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Low Power Extended Race Wireless Skin Temperature Measurement System

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Abstract: *Wireless Sensors networks plays a vital role in the field of telemedicine with a wide range of capabilities like these networks are being used to monitor critical illness such as diabetes, cardiovascular diseases etc. In this paper we discuss the core application of remote medical monitoring using fixed node wireless sensor networks in telemedicine healthcare system. This proposed system is used to measure the skin temperature of a particular patient for long period, in hospitals or at home as a part of recovery procedure. This system uses a wireless sensor attached on patients skin to measure the patients skin temperature and then transmit the data wirelessly to central monitoring station through ZigBee.*

Keywords: *Telemedicine, Remote Patient Monitoring, Wireless Sensor, Skin Temperature.*

I. Introduction

One of the major problems faced by health professionals/organizations is continuous monitoring of health parameters of a patient. It must be accurate, precise and real time parameters. In early days, the Patient monitoring system consist of single patient monitoring system, where sensors are hard wired to a PC next to the bed. But for employing a multiple patient monitoring system as opposed to single patient monitoring system, then these systems would be more cost and power efficient, and allows professionals and experts to monitor many patients simultaneously without being in the same location. The parameters are processed and compared with the existing system with threshold limits of each patient.

This paper describes a temperature monitoring system for wireless skin temperaturemeasurement system based on the wireless sensor with fixed nodes. The sensor nodes consist of commercially available temperature sensor and Arduino Nano as a wireless module that performs the temperature measurement and wirelessly transmit them to the central monitoring station through the ZigBee protocol (802.15.4 IEEE Standard). The central monitoring station displays the patient's skin temperature and alerts when patient temperature values exceed the preset limits.

II. Material and Methods

The conceptual view of the proposed system (shown in fig.1)is that consists of the following components: a WSN of a temperature measuring devices, one sensor node attached on patients chest, that is used to measure the skin temperature of the patient, network coordinator and a PC as a central monitoring station[2]. Each temperature-sensing device consists of XB24Z7WITas wireless module. The hardware devices used by the proposed system (i.e. RPM) are commercially available such as temperature sensor PT-100 [3].

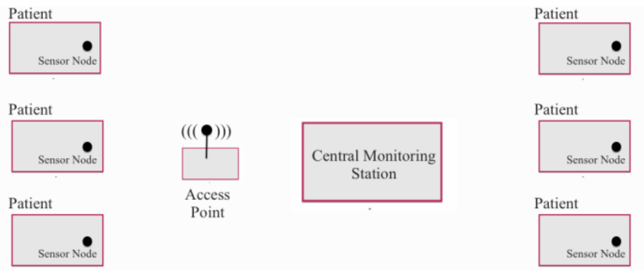

Fig.1 Wireless Skin Temperature Measurement System [2]

The AT-MEGA 32L is a high performance, low power, and 8-bits microcontroller with advanced RISC architecture(as shown in fig. 2). The XB24Z7WIT is a complete wireless development module for the AT-

MEGA-32L [4] microcontroller and wireless RF transceiver that includes the hardware and software resources required to develop a small applications. It has an internal memory structure of 32Kbytes in system self-programmable flash memory and 2Kbytes of internal SRAM. Other features of AT-MEGA-32L [5] includes: It performs fully static operations 10 bit Analog to Digital Converter with operational differential input stage with programmable gain, a programmable watchdog timer with internal oscillator, SPI serial port & six software selectable power saving mode.

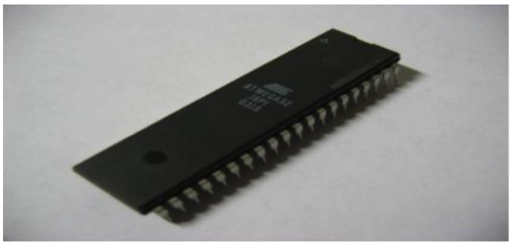

Fig.2 The AT-MEGA32L SMD Microcontroller [4]

Typical applications of AT-MEGA 32L SMD includes sensor system that capture analog signal and convert them into digital signal and processed that data for display or for transmission at a host system.

The XB24Z7WIT (as represented in fig. 3) is a lower cost 2.4GHz wireless RF transceiver designed for lower power wireless applications. The circuit used for data transmission id ISM & SRD. The XB24Z7WIT [6] is connected to AT-MEGA 32L microcontroller by using the SPI interface and has indoor line of sight range up to 50 meters.

Fig.3 The XB24Z7WIT Wireless module [6]

This uses the ZigBee (IEEE 802.15.4) protocol from Texas instrument to transfer data from sensor node to a central monitoring station [7]. ZigBee is a low data rate, low power consumption and low cost wireless transmission protocol. It provides connectivity to the equipment's that requires long battery life but does not consider the data units. ZigBee has three components (as shown in fig. 4):

1) Network coordinator: it is the coordinator that maintains the whole network to store and forward the measured temperature of the patient to the central monitoring station.

2) The Full Functional device/FFD: it works as network router to provide route to data to reach the central monitoring station or it can be used as edge devices.

3) The Reduced functional device/RFD: it contains the limited functionality to lower the cost and complexity of a system.

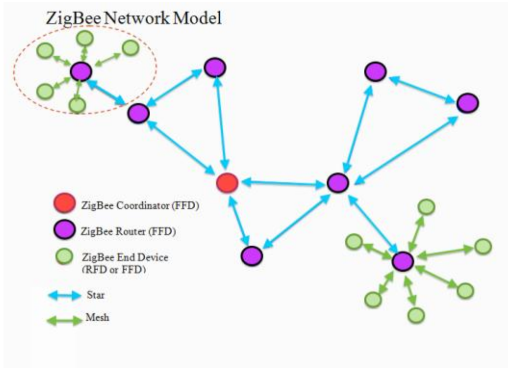

Fig. 4 ZigBee Protocol (IEEE 802.15.4) [7]

The ADS7825 (as represented in fig.5) is a low power 16 bits sampling analog to digital converter with four channels multiplexer [8]. It can be configured in a continuous conversion mode to sequentially digitize all four channels.

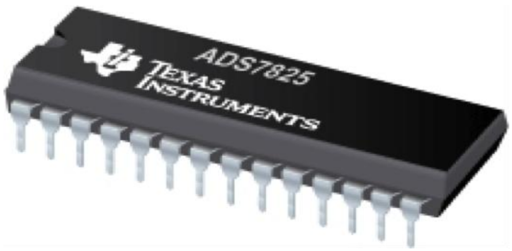

Fig.5 The ADS78245 Analog to Digital Converter [8]

For skin temperature measurement we use PT100 temperature sensor [9]. The PT100 (shown in fig.6) temperature sensor is high precision, accurate, two wire temperature sensor with serial output, capable of reading temperature with resolution of 0.0325. By PT 100 means its photothermister device with 100-Ohm resistance. PT100 is directly connected to ADS7825 using the standard communication interface [10]. The principle of operation is to measure the resistance of a platinum element. The most common type (PT100) has a resistance of 100 ohms at 0 °C and 138.4 ohms at100°C.

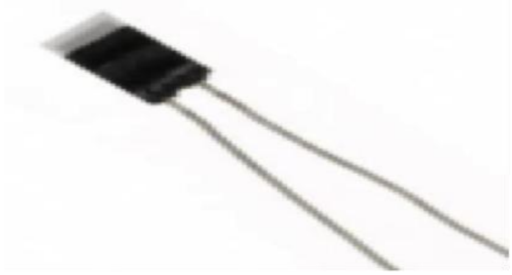

Fig.6 The PT100 Temperature Sensor [9]

This Fig.7 circuitry is used to implement the proposed system by which we are able to get the results of the system. In this system we are connecting the 10-ohm resistance in series with the temperature sensor to check the voltage drop. The output generated by the temperature sensor is then fed o the ATX block to increase the strength of the signal, then fed this to the analog to digital converter to made the data understandable by the Arduino and then further broadcast through the ZigBee router.Then that signal is received by the ZigBee coordinator at the receiver end and then fed to central monitoring station through the serial to USB adaptor to show the results on CMS.

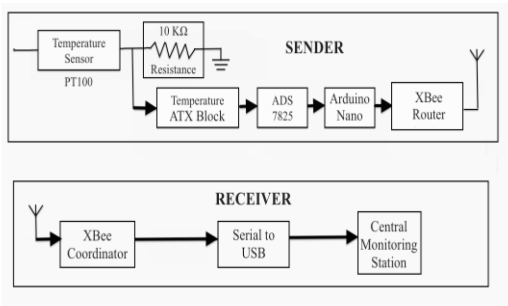

Fig.7 The PT 100 Temperature Sensor Interface

III. Results

The accuracy of the PT100 temperature sensor for the 35-50 temperatureinterval is below ±O.2°C (Fig. 8) and the conversion of 16 data bits took place in 25microseconds.

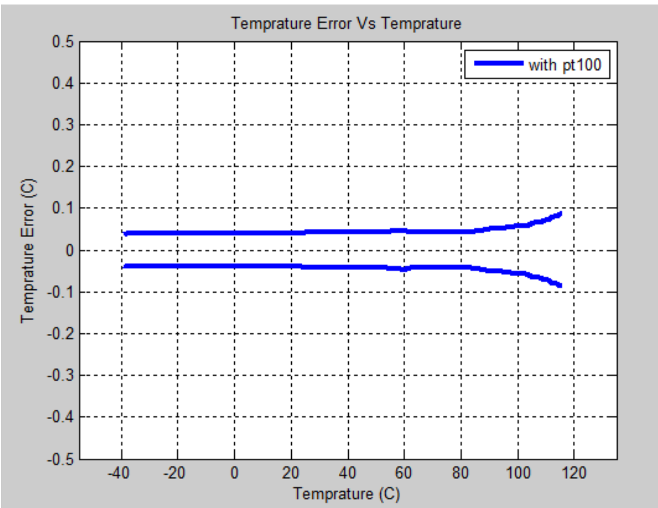

Fig.8 The PT100 Temperature Error Vs. Temperature

Fig.9 represented the flowchart of firmware working on ZigBee module XB24Z7WIT. In this instance, the XB24Z7WIT, after the acknowledgement from the access point this starts measuring the patients skin temperature from sensor node, sensor battery voltage, and sends result to the central monitoring station. It reduces the power consumption of wireless module by sending it into the sleep mode when not in use.

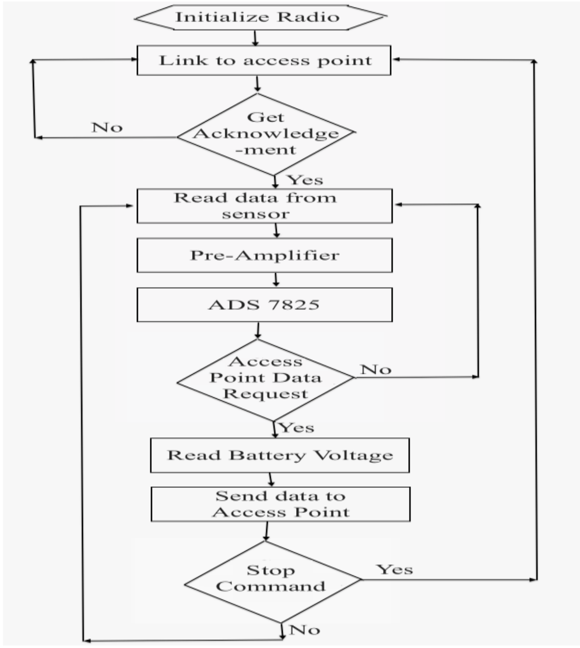

Fig.9 The Flowchart of firmware on ZigBee (XB24Z7WIT) Module

A user application interface (Fig. 9) running on the central monitoring station, was developed to run on Windows based operating systems, and was written using the MATLAB 2011b.

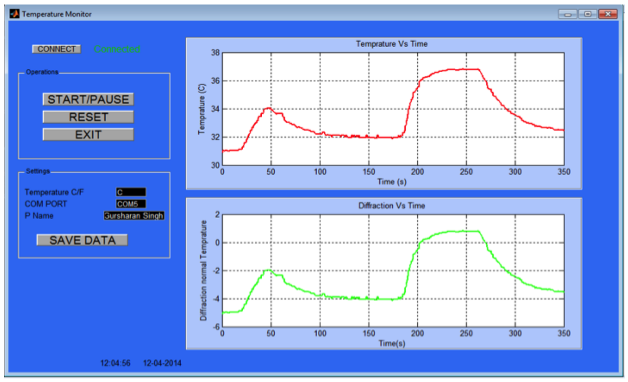

Fig.10 The GUI of application

This Fig.10 shows the interface consists of a drawing area for displaying the patients skin temperature, an area consisting of various control buttons and indicators/alert messages. The operation area consists of buttons like Start, Pause and Exit. The Configuration Panel allows the users to select the RS 232 communication parameters between the eZ430-RF2500 receiver module and central monitoring station with several options: COM Port, Baud Rate, Parity, Data Bits and Stop Bits. The default values for these parameters are presented in the Fig. 11.

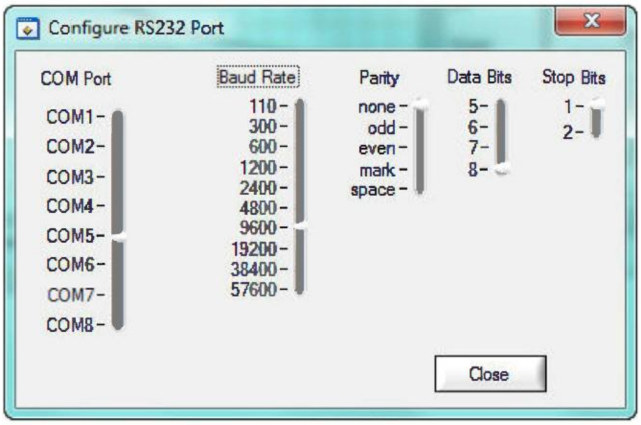

Fig.11 The Configuration Panel

A prototype system containing all described above has been implemented and tested. Using wireless sensor nodes attached on patient's chest we have successfully making patient's temperature measurements and forward the measured values to the central monitoring station through WSN. The sample time used to acquire the patient temperature was chosen at 10 seconds order to analyze the current profile of the wireless sensor node; the hardware used is represented in the Fig.12

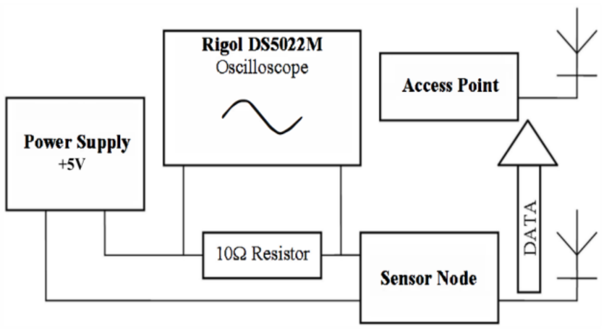

Fig.12 Result Testing Hardware

The largest contributor to current consumption is XB24Z7WIT RF transceiver. To calculate the average current consumption by the sensor node, we transferred the data acquired by Rigol DS5022M digital oscilloscope to a computer and, with the aid of MATLAB [11] software we computed the integral of the voltage curve - resulted an area underthe curve. In this way, we theoretically

Calculate the constants for temperature:

$$Temp= P1*x^4+P2*x^3+P3*x^2+P4*x+P5$$

Computed an Average Current (AC) and Hours of Operation:

$$AC = \frac{\text{Measured Voltage/10Ohm}}{\text{Period of Transmission}}$$

$$\text{Hours of Operation} = \frac{\text{Current Rating}}{\text{Average Current}}$$

Current Time can be calculated:

Current Time = Current Day*24*60*60 + Current Hour*60*60 + Current Minute*60+Current Second.

IV. Comparison

This graph (Fig.13) shows the comparison between the temperature error versus temperature with PT100 and TMP275. This graph compares:

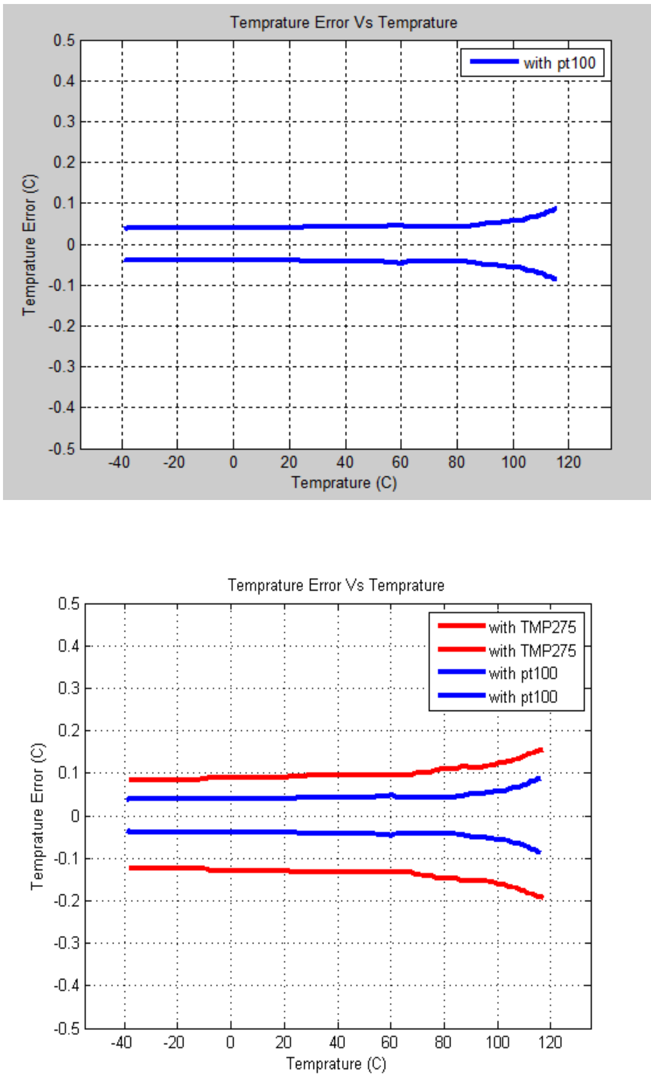

Fig. 13 Comparison Graph with PT-100 and TMP275

Table 1 Comparison Table for TMP275 & PT100

Parameter	Existing System	Proposed System
Precision	0.0625°C	0.0265
Data Rate	500KBauds	750KBauds
Power Consumption	High: uses high power consumption devices	Low: Uses low power consumption devices
Battery Life	690 days	1052 days
Average Current	14.5micro Amp	9.5mill Amp
Protocol	SimpliTi	ZigBee(802.15.4)

V. Conclusion and Future Scope

A prototype of remote patient monitoring is developed for the long term monitoring at home or at hospital. It is also used to measure and transmit the patients skin temperature wirelessly using ZigBee protocol (IEEE 802.15.4 standard) to a central monitoring station [2]. The devices used in this prototype are commercially available, the temperature sensor and the ZigBee module. The prototype developed is suitable for the underlying implementation technologies, with the purpose of establishing the requirements for building a framework for remote patient monitoring with the mobility of patient using telemedicine healthcare system. This system is measuring patients skin temperature using temperature sensor capable of efficient processing of the complex areas where distance is a critical factor and subsequently offer support in delivering the relevant medical advice. The next phase of this work involves the completion of the system implementation, with force sensors in the shoe soles of patients [1]. While they walk about, we can gather data from their normal ambulatory movements.

References

[1] Anagha Jamthe, Suryadip Chakraborty, "An Implementation of Wireless Sensor Networks in Monitoring of Parkinson's Patients using Received Signal Strength Indicator", *IEEE International Conference on Distributed Computing in Sensor Systems*, pp. 442-447, 2013

[2] Cristian Rotariu, Hariton Costin, "Wireless Skin Temperature Measurement System for Circadian Rhythm Monitoring", *The 4th IEEE International Conference on E-Health and Bioengineering – EHB*, pp. 825-832, 2013

[3] Hassan N. M, Olaniyi O. M, Ahmed A, Dogo E. M, "Wireless Sensor Networks for Remote Healthcare Monitoring in Nigeria: Challenges and Way Forward",*IEEE International Conference on Emerging and Sustainable Technology for Power and ICT in Developing Society*, pp.182-187, 2013

[4] www.atmel.in/AT-MEGA-32L-SMD datasheet.
[5] www.eti.ca.it/get.pdf
[6] www.digikey.c/product/XB24Z7WIT
[7] www.staff.ustc.edu.cn/ZigBee.pdf
[8] www.ti.com
[9] www.omega.ca.uk/pt100
[10] www.picotech.com/pt100
[11] www.mathworks.com