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Study and Development of Temperature & Humidity monitoring system through Wireless Sensor Network (WSN) using Zigbee module

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ABSTRACT
Wireless sensor networks have become an integral part of any developing country as it is being used nowadays as the primary monitoring system in various applications. The wireless sensor networks eliminate the hazards associated with the wiring systems and make data measurement and monitoring process much easier and cost effective. The decentralized architecture of the wireless sensor network and its flexibility of deployment make wireless networks most suitable for various process plants, industries and remote & rural communication. In this work, applications of wireless sensor network is carried out on online measurement and monitoring of reaction chamber, furnace etc, which is to be measured in the industries.

Keywords – Arduino Development Board, IDE Software, LM35 Sensor, Liquid Crystal Display (LCD), Wireless Sensor Network (WSN)

I. INTRODUCTION

Wireless sensor networks (WSNs) have gained worldwide attention in recent years, in order to overcome the hazards and complexities in operation caused due to the wired networks connecting all the hardware elements. Wireless sensor networks (WSNs) have improved the efficiency of the systems particularly with advancement in Micro-Electro-Mechanical Systems (MEMS) technology, which has facilitated the development of smart sensors [1][2]. Field of monitoring and remote sensing has been revolutionized by wireless sensor network. Wireless sensor networks can collect data from different sensors such as temperature, humidity, voltage, current etc from remote locations and co-operatively pass the data through the network to the control station. Hence, wireless sensor networks can be used for monitoring of power data even from remote locations [3].

Online continuous monitoring of these physical quantities from remote control stations to co-ordinate the uninterrupted operation in the process plants and industries [5]. Keeping this situation in view, an attempt has been made in this work to monitoring data online through wireless sensor network for measurement of temperature and humidity. All the measured data are transmitted from site to the control station.

The experimental set up includes temperature sensor, humidity sensor and WSN kits as hardware. Codes developed in-house are run in Arduino IDE software. The number of WSN kits may be increased to increase the transmission distance and improve reliability of the online wireless monitoring process.

A wireless sensor network (WSN), sometimes called wireless sensor and actor network (WSAN) of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure etc and cooperatively pass their data through the network to a main location. The modem networks are bidirectional, also enabling control of sensor activity. Wireless sensor node consists of sensing, computing, communication and power components, which are shown in figure-1.

- Sensing unit- Different type of sensors (Temperature, Humidity, Pressure, Flow etc)
- Processing unit - Microprocessor or Microcontroller

- Communication unit- Radio, Transceiver
- Power unit- battery

I. PROBLEM DEFINITION AND WORK PLAN

This paper basically covers the development of board, which collects the temperature and humidity parameters in various industries through wireless sensor networks (WSNs) ranging – 55° to 150° C and 0 to 100 RH respectively.

The design methodology is available in the literature and due to availability of the design software developed; a plan has been worked out to develop the board using microcontroller. This is done using the open source available Arduino IDE software. The Arduino integrated development environment (IDE) is a cross-platform application written in Java and derives from the IDE for the processing programming language and the wiring projects.

Due to maximum limit of Xbee transmitter for the measurement, we can able to measure the temperature and humidity in perimeter of 100 meters outdoor and 30 meters in indoor environment.

II. METHODOLOGY

The methodology followed in my project is as follows:

First of all, we have placed the temperature and humidity sensor in the plant, where the monitoring is to be done. This sensor is interfaced with the Arduino development board. Programming in the Arduino board will convert the analog output of the sensor into the digital form. After that, the digital information is given to the Xbee module for transmission. The Xbee module will transmit data from the microcontroller board.

At the receiving node, the Xbee module will receive the data transmitted by the transmitter node. This digital is received by the Arduino development board. The program in the microcontroller will convert the digital data into the corresponding temperature and humidity.

Finally this data is displayed on the Liquid Crystal Display (LCD) module. All the different parts of the experimental setup require supply to work, which is given from a single power source.

III. EXPERIMENTAL SETUP

We have developed an experimental setup using various hardware modules to measured and monitoring temperature and humidity parameters in various industries.

3.1 HARDWARE MODULES

In this paper, different hardware modules have been used whose brief introduction is given in the section below.

TEMPERATURE SENSOR (LM35)

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the centigrade temperature.

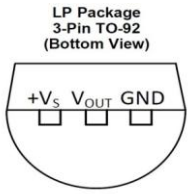


Fig. 1 Shows the Pin diagram of LM35

ARDUINO DEVELOPMENT BOARD

Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors and other actuators. The microcontroller on the board is programmed using the Arduino programming language (based on wiring) and the Arduino development environment (based on processing).

Fig.2 Shows Arduino Development Board

ATMEGA328 MICROCONTROLLER

The ATmega328 is an Atmel 8-bit AVR RISC-based microcontroller.

Fig. 3 Shows ATmega328 AVR microcontroller

XBEE MODULES

The 802.15.4 Xbee modules provide two friendly modes of communications – a simple serial method of transmit/receive or a framed mode providing advanced features. XBees are ready to use out of the package, or they can be configured through the X-CTU utility or from microcontroller. These modules can communicate point to point, from one point to a PC, or in a mesh network.

Fig. 4 Shows the Xbee Module

LIQUID CRYSTAL DISPLAY (LCD)

A liquid crystal display (LCD) is a thin, flat panel used for electronically displaying information such as text, images and moving picture. In this paper, we have used 16X4 LCD display.

Fig. 5 Shows the 16X4 LCD Modules

BLOCK DIAGRAM AND HARDWARE SETUP

We have used here point to point (P2P) communication topology between two nodes. The two nodes are transmission node (sensor interfacing in the plant) and receiving node (control station).

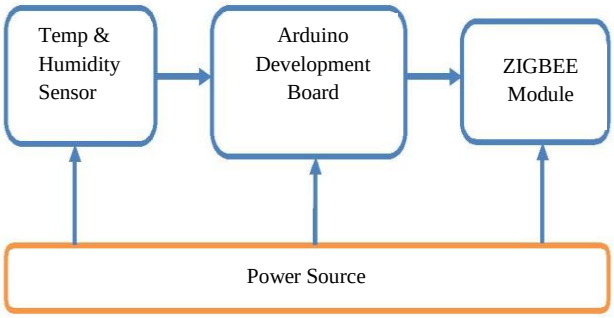


Fig. 6 shows the block diagram of transmitter node

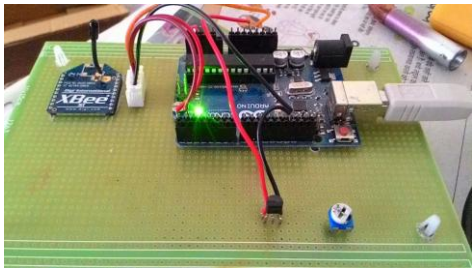


Fig. 7 shows the hardware of transmitter node

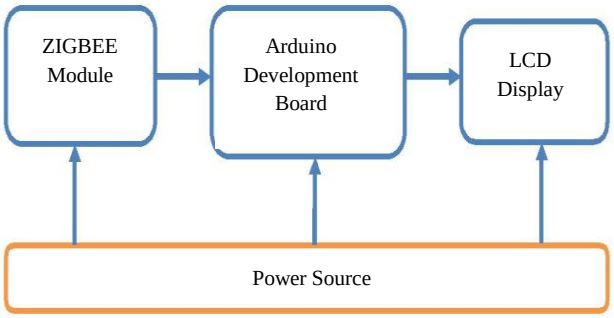


Fig .8 shows the block diagram of receiver and display node

Fig. 9 shows the receiver and display node

MEASUREMENT AND DATA ANALYSIS

We have measured the temperature and humidity at various places and also have done data analysis. Studies of few cases are given below.

Fig. 10 Shows measurement in high voltage lab

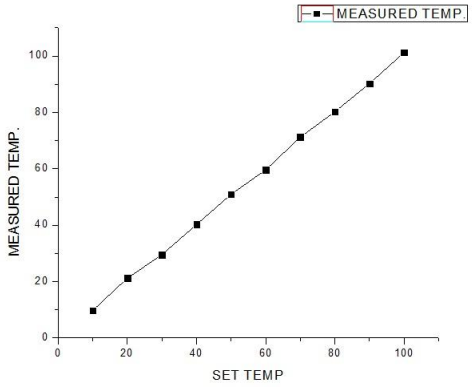
CASE: 1 – Data analysis at different set temperatures at 0% humidity level and corresponding plot.

Table.1 shows the measured temperature at 0% humidity level

S NO	SET TEMPERATURE (°C)	MEASURED TEMPERATURE (°C)
1.	10	9.79
2.	20	21.21
3.	30	29.56
4.	40	40.26
5.	50	50.95
6.	60	59.62
7.	70	71.25
8.	80	80.22
9.	90	90.24
10.	100	101.22

The temperature of chamber been fixed by user and then increased by 10° C step.

Plot 1 shows set temperature vs measured temperature at 0% humidity level



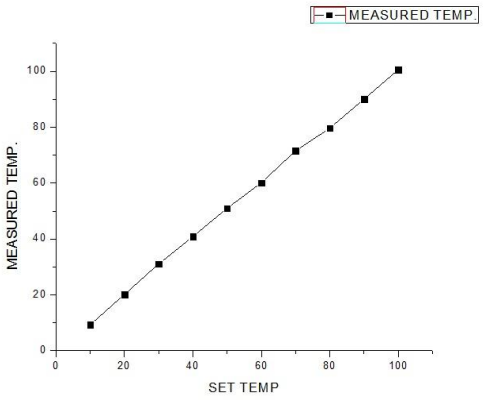
From the results, it is observed that measured values are very near to set values.

CASE: 2 – Data analysis at different set temperatures at 40% humidity level and corresponding plot.

Table.2 shows the measured temperature at 40% humidity level.

S NO	SET TEMPERATURE (°C)	MEASURED TEMPERATURE (°C)
1.	10	9.32
2.	20	20.15
3.	30	31.11
4.	40	40.88
5.	50	51.02
6.	60	60.11
7.	70	71.58
8.	80	79.62
9.	90	90.11
10.	100	100.54

Plot 2 shows set temperature vs measured temperature at 40% humidity level



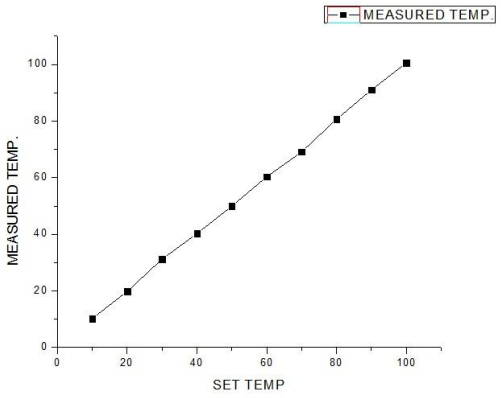
It is observed that measured temperatures are much closed to set values.

CASE: 3 - Data analysis at different set temperatures at 80% humidity level and corresponding plot.

Table 3 shows the measured temperature at 80 % humidity level

S NO	SET TEMPERATURE (°C)	MEASURED TEMPERATURE (°C)
1.	10	10.25
2.	20	19.84
3.	30	31.22
4.	40	40.25
5.	50	49.97
6.	60	60.34
7.	70	69.13
8.	80	80.65
9.	90	91.00
10.	100	100.56

Plot 3 shows set temperature vs measured temperature at 80% humidity level



From the results, it is observed that measured temperatures are very much near to set values of temperature.

IV. CONCLUSION

In this work, applications of wireless sensor network is carried out on online measurement and monitoring of reaction chamber, furnace etc in various industries. The board has been developed using WSN kit to measure physical quantities temperature and humidity.

From the above analysis, it is concluded that the nested wires systems can be replaced by wireless sensor networks in order to get an accurate data as well as to avoid many hazardous issues.

This WSN kit could be used for lager applications, if feedback control signals are used with the help of WSN kits for actuation purpose.

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