# Real-Time Health Monitoring System Using GPRS Communication between Embedded System and Android Phone

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**Abstract:** At present, patient monitoring systems which continuously monitor patient's health parameters in hospitals require that sensors need to be attached to monitoring system or PCs, and hence confining the patient to the hospital bed. Consistent monitoring of patient's vital health related signs is very important in the medical field. Remote medical monitoring allows patients to collect and view health related data while on the go, improving the quality of life of those asked to wear sensors for tests. This data is then easily accessed by health care providers, given that Smartphone's are easily synced with an online database that hosts a content management system (CMS).This has proven to lower health care costs, improve the quality of the care provided by offering 24 hour monitoring, and provide access to those living in remote areas or have trouble travelling to hospitals and clinics. This project present a health monitoring system which monitors certain health parameters like pulse rate, body temperature and electrocardiogram (ECG) activity. This health monitoring system consists of a data acquiring module, a GPRS module for communication and a module for displaying the data at the destination (Android phone). The design is ideal for applications that require real-time monitoring of data and communicating the measured values instantaneously. So in this project smartphones running the Android Operating System communicate wirelessly in real-time with an embedded system. System uses FPGA based embedded system which communicates using GPRS communication module to an android phone. The Android OS is the fastest growing OS on the mobile market. Furthermore, it is open source; thus allowing more ease and freedom when developing applications.

**Keywords:** FPGA, Wireless communication, Android, GPRS.

## I.     INTRODUCTION

In the past pace of life it is difficult for people to be constantly available for their near ones who might need them while they are suffering from any disease or physical disorder. So constant monitoring of the patient's body parameters such as pulse rate, body temperature and ECG becomes difficult. In ICU's nurses or other care taker may not be available for constant monitoring of the patient's health. Due to this sometime the patient's health changes to critical from normal condition. The present patient monitoring systems in hospitals allow continuous monitoring of patient vital signs, which require the sensors to be hardwired to nearby, bedside monitors or PCs, and essentially confine the patient to his hospital bed. Even after connecting these systems to a particular patient, a paramedical assistant need to continuously monitor and note down all the vital parameters of a given patient by keeping track of all of his/her records manually. Adopting such a method is error prone and may lead to disaster in the case of a human error. Also in recent years, Smartphone's have become many people's primary personal computing device due to their vast capabilities, low cost, and mobility. By exploiting the Smartphone's wireless capabilities, a user is then able to control various other devices and monitor a wide array of sensors remotely. As an example, the advantages of this ability in tele health applications are numerous.

*A.   Selection of physiological parameters*
1. Pulse Rate: As the statistics revealed earlier that Heart Attack causes the most number of Deaths in the world, it was decided that have Heart Beat Monitoring as one of the Parameters.

Below it is explained as to How Heart Beat is monitored:-
1.      The heart beat rate of the patient is constantly monitored.
2.      The normal range of heart rate is 60 to 100.
3.      If at all the rate increases above 100 or decreases below 60, it may be fatal.
The sensor records the data and constantly sends the parameter to graphical display which is placed near to the patient. If the parameter(s) deviate from the standard range, it will indicate the doctor via a GPRS consisting parameters of the patient.
2. Temperature: Also High/Low Body Temperature can cause such illness that can prove Fatal. It plays a very important part in maintaining Blood Pressure etc.

Below it is explained as to How Body Temperature is monitored:-
1.      The temperature of the patient is said to be normal above 95^F and below 104^F.
2.      If the temperature falls below 95^F, that means the blood circulation has fallen below reqd. level and hence it may prove fatal.
3.      As soon as the temperature falls below 95^F the doctor is notified via SMS.

Body temperature is lower in the morning than it is in late afternoon and evening. Temperature can vary with other factors, such as exercise, drinking hot or cold fluids, sitting in a cold room, fighting an infection, and by the accuracy and type of thermometer used. The normal core body temperature of a healthy, resting adult human being is stated to be at 98.6 degrees Fahrenheit or 37.0 degrees Celsius.

3. ECG: Nowadays, diseases related to heart are increasing. Around world due to cardiac arrest unexpected & sudden death rate has been increased. The system which will warn about onset of diseases early will be helpful to the society. This can be achieved by doing enhancements in the existing health monitoring systems. According to WHO (World Health Organization) heart related problems are increasing. These heart related problems occur due to modern lifestyle, smoking, obesity, food habits & lack of physical exercises etc. The patient after their operation may develop some complications after they get discharge from the hospital. Post operation when patient start doing their work, the heart problems can reoccur. Hence after the treatment for some time ECG monitoring is necessary. This help in detecting the improper functioning. If the treatment is provided the patient in so-called golden hour then many of the lives can be saved.

*B.  Usage of Android application*
Mobile phone based health monitoring allows caregivers a better way to monitor their patients and the cost is also less compared to staying in hospitals. The objective is to develop a mobile platform that has the capability to collect sensor data from heterogeneous wearable sensors, process the data, analyze the data and trigger the warning messages to doctors. The system will provide the capability to visualize the signal in doctors mobile. The doctor will get the warning message in his mobile. The involvement of the doctors will help this system to be more accurate and acceptable for health monitoring.

The android application can communicate to the hardware via GPRS device. The data is received from hardware. Data received can be displayed on application i.e. temperature and heart rate pulse and ECG related information. This data can be analyzed for predicting patient's condition. For prediction of threshold values for these parameters are set. When these values will be below or upper the threshold value then message will be popped up on doctor's phone on which an android application is installed. In that application doctor will be able to see the details of the patient.
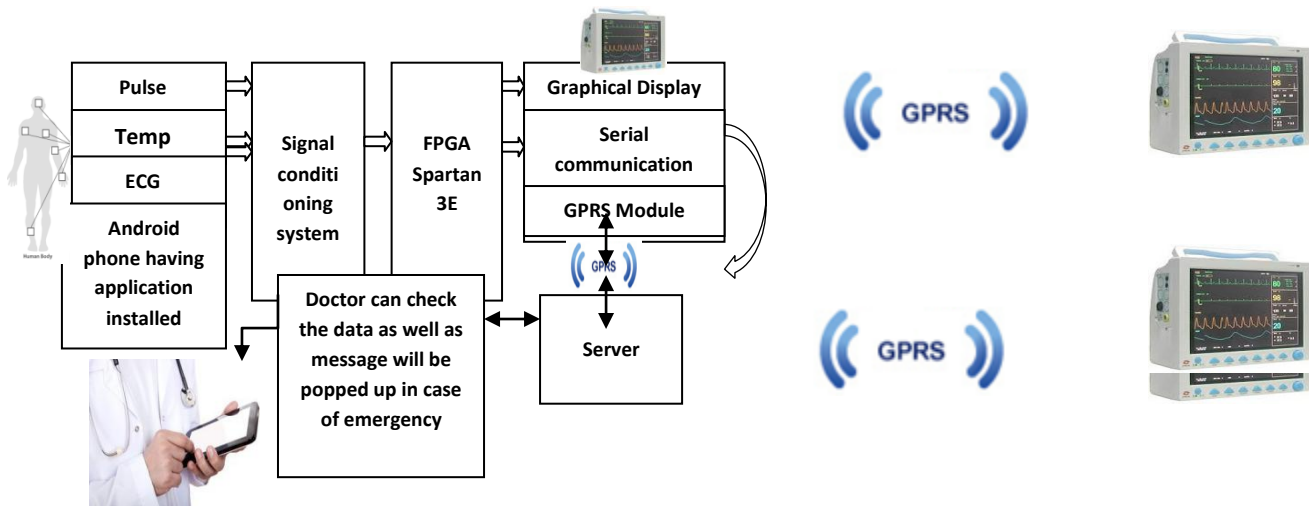
## II.      BLOCK DIAGRAM



Fig 1: Complete Block Diagram of Proposed System

Mainly the block diagram of the project consists of FPGA, Sensors, GPRS modem, Power supply and Liquid Crystal Display. Doctor should receive immediate alerts in all the emergency cases. So GPRS based network is used for communication between doctor and patient. Each patient will be given this module and with the help of this module the patient health condition is monitored and if there is any change in the condition of the health then it immediately sends that changed data through GPRS to the doctor's phone on which android application is installed. In this we check the patient's health condition by monitoring the heartbeat.

Firstly, the signal acquisition occurs from the transmitter section. Then comes the signal processing and if required data conversion to digital form takes place. Later on decision is made by comparison of signal values obtained with the standard values and; and the last stage is the transmission of patient's condition to the doctor. Sensors continuously monitor and provide analog/digital signals in response to inputs of various features of the patient like temperature, heart beat and ECG and these outputted signals can be read by a reader or an instrument. Usually the sensor signal is weak in nature and hence it requires processing. The processing may include amplification and noise cancellation. The amplified signal is converted into the corresponding digital signals if required using an analog to digital converter by means of which, it provides the easiest way to communicate. These digital processed signals are given to a decision algorithm. These signals are compared with the standard statistics of a normal standard values. Finally the data/ health condition of the subject is transmitted to the doctor (receiving wireless device on which the android application is installed). LCD displays are used to display the good and bad conditions of the patient. The doctor receives real time data in his Android based mobile device. Android platform is used due to its availability and future growth related aspects.

## III. RESULTS

Temperature sensor is interfaced to ADC0808 and FPGA Spartan 3. Temperature sensor gives analog output which is converted to digital using ADC0808 and then processed on FPGA. Hear beat sensor does not ADC. Then this data from all the sensors is uploaded on server. And android application which is installed on doctor's phone displays message in case of emergency or critical situations.
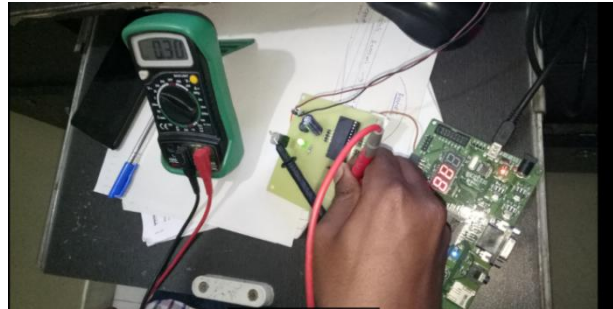


Fig 2: Output of Temperature Sensor



Fig 3: 7 Segment display showing the output



Fig 4: Clear view of the output

## IV. CONCLUSIONS

This paper can help to monitor health parameters such as temperature of the body, pulse rate and ECG. Thus communication established between microcontroller and Android phone (having application installed) using GPRS can serve as the infrastructure in the health monitoring system. And this wireless communication then can help medical personnel to see the data on Smartphone and analyze that data. Doctor can check the data as well as message will be popped up in case of emergency on doctor's phone. This helps to track emergency and dangerous situations and any change in patient's health parameters can be handled in a real time. This system can be expanded by adding various other sensors such as blood pressure sensor and biometric sensors. The main advantage of this system is that when abnormalities are detected in the patient's health parameters then doctor is immediately notified with a message so that patient receives fast treatment.

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