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## Wireless Physiological Monitoring System

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**ABSTRACT:** Care of the critically ill patient requires very prompt and accurate decisions so that life-protecting and lifesaving therapy can be appropriately applied. Because of these requirements, ICUs have become widely established in hospitals. The difficulty found in most hospitals is that physician / Expert has to frequently visit the patient and assess his/her condition by measuring the different parameters. In case of emergencies, the nurse informs the doctor through some means of communication like mobile phone.

A rising selection of innovative electronic monitoring devices is available, but significant communication and decision supports are also needed for both patients and clinicians. We know that ICU patients require a very attentive and continuous care also requires a timely decision to be taken in order to increase the lifesaving ratio of that patient. There are number of wired monitoring systems developed for the monitoring of the patients. The development of different wireless systems for monitoring of patient activity is one of the most important fields in telemedicine and telecare. This project is mainly used for continuous monitoring aspect of ICU patients. The motivation is to develop a reliable, energy efficient and easily deployable patient monitoring system which is able to send all the parameters of ICU patient. This system enables expert doctors to monitor patient's different parameters from or in remote areas of hospital. So that measured parameters data can be processed, stored and transferred measured parameters to clinicians for further analysis or diagnosis.

The timely manner of conveying the real time monitored parameter to the doctor is given highest priority which is very much needed. Hence On line Real time Health monitoring is becoming popular for the ICU patients. In this project we have designed and developed an energy efficient, easily deployable and interference free health monitoring system for ICU patient in order to increase their life saving ratio.

**KEYWORDS:** *Sensors*, ARM 7 - TDMI Processor, Zigbee Module, RS-232

### I. INTRODUCTION

Wireless health monitoring systems integrated into a telemedicine system are novel information technology that will be able to support early detection of abnormal conditions and prevention of its serious consequences. Many patients can benefit from continuous ambulatory monitoring as a part of a diagnostic procedure, optimal maintenance of a chronic condition or during supervised recovery from an acute event or surgical procedure. Important limitations for wider acceptance of the existing systems for continuous monitoring are:

- unwieldy wires between sensors and a processing unit,
- lack of system integration of individual sensors,
- interference on a wireless communication channel shared by multiple devices, and
- nonexistent support for massive data collection and knowledge discovery.

Traditionally, personal medical monitoring systems, such as Holter monitors, have been used only to collect data for off-line processing. Systems with multiple sensors for physical rehabilitation feature unwieldy wires between electrodes and the monitoring system. These wires may limit the patient's activity and level of comfort and thus negatively influence the measured results. A wearable health-monitoring device using a Personal Area Network (PAN) or Body Area Network (BAN) can be integrated into a user's clothing.



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Recent technology advances in wireless networking, micro-fabrication, and integration of physical sensors, embedded microcontrollers and radio interfaces on a single chip, promise a new generation of wireless sensors suitable for many applications, such as stroke rehabilitation, physical rehabilitation after hip or knee surgeries, myocardial infarction rehabilitation, and traumatic brain injury rehabilitation. Increased system processing power allows sophisticated real-time data processing on sensors, which reduces wireless channel utilization and power consumption. We propose a wireless BAN composed of off-the-shelf sensor platforms with application-specific signal conditioning modules.

## II. PATIENT MONITORING IN INTENSIVE CARE UNITS

There are different categories of patients who need physiologic monitoring like patients with a suspected life-threatening condition, patients at high risk of developing a life-threatening condition, patients in a critical physiological state. Because of these, ICUs have become widely established in hospitals. Such units use computers for the following purposes.

- To acquire physiological data frequently & or continuously.
- To communicate information from data-producing systems to remote locations.
- To store, organize, and report data.
- To integrate and correlate data from multiple sources.
- To provide clinical alerts and advisories based on multiple sources of data.
- To function as a decision-making tool that health professionals may use in planning then care of critically ill patients.
- To measure the severity of illness for patient classification purposes.
- To analyse the outcomes of ICU care in terms of clinical effectiveness & cost-effectiveness.
- That is why, the efforts in direction of “Wireless Physiological parameters Monitoring.”

## III. PROBLEM DEFINITION

As we know that the monitoring of patient is done using fixed monitoring system. But the main complexity is that we can not use the same system or unit for the patients which are fixed or in ICU. So, for the critical patients we need to develop wireless monitoring system which monitors data of that patient in real time. In general health monitoring system (fixed) the parameters data is continuously monitored but not transmitted to remote server in Real Time. If there is any abnormality occurs in the parameter values then only the parameters data is transmitted / send to the server or remote PC via different wireless technologies, like Bluetooth, wi-fi etc. It means that the data is not analysed continuously at each instant of time. So, to overcome all the above limitation related to monitoring systems of patients in ICU, we have to design a new system which operates in real time and sends all the data of patient on doctors PC.

**IV. THE PROJECTED SYSTEM**

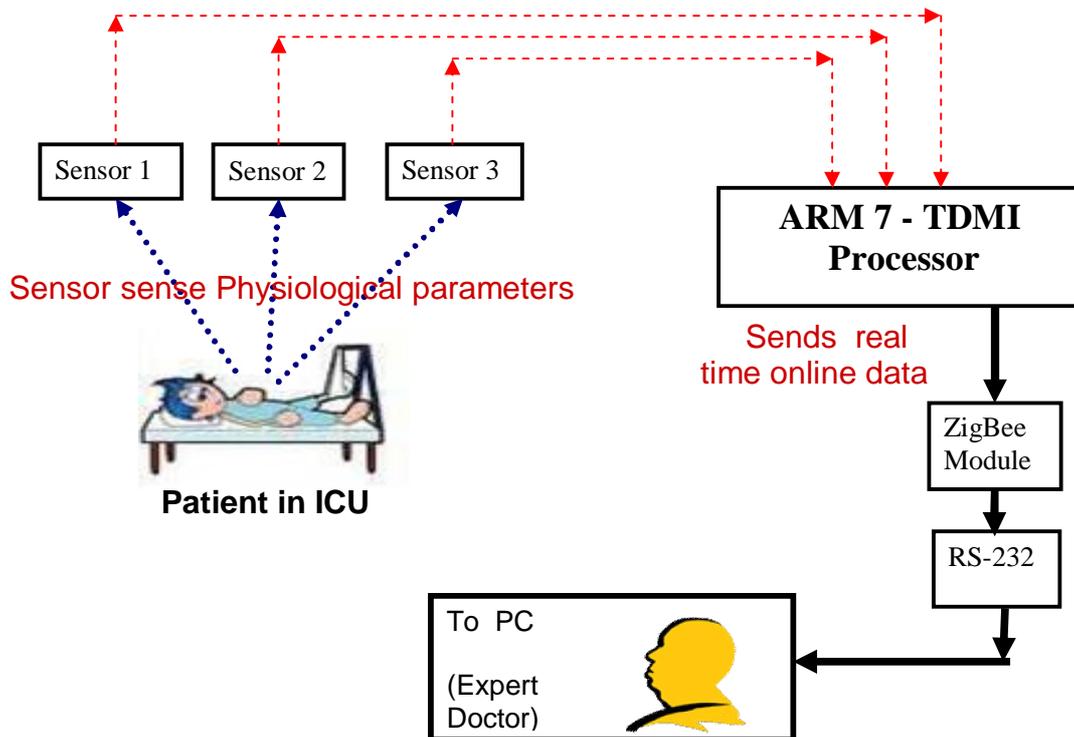


Fig:Proposed System

The above figure 1 shows the proposed system. The projected system on the whole focuses on the transmission of parameters in real time, on line over Doctors PC via wireless technology (ZigBee).

The proposed system is constructed such that it senses different parameters of patient end which is in ICU, without any interference. Vital parameters like temp, heart rate, ECG can be measured. Sensors at patient end play a vital role in monitoring of parameters. The measured parameters are collected by microcontroller (ARM7: LPC 2148) and converted into digital form, transmitted to Local PC via ZigBee Module which collects all the parameters data and put in the form of array and then transmits this data by converting it into packets to remote server via Modem by establishing the HTTP (Hyper Text Transfer Protocol) connection with remote server. On server side we get all transmitted parameters waveforms continuously in real time. If parameters are exceeding the limits; which are already specified, then an automatic buzzer or alarm is generated to concerned physician / Expert doctor. The proposed system is constructed with low power consumption so that it would not cause much obstruction to patient and also less interference.

**V. DESIGNING OF SYSTEM**

The proposed system is combination of both hardware and software. Thus, the selection of these basic components plays important role in the operation of entire system. When the design issues such as size, weight, reliable communication and complexity of the design were considered prior to actual implementation. The requirements of the proposed system were observed as follows:

1. Light in weight.
2. Size should be such that it suffices for both placement of system components and there should be provision for patient comfort.



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3. Less complexity.
4. Very secure to avoid shocks.
5. Provision of unique assignment of all desired functionalities.
6. Less power consumption.
7. Easy maintenance.
8. Ease for further modification.
9. Having capability of hardware reconfiguration and software programming

## A. DESCRIPTION OF HARDWARE

Proposed system is on line Real Time health monitoring system for ICU patients it is developed into parts namely:

- Sensors hardware design for ICU patient.
- RS -232 connector circuit
- Software for data collection from sensors.
- Software for sending of data of patient to the server PC.
- Software for graphical user interface of parameters on Server PC.

**HARDWARE REQUIREMENT:** The hardware consists of following main parts:

- ARM7 microprocessor (LPC 2148 by Philips)
- ZigBee Module
- Regulated Power Supply ( IC : 7805)
- Temperature sensor. (IC :LM 35)
- Heart beat sensor. (IC : LM 358)
- ECG sensor. (IC : AD624 )

## B. SYSTEM DESIGN:

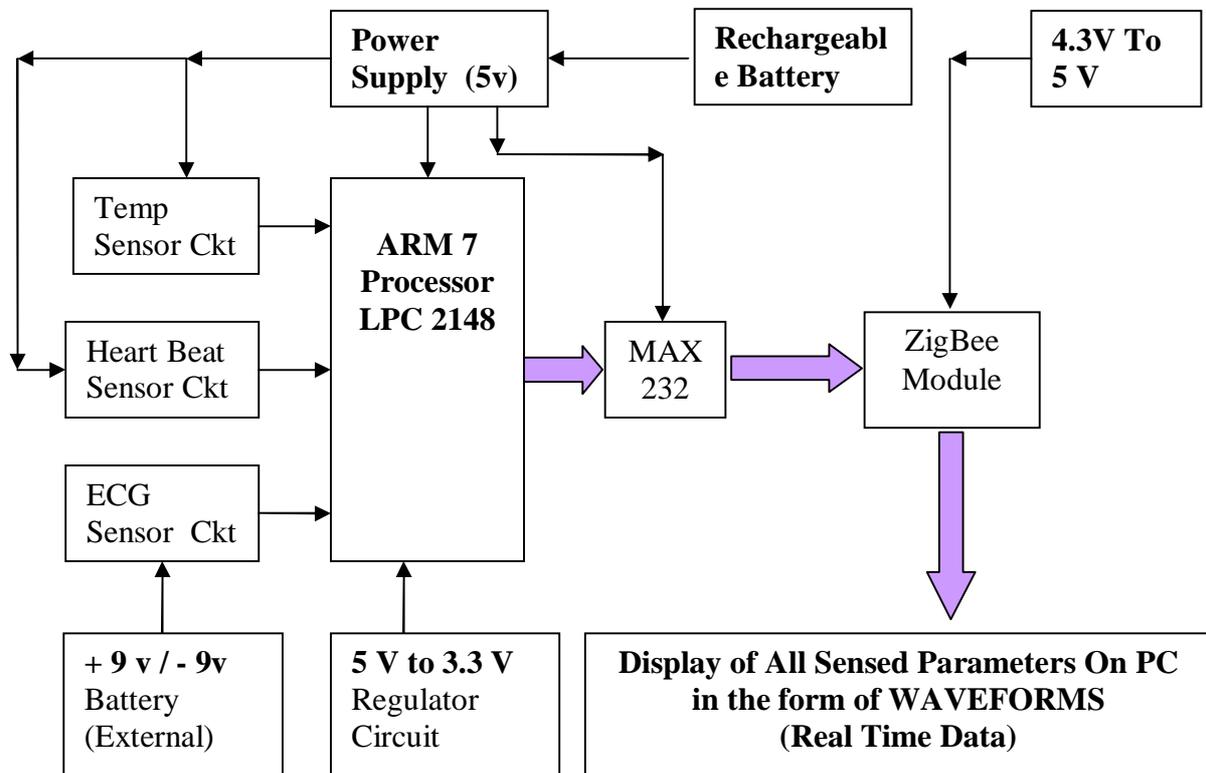
The hardware designing process is a crucial step in the actual implementation of the proposed system. The performance of the system highly depends upon the hardware designing. This section includes designing of power supply, control unit, sensor circuits and other units.

## IMPLEMENTATION OF THE HARDWARE

The implementation of hardware is step process. As per the design requirements of the system different modules and selected modules together form modified block diagram as shown in fig 3.2. After development of block diagram implementation includes circuit diagram, component selection and their interpretability. Testing is an important issue for hardware implementation. Thus, testing is done at different levels. Primary hardware testing is carried out then testing by software is followed by entire system testing. The expectations from the system are described in the system operation section. These processes are described in the following sections

## C. Primary Testing

The different modules of systems require set of components. In other words, each module is represented by its particular circuit diagram. The working condition and ease of performance of these components need to be tested prior to actual implementation. The hardware components are gathered for primary testing purpose. This is done by making use of breadboards. All of the circuits are tested for the modules. The testing can also be carried out on software as well.



**Fig: 2 Complete System Block Diagram**

The needs of the system are to be fulfilled by different electronic components such as IC, resistors etc. The hardware designing section gives brief idea of the components required and their specification as well. Using all this information the complete circuit diagram is developed using Express SCH software is shown in figure 3.2. This circuit diagram forms the base for the operation of the system.

## VI. SYSTEM DEVELOPMENT SOFTWARE

In any digital system cooperation of both hardware and software is essential. Basically, the software (specifically programming) controls the overall systems (specifically hardware). The assembly or C-language codes are burned in the microcontroller of the systems with the help of assembler. Two software's named Keil and uflash+ Programmer are used for the burning the systems program into the microcontroller. The  $\mu$ Vision4 IDE is a window-based software development platform that combines a robust and modern editor, project manager and other facilities.  $\mu$ Vision4 integrates all the tools you need to develop embedded application including C/C++ compiler, macro assembler, linker/locator and a HEX file generator. The  $\mu$ Flash+ programmer is an affordable, reliable and fast programmer for microcontrollers and EEPROMS. USB TTL interfacing card is necessary to plug the module into a PC. The menu-driven software interface makes it easy to operate. The database is created using visual basic software for displaying online monitoring of various parameters using GUI. In the nutshell it can be said that all these software's were selected on the basis of their excellent support to the developer and readily available.

### A. DESCRIPTION OF SOFTWARE

The electrical signal at the input of the system is used by the microcontroller as an operand, the further decision is made on the account of pre-programming in the memory and then output is produced. Software also assigned the I/O pins of

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the microcontroller as input or output. Also software initializes ADC to give electrical values of the physical parameters given by sensor circuits. The flowchart of the system operation is as shown in the figure 4.1. The sensor circuits detects the signals and follows the instructions of the controller as detected in the flowchart. Main role of software lies in monitoring the patient parameters obtained from the controller and are displayed on the GUI. After displaying parameter GUI, the ECG signal is compressed and transmitted online using Zigbee. The code is developed using flowcharts and controller IO status. C language is used for coding purpose. The software implementation is to be done after coding or programming. This process is mentioned in the next section.

## B.SYSTEM OPERATION

Initially system must be powered manually by putting switch on from mains. Also slide switch on the hardware must be 'ON'. For heartbeat monitoring, place the sensor on fore finger such that LED should be on the nail. For ECG, place the electrodes in proper position. This is all about hardware concerns now, move towards the software part. This includes assignments of the functions such as monitoring physical parameters in real time. Monitoring includes temperature values, calculating heartbeat and monitoring ECG of the patient.

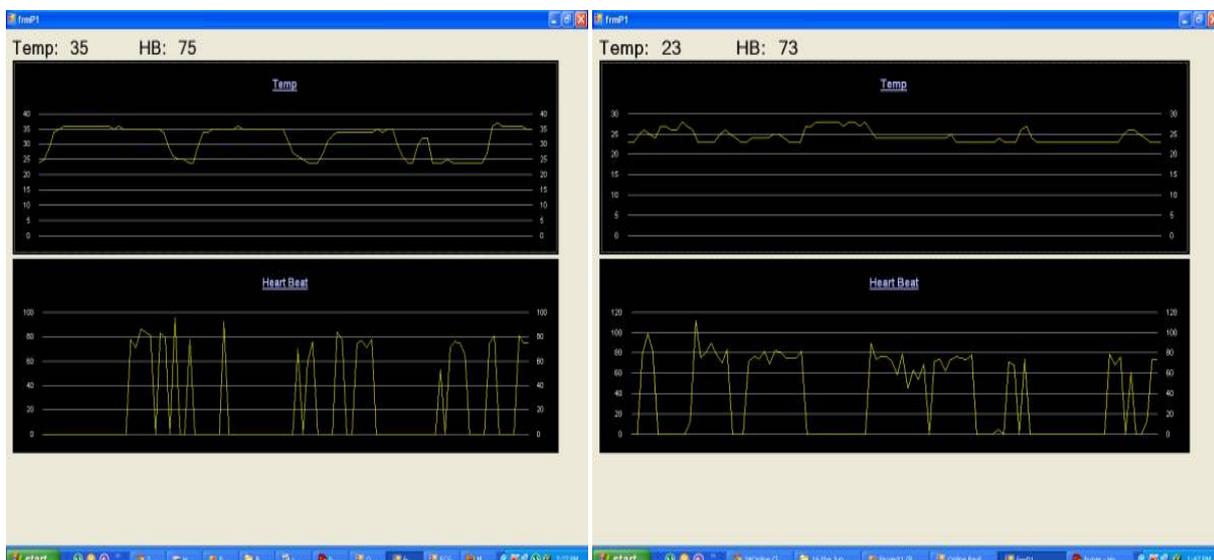


Figure 5: Photograph of the system

The monitoring of parameters in real time is done by the microcontroller which controls all the assigned tasks in program. Also, data base of this is created and stored in the computer for further analysis of the patient. This data is then compressed and transmitted to doctors PC. The values are transmitted using USB TTL driver which transmits the data through Zigbee module

## VII. RESULTS

### A.RESULT OF TEMPERATURE AND HEART BEAT SENSOR:





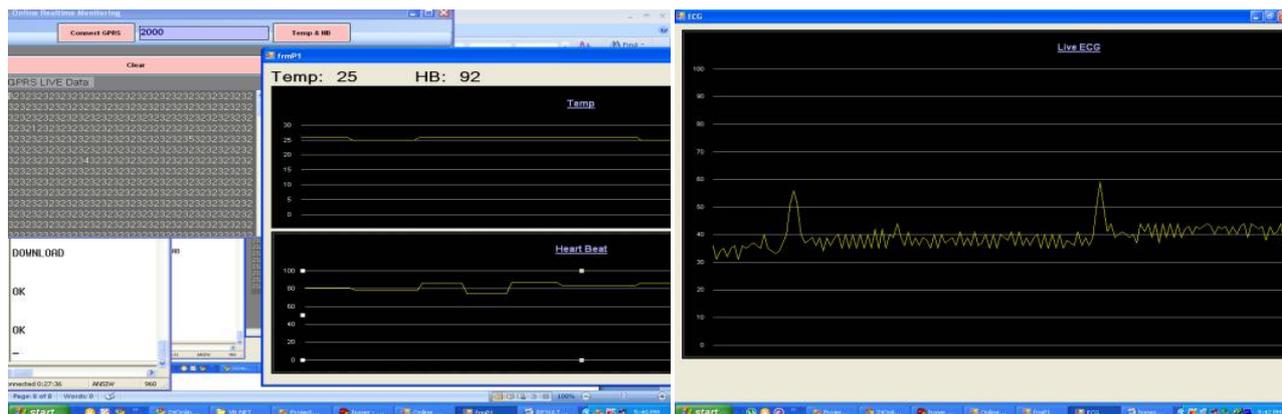
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## B.RESULT FOR TEMP AND HB SENSOR ON SERVER PC



## C. RESULT OF ELECTROCARDIOGRAPH SENSOR :



## VIII. CONCLUSION

From the above designed project I can conclude that we are able to transmit the data which is sensed from ICU patient to the server PC by establishing http communication to server via GPRS .The data is transmitted to server in real time, but if there is any network error or GPRS error then the data transmission might be get delayed. We can also check the data transmission and data downloading status on hyper terminal. So that we can remove the error if any. The leads of the ECG sensor must be stick properly to the patient, which is nearest to the chest side of patient. So that we get more and more correct ECG.

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