Remote Monitoring System of ECG and Body Temperature Signals

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Abstract:

A Remote monitoring system for electrocardiographic and temperature signals. The system consists of a hardware module for acquisition, a Bluetooth transmission module and finally a displaying module (mobile devices). Information is sent via TCP\IP Protocol (GPRS) to a database server containing clinical data, which can be accessed through a web application. The system was assessed by testing different patients with the support of a medical doctor, obtaining a positive performance. Heart disease is increasingly affecting human lifestyle, rehabilitation and practical devices are being carried out and created in order to reduce the disability from heart diseases. This paper proposed a wireless patient monitoring system which integrates Bluetooth technology.

Keywords: TCP\IP Protocol, GPRS, Wireless Sensor Networks(WSNs), BSN.

1. INTRODUCTION

Wireless sensor networks (WSNs) consist of number of sensor nodes. These nodes can be deployed especially in regions where remote monitoring is not possible. Regions can be thick forest, inaccessible terrains or areas affected by disaster. With evolution in fabrication technologies, size of devices have become smaller, consume less power and are priced low. This motivation has made size of the sensor node to shrink, with extending its computation capabilities. Number of such small sensor nodes can be deployed in a large region. Because of their increased capabilities, these nodes can hop data to their neighboring node using advanced network protocols. Data can be sent to any distant node through these clustered nodes. These nodes together perform large data processing activities at very low power. Putting together, WSN's provide advantages like flexibility, fault tolerance, high sensing fidelity at low cost. Rapid deployment characteristics of sensor networks fancy their use in remote patient monitoring system and sports training facilities. Remote care helps to measure vital body signals such as blood pressure and body temperature from a remote distance.

Advantages of WSN have helped to design Body Sensor Network technology (BSN). BSN consists of number of sensors attached on different areas of body called Body Area Network (BAN) . These sensors individually collect data and transmit to the remote clinics or hospitals. This technique is very much helpful for elderly patients who face difficulty in visiting hospitals regularly and long term monitoring is recommended. Adhesive electrodes cannot be used for long term ECG monitoring. Nodes with non contact electrodes are preferred for such patients. ECG monitoring system designed using microcontrollers require external amplification and filter circuits to acquire ECG signal. Thus, increase power consumption. The project represents a problem of Real Time processing of ECG signal from patients by mobile embedded monitoring stations. Two ECG measurement devices were used in real tests. A two ECG channel bipolar ECG CorBelt and a 12 channels ECG device Blue ECG.

2. RELATED WORK

Designs of ECG devices which are small in size, easy to wear, convenient to use and consume less power are being carried out very extensively. Advantages of WSN have made a popular choice among other techniques in designing such portable devices. Ebrahim Nemati, M. Jamal Deen, and Tapas Mondal [6] have designed a small, portable two-lead capacitive coupling ECG sensor and a wireless module. This wireless module sends the processed ECG signal at patient side to a PC using the low power ANT protocol. Each node in an ANT network consists of an ANT engine and a host microcontroller unit (MCU). The ANT engine is responsible for establishing connection, maintaining connection and channel operation. However, the MCU handles the specifics of a particular application. Low power consumption is achieved by switching node on and off based on their neighbor's nodes activity. ANT network employs such intelligence to overcome high power consumption.

Ebrahim Nemati, M. Jamal Deen, and Tapas Mondal have designed WSN using Zigbee protocol. System on Chip (SoC) provides low power solution to acquire ECG signal. Zigbee protocol uses 2.4 GHz transmitter and receiver. Transmitter and receiver use low noise amplifiers, differential power splitter (DPS), and quadrature mixer for low-IF architecture. These blocks provide good conversion gain and signal switching, making it ideal for use in low power applications. Tsung-Heng Tsai, Jia-Hua Hong, Liang-Hung Wang, and Shuenn-Yuh Lee, [8] have designed a very low power system on chip. This can be configured as wireless sensor node for continuous and real time health monitoring. transmits acquired ECG signal over 433.95 MHz channel. Transmitted signal can be received by personal server like PDA. On PDA ECG signal is displayed and monitored. SoC consumes 700 uWatt with 0.7 V supply. This can run more than 200 hours, without changing it. This makes it a low power WSN solution.

3. SYSTEM ARCHITECTURE DESIGN:

The design of the remote monitoring of the ECG and the body temperature system consists of the two sections 1. The patient section and 2. Monitoring section. The patient section of the system consists of 8052 microcontroller, ECG module, temperature sensor, power supply, and LCD Display and Bluetooth communication module. The monitoring section of the system consists of ARM 11 microcontroller, Bluetooth and WIFI wireless communication module.
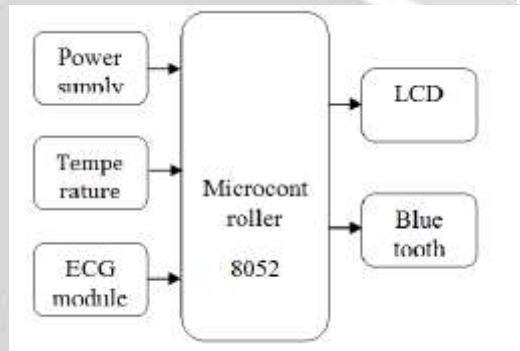

Fig1. Patient Section.

a.   Patient Section

The patient section of the system consists of the temperature sensor and the ECG module which collects the body temperature and Generally ECG analog signals from the sensors are converted into a binary bit sequence by using the analog-to-digital converter. Digital bits are stored in the microcontroller cushion before shipment. Signal processing circuit, act as intermediate nodes between ECG sensor circuit and a PC. The ECG data is sent to the display
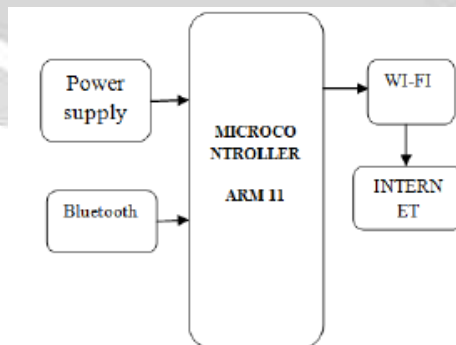

Fig2. Monitoring Section.

b. Monitoring Section

The body temperature and ECG values transfer from the patient section are received by the monitoring section through Bluetooth wireless communication these data will be given to the server from the WI-FI through the ARM microcontroller.

4. HARDWARE DESIGN:

The hardware design of the Remote Monitoring Of ECG and Body Temperature Signals consists of the ARM 11 microcontroller ECG module, body temperature sensor, LCD Display

Microcontroller(ARM11):

ARM stands for Advanced RISC Machine .The ARM11 is based on the ARMv6 instruction set architecture. Bi-endian – can operate in either little-endian or big-endian format .Most devices today use little-endian. Actually uses two instruction sets– the 32-bit ARM and the 16-bit Thumb Since many embedded devices have small amounts of memory, a smaller, 16-bit instruction set can be used . This 16-bit 'Thumb" instruction set makes use of implied operands and reduced functionality to reduce code size .Thumb instructions are decoded into ARM instructions on the fly at execution time, though consuming one additional cycle . CPU is either in ”ARM state” or ”Thumb state. 16 general-purpose registers R0-R15-R13 is the stack pointer and is often called SP. R14 holds return addresses and is often called LR (for link register) R15 is the program counter and is often called PC . PC is always word-aligned. 17general-purpose” mode-specific” registers (used for exception handling, etc.). 7 status registers, one for each operating mode.
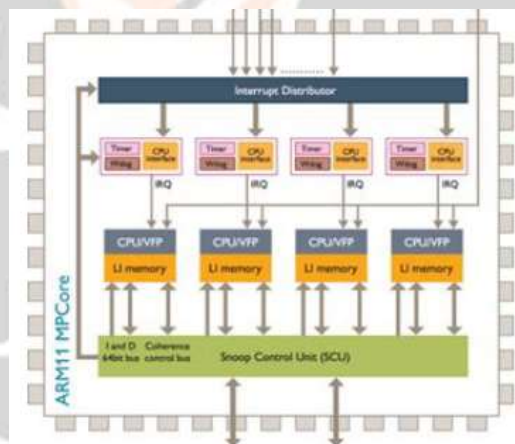

Fig3. ARM 11 architecture.

a. **ECG Module**

A 2-lead electrocardiogram (ECG) sensor, transmitting the ECG data acquired from the ECG sensor via the Bluetooth wireless link, and receiving the ECG data at the PC is illustrated. The acquired ECG data is processed, manipulated and constructed as an ECG waveform. Lastly, the ECG waveform is displayed on the personal computer (PC) screen. The results show that implementation of wireless technology in the existing ECG monitoring system eliminates the physical constraints imposed by hard-wired link and allows users to conduct own check up at anytime anywhere. The newest Bluetooth communication technology was added to our previously-developed Internet based information system, which collects short an1d long-term digitized ECGs together with relevant clinical data for the management of patients. A wireless communication protocol was developed using the Bluetooth system for short-distance (10-20 m) RF data transmission.

b. **Temperature Sensor**

The LM35 series are precision integrated circuit temperature sensors. Output voltage is linearly proportional to centigrade temperature. Operates from 4 to 30 volts. Rated for full b55§ to a150§C range Linear a 10.0 mV/§C scale factor . The LM35 arrangement are exactness incorporated circuit Lm35 temperature sensors, whose yield voltage is directly corresponding to the Celsius temperature. The LM35 sensor consequently has leverage over straight temperature sensors adjusted in ° Kelvin, as the client is not needed to subtract an extensive steady voltage from its yield to get advantageous Centigrade scaling.

Fig4. Temperature sensor.

c. **8052 Microcontroller**

The AT89S52 is a low-control, prevalent CMOS 8-bit microcontroller with 8k bytes of in-system programmable Flash memory. The contraption is created using Atmel's high-thickness nonvolatile memory development and is great with the business standard 80c51 rule set and stick out. The on-chip Flash allows the task memory to be reproduced in-system or by a routine nonvolatile memory programming specialist. By combining an adaptable 8-bit CPU with in-structure programmable Flash on a strong chip, the Atmel At89s52 is a convincing microcontroller which gives a significantly versatile and wise response for some embedded control applications. The At89s52 gives the going with standard eccentricities: 8k bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog clock, two data pointers, three 16-bit clock/counters.

d. **Bluetooth** Bluetooth is overseen by the Bluetooth Special Interest Group (SIG), which has more than 20,000 part organizations in the ranges of telecom, figuring, systems administration, and purchaser electronics. Bluetooth was institutionalized as IEEE 802.15.1, however the standard is no more kept up. The SIG directs the advancement of the determination, deals with the capability program, and secures the trademarks. To be advertised as a Bluetooth gadget, it must be qualified to norms characterized by the SIG. A system of licenses is obliged to actualize the innovation, which is authorized just for that qualifying gadget.

e.   **WI-FI:** Remote innovation has ended up predominant in advanced society as it exhibits an answer for the situation of making life less demanding by separating the systems administration obstructions of separation and versatility. In an investigation of the advantages of remote LAN directed in 2001[1], 87% of study respondents attributed WLAN to an increment in their personal satisfaction because of the adaptability and versatility of remote web integration; besides, WLAN has been ascribed to a 22% efficiency increment for end-clients. The advance of remote systems administration has brought about the boundless extension of WLAN base with a great many open, private, and business remote access focuses scattered the world over.
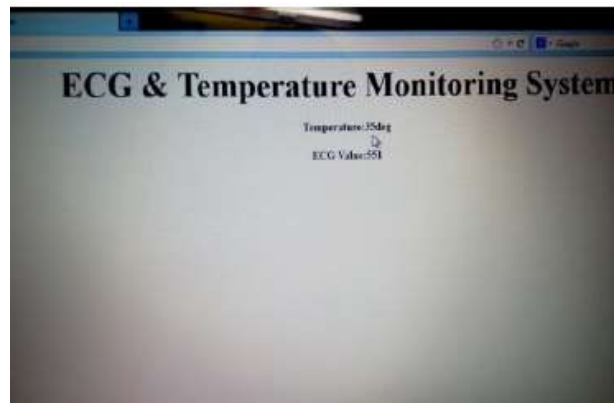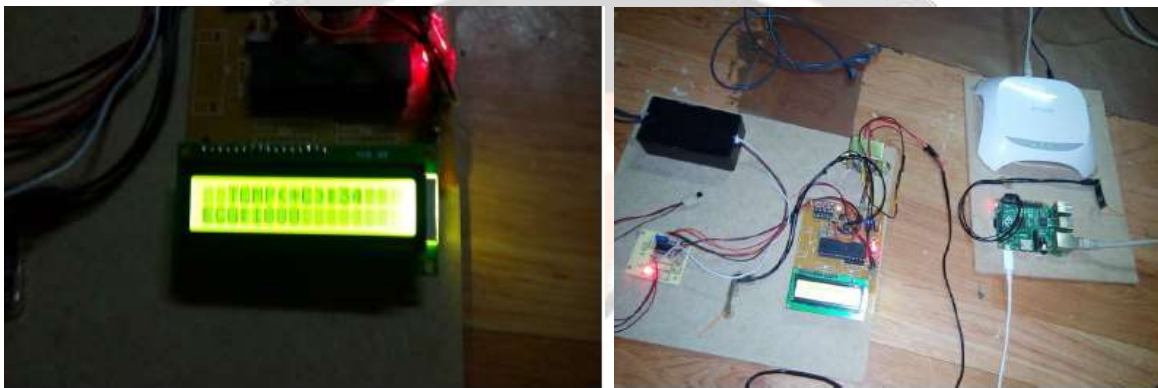
5.RESULTS

Fig5

Fig6.   **Fig7**

7. CONCLUSION

With the fast development of the industrialization and urbanization process in the world and hence with the increase of busyness of people it has become difficult To monitor the health conditions of a patient continuously. Also with the increase in the number senior citizens and chronic diseases, the number of elderly patients who need constant assistance has increased. One key point of all critical care for elderly patient is the continuous monitoring of their vital signs. To avoid unexpected health problems and obtain higher accuracy in diagnosis of the health conditions of a patient, efficient and comprehensive data collecting, monitoring and control play an important role to improve the health care system more reliable and effective

8. REFERENCE

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