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Smart Wireless Data-logger

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Abstract — This Paper proposed a portable wireless data acquisition system for temperature in real time process dynamics. Process variables (like temperature, pressure, flow, level) vary with time in certain applications and this variation should be recorded so that a control action can take place at a defined set point This paper proposes an embedded platform for a sensor having a network interface using the ZigBee protocol, that is specially designed for the sensors network. The ZigBee protocol is a wireless technology developed as an open global standard to address the unique needs of low-cost, low power, wireless sensors network .This wireless data logger senses and monitors the variations in the local temperature thereby transmits the data within the range to an assigned embedded processor based server. Received temperature is displayed on a local liquid crystal display (LCD) on assigned server and simultaneously on a computer.

Index Terms—Temperature Sensor, Embedded Controller, ZigBee Protocol, Control Algorithm.

1] INTRODUCTION

The smart logger is the convergence of the sensing features of a sensor with the intelligence and decision making abilities of a micro system. They have been successfully deployed in many industrial applications such as maintenance, monitoring, control, security, etc. Free from the hassles of any ordinary sensor system, it has its advantages in terms of portability, reliability, flexibility and robustness. Temperature is recorded using a temperature tag at user defined time intervals. The temperature tag can be programmed so that when the memory is full it either stops further recording or continues recording by overwriting the earliest of the previously recorded data [1][2].

The sensed temperature is transmitted through ZigBee module. On receiving end temperature is received through another ZigBee module and displayed on a local LCD display. Each acquisition of temperature is compared with a user defined set point. If this value exceeds the set point a control signal goes to a final control element or a buzzer. This temperature data is also communicated to the COM port of a Personal Computer (PC). Every time a temperature data is transmitted and received it is entered into a log, that is maintained in a PC connected via serial port and the plotting of the recorded temperature variations is also carried out simultaneously. The temperature log is maintained in the PC until the power supply to the microcontroller is reset.

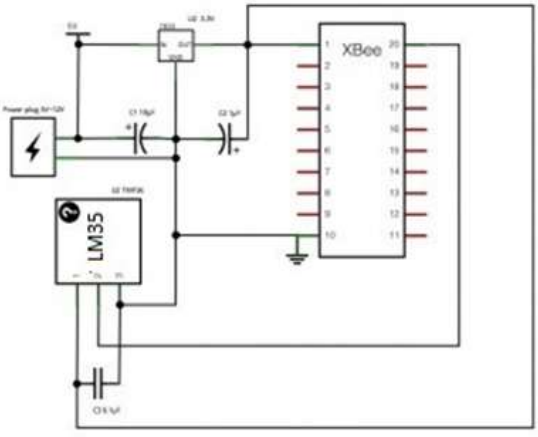

Fig 1 interfacing LM35 with Xbee

We have used the LM 35 interfaced with XBee module shown in Fig. 1 with a range of 0 to 150^{o}C. The temperature value is sensed and is then fed to the input ZigBee trans-receiver which transmits this temperature data to another ZigBee trans-Receiver located within a 10 m radius with minimum noise .The wireless technology, IEEE 802.14.5, that is used to implement our work enables broad-

based deployment of wireless networks with low-cost, low-power solutions. Most RF applications require battery power, so the lower the output power, better the durability. The proposed data logger can also be used for other process variables like pressure, flow, humidity and level like existing models [3][4]. The main functions of proposed temperature data logger are:

1) Continuous temperature monitoring.
2) Comparison with the set point.
3) To generate manipulating signal to the final control element.
4) A peer to peer and multipoint network can be established by configuring each module to operate as end device.
5) To transmit the data to remote display (PC or PDA).

Since this temperature data logger is equipped with 8 bit Microcontroller and ZigBee modules, it can be networked with same data loggers for other process variables in specific control applications [5].

The organization of the paper is as follows: In section 2, we discuss the proposed design that also presents the block diagram for our proposed system. Detailed circuit description is provided for each block used in this section. We have used the LM 35 interfaced with XBee module shown in Fig. 1 with a range of 0 to 150^{o}C. The temperature value is sensed and is then fed to the input ZigBee trans-receiver which transmits this temperature data to another ZigBee trans-Receiver located within a 10 m radius with minimum noise .The wireless technology, IEEE 802.14.5, that is used to implement our work enables broad-based deployment of wireless networks with low-cost, low-power solutions. Most RF applications require battery power, so the lower the output power, better the durability. The proposed data logger can also be used for other process variables like pressure, flow, humidity and level like existing models [3][4]. The main functions of proposed temperature data logger are:

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II) PROPOSED WORK

This work is divided into the following modules: first is the LM35-DZ temperature sensor, interfaced with ZigBee transreceiver Fig. 2.

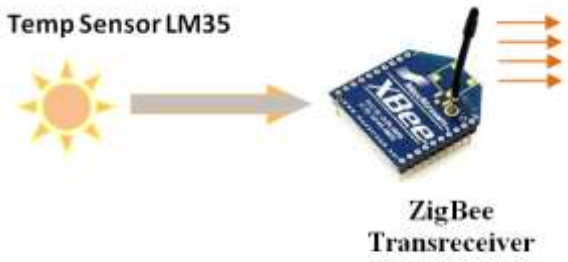

Fig 2 Transmitting End Block

Second is the ZigBee transreceiver present at both the transmitting and receiving end, providing the wireless interface to the controllers.

The final module is microcontroller at the receiving end interfaced with a MAX 232, an LCD and a DB9 connector as shown in Fig.3.

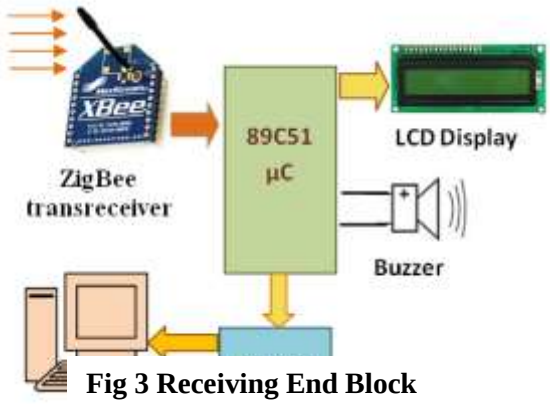

Fig 3 Receiving End Block

a) LM35-DZ Temperature sensor

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a 0° to +100°C temperature range.

b) ZigBee /IEEE 802.15.4 Modules

ZigBee or XBee Modules were engineered to meet IEEE 802.15.4 standards and support the unique needs of low-cost, low-power wireless sensor networks. The modules require minimal power and provide reliable delivery of data between devices. The modules operate within the ISM 2.4 GHz frequency band and are pin-for-pin compatible with each other. XBee/XBee-PRO RF Modules were engineered mount into a socket and therefore do not require any soldering when mounting them to a board.

Features

1) High Performance, Low Cost:
- XBee•Indoor/Urban: up to 100' (30 m)
- Outdoor line-of-sight: upto 300' (100 m)
- Transmit Power: 1 mW (0 dBm)
- Receiver Sensitivity: -92 dBm

2) Low Power Module:
- XBee•TX Current: 45 mA (@3.3 V)
- RX Current: 50 mA (@3.3 V)
- ower-down Current: < 10 µA

Advantages

1) Low duty cycle - Provides long battery life
2) Low latency
3) Support for multiple network topologies: Static, dynamic, star and mesh
4) Direct Sequence Spread Spectrum (DSSS)
5) Up to 65,000 nodes on a network
6) 128-bit AES encryption – Provides secure connections between devices
7) Collision avoidance
8) Link quality indication
9) Clear channel assessment
10) Retries and acknowledgements
11) Support for guaranteed time slots and packet freshness

c) MAX 232 (Communication Interface)

RS-232 (Fig. 4.) was created for one purpose, to interface between Data Terminal Equipment (DTE) and Data Communications Equipment (DCE) employing serial binary data interchange. So as stated the DTE is the terminal or computer and the DCE is the modem or other communications device. RS 232 is the most widely used serial I/O interfacing standard. In RS 232, a 1 is represented

by -3 to -25 v. while a 0 bit is +3 to + 25 v, making -3 to +3 undefined. For this reason, to connect any RS 232 to a microcontroller system we must use voltage converters such as MAX 232 to convert the TTL logic levels to the RS 232 voltage level, and vice versa. This chip is used when interfacing micro controller with PC to check the Baud rate and changes the voltage level because micro controller is TTL compatible whereas PC is CMOS compatible.

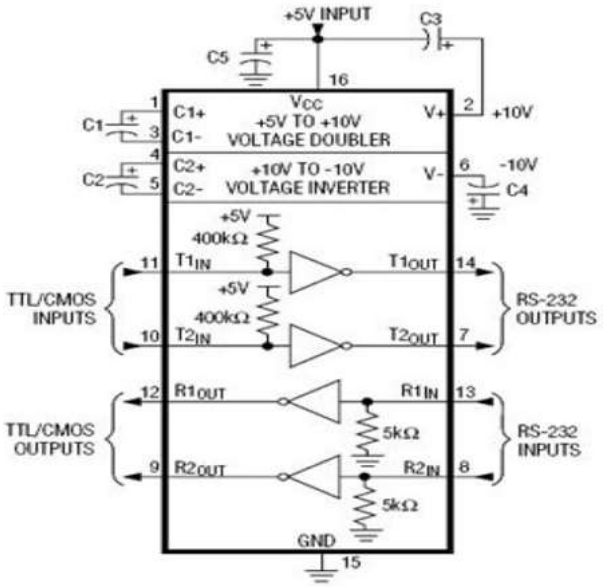

Fig 4 Operating Circuit of MAX 232

III) Hardware Circuitry (Transmitter/ Receiver)

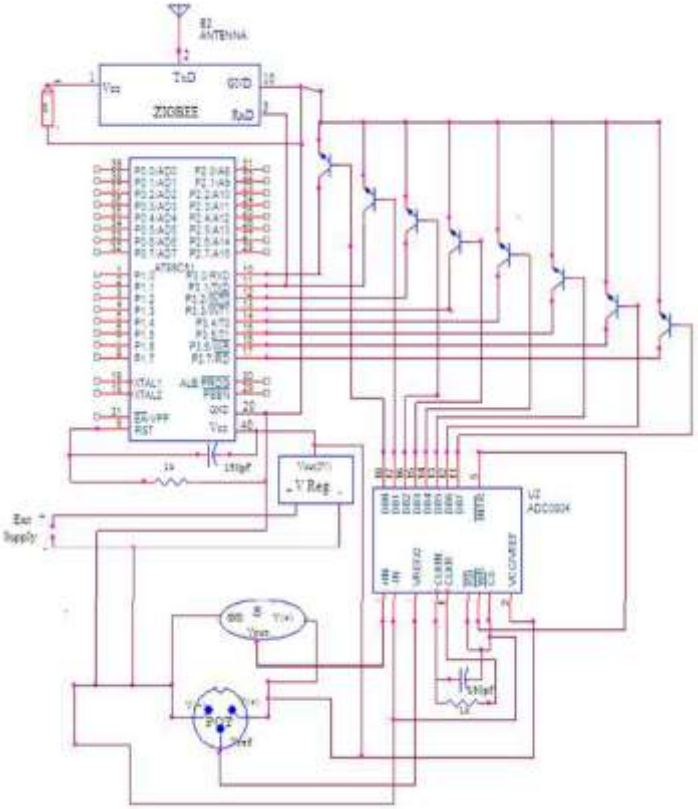

Fig 5 Transmitter

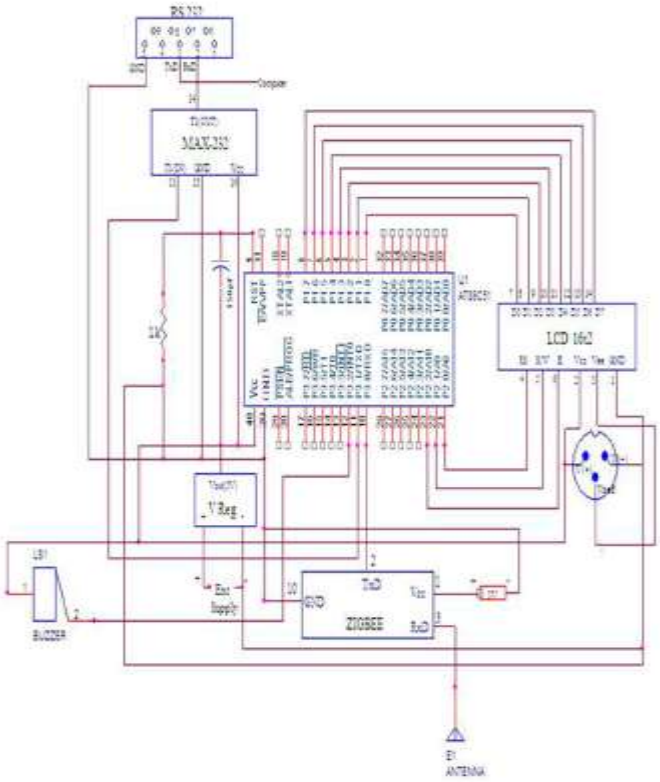

Fig 6 Receiver

IV) CONCLUSION AND FUTURE SCOPES

The proposed temperature logger can be used in the following applications:

1) The remote areas where battery power consumption is major issue.
2) The process industries where the physical channel between sensor and display unit is not possible.
3) Long range error free wireless transmission in sensor networks
4) Mining, Agriculture, Defense and biomedical applications

The future scope of this work is:

1) It can be used to make a network of clusters consisting of sensors in real time control applications
2) Compatible with different network protocols
3) A memory database can be built by using on chip memory as well as remotely connected PC through wireless link.

REFERENCES:

[1] Radek Kuchta, Radimir Vrba, "Wireless and Wired Temperature Data System", IEEE – ICONS,07 pp 49-53.

[2] Crowley, K. Frisby, J. Edwards, S. Murphy, S. Roantree, M. Diamond,"Wireless temperature logging technology for the fishing industry", IEEE - ICSENS.2004 pp 571-574. Vol (2).

[3] Wireless Sensor Networks: Technology, Protocols, and Applications by Kazem Sohraby, Daniel Minoli, and Taieb Znati (Hardcover - April 6, 2007).

[4] Ahonen T, Virrankoski R, and Elmusrati M.,.Greenhouse Monitoring with Wireless Sensor Network.Mechtronic and Embedded Systems and Applications. IEEE/ASME International Conference 1-4244-2368-2/08/IEEE, 2008

[5] Al adwan, Ibrahim, Munaf SN, . The Use of ZigBee Wireless Network for Monitoring and Controlling Greenhouse Climate., International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 . 8958, Volume-2, 2012

[6] Anjar Rinaldi, .Rancang Bangun Sistem Monitoring Parameter Lingkungan Mikro Pada Rumah Kaca (*Greenhouse*) Berbasis Internet., [skripsi], Bogor (ID) :Institut Pertanian Bogor, 2006

[7] Chusnul Arif, .Sistem Monitoring Pertumbuhan Tanaman dan Lingkungan Mikro di dalam Greenhouse Menggunakan Field Server., [skripsi], Bogor (ID) : Institut Pertanian Bogor, 2009

[8] Haryono, .Pedoman Umum Adaptasi Perubahan Iklim Sektor Pertanian., adan Penelitian dan Pengembangan Pertanian Kementrian Pertanian, 2011