

Study and Implementation of IOT based Smart Healthcare System

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Abstract-Heart is one of the most important and delicate organ of the human body. It is very important for a heart to be healthy in order to maintain the overall health of every individual. The Heart related diseases and issues have been increasing in a number of people at a very alarming rate, which makes it a very prominent reason to constantly monitor the heart rate of an individual for any sudden changes. Heart rate varies during exercises or during any activity, which requires physical movement. Any kind of stress can also lead to Heart problem. This paper portrays the current research and development in the field of devices created to monitor the Heart rate. Different methods have been implemented and discussed to identify the components lacking in the current scenario devices and identifying the future scope of the Heart rate monitors.

Keywords:-Heart monitoring system, GSM, Pulse rate sensor, Temperature sensor

I. INTRODUCTION

Heart rate monitoring sensors have been immensely on the rise in the recent years due to the increasing level of heart related risks. Heart rate monitoring system is a useful research area where basic heart rate can be viewed and reviewed anytime by any individual or the concerned people to monitor the heart rate for any sudden changes to see if it is alarming in case the heart rate is extremely high or extremely low.

The Heart rate monitors range back to 1977, which consisted of electrode leads, which were attached to the chest. The traditional Monitors usually consisted of two elements: A chest strap and a wrist band where water or liquid were used to measure the heart rate. As the time and people evolved and we became more technologically advanced, so did our sensors and monitors. In the current scenario we have a very well equipped heart rate monitor with built in microprocessors to analyze all the activities and provide more accurate reading of the same.

New advanced equipped models helps in the measurements of heart rate variability, activity, and breathing rate to examine parameters relating to a subject's fitness. Sensor fusion related algorithms allow these monitors to detect core temperature and dehydration.

With the world evolving at the most rapid rate, the technology is growing even bigger and faster than ever. It has made people more aware of the consequences of health and thus people are willing to learn to use the technology to their maximum benefit. The modern day technology not

only gives them scope for easy analysis of their health but also provides them a more accurate result than ever before. It is very difficult to get a very accurate reading for heart rate because we are constantly moving around and managing the work that we need to complete. Heart rate varies with many components like driving, exercising, and the adrenaline before doing something that you have never done, stress. Thus, it is very important to measure the heart rate very accurately to measure all the minute changes to give a well-formed and detailed report for any individual wearing the device with the heart rate monitor.

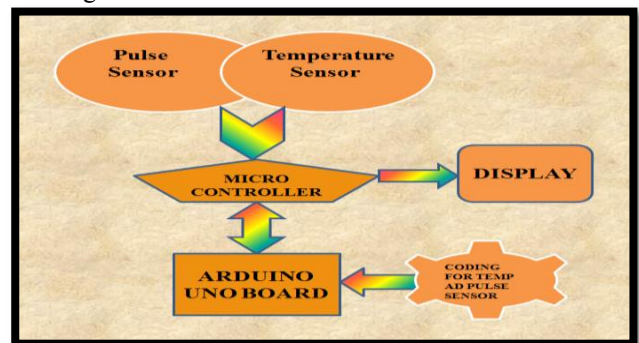


Fig. 1:- Basic Heart Rate monitoring flow chart

In this paper we will be discussing the various traditional Heart rate monitors that came into existences and analyzing the devices to create a framework to improve on the drawbacks from the existing devices and make a device with the maximum efficiency.

II. HARDWARE REQUIREMENTS

1. Pulse sensor- The plug and play oriented pulse sensor is used in this system. It is easy to use equipment targeted towards all kind of users such as students, athletes, elderly people and etc who want to get hold of the real time data acquired by the heart rate monitoring system. It consists of a simple optical heart rate sensor with amplification and noise cancellation functions. It gives out simple and reliable data and procures the advantage of being user friendly. It simply draws 5 volts power supply and is ready to be used. It consists of circular platform with a heart engraved on it, which is used to place the finger tip in order to obtain real time results. The pulse rate sensor

consists of a plug in unit which is attached to the Arduino and then it is ready to be used. As far as the wiring goes it consist of a standard male headers therefore there is no further requirement of soldering.

2. GSM module- GSM (global system for mobile) as the name suggests it a global initiative to connection two subscribers in order to communicate with each other. It also is used to establish a connection between a subscriber and a computing system. GSM module consists of a GSM modem along with a power supply to provide complete power to the system. A modem consists of a SIM (Subscriber Identity Module) in order to activate a subscriber and its network. The GSM also consists of a IMEI (International Mobile Equipment Identity) number for identification purposes. AGSM module can perform various different operations such as:
 - Receive or Send SMS
 - Add contacts
 - Make, Receive, or reject a voice calls
3. Atmega328 Micro controller- It is a single chip micro-controller created by Atmel in the megaAVRfamily.It is commonly used in projects related to engineering and electronics where power consumption, low cost low and a simple micro controller is needed. Its main application is on the Arduino Uno board which we shall be using in our prototype as well.
By executing powerful instructions in a single clock cycle, the device achieves throughput approaching 1 MIPS per MHz, balancing power consumption and processing speed.
4. Arduino Uno-It is a company that designs and manufactures micro-controller kits for projects. They are boards well equipped with input output pins that can be interfaced to various circuits and programmed to work as per the need or demand by the circuits. It can be programmed using C or C++ language for achieving the desired result. It provides IDE (Integrated development environment), which is a cross platform application written in the language Java. The Arduino can be connected to the power source through a power adapter or battery. It consists of both Hardware and a piece of software; therefore, it does not need a separate piece of hardware. Finally, it provides a standard form factor that breaks out the functions of the micro controller into a more accessible package.
5. Temperature Sensor- The LM35 temperature sensor varies voltage with the temp which is in centigrade. The 3 pins of temperature sensor are Vcc, output and ground.
6. LCD – It refers to liquid crystal display. It includes a register that stores the commands which is to be displayed on to the LCD screen. Generally, we use 16x2 LCD.
7. Li Ion Battery- It refers to Lithium Ion Battery. It is a rechargeable battery along with that it has a good capacity.

III. EXISTING SYSTEM MODELS

1. Thepaperin [1] deals with the body temperature and measures the heart rate with the health of

photoplethysmography technique. In which a light of a certain wavelength is incident on the body and the depth of the intensity determines the certain parameters which would be required to produce a result of the heart rate.

The hardware components such as Bluno development board is used which is a combination of Arduino UNO with BLE module. The three hardware components interfaces with the computer to display the results, for the same purpose the graphical user interface (GUI) design is developed using Window based application. The reading is taken after regular time intervals and the readings is recorded and displayed on the computer.

2. The system prescribed in [2] produces heartbeat measurement results detecting abnormalities based on the threshold level and informs the user of the abnormalities. It works after certain time frame.
3. The paper as proposed in [3] keeps tabs on the heart rate observing and caution capacity should screen those heart beat rate state about tolerant. The framework determines those heart beat rate for every minute and sends short message administration (SMS) caution to the cell phone. It is transportable and expense powerful. It is a proficient framework, which is not very tough to handle and accordingly gives extraordinary adaptability. Furthermore serves as an incredible change again over other traditional systems.
The systems describes two methods for measuring the heartbeat i.e., either by using the electrical method or by using the optical method. As per their structure, PPG waveforms and heart beat is displayed but this structure needs a lot of improvement as it lacks the alarm facility and other features.
4. The core purpose or the focus of the entire project has been on heart rate monitoring especially when a person fall fatigue. In this system Artificial Neural Network (ANN) is implemented which is capable to classify the fingerprint scanned into different groups.
Other than this system the architecture consists of four core parts such as pulse sensor, GPS sensor, GSM module and microcontroller.
The process flow of this device is as follows: Data acquired from the pulse sensor, followed by implementation of ANN and finally display of results and SMS being generated when such a situation is detected.
The ANN system described in [4] works is such a way that the input layer of the ANN consists of 2 neurons, which represent the reference heart rate and the current heart rate. In a real time system or practical implementation heart rate is taken at the first 2 minutes before the driver started to drive, and the current hear rate is measured and comparison is performed with the reference. The prime focus of this device is on drivers.
5. The hardware components used in this device referred in [5] are heart beat sensor, power supply unit, temperature sensor, Transmitter and receiver, zigbee

module, lcd. This paper consists of a very basic implementation of the heart rate and temperature monitoring system in order to focus on the senior citizens.

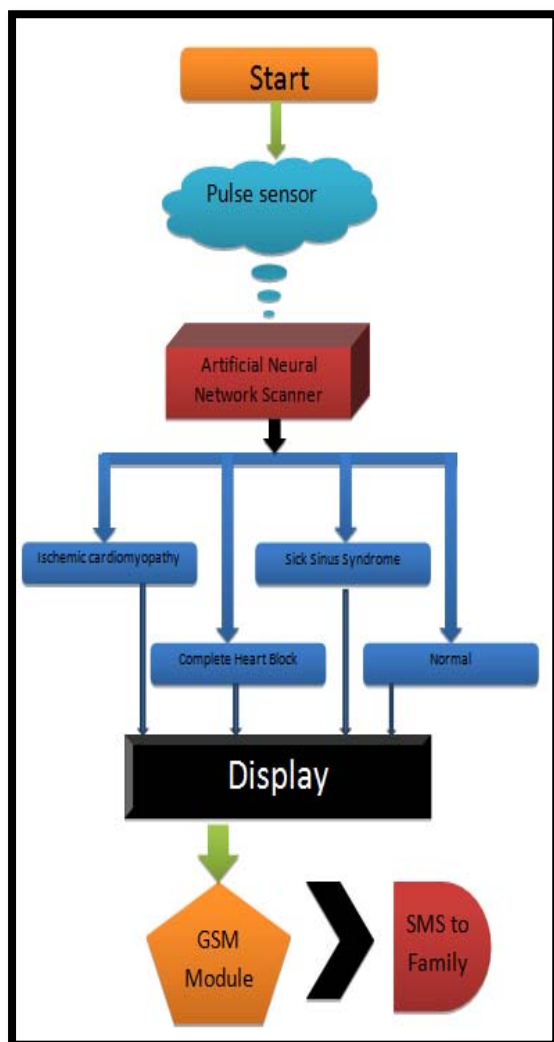


Fig. 2:-Flow Chart depicting an artificial network scanner components

6. This device in [6] consists of a GSM module, Microcontroller (MAX232), Temperature sensor, LCD, SMS and commands. The GSM is initialized by the help of (AT+CMGF) command. On the LCD a message is displayed regarding a reminder to check the temperature. After pressing a reset button the heart rate and temperature is calculated and the heart beat sensor gets the beat count and convert it per minute using a certain formula.
7. In the paper [7] they propose a Simple Wireless transmission System using common approach Sensor Platform called The wireless based Patient Sensor platform (WSP, Sensor Node) which has remote access capability. The architecture offers flexibility, easy customization for different vital parameter collecting and sending. Vital

parameter can be adjusted to meet demand. The wireless transceiver module technology can be suited for short distance limited only about 10 meters.

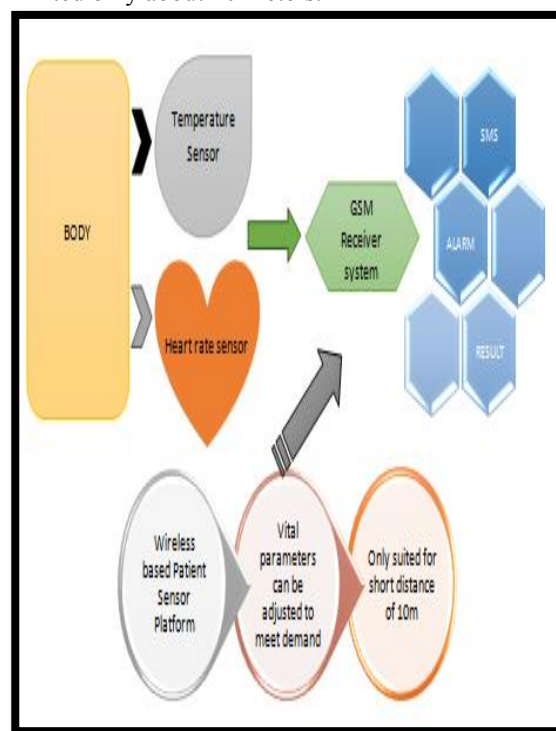


Fig. 3:-Simple Wireless Transmission System

8. The paper proposed in [8] highlights 3 main aspects on which the study is focused i.e., coverage, consumption of energy and the speed. Sensors sense and collect the vital parameters from the body and send it to the health care units. By WSNs they tend to show the importance of wirelessly connecting allowing the patient to be freely roaming and not being restricted to a specific area. It focuses on increasing the number of relay nodes so that the packet loss is minimized by the obstructions and specifically making the network more reliable.
9. The paper in [9] presents the model which is entirely focused on senior citizens wherein the device doesn't affect the daily routine activities of the person who is wearing it. apart from that, they have addressed power management as one of the key point including the water resistant capability and at the same time making the device user friendly testing it on the a group of senior citizens and thereby, analyzing their response.
10. In the architecture proposed in [10], they use a smart phone for calculating the light intensity which is used for heart beat calculation and along with that, specifying the algorithm for heart beat sound. With the help of these two, various heart related problems can be detected.
11. In the paper [11], the writers recommended that for measuring mental workload in a test and evaluation environment, observed that heart rate was one of the most frequently used techniques for assessing aspects

of operator workload. They conducted the test in two stages, where in at first they were given no task to do and had to take a test but in the second half of the test they were exposed to driving a vehicle and bear through more distractions; after which their heart rates were measured for all the obtained changes.

IV. IMPLEMENTATION

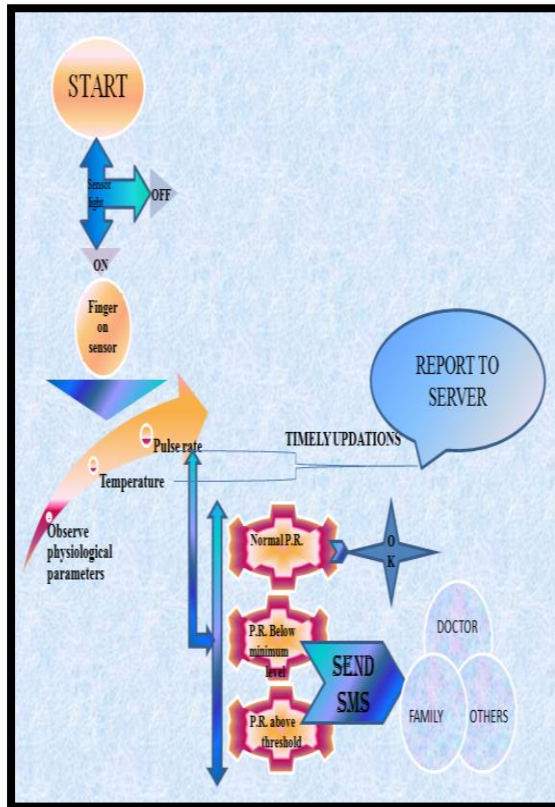


Fig. 4:- flow chart depicting work of each entity

Herein is a description of the device to be implemented.

1. After making the connections, switch on the power supply.
2. The sensor light will be on in case of pulse rate sensor. If the light doesn't get on check for the faults.
3. Once the connections are made keep your finger on pulse rate sensor and temperature sensor.
4. Observe your physiological parameters. Along with that, check whether the pulse rate is normal, above threshold or below the minimum level.
5. In case the pulse rate and temperature is normal, everything is ok.
6. If the pulse rate goes above the threshold, there are chances of major heart attack keeping in account the physiological parameters. If the pulse rate goes below the minimum level set, then there are chances of minor heart attack noticing physiological parameters herein too.

In such cases of abnormalities, an SMS will be sent through GSM to doctors, family members or any other concerned person.

7. Also, timely updated information will be sent to the server of pulse rate and temperature wherein any authorized person can view the details at any given time by login.

V. RESULTS AND DISCUSSION

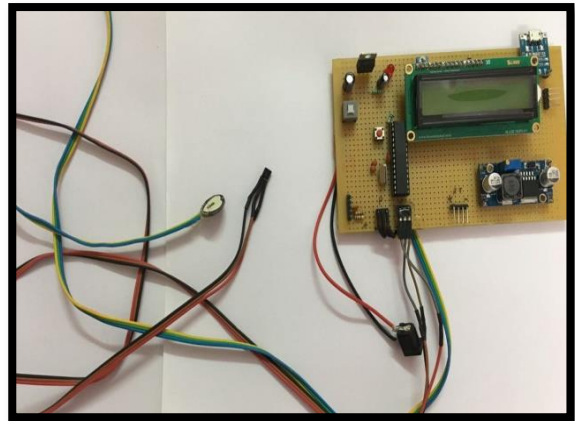


Fig. 5 Actual heart rate monitoring prototype

Figure 5 describes the heart rate monitoring system which consists of different components such as temperature sensor, pulse rate sensor, LCD display, battery and power supply, microcontroller. The pulse and temperature sensor wires extend along with a platform attached to them in order to avail the results of a patient. All the devices have been carefully soldered onto the printed circuit board making sure that none of the wires collide with each other. The heart rate monitoring system works in the following manner:

Once the switch on button has been pressed, the LCD will display the desired name of the device. Within few seconds the device will be stable & one can place their finger on the pulse sensor and gripping the temperature sensor with the fingers. After waiting for few seconds the results would be displayed on the screen. For instance if a person's pulse is below a certain limit or above the certain limit then in that case the alarm would be generated. Further on by incorporating the GSM module along to this very particular system SOS SMS would be sent out to the concerned people. The GSM module would be programmed along with the microcontroller in such a way that it processes the data in an accurate manner and only process the data whenever required.

The various alarms that could possibly take place are:-

1. Ischemic Cardiomyopathy - This is type of a condition which needs to be addressed by the heart rate monitoring system. This situation takes place the heart tends to get weak causing a heart attack or a disease. It occurs when the arteries that supply blood to your heart muscle become narrow. This restrains the blood to

reach out to the heart. This inhibits the heart to pump blood to the body and therefore cause to heart failure.

In such a condition a prior alarm will be generated just when the pulse seem to be dropping.

2. Sick sinus syndrome -It is a group of heart rhythm problems which tends to develop with age due to which a pacemaker is required in order regulate the heart beats, which tend to get faster and slower on a random basis. Since this a medical situation particularly of elderly people therefore it is also vital to incorporate the limits in the heart rate module which can alarm out to the concerned people of the patient.
3. Heart block- Often people are born with such medical condition of heart block while other develop it. The ones who further develop are due to diseases, surgery, or medicines. Mainly there are three types of heart blockages, first is the least severe one and third degree being the most therefore such conditions are also looked after in the alarming system of the device.

Along with that, on the server we can view the data depicting temperature and pulse rate along with date and time. The possible ways to send readings to the server could be either through accessing the site requestmaker.com which helps to process the request to the requested URL wherein you can set the values by yourself(temperature and pulse rate) and view them on the server page (specified URL). The URL can be created using Hostinger.in where we can create files after creating database and thereafter writing programming in PHP language. The specified URL will act as a server page.

ID	Date	Time	Temp	Pulse
1	01-03-2017	07:13:43 am	90.0	78.0
2	01-03-2017	10:53:12 am	92.0	89.0
3	01-03-2017	11:23:50 am	89.0	78.0
4	01-03-2017	11:36:08 am	78.0	78.0
5	10-03-2017	05:54:44 pm	98.6	72.0

Fig. 6 Glimpse of server page

Figure 6 shows the server page. Using the details of FTP access in the Hostinger account and thereafter logging on WinSCP application will help to view the files created for the server. The continuous readings can be sent to server after amalgamating hardware and software. The URL will display readings after every certain time interval. The

health care units can view the same on the server after login.

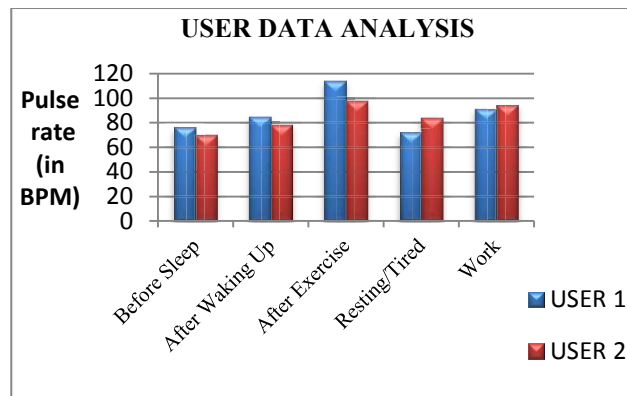


Fig. 7 Analysis of 2 users of different age groups

Figure 7 shows the analysis of two users. User 1's age is 21 and user 2's age is 50. On the basis of various evaluating parameters (Before Sleep, After Waking up, After Exercising, When Resting or Tired or While at Work place), beats per minute(bpm) have been tested with the help of HeartRateFree application. The evaluation shows a great rise in bpm after exercise, shows normal heartbeat when tired or before sleep and after waking up shows a small rise in heart beat above normal level.

On the basis of above analysis, various variations can be drawn. Some of them are listed below:-

- A normal pulse rate lies in the range of 60-80 bpm but when a heart attack take place the heart rate gets changed due to the disrupted flow of blood.
- During a heart attack, there is a rapid fluctuation of heart rate; it could vary from slow to fast.
- Tachycardia is a heart rate that refers to the condition when the heart rate exceeds the normal heart rate i.e., it is above the threshold in the resting condition. In such a condition there are chances of stroke. Sometimes, the heart rate above threshold might be due to workout but that doesn't count in for tachycardia.
- Heart block occurs during heart attacks when there is a delayed heart rate response due to improper functioning of the electrical conduction system.

VI. CONCLUSION

Hitherto the idea of heart rate monitoring system has kept on evolving ever since the concept of pulse sensor came into action. Heart rate monitoring system is a project which has great potential to develop in the near future. The idea that has been proposed in this system requires some basic hardware which can easily be procured. Further on proposing to do some additional changes in the system which requires of a GPS module which is linked to all the hospitals of the city. During such alarming situation stringent measures can be taken. The module can map out the nearest hospital and send out SOS to it and the kin of

the patient so that hasten work is carried forward. Further on an application can be developed which can carry forward next steps which need to be taken for a heart patient. Being cognizant regarding a medical patient special care must be taken therefore it is vital to have an app which follows up with the graphical representation of the results obtained from the patient's pulse rate.

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