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Embedded Patient Monitoring System

Seetharam Khetavath
Associative Professor, Dept. of ECE, CITS Warangal, Telangana
Mail id: seetharamkhetavath@gmail.com

Abstract— *ICU stands for Intensive Care Unit, a place in the hospital where very ill patients are monitored very closely. Typically, the patient-staff ratio is very low and the LIFE-SAVING EQUIPMENT used is very advanced Generally ICU is a hospital facility for provision of intensive nursing and medical care of critically ill patients, characterized by high quality and quantity of continuous nursing and medical supervision and by use of sophisticated monitoring and resuscitative equipment The patients in the ICU need a constant monitoring of their Temperature and heart beat blood pressure. This project is a working model, which incorporates sensors to measure important parameters namely the Temperature, Respiratory temperature and Heart Beat. The sensors are interfaced to computer, so that the condition of a patient can be analyzed by doctors in any part of the hospital wherever they are.*

Whenever there is an abnormality felt by the patient, the particular patient will give an alarm signal, by which the doctor can rush to the patient. Even when the patient is in an unconscious condition, all the parameters will be sensed and doctor will be cautioned, thus it reduces doctor's workload and also gives more accurate results .Our project is a working model which incorporates sensors to measure all these parameters like body temperature, Respiratory Temp and Heart Beat rate and transfer it to the computer, so that the patient condition can be analyzed to by doctors in any part of the hospital wherever they are. Thus it reduces doctors work load and also gives more accurate results, wherever there is an abnormality felt by the patient, we have also incorporated saline monitoring system which gives an alarm when the saline bottle about to empty.

1INTRODUCTION

The present patient monitor systems in hospitals allow continuous monitoring of patient sign,which require the sensors to be hardwired to nearby,bedside monitors or PCs, and essentially confine the patient to his hospital bed.Even after connecting these systems to a particular patient, a paramedical assistant need to continuously monitor and note down all the vital parameters of a given patient by keeping track of all of his/her records

manually. Adopting such a method is error prone and may lead to disaster in the case of a human error.

In the current proposed system the patient health is continuously monitored by the Mobile multi patient monitoring system and the acquired data is transmitted to a centralized ARM server using Wireless Sensor Networks. A ZigBee node is connected to every patient monitor system that consumes very low power and is extremely small in size. These slave nodes are specifically designed for low power consumption, with minimal circuit components (Aliaksei Kerhet,2007)18. They are intended for small packet, long distance range applications and typically consist of a low power processor with minimal resources and interface capabilities. They also have a conservative transceiver that is capable of transmitting 8 bytes of data at a time and has a moderate transmitting range of about 130 m. Therefore, WPANs seem to be a perfect fit for remote patient monitoring. This paper builds an independent system that automatically logs vital parameters of patients for easy access. The data is accessible to doctors through mobile device for convenience. Data of all patients is stored in a common database. Mobility of the equipment is improved by making the equipment more portable.

The literature reviews Diagnosing and continuous record of real-time data by the use of portable patient monitoring system during normal activity would be beneficial for medical practitioners to do proper and better treatment; also it would be useful for health care providers to improve diseases management (Otto,1999)[11].

This challenge attracts many researchers to invent a new design and deploy comprehensive patient monitoring solutions for hospital health care system (Connor et al., 2001)[6]. Advances in wireless networking have opened up new opportunities in a variety of applications (Pierce, 2001)[8] including healthcare systems (Lorincz et al., 2004; Lubrin et al., 2005; Dayu,` 2010; Dishman, 2004; Jafari et al.,2005).

The advancements of Wi-Fi and Bluetooth have facilitated breaking the cord between the noninvasive patient sensor and the bedside equipment (Lubri et al., 2005)[8]. These systems do not require the patient to be confined to his bed and allows him to move around freely in his room but requires him to be within a specific distance from the bedside monitor.For example, adopting a wireless

technology like Bluetooth has a range of transmission about ten meters. Beyond this distance, it is not possible to acquire data. Patient mobility beyond his hospital room can be incorporated by using a network of such nodes placed at appropriate distances in order to transfer data to the monitoring station. However,network nodes that use protocols such as Bluetooth require a larger volume and higher power consumption. This indirectly indicates a higher cost per node and a fairly high burden on its power source, further increasing its size and cost.

Depending on the size of the hospital, several such nodes might be required resulting in a much higher system infrastructure cost. Secondly, a typical Bluetooth Personal Area Network (PAN) has a limitation of 8Nodes per PAN which will limit the expansion of such systems. Moreover, such protocols are meant for moderate to high bandwidth applications where relatively large packets of data need to be transmitted and received. In the case of patient vital sign monitoring, the data packet size is much smaller and could be in tens of hundreds of bytes, which seems to suggest that networks using such protocols might seem impractical and it's obvious that we need a low power, low cost network nodes for such applications.To improve the accuracy and to increase the efficiency of the above processes a real time patient monitoring system based on Wireless Sensor Networks (using IEEE 802.15a) and a centralized ARM Server integrated with GSM module is designed. ZigBee is a specification for a suite of high level communication protocols using small, lowpower digital radios based on an IEEE 802 standard for personal area networks. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. ZigBee is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking. ZigBee has a defined rate of 250 kbps best suited for periodic or intermittent data or a single signal transmission from a sensor or input device.

The present paper is organized as follow the section 2 gives overview of the system, section 3 introduces the System Architecture and the hardware design . The section 5 deals with software implementation of the architecture ,section 6 covers results and discussions and section 7 deals with conclusions.

1. OVERVIEW OF THE SYSTEM

To build an independent system that automatically the ARM server will first check for a valid doctor'she data is accessible to doctors through mobile device for convenience. Data of all patients is stored in a common database. Mobility of the equipment is improved by making the equipment more portable. In the current proposed system the patient health is continuously monitored by the Mobile Multi Patient Monitoring System and the acquired data is transmitted to a centralized ARM server using Wireless Sensor Networks. A ZigBee node is connected to every patient monitor system that consumes very low power and is extremely small in size. These slave nodes are specifically designed for low power consumption, with minimal circuit components[15]. Therefore, WPANs seem to be a perfect fit for remote patient monitoring. Upon system boot up, the mobile patient monitor system will continuously monitor the patients vital parameters like Heart Beat, body temperature etc and will periodically send those parameters to a centralized server using ZigBee node configured as co-coordinator. If a particular patient's health parameter falls below the threshold value, a buzzer alert is triggered by the ARM server. Along with abuzzer an automated SMS is posted to the preconfigured Doctors mobile number using a standard GSM module interfaced to the ARM server. The Doctor is continuously connected to the ARM server using GSM Module and he/she can get a record of a particular patient's information by just posting a SMS message to the centralized ARM server. This will reduce treatment time, cost and power consumption to a greater extent. At the same time, the efficiency of examining ward will be improved by making the system more real-time and robust. If a particular patient's information is required by the doctor, then he/she can send a SMS to the ARM server mentioning the record number of a particular patient.

mobile number which is provided to the GSM module during system boot up time. If the mobile number requested by the doctor matches with the one present in the ARM server then a SMS response will be sent back to the doctor based on the request.

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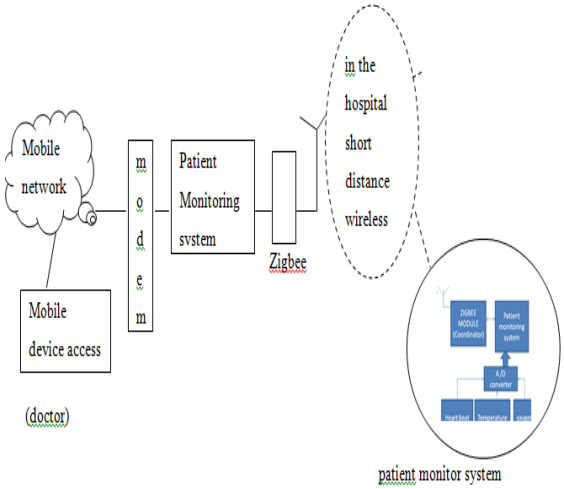


Fig:1 Overview of system

1.1 TECHNICAL APPROACH

A serial interface program is implemented to collect the data from different WSN's to the central mobile monitor station running on Linux with ARM controller. The received data from different wireless sensors are processed by the controller periodically.SMS alerts are generated by the controller based on the preconfigured threshold values of the monitoring parameters of a particular patient. Another serial interface program is implemented to interface with astandard GSM module on the controller. The SMS send and receive functionality is also implemented and is interfaced with a serial interface for a standard GSM mobile module.

1.2. SYSTEM ARCHITECTURE

The hardware design of Wireless Sensor Network Gateway is based on ARM microprocessor. Through expanding ZigBee and GSM modules, the platform can realize the function of wireless sensor network nodal data collection and transmission. In this the zigbee modules are considered as zigbee transceivers. Zigbee modules can communicate and send the information from one place to another. Zigbee is connected to center core ARM processor in which the application runs. This ARM processor acts as the gateway to zigbee and GSM module. ARM is connected to GSM module through which text messages like SMS alerts are sent to the doctor's mobile number which is configurable. A set of preconfigured AT commands are required to prepare a SMS and send it to the configured mobile number which is implemented used a program for the GSM module. The design is made flexible so that the doctor's number can be changed during the system bootup time (Zhou Pengshuo,2008)14. Structure of the system.

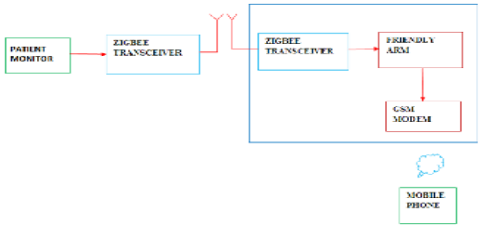


Fig: block diagram

1.2.1 INTRODUCTION TO EMBEDDED SYSTEMS

Many embedded systems have substantially different design constraints than desktop computing applications. No single characterization applies to the diverse spectrum of embedded systems. However, some combination of cost pressure, long life-cycle, real-time requirements, reliability requirements, and design culture dysfunction can make it difficult to be successful applying traditional computer design methodologies and tools to embedded applications. Embedded systems in many cases must be optimized for life-cycle and business-driven factors rather than for maximum computing throughput. There is currently little tool support for expanding embedded computer design to the scope of holistic embedded system design. However, knowing the strengths and weaknesses of current approaches can set expectations appropriately, identify risk areas to tool adopters, and suggest ways in which tool builders can meet industrial needs. If we look around us, today we see numerous appliances which we use daily, be it our refrigerator, the microwave oven, cars, PDAs etc. Most appliances today are powered by something beneath the sheath that makes them do what they do. These are tiny microprocessors, which respond to various keystrokes or inputs. These tiny microprocessors, working on basic assembly languages, are the heart of the appliances. We call them embedded systems. Of all the semiconductor industries, the embedded systems market place is the most conservative, and engineering decisions here usually lean towards established, low risk solutions. Welcome to the world of embedded systems, of computers that will not look like computers and won't function like anything we are familiar with.

2 LITERATURE SURVEY

Karandeep Msalhi et al [1] develop Zigbee smart noninvasive wearable physiological parameters monitoring device has been developed and reported in this paper. The system can be used to monitor physiological parameters, such as temperature and heart rate, of a human subject. The system consists of an electronic device which is worn on the wrist and finger, by an at risk person. Using several sensors to measure different vital signs, the person is wirelessly monitored within his own home. An impact sensor has been used to detect falls. The device detects if a person is medically distressed and sends an alarm to a receiver unit

that is connected to a computer. This sets off an alarm, allowing help to be provided to the user.

Rubina.a.shaikh, et al [2] Design a module to monitoring of remote patients, after he is discharged from hospital. I have deto send parameters of patient in real time. It enables the doctors to monitor patient's parameters (temp, heartbeat, ECG) in real time. Here the parameters of patient are measured continuously (temp, heartbeat, ECG) and wirelessly transmitted using Zigbee. B. sirisha et al [3] describes a solution for enhancing the reliability, flexibility by improving the performance and power management of the real-time multi-patient monitoring system (MPMS). In the current proposed system the patient health is continuously monitored by the MPMS and the acquired data is transmitted to a centralized ARM server using Wireless Sensor Networks. A Zigbee node is connected to every patient monitor system which will send the patient's vital information .Upon system boot up, the mobile patient monitor system will continuously monitor the patients vital parameters like Heart Beat, body temperature etc and will periodically send those parameters to a centralized server using Zigbee node configured as co-coordinator. If a particular patient's health parameter falls below the threshold value, a buzzer alert is triggered by the ARM server. Along with a buzzer an automated SMS is posted to the pre-configured Doctors mobile number using a standard GSM module interfaced to the ARM server.

2.1 EXISTING SYSTEM

There are some shortcomings present in existing system. The patient is monitored in ICU and the data transferred to the PC is wired. Such systems become difficult where the distance between System and PC is more. The available systems are huge in size. Regular monitoring of patient is not possible once he/she is discharged from hospitals. These systems cannot be used at individual level.

The other problem with these systems is that it is not capable of transmitting data continuously also range limitations of different wireless technologies used in the systems. So to overcome these limitations of systems we proposed a new system. Our system is able to transmit the parameters of patient continuously and over long distance in wireless medium. Due to which we would be able attend the patient immediately.

Therefore by developing a system that can constantly measure the important parameters of patient's body and which can

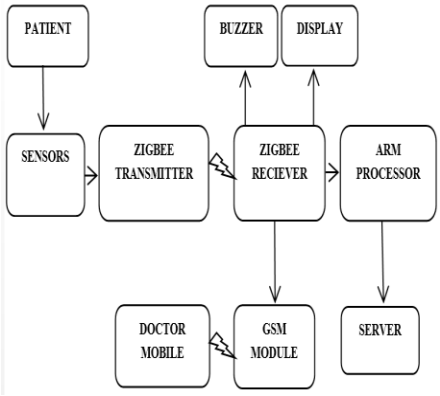
alert the closed ones and the doctor on any time when the patient's condition gets bad, this can really provide quick service and be beneficial in saving a lot of lives.

DRAWBACKS

- The distance between System and PC is more.
- The available systems are huge in size.
- Regular monitoring of patient is not possible once he/she is discharged from hospitals.
- It is not capable of transmitting data continuously

3 PROPOSED SYSTEM

The proposed system is designed for monitor the patient is in any place. The system would constantly monitor important physical parameters like temperature, heartbeat, ECG, blood sugar, and would compare it against a predetermined value set and if these values cross a particular limit it would automatically alert the alarm and doctor via a SMS. This system provides a continuous health monitoring service.



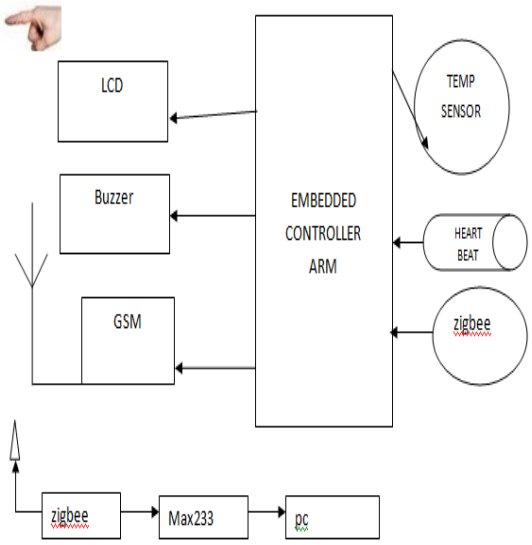
Block diagram of the Proposed Systems

The data processed are transmitted by Zigbee wireless. Finally the received data is sent to the PC. The graphical user interface programs on the PC are coded using keil C software, Using GSM modem message is transmitted to the doctor mobile number when the measured temperature exceeds the allowable value or if the pulse measured is abnormal

BLOCK DESIGN PROPOSAL FOR THE SYSTEM

Buzzer Should On Based on Command Received Through GSM in Emergency.

DATA FROM THE PATIENT



ADVANTAGES

system is able to transmit the parameters of patient continuously

System can transimit the data over long distance in wireless medium

a system that can constantly measure the important parameters of patient's body

which can alert the closed ones and the doctor on any time when the patient's condition gets bad,

this can really provide quick service and be beneficial in saving a lot of lives

We would be able attend the patient immediately

ARM7 (CONTROLLER)

The ARM7 family includes the ARM7TDMI, ARM7TDMI-S, ARM720T, and ARM7EJ-S processors. The ARM7TDMI core is the industry's most widely used 32-bit embedded RISC microprocessor solution. Optimized for cost and power-sensitive applications, the ARM7TDMI solution provides the low power consumption, small size, and high performance needed in portable, embedded applications.

4 Hardware Components

4.1 INTRODUCTION:

This chapter consists of all the hardware components required for the project implementation. The component selection place in a vital role in the result. Some of the project components are ARM processor, LCD, light sensor, humidity sensor, temperature sensor.

4.2 MICROCONTROLLER(ARM7):

4.2.1 INTRODUCTION:

The ARM7 family includes the ARM7TDMI, ARM7TDMI-S, ARM720T, and ARM7EJ-S processors. The ARM7TDMI core is the industry's most widely used 32-bit embedded RISC microprocessor solution. Optimized for cost and power-sensitive applications, the ARM7TDMI solution provides the low power consumption, small size, and high performance needed in portable, embedded applications.

The ARM7EJ-S processor is a synthesizable core that provides all the benefits of the ARM7TDMI low power consumption, small size, and the thumb instruction set while also incorporating ARM's latest DSP extensions and enabling acceleration of java-based applications. Compatible with the ARM9™, ARM9E™, and ARM10™ families, and Strong-Arm® architecture software written for the ARM7TDMI processor is 100% binary-compatible with other members of the ARM7 family and forwards-compatible with the ARM9, ARM9E, and ARM10 families, as well as products in Intel's Strong ARM and x scale architectures. This gives designers a choice of software-compatible processors with strong price-performance points. **4.3ARM7 TDMI:**

The ARM7TDMI core uses a three-stage pipeline to increase the flow of instructions to the processor. This allows multiple simultaneous operations to take place and continuous operation of the processing and memory systems. The instructions are executed in three stages: fetch, decode and execute.

4.3KEIL C COMPILER

Keil Software publishes one of the most complete development tool suites for 8051 software, which is used throughout industry. For development of C code, their Developer's Kit product includes their C51 compiler, as well as an integrated 8051 simulator for debugging. A demonstration version of this product is available on their website, but it includes several limitations.

The C programming language was designed for computers, though, and not embedded systems. It does not support direct access to registers, nor does it allow for the reading and setting of single bits, two very important requirements for 8051 software. In addition, most software developers are accustomed to writing programs that will by executed by an operating system, which provides system calls the program may use to access the hardware. However, much code for the 8051 is written for direct use on the processor, without an operating system. To support this, the Keil compiler has added several extensions to the C language to replace what might have normally been implemented in a system call, such as the connecting of interrupt handlers.

The purpose of this manual is to further explain the limitations of the Keil compiler, the modifications it has made to the C language, and how to account for these in developing software for the 8051 microcontroller.

Keil Limitations

There are several very important limitations in the evaluation version of Keil's Developer's Kit that users need be aware of when writing software for the 8051.Object code must be less than 2 Kbytes

The compiler will compile any-sized source code file, but the final object code may not exceed 2 Kbytes. If it does, the linker will refuse to create a final binary executable (or HEX file) from it. Along the same lines, the debugger will refuse any files that are over 2Kbytes, even if they were compiled using a different software package.

Few student projects will cross this 2Kbyte threshold, but programmers should be aware of it to understand why code may no longer compile when the project grows too large.

Program code starts at address 0x4000

All C code compiled and linked using the Keil tools will begin at address 0x4000 in code memory. Such code may not be programmed into devices with less than 16Kbytes of Read-Only Memory. Code written in assembly may circumvent this limitation by using the "origin" keyword to set the start to address 0x0000. No such work-around exists for C programs, though. However, the integrated debugger in the evaluation software may still be used for testing code. Once tested, the code may be compiled by the full version of the Keil software, or by another compiler that supports the C extensions used by Keil.

C Modifications

The Keil C compiler has made some modifications to another wise ANSI-compliant implementation of the C programming language. These modifications were made solely to facilitate the use of a higher-level language like C for writing programs on microcontrollers.

Variable Types

The Keil C compiler supports most C variable types and adds several of its own.

Standard Types

The evaluation version of the Keil C compiler supports the standard ANSI C variable types, with the exception of the floating-point types. These types are summarized below.

5 Conclusion

As this project is based on ARM and zigbee technology is used to transmit data this can be of great use in the field of medicine and nelp the doctor to akeen eye on the patient health. System is Potable and easy to use,Modern

technologies have developed that promotes comfortable and better life which is disease free and Prevention is better than cure

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