

# Heartbeat Sensor System for Remote Health Monitoring

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## ABSTRACT

This paper portrays a heartbeat sensor system with a database connection to the hospital which would be part of a project called heartbeat sensor for the hospital management with database connection. The database stores the entire details of the patient which enables the doctor to monitor the patient accordingly via the web app. The heartbeat sensor device with a database links to the hospital network is beneficial to patients and the community where the introduction of such a device can reduce the risk of the patient as well as save hospital bills, waiting time and reduce hospital traffic. Wireless sensors for heart rate and body temperature are incorporated in the proposed health monitoring program but this paper focuses only on heartbeat sensors for hospital management with a database communication system. Arduino is the primary element that is convoluted in this project. This paper highlights the sensor health monitoring system which establishes a selection model for sensor automation to find the least informative, cost-effective sensor component and builds an energy-efficient, automated detection scheme based on the sensor selective method.

## Keywords

Remote Health Monitoring, Sensor System

## 1. INTRODUCTION

A heartbeat sensor is a device that helps us to detect the heart rate of a person. It helps a person to get the heart rate checked up and thus helps us to monitor the heartbeat. It is mainly a heartbeat sensor framework that is connected with the database and there is also an emergency system that is associated with any hospital management. Said device also, can store the data of patients as well.

## 2. HEARTBEAT SENSOR SYSTEM

### 2.1 Previous Work

The heartbeat sensor system is developed on a system that uses android applications which is a remote monitoring system. The LM35 and ppm sensors are attached to the PIC16F887A microcontroller and it is converted to the android-based mobile application via Bluetooth and GSM module technology [1]. All the related data can be stored on computers, smartphones and cloud storage also. The Arduino transforms this transition into the heartbeat per minute (BPM) [2] and the LED attached to pin 13 would blink. The number of veins in the finger varies with the aid of sensors and bright LED, the heartbeat is calculated while the thermostat is calculated by using the accurate digital temperature sensor LM35 [2]. The data received is collected in the Arduino UNO and displayed on the LCD. Monitoring remote patients preserve both their and doctor's time and thereby enhance the performance and the quality of health care services [3]. The Digital Health Control System comprises three functionalities, namely the data sensor unit, data processing unit and the data

communication unit [3]. The use of wireless communication is improved to satisfy the need for motion sensors and tracking. Monitoring devices for hospital health care are very necessary to control and record the patient's physical and physical parameters continuously because of the growth of the aging population as well as the increasing population globally. R&D covers a smart object or device manufacturing techniques, effective wireless devices, development boards, communication protocol design technologies and many more. The latest projects are explored in designing something relevant and helpful applications for using low-cost development boards like Raspberry Pi and Arduino [4]. Most of the popular apps are developed to use these boards to facilitate the residential need, patient's security services as well as climate and remote sensing systems [5].

There are so many functions on cardiac beats viz. many wireless device monitoring systems use Arduino board for patients (heart rate and humidity) [2]. It also helps for heart pulse scanning technique in real time by using wireless sensor network and smart phone device. Heart beat diagnosis and the data system used Arduino that monitors heart beat with the heartbeat sensor displays the BPM measurements on the LCD linked to it.

Development of medical sector is largely contributed by the rapid growth of technological progress in industrialized and developed countries which help the human legibility and also the survival rate gets increased. But because of inadequate facilities of advanced medical equipment developing countries are deprived of having proper diagnosis and treatment. Wireless network is now available to ordinary citizens which facilitate them to avail its services. During the aftermath of Gulf war crisis in Iraq the use of new technology such as internet networks including satellite became dominant control within its structure. In this crisis period of Iraq these techniques were used to support the outbreak of many infections and epidemics which led to rising fatality rates including a high hart rate of aged folk and extreme high fever temperature with the children. Thus, after the crisis in Iraq a system was developed to detect the said diseases quickly which helped to eliminate the number of fatalities. It is to be noted that previously some groups proposed about the wireless sensor networks which can monitor patient's temperature, heart rate, body temperature and accurate blood pressure measurement [9]. Traditionally a WSN based mobile sensor monitoring device includes ECG 24 which measures the heart's rhythm and electrical activity and also check pulse rate from oxygen saturation level [9]. This technique addresses a concept which advices the patients to always use the device that helps to track patient's critical conditions. Also, the medical workers and family members are provided with the information which is sent to the remote end from the computer and shown on an LCD monitor by the system [2].

## 2.2 Limitations

It is to be stated that as per earlier method body temperature and human heart rates are measured by raspberry pi and the obtained data are stored in a third-party online platform Amazon [7]. But the core idea of this paper is about wireless health sensor integration cloud and network computing which can store the related information in the hospital database that is directly connected with our proposed system.

The heartbeat monitoring sensor system is developed and designed with a small, reliable, secure, and low power medical device. Taking into consideration the previously-stored history in the proposed database system which includes monitored condition of the patients and all other related information viz. prescription and identification etc. doctors and patients can now monitor and record in detail which was not possible in the past. The sensor is equipped with an emergency feature by which a message is relayed to the hospital management in case the patient faces an emergency and thus hospital can take necessary steps for the treatment of the patient but this feature was not available in the past. This device can be made by many hardware but the Arduino UNO is the cheapest one and most people can afford it. On the other hand, the other devices like Raspberry Pi etc. are more costly than Arduino UNO. In the other paper for communication, a device for monitoring parameters including body heat, heart rate, blood pressure, and ZigBee is proposed by some researchers to forward the data to the computer through the RS-232 serial port. Here the data is not only stored on the computer but also transmitted to a smartphone [8] but WSN is easier, helpful, and faster technology. Globally population is getting increased and a good number of people are getting aged. Therefore, it is the demand of the time for hospital management to track and monitor these highly risked aged patient's heartbeat parameters regularly. Nowadays with the technological innovations wireless networks play a vital role to create exciting opportunities in the medical markets [3]. Heartbeat sensor offers a way to research bone density which can be based on the psycho-physiological signal concept used as a signal for the virtual-reality system. The number of veins in the finger varies with the aid of sensors and bright LED, the heartbeat is calculated while the thermostat is calculated by using the accurate digital temperature sensor LM35. Both of the data are recorded in the Arduino UNO and sent wirelessly to the receiver side using an NRF transmitter and collected by using an NRF receiver at the user end. The data received is collected in the Arduino UNO, and the test result is successfully displayed at the remote end with the help of the LCD. The wireless transmission is chosen although it allows the sensor devices greater functionality and eliminates the expense of multi-transmission parts [1]. But here using a smartphone and an app it can display and save the data comfortably and also there should be a hospital main device that stores individual data for each patient. The heartbeat sensor works on the human body which takes many parameters from the body that are usually the reasons of heart failure [12].

## 3. METHODOLOGY

Sensor health monitoring is a list of techniques performed to keep a system in fully functional conditions that can be restricted to observe the current state of the system with these kinds of observations requiring maintenance and repair. The segment on methodology must explain clearly why the approaches match to the goals and reassure the user and why it is chosen to relate the choices to the core aim of the analysis

in the section. The main objectives and research are to give the patient proper treatment and services as much as possible.

The purpose is not just to describe the methods but to show how and why those are applied and to demonstrate that the research is rigorously conducted. The paper shows that the sensor health monitoring system begins a selection model for sensor mechanization to find the minimum helpful and cheap sensor component which builds an energy-efficient, automated detection scheme based on the sensor selective method.

### 3.1 IoT Device

To configure the system and to introduce the IoT implementation certain types of equipment are to be discussed at first. For example, there are many forms of devices available in the mart but this method is using the Arduino Uno microcontroller board which is based on ATmega328P. It is mostly known to all the people who are in the electronics field [6]. It is also easy to store program code into it [7]. By using a USB cable, the simplified version of the C++ code can be uploaded into it and that is why it can easily bypass all the functions of the micro-controller into a more accessible package and sends it to the database. In this project, the patient can use Arduino Uno which enables the heartbeat sensor to check his/her heartbeat rate regularly. The design of the project can be done by adding an LCD (16x2) monitor with Arduino UNO which can calculate the human heartbeat rate. Arduino is mostly affordable to all which can be used in thousands of projects, especially it can run on Mac, Windows, and Linux. Arduino UNO has also an option to upload in the cloud and it has also the privilege to keep backups on the device. It always updates the device regularly when it is necessary and it also installs a community-generated library. This device can also be used offline while it must be used with an Integrated Development Environment (IDE) version on the desktop. The proposed device helps to get those required parameters tracked which are important for measuring a health condition of a human heart [11]. Heartbeat can be measured in two ways - either manually by checking the pulse rate of the finger, wrist, and neck or it can be measured through digitally used sensors but in that case, the patient must carry a sensor device like Arduino UNO. When the heartbeat sensor is added to the Arduino Uno then the sensor can measure the heartbeat rate. While the heartbeat rate is measured it then generates a digital numbered output of the heartbeat and displays the result on the screen. The heartbeat sensor counts every pulse through the hand by using the principle of the light module.

### 3.2 Work Procedure

To process the work at the very beginning it is needed to scan the QR code from the Arduino Uno device which is the IP address of the device and then the database checks the patient's identity (patient's ID is valid or not). So, it is evident that every Arduino Uno has individual IP addresses by which the database traces individual patient's information. A wireless sensor network is used for this type of sensor which is linked to the database remotely from anywhere. That is why tracking every IP address in a sensor is highly important.

When the database detects the patient's ID validity then it gives the login page. It can get now access anywhere from both mobile or web applications and all the information obtained from the patient through the sensor will be stored securely in the hospital database. The saved database then sends a confirmation text to the patient's device that the sensor starts running successfully.

For this procedure, the database measures the patient's actual physical condition from the beginning. The sensor reads the data and compares it with the medical history of the patient which is stored immediately in the database system. Then by using a wireless sensor network the database communicates with the master device remotely.

A sensor grid is designed in the United States where all the grid networks can be connected to WSN and it is a sensor grid gateway. Sync is sometimes used to update data flow WSN application which is called upstream. Again, many sensors work to spread configurations or commands which are called downstream. Some of the non-IP based gateways used for WSN interconnection are called the Internet. A sensor device sometimes has a weakness for delays, incorrect results, inaccurate measurements, data drops, and so on. Traditionally WSN (wireless sensor network) may be connected via non-IP-based Bluetooth or scanning bar code using only a gateway for an interconnecting sensor to the database. Heartbeat monitoring system which is reliable can carefully send the data much faster using IP address, gateway, and internet [6]. It takes only 0.13 seconds when the server of the sensor is connected with the smart border router and database through the Local Area Network (LAN) and the duration for Wireless LAN (WLAN) is approximately 0.17 seconds [6] but sometimes it lacks and sometimes it takes much more time to give a result. Such a system can process a real-time signal which is generated from the biosensor. It smoothly passes the information to the database by using an IP address and a gateway [5]. The signals also transmit the patient's details and all related information to the medical center's server.

When the message gets inflicted on the database then firstly it saves the information and by using the said information the database starts to analyze the situation. The system will notify the user that everything is well monitored and the system will also continue normally while the device detects the patient's heartbeat rate is under control. On the other hand, the

system sends a message immediately and notifies the hospital database and management if an unbalanced heartbeat rate of the patient and something wrong is detected.

After receiving the notification, the system will automatically find the nearest available ambulance to pick up the patient. With the help of GPS, the driver can trace the location of the patient to pick him/her up to the hospital immediately. Thus, these services can easily avoid the wastage of time and can arrange the transportation of the patient with the ambulance. The said services work through a simple procedure with the help of the hospital database.

In absence of said services, the relatives of the patient cannot understand what steps are to be taken immediately in case a patient suffers from a heartbeat fall. But it is easier for the patients and his/her relatives to find an immediate solution for arranging an ambulance automatically through this procedure. While the ambulance starts for the hospital with the patient the database sends a message to the specialized doctor to get ready for receiving the patient for appropriate treatment according to the record already stored in the hospital database. For further checkups, the master device sends information to the database which displays the information about the patient to the interface.

In case no specialized doctor is found available then the information is relayed to the emergency department and consequently the doctors on duty start giving the emergency treatment to the patient. After the treatment in the emergency department further visiting appointments is given to the patient in case of requirement. Details of treatment together with prescribed medicines are stored in the database. The system can retrieve the patient's treatment in detail if he/she faces any heart problem in the future which helps the attending doctor for the proper treatment. All these procedures for conducting the treatment are saved and displayed in both the hospital database and the master device for future requirements. The process is illustrated below in Figure 1.

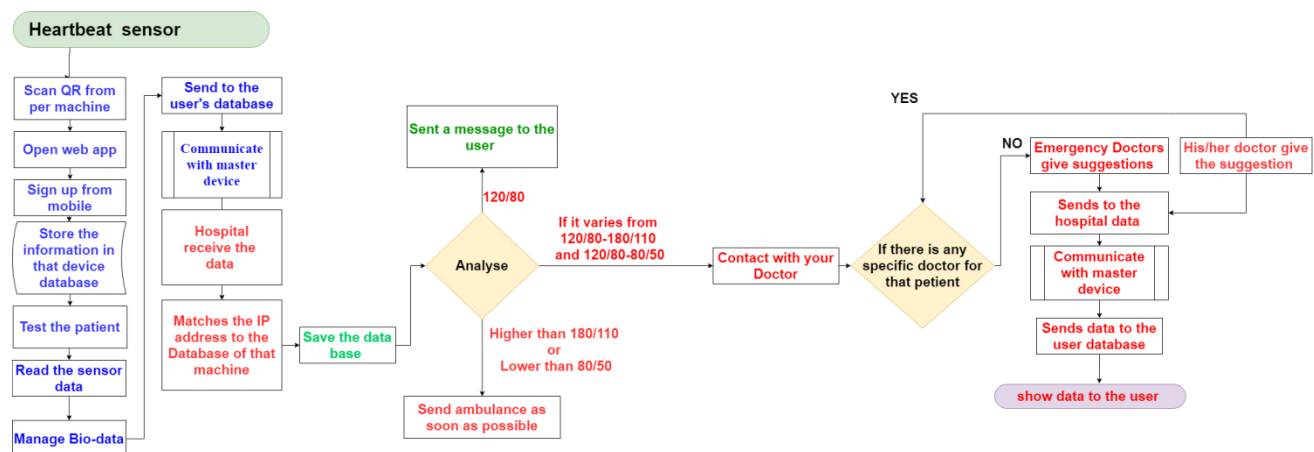


Fig 1: Flow Chart of the Proposed System

### 3.3 Result and Analysis

The proposed system is directly connected with the hospital database which helps to communicate the patients while necessary but these facilities are not available in the previous works. A patient is in normal condition if the measurement shows 120-80 mm Hg; consequently, no emergency notification is sent to the hospital. A physical problem confronts the patient when the bp fluctuates and as a result the system automatically notifies the hospital. Doctors can take necessary steps according to the condition of the patient as per

data provided with the system. The situation becomes very critical while the bp goes up 180/110 or goes below 80/50 according to flowchart. Under this situation alarming notification is sent to the hospital and the ambulance is sent immediately together with the doctor if necessary, to pick up the patient. Thus, the proposed system can save many lives and develop the hospital management system.

### 3.4 Discussion and future work

Normally the heart and blood circulation of a healthy person is always normal but the person gets heart attacked if the

circulation is disrupted. It can be measured by heartbeat rhythm by using a blood pressure sensor but it is hard to use and difficult to carry and some sensors give incorrect information as well. This problem can be solved by new technology. The theoreticians and developers are trying to develop a perfect system to measure the accurate heartbeat rate but modern technology sometimes cannot solve this problem. However, in course of new development, some electromechanical and Nano system technology is developed and now the newly developed sensor technology is used to measure the heartbeat rhythm with Body Sensor Network (BSN) application. With these sensors, the doctors can give the patients emergency treatment which helps the patients to recover quickly. It is a user-friendly device by which the patients can get the services quickly who are far away from the hospital. Patients' mortality rate is reduced due to the immediate availability of ambulance through this sensor which does not keep the patients waiting for getting admitted to the hospital. To operate this device, it only needs a portable battery that provides enough energy with a backup of 10 hours duration. The proposed heartbeat monitoring system is user-friendly, easy to operate, low cost, and reusable [7] [10].

Sometimes heartbeat sensor systems may face a single point failure problem because of the central control-based system but to get rid of this problem there are some reliable solutions with standard and calibrated medical devices. Multiple biosensors can ensure signal quality as well. An infrastructural ad-hoc property is good for traffic that allows adaptability and the traffic interrelation is very important for BSNs which work in places that collect physical parameters. When a patient feels fever his/her body temperature rises and at the same time blood pressure also increases while breathing rate is gradually decreased. At the same time, this changes the blood oxygen saturation level. A person's physical parameters are triggered by heart beating and a bio signal rhythm can be discovered by a similar biosensor. In modern times there are some biosensors that are accessible to the body sensor network. Some electrical devices can keep the heart moving and this electrical rhythm of the heart is changed by the contraction of the electric heart and by this electrical rhythm examination of the heart by an Electrocardiogram (ECG). But all the electronics biosensors have certain buffer issues to their sensitive and sensory data. Serious patients always need proper monitoring, proper medication, and all kinds of medical services as long as they do not recover properly. In such cases, a new technology of wireless monitoring systems can be brought for the treatment of the patients by which they can operate everything on their own to connect their phone with the Heartbeat Patient Monitoring App. Red blood cells and hemoglobin are added while blood passes through the body and the advantage of measuring is how the LED light is transmitted through the finger, wrist and neck. Here optical sensors are used only to measure the amount of blood while heartbeat rate is measured by measuring blood volume. It consists of a combination of two things: infrared LED and photodiode. For example, in the accelerometer, accelerators are embedded for ECG which leads to increased performance. Heartbeat patients' monitoring system is used as a portable device that connects with mobile or PC or Bluetooth devices. Many tests such as glucose test, uric acid, cholesterol, and other test induce with the help of biosensor.

Health care product nowadays helps us to monitor physical condition instantly and efficiently. This paper represents a secure health monitoring system with an emergency service to the hospital and also the database which can store all records of a patient. For emergency reasons, there are so many things

in line but blood pressure may cause the major reason as blood pressure fluctuates which may cause stroke and other heart diseases including many risk factors. With the introduction of this device, there will be a tremendous improvement in the future which will contribute to reducing the death rate of the patient in the hospital. The plan is to build a device using different kinds of microcontroller and also to build a database that links with the hospital.

### **3.5 Conclusion**

The main objective of this paper is to present the idea that can help many dying patients who can be saved by regular monitoring of the heart rate. Emergency service can be helpful to get an ambulance to the doorstep which in turn will be beneficial for those who stay alone in a house. The patient just has to use it in their hand to get the optimal result.

The proposed theory can help the patient to be more careful and reduce the chance of dying without proper medical treatment. Therefore, we propose and highly recommend working on this research work to get it implemented for the welfare of mankind.

### **3.6 Acknowledgment**

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