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Iot Based Human Health Monitoring System

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Abstract: ***IOT has plays important role in the upcoming technologies. It is connecting appliance each other over the internet. The main purpose of this paper is to give better services for remote place patient. Our plan is to design the Human Health Monitoring System based on IOT is measure the patient's Heart rate, temperature, drop down detection and giving the caution in critical situation. It can be used to promote basic nursing care in the hospital environment by improving the quality of care and patient safety. Rural area of India is lack behind from the proper patient monitoring system. The main objective is to give the awareness instruction and also remote monitoring by sharing proper information in an authenticated manner and decreases valuable time of doctors. They don't need to wait for the reports because sensors are giving real time data. It is useful rural areas people.***

Keywords**: Android phone, ESP 8266 WiFi module, LM35 temperature sensor, MEMS sensor, Heart sensor, Arduino module.***

I. INTRODUCTION

Because of expanding work cost, medical institutions would constrain to decrease nursing staff for patients. This paper is to develop new innovations for the use of basic nursing care. In this paper, initiate reliable IOT based healthcare monitoring system. In order to achieve a robust and efficient IOT based communication model that will use strong crypto-primitives to design two communication systems for secure transmission. By designing a separate nursing system that will give a new proportions and each patient can be observe remotely. By this on the basis of derived data if a patient is in critical situation, an immediate instruction can be given to the one who is in charge. It may play a vital role to reduce labor cost, rather will be easy to assess from anywhere anytime and will be helpful to take immediate decision[1]. Wireless healthcare is playing a major role with the upcoming rate of senior citizens, these technologies are commercially available for physical and personal health care, fitness and activity awareness.

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Plus in addition to that researches have also claimed that applications of such technologies are also used in remote health care for a long term data and to access the medical data of patients .Currently wireless system is playing a important role for various requirements. Traditionally in health check-up Doctors play a major role[2].

As concern to this technique it'll consume a huge time for the process that deals with registration, appointment and check-up and later on reports are generated. The major drawback of this process is patients will mostly ignore or postpone the appointment because of the prolong process. So the overcome that the smart system is designed to reduce the time consumption[3].

The evolution in technology has emphasized the convenience for the people. Human health monitoring system is one of best example that uses IoT. In the past ten years, different technologies used in patients health monitoring system like GSM, RFID, Arduino, ZigBee, Accelerometer etc. IOT equipped the smart life with innovated technology IOT offers an encouraging technology to accomplish the aforementioned health care service[4]. This system is implemented for the old age and physically challenged people those who are cannot visited the doctor for day to day checkups. With the support of IoT, the above system is monitors the health condition without going to the hospital by the patient. This is a wireless, cheaper, reliable, movable system which can be used more easily and also gives a fast response.

Firstly for this paper, we need an Arduino Uno because it is the controller board which is a heart-whole system for the device. As we have three analog input sensors that is LM35 Temperature sensor, MEMS sensor and Heart rate sensor which should be connected to the analog inputs of the Arduino. LCD screen should also be connected to the Arduino to display the output because an Arduino has an Analog to Digital Converter and as usually power supply is given to it. In this health monitoring system we use ESP8266 Wi-Fi module to connect the whole system to a Wi-Fi network. By using this ESP8266 Wi-Fi module, data from the sensors are uploaded to the LCD screen and Android application in mobile as it provides network and we use a step down transformer of 230 volts input which results 12 volts A.C output which is not pure. So to remove harmonics we used CAPACITOR section as a Filter. We use 7805 Voltage regulator which provides 5 volts for the entire whole system. To intentionally increase the heart beat rate we have used momentary switch. To receive pulses from the comparator we used driver circuit which consists of Transmitter, receiver and comparator. As receiver receives pulses from the transmitter and sends these pulses to the comparator. To receive data in Android phone we have used Telnet Android Application.

In this paper, Section1 contains the introduction of the "IoT based Health Monitoring System". Section2 explanation of the proposed method. The components used for developing the proposed system in section3. Section4 presents the working of the proposed System along with flowchart. Section5 summa -rizes the report and explains how the patient health data will be displayed in LCD screen and TELNET Android application with a detailed explanation that will be used to fulfill the objectives of the project with appropriate results. Finally, section6 concludes the work and with a brief note on future scope of the work.

II. PROPOSED METHODS OF THE HEALTH MONITORING SYSTEM

Diagnosing with the help of a doctor for normal checkups, But by using our device we can diagnose in home and it can measure multiple parameters[5]. Conventional devices that can only measure a particular parameter but our device can measure multiple parameters. Smart watches are expensive and not specifically for healthcare, where as our device is less expensive and can measure health parameters. Some of the existing systems are not portable, but our existing system is portable. In some of the existing systems output can be seen on the PCB only on LCD screen. But in our existing system output will display both in LCD and mobile which is a two way communication both wired and wireless serial communication. So that patient data can be seen to the doctors when they were at home, In case of emergency it is very useful.

III. HARDWARE REQUIREMENTS OF PROPOSED SYSTEM

- Node MCU (ESP 8266) Wi-Fi Module
- Arduino Module
- LM35 Temperature Sensor
- Heart Rate Sensor
- MEMS Sensor
- Driver circuit
- 16x2 LCD Display
- Android Module

A. Node MCU Wi-Fi Module

NODE MCU (ESP8266) is embedded system with wi-fi network. It will be interface with vehicles, home appliances, sensors, actuators to connect and exchange data. Each object is identified uniquely and communicate with each other with the existing Internet support[6]. IoT always sensed or controlled their objects through the remotely around existing network, getting chances for higher direct connection of the physical devices into machine based systems, and resulting in enhance their effectiveness, precision and cost benefit in addition to minimize human interaction. Node MCU includes firmware which runs on the ESP8266 Wi-Fi System on Chip with CPU frequency of 80 MHz and the upload speed is 115200.The ESP8266 is a economical Wi-Fi chip with complete TCP/IP stack and microcontroller interfacial device as shown in figure1. It is an Intercommunicate device, reprogrammable, cheaper, inbuilt WI-FI.

Figure1: Node MCU

Configuring and programming the board

1. Download the driver from the link from the website
2. Download Arduino IDE.
3. Start Arduino and open Preferences window.
4.Enter http://arduino.esp8266.com/stable/package _esp 8266com_index.json into Additional Board Manager URLs field.
5. Open Boards Manager from Tools. Enter esp8266 intro the search field to install ESP8266 platform Go to Tools > Board menu, and then select your ESP8266 board.
6. Upload Using: Serial CPU Frequency: 80 MHz Flash Size: 4M Upload Speed: 115200 PORT: Select Assign Port Only.
7. To check the ESP8266 upload the Wi-Fi connect code on to the board. This program will nterface your ESP to Wi-Fi network and display of IP address in arduino serial monitor.

B. ARDUINO (ATMEGA328)

Arduino is available in open source. It can program hardware/software easily.

Figure2: Arduino Uno Board

Arduino boards are used to design a different microprocessors and controllers as shown in figure2. The boards will contain a group of analog and digital I/O pins that interfaced to another circuit board. The board is used to load programs from laptop by serial communication port or USB. The microcontrollers are programmed by using programming languages C/ assembly.

C. Heart rate Sensor

Heartbeat Sensor is used to measure the heart beat. The basic thing to measure healthy person is temperature, heart rate and blood pressure. Measuring the heart rate is essential for patients to check condition of the heart. But the more easy way to monitor the heart rate is to use a heartbeat sensor as shown in figure3. The heartbeat is measured in beats per minute which indicates the number of times the heart is contracting or expanding in a minute. Heart rate Sensor is a well-designed plug-and-play heart-rate sensor for Arduino. Place the finger tip on sensor films, by using monitoring app that will generate pulse rate graphs at that time directly. Heart shape logo is place covered in front of the sensor. This is the side that makes contact with the skin.

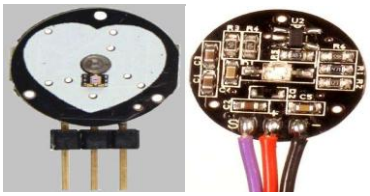

Figure3: Heartbeat Sensor

There is a noise elimination circuitry which is supposed to keep away the noise from affecting the readings. When a finger is place on heart beat sensor, it will generate a digital o/p. Heart beat detector is properly working, the LED will glow in every heart beat. This output will be connected to audinuo to measure the beats/minute rate. This sensor wills works based on optical modulation principle by flowing the blood passing into finger at every pulse.

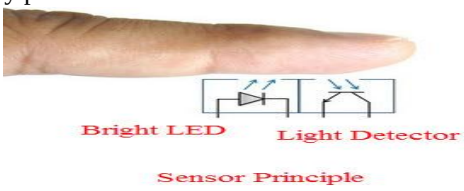

Figure6: Pulse Sensor Principle

The sensor consists of a super bright red LED and light detector as shown in figure6. This LED will give more brightness as maximum light that pass into finger and detected by detector. Heart will inject a pulse of blood through the blood vessels, the finger will become more filmy and small light fall on the detector. Detector signal varies based on the heart pulse and the variation can be transformed to electrical signal. This signal is boosted and triggered through an amplifier which give an output of +5V logic level. Each heart beat signal the LED will blink based on the output signal.

Classification of Heart beat men and woman at various age groups. The details are mentioned in below table1.

Table1: Classification of heart beat of men and women

Resting Heart Rate for MEN

Age	18-25	26-35	36-45	46-55	56-65	65+
Athlete	49-55	49-54	50-56	50-57	51-56	50-55
Excellent	56-61	55-61	57-62	58-63	57-61	56-61
Good	62-65	62-65	63-66	64-67	62-67	62-65
Above Average	66-69	66-70	67-70	68-71	68-71	66-69
Average	70-73	71-74	71-75	72-76	72-75	70-73
Below Average	74-81	75-81	76-82	77-83	76-81	74-79
Poor	82+	82+	83+	84+	82+	80+

Resting Heart Rate for WOMEN

Age	18-25	26-35	36-45	46-55	56-65	65+
Athlete	54-60	54-59	54-59	54-60	54-59	54-59
Excellent	61-65	60-64	60-64	61-65	60-64	60-64
Good	66-69	65-68	65-69	66-69	65-68	65-68
Above Average	70-73	69-72	70-73	70-73	69-73	69-72
Average	74-78	73-76	74-78	74-77	74-77	73-76
Below Average	79-84	77-82	79-84	78-83	78-83	77-84
Poor	85+	83+	85+	84+	84+	84+

D. LM35 Temperature Sensor

Temperature sensor (LM35) is an output voltage linearly proportional to the Centigrade in temperature. It can be calibrated in Kelvin by subtract a constant voltage from the output to calculated in centigrade. The LM35 device has low-output resistance, linear output and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry. LM35 is a IC temperature sensor as shown in figure4, output voltage changes based on upon the temperature. It is a small and cheap IC which can be used to measure temperature anywhere between -55°C to 150°C. This can connected with development platform like Arduino. If the temperature is 0°C, then the output voltage will also be 0V. There will be rise of 0.01V (10mV) for every degree Celsius rise in temperature.

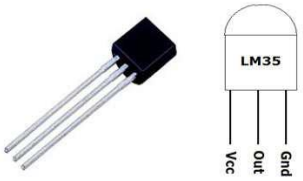

Figure4: Temperature Sensor

V out is a scalable sensor output voltage linearly with the measured temperature, which is 10 mV/Co. So if V out = 530mV, then the measured temperature is 53 degrees Celsius and if V out = 320mV, then the measured temperature is 32 degrees Celsius. The output voltage of LM35 that connected directly to the operational amplifier, filter, voltage comparator and ADC.

E. MEMS Sensor

MEMS sensor stands for Micro Electrical sensing mechanical systems as shown in figure5. MEMS sensor which is used for the fall detection of patient.

Figure5: MEMS Sensor

The fall detector board has two dual-axis MEMS accelerometers (Analog Devices ADXL210E) mounted at right angles to each other, such that three orthogonal axes of acceleration can be measured. MEMS based sensors is used for the fall detection having one three axis gyroscope, accelero and magneto meters. However, sometimes difficult to identify daily living fall down activities like jumping and sitting down quickly from real fall down. A model is suggested using attitude angles to decrease false falls can be tests of fixed postures and moved transitions. Now, the proposed model has good real-time performance and increase computation. With the aged population increased continuously to 15% of population in developed countries, the elderly will suffer from more injuries caused by fall. Falls not only cause physical injuries such as disabling fractures, but also have dramatic psychological consequences that reduce elderly people's independence. Hence reliable fall detection for elderly is of great importance for the whole society. So MEMS sensor is very useful in this situation.

MEMS are one of the most advanced technologies that have been applied in the making of the most of the modern devices. In MEMS sensor, some is tilt is applied then a balanced mass generate a difference within the voltage. This can be measured like a change within capacitance then that signal can be changed to get a constant output in digital, 4-20mA or V_{DC}.
The device does not change values depending on the base materials used and depends only on the capacitive value that occurs due to the change in distance between the plates.
If two plates are kept parallel to each other and are separated by a distance'd', and if 'E' is the permittivity of the separating material, then capacitance produced can be written as
C0 = E0.E A/d = EA/d
EA = E0EA
A = Area of the electrodes

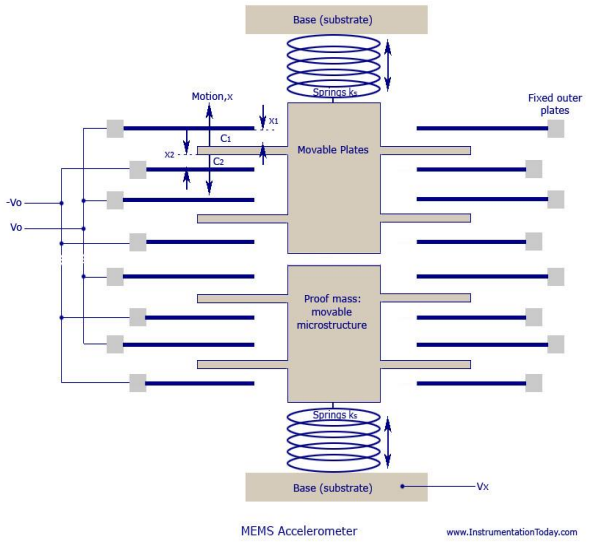

Figure7: Working of MEMS Sensor

Alter in the values of E, A or d will calculate the difference in capacitance and thus helps in the working of the MEMS transducer. Accelerometer parameters are changing based on values of d or A.

IV. WORKING OF THE PROPOSED SYSTEM

Human health monitoring system mainly consists of three devices namely heartbeat sensor, temperature sensor and MEMs sensor. In this device Arduino Uno is the controller board which is the heart of whole system.
In this paper, 7805 voltage regulator to generate the voltage of 5V, this voltage is given as power supply to the Arduino, LCD, Wi-Fi-module and heartbeat sensor. Heart rate sensor consists of transmitter and receiver which sends the input pulses to the comparator.LM35 temperature sensor gives the output in the analog form which is converted into the digital data with the help of ADC in the microcontroller and by calibrating the data we will display the temperature in the 16X2 LCD display. For the intentional increase in the heartbeat we are using the momentary switch.ESP8266 Wi-Fi module consist of antenna in gold colored stripes, serial communication will be taken place between the sensors and the Arduino and parallel communication will be between the Arduino and LCD display. Wireless serial communication will be taken place between esp8266 and Telnet android application.
Here in this paper, we will make an IOT based Patient Health Monitoring System which records the patient heart beat rate, body temperature and fall detection. Heart rate and body temperature are recorded in the Android Application and it is displayed in the LCD screen. Fall detection can be detected by the buzzer which makes continuous beep. We are using TELNET Application in the Android phone, which records the necessary values required for the patient. The flow chart of the proposed system is shown in figure9.

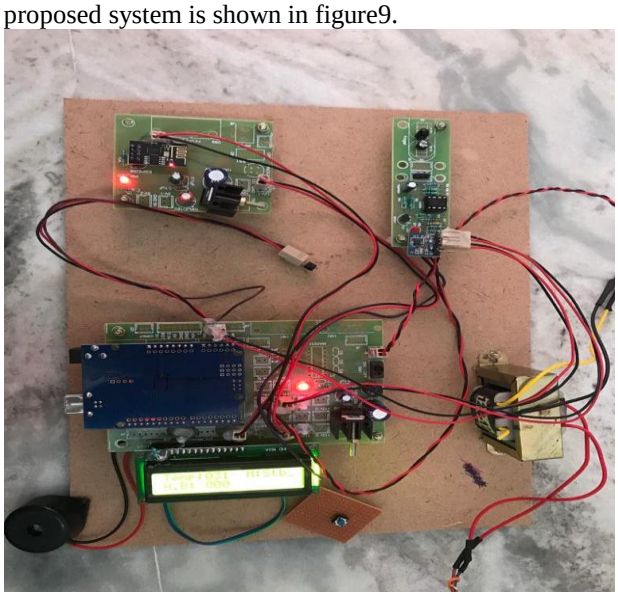

Figure8: Design of the proposed system

A. Circuit Connections with Arduino

Name of the pin	Connected
Pulse sensor output	A0 Pin of Arduino
Pulse sensor (VCC)	VCC Pin of Arduino
Pulse sensor (GND)	GND Pin of Arduino
LM 35 sensor(o/p)	A1 Pin of Arduino
LM 35 sensor(VCC)	VCC Pin of Arduino
LM 35 sensor(GND)	GND Pin of Arduino
LCD (1,3,5,16) Pins	GND Pin of Arduino
LCD (2,15) Pins	VCC Pin of Arduino
LCD(4,6,11) Pins	(12,11,5) Pins of Arduino
LCD(12,13,14) Pins	(4,3,2) Pins of Arduino
ESP8266 (RX pin)	10 Pin of Arduino
ESP8266(TX pin)	9 Pin of Arduino
MEMS (SCL)	A5 Pin of Arduino
MEMS (SDA)	A4 Pin of Arduino
MEMS (INT)	2 Pin of Arduino

B. TELNET APP

Telnet is an application protocol. It will used on the LAN to provide both direction inter action communication in virtual connection of the terminals. User information is in-band with Telnet control information in 8 byte data connect via TCP. Telnet was designed in first with RFC15, after extension of RFC855, and Internet Engineering Task Force (IETF) standards. The term telnet is the software used to design for the client part of the protocol. Client telnet applications are implemented for all virtually computer platforms and also used for verb. It is a client-server protocol, formed on a stable connection-oriented transport. Typically, it is used to set up a connection to TCP port number 23, where Telnet server application (telnetd) is listening.

Telnet, but predates TCP/IP and initially start with Network Control Program (NCP) protocols. Telnet is an adhoc protocol, also referred to as Teletype over Network Protocol, in this Telnet generate to establish the connection clear.
The first function of a User TELNET is to supply convey by which its users can 'hit' all the keys on that virtual teletype.

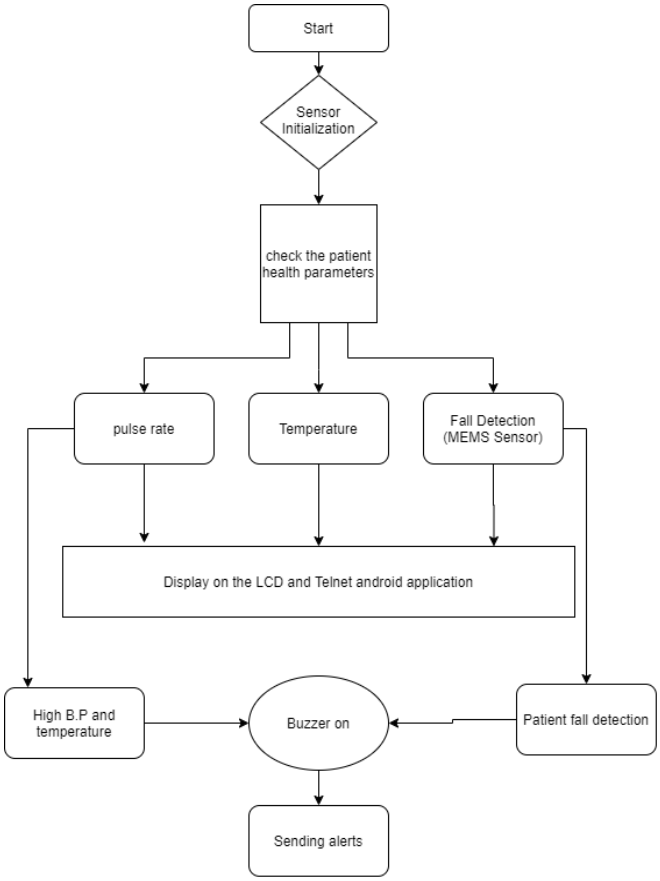

Figure9: Flow chart of the proposed system

V. RESULT AND DISCUSSION

The output of the IOT based human health monitoring system will be displayed in the LCD screen as shown in figure 10 and 11. The patient detailed information is display by using Telnet android application is shown in figure12. MEMS sensor which detects the fall detection and when the patient moves, continuous beep sound occurs from the buzzer. Temperature, heart rate information about the patient based on that MEMS sensor output will give the patient condition is tabulated in below table2.

Table2: Patient condition based on the sensors information.

Patients	Temperature	Heart rate	MEMS sensor o/p
Patient-1	32	66	Patient moved
Patient-2	36	71	Patient stable
Patient-3	33	69	Patient moved
Patient-4	39	77	Patient moved

Figure10: Output of LCD when patient is stable, temperature and pulse rate are normal

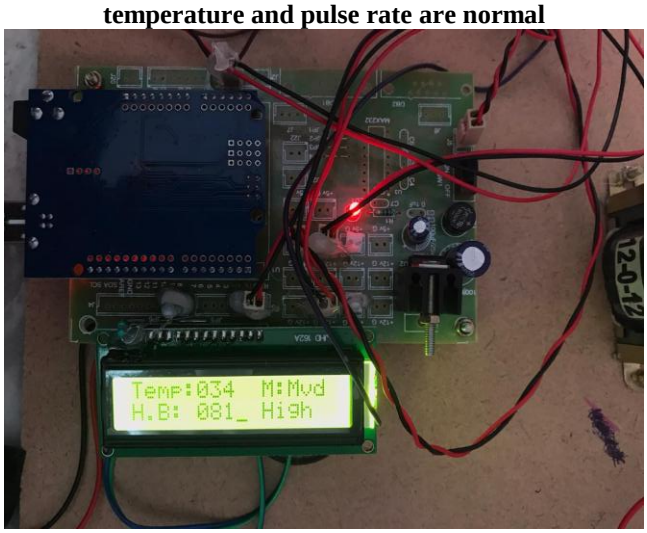

Figure11: Output of LCD when patient fell down and having high pulse rate.

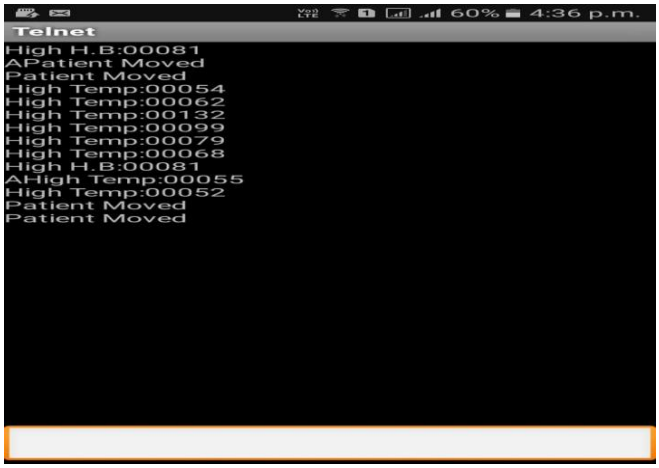

Figure12: Output displayed in Telnet application.

VI. CONCLUSION AND FUTURE SCOPE

In this paper, developing the IOT based human health monitoring system which would monitor the heart rate, temperature and the fall detection of the patient. We are using the LM35 sensor for measuring temperature and the MEMS sensor for the fall detection.

Recent advance in medical field, efficiency of hospital staff is increased by using some of these newly available applications and tools. In the healthcare field, issues such as long-term patient care in hospitals, support for elderly people at home and in an ambulatory environment are being discussed. This paper has presented a remote patient monitoring system architecture using various sensors capable of monitoring several different environments: hospitals, home, and ambulatory. The proposed system designed for a patient monitoring information which will send medical doctors to observe their patients on a remote place and to give some guidance for first-aid treatment. The system developed has the following facilities added to have a positive impact on time-saving and cost effectiveness by preventing the patients from re-hospitalization and monitoring multiple patients' health status simultaneously

In the future, the proposed system will support independence, elderly, sick, physically changed people, mental patients reduces stress for family and doctors who can be alerted and responded immediately as issue occurs. In future the patient's health will better by combining the proposed system with smart sensors and new technology. Through this system vital signs such as heart rate, fall detection, body temperature and blood pressure in post-operative patients can be monitored over the internet.

Multiple factors like age and weight of the patient can be added as controlling parameters in the future. This system can also be developed using advanced GSM and GPRS technology in future.

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