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# A Realtime Telehealth System using Lpc2148

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***Abstract*— The world of automation is rapidly improving and growing. Along with it application of IoT is also increasing. Application of engineering and technology has proved its significance in the field of bio-engineering. Health monitoring systems have become the need and the hot areas of development in the society. Along with monitoring there is also a need to analyze the monitored data. In this paper a system to measure/monitor a two vital parameters of human body is developed. The monitored values are stored on cloud using a WiFi module and analysis on the data stored on the cloud is done using Tableau , An Android Application and an IoT platform ThingSpeak. If abnormal values are detected then immediately the values are sent to the doctor as well as the family members using GSM module. The data is continuously updated in the database. With the help of this system the doctor can monitor and analyze the parameters of the person remotely , the physical presence of the person is not required , which means wherever the person might be doctor will be able to advice and suggest the needed medication to the person.**

**Index terms— IoT , BSN , GSM ,WiFI ,JSON , XML.**

## I. INTRODUCTION

IoT : Internet of Thing is networking as well as internetworking of devices , automobiles , sensors , embedded systems , offering advancement in connectivity of the things physical or cloud .

Everything around us , inside us , our inventions , our work ,a students marksheet , attendance record , electric meter readings is data. What is this data? Data is information. For example , a students marksheet of a particular class : by reading a students marksheet we get to know how much the student has scored per subject and also get to know how much the student has scored overall, the marks are data which provided us with the information about the students grades. Likewise there will be many students and they would be having their marksheets. By reading more marksheets we will get to know grades of many other students. By now we know marks of all students in a class. Now we can tell who is the topper in the class , how many have passed all/few subjects , how many have failed all/few subjects. Just by reading mark sheets of one class we get so much information.

Likewise Human Body is also a source of data. Vital Parameters of a human body like heart rate, body temperature, Systolic blood pressure , diastolic blood pressure , ph level , oxygen content in the blood and many more can be measured with the use of body sensors . These measured values can then be analyzed and one can get to know about the health condition of the concerned being One of the core IoT technologies to measure the vital parameters of a human body is body is Body Sensor Network technology. This technology covers a wide range of tiny , light weight powerful sensors. These sensors are of two types inbound sensors and outbound sensors. Inbound Sensors are deployed inside the body and outbound sensors are placed on the body.

In this paper we have developed a Healthcare System which will be able to detect all abrupt variations in body temperature and abnormalities in the heart rate , along with the normal values, will store the data i.e the measured values on cloud , if the measured values are abnormal , these values will be sent to family members and the family physician immediately. Analysis of the measured values is done at three platforms , Thing Speak , Tableau and Android.

For developing this system we have used LPC2148 microcontroller which is interfaced with hear beat and temperature sensor , GSM module and WiFi module. We have used the platforms Tableau , Things Speak and Android for visually representing the variations in the measured values by plotting graphs and creating a dashboard.

### *2 :Design Of The System*

BLOCK DIAGRAM:

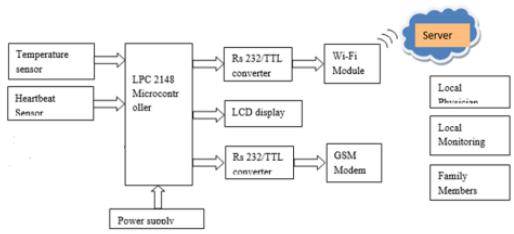

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*Fig 2.1: Block Diagram : Hardware*

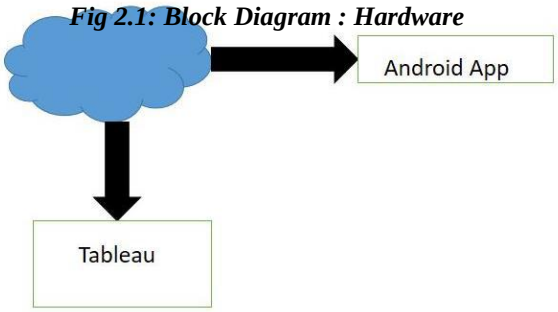


*Fig 2.2: Block Diagram : Software*

The block diagram is split in to two figures for better understanding. Fig 1.1 comprises of LPC2148 microcontroller ,Heart Beat monitoring sensor , Body temperature monitoring sensor , GSM module , WiFi module and LCD.

Fig 1.2 describes that the data from cloud can be taken onto Tableau for analysis and the same data is used to develop an Android application to observe the changes in real time.

We have used LM35 which is body temperature sensor. The output of the sensor is in analog format. This analog output from the sensor is an input to LPC2148. LPC 2148 has an on chip 10 bit ADC module. The output of the temperature sensor is converted into digital format for processing. The values normal or abnormal are updated onto the server using the WiFi module. We have used UART protocol to communicate with the WiFi module. When abnormal value of body temperature is detected, the respective value is immediately sent to the Family members and to the Family doctor using GSM module. We have used UART protocol to communicate with the GSM module.

We have used TCRT1000 which is a heart beat sensor. We measuring the heartbeat for one minute and the output of the sensor is send as an interrupt to LPC2148 from where it is processed and gets stored on the cloud through WiFi module and if the measured value is abnormal , immediately the value is sent to the family members and the family doctor through GSM module. We have used UART protocol to communicate with the WiFi module. We have used UART protocol to communicate with the GSM module.

Once the data is on cloud , it is available in JSON , XML and Excel format . We have then establish a connection with the by downloading the data in excel format with Tableau and have developed a dashboard which reflects the variations in hear rate and body temperature in graphical format.

An android application called Monitor is also developed for the family members where even they can observe the variations in the heart rate and the body temperature in a graphical format.

### *3: AIDS For System Development*

The modules and tools that we have used for development of this system are as follows.

1- Modules

- LPC2148
- TCRT1000
- LM35
- GSM Module
- WiFi Module
- ADC
- UART
- LCD

2- Tools

- Keil
- Flash Magic
- Tableau
- Android Studio
- ThingSpeak

#### *3.1.1 : LPC2148*

LPC 2148 is a ARM7 based 32 bit microcontroller. It follows a RISC architecture. It is a widely used integrated chip belonging to ARM7 family . Phillips has manufactured LPC2148 and is also preloaded with in-built peripherals. Following are some of the features of LPC2148.

- 32 bit , RISC Controller
- On-chip static RAM : 8 to 40 kB
- It has 45 GPIO pins.
- On-chip flash program memory: 32 to 512 kB
- It has 128 bit wide interface enables high speed 60 MHz operation
- It has two 10-bit A/D converters .
- Two 32-bit timers/external counters
- It has Multiple serial interfaces including two UARTs, two fast I2C-bus (400 kbit/s), SPI and

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SSP with buffering and variable data length capabilities

- It has On-chip integrated oscillator operates with an external crystal in range from 1 MHz to30 MHz and with an external oscillator up to 50

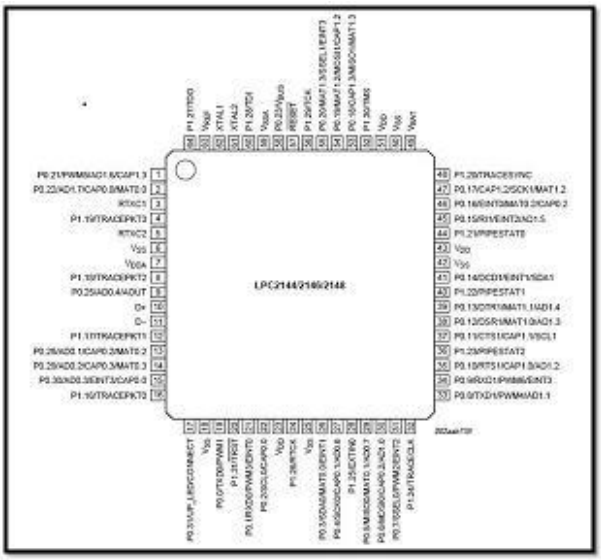

*Fig 3.1 : Pin Diagram of LPC2148*

### *3.1.2 TCRT1000*

The heartbeat sensor that is used in this design is TCRT1000. It works on the principle of photophlethysmography. It is a non-invasive method of measuring heart rate where light is transmitted and it gets reflected back when the hear beats. Now the reflected pulses are the heartbeats. Light emitted from the light emitting device is transmitted through any vascular region of the body like finger. Light emitted from the light emitting device is reflected by the regions. The basic heartbeat sensor will consist of a light emitting diode and a detector. Light Emitting Detector will be the transmitter and the detector will the receiver.

When a tissue is illuminated with the light source, i.e. light emitted by the led, it either reflects (a finger tissue) or transmits the light. Some of the light is absorbed by the blood and the reflected light is received by the light detector. The amount of light absorbed depends on the blood volume in that tissue.

### *3.1.3 LM35*

The skin temperature measurement is done using an integrated circuit, the LM35 temperature sensor. The Sensor gives an analog output depending on the measured temperature. This voltage has to be measured by the microcontroller using a 10 bit Analog-to-Digital converter (ADC). This sensor is mounted within the wrist strap, positioned in such a way that it is in contact with the skin, allowing it to measure the external temperature of the skin.

### *3.1.4 GSM Module*

GSM is an acronym for Global System for Mobile Communications. It uses a variation of Time Division Multiple Access(TDMA). SIM card is one of the key features of the GSM module. Following are some features of our GSM module

- Dual-Band GSM/GPRS 900 / 1800 MHz.
- Configurable baud rate(9600-115200).
- Inbuilt Powerful TCP/IP protocol stack for internet data transfer over GPRS.
- The SMS message in text mode can contain only 140 characters at the most

### *3.1.5 WiFi Module ESP8266*

WiFi is the acronym for Wireless Fidelity. It is the most popular wireless communication technique. It is used for network communication. It follows IP based communication. It is an IP based communication.

The WiFi module that is being used in this system is ESP8266. This UART to WiFi module is cheap , easily available and is currently widely used in the field of IoT. This module comes with a built-in TCP-IP stack. We have to use AT command to connect with WiFi networks and also open TCP connections. We can connect any microcontroller with ESP8266 and get connected to internet.

### *3.1.6 ADC*

ADC is acronym for Analog to Digital converter and as the name suggests its work is to convert analog signal such as heartbeat into a digital signal. The ADC in LPC2148 is a 10 bit successive approximation ADC. Features of ADC in LPC2148 are

- ADC0 and ADC1 are two inbuilt modules in LPC2148
- The maximum resolution is 10 bits.
- There are 6-channels in ADC0.
- The are 8-channels in ADC1. Channel basically means pin. So 6 pins in ADC0 and 8 pins in ADC1 can be used for ADC conversion. So 14 different signals can be converted.
- Conversion time is 2.44 microseconds/channel.
- Operating frequency 4.5Mhz (maximum).
- Step size is 3.23mV approximately.

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### *3.1.6 UART*

UART is acronym for Universal Asynchronous Receiver Transmitter. It is an asynchronous form of data transmission in a serial manner. To communicate with peripherals(GSM or WiFi) we use UART of many protocols available. There are two types by which communication can be established , Parallel Communication and Serial Communication. UART0 and UART1 are the two UARTS which are supported by LPC2148 ARM core. We can use UART0 as a general purpose UART or for ISP programming. UART1 has additional support of modem. Both of these UART's have a built-in baud rate generator. The FIFO's transmit and receive are both of 16-bytes. Port pin P0.0 and Port pin P0.1 is are used as transmitter and receiver pins respectively for UART0. Port pin P0.8 and Port pin P0.9 are used as transmitter and receiver pins respectively for UART1.

### *3.1.7 LCD*

LCD is an acronym for Liquid Crystal Display. The LCD used in the development of this system is a 16x2 display. The LCD is used to display the measured values

### *3.2.1 Keil*

Keil is an IDE i.e integrated development environment. We have used Keil micro-vision 4 to program LPC2148.

### *3.2.2 Flash Magic*

We have used Flash Magic to dump the .hex file(source code) (generated after building the project on Keil) on LPC2148. We also have used this tool to configure the WiFi module using AT commands.

### *3.3.3 Tableau*

Tableau is a business intelligence tool used for visually analyzing the data. Users can create, share , distribute , publish dashboards depicting the variations , trends in form of graphs and charts. Tableau can connect to flies , data sources(servers/databases) to acquire and also to process data. Data blending is possible with tableau along with real time collaboration , these are unique features of tableau. This tool can be used by anyone who wants to process and analyze data.

### *3.3.4 Android Studio*

Android Studio is an IDE , integrated development environment used for developing android application. We have developed an android application named Monitor using android studio. The pre-requisite for installing Android Studio is jdk 1.6 or above . To develop an android application one must also know core Java , XML , JSON ,databases . We have used core java for back end development and XML for UI(User Interface Development). Data is accessed and Stored in JSON(Java Script Object Notation) format

### *3.3.5 ThingSpeak*

ThingSpeak in an IoT analytics platform develop by mathworks. that allows you to aggregate, visualize and analyze live data streams in the cloud. ThingSpeak provides instant visualizations of data posted by your devices to ThingSpeakWe have used this platform to update live feed from our system. We have created two channels one for each feed getting transported from our system. Some of the key capabilities of ThingSpeak include the ability to:

- Easily configure devices to send data to ThingSpeak using popular IoT protocols.
- Visualize your sensor data in real-time.
- Aggregate data on-demand from third-party sources.
- Use the power of MATLAB to make sense of your IoT data.
- Run your IoT analytics automatically based on schedules or events.
- Prototype and build IoT systems without setting up servers or developing web software. 4 :

**Results**

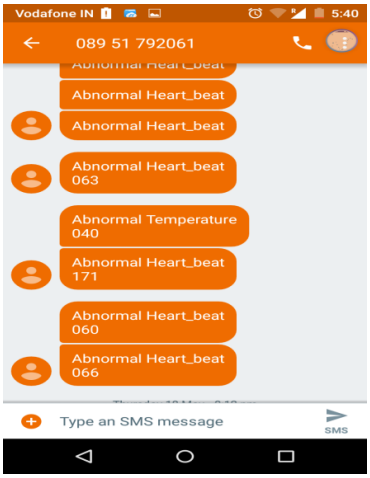


***Fig 4.1 : GSM Output.***

Fig 4.1 shows the text message which the family members and the family doctor will get if the measured values of body temperature and heart rate are abnormal.

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*Fig 4.2 : Feed 1 on ThingSpeak Platform.*

Fig 4.2 and Fig 4.3 show the feed in a graphical format in real time. Fig 4.2 is the graph of time(date) vs temperature. Fig 4.3 is the graph of time(date) vs heart

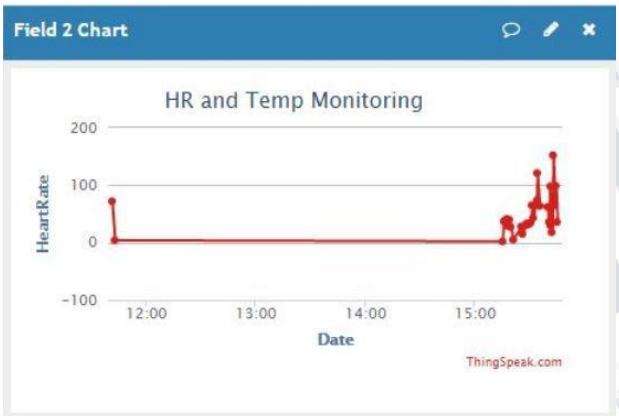


*Fig 4.3 : Feed 2 on ThingSpeak Platform.*

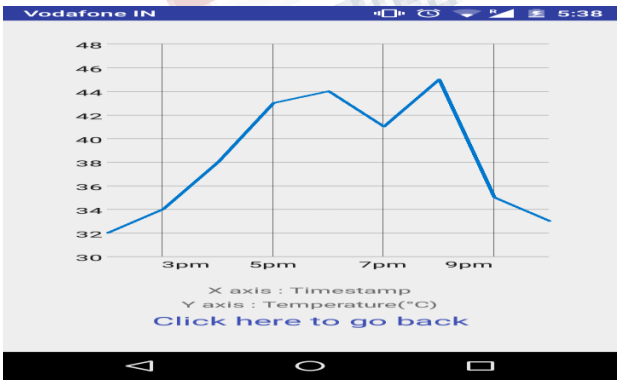


*Fig 4.4 : Android Application Screenshot*


*Fig 4.5 : Android Application Screenshot*

Fig 4.4 and Fig 4.5 are the screenshots of the android application Monitor that we have developed. Fig 4.4 is the graph of timestamp vs temperature . Fig 4.5 is the graph of timestamp vs heart rate. The values on both the figures are updated in real time.

## 5: CONCLUSION

An IoT based healthcare system is developed which will be able to measure the heartbeat and the body temperature of a person. In case of an emergency i.e when heartrate becomes abnormal and/or the body temperature becomes abnormal an intimation about the information would be sent through SMS to family members and the doctor. Also the measured values are sent to cloud (Thingsspeak.com) through Wifi where the doctor can observe the parameter trends in real time. If the trend values is/are abnormal then the doctor can prescribe suitable medication.

Tableau is a reporting tool where I have designed a dashboard which shows us the variation in the trend values of both the parameters. Here one can make an observe both the parameter variations and get to know whether they are interdependent or not.
An Android application called “Monitor” is developed for the family members where even they can observe the trend variations.

With the help of this system the doctors will be able to monitor the parameters remotely. Even if the patient is in some remote corner the doctors will be able to provide their advice and suitable medication.

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