IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
ISSN: 2278-2834, ISBN: 2278-8735, PP: 66-71
www.iosrjournals.org

ZIGBEE BASED SENSOR NETWORKS FOR TEMPERATURE MONITORING AND CONTROLLING

Sachin S. Patil[1] ,Shrenik S. Sarade[2],Sagar V. Chavan[3]
[1, 2](Department of Electrical Engineering, ADCET ASHTA/Shivaji University, Kolhapur, India)
[3](Department of Electrical Engineering, RIT Sakharale/Shivaji University, Kolhapur, India)

ABSTRACT : *In Now days we have many different types of emergencies in the indoor environment. Response to such emergencies is critical in order to protect resources including human life and to save property from damage. There is need to develop wireless sensor network for temperature controlling. In this Paper, we present wireless sensor network for Temperature Controlling. Which can Control the temperature, This can use for number of applications such as control the temperature of water , control the temperature of industrial machines, in the industry where temperature Controlling is necessary. In future this system can use for Protection from Fire, then obviously we can save life of people.*

Keywords: - *IEEE 802.15.4, Temperature Controlling, WSN, Zigbee, TCN75, PIC Microcontroller*

I. INTRODUCTION

In this world we are facing number of emergency problems so that to response to such type of emergencies we need to design a wireless network which responds to such emergency and possible to control it. Temperature monitoring is possible using wireless network also controlling of temperature is also possible .If we are able to design a such type of network then definitely in future we can avoid property from damage and also we can save life of people.

1.1 Wireless Sensor Networks:-

It is equally distributed autonomous devices using sensor which has capable of controlling temperature of wireless sensor nodes.

Actually what is a wireless sensor network? It is nothing but equally distributed autonomous devices which has capable of monitoring physical as well as environmental conditions .Each autonomous device known as sensor node Each sensor node consist of TCN 75, pic 16f877, Zigbee 802.15.4. Sensor network can inform different environmental condition such as temperature, sound, vibration, pressure, motion, and pollutant at various different locations especially for building in campus area.

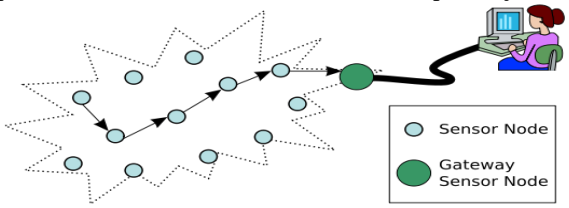

Fig.1 Wireless sensor network Architecture

Fig.1 shows wireless sensor network which consist of equally distributed autonomous devices. Each device has TCN 75 temperature sensor, PIC 16F877, Zigbee 802.15.4.When sensor node detect emergency then that sensor node will inform about emergency to Master node. We have to control the temperature of sensor node. Here sensor node consists of TCN 75, PIC 16f877, Zigbee 802.15.4, and LCD. Next, we will discuss role of the each component in detail.

II. IMPLEMENTATION PLAN

We are using for the project to use PC's as the 'sink' in order to collect data from various sensors and provide them in a user friendly fashion. This data can then be stored appropriately as well. Client software can be developed and can be programmed to read out messages or pop out notifications that are we can say as emergency our project will focus on fire emergency and temperature Sensors are used to conduct the feasibility study of the system

1) TCN 75 - It is a 2 Wire serial programmable digital temperature sensor.
2) It has total 8 pins, out of 8 pins we are using only 4 pins.

3) It has temperature range -55 to 125 degree Celsius.
4) It require 2.7 to 5.5 volt power source to operate.
5) It is available in dual in line package format.

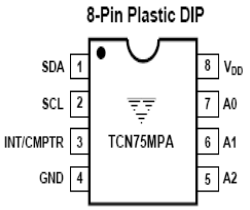

Fig.2 Pin out TCN 75 Digital Temperature Sensor

As shown in fig.2 TCN 75 is a two wire serial programmable digital temperature sensor .It has three address selection input lines A0, A1, A2 respectively. Here this address selection input lines are grounded so that it will be consider as 0, 0, 0 respectively. It has pin number 3 is INTR/CMPTR, It is output pin of TCN 75 but this is input pin for PIC 16f877.This pin will activate when input temperature increases user programmable set point temperature .TCN 75 has SDA and SCL where

1) SDA-Serial data line
2) SCL-Serial clock line

1) SDA-Serial data line

SDA is a serial data line is a bidirectional pin of TCN 75.with the help of this pin it is possible to transfer data bidirectional from TCN 75 to PIC 16f877 and from PIC 16f877 to TCN 75, but this data transfer can happen with respect to SCL serial clock line .Here we are focusing on temperature controlling means we need to write the data to TCN 75 into Tset resister we will discuss about this later.

2) SCL-Serial Clock line

SCL is a serial clock line is a unidirectional pin of TCN 75 .This in output pin of PIC 16f877 and It is input pin of TCN 75.Here we can read the content of the temperature register through serial data line also we can write the temperature value to the Tset register. Temperature register is only read only register and Tset register is write only register. Means We cannot read the content of the Tset register, we cannot write the data to Temperature register.

3) INTR/CMPTR:-interrupt /Comparator

This is output pin of the TCN 75 and it is input pin of the PIC 16f877.This pin we require in the temperature controlling operation, it does not require in temperature monitoring.

4) GND:-This is ground pin of the digital temperature sensor .This pin should be grounded to unable the TCN 75.

5) A2, A1, and A0:-

A2 is 5th pin of the TCN 75
A1 is the 6th pin of the TCN 75
A0 is the 7th pin of the TCN 75

6) Vcc:-This is 8th pin of the TCN 75 .It require 2.7 to 5.5 volt power source to operate.

As shown in Fig.3 TCN 75 is a two wire serial programmable digital temperature sensor. In this we are using only 4 pins out of 8 pins.

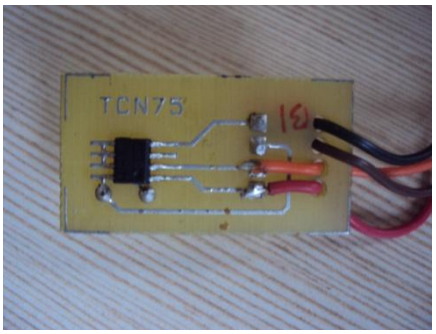

Fig.3 TCN 75 Digital Temperature Sensor

I have developed this connections of the TCN 75.It has many advantages over the LM 35. LM 35 is analog temperature sensor it has same temperature range as TCN 75,but if we are using LM 35 then we will require the

external ADC if we are using TCN 75 then we will not require external ADC because it is digital temperature sensor. Next will discuss the architecture of the TCN 75.

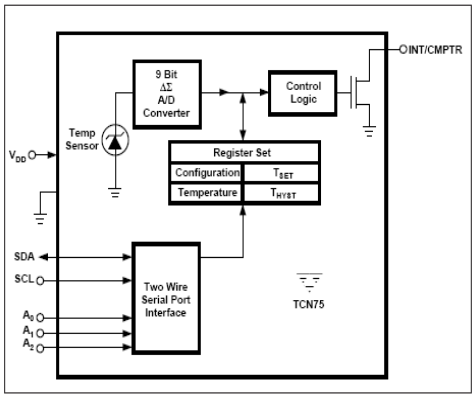

Fig.4 Internal Block diagram/architecture of the TCN 75

As shown in fig.4 internal block diagram of the TCN 75.It consist of Temperature sensor, 9 bit A/D convertor ,Control logic, Tset register ,Temperature register, Two wire serial port Interface.TCN 75 has in built 9 bit analog to digital convertor.8bits indicate that digital equivalent of the analog value.9th bit indicate whether temperature value is positive or negative .If 9th bit is 1 it indicate that temperature value is negative. If 9th bit is 0 indicate that temperature value is positive. Suppose we take the example of temperature is 25 degree Celsius then it will be store into the temperature register as 32 means "000110010".
Here 9th bit is 0 indicate input temperature is positive.

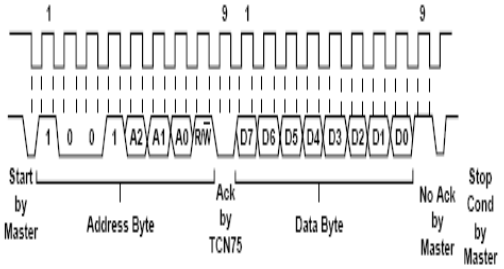

Fig.5 1 Byte read from temperature register

Fig.5 indicate 1 byte read from temperature register when serial changes from high to low and serial clock line is high it indicate start of conversion. When Serial data line change from low to high and serial clock line is high it indicate end of conversion.First,PIC 16f877 will send address byte to TCN 75 through serial data line with respect to serial clock line When we have to read data from Temperature register TCN 75 then PIC 16f877 will send 91H and when we have to write the data to TCN 75 then PIC 16f877 will send 90H.When TCN 75 will receive that data through serial data line then it will understand that PIC 16f877 wants to read the content of the register or PIC 16f877 wants to write the data to Tset register of the TCN 75.
Address byte: - 91-10010001 – read the content of the temperature register of the TCN 75.
Address byte: - 90-10010000 – Write the data to the Tset register of the TCN 75.
D0 bit of the TCN 75 If it is 0 means
R/W =0 indicate write operation
R/W =1 indicate read operation

Read the content of the temperature register .PIC 16f877 convert hexadecimal value into ASCII Code and display it on LCD.PIC 16f877 also convert the Hexadecimal value into decimal and display that value on to the master node/monitoring node.

3) PIC 16f877:-We are using PIC 16f8877 instead of the 8051 because It has on chip A/D convertor, It has I^2C communication facility, It has five ports, It has reduced instruction set, It has only 35 instruction set, one more important advantage is that It has Von-Neumann architecture same program memory and data memory so that it require less execution time.

4) Zigbee 802.15.4:-It is Zigbee IEEE 802.15.4 standard, it has high data rate and high power consumption .It has smaller packet size and support larger number of devices. It supports mesh, tree, and star topologies.Comparision between Zigbee 802.15.4 and Bluetooth is that Bluetooth is IEEE 802.15 standard, It

does not support networking topologies, It has small form factor low power consumption, It uses high data rate, It has high power consumption, It handle larger packet size and support smaller number of devices. It has shorter communicating range between two devices. In this we are using Zigbee 802.15.4 standard with 30meter communication range,250kbps data transmission rate,2.4 GHz frequency range.

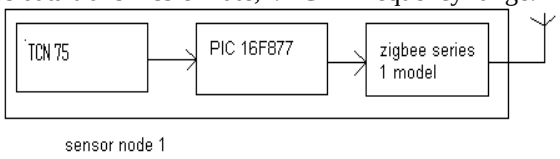

Fig.6 Sensor Node Architecture

Actually what is the sensor? Sensor it is physical device which stimulus input signal such as temperature, sound, vibration, pressure, motion, pollutant and provide and electrical equivalent signal known as sensor. Here Fig.6 indicates sensor node architecture It consist of TCN 75, PIC 16f877, Zigbee 802.15.4 Standard .TCN 75 is two wire serial programmable digital temperature sensor. There is I2C communication between TCN 75 and PIC 16f877 .PIC 16f877 has Von-Neumann architecture means it has same program memory and data memory. It requires less execution time for the instruction. It has only 35 assembly language instructions and these are easy to remember because of this reason we are using PIC 16F877 instead of the 8051. Fig.7 Shows master node/Monitoring node .It consist of Zigbee 802.15.4 standard, Max 232,DB-9 Connector and laptop. Zigbee 80.2.15.4 standard is of maxstream wander.DB-9 connector require to TTL to RS 232 signal conversion. As shown in the fig.7 Zigbee 802.15.4 has on chip antenna .It has 20 pins and out of 20pins we are using only 4 pins Vcc, Gnd, SDA, and SCL respectively.

Fig.7 Master node/Monitoring Node

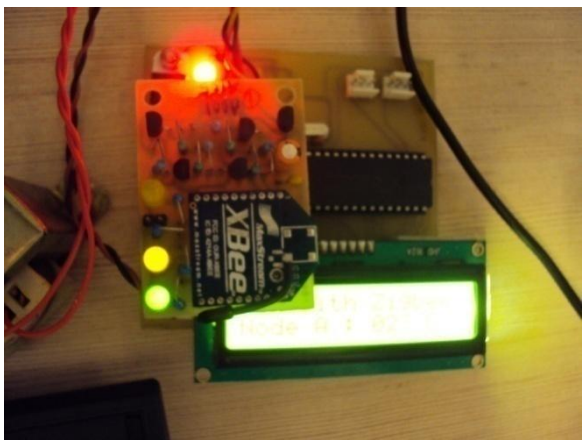

Fig.8 Wireless sensor node A

As shown in figure indicates wireless sensor node A .It shows whatever the temperature is available at sensor node A. It consists of TCN 75 digital temperature sensor, PIC 16f877, Zigbee 802.15.4 standard. Where TCN 75 is two wire serial programmable digital temperature sensor. Zigbee 802.15.4 standards has three light emitting diode one is for power on mode, second is for blinking mode, third is for enable mode.

III. IMPLEMENTATION STEPS

1) Sensor node will contain TCN75, PIC16f877, Zigbee series 1 model For Tx/Rx
2) Master node will contain the zigbee series 1 model and PC.
3) Locate the sensor node at different locations in building.
4) When emergency detected by any sensor node, it will inform to master node.
5) Master node will show temperature on PC.
6) Wireless sensor nodes will provide temperature monitoring.
7) This project will focus on fire emergency and temperature monitoring and controlling.

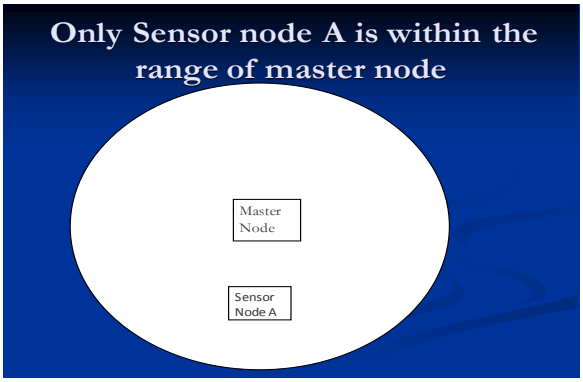

Fig.8 Wireless sensor network

As shown in fig. 8 we are going to develop sensor network which consist of master node/monitoring node and sensor node. As previous discussion sensor node consist of TCN 75, PIC 16f877, and Zigbee 802.15.4 standard. Master node/Monitoring node consists of Zigbee 802.15.4, Max 232, DB-9 Connector and laptop. But how the communication take place from master node to sensor node first up all master node will send the request in the form of frames <RAM> when sensor node receive it then sensor node will send temperature available at sensor node A will send <DMA025> when master node decode it and display the temperature on master node/monitoring node.
Frame structure :-< RAM>-Read data from sensor node A to M
<-Start of frame
R-Read
A-Sensor node A
M-Master node A
>-End of frame
<DMA025>-Data from Sensor node A to M.
<-Start of the frame
D-Data
M-Master node
A-Sensor Node A
025-Temperature available at sensor node A
>-End of frame

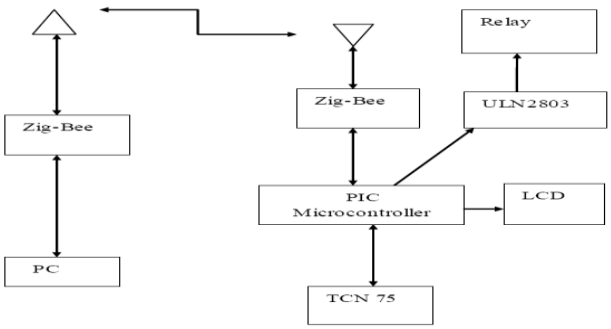

Fig.9 Sensor network for temperature controlling

As shown in figure 9 we can design circuit for sensor network for temperature controlling. It consist of Master node/Monitoring node ,Sensor node .Sensor node consist of TCN 75,PIC 16f877,Zigbee 802.15.4 ,LCD, driver circuit ULN 2803 and relay. We have discussed in the architecture of TCN 75 It consist of Tset, Thyst registers. We have to write the T set value into T set register if input temperature increases above set point temperature it generate interrupt activate relay and in this way we can use as relay as simple on off controller. In the application we can use temperature controlling of water or temperature controlling of industrial machines.

REFERENCES

[1] Build an IEEE 802.15.4 *Wireless Sensor Network for Emergency Response Notification for Indoor Situations by V.A. Victor, C. Khadar, C. Rao and A. Mehta march 2008*

[2] Wireless sensor for home monitoring by gourab s. gupta, subhas c. mukhopadhay recent patent on Electrical Engg. 2008

[3] Zigbee wireless network by Carl binkies 17th Telecommunications forum TELEFOR 2009 Serbia, Belgrade, November 24-26, 2009.

[4] Routing in Zigbee by Francesca Cuomo IEEE Communication *Society Subject matter expert for publication in the ICC 2007 Proceeding.*

[5] Johann lonn and Jonas Olsson, Zigbee for wireless network 15th March2005.A. 6. William Stallings, Wireless Communication and Networking, Prenctice Hall 2002, ISBN 0-13-040864-6.

[6] IEEE standard 802.15.4,IEEE 2003,ISBN-0-7381-3677-5 SS95127

[7] Zigbee Aliance,http:/zigbee.org,2005-03

[8] *Sinema coleri Ergen zigbee/IEEE 802.15.4 Summary, September*