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HUMAN BODY MONITORING SYSTEM USING WSN WITH GSM AND GPS

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ABSTRACT
The main aim of our paper is to monitor and analyze the human body temperature, blood pressure (BP), Pulse Rate and ECG and tracking the patient location. The human body temperature, BP, Pulse Rate and ECG are detected and can be sensed by using respective sensors. The sensed information is send to the PIC18F4520 microcontroller through signal conditioning circuit in the patient unit. A desired amount of sensor value is set and if it is exceeded preliminary steps should be taken by the indicating by buzzer. The sensor information will be transmitted from the patient unit to the main controller unit with the help of GSM communication system which is connected with the microcontrollers in the both units. The main controller unit will send those sensed data as well as the location of that patient with the help of GPS Module to the observer [1]. The observer can receive the SMS sent by GSM module and further decision can be taken. The message is sent to a mobile phone using Global system mobile (GSM) Modem. MAX232 was a driver between microcontroller and modem.

INTRODUCTION
In medical instrumentation, the main function is to measure or determine the presence of some physical quantity that may be useful for diagnostic purposes. Therefore, many types of instrumentation systems are used in hospitals and physician's clinics**.** The primary purpose of medical instrumentation is to measure or determine the presence of some physical quantity that may assist the medical personnel to make better diagnosis and treatment. Accordingly, many types of instrumentation systems are presently used in hospitals and other medical facilities. Certain characteristic features, which are common to most instrumentation systems, are also applicable to medical instrumentation systems. In the broadest sense, any medical instrument would comprise of the following four basic functional components: Measured, Transducer/Sensor, Signal conditioner and display system. Patient monitoring system in all ICUs is the most needed and essential device for monitoring the patient's vitals. As the physicians can not stay next to the patients for all time round the clock. We go up for the wireless patient monitoring and tracking system, to have a quantitative assessment of the important physiological variables of the patients. Patient monitoring systems are used for measuring continuously or at regular intervals, automatically, the values of the patient's important physiological parameters. The choice of proper parameters, which have high information content, is an important issue in the patient monitoring system. The important parameters are ECG, heart rate, pulse rate, blood pressure, body temperature, respiratory rate and SPO2. This system consists of simple and low cost components that are capable of processing real time temperature, ECG, BP, heart rate and transmitting the same. There exists a demand for such a system, as current implementations are complex to use and high in cost. Our system design aims to provide solutions to the problem encountered in acquiring temperature, ECG, BP and heart rate from the subject, as well as providing remote transmission of the data. The availability of the patient stationary can be possible to make a good hardware and software development is possible. The main aim of our system is to show how persons suffering from cardiovascular and other hypertension disease can directly monitor their physiological parameters without effecting to their daily activities by using the GSM, GPS and WSN [2].

ARCHITECTURE
Patient unit, Main Controller unit, Observer unit are three basic units of our system. Heart rate sensor, Temperature Sensor, ECG Sensor, BP Sensor, GSM modem, GPS modem, Microcontroller (PIC18F4520) are the major components.

PATIENT UNIT

This unit consists of four different types of sensors for measure the temperature, heart rate, BP and ECG of the human body shown in fig. 1. The sensors are connected in the basis of Wireless Body Sensor Network [2]. The microcontroller acquires the sensor information by the help of the signal conditioning circuit. And in the mean time microcontroller passes that acquired information the Main Controller Unit with the help of the GSM transmitter module.

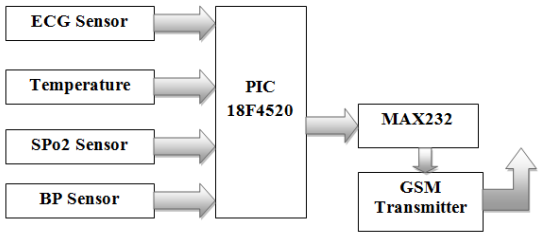

Figure.1: Patients Unit

CONTROL UNIT

This unit consists of GSM receiver module, GSM and GPS modem shown in fig. 2. The information of the patient unit received by the microcontroller by GSM receiver module and the same time it also receives the location through GPS [1]. The Display of the controller unit shows the sensor output information and the Alarm is for the any critical condition of the patient. By the use of the GSM modem all the information of the patient vital parameters and location of the patient will transmit to the Observer mobile as a SMS.

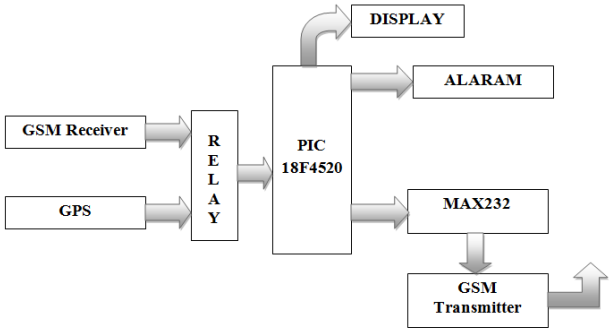

Figure 2: Control Unit

WIRELESS BODY AREA NETWORK

A wireless body area network (WBAN) is a wireless network of wearable computing devices. In particular, the network consists of several miniaturized body sensor units (BSUs) together with a single body central unit (BCU). A WBAN system can use WPAN wireless technologies as gateways to reach longer ranges. A number of intelligent physiological sensors can be integrated into a wearable wireless body area network, which can be used for computer-assisted rehabilitation or early detection of medical conditions. The information will be transmitted wirelessly to an external processing unit. This device will instantly transmit all information in real time to the doctors throughout the world.

HARDWARE

ECG SENSOR

ECG Sensor is used to measure the rate and regularity of heartbeats, as well as the size and position of the chambers, the presence of any damage to the heart, and the effects of drugs or devices used to regulate the heart. Most ECGs

are performed for diagnostic or research purposes on human hearts, but may also be performed on animals, usually for diagnosis of heart abnormalities or research.

BP SENSOR

The Blood Pressure sensor is used to measure arterial blood pressure in humans. It measures the pressure signal caused by the interaction between the cuff and the blood flow through the brachial artery. The pressure sensor uses the pressure transducer. It is arranged to measure differential pressure. The sensor produces an output voltage that varies in a linear way with pressure. Special circuitry minimizes the errors that might be caused by changes in temperature.

SPO2 SENSOR

It consists of light emitting diode and light detection resistor which are placed parallel to each other. LED emits Infrared rays so that, when the finger is placed in between LED and LDR so that there exists some systolic pressure. LED emits IR rays which are travelled through finger and blood flows with arteriole pressure. Whenever systolic pressure is applied, normal pressure of blood flow is disturbed at finger tip which is high and IR rays penetrate through blood and are received by LDR. The signals are analog which are converted into digital by Analog-Digital Converter suitable for the MCU.

TEMPERATURE SENSOR

Temperature Sensor is also known as analog temperature sensor. It provides a voltage output that is linearly proportional to Celsius (centigrade) temperature. It uses a solid state technology to determine the temperature. If the temperature increases means voltage also increases. By amplifying the voltage change it is easy to generate an analog signal which is directly proportional to temperature. They are precise; never wear out, don't need calibration work for any environmental Conditions. It can be consistent between sensor and readings.

MICROCONTROLLER

PIC18F4520 Microcontroller is used for processing the data which is come from analog to digital converter. The amplified & conditioned signal comes from various sensors is fed to different input ports of the microcontroller. The Blood Pressure (BP), ECG, heart rate and temperature can be read & stored in the RAM of microcontroller. It is then converted and stored in the memory as two 8-bit unsigned integers. The microcontroller constructs the SMS messages and packs the data samples after completion of signals acquisition, and then communicates with the mobile phone using at-commands on its GSM modem port to send the messages. The graph of ECG is plotted on PC.

GSM MODEM

The GSM modem consists of a slot for inserting subscriber identity module (SIM). GSM network generally contains three major stations 1). Mobile Station, 2) Base station subsystem and 3) Network subsystem. The mobile station contains an International Mobile Station Equipment Identity (IMEI) number and SIM has IMSI number. The base station subsystem contains Base Transceiver Station which has an antenna for communication and a Base Station Controller that controls multiple base stations. Network subsystem contains visitor location register (VLR), home location register (HLR), Authentication Centre and equipment identity register (EIR). Mobile switching centre (MSC) is the major part which is the gate way for communication between mobile station and public switched telephone network (PSTN). HLR stores the information about the subscriber and the current location of subscriber. VLR provides the services to the subscribers of HLR who are visitor users. Authentication Centre gives the security of the user and to identify the location of the subscriber. EIR is also for security purpose and to identify the mobile station. By connecting the MAX232 to GSM modem, the serial data transmission can be done. Operation support system (OSS) is used to control the traffic of users. In order to communicate with the GSM modem we have a special set of commands called SMS AT commands.

MAX232 DRIVER

MAX232 is uses parallel-in-serial-out shift registers to convert the digital data in the serial form for wireless communication. UART IC in PIC18F4520 microcontroller allows the digital data transmission in the form of bits per second in asynchronous manner. RS232 standards are commonly used in computer serial ports for serial communication transmission of data, which are not Transistor --Transistor logic (TTL) compatible.

DISPLAY

The transmitted digital data after conversation from analog data by ADC, the data stores EPROM and the data is displayed on LCD Display. By MAX232 the digital data converts into serial form for GSM communication so that the respective vital sign values are received by the observer in his mobile phone.

RESULT

The body temperature, heart rate, ECG and blood pressure of a Patient is measured by taking the average of readings by fixing maximum and minimum values and the data is transferred to microcontroller. The transmitted digital data after conversation from analog data by ADC, the data stores EPROM and the data is displayed on LCD. By MAX232 the digital data converts into serial form for GSM communication so that the respective vital sign values are received by the doctor/observer in his mobile phone.

Figure 3 shows the observation of oxygen saturation in Human blood.

Figure 3: observation of oxygen saturation in Human blood

Figure 4 show the Overall Setup of Healthcare System.

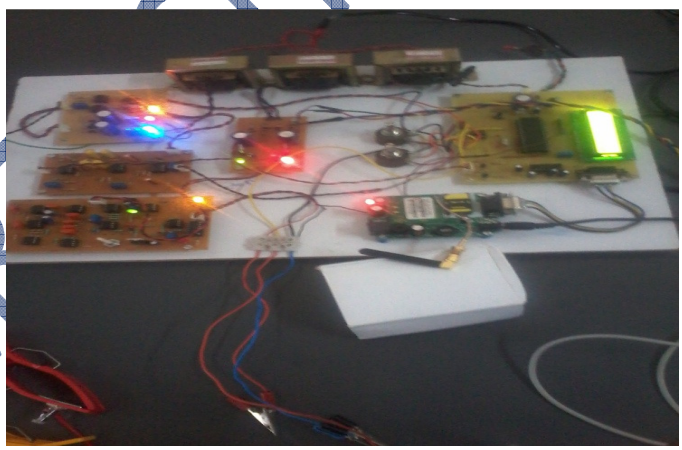

Figure 4: Overall Setup of Healthcare System

CONCLUSION

By using this system, the circuit of the prototype containing PIC18F4520 Microcontroller, GSM Modem, GPS Modem, , LCD, respective sensors and other hardware circuit so that the message can be transferred to corresponding observer mobile phone for taking necessary precautions to take care about the patient in a given fixed time interval. The auto alarm facility in this systems works for the abnormal conditions, when the reading of the vital signs exceeds from fixed level. Tracking of patient location can be done continuously by using GPS environment. By using GSM network continuous monitoring also can be done for the corresponding patient. The

device has enough scope of improvement by further research.

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