs.

Keywords : *Arm, Ecg, Heart Attack, Mobile App*

I. INTRODUCTION

Heart attack is a most medical emergency. It occurs due to blood clot that blocks the flow of blood to the heart. Without the blood, the tissue dies due to lack of oxygen. Some of the symptoms of heart attack are found to be fatigue, tightness or pain in the chest, neck, back or arms, light-headedness, abnormal heart beat and anxiety. Women are more likely to have a typical symptom than men. In the recent years the technology has been growing enormously in the field of healthcare and medical. Health professionals or patients can use these devices to provide health care to people. The main cause of death in the world is due to cardio vascular disease [CVD] which represents 30 to 35 percent of the global deaths. The statistics given by the World Health Organisation [WHO] say that in the worldwide scenario about 17.5 million people die of heart attack or strokes each year. Most of the people consider that the pain of heart attack as a pain from some other physical problems such gastric problems or indigestion problems. If the exact pain or symptom of heart attack is known, then the number of casualties who are suffering from heart attack can be reduced. The heart conditions can be measured mainly using the heart beat. In recent years, medical technology has been improved rapidly by using computer components. Scientists have developed various algorithms, programs and devices for early detection of heart attack. Most of them have used conventional medical equipments to produce their results and detect heart attack accurately. In this work a device is developed that with optimum functionally so that the use of conventional equipments can be minimized as much as possible and also to maintain the accuracy of detection.

An existing method to detect heart attack uses a smart stethoscope using the camera of the mobile .They detect the function of heart such as heart beat and blood pressure which may not be accurate . Moreover this type of detection of heart attack in early stage may be difficult since they do not produce precise value. This method was not implementable since detecting the heart function using stethoscope and the mobile is found to inefficient and is of high cost. The installation of stethoscope with a mobile has higher risk of getting infra red rays from the phone. The accurate beating of the heart cannot be noted using this application. Therefore to overcome these disadvantages a system is proposed which uses a heart beat sensor and ECG electrode pads to accurately detect the heart beat or pulse of a person and the graph that gives the overall functioning of the heart using the ECG electrode. The proposed system is portable and also has higher efficiency with less cost compared to the existing method. It makes use of advanced ARM processor like LPC 2148 for fast processing.

II. DESIGN OF PROPOSED SYSTEM

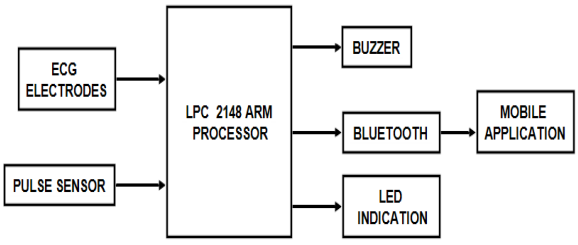

Fig. 1 Block Diagram of proposed system

From Fig. 1, the inputs are Pulse sensor and ECG electrodes. The outputs are Buzzer, Bluetooth, and LED Indication. The pulse sensor senses the pulse or heart rate of the patient and sends the output to the Arm processor and the output of ECG electrodes are also sent to the processor. The processor processes these data and sends the data to the mobile application using the Bluetooth Connectivity module. A buzzer is used to provide sound whenever the pulse rate is lesser or greater than

the default values. The LED indicator is used to indicate the level of pulse such as LOW, NORMAL and HIGH using different colours such as RED, GREEN, and YELLOW. The measured values of pulse rate and Blood pressure are displayed in the mobile application and the values are compared with pre-defined values and SMS or a call is made to the personal doctor or concerned number given by the patient.

III. ANALYSIS OF DATA

The data collection for heart rate for different ages are tabulated in Table.1

Table-1 Heart beat Range for different age groups

Category	Heart Beat Range
Newborns 0 to 1 month old	70 to 190 beats per minute
Children 1 to 2 years old	80 to 160 beats per minute
Children 3 to 6 years old	75 to 120 beats per minute
Children 7 to 9 years old	70 to 110 beats per minute
Children 10 years and older, and adults	60 to 100 beats per minute
Well-trained athletes	40 to 60 beats per minute

From the tabulated values the normal range for adults is taken as reference to proceed with other measurements. The blood pressure range for normal and various typical cases are given in Table.2 Blood pressure that is too low is known as Hypotension .

Table -2 Range of Blood Pressure

Category	Systolic pressure (mm Hg)	Diastolic pressure (mm Hg)	Pressure Range
Normal	130	85	High Normal Blood Pressure
	120	80	Normal Blood Pressure
	110	75	Low Normal Blood Pressure
Low Blood Pressure	90	60	Borderline Low blood Pressure
	60	40	Too Low Blood Pressure
	50	33	Dangerously Low Blood Pressure
High Blood pressure range	210	120	Stage 4
	180	110	Stage 3
	160	100	Stage 2
	140	90	Stage 1

The range of blood pressure for every individual is categorised based on their age which is presented in Table -3

Table-3 Range of BP For different age groups

Age	Systolic BP	Diastolic BP
3-10	116-122	76-78
11-16	126-136	82-86
17-24	120	79-85
25-34	121-122	80-81
35-44	123-125	82-83
45-54	127-129	84-85
50-59	129-131	85-86
60 and above	134	87

The range of blood pressure for male and female are given separately in Table .4 for setting up the reference value to provide more clarity on measurement.

Table –4 Range of BP For male and Female

Age Group	Female	Male
15 to 18	117/77 mm Hg	120/85 mm Hg
19 to 24	120/79 mm Hg	120/79 mm Hg
25 to 29	120/80 mm Hg	120/80 mm Hg
30 to 35	122/81 mm Hg	123/82 mm Hg
36 to 40	123/82 mm Hg	124/83 mm Hg
40 to 45	124/83 mm Hg	125/83 mm Hg
46 to 50	126/84 mm Hg	127/84 mm Hg
51 to 55	129/85 mm Hg	128/85 mm Hg
56 to 60	130/86 mm Hg	131/87 mm Hg
61 and above	134/87 mm Hg	135/88 mm Hg

IV. IMPLEMENTATION OF THE PROPOSED SYSTEM

A. *Software Implementation*

The software part of the proposed system is done by LPC2148 Microcontroller. It is 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine the microcontroller with embedded high-speed flash memory ranging from 32 kB to 512 kB. The following are the features and benefits of the controller.

The architecture of the LPC2148 Microcontroller is shown in Fig. 2

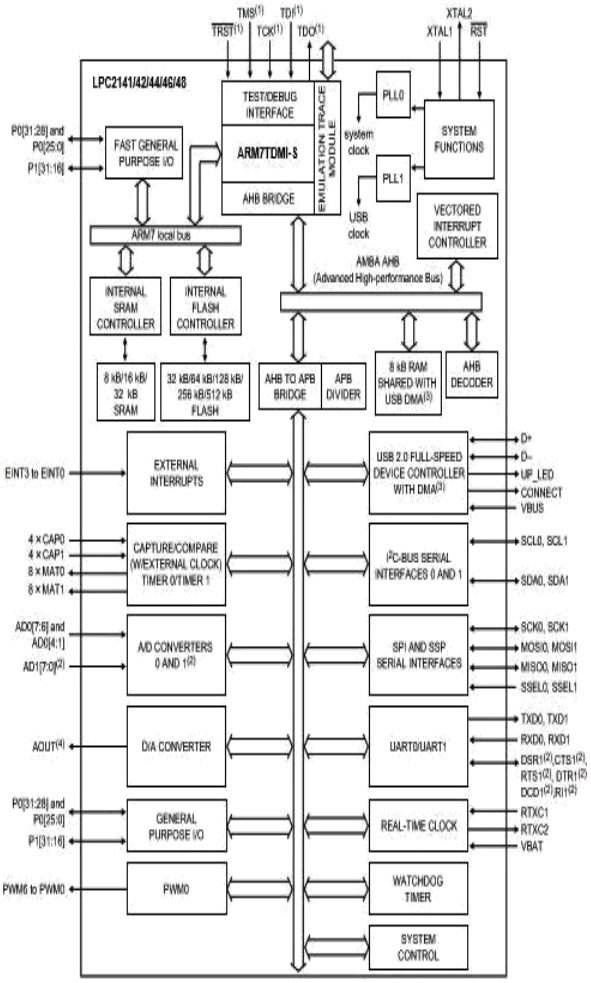

Fig. 2 Architecture of LPC2148 Microcontroller

1) *Features and Benefits*

- 16-bit/32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package.
- 8 kB to 40 kB of on-chip static RAM and 32 kB to 512 kB of on-chip flash memory. 128-bit wide interface/accelerator enables high-speed 60 MHz operation.
- Embedded ICE RT and Embedded Trace interfaces offer real-time debugging with the on-chip Real Monitor software and high-speed tracing of instruction execution.
- One or two (LPC2141/42 vs. LPC2144/46/48) 10-bit ADCs provide a total of 6/14 analog inputs, with conversion times as low as 2.44 s per channel.
- Single 10-bit DAC provides variable analog output (LPC2142/44/46/48 only).
- Two 32-bit timers/external event counters (with four capture and four compare channels each), PWM unit (six outputs) and watchdog.
- Low power Real-Time Clock (RTC) with independent power and 32 kHz clock input.
- Up to 21 external interrupt pins available.
- Power saving modes include Idle and Power-down.
- Individual enable/disable of peripheral functions as well as peripheral clock scaling for additional power optimization.
- Processor wake-up from Power-down mode via external interrupt or BOD.
- Single power supply chip with POR and BOD circuits:

2) *Hardware Implementation*

The experimental set up is composed of the hardware kit with pulse rate and BP Measurement sensor .From the measurement ,values are compared with normal reference values so as to diagnose the type of problem which is then interfaced with mobile app to pass the information to the concerned person. The photo of the hardware set up of the measurement is shown in Fig. 3.

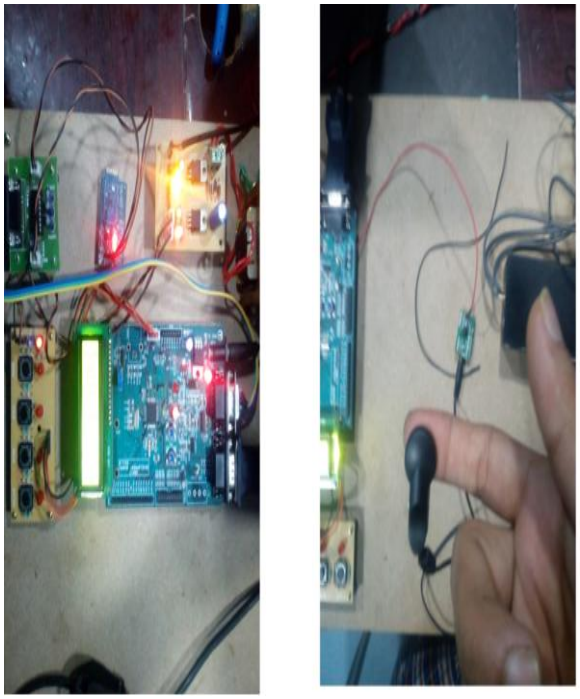

Fig. 3 Hardware set up .

V. RESULTS AND DISCUSSION

The flow chart for the entire proposed system is shown in Fig. 4 which explains the stagewise measurement .

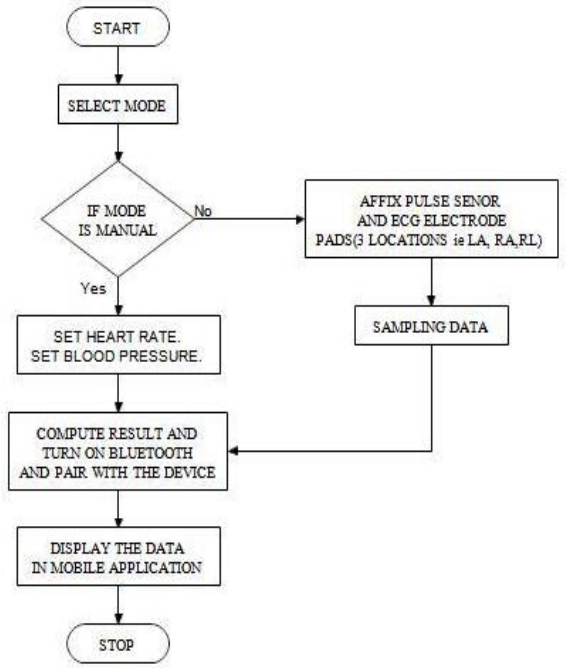

Fig. 4 Flow Chart for Measurement

The Sample of measured values are plotted like ECG Waveforms for a normal and slightly abnormal cases are presented in Fig. 5.

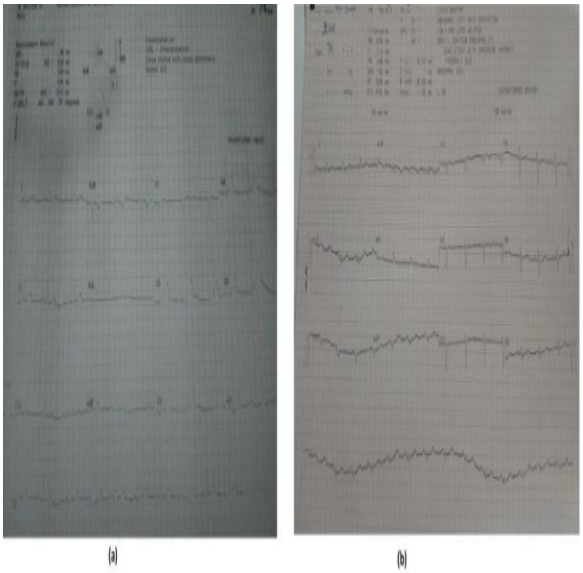

Fig. 5 Sample ECG Waveforms (a) Normal (b) Slightly Abnormal

The various phases of measurement are shown like different steps in Fig. 6.If the person who feels abnormal in health related issues ,can start answering for the questions which are listed in the mobile app.At the end of survey they will get a report in the screen as well as in the SMS form.If anything found to seriourly abnormal from the report and also from the parallel measurement of BP and Pulse rate , they will be taken care by the personnal/doctor whose contact number is given in the App.

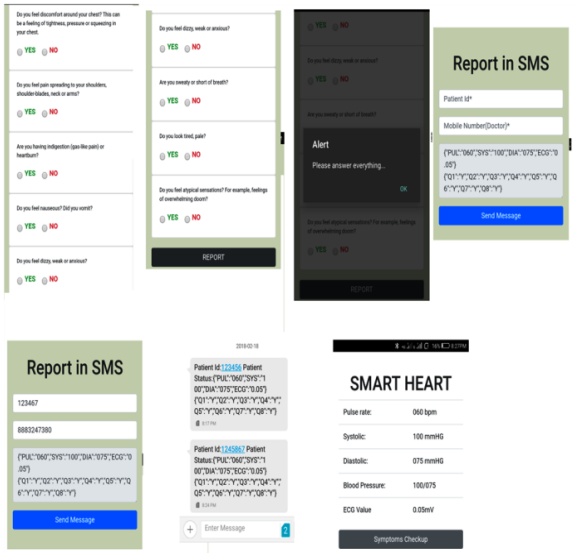

Fig. 6 Various Phases of Measurement

VI. CONCLUSION

A number of heart attack detection techniques have been introduced so far, but most of the devices invented are costly and not user friendly and also time consuming. In this modern age of smart phone, we believe and deserve that this proposed technique provides an alternate method with accurate outcome and can reach to people doorstep at every level in the society. In this proposed system different techniques are focussed and combined into a single algorithm. The user is provided with the option of choosing the technique which they need to detect heart attack. The application of the project is efficient in terms of lower cost, high accuracy and user-friendliness.

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