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# Real Time Self Health Monitoring System

Darshana Varma[1], Virendra Shete[2], Sunil Somani[3]

ME Scholar, Dept. of E&TC, MITCOE, Savitribai Phule Pune University, Pune, India[1]

Professor, Dept. of E&TC, MITCOE, Savitribai Phule Pune University, Pune, India[2]

Associate Professor, Dept. of E&TC, MITCOE, Savitribai Phule Pune University, Pune, India[3]

**ABSTRACT**: Heart related disease is rising among today's population. The need for an accurate, yet affordable heart monitor is essential to ensure one's health quality. However, in today's market, most heart monitors are expensive and are not user friendly. Our goal is to design and build an affordable heart monitor that is user friendly. In order to make our goal possible, we will utilize optical technology to construct an accurate and inexpensive means for one to monitor his heart rate and stay in touch with his physical condition. Health information science which deals with the acquisition, transmission, processing, retrieval, and utilization of health information has been evolving as an active field of interdisciplinary research area. In particular, acquisition of health-related information by wearable technologies is considered as a cornerstone in health information science. With rapid aging and economic growth, people became more interested in their long-term health, fitness and wellness. In India, everyday many lives of human are affected by heart attacks. Analysis of health parameters of patients after post hospitalization is very difficult. It is necessary to have a record of the patient's health after he is discharged from the hospital. In this paper, we implement a miniature real time self healthcare monitoring system which can monitor heart rate, blood oxygen saturation and temperature. The obtained bio-signal from the each sensory unit is transmitted using a Bluetooth wireless communication in real time at home to the personal computer as well as on the smart phone.

**KEYWORDS**: Post Hospitalization, Heart Rate, Oxygen Saturation, Body Temperature, Bluetooth wireless communication.

## I. INTRODUCTION

The pulse rate gives an indication during exercise routines of how effective that routine is improving your wellness & fitness. Earlier it was used only by elite athletes, but now health monitors are now becoming an indispensable tool for everyone from the casual athlete to the personal trainer as well as used by health conscious people. Health monitoring system provides an easy and scientific measure of the exertion that we are investing into our physical exercises. A health monitor is simply a device that contains a sample of heart beats and computes the beats per minute so that the data can easily be utilized to track heart condition. Current technology consists of optical and electrical monitors. The electrical approach is having a bulky strap around one's chest. So its not that convenient to use. The optical method does not need any strap and hence can be used more conveniently than the electrical method [1].

There are many considerations in developing a health monitor. A cost effective way of measuring the heartbeat is using an LED and photo-sensor. With the LED technology, ambient light causes excess noise. Thus, a filter would be needed to attenuate the noise in order that the pulse signal can be taken out. The device must have a display or some way to observe the heart rate. The device should be precise and easygoing to use to be attractive to the world-wide public. To create an impact on the market, the invention must be modest, lightweight, durable and low-cost. With these constraints noted, one can propose a blueprint to create a health monitor [1].

Applying the design constraints described above, we can now tell how we will approach our aim. The base of our plan is to construct an efficient and affordable heart monitor. An LED and photo-sensor will be utilized to assess the pulse by measuring the change in line flow through one of the index fingers. A signal conditioning circuit will be designed to filter out any unwanted noise and interference. A micro-controller will be programmed to calculate the heartbeat rate and LCD is used to display the pulse rate [1].

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## II. RELATED WORK

This section of paper describes the work that has been done in the area of health monitoring systems. Jubadi et al. [2] has proposed heart rate monitoring alert via SMS. In this an alert system is used to monitor the heart beat rate of a patient. This heart rate measurement is based on the principle of photoplethysmography (PPG) technique. Then this PPG signal was processed using PIC16F87 microcontroller to check the heart beat rate per minute. An alert was given to medical experts or family members via SMS. With the help of this system doctors could monitor & diagnose patient's condition continuously & could suggest them precautions if any. Saravanan [3] designed remote patient monitoring system using computer communication networks through Bluetooth, WiFi, Internet Android Mobile. ECG, EMG, Pulse, BP, arterial oxygen saturation, blood glucose concentration & temperature signals were monitored. They had designed android Bluetooth API & constructed a simple peer-to-peer messaging system to work between two paired Bluetooth. The monitoring section receives data via Bluetooth, Wi-Fi & Internet. This system was mainly designed to send data to the doctor.

Purnima et al. [4] proposed health monitoring systems based on GSM & Zigbee technology. In this ECG, temperature & heart beat signals are continuously transmitted & monitored through Zigbee. A Zigbee node was connected to every patient monitoring system. The data are transmitted to the doctors PC via Zigbee as well as GSM technology is used to send data to doctor's mobile. Aditya Kurude et al. [5] developed advanced digital thermometer which highlighted the idea of adding a database storage facility as well as GSM communication. They have designed an embedded system that records body temperature & stores this data in memory card along with its date & time for future use. This data can be directly transmitted to doctors using GSM communication.

Singh et al. [6] proposed wireless transmission system which is having a wireless sensor platform along with remote monitoring capability. They have designed sensor nodes for temperature & heart rate. This sensor data are wirelessly transmitted to the controller using RF transmitter & receiver module. This data is also wirelessly transmitted to the remote monitoring station. Verma et al. [7] developed a wireless system that allows patients to measure their won vital signs, such as heart rate & temperature. Health professionals could also remotely monitor patient's vital parameters through messages sent by GSM along with date & time, patient's location, name of the patient. The patient's location was given by the GPS.

Chandana et al. [8] proposed a tele-medicine system for measuring heart rate, blood pressure & drug level detection. This system implies where ever the person is he could stay connected with doctor & take immediate action in emergency case. The heartbeat rate, blood pressure, drug (alcohol) level measured by the sensor & this data is sent to doctor's mobile in the form of message or call via GSM network. Venugopal et al. [9] presented a centralized heart rate monitoring system. The data obtained from sensors of various patients are then transmitted over a WBAN and then this data is transmitted to the main location with the help of Wi-Fi. Kumar et al. [10] presented health monitoring & tracking of soldiers using GPS. It focuses on tracking the location of soldier from GPS; this position is given to control stations so as to get exact location of soldier & guide them. Body temperature, heart rate & location of soldier are transmitted using GSM to central base station.

Sungchul Bae et al. [11] proposed health management based on self-organizing software platform. This system uses PHDs and smart devices. It is a type of plug-in system where one could add new devices & services without modifying the whole system. They have proposed a smart watch which was worn by user that measures blood pressure. This was also based on SOSp platform & other devices are also based on SOSp platform. In this blood pressure monitor transmits a low frequency signal to identify smart watch. Then blood pressure monitor transmits data to watch in order to record the BP. Then watch sends this data to SOSp based router & then patient information, blood pressure data to main server. Kiran Kumar et al. [12] developed health monitoring system using PSOC mixed signal. They developed data acquisition system to remotely monitor patient's parameters like temperature, heart rate, blood oxygen saturation, blood pH level & ECG. In this system doctor was able to monitor patient on PC using Zigbee wireless communication technology.

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Fezari et al. [13] developed a microcontroller based heart rate monitor in real time. Doctors access pulse rate file of patient by email every twenty four hours. This system could also be used by athletic persons. This system reads, stores, & analyses the pulse rate. Deshmukh [14] developed real time patient monitoring system that involved various sensors like temperature & pulse rate sensor along with Wi-Fi functionality. This feature helps medical professionals to monitor patient's health in real time on website. Chi Kin Lao et al. [15] proposed a system a miniaturized portable pulse rate detector system. The heart rate was extracted from PPG principle & transmitted using RF Tran-Receiver to PC or smart phone. They also developed an android app in order to view heart rate data on smart phone.

## III. PROPOSED SYSTEM

The main aim here is to develop a system for real time self health monitoring of person/patient/athlete who wants to monitor one's fitness level and for home care monitoring purpose with miniature device which should be easy to handle, accurate and low cost. Heart rate, Body Temperature, oxygen saturation, etc are the parameters that to be analysed to improve one's fitness level. It is necessary to monitor in real time patient's position on bed if the patient is a paralysed patient.

Following are the objectives of idea implementation:

- To measure health parameters of a person like heart rate, body temperature and oxygen saturation.
- To collect data from this sensor and send it to smart phone by wireless channel on Android App.
- To send data to Personal Computer (PC).
- To alert the person if the reading go beyond set standards via buzzer.

The detailed block diagram of self health monitoring system is shown in Figure 1.

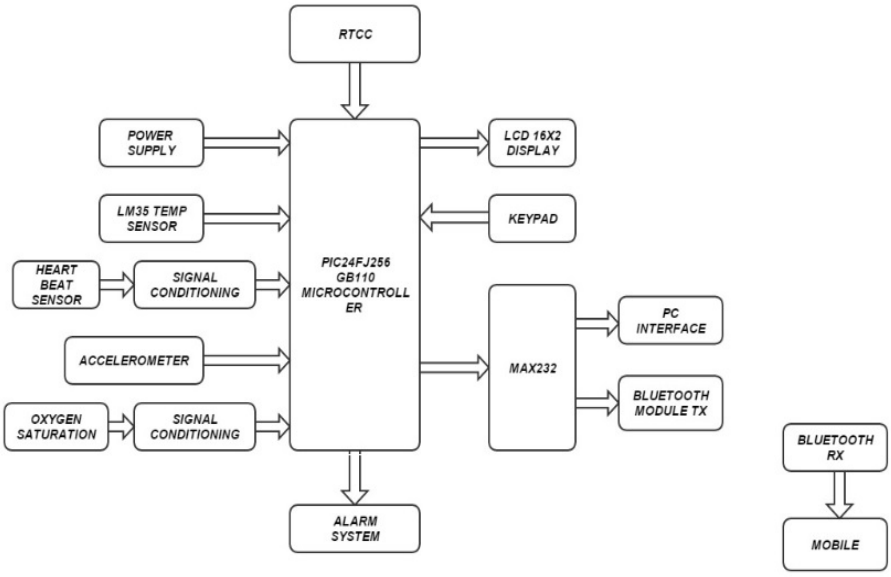


Fig.1 Block diagram of proposed Self Health Monitoring System

The figure 1 shows the block diagram of proposed system. Temperature sensor, accelerometer, heart rate sensor and oxygen saturation sensor are inputs to the controller. For real time application RTCC DS1307 is used. LCD is used for displaying the sensor data in real time. For transmitting data to mobile phone's android app Bluetooth protocol is used. Buzzer is used for alerting the person.

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A. *Hardware Design:*

In the proposed self health real time monitoring system I have used heart rate sensor that is designed using IR LED & photodiode, oxygen saturation sensor, ADXL335 accelerometer & LM35 body temperature sensor. These parameters are digitized with the help of in built ADC present in the PIC24FJ256GB110 PIC microcontroller. All this sensor data is displayed on LCD in real time using DS1307 RTCC IC. With the help of Bluetooth wireless communication these data is sent to the smart phone which is to be displayed by developing an Android App. These data is also sending to PC for analyzing one's health. Whenever the sensor data crosses the specified threshold values it alerts the person with the help of a buzzer. So that he will get to know something wrong happened to him.

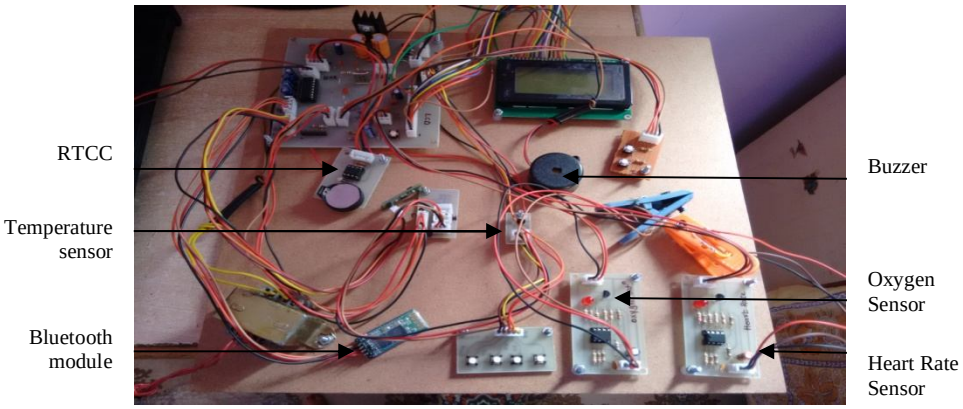


Fig.2 Real Time Self Health Monitoring System

Figure 2 shows the hardware implementation of the system. Simulation was done in proteus 8 professional simulation software and schematic and PCB design was done in diptrace software.

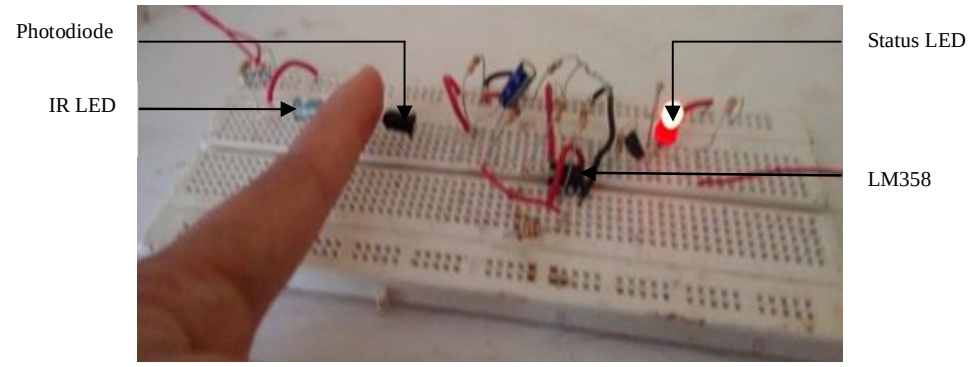


Fig.3 Heart Rate Sensor Design

i. **Heart Rate Sensor:** Heartbeat is sensed by using high intensity type LED and photodiode pair as shown in Figure 3. The variety in forces caused by the pressure pulse is detected by illuminating the fingertip's skin with the illumination from an LED using a photodiode detector. With each pulse, a deluge of blood is forced through the vascular system, expanding the capillaries in the finger, and varying the amount of light that returns to the photo detector [16]. The LM358 is used for signal conditioning purpose. One is used for amplifying the weak signals from photodiode and another one is used as a comparator. The breadboard implementation of the sensor is as shown in figure-3. We have used IR LED and photodiode. Red LED is used

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as status LED which blinks with each heart pulse. The waveform generated through this implementation is as shown in Figure 6.

ii. **Temperature Sensor:** LM35 is a precision integrated-circuit temperature sensor whose output voltage is linearly proportional to the Celsius temperature. The LM35 does not need any external calibration or trimming to have accuracies. This is 3 legs IC that directly gives analog output. This unit requires +5V DC for its proper functioning [17].

iii. **Accelerometer:** The three axis accelerometer is basically used to find the movements across the three axis, i.e. x-axis, y-axis, z-axis. The accelerometer is an electronic device which is interfaced using I2C protocol and provides the reading after every 1msec. We have used ADXL335 accelerometer. The ADXL335 accelerometer is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs IC. The product measures acceleration with a full scale range of ±3 g. It measures the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration that results from motion, shock, or vibration.

iv. **Microcontroller:** In this project we have used PIC24 microcontroller. It has wide range of interfaces including $I^2C$, SPI, USB, UART, A/D, programmable comparators, PWM, LIN, PSP, and Ethernet. It is a 16-bit Flash microcontroller with USB on-the-go (OTG). It has 256KB of flash program memory along with 10bit 16 channel ADC. Internal oscillators are 31 kHz to 8 MHz with on chip LDO voltage regulator.

v. **LCD Display:** The model JHD 162A series LCD is the typical standard HD44780 type of LCD with 16 characters x 2 row LCD module. For displaying heart beat rate, temperature and accelerometer reading we have used LCD display.

vi. **Bluetooth:** In order to transmit sensor data to the smart phone, a Bluetooth is used as a wireless transmission interface. This is simple, cost effective, compatible and reliable. We have used HC-05 Bluetooth module. It is an easy to use. The Bluetooth SPP (Serial Port Protocol) module is designed for transparent wireless, serial connection setup.

B. *Software Design:*

Software design approach for health monitoring system is based on four parts, first is PIC programming, simulation software, schematic and PCB layout design software and Android App. PIC programming is done in MPLAB IDE version v8.92 and Embedded C is used as the programming language. The Android App is successfully developed using the Basic4Android software. Simulation of the project was done in Proteus 8 Professional and Diptrace is used for schematic and PCB design purpose.

## IV. SIMULATION RESULTS

The Android App and Docklight terminal, displaying results is shown in figure 4 & figure 5. Heart rate sensor waveform is as shown in figure 6. The experimentation was conducted on number of patients as shown in the following table I.

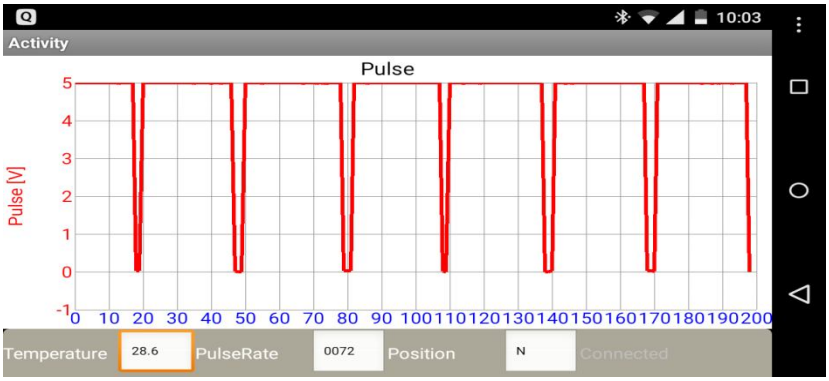


Fig.4 Snapshot of Android App

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Figure 4 shows the snapshot of Android App. This app displays the pulse reading, the temperature value and the position of accelerometer. The ADC data from the oxygen saturation is plotted with a scale of 0-200 on x-axis and 0-5 on y-axis. This waveform shows the variation of blood oxygen saturation.

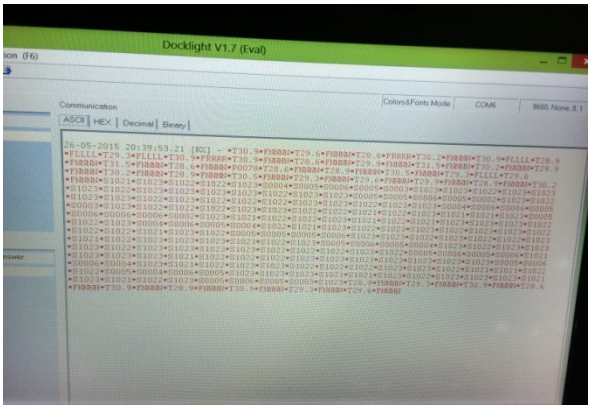


Fig.5 Docklight software used to show data on PC

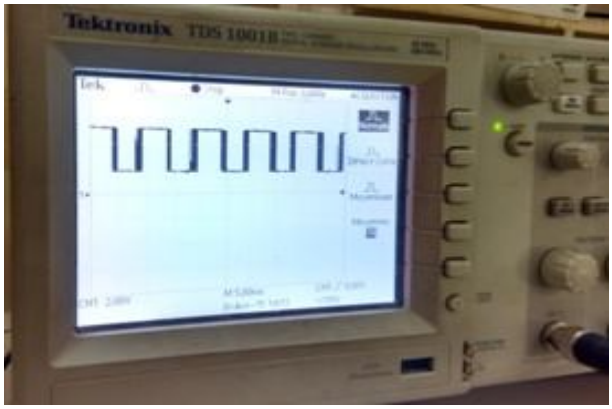


Fig.6 Waveform of Heart rate on DSO

In figure 5, *T is used to indicate temperature reading, *P is used for showing pulse rate, *F is used for indicating accelerometer position such as N for No fall, R for Right fall, L for Left fall and *S for displaying oxygen saturation reading.

Figure 6 shows the waveform obtained from the circuit implemented in figure 3. When a person places his finger between the sensors the status led starts blinking and we get a square pulse on the DSO as shown in figure 6.

Table I shows the heart rate of various subjects in beats per minute (bpm). Heart beat rate data (in bpm) were taken under unexercised state (relaxed condition) and exercised state (stressed condition). For the unexercised state each subject was asked to sit on a chair closing their eyes for 5 minutes in relaxed mood before their data were recorded. These data referred to their heart rates in relaxed condition. For the exercised state, each subject was instructed to perform 5 minute bicycling or jogging at their place and thereafter, their data were again recorded. These data referred to as their heart rates in stressed condition.

Percentage of Error (E1) = [(68.14- 67.71)*100]/68.14= 0.63 % < 1 % ----------Relaxed state

Percentage of Error (E2) = [(119- 118.28)*100]/119= 0.60 % < 1 % ----------Stressed state

TABLE I
RECORDED DATA OF VARIOUS SUBJECTS

| SI No | Subjects | Heart Rate (bpm) | | | |
|---|---|---|---|---|---|
| | | Designed Device Output | | Standard Device Output | |
| | | Relaxed State | Stressed State | Relaxed State | Stressed State |
| 1 | Subject 1 | 67 | 112 | 66 | 114 |
| 2 | Subject 2 | 62 | 112 | 63 | 112 |
| 3 | Subject 3 | 72 | 124 | 73 | 125 |
| 4 | Subject 4 | 74 | 130 | 74 | 126 |
| 5 | Subject 5 | 64 | 112 | 65 | 114 |
| 6 | Subject 6 | 72 | 128 | 72 | 130 |
| 7 | Subject 7 | 63 | 110 | 64 | 112 |
| Mean | | 67.71 | 118.28 | 68.14 | 119 |
| Standard Deviation | | 4.92 | 8.67 | 4.67 | 7.68 |

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## V. CONCLUSION AND FUTURE WORK

This project is developed in order to alert patient or any person or athlete about their fitness at home. They can have a record of their health parameters on PC as well as they can monitor the health on the android app via Bluetooth communication at home. People can monitor their health regularly with the help of this project. This system also alerts the family member of the patients in case in of critical conditions. From the above calculations it can be seen that percentage of error between my device and standard device is below 1 %. Hence, it can be concluded that the designed low-cost heart rate counter can function satisfactorily as well as that of a standard device. Further advancements can be done in this system by incorporating sound to the system such that sound will be an output each time a pulse is received. GPS can be implemented to indicate person's position in real time. The system can be made battery operated & can have Wi-Fi/ Ethernet connection to load data on cloud. The system may have USB compatibility so that real time data will get automatically be stored in flash drive to maintain record.

## REFERENCES

1. Todd Peacock, Chong-Meng Teh, K'lvin Sui, Craig Williamson, "Design of A Heart Monitor", CiteSeer$^{X}$, April, 2001.
2. Warsuzarina Mat Jubadi, Siti Faridatul Aisyah Mohd Sahak, "Heartbeat Monitoring Alert via SMS", *IEEE Symposium on Industrial Electronics and Applications*, Oct. 4-6, 2009.
3. S.Saravanan, "Remote Patient Monitoring in Telemedicine using computer communication network through Bluetooth, Wi-Fi, Internet Android Mobile", *International Journal of Advanced Research in Computer and Communication Engineering*, Vol. 3, Issue 7, July 2014.
4. Purnma, Puneet Singh, "Zigbee and GSM Based Patient Health Monitoring System", *Interntional Conference on Electronics and Communication System (IECS -2014).*
5. Aditya Kurude, Mayur Bhole, Sagar Pawar, "GSM Based Advanced Digital Thermometer with Data Storage in Memory Card", *International Journal of Advanced Research in Computer and Communication Engineering*, Vol. 2, Issue 8, August 2013.
6. Nisha singh, Sr. Asst. Prof. Ravi Mishra, "Microcontroller Based Wireless Temperature and Heart Beat Read-Out", *IOSR Journal of Engineering (IOSRJEN), (*Jan. 2013), PP 01 -06.
7. Sanjay Verma, Namit Gupta, "Microcontroller-based Wireless Heart Rate Telemonitor for Home Care", *IOSR Journal of Engineering (IOSRJEN),* (July 2012), PP 25-30.
8. D.Chandana, B.Hema Latha, "A Tele-medicine System for Measuring Heart Rate, Blood pressure, And Drug Level Detection", 2014 IJEDR | Volume 2, Issue 1 | ISSN: 2321-9939.
9. Kala Venugopal, Amit Kumar, "*Centralized Heart Rate Monitoring and Automated Message Alert System using WBAN*", International Journal of Scientific and Research Publications, Volume 3, Issue 9, September 2013 1 ISSN 2250-3153.
10. M.V.N.R. Pavan Kumar, Ghadge Rasika Vijay ,Patil Vidya Adhikrao, Bobade Sonali Vijaykumar, "*Health Monitoring and Tracking of Soldier Using GPS*", International Journal of Research in Advent Technology, Vol.2, No.4, April 2014 E-ISSN: 2321-963.
11. Sungchul Bae, Il Kon Kim, Do-Youn Lee. "*A Scalable Health Management System based on a Self-Organizing Software Platform*", 2014 IEEE.
12. D.J.R.Kiran Kumar, Nalini Kotnana, "*Design and Implementation of Portable health monitoring system using PSOC mixed signal Array chip*", International Journal of Recent Technology and Engineering (IJRTE), ISSN: 2277-3878, Volume-1, Issue-3, august 2012.
13. Mohamed Fezari, Mounir Bousbia Salah, and Mouldi Bedda, "*Microcontroller Based Heart Rate Monitor*", the International Arab Journal of Information Technology, Vol. 5, No. 4, October 2008.
14. Mr. Deshmukh R.S, "*Wi-Fi Based Vital Signs Monitoring and Tracking System for Medical Parameters*", International Journal of Engineering Trends and Technology (IJETT) - Volume4Issue5- May 2013.
15. Chi Kin Lao, U Kin Che, Wei Chen, Sio Hang Pun, Peng Un Mak, Feng Wan, and Mang I Vai, "*Portable Heart Rate Detector Based on Photoplethysmography with Android Programmable Devices for Ubiquitous Health Monitoring System*", December 16, 2012.
16. Nisha singh, Sr. Assistant Prof. Ravi Mishra," Microcontroller Based Wireless Temperature and Heart Beat Read-out", IOSR Journal of Engineering (IOSRJEN), Vol.3, Issue 1, pp 01-06, Jan.2013.
17. National Semiconductor, "Precision Centigrade Temperature Sensors", LM35 datasheet, Nov.2000.

## BIOGRAPHY

Darshana R. Varma has completed her B.E. in Electronics & Telecommunication Engineering from DCOER, Pune, Maharashtra, India and currently pursuing her M.E in VLSI & Embedded System from MIT College of Engineering, Pune and completing project based on PIC24F. Her research interests include Embedded system design.

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Dr. V.V Shete, Head, Department of E&TC, MITCOE Pune, affiliated to Savitribai Phule, Pune University. He has published numerous scientific papers in various domains. His area of interest are soft computing, Signal Processing, Communication.

Sunil B. Somani received the M.E. degree in Electronics and Telecommunication Engineering. He has been in the teaching field since last 20 years and specialized in areas such as Advance communication, Microwave engineering and Mobile communication. He is currently working as PG coordinator at MIT College of Engineering, Pune, India.