

Controlling Robot using Long Distance Wireless Communication Technique

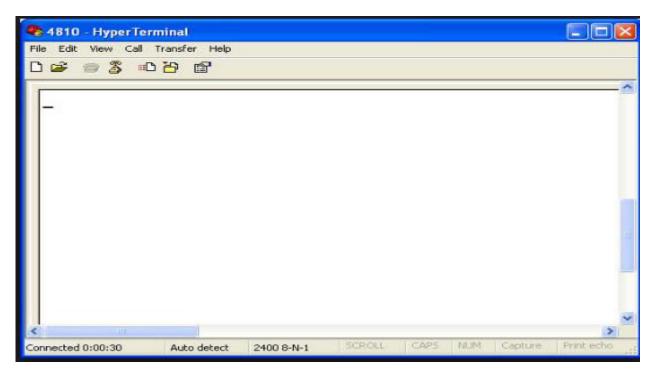
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Abstract:-

In this project we had controlled the robot to **1.2 km** distance. The Zigbee module used is S2C. We have router and coordinator module interaction in order to control the robot. The router module is used to send the signal and coordinator module is to receive the signal generated from router module. The signal is generated using UART serial communication. The microcontroller used for UART serial communication is PIC16F877A. **UART** communication is tested using **hyperterminal** software. The XCTU software is for router and coordinator interaction. We have controlled robot using **AT command**. Components used are two S2C modules, PIC16F877A development board, Zigbee adapter, Zigbee shield, Wheel mobile platform, UART adapter and Two 12V, 2A battery.

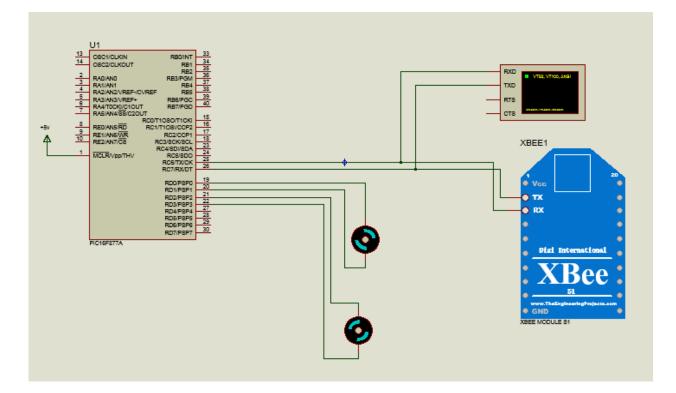
Interfacing UART with Hyperterminal:-

In this we can check the serial communication of PIC16F877A uC using universal serial bus with hyper terminal software.



Proteus Simulation:-





AT command using XCTU Software:-

Steps to be followed for giving AT command:-

- (a) In the Consoles working mode of XCTU, click the Open the serial connection with the radio module button.
- (b) Use +++ to enter into command mode and wait for an OK response.
- (c) To set a register, type an AT command followed by the value you want to set; for example, **ATID 2015**; followed by a Return.
- (d) To read a register, type an AT command; for example, **ATID**; followed by a Return.
- (e) Use the **ATWR** command to write the new configuration to the module's memory.
- (f) Exit command mode with the **ATCN** command.



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Rado Modules	·0013A20040A15861	10· 🔅 🛂 🤾
Function: XEE 1 8 Function: XEE Fort: CONS-960_NU/N-AT	🔏 🕑	AT Console Tx Bytes: 28 Status: Connected Rx Bytes: 17
MAG: 0013A20045A35861	Console log	B B B B X
	***0K 4 28 28 28 45 48 60 ATID 2015 41 54 49 44 20 32 30 31 35 60 OK 41 54 49 44 20 32 30 31 35 60 ATID 41 54 49 44 60 2015 32 30 31 35 60 ATR. 41 54 57 52 60 OK 41 54 43 42 80 ATON 41 54 43 42 80 OK 45 48 60 ATON 41 54 43 42 80 V 41 54 43 42 80 V 41 54 43 42 80 OK 45 48 60 V 41 54 43 42 80 V 45 43 42 80 V 45 43 42 80	
	Send packets	(x) Send a single packet
	Name Data	Send selected packet
		© Send sequence
		1 Transmit interval (mg): 500 (* Repeat times: 1 Leop infinitely

For controlling zigbee there is need for router and coordinator configuration. If the instruction is given by coordinator the router should perform the same action. This is based on master and slave condition.

Steps to be followed for router and coordinator configuration:-

(a) Selecting COM port for router and coordinator.



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click Sear	ch button	
Radio Modules	Discover radio devices Select the ports to scan Select the ports to scan Select the ports to be scanned COM4 Communications Port COM3 Silicon Labs CP210x USB to UART Bridge COM3 Intel(R) Active Management Technology - SOL COM3 USB Serial Port Select the COM ports where your Radios are connected Refresh ports Select all Deselect all Cancel	

(b) Selecting port parameters.

Radio Modules	Discover radio dev	Image 2		
	Set port parameter Configure the Serial	s 'USB port parameters to disco	ver radio modules.	2
Click on 🖪 Add dev	Baud Rate:	Data Bits:	Parity:	e betwe
Discover devices radio modules to the l		↑ 7 ▼ 8	V None Even Mark Odd Space	onsoles Device C splay t orking a
Port parameters	Stop Bits:	Flow Control:		
C. March C. C. March		V None Hardware	Select all	
9600 8N1	2	Xon/Xoff	Deselect all	
			Set defaults	

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(c) The XCTU Scans the USB ports selected and lists the RADIOs found with their unique 64 bit address.

хсти	Table top of the office, or all the 2 countries from	
	Discovering radio modules	
Radio Modules	Search finished. 2 device(s) found	
$\wedge \wedge$	2 device(s) found	
	Devices discovered:	
Click on Add devi Discover devices tradio modules to the l	Port: COM3 - 9600/8/N/1/N - AT Name: MAC Address: 0013A2004103606A	e between 🌣 Configuration, onsoles, 🥐 Network and
	Port: COM31 - 9600/8/N/1/N - AT Name: MAC Address: 0013A20041036040	Device Cloud working modes splay their functionality in prking area.
	Select all Deselect all Your device was not found? <u>Click here</u> Cancel Add selected devices	
	< Back Next > Einish Cancel	

(d) Now both the Radios appear on left plane.

💦 ХСТИ	
	🔀·ÈQ?·) 🔅 🖳 🦑 🏈
Radio Modules	Radio Configuration
Name: Function: ZIGBEE TH Reg Port: COM3 - 9600/8/N/1/N - AT MAC: 0013A2004103606A Image: Function: ZIGBEE TH Reg Port: COM3 - 9600/8/N/1/N - AT Port: COM31 - 9600/8/N/1/N - AT MAC: MAC: 0013A20041036040	 Select a radio module from the list to display its properties and configure it. Image: Select a radio module from the list to display its properties and configure it.



(e) Updating the firmware.

click on first Radio	× = @ ? ·	ö 🖭 🎗	
Radio Modules	Radio Configuration [- 0013A2004103606A]		
Runction: ZIGBEE TH Reg Port: COM3 - 9600/8/N/1/N - AT MAC: 0013A2004103606A	Image: Second	• Param Written an Written an	
Name: Function: ZIGBEE TH Reg Port: COM31 - 9600/8/N/1/N_AT	Product family: XB24C Function set: ZEGBEE TH Reg Firmware version: 4059		but not written
	Reading radio module settings Reading AI parameter: DE Image 5	Batseld exponent	9 9 9 9 9 9 9 8
	25 ZigBee Stack Profile 0 NJ Node Join Time FF	x1 sec	 Ø Ø
	NW Network Watchdog Timeout 0	x1 minute	
		oled (0)	
	JN Join Netification	oled (0)	• 🕲 🥥
	OP Operating PAN ID		•
	OI Operating 16-bit PAN ID		•
	CH Operating Channel		9
	NC Number of Reing Children		

(f) Changing the coordinator configuration.

Radio Modules		Radio Configuration [- 0013A2004103	60641		
Rest Name: Function: ZIGBEE TH Reg Port: COM3 - 9600/8/N/1/N - AT MAC: 0013A2004103606A	*	Networking Change networking settings	Range: 0x0 - 0xFFFF	Paramete	er (†)
Name:	*	① ID PAN ID	1234		
Function: ZIGBEE TH Reg Port: COM31 - 9600/8/N/1/N - AT	22	SC Scan Channels	7FFF B	Sitfield	
MAC: 0013A20041036040		SD Scan Duration	з е	sponent	90
		ZS ZigBee Stack Profile	0		3
		NJ Node Join Time	FF x	1 sec	3
set a PAN ID unique to your Network	2	NW Network Watchdog Timeout	0 ×	1 minute	3
between 0 and FFFF hex		JV Channel Verification	Disabled [0]	•]	3
For e.g enter 1234 as PAN ID .The ot	her Radio	JN Join Notification	Disabled [0]	•]	3
must be in the same PANID		OP Operating PAN ID	0		۲
Scroll down to Enable CE , so that the	first Radio	OI Operating 16-bit PAN ID	FFFF		9
acts as Coordinator		CH Operating Channel	0		\$
		NC Number of Reing Children	14		\$
		GE Coordinator Enable	Enabled [1]	-	3
		DO Device Options	0 8	Bitfield	3
		DC Device Controls	0 8	Sitfield	3



(g) Changing the router configuration.

Firmware information Product family: XB24C Function set: ZIGBEE TH Reg Firmware version: 405F		Written and default Written and not default Written and not default Written and but not writter Error in setting	
Networking Change networking settings			
① ID PAN ID	1234		۲
SC Scan Channels	1FFE	Bitfield	۲
SD Scan Duration	4	exponent	۲
ZS ZigBee Stack Profile	0		۲
NJ Node Join Time	FF	x1 sec	۲
NW Network Watchdog Timeout	0	x1 minute	۲
JV Channel Verification	Enabled [1]	>	۲
JN Join Notification	Disabled [0]	•]	۲
() OP Operating PAN ID	1234		
() OI Operating 16-bit PAN ID	2CE4		
CH Operating Channel	E		
O			

(h) Changing the router and coordinator address.

	-			
Radio Modules		Radio Configuration [- 0013A20041036	506A]	
Name: Function: ZIGBEE TH Reg Port: COM3 - 9600/8/N/1/N - AT MAC: 0013A2004103606A	× *	Addressing Change addressing settings	2 • ® 1	Parameter
Name:	*	SH Serial Number High	13A200	٢
Function: ZIGBEE TH Reg Port: COM31 - 9600/8/N/1/N - AT		SL Serial Number Low	4103606A	۲
MAC: 0013A20041036040		MY 16-bit Network Address	FFFE	۲
		MP 16-bit Parent Address	FFFE	۲
scroll down to Destination Address Low Enter FFFF to make the Radio Broadcast Mode Now the Coordinator can speak to all Routers/E in the Network or you can enter the 64 bit address of the other Radio in to the DH_DL space		OH Destination Address High	0	۷ ک
		DL Destination Address Low	FEEE	۷ کې ا
		NI Node Identifier		۷ کې
		ndDevices	16	۷ کې ا
		BH Broadcast Radius	0	ی چ
		AR Many-to-Oneoadcast Time	FF x 10 sec	ی چ
		DD Device Type Identifier	A0000	۷ ک
		NT Node Discovery Backoff	3C x 100 ms	ی چ
		NO Node Discovery Options	1	۷ ک
		A	F.4	

This configuration helps coordinator to be connected with router. Number of routers can be connected to coordinator using this configuration. When both the zigbee led is blinking that means they are transmitting



the signal. But this doesn't means router and coordinator is connected. The Zigbee is always operated under **AT command mode**.

Robot code:-

#include "htc.h"

//#include "stdio.h"

#ifndef _XTAL_FREQ

// This definition is required to calibrate $__delay_us()$ and $__delay_ms()$

#define _XTAL_FREQ 8000000

#endif

__CONFIG (FOSC_HS & WDTE_OFF & PWRTE_OFF & CP_OFF & BOREN_ON & LVP_OFF & CPD_OFF & WRT_OFF & DEBUG_OFF);

#include "uart1.h"

#define SBIT_TXEN 5

#define SBIT_SPEN 7

#define SBIT_CREN 4

void UART_Init(int baudRate)

```
{
```

TRISC=0x80; // Configure Rx pin as input and Tx as output

TXSTA=(1<<SBIT_TXEN); // Asynchronous mode, 8-bit data & enable transmitter

RCSTA=(1<<SBIT_SPEN) | (1<<SBIT_CREN); // Enable Serial Port and 8-bit continuous receive

SPBRG = (2000000UL/(long)(64UL*baudRate))-1; // baud rate @20Mhz Clock

}

```
void UART_TxChar(char ch)
```

{

while(TXIF==0); // Wait till the transmitter register becomes empty



```
// Clear transmitter flag
  TXIF=0;
  TXREG=ch;
                    // load the char to be transmitted into transmit reg
}
char UART_RxChar ()
{
  while (RCIF==0); // Wait till the data is received
  RCIF=0;
                  // Clear receiver flag
  Return (RCREG); // Return the received data to calling function
}
int main()
{
  TRISD=0x00;
  char i,a[]={"a"};
  char ch;
  char x,y;
  init_comms ( );
  UART_Init (9600);
                           //Initialize the UART module with 9600 baud rate
 for (i=0;a[i]!=0;i++)
  {
    UART_TxChar (a[i]); // Transmit predefined string
 }
 while(1)
  {
  ch = UART_RxChar (); // Receive a char from serial port
```



UART_TxChar (ch); if (ch=1'){ PORTD=0x00; // Stop } if (ch=='2') { PORTD=0x09; // Forward } if (ch=='3') { PORTD=0x05; // Left } if (ch=='4') { PORTD=0x08; // Right } } } Library file uart1.h:-# ifndef _SERIAL_H_ # define _SERIAL_H_

define BAUD 9600

define FOSC 800000L

define NINE 0 /* Use 9bit communication? FALSE=8bit */



define DIVIDER ((int)(FOSC/(16UL * BAUD) -1))

define HIGH_SPEED 1

if NINE == 1

define NINE_BITS 0x40

else

define NINE_BITS 0

endif

if HIGH_SPEED == 1

define SPEED 0x4

else

define SPEED 0

endif

if defined(_16F87) || defined(_16F88)

#define RX_PIN TRISB2

#define TX_PIN TRISB5

else

define RX_PIN TRISC7

define TX_PIN TRISC6

endif

/* Serial initialization */

define init_comms ()

 $RX_PIN = 1;$

 $TX_PIN = 1;$



SPBRG = DIVIDER;

 $RCSTA = (NINE_BITS|0x90);$

TXSTA = (SPEED|NINE_BITS|0x20);

void putch (unsigned char);

unsigned char getch (void);

unsigned char getche (void);

#endif

Conclusion:-

Using zigbee S2C module we can control robot upto 1.2 Km distance. Through robot code we can control wheel movement of robot by pressing some characters or integer values from keyboard . With this technology any electronics components can be controlled like servo motor, stepper motor, dc motor etc at a given distance for a particular module. The various motions of robots are Forward, Reverse, Right, Left, Stop. There is wireless interaction between router and coordinator modules for movement of robot. The wireless interaction occurs at frequency (2.45 GHz). We can use Zigbee S2C Pro module for increasing control of robot upto 2 Km distance. The wireless interaction is based on UART serial communication. Thus, robot performs various motions successfully by pressing particular integers i.e. 1,2,3,4 from keyboard.