CHAPTER 1

INTRODUCTION

1.1. Background of Study

The operation and maintenance of infrastructure and facilities of power distribution has always been a major concern of the power utility companies and local authority who manages the power distribution within their jurisdiction (Tenaga Nasional Berhad, TNB). They are concern on the inefficient utilization of resource which may affect the efficiency and quality of their services to the customers.[1]

The TNB's main interest is to manage the street lighting within the country as there is a vast distribution of street lighting network being implemented throughout the country. The size of the distribution keeps on growing to the point where it needs to have a monitoring and management system in order to minimize the operating cost and maximize the utilization of the workforce to handle the maintenance activities.

The maintenance of the street light that is done currently by the local operators is done manually. The operators has to send patrol cars around in order to do routine check on the condition of the street lights (faulty or not) and to check on the faulty lights reported by the customers. This paper is done to find a solution to automate the monitoring process in order to reduce the cost (man hours and expenditure) that they are spending yearly while using the manual monitoring.

1.2. **Problem Statement**

The current monitoring of the street lights that is being done by the local operators are costing a lot of money. They have to send staff to go and check on all the street lights within their area of responsibility daily. Therefore, their expenditure is increased since they have to;

a) Hire men to do the monitoring daily.
b) Spend money on transportation for the monitoring daily.

The operators are trying to find a new way to replace the current system. This is why the wireless monitoring system is being developed in order to fulfill this requirement.

1.3. Objectives

This project first section consists of making a few prototypes of sensor that are attached to the street lights who communicate with each other using wireless network and send the data from the street lights to a local monitoring system. The second section of this project is to send the data from the local monitoring system to the centralized monitoring centre. This interim report consists of the first section of this project while the second section is authorized to another person. This report objectives are;

- To make a prototype sensor to sense whether the condition of the street light is faulty or not.
- To transmit and retrieve data from the sensor.
- To make a local monitoring system using Graphic User Interface (GUI) to verify the functionality and reliability of the sensor and transceiver.

1.4 Scope of Studies

The scopes of study involved in this study are;

1) To design and make a few prototypes that sense the condition of the street light. These prototypes is equiped with a transceiver to send and receive data. Transceiver is used in order to cater for the area covered by a local monitoring system where the data transmission from the sensor cannot reach the local monitoring system directly.
2) To study and implement on how to send data; using the multi-hop concept; from a prototype to another prototype (nodes to nodes) on a different street light.
3) The tranceiver of the prototype on the last street light will send data from the other street lights and the street light it is attached to, to a local monitoring system. The local monitoring system is equipped with a receiver to get the data from the prototype on the nearest street light.
4) The local monitoring system can monitor all the street light conditions.
5) The local monitoring system will use GUI that is user friendly and easy to be used. It is needed to verify the concept of multi-hop and sensor that is being introduced in this project.

CHAPTER 2

LITERATURE REVIEW

2.1 Prototype Sensor Unit

Prototype sensor unit that is intended to be designed in this project is a type of sensor that can detect changes in the surrounding light intensity. The purpose of this sensor is to sense the street light's light and set the prototype circuitry to send the data through the system. There are two common types of the basic components used in the sensor circuit which are the resistor and the transistor. The main component needed by the sensor circuit is the Photo Resistor.

2.1.1 Photo Resistor

A photo resistor is a resistor whose resistance decreases with increasing incident light intensity. It is made of a high resistance semiconductor. Its principle of work is as below;[3]

i. Light falls on the device (need to be of high enough frequency).
ii. When the frequency is high enough, the photons absorbed by the semiconductor (from the light) would give the electron enough energy to jump into the conduction band.
iii. The electron will be free, leaving a hole in its place.
iv. The hole will attract other electron to fill in for the freed electron.
v. This flow of electron means conductivity of electricity, thus lowering the resistance of the photo resistor.

2.2 Data Transmission and Receiver Unit

Data transmission and receiver unit is a type of transmission media that is used to send and retrieve data. In this project, the type of media that is used is the unguided media (wireless). There are many types of wireless communication that existed in the electronics industry. The concept of multi-hop is used in this project. XBee RF Module is a type of wireless device that performs the multi-hop function. It runs using the XCTU software.

2.2.1 XBee RF Module

XBee RF Module is a wireless technology that follows the IEEE (Institute of Electrical and Electronics Engineering) 802.15.4 physical radio specifications. It is a low-cost packet-based radio protocol which operates using battery. It operates in low-power, which make the battery last years. Besides, it solves many wireless sensor network issuess while allowing intercommunications between devices.[2]

The XBee RF Module operates in unlicensed bands worldwide at the frequencies of 2.4000 – 2.484 GHz, 902 – 928 MHz and 868.0 – 868.6 MHz. Since it is unlicensed, the cost for using the bands is free.

The mechanical drawings of the XBee and XBee-Pro RF Module is shown in **APPENDIX I.** The specifications of XBee and XBee-Pro RF Modules is shown in **APPENDIX II.**

2.2.2 *X-CTU Software*

The X-CTU software is the software that is used to configure the XBee RF Module. It provides simple programming configuration and compatible to be used by XBee RF Module. It is easy to use and has a loopback range test function to test the set up configurations. It also has the save and retrieve commonly used module configuration function such as profile. This make it easier to store and retrieve data and changes made in the configuration.

X-CTU is compatible with Windows 98, Windows 2K, Windows ME and Windows XP.

2.2.3 *XBee RF Module Network Formation*

XBee networks are called personal area networks (PAN). Each network contains a 16-bit identifier called a PAN ID. ZigBee defines three different device types – coordinator, router, and end device. An example of such a network is shown below. [5]

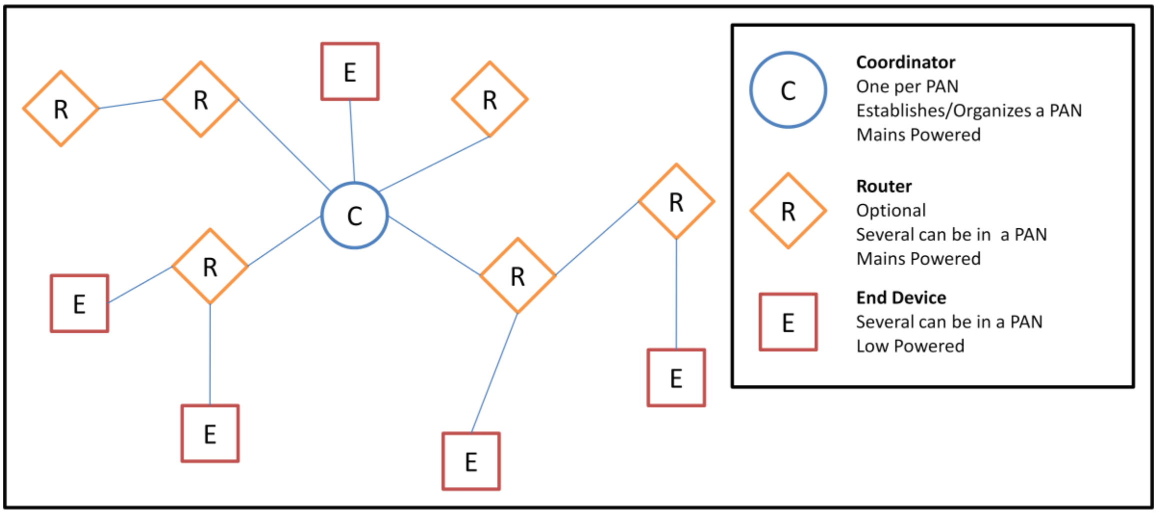


Figure 1: Node Types / Sample of a Basic XBee Network Topology

Coordinator Responsible for selecting the channel and PAN ID. The coordinator starts a new PAN. Once it has started a PAN, the coordinator can allow routers and end devices to join the PAN. The coordinator can transmit and receive RF data transmissions, and it can assist in routing data through the mesh network. Coordinators are not intended to be battery-powered devices. Since the coordinator must be able to allow joins and/or route data, it should be mains powered. [5]

Router A router must join a ZigBee PAN before it can operate. After joining a PAN, the router can allow other routers and end devices to join the PAN. The router can also transmit and receive RF data transmissions, and it can route data packets through the network. Since routers can allow joins and participate in routing data, routers cannot sleep and should be mains powered. [5]

End Device An end device must join a ZigBee PAN, similar to a router. The end device, however, cannot allow other devices to join the PAN, nor can it assist in routing data through the network. An end device can transmit or receive RF data transmissions. End devices are intended to be battery powered devices. Since the end device may sleep, the router or coordinator that allows the end device to join must collect all data packets intended for the end device, and buffer them until the end device wakes and is able to receive them. The router or coordinator that allowed the end device to join and that manages RF data on behalf of the end device is known as the end device's parent. The end device is considered a child of its parent.[5]

2.3 Local Monitoring System Unit

The local monitoring system unit is develop for the sole purpose of verifying the prototype sensor unit and the transmitting and receiving unit are operational and work as they should be. When both of the parts of this project is combined, the local monitoring unit will be cut-off from the system. The local control center that will be developed in this study has the following functions;

a) Communicate using the XBee RF Module to receive the data transmitted by the prototypes on the street light.
b) Understand the data transmitted by the XBee RF Module and transform the data into simpler data that can be displayed on the monitoring system.
c) Detect and locate the street light which is not functioning or not working during night time and dark weather.

CHAPTER 3

METHODOLOGY

3.1 Procedure Identification

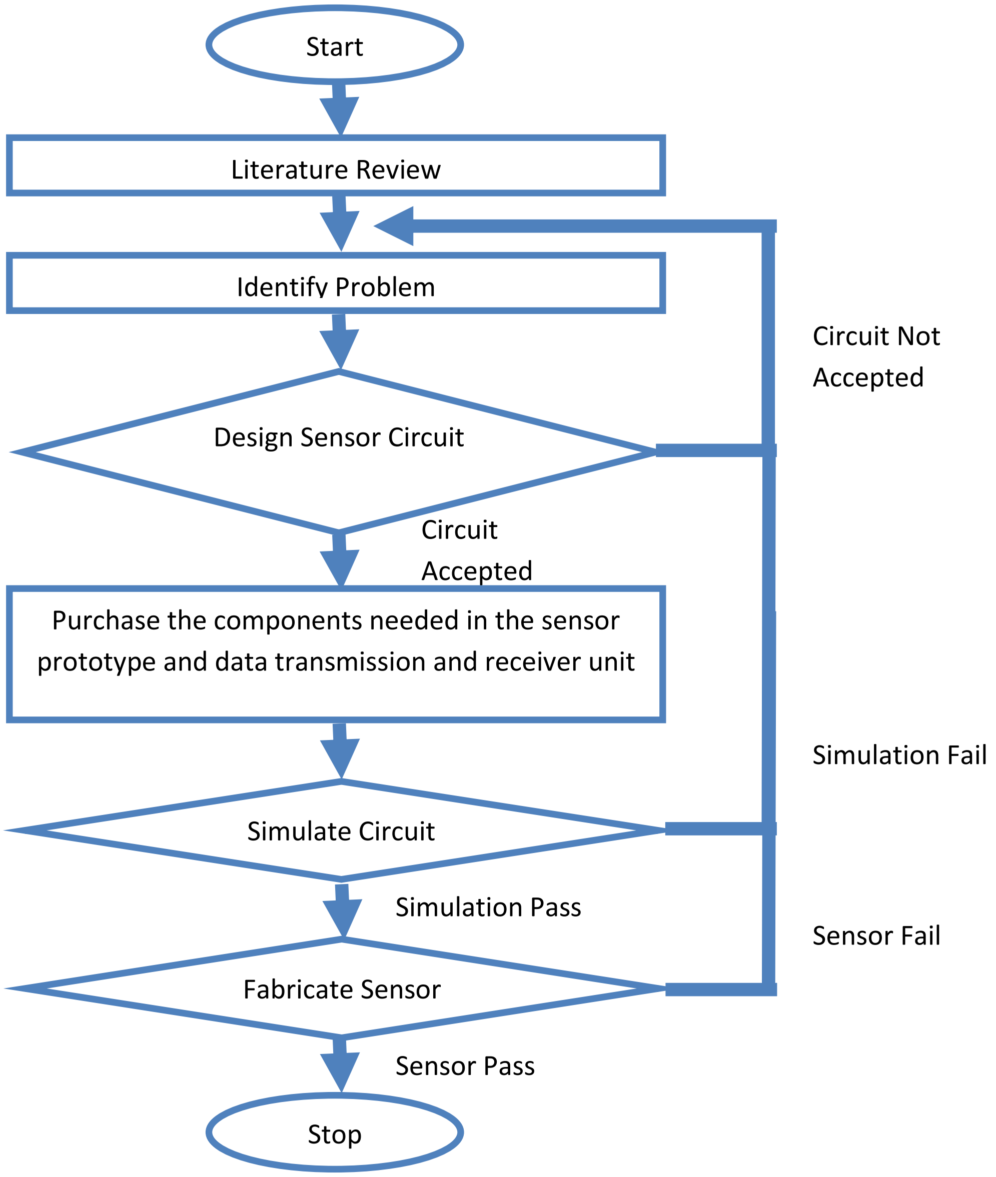


Figure 2: Final Year Project 1 Procedure Flow

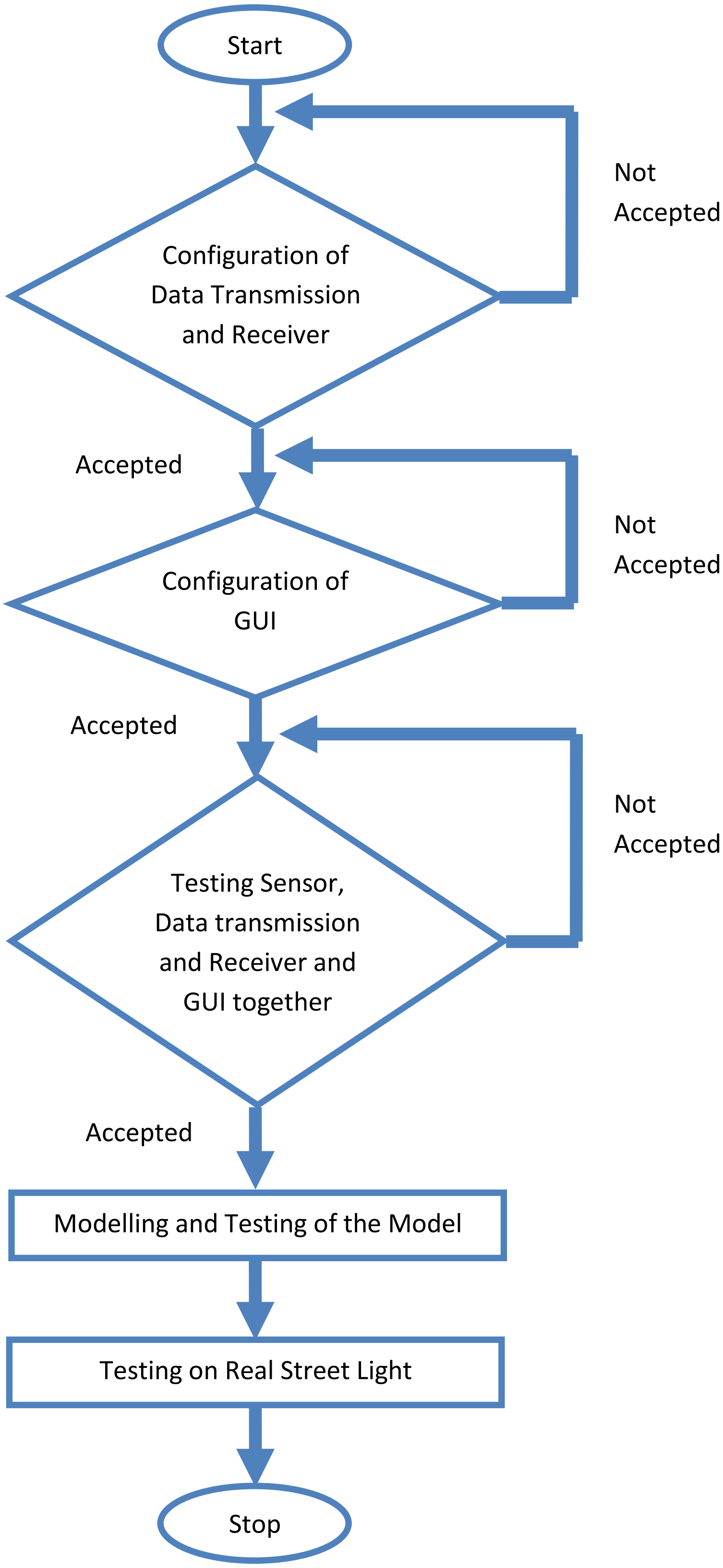


Figure 3: Final Year Project 2 Procedure Flow

3.2 Research Methodology

The main part of the research that will be done in Final Year Project 1 (FYP 1) and Final Year Project 2 (FYP 2) consist of the followings;

i. Literature Review
   a. Focuses on learning and understanding the concept and theory behind the equipments, devices and software that will be used in this project.
   b. Learn on how to implement and used them in the project.
   c. Get and learn from the datasheet, user manual and tutorial on the equipments, devices and software in order to grasp the concept and theory behind them.

ii. Designing and Fabricating
   a. Develop the design for the sensor prototype and fabricate them.
   b. Develop the configuration that will be used by the sensor prototype and the wireless network system.
   c. Develop a monitoring system at the control center which is easy to be used and user friendly.

iii. Testing
   a. Calibrate and test on all of the designs used and make certain adjustment in order to make sure the prototype works and fulfill its requirements.

3.3 Tools, Software and Hardware

3.3.1 Tools

a) Multi-meter
b) Wire stripper
c) Solder

3.3.2 Software Required

a) XCTU
b) Visual Basic 2008
c) P-Spice

3.3.3 Hardware Required

a) Resistor
b) Transistor
c) Photo Resistor
d) XBee RF Module
  - XBee Explorer Regulated
  - XBee Explorer USB
  - XBee 1mW Wire Antenna

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Monitoring System

The Street light monitoring system would consists of three main parts which are the Prototype Sensor Unit, Data Transmission and Receiver Unit and the Local Monitoring System Unit.

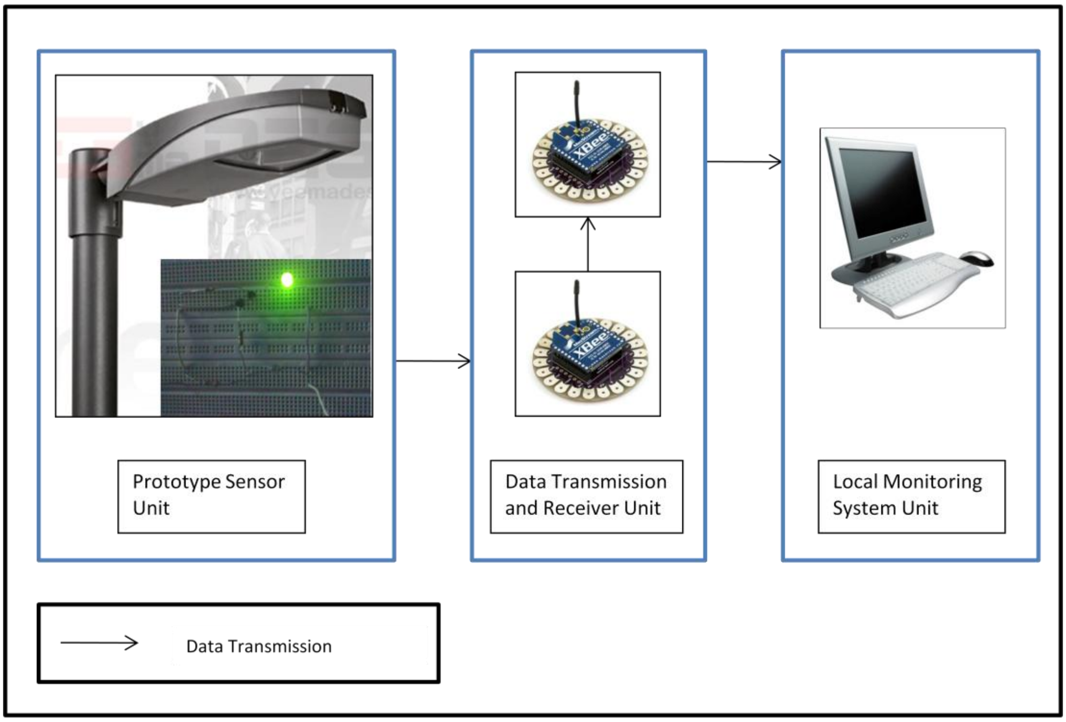


Figure 4: The Monitoring System Diagram

The Prototype Sensor Unit is the part that consists of electrical devices that is use to sense whether the street light is on or not. It is put at the street light base to sense the data from the street light. The data from this unit will be sent to the local monitoring system.

The data retrieved by the Prototype Sensor Unit is sent by the data transmission and receiver unit. It is basically done by using a mesh of XBee RF Modules that acts as transmitter and receiver. It is placed at each of the Prototype Sensor Unit and the local monitoring system in order for the transmission and retrieving system can be made.

The Local Monitoring System Unit is a computer that is used to retrieve the data sent by the data transmission and receiver unit.

4.2 Prototype Sensor Unit

There were a few circuits that were considered be used for the Prototype Sensor Unit. During the early stage, the prototype sensor unit that was considered as a switching device for the XBee RF Module uses a relay (Refer to Figure 4). However, after the discussion with the supervisor and further research, it has been found out that the circuit was not appropriate since it uses relays as a switching device. Relays are not needed to be used in this prototype as the relay is usually used in a low-power circuit to control a high-power circuit.[4]

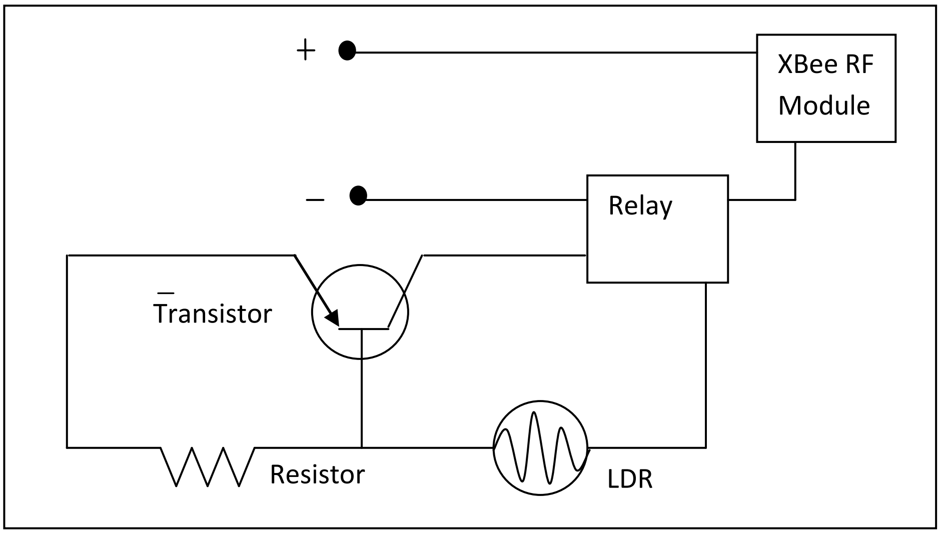


Figure 5: Prototype Sensor with Relay

Then, a different approach which does not involve relay switching method to gives signal to the XBee RF Module was researched and analyzed. It was determined that the signal should be send all the time during the night time. Therefore, the idea for the prototype only to switch on the XBee RF Module to send data is not relevant.

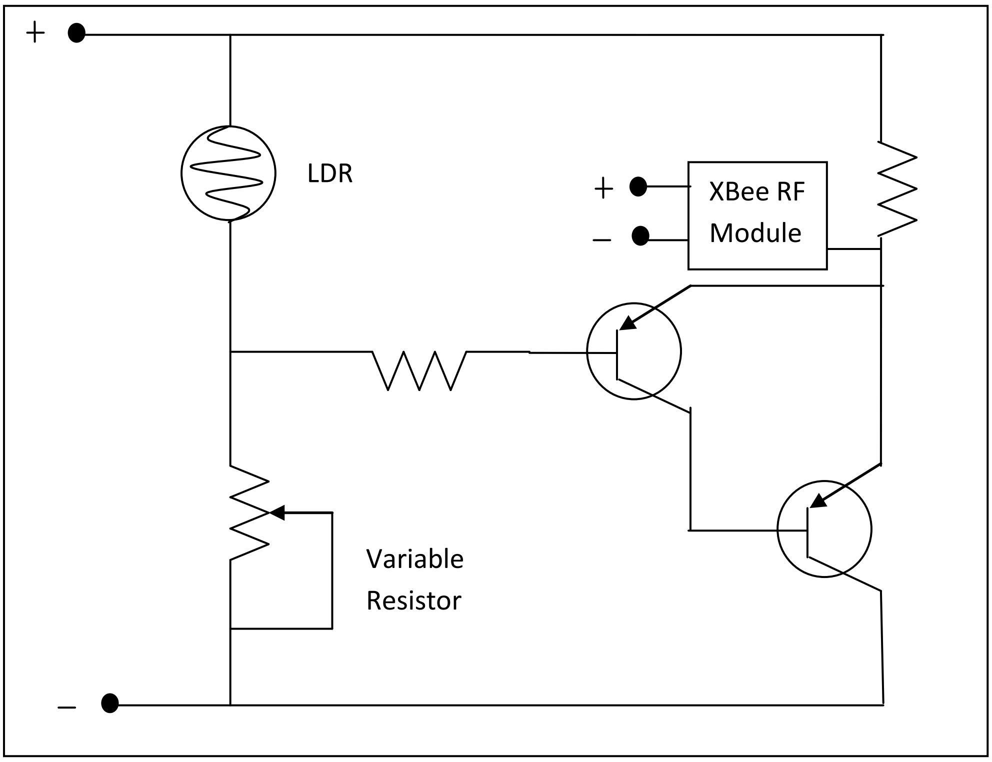


Figure 6: Prototype Sensor Unit – Light Sensor

Then, the idea of using a photo sensor which uses a Darlington Pair was taken into consideration for further analysis to see whether it can be used in this project. The circuit is shown in Figure 5. However, this circuit arouse a new problem which is the problem of differentiating the day and night. Since this circuit is a light sensor circuit, it will detects the sunlight as light, which means that the circuit will send signal that indicates the street light is turned on.

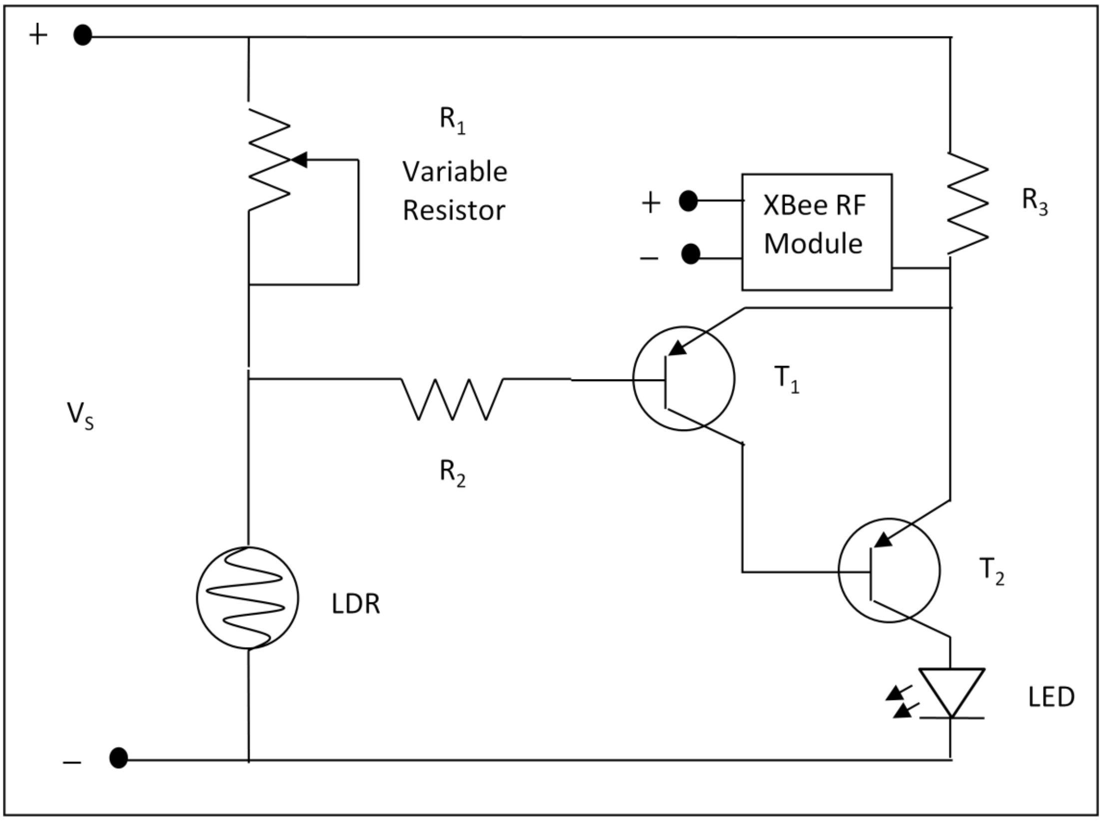
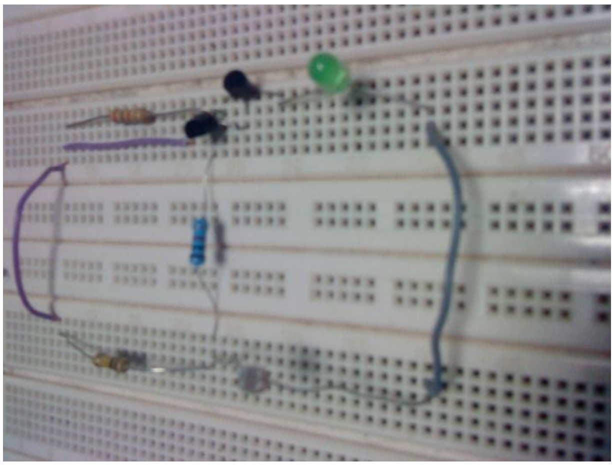
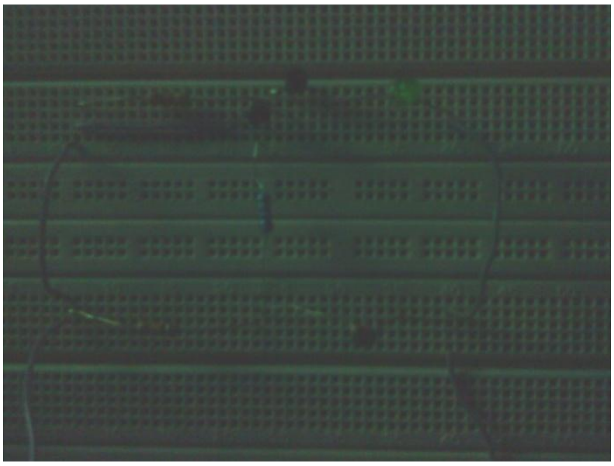


Figure 7: Prototype Sensor Unit – Dark Sensor

In order to eliminate this problem, a new approach is taken into consideration. Since the light from the light bulb of the street light and the sunlight both have the same properties that affects the LDR to turned on a light sensor circuit, there is a possibility to use the LDR to sense no light (low intensity light) and turned on the dark sensor circuit. Therefore, a new circuit which is shown in Figure 6 was develope.

Some experiments were made to see the effects of changing the Voltage Supply, V_S with two sets of resistor R_1, R_2 and R_3 to the circuit. Below are the effects of changing them. The changes can be seen in the brightness of the LED in this circuit.

Table 1: Effects of Changing changing the Voltage Supply, V_S with two sets of resistor R_1, R_2 and R_3

<table>
<tr><td>Resistance</td><td>Effect on LED</td></tr>
<tr><td rowspan="3">R_1= 100kΩ
R_2= 1kΩ
R_3= 2.7kΩ</td><td>
Figure 8: Sensor in Bright Light</td></tr>
<tr><td>
Figure 9: Sensor in Darkness V_S = 4.5V</td></tr>
<tr><td>
Figure 10: Sensor in Darkness V_S = 9.0V</td></tr>
</table>

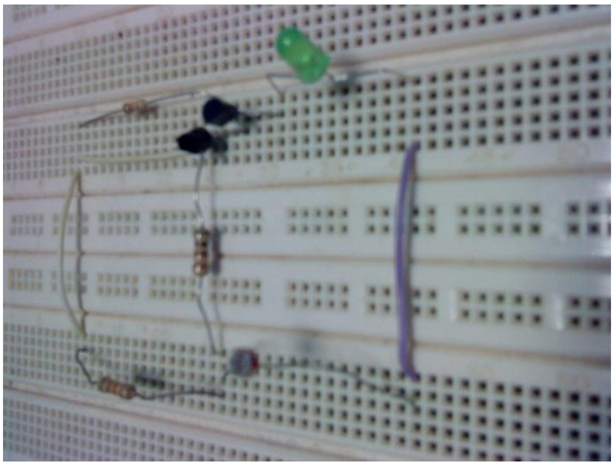
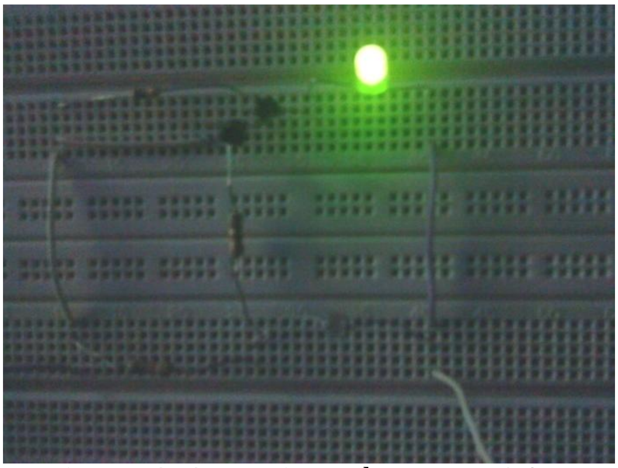
<table>
<tr><td rowspan="3">R_1= 50kΩ
R_2= 500 Ω
R_3= 1kΩ</td><td>
Figure 11: Sensor in Bright Light</td></tr>
<tr><td>
Figure 12: Sensor in Darkness V_S = 4.5V</td></tr>
<tr><td>
Figure 13: Sensor in DarknessV_S = 9.0V</td></tr>
</table>

Figure 7 and Figure 10 shows that the LED does not work in the bright light. Figure 8, 9, 11 and 12 shows that the LED is on in the darkness. This proves that the sensor circuit can differentiate the intensity of the light in its surrounding. In Figure 9, the brightness of the LED light is too low since the voltage supply is too low while the resistance is high. In Figure 12, the brightness of the LED is the highest since the voltage supply is high and the resistance is low.

4.3 Data Transmission and Retriever Unit

The data tranmission and retriever unit consists of a few XBee RF Modules that acts as the transmitter and receiver in the system. According to the research done on the XBee RF Module, it was decided that there will be three types of XBee that will be used through out this course. [2]

a) *XBee 1mW Wire Antenna*

This device is use to tansmit and retrive data from one XBee to one another. For this project each prototypes and the receiver for the Local Monitoring Unit will use this device.

b) *XBee Explorer USB*

This device is used to configure the XBee 1mW Wire Antenna so that it can works as the user desired. Besides, it can be made as an interface for the XBee 1mW Wire Antenna (receiver) to communicate with the computer. For this project, after this device is used to configure the XBee 1mW Wire Antenna, it will be used as interface for the receiver to communicate with the Local Monitoring Unit.

c) *XBee Explorer Regulated*

The XBee 1mW Wire Antenna can only withstand 3.2V and is difficult to be connected to breadboard and veriboard because of its legs that are small and very near to each other. This device is used to overcome both of the problem. However, the highest voltage that can be withstand by the device is 5V.

The X-CTU software were used to checked the condition of all the XBee. After the test, it is proven that all of them is in a good condition and they can transmit and receive data from each other. Besides from that, X-CTU software is used to transmit and received data from each XBee 1mW Wire Antenna. Through the test, it is determined that the main compenent in the transmitting and receiving using XBee 1mW Wire Antenna is the PAN ID. The PAN ID need to be set to make sure XBee 1mW Wire Antenna san sommunicate with each other.

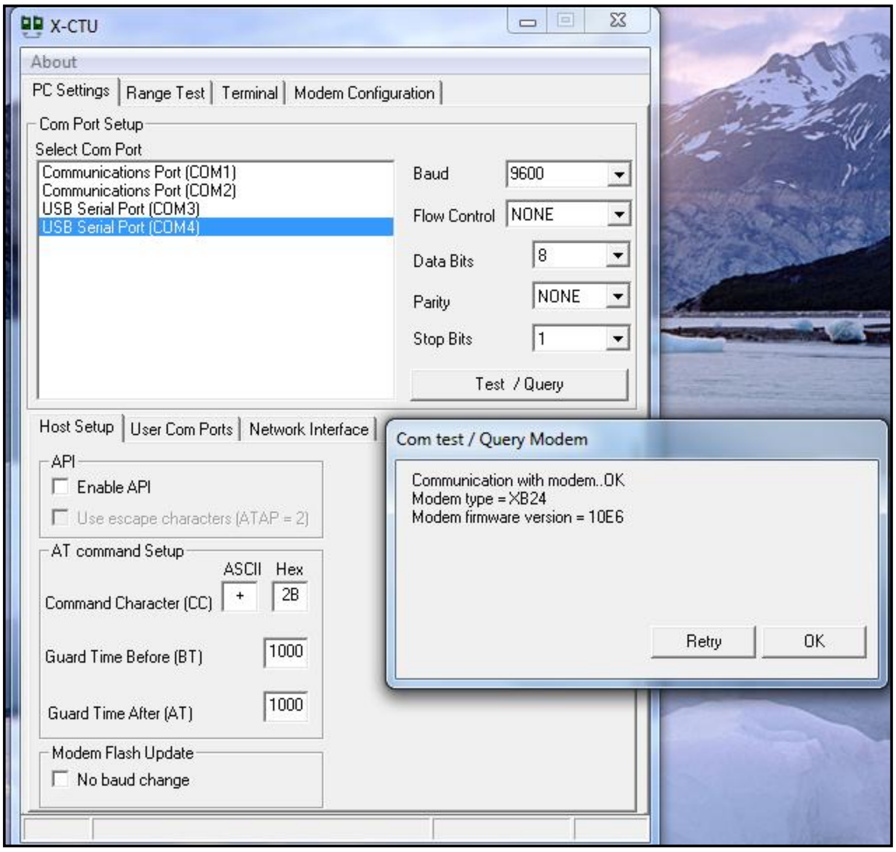


Figure 14: Test/Query Modem using X-CTU

The X-CTU is used to test the transmission between two XBee 1mW Wire Antenna. The X-CTU is connected to the computer using USB devices. Both of the XBee 1mW Wire Antenna are opened using the X-CTU software (One as

COM3 and the other as COM4). Figure 15 shows the windows of both of the XBee 1mW Wire Antenna. Both of them is set to have the same PAN ID. In the figure, the data that is send through the XBee 1mW Wire Antenna is blue in color, while the data received is red in color.

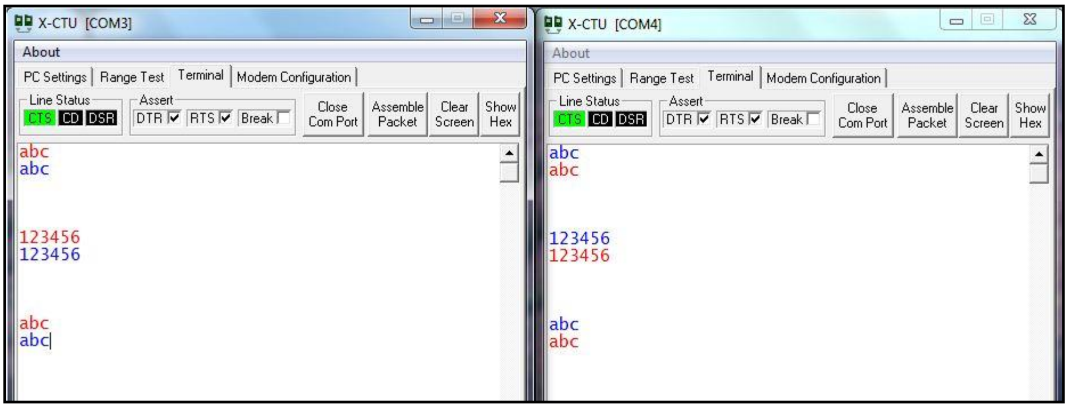


Figure 15: Communication with the same PAN ID

The next test is done by using different PAN ID. For COM3 the PAN ID set is to be 3222 while COM4 is set to 3332. When both of them is different, the data send by COM3 cannot be received by COM4 and vice versa. This effect can be seen in Figure 16. Through this test, it is clear that both XBee 1mW Wire Antenna need to have the same PAN ID in order to communicate with each other.

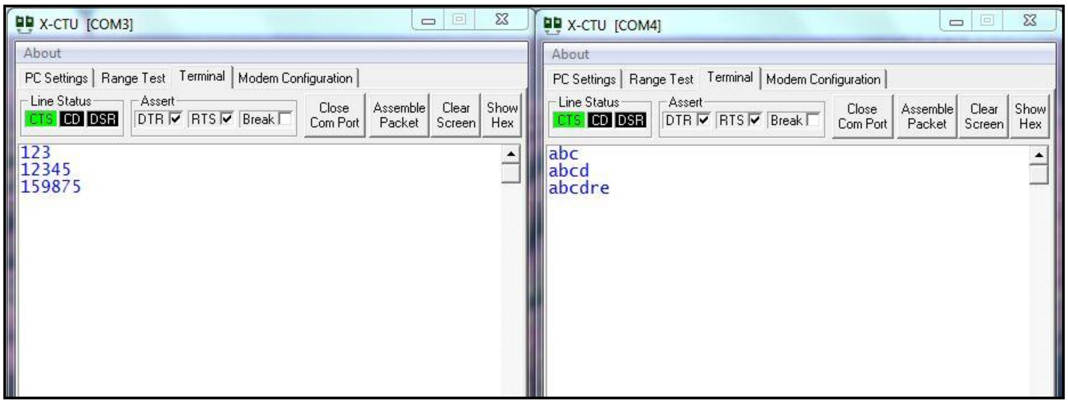


Figure 16: Communication with different PAN ID

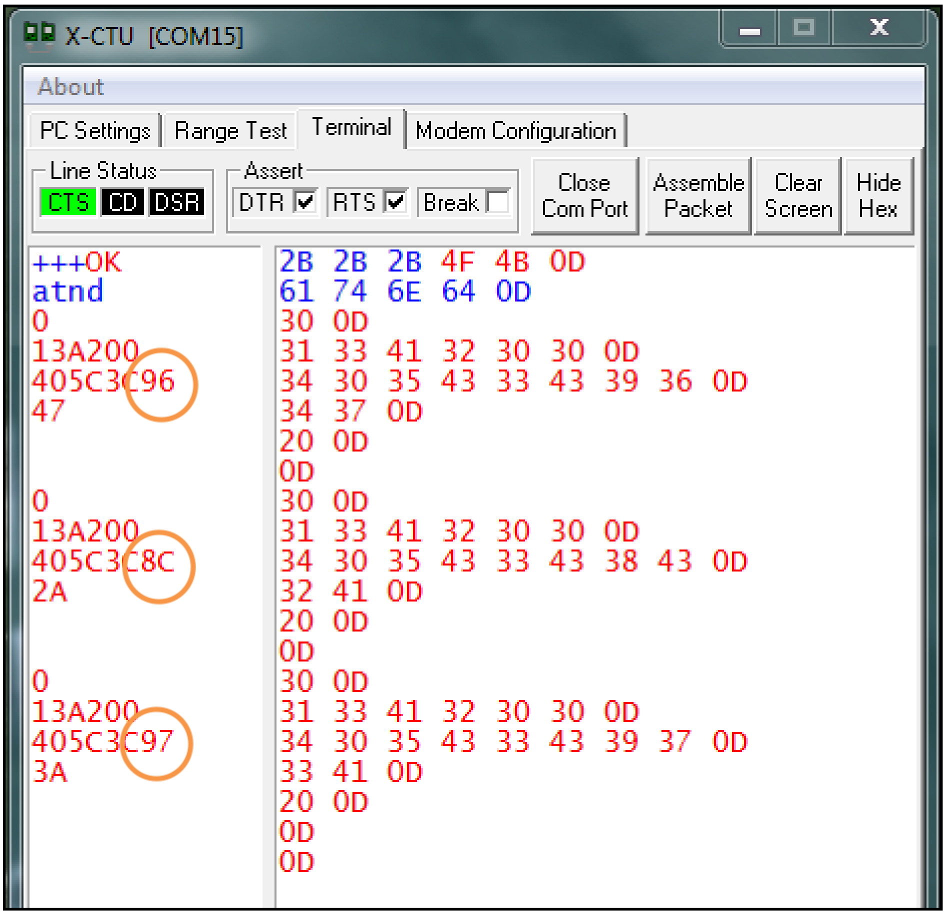
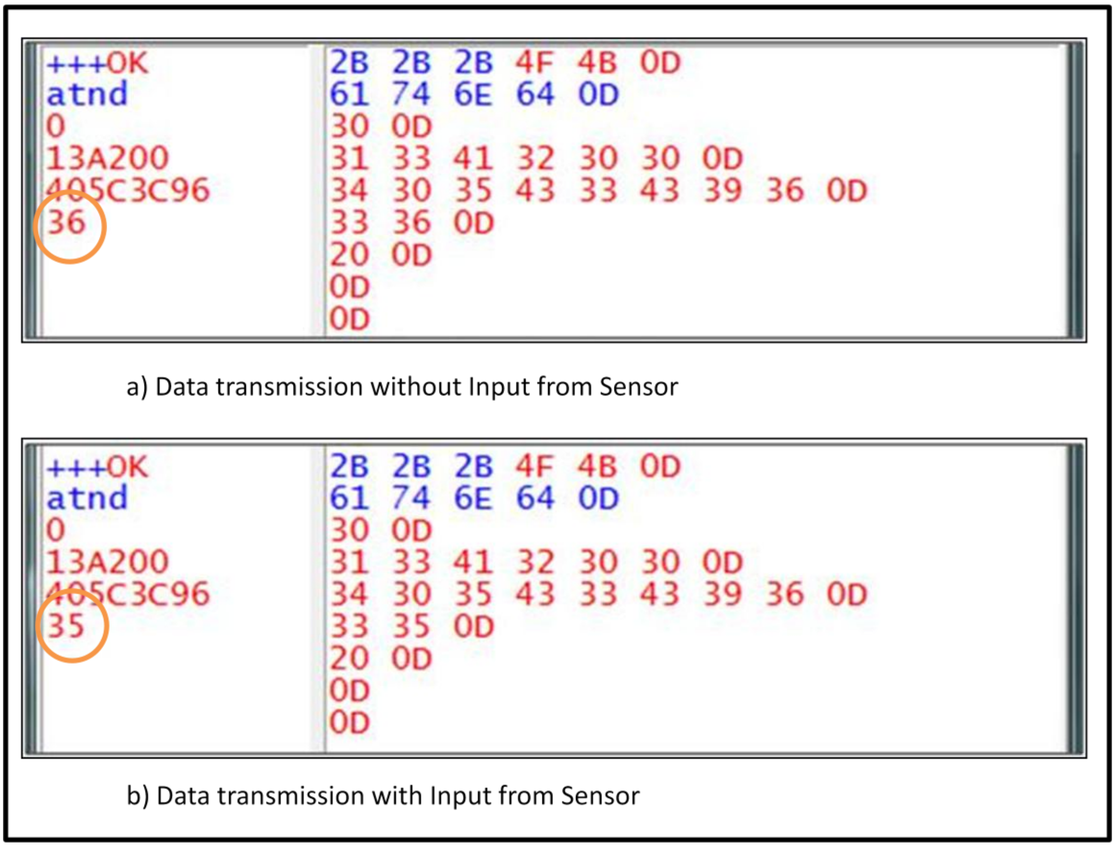


Figure 17: Node Test

A XBee 1mW Wire Antenna (Receiver) is connected to the computer using the XBee Explorer USB while another three XBee 1mW Wire Antenna (Transmitter) is connected to the XBee Explorer Regulated and powered by the 3.0V bateries. The X-CTU is by detect the Receiver to show the data detected by it. The command “+++” and “atnd” is used to call the function “Node Detection”. Then the nodes which are the transmitters that are detected by the Receiver is shown in Figure 17. In the figure, we can see that there are three chunks of output which are red in color that indicates there are three nodes detected by the Receiver.



a) Data transmission without Input from Sensor

b) Data transmission with Input from Sensor

Figure 18: Data Treansmission from Sensor Test

The test are done by giving the transmitted input and no input to the sensor to differentiate the data received by the X-CTU programme during both of the condition. The data transmitted is shown in Figure 18. The data received is circled and from the data it shows that the trasmitter transmit different type of output according to the data it received from the sensor. The data from the node identifier is used to further develope the transmission system of this project.

The next step in the transmission device is to allocate the address for each of the XBee 1mW Wire Antenna. This is done using X-CTU > Select USB Serial Port > Modem Configuration > MY > allocate new adreess. The step by step configuration is shown in Figure 19. MY is the 16-bit Network Address for the XBee 1mW Wire Antenna module. For the receiver and transceiver, MY is the main allocation that needed to be configured for them to receive data.

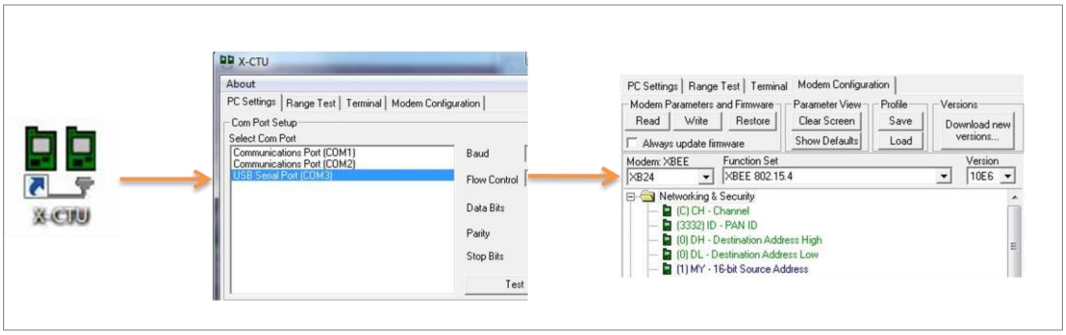
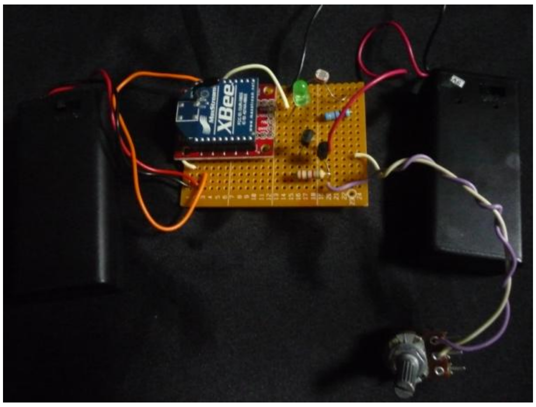


Figure 19: Address Allocation Steps

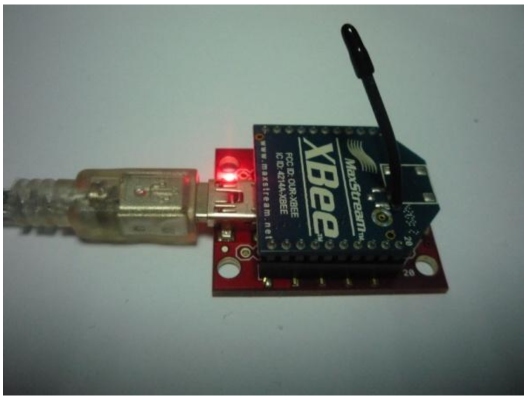
The next step is to setup the transmitter or tranceiver to send data from XBee 1mW Wire Antenna to another XBee 1mW Wire Antenna. This is done by allocating the Destination Address Low (DL) or Destination Address High (DL). For this project, only DL is used in the transmission process. The previous steps are taken until the Modem Configuration step. Select DL and assign the receiver's MY address to the transmitter's DL. This step makes the transmitter to only transmits its data to the specified receiver.

Then, still in the Modem Configuration mode, the transmitter's I/O's Setting is configured. For this project, the tranceivers have two inputs which are the D0 for DIO0 pin and D2 for DIO2 pin. DIO0 pin gets the input from the sensor and the DIO2 pin gets the input from the DOUT pin of the XBee 1mW Wire Antenna. The D0 is set to mode 2 (ADC input) while the D2 is set to mode 3 (Digital input).

The next step is the most important step which is the transmission rate of the transmitter or tranceiver. The transmission rate is controlled by assigning the IR (Sample Rate). The fastest transmission is 0.001s per sampling rate and the slowest is 1 minute per sampling rate. In this project, the sampling rate is set to 3E8 (1 second). If this project is to be used on real street light, the transmission rate should be set to FFFF (1 minute) in order to reduce the power consumption in transmission.



a) Prototype Sensor Unit with Transceiver



b) Data Receiver Unit

Figure 20: Finalized Prototype Sensor Unit and Data Transmission and Receiver Unit

Figure 20 shows the finalized Prototype Sensor Unit and Data Transmission and Receiver Unit. The tranceivers and the data receiver unit are configured based on Table 2. This table shows the configuration that is used in this project in order to fullfill the transmission requirements of this project.

Table 2: Tranceivers and Data Receiver Unit Configuration

	DL	MY	D0	D2	IR
Receiver	-	1	-	-	-
Sensor 1	1	2	Mode 2	Mode 3	3E8
Sensor 2	2	3	Mode 2	Mode 3	3E8
Sensor 3	3	4	Mode 2	Mode 3	3E8

Based on this table, the multi-hop transmission that is required in this project is achieved.

4.4 Local Monitoring System Unit

The author planned to use the Visual Basic 2008 software, an object-oriented language to make the GUI for the Local Monitoring System Unit.

The object-oriented language is a language that allows the programmers to use objects to accomplish a program's goal. An object is anything that can be seen, touched or used. This means that the objects can be anything. The object that is used in this program is basically a program that can take many different forms, for example, check boxes, list boxes and buttons.

This is different from the payroll program which might utilize objects found in the real life world (i.e. time card object, an employee object and a check object).

Each of the objects used in an object-oriented program is created from a class, which is a pattern or blueprint that the computer uses to create them.

However, for this project, since the reseach on the transmission part takes longer period than expected, the GUI to convey the data could not be produced. The only way to show them is by using the X-CTU software to show the transmission of the data by selecting X-CTU > Select USB Serial Port > Terminal > Show Hex. This meets the requirement of GUI in this project which is to show that the transmission of the devices. Figure 21 shows the transmission received by the receiver.

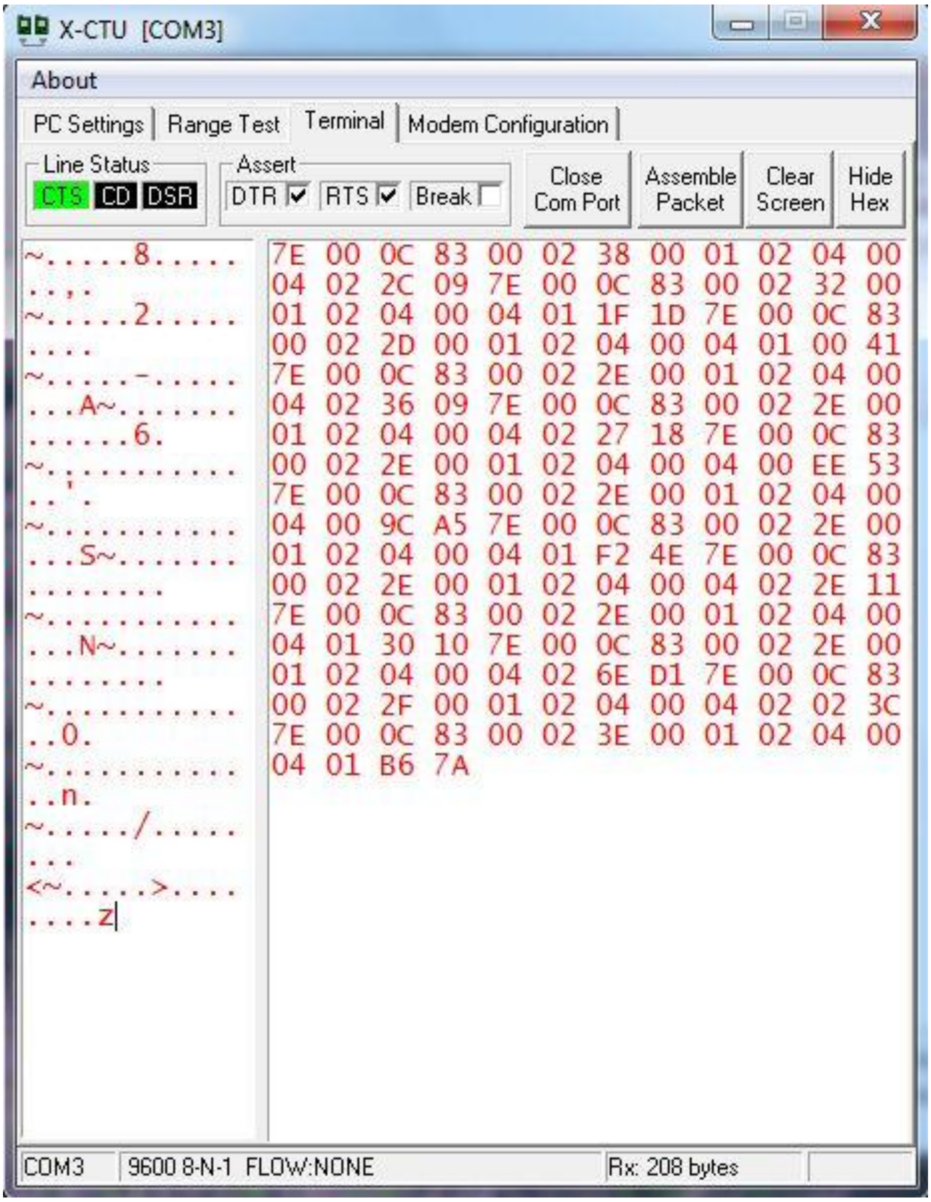


Figure 21: Transmission Received by Receiver

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This project achieved its primary objective which is to find a way to minimize the operating cost for street light monitoring and maximize the utilization and the number of TNB workers to do the street light monitoring from the street light to local monitoring system. However, there are still some improvements need to be done in order to use this system in the real world.

5.2 Recommendation

For future works, there are a few recommendations that can be done to improve the monitoring system.

1) To incorporate PIC into the sensor circuit to the data
2) To improve the transmission process, making the multi-hop to not have specified transmission address, instead it can choose the shortest transmission route to the local monitoring system.
3) To reduce the power consumption of the transmitter.
4) To create a GUI for the system that is user friendly and can decipher the data from the transmission line.
5) To make a container for the prototype that do not interfere with the transmission process

REFERENCES

[1] IRPA Grant Final Report Design &Development Of Street Light Monitoring And Management System, Musa Bin Mohd Mokji Et All

[2] Maxstream (31/05/2007), XBee™/XBee-PRO™ OEM RF Modules [Datasheet]. Available: http://www.sparkfun.com/datasheets/Wireless/Zigbee/XBee-Manual.pdf, Accessed: 20/02/2010

[3] Sunrom Technologies (28/07/2008), Light Dependent Resistor – LDR [Datasheet]. Available: http://www.sunrom.com/files/3190-datasheet.pdf, Accessed: 30/02/2010

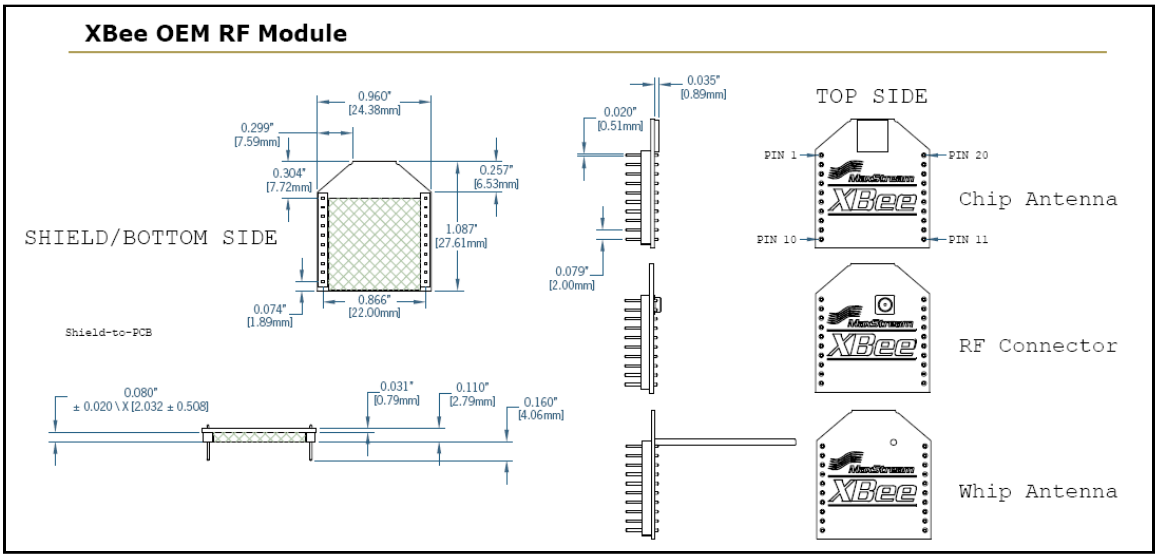
[4] How Stuff Works, How do the streetlights turn on automatically at night? [Web]. Available: http://science.howstuffworks.com/question363.htm, Accessed: 10/02/2010

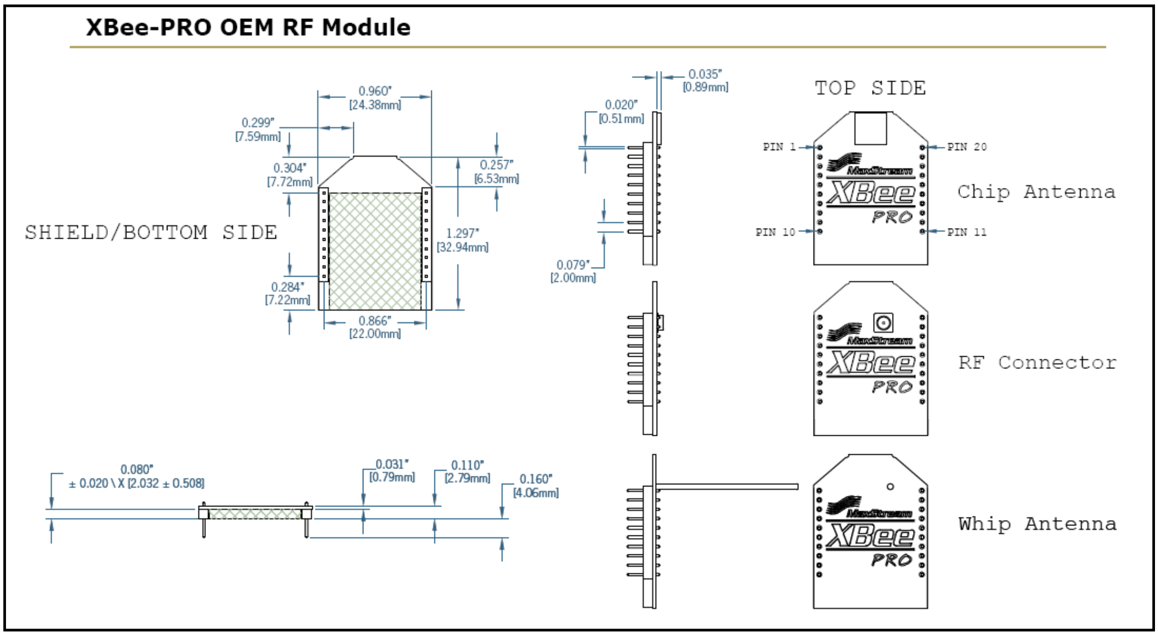
[5] XBee™ ZNet 2.5/XBee-PRO™ ZNet 2.5 OEM RF Modules [Datasheet]. Available: http://www.sparkfun.com/datasheets/Wireless/Zigbee/XBee-2.5-Manual.pdf, Accessed: 27/08/2010

APPENDICES

APPENDIX I

MECHANICAL DRAWINGS OF XBEE AND XBEE-PRO RF MODULE





APPENDIX II

SPECIFICATIONS OF XBEE AND XBEE-PRO RF MODULE

Specification	XBee	XBee-PRO
Performance		
Indoor/Urban Range	up to 100 ft. (30 m)	Up to 300' (100 m)
Outdoor RF line-of-sight Range	up to 300 ft. (100 m)	Up to 1 mile (1500 m)
Transmit Power Output (software selectable)	1mW (0 dBm)	60 mW (18 dBm) conducted, 100 mW (20 dBm) EIRP*
RF Data Rate	250,000 bps	250,000 bps
Serial Interface Data Rate (software selectable)	1200 - 115200 bps (non-standard baud rates also supported)	1200 - 115200 bps (non-standard baud rates also supported)
Receiver Sensitivity	-92 dBm (1% packet error rate)	-100 dBm (1% packet error rate)
Power Requirements		
Supply Voltage	2.8 – 3.4 V	2.8 – 3.4 V
Transmit Current (typical)	45mA (@ 3.3 V)	If PL=0 (10dBm): 137mA(@3.3V), 139mA(@3.0V) PL=1 (12dBm): 155mA (@3.3V), 153mA(@3.0V) PL=2 (14dBm): 170mA (@3.3V), 171mA(@3.0V) PL=3 (16dBm): 188mA (@3.3V), 195mA(@3.0V) PL=4 (18dBm): 215mA (@3.3V), 227mA(@3.0V)
Idle / Receive Current (typical)	50mA (@ 3.3 V)	55mA (@ 3.3 V)
Power-down Current	< 10 µA	< 10 µA
General		
Operating Frequency	ISM 2.4 GHz	ISM 2.4 GHz
Dimensions	0.960" x 1.087" (2.438cm x 2.761cm)	0.960" x 1.297" (2.438cm x 3.294cm)
Operating Temperature	-40 to 85° C (industrial)	-40 to 85° C (industrial)
Antenna Options	Integrated Whip, Chip or U.FL Connector	Integrated Whip, Chip or U.FL Connector
Networking & Security		
Supported Network Topologies	Point-to-point, Point-to-multipoint & Peer-to-peer	
Number of Channels (software selectable)	16 Direct Sequence Channels	12 Direct Sequence Channels
Addressing Options	PAN ID, Channel and Addresses	PAN ID, Channel and Addresses
Agency Approvals		
United States (FCC Part 15.247)	OUR-XBEE	OUR-XBEEPRO
Industry Canada (IC)	4214A XBEE	4214A XBEEPRO
Europe (CE)	ETSI	ETSI (Max. 10 dBm transmit power output)*
Japan	n/a	005NYCA0378 (Max. 10 dBm transmit power output)**

APPENDIX III

PROJECT GANT CHART FYP 1

No.	Detail/ Week	1	2	3	4	5	6	7	Mid-semester break	8	9	10	11	12	13	14	15
1	Selection of Project Topic																
2	Research Work																
3	Submission of Preliminary Report			●													
4	Submission of Progress Report									●							
5	Designing Prototype and GUI																
5	Fabrication and testing of Prototype																
6	Seminar																
7	Submission of Interim Report Final Draft														●		
8	Submission of Interim Report															●	

APPENDIX IV

PROJECT GANT CHART FYP 2

No.	Task Name	1	2	3	4	5	6		7	8	9	10	11	12	13	14	15	16-18	20
1	Analyze, combine and test the transmitter with the sensor.	■	■	■	■	■	■	MID SEM BREAK	■	■								EXAM WEEK	
2	Prepare the transmitter and the receiver.			■	■	■	■		■	■									
3	Preparation for Progress Report 1			■	■														
4	Submission of Progress Report 1				●														
5	Develop the GUI system						■		■	■	■								
6	Combined the GUI with the receiver								■	■	■	■							
7	Preparation for Progress Report 2								●										
9	Submission of Progress Report 2									●									
10	Complete the entire model									■	■	■							
11	Analyze and test the performance of the design.										■	■	■	■					
12	Preparation for the Final Report											■	■						
13	Submission Draft of Final Report												●						
	Submission Final Report (Soft copy) and Technical Report														●				
15	Oral Presentation (week 18)																	●	
16	Submission Final Report (Hard Bound)																		●