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# Health Care System Based on Wireless Sensor Networks

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**ABSTRACT:**Healthcare technologies have successfully entered the Wireless age through application of Wireless networks. Vital healthcare services such as medical data analysis, medical monitoring and alert services are today feasible to common people through this application of Wireless networks. These networks will radically change Healthcare by providing features of mobility, flexibility and constant monitoring. A cost efficient, energy efficient and compact design is presented to facilitate further development of this paradigm.

**KEYWORDS**: Healthcare, ZigBee, Arduino.

## I. INTRODUCTION

Driven by technological advances in low-power networked systems and medical sensors, we have witnessed in recent years the emergence of wireless sensor networks (WSNs) in healthcare. Wireless sensor network systems can help people by providing healthcare services such as medical monitoring, medical data access, and communication with the healthcare provider in emergency situations through the SMS [1] or GPRS. These WSNs carry the promise of drastically improving and expanding the quality of care across a wide variety of settings and for different segments of the population. The power for each sensor node is derived from a battery. Although present systems allow continuous monitoring of patient's vital signs [2], these systems require the sensors to be placed bedside monitors or PCs, and limit the patient to his bed. But now, there is no relation between the sensors and the bedside equipment due to the wireless devices and wireless networks. These systems do not require the patient to be limited to his bed and allow him to move around but requires being within a specific distance from the bedside monitor. We aim to incorporate the recently developed ZigBee standard (IEEE 802.15.4) in our sensor network design, availing the various benefits it provides over the present technologies such as Bluetooth (IEEE 802.15.1).Main focus is on removal of limitations of wired technologies and to use wireless technology. Remote and wireless health care at home or in the hospital is an important technology with many advantages:

1. With the help of this people can monitor their physiological Parameters at home without the necessity to go to the hospital from time to time.
2. The people who carry the sensing devices can move around freely without the obstacle from complex connecting cables; and
3. Doctors in the remote server centre can watch the patient's health condition closely and hence provide real-time advices for the patients' recovery and long-term care. [3]

## II. RELATED WORK

### WIRELESS SENSOR NETWORKS IN HEALTHCARE

Healthcare is an oft-cited application for sensor networks. The use of wireless sensor networks in Developing Countries has a great role to play not only to expedite novel solutions that help mitigate development problems, but also to facilitate research activities in crucial scientific areas such as environmental monitoring, physics of complex systems and energy management.There are Different systems adopting different kinds of intermediate wireless communication. Some of the systems are given below [4]:

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Table 1: Example systems according to different communication used [4]

| Projects | Sensors | Intra BAN communication | Inter BAN communication | Beyond BAN communication | Target Application |
|---|---|---|---|---|---|
| CodeBlue | Pulse oximeter, EKG, motion | Wired | Mesh and ZigBee | -- | Medical care |
| AID-N | Pulse, Blood, Temperature, ECG | Wired | Mesh and ZigBee | Internet/WiFi/ Cellular networks | Mass Casualty incident |
| SMART | ECG, SpO2 sensor | Wired | 802.11b | -- | Health monitoring in waiting room |
| CareNet | Tri-axial accelerometer/ Gyroscope | -- | ZigBee | Multihop 802.11/ internet | Remote healthcare |
| ASNET | Blood pressure, Temperature | Star topology | GPRS/GSM | -- | Remote health monitoring |
| MITHril | ECG,EKG | Wired | WiFi | -- | Healthcare |
| WHMS | ECG,EMG,EEG , SpO2 & motion sensor | Star topology | WLAN/Bluetooth /GPRS | Internet | Telemedicine |
| WiMOCA | Tri axial accelerometer | Star topology & Time table based MAC protocol | Bluetooth | Internet/WiFi/ Bluetooth/ Cellular networks | Gesture detection / Sports |
| MIMOSA | Any sensor/ RFID sensor | Wibree/Blue tooth/RFID | Cellular networks | Internet | Ambient Intellegence |

## III. PROPOSED SYSTEM ARCHITECTURE

The proposed system architecture consists of three tiers. Tier-1 consists of sensor nodes wired to intermediate control unit. The data acquired through the sensors are transmitted through this control unit. Also the unit serves as power source to the sensor nodes. Tier-2 is the intermediate receiving unit which acquires the forwarded data. It is also responsible for storage, processing and displaying the data. Tier-3 is concerned with alert systems and data transmission to longer distances through appropriate internet services.

The temperature sensor and heart-rate sensor are the two sensor nodes used. These wired sensors are connected to Arduino Uno microcontroller board. The board also incorporates XBee module mounted on expansion board for wireless transmission of data. This entire unit receives power through a 9volt battery.

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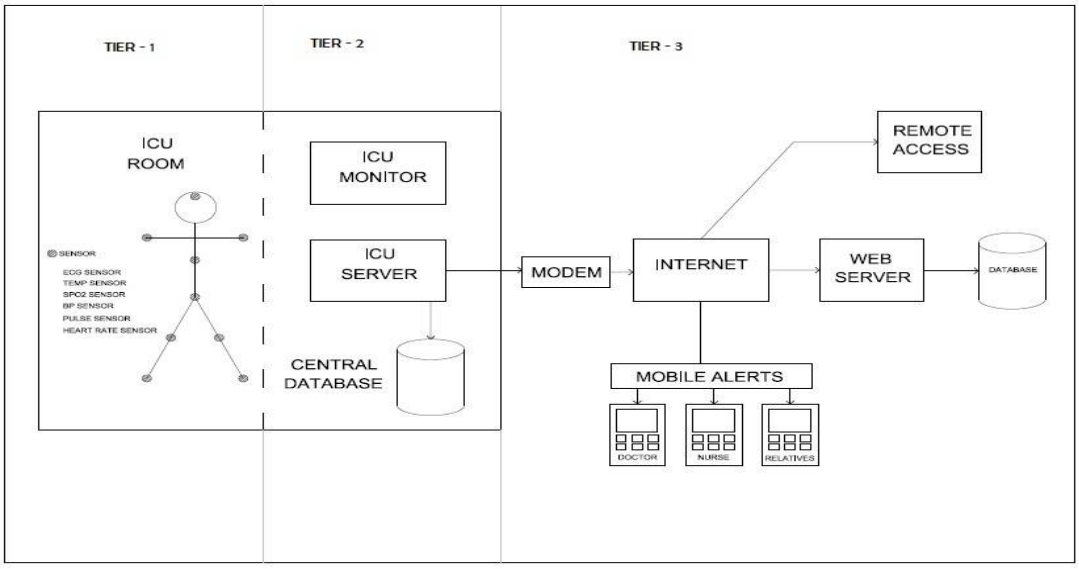


Fig 1: System Architecture

The presented comparative study of various wireless technologies provides us with the preferred candidate for this application of wireless technologies. From the below mentioned technologies we are using ZIGBEE because of its low power consumption and also as because WBAN[5][6][7] is not commercially available.

Table 2: Comparison of different wireless technologies for healthcare applications.

| Metric/ Platform | ZIGBEE | Bluetooth Low energy (BLE) | WBAN |
|---|---|---|---|
| IEEE Standard | 802.15.4 | 802.15.1 | 802.15.6 |
| Range | 10-100 m | >60m (10m for Classic BT) | low range 1m to 10 m |
| Power/ energy consumption | Low | Very Low (High for classic BT and medium for others) | less energy consumption <1mW [15.6NB][15.6UWB] |
| Number of nodes | >64000 per network | 2 Billion (Classic:7) | 256 |
| Frequency Band | 2.4GHz, 915MHz & 868 MHz | 2.4 GHz only (BT + HS: 6-9 GHz) | 400MHz, 2.4GHz, 3.1G~11.2GHz Mostly 2.4 GHz |
| Channel Bandwidth | 0.3/0.6 MHz 2 Mhz | 1 Mhz | 1.2 Mhz |
| Transmission Rate | Up to 250Kbps | 1Mbps (BT v4.0: 25Mbps) | wide range of data rates 500Kbps[15.6NB][15.6UWB] |

## IV. WORKING

**Step 1:**Attach the sensory device to the body of the patient and turn it on.
**Step 2:** The sensors, namely temperature sensor and Pulse rate sensor, will collect the data and transmit it through the

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ZigBee module attached on the Arduino board.

**Step 3:**Thereceiving end on the laptop, again consisting of a ZigBee module will receive the transmitted data.

**Step 4:** The received data will be processed using a custom software which is developed on Processing.

**Step 5:** All the parameters viz. body temperature and the pulse rate of the patient would be displayed using a specially developed software.

**Step 6:** The processed data will be stored in the MySQL database.

**Step 7:** If the received values exceed the medically predefined thresholds, alerts will be sent to the corresponding member.

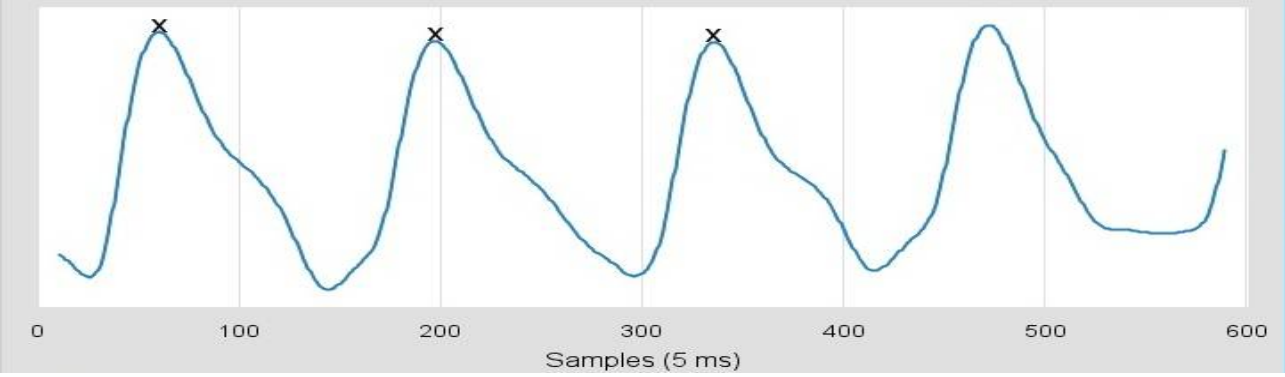


FIG 2: OUTPUT PULSE RATE OF PATIENT

As shown in FIG 2 we are able to see pulse rate of target body with sample time of 5ms. Two adjacent trenches denote a single pulse.

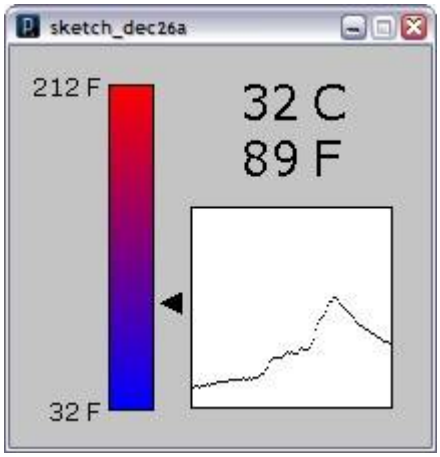


FIG 3: OUTPUT TEMPERATURE OF PATIENT

The above FIG 3 displays current temperature sensed in two units, Celsius and Fahrenheit. It continuously plots temperature graph and also presents a temperature indicator bar denoting the warmth/cold.

## V. SPECIFICATION

Software Specification-:

1. Processing 3

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2. XCTU
4. XAMPP-1.8.3-5-VC11

Hardware Specification-:
Processor – Intel Dual Core or similar
Operating System - Microsoft windows 7 or higher
Browser - Mozilla Firefox, Google Chrome, Internet Explorer

## VI. RESULT ANALYSIS

The analysis of the proposed network infers that it will provide:

- Hassle-free monitoring and remote supervision of patients.
- Compact and energy efficient wireless sensor network.
- Continuous monitoring of body vitals and alert mechanism for emergency situations.
- Development of flexible and mobile monitoring system.

## VII. CONCLUSION AND FUTURE WORK

A Wireless Sensor Network of physiological sensors integrated into a medical system will be a cornerstone in remotely supervised, mobile monitoring system. Current system with two sensors can be augmented to a system with multiple sensors. Also the simple proposed system implemented on single patient will be expanded to cover multiple patients, simultaneously being monitored. Such a system can be implemented in medical institutions as well as home-based monitoring systems [8].

A more energy efficient and compact sensors will form the part of future of this system. Recent developments that allow sensors to be as simple as skin patches will provide absolute freedom to the users to follow their daily life [2]. Last but not least, the valuable data that will be acquired from continuous monitoring will be vital for medical analysis, research, and forming health based patterns through integrated data mining.

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