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"Wearable Sensor Use for Remote HealthMonitoring System for Elder User."

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Abstract— *Wearable physiological monitoring devices are used to monitor the health status of a Patient in Intensive Care Units (ICU). These systems are wired everywhere. A wireless Physiological parameter monitoring system is presented in this paper. Literature review carried out in the area of wearable physiological monitoring systems. The proposed system includes sensors for continuous collection and evaluation of physiological parameters. A wireless personal area network has been introduced for reliable transmission of physiological information. The hardware design of this patient monitoring system is based on 8051 microcontrollers.*
Microcontroller acts as the gateway to ZigBee and GSM module. ZigBee wireless communication module has the advantage of lower power consumption which is attractive for portable applications. This system provides safe and accurate monitoring. It also gives the freedom of movement. The proposed system can be used to monitor the physiological condition of a person in out of hospital condition also.
Keywords— *Pulse Sensor, Temperature Sensor, ZigBee,Microcontroller, LCD, Buzzer Arduino.*

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I. INTRODUCTION

Rapid advances in wireless communication devices and systems had a significant impact on the healthcare industry. One important application is to monitor patient's health status anytime and anywhere without restricting the patient's movement. Through the Miniaturizations of sensors and the use of wireless interface to transmit the data recorded by the sensors, health care monitoring can be extended beyond the hospital confines. This project presents a wireless system which enables real-time health monitoring of multiple patients. In health care center patient's data such as heart rate, temperature needs to be constantly monitored. The proposed system monitors the heart rate and Temperature of patient's body. For example, heart rate is measured through a Pulse sensor And Temperature sensor will be used to read body temperature.

A transmitting module is attached which continuously transmits the encoded serial data using Zigbee module. A receiver unit is placed in doctor's cabin, which receives and decodes the data and continuously displays it on LCD Display. Thus, doctor can observe and monitor many patients at the same time. System also continuously monitors the patients' data and in case of any potential irregularities, in the condition of a patient, the alarm system connected to the system gives an audio warning signal that the patient of a particular room needs immediate attention. Biomedical devices benefit from the rapid growth of wireless technology for measuring Health Parameters. The use of wireless communications in healthcare systems provides great mobility and increase comfort level of patients. The wireless technology for biomedical applications should be suitably selected depending on the data rate and range required for the transmission. With advanced wireless technologies easy access can be made possible and quality healthcare can be provided to people, especially to those residing in the rural areas. Shorter hospital stay and better community care are expected to be the future trend of national health services. Recent advancements in sensor technology wireless communications and information technology in general give opportunities to new models for providing health care and wellness or disease management tools, which enable extended independent living at home and improvement of quality of life for individuals. The biomedical monitoring system discussed in this paper consists of microcontroller, sensors, ZigBee module, power supply and Liquid Crystal Display. The doctor can continuously monitor the condition of the patient and in case of emergency and dangerous situations the system will alert the doctor immediately. The wireless communication link used in this work is a ZigBee based network for communication within the hospital environment. This type of communication is done with ZigBee network topology. Each patient will be given this module and with the help of this module the patient's health condition is continuously monitored. If there is any change in the condition of the Health parameters, it immediately sends that changed data through ZigBee to the local monitoring system where the main module is connected. The doctor can observe the status of the patient through the computer.

II. METHODOLOGY

The system consists of microcontroller, Pulse sensors, Temperature Sensor, ZigBee module, power supply and Liquid Crystal Display. In case of emergency and dangerous situations the system will alert the doctor immediately. A ZigBee based network is used for the purpose of doctor to patient communication in the hospital environment. For communicating to a distant location SMS facility is implemented.

The emergency situation is indicated to a preset phone number through SMS. This way of communication is actually done with ZigBee network. In a hospital environment each patient is having this module and with the help of this the patient's health condition is monitored. If there is any change in the normal condition of the health parameters then this module immediately sends that changed parameter to the local central monitoring system in the hospital through ZigBee wireless technology. The same information is transferring a message or SMS through GSM network to the care taker.

A. Modes System Architecture at The Patient End Operation.

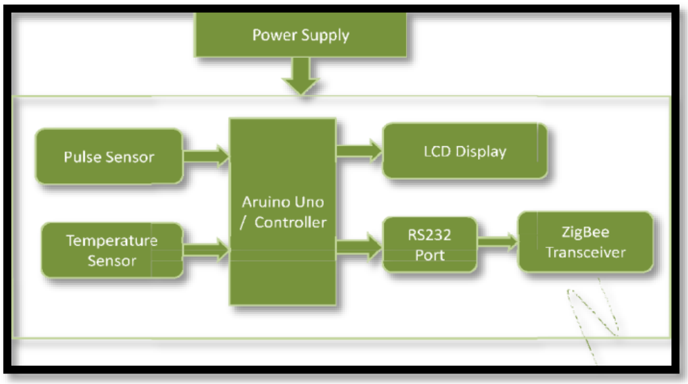

Fig.1 Block Diagram of Transmitter

The system architecture at the patient end is shown in Figure 1. The system architecture at the patient end several temperature sensing techniques are currently in widespread use. The most common methods are Resistance Temperature Detectors (RTDs), thermocouples, thermistors, and sensor ICs. The right one for specific application depends on the required temperature range, linearity, accuracy, cost, features, and ease of designing the supporting circuitry. In this work IC LM35 sensor is used as temperature sensor.

The LM35 series are precision integrated-circuit temperature sensor, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The analog information is converted to digital form with the help of ADC.

Heart beat sensor is designed to give digital output of heart beat when a finger is placed on it. This digital output can be connectedto microcontroller directly to measure the Beats per Minute (BPM)rate.

Heart beat is sensed by using a high intensity type LED and LDR. The finger is placed between the LED and LDR. The skin is illuminated with visible (red) using transmitted or reflected light for detection. This circuit made from an infrared phototransistor and infrared LED.

The skin is used as a reflective surface for infrared light. The density of blood in the skin will `effect on the IR reflectivity. The pumping action of heart causes the blood density rises and falls. So that we can calculate the heart rate based on the rise and fall of intensity of infrared that reflected by skin. It works on the principle of light modulation by blood flow through finger a teach pulse.
If there is any change in the pulses then it is noticed as the change in the heart's normal rhythm. The controller will get an interrupt at this time, which indicates the malfunction of the heart. Then it sends the pulse count with the patient's ID to the doctor in the hospital and at the same time it sends SMS to a preset number stored in the

microcontroller.

B. The System Architecture at the Doctor End.

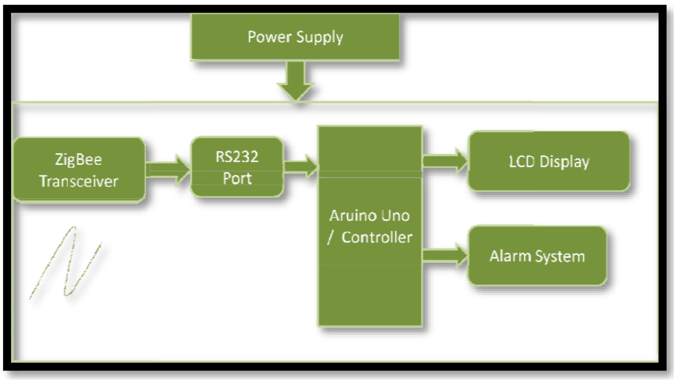

Fig.2 Block Diagram of Receiver

The system architecture at the doctor end is shown in Figure 2. The system architecture at the doctor end Embedded technology is implemented to perform a specified task and the programming is done using assembly language programming or embedded C. The AT89C51 microcontroller is used at the patient end as well as at the doctor end. This is a low-power, high- performance CMOS 8- bit microcomputer. It has 8Kbytes of Flash programmable and erasable read only memory (PEROM). The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Philips AT89C51 is a powerful microcomputer, which provides a highly flexible and cost-effective solution to many embedded control applications.

a) Flow Chart.

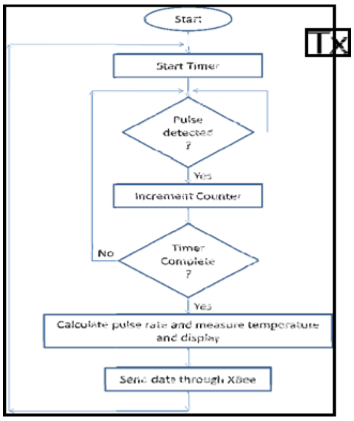

Fig.3 Flow Chart of Transmitter

At transmitter End our system has Pulse Sensor, Temperature Sensor, Controller (Arduino), ZigBee Transceiver Module. Controller checks whether pulse is detected or not and once it detects pulse it starts counting pulses for specific interval. After completing the timer interval controller coverts that count to pulses per minute and then senses temperature of the body using LM35 Sensor. And once heart rate and temperature is calculatedcontroller send that data wirelessly to Doctor's End (Receiverside) via Zigbee Transceiver Module.

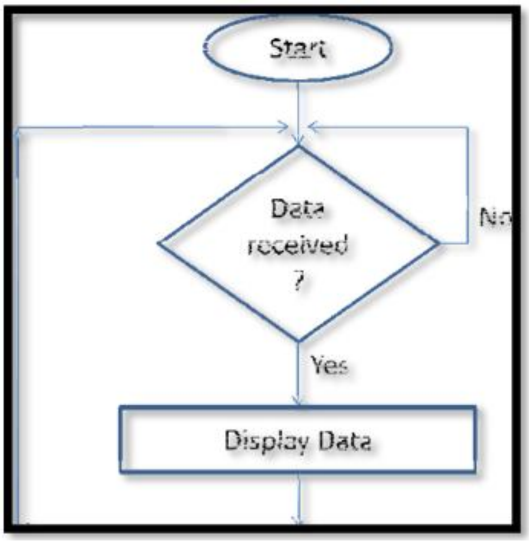

Fig.4 Flow Chart of Transmitter

At Receiver End systems have ZigBee Transceiver Module, Controller (Arduino), LCD Display. Controller keeps checking for the data from Zigbee module and as soon as data is received by ZigBee Module Controller reads that and Displays the same data on LCD in specific Format with patient ID which can be monitored by Doctor easily without going to patient's location or Room.

III. MAIN COMPONENT

A. ARDUINO UNO

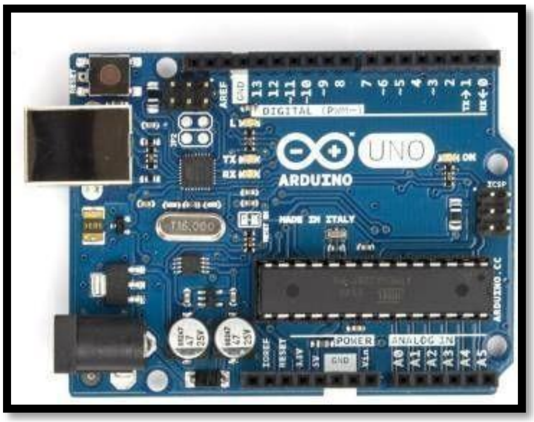

Fig.5 ***Arduino*** *UNO*

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. The Uno board is the first in a series of USB-based Arduino boards and version 1.0 of the Arduino IDE were the reference versions of Arduino, which have now evolved to newer releases. The ATmega328 on the board comes preprogrammed with a boot loader that allows uploading new code to it without the use of an external hardware programmer. inductor current of the converter by regulating the inductor ripple or a scaled version of it within the hysteretic band.

- **Advanced RISC Architecture**
  - 131 Powerful Instructions – Most Single Clock CycleExecution
  - 32 x 8 General Purpose Working Registers
  - Up to 20 MIPS Throughput at 20 MHz
  - On-chip 2-cycle Multiplier

- **High Endurance Non-volatile Memory Segments**
  - 4/8/16/32K Bytes of In-System Self-ProgrammableFlash program memory
  - 56/512/512/1K Bytes EEPROM
  - 512/1K/1K/2K Bytes Internal SRAM
  - Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
  - Data retention: 20 years at 85°C/100 years at 25°C
  - Optional Boot Code Section with Independent Lock Bits
  - In-System Programming by On-chip Boot Program
  - True Read-While-Write Operation
  - Programming Lock for Software Security

- **Peripheral Features**
  - Two 8-bit Timer/Counters with Separate Prescaler andCompare Mode
  - One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
  - Real Time Counter with Separate Oscillator
  - Six PWM Channels
  - 8-channel 10-bit ADC in TQFP and QFN/MLF package
  - Temperature Measurement
  - 6-channel 10-bit ADC in PDIP Package
  - Temperature Measurement
  - Programmable Serial USART
  - Master/Slave SPI Serial Interface
  - Byte-oriented 2-wire Serial Interface (Philips I2 Ccompatible)
  - Programmable Watchdog Timer with Separate On-chipOscillator
  - On-chip Analog Comparator
  - Interrupt and Wake-up on Pin Change

developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.

- **Special Microcontroller Features**
  - Power-on Reset and Programmable Brown-out Detection
  - Internal Calibrated Oscillator.
  - External and Internal Interrupt Sources.
  - Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power- down, Standby, and Extended Standby.

- **I/O and Packages**
  - 23 Programmable I/O Lines
  - 28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF

- **Operating Voltage:**
  - 1.8 - 5.5V

LED: There is a built-in LED driven by digital pin 13. Whenthe pin is high value, the LED is on, when the pin is low, it is off.

VIN: The input voltage to the Arduino/Genuino board whenit is using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

5V: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 20V), the USB connector (5V), or the VIN pin of the board (7-20V). Supplying voltage via the5V or 3.3V pins bypasses the regulator, and can damage theboard.

3V3: A 3.3-volt supply generated by the on-board regulator.Maximum current draw is 50 mA.

GND: Ground pins.

IOREF: This pin on the Arduino/Genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source, orenable voltage translators on the outputs to work with the 5Vor 3.3V.

Reset: Typically used to add a reset button to shields that block the one on the board.

Serial / UART: pins 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL serial chip.

External interrupts: pins 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising orfalling edge, or a change in value.

PWM (pulse-width modulation): pins 3, 5, 6, 9, 10, and
11. Can provide 8- bit PWM output with the analog Write ()function.

SPI (Serial Peripheral Interface): pins 10 (SS), 11 (MOSI), 12 (MISO), and 13 (SCK). These pins support SPIcommunication using the SPI library.

TWI (two-wire interface) / I²C: pin SDA (A4) and pin SCL (A5). Support TWI communication using the Wire library.

AREF (analog reference): Reference voltage for the analoginputs.

B. ZigBee Module

The Zigbee standard is a standard built on top of IEEE 802.15.4 which provides the upper layers for control and sensor applications. It has been designed to be very robust so that it can operate reliably in harsh radio environments, providing security and flexibility. As an open standard, Zigbee is able to operate using items from a variety of manufacturers. It has been designed to be very robust so that it can operate reliably in harsh radio environments, providing security and flexibility. As an open standard, Zigbee is able to operate using items from a variety of manufacturers.

- ***ZigBee Alliance***

Fig.6 ZigBee Module

As Zigbee is an open standard it is developed and maintained by an industry alliance called the Zigbee Alliance. This was initially set up in 2002 and since then its membership has grown considerably as the adoption of the standard has increased.
The Zigbee Alliance has three levels of membership:

o Adapter: The Adapter Zigbee Alliance members are allowed access to completed Zigbee specifications and standards

o Participant: Participant members have voting rights, play a role in Zigbee development, and have early access to specifications and standards for product development.

o Promoter: The Promoter membership of the Zigbee Alliance provides automatic voting rights in all work groups, final approval rights on all standards and a seat on the Alliance Board of Directors.
A further advantage of Zigbee Alliance membership is the benefits of the global marketing efforts of the Alliance

which actively promotes use of Zigbee standards.

- ***ZigBee Basics***

The distances that can be achieved transmitting from one station to the next extend up to about 70 meters, although very much greater distances may be reached by relaying data from onenode to the next in a network.

The different ISO layers in a Zigbee protocol stack.

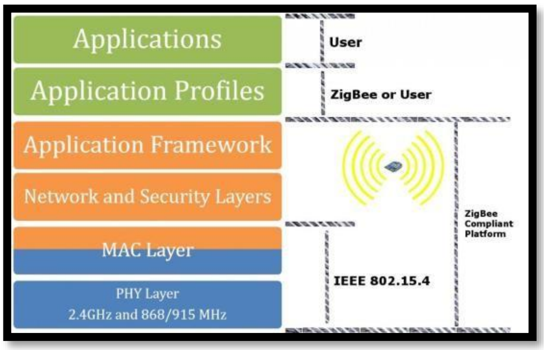

Fig.7 ZigBee ISO Layer

The main applications for 802.15.4 are aimed at control and monitoring applications where relatively low levels of data throughput is needed, and with the possibility of remote, battery powered sensors, low power consumption is a key requirement. Sensors, lighting controls, security and many more applications are all candidates for the new technology.

IV. SIMULATION RESULT

V. CONCLUSION

This paper stresses the design of patient monitoring system based on ZigBee. The biomedical telemetry system consists of temperature sensor, Pulse sensor, signal conditioning circuit, microcontroller, data cable, mobile phone, LCD display.

This is a convenient method to monitor the patient's health condition. The temperature, heart beat and blood pressure are all sensed by using the appropriate sensors which are placed near the patient's body that is under investigation. The sensed output is given to A/D converter where the analog signal is converted to digital signal. The digital output is given to microcontroller. The microcontroller delivers the signal for mobile phone ZigBee. ZigBee and GSM networks enable the user to communicate within the hospital networks as well as to a distant place. The monitoring device can be improved by imparting system for measuring more physiological parameters like glucose level monitoring, ECG,Blood Pressure etc.

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