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Implementation of Wireless Patient Body Monitoring System using RTOS

Gunalan .M.C[1], Satheesh.A[2]
PG Scholar[1], Prof. & DEAN/EEE[2]
M.E - Embedded System Technologies[1], Department of Electrical and Electronics Engineering
Nandha Engineering College, Erode
guh1820@gmail.com[1] ,asatheeshnec@rediffmail.com.com[2]

Abstract— In the past decades, the requirement in the health care field is rising rapidly, and therefore we need a well-equipped efficient monitoring systems for health care centers. In general, most of the hospitals, manual inspection is done in order to collect the records of patient's condition. Continuous and frequent monitoring of patients is required based on their health state. This leads to disadvantages like long measurement time, low monitor precision, and deployment of more manpower, this paper provides a fully automated and wireless monitoring system.
In this paper, a wireless network is created for remotely monitoring of patient's health parameters like Temperature, ECG, Heartbeat, Coma recovery and saline level indication. All these parameters are continuously measured using appropriate efficient low cost modules, which are designed for each parameter. The measured data from the patients are transferred to a central monitoring station via a Zig-bee. In this a PC acts as a central monitoring station which runs LabVIEW for monitoring the parameters.

Terms— RTOS, Wireless, Zig-bee, LabView, body monitoring, monitoring, patient monitoring

1. Introduction

In present scenario, patient health parameters are adopting rapidly. For implementing automated measurements each patient is given a dedicated system and does not works on centralized mode of operation. If a patient is admitted in ICU a regress monitoring of health parameters is done but consider if a patient is admitted in a normal ward there advance measurement systems doesn't exist. In such cases nurse goes to ward and measures patient's body parameters for every certain interval of time, During this manual measurement there is chance of missing the accuracy during to inefficient nurses, the measurement records which taken by nurses are can be analyzed by doctors as reference of disease diagnosis. If the measurement goes wrong the diagnosis fails or misleads. This term of conventional not only wastes nurses' massive manpower, but also aggregation, query analysis to measurement result is miscellaneous, as well as cannot feedback in time when patient appears special condition, which can cause delay of treatment time. Through analysis we can see, this kind of style has bigger limitation, especially, to those patients with infectious diseases, monitoring personnel is inconvenience to contact.

So, aiming to this problem, by sensor technology, single chip microprocessor technology, etc., we design a wireless remote monitoring system. This system uses wireless communication (Zig-bee) technology, which eliminates the manual measurements. Monitoring of each patient sub-system in real time, as well as communicating with central monitoring station, we can increase work efficiency, and data reliability, etc

2. SYSTEM ANALYSIS

2.1 EXISTING SYSTEMS

In this chapter we have mentioned the existing and proposed system as follows

2.1.1 In-Home Wireless Monitoring Of Physiological Data for Heart Failure Patients

This system proposes an integrated system (hardware and software) for real-time, wireless, remote acquisition of cardiac and other physiologic information from HF patients while in the home environment. Transducers for measurement of electrocardiogram (ECG), heart rate variability (HRV), acoustical data are embedded into patient clothing for unobtrusive monitoring for early, sensitive detection of changes in physiologic status. Sampling rate for this system is 1 kHz per channel. Signal conditioning is performed in

hardware by the patient wearable system, after which information is wirelessly transmitted to a central server located elsewhere in the home for signal processing, data storage, and data trending. The dynamic frequency ranges for the ECG and heart sounds (HS) are 0.05-160 Hz and 35-1350 Hz, respectively. The range-of-operation for the current patient-wearable physiologic data capture design is 100±10 feet with direct line-of-sight to the home server station. Weight measurements are obtained directly by the in-home medical server using a digital scale. Physiologic information (ECG, HRV, HS, and weight) are dynamically analyzed using a combination of the LabVIEW (National Instruments, Inc.; Austin, TX) and MATLAB (MathWorks, Inc.; Inc

Natick, MA) software strategies. Software-based algorithms detect out-of-normal or alarm conditions for HR and weight as defined by the health care provider, information critical for HF patients. Health care professionals can remotely access vital data for improved management of heart failure.

2.1.2 A wireless surface electromyography system

Surface electromyography (SEMG) systems are utilized throughout the medical industry to study abnormal electrical activity of the human muscle. Historically, SEMG systems employ surface (skin) mounted sensors that transmit electrical muscle data to a computer base via an umbilical cord. A typical SEMG analysis may exercise multiple sensors, each representing a unique data channel, positioned about the patient's body. Data transmission cables are linked between the surface mounted sensor nodes and a backpack worn by the patient. As the number of sensors increases, the patient's freedom of mobility decreases due to the lengthy data cables linked between the surface sensors and the backpack. An N-channel wireless SEMG system has been developed based on the ZigBee wireless standard. The system includes N-channels, each consisting of a wireless ZigBee transmitting modem, an 8-bit microcontroller, a low-pass filter and a pre-amplifier. All channels stream data to a central computer via a wireless receiving modem attached directly to the computer. The data is displayed to the user through graphical development software called LabView. The wireless surface electromyography (WSEMG) system successfully transmits reliable electrical muscle data from the patient to a central computer. The wireless EMG system offers an attractive alternative to traditional wired surface electromyography systems as patient mobility is less compromised

2.1.3 Automatic Mental Health Assistant: Monitoring and Measuring Nonverbal Behavior of the Crew During Long-Term Missions

This system presents a method for monitoring the mental state of small isolated crews during long-term missions (such as space mission, polar expeditions, submarine crews, meteorological stations, and etc.) The research is done as a part of Automatic Mental Health Assistant (AMHA) project which aims to develop set of techniques for automatic measuring of intra- and inter- personal states in working groups. The method is focused on those aspects of psychological and sociological states that are crucial for the performance of the crew. In particular, we focus on measuring of emotional stress, initial signs of conflicts, trust, and ability to collaborate. The developed method is also currently tested by usage of a web-based platform.

2.1.4 DRAWBACKS

The above mentioned three systems were having some drawbacks as follows

Any one of the parameter is taken and measured

Long measurement time

Low monitor precision

Difficulty in monitoring patient

connection of many instruments are tedious process

difficulty in monitoring patient body temperature by thermometer

Heart beat is measured manually.

Como patients should be monitored closely in person

No indication for saline level

2.2 PROPOSED SYSTEM

This paper uses a wireless medium for communication between sub-system and main monitoring station. In this system five parameters are measured.

Body temperature

Saline level indication

Comma level indication

Heartbeat counter

EMG (Electro Myo Gram)

ECG (Electro Cardio Gram)

These parameters will be measured for a specific interval of time continuously and these data will be collected by the monitoring sub-system. Now the data will be sent from sub-system to the main monitoring station via Zig-bee network. The data will be fetched by the software (LABVIEW) and the data will be processed by software. If the parameter goes beyond the predefined values at once it sends an SMS to the concerned doctor that the patient is in serious stage.

The block is as follows

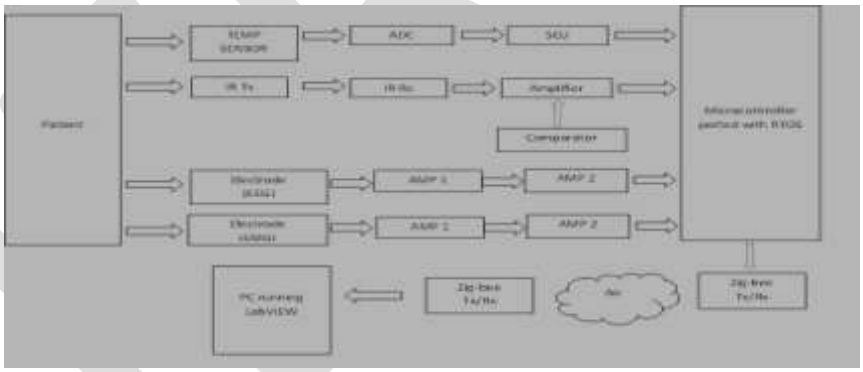


Fig 2.1 System Block Diagram

2.2.1 ADVANTAGES

Eliminates the manual system measurements and monitoring processes

Temperature measurement has high accuracy as LM35 is used

The patient status is sent effectively to the doctor via SMS

Very instantly the status of the patient is monitored with high accuracy

All the parameters are embedded in to single system which easy to handle by a normal person

2.3 FEASIBILITY STUDY

In our analysis the methodology we use is more feasible than the existing methods of measuring the patient body parameters

2.3.1 ECONOMICAL FEASIBILITY

The existing methods are not so cheaper because it has many disadvantages like all systems are being designed for measuring a specific parameter only. The systems which are existing today are also so costly. And these systems must be stored in a certain temperature for a perfect working. So, for the maintaining of these system air conditioners will be used this consumes much electricity and we have to pay for electricity board a lot.

2.3.2 OPERATIONAL FEASIBILITY

When compared with the existing methods the proposed system is not as complex as the existing methods because no manual operations are carried out. All the equipment will be controlled from a pc by software. No manual attention is needed until the emergency alarm rings. And an alert SMS is sent to the concerned doctor. For that we have to simply feed the mobile number of doctor. And if anything badly occurs it will inform through a message to doctor.

2.3.3 TECHNICAL FEASIBILITY

The existing methods must have a trained person to operate that system any one cannot operate the easily. If problem comes to user end it is not easy to solve. In our system it is very easy to operate and ordinary person who know to operate a pc can operate the software very easily for monitoring purpose.

3 SOFTWARE DESCRIPTION

We are using two software in our paper they are explained below as follows

3.1 NI LabVIEW

LabVIEW (Laboratory Virtual Instrumentation Engineering Workbench) is a platform and a development environment for a visual programming language from National Instruments. The purpose of such programming is to automate the usage of decicision making and measuring equipment in a laboratory setup. The graphical language named "G" was originally released for the Apple Mac systems, LabVIEW is commonly used for data acquisition, complex processing, instrument control, industrial automation etc.. on a various platforms including Microsoft Windows, UNIX, Linux, and Mac OS X. The recent versions of LabVIEW provides more features and interface modules.

4. Paper Descriptions

4.1 PROBLEM DEFINITION

- Long measurement time
- Low monitor precision
- Difficulty in automatic monitoring patient
- connection of many instruments are tedious process
- difficulty in monitoring patient body temperature by thermometer
- Heart beat is measured manually
- Como patients should be monitored closely in person
- No indication for saline level

4.2 OVERVIEW OF THE PAPER

Now-a-days every instrument is automated. In medical field also the automation is developing very rapidly. Large hospital and medical research centre are adopting towards automation. But the cost implementing automated systems is very huge. For each patient an individual monitoring system should kept.

This drastically increases the implementing cost and also the system occupied space. To overcome this problem this paper has been framed with methodologies which can be used for this monitoring system.

This paper presents a wireless patient body monitoring system in which Zig-bee is used for wireless communication. The sub-systems are integrated with main monitoring server with a mesh network formed using Zig-bee communication. **4.3 MSP430F5438**

MSP430F4538 microcontroller comes under MSP430 family of ultralow-power microcontrollers which is a product of Texas Instruments. This device consists of several different sets of peripherals targeted for various applications. The architecture supports five modes. These are optimized to extended battery life in portable high precision monitoring and control applications. This microcontroller has a powerful 16-bit RISC CPU and constant generators that can produce maximum code efficiency.

The digitally controlled oscillator (DCO) allows the microcontroller wake-up from low-power modes to active high performance mode in milli-seconds. The MSP430F5438 microcontrollers are integrated with a high performance analog-to-digital (A/D) converter, universal serial communication interfaces (USCI), three 16-bit timers, real-time clock module with alarm capabilities, hardware multiplier, DMA and up to 87 I/O pins.

Applications includes analog and digital sensor systems,digital timers, digital motor control, thermostats, hand-held meters, remote controls, etc.

4.4 GSM MODEM (900/1800 MHz)

GSM Modem can accept any GSM network operator SIM card and act just like a mobile phone with its own unique mobile number. The advantage of using this modem will be that you can use its RS232 port to communicate and develop embedded applications. Applications includes SMS Control, data transfer, remote control and logging can be developed easily.

This modem can either be connected to PC serial port directly or to any microcontroller through RS232. It can be used for sending and receiving SMS and calls. It can be used in GPRS mode to interface with internet and perform applications for data logging, decision making and control. In GPRS mode you can also connect to any remote FTP server and upload files for data logging.

This modem is a plug and play highly flexible quad band SIM900A GSM modem for direct and easy integration to RS232 applications.

4.4.1 Applications

- SMS based Remote Control & Alerts
- Security Applications
- Sensor Monitoring
- GPRS Mode Remote Data Logging

4.4.2 Features

- Status of Modem Indicated by LED
- Simple to Use & Low Cost
- On board switching type power supply regulator
- RS232 output

4.5 MicroC/OS II (µCOS II)

µC/OS-II is a completely real-time, portable, preemptive, ROMable, scalable, multitasking kernel. µC/OS-II is written in ANSI C and contains a small portion of assembly language code to adapt it to different processor architectures. To date, µC/OS-II has been ported to different processor architectures.

µC/OS-II is based on µC/OS, The Real-Time Kernel that was first created. Millions of people around the world are using µC/OS and µC/OS-II in all kinds of applications, such as cameras, highway telephone call boxes, avionics, high-end audio equipment, medical instruments, musical instruments, network adapters, ATM machines, industrial robots, engine controls, and more. Numerous colleges and universities have also used µC/OS and µC/OS-II to teach students about real-time systems.

µC/OS-II is upward compatible with µC/OS v1.11 (the last released version of µC/OS) but provides many improvements. If you currently having an application that runs with µC/OS, it should run virtually on µC/OS-II. All of the services (i.e., function calls) provided by µC/OS have been saved for back . You may, however, have to change include files and product build files to point to the new filenames.

4.5.1 Features

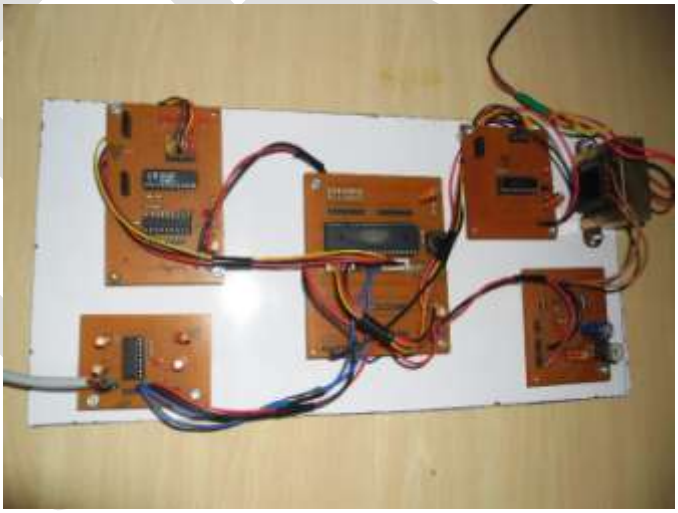
- Portable
- ROMable
- Scalable

- Preemptive
- Multitasking
- Deterministic Execution times
- Task Stacks
- Interrupt Management
- Robust and Reliable

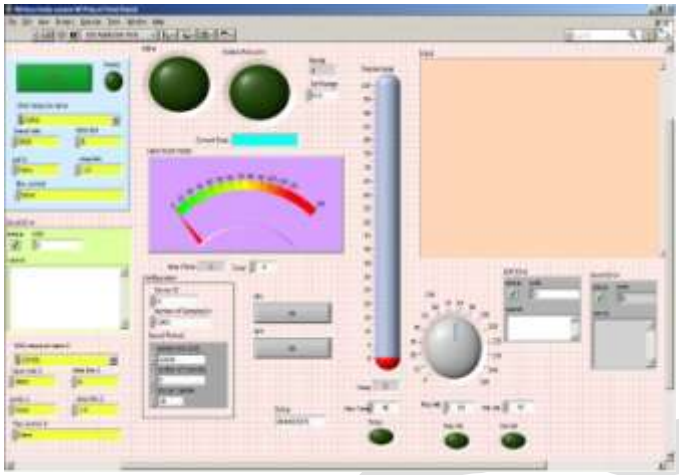
4.4 PAPER SNAPS

4.4.1 PATIENT SIDE CIRCUIT

4.4.2 PC SIDE CIRCUIT



4.4.3 PC LABVIEW SNAP



5 CONCLUSION

The patient body monitoring system implemented with RTOS gives promising results than the other conventional methods. It works effectively in term of automated systems compared to the existing method. However, it has room for improvement in this project. In the future, the system will be intergrated with WWW (World Wide Web). so, that patient data can be accessed over internet from any part of the world. As a result, medical prescriptions and precautions can be made easier. In a nutshell, this project is highly potential for application purposes in ICU monitoring.

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