ZigBee based Data Acquisition from different sensors and Relay control

Introduction:

Wireless communication technologies are rapidly spreading too many new areas, including automation and the importance of the use of wireless technologies in data acquisition, building control, monitoring systems and automation of manufacturing processes will grow.

The ZigBee communication technology is to connect local wireless nodes and provides high stability and reasonable transfer rate of data communication with low power, long battery life and secure networking. ZigBee has a defined rate of 250kbit/s, best suited for periodic or intermittent data or a single signal transmission from a sensor or input device. In home automation applications, transmission distances range from 10 to 100 meters line-of-sight, depending on power output and environmental characteristics. ZigBee involves 3 types of nodes: Coordinators, Routers & End Devices. Based on IEEE 802.15.4 Low Rate-Wireless Personal Area Network (LR-WPAN) standard, the ZigBee standard has been proposed to interconnect simple, low rate and battery powered wireless devices.

Zigbee is based on IEEE 802.15.4 standard for Personal Area Network. IEEE 802.15.4 specifies physical and MAC layer of low-rate WPANs. The modules operate within the ISM 2.4 GHz frequency band.

IEEE 802.15.4 specification:
802 = networking group
15 = wireless network
4 = low data rate ,consuming less power

SPECIFICATIONS:
☐ Zigbee module:
☐ Configurable as : Coordinator, Router, and End device.
☐ Operating frequency band : ISM 2.4GHz
☐ Interface : Serial RS-232
☐ Power supply : 3.0 to 3.4V
☐ Operating temperature : -40 to 85o C
☐ Operating current(transmit) : 295mA at 3.3V
☐ Operating current (receive) : 45mA at 3.3V
☐ Transmitting power: 50mW (+17dBm)
☐ Indoor range : Up to 90mts(300 ft)
☐ Outdoor line of sight range : Up to 3200mts (2 miles)
☐ Number of Channels: 15 Direct Sequence Channels
☐ Low-cost, low-power wireless sensor networks.

Zigbee Network Topology
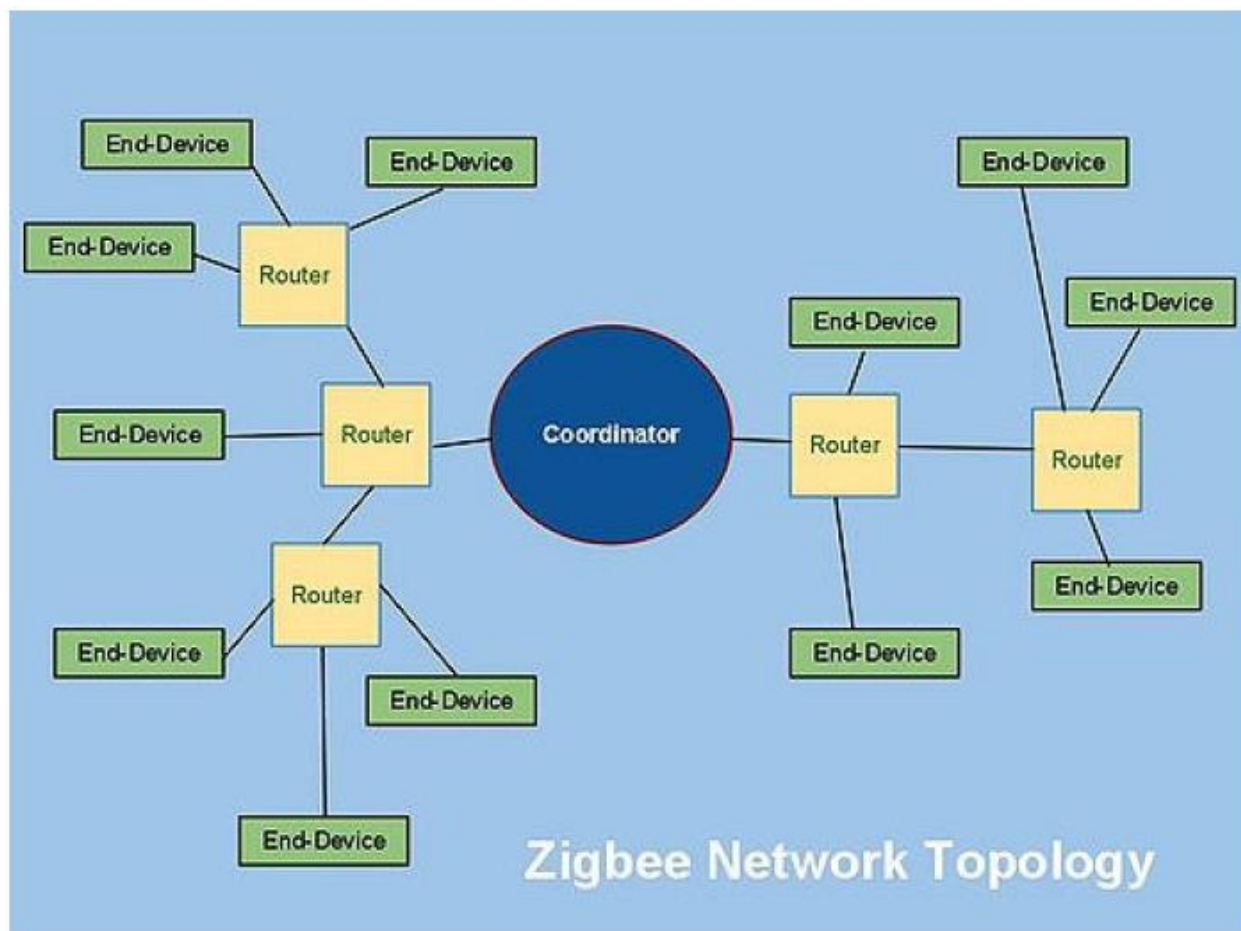
ADVANTAGES OF ZIGBEE:
- Low cost
- High reliability
- Very long battery life
- High security
- Self-healing properties
- Large number of nodes supported
- Ease of deployment
- Guaranteed delivery
- Route optimization

APPLICATION AREAS INCLUDE:
- Home Entertainment and Control— Home & office automation, smart lighting, advanced temperature control, safety and security, movies and music
- Wireless sensor networks
- Embedded sensing
- Medical data collection
- Smoke and intruder warning
- Building automation
- Wireless light switches
- Electrical meters with in-home-displays

Procedure to configure the modem as Coordinator or end device
(AT commands are instructions used to control modem)

    Zigbee coordinator AT: configure the zigbee s2c module as a coordinator in AT mode follow the below steps.
➢ Step1- click on the coordinator Enable[1] option.
➢ Step2- write DL address FFFF for broadcasting.
➢ Step3- select sleep mode (SM) as No sleep (Router)[0].
➢ Step4- Click on write.

    Zigbee End Device AT: configure the zigbee s2c module as End device in AT mode follow the steps.
➢ Step1- click on the coordinator disable[0] option.
➢ Step2- write DL &DH address as 0.
➢ Step3- select sleep mode (SM) as cyclic sleep[0].
➢ Step4- Click on write.

Experiment 1: Local and Remote sensor data acquisition using Zigbee module

Aim: To Access different sensor data locally and remotely using Zigbee module

Components required : ZigBee module with different sensors(Temperature, Humidity, Light and Gas), RS 232 Interface, XCTU Software

Procedure to Access sensor local data : (ADC lines AD1, AD2, AD3, AD4 are connected to 4 sensors : Temperature, Gas , Humidity and Light sensor respectively)
➢ Go to XCTU software
➢ Add radio module, select COM3 port, Finish
➢ Configure the modem as either Coordinator or End Device
➢ Add frame: Select 0x08 AT Command for local sensor data access,
➢ Set ASCII – **IS** command(Read all enabled digital and analog input lines), OK
➢ Send selected frame , Check the Respose Packet and note down

Procedure to Access Remote sensor data : (ADC lines AD1, AD2, AD3, AD4 are connected to 4 sensors : Temperature, Gas , Humidity and Light sensor respectively)
➢ Go to XCTU software
➢ Add radio module, select COM3 port, Finish
➢ Configure the modem as either Coordinator or End Device
➢ Add frame: Select 0x17-Remote AT Command for local sensor data access,
➢ Destination Address - FFFF
➢ Set ASCII – **IS** command(Read all enabled digital and analog input lines), OK
➢ Send selected frame , Check the Respose Packet and note down

Results:
Transmitted Frame.
7E 00 04 08 01 49 53 5A
Start delimiter: 7E
Length: 00 04 (4)
Frame type: 08 (AT Command) or 0X17 –remote AT command
Frame ID: 01 (1)
AT Command: 49 53 (IS)
Checksum: 5A

Response frame:
7E 00 13 88 01 49 53 00 01 19 10 0F 19 10 03 FF 03 FF 02 26 02 1E 2C
Start delimiter: 7E
Length: 00 13 (19)
Frame type: 88 (AT Command Response)

Frame ID: 01 (1)

AT Command: 49 53 (IS)

Status: 00 (Status OK)

Response: 01 19 10 0F 19 10 03 FF 03 FF 02 26 02 1E
Checksum: 2C

Response:

01 – Number of samples (always set to 1)

19 10 –(0001 1001 0001 0000):D4, D8, D11, D12‑ Digital out high.

0F – D0, D1, D2, D3 ‑ Configured as ADC's.

19 10 –(0001 1001 0001 0000):D4, D8, D11, D12‑ Digital out high.

03 FF -ADC value of D0. (Temparature data)

03 FF -ADC value of D1(Gas data)

02 26 -ADC value of D2.(Humidity data)

02 1E -ADC value of D3. (Light data)

Experiment 2: Local And remote relay control using Zigbee module

Aim: To contrl relay locally and remotely using Zigbee module

Components required : ZigBee module with different sensors(Temperature, Humidity, Light and Gas), RS 232 Interface, XCTU Software

Procedure to control local relay :
➢ Go to XCTU software
➢ Add radio module, select COM3 port, Finish
➢ Configure the modem as either Coordinator or End Device
➢ Add frame: Select 0x08 AT Command for local relay control,
➢ Set ASCII – **D4** command, HEX – **04(low)/ 05(high) ,** OK
➢ Select frame, Send selected frame , Check the relay operation

Procedure to control remotel relay :
➢ Go to XCTU software
➢ Add radio module, select COM3 port, Finish
➢ Configure the modem as either Coordinator or End Device
➢ Add frame: Select 0x17-Remote AT Command for remote relay control,
➢ Set ASCII – **D4** command, HEX – **04(low)/ 05(high) ,** OK
➢ Select frame, Send selected frame , Check the relay operation

Result:
Check the relay operation using LCD display