DESIGN DATA HANDLER IN WIRELESS SENSOR NETWORK

Nurul Syuhada Abd Ghani
nurrieda_1512@yahoo.com.my
Faculty of Electrical Engineering
MARA University of Technology Malaysia (UiTM)
40450 Shah Alam

Abstract – **The development wireless sensor network (WSN) is to monitor indoor air quality of laboratories. The architecture for WSN as indoor air quality monitoring system can be divide into two stages which is architecture for sensor nodes and GUI development for base station (data handler). This project just concentrates on GUI development for base station. In this project, WSN system has 3 sensor nodes which are placed in different laboratories. The sensor node delivers the indoor air temperature and relative humidity for every hour until 24 hours of monitoring to base station. Data handler act as base station to collect message or information that relay from sensor nodes through transceiver. Base monitoring is the last part of WSNs which is to analyze all information and handle the event data from sensor node. The result of monitoring is use to determine the dew point and humidex value can be predicted as a range and degree of comfortable.**

Keywords: **Temperature, Transceiver**

1.0 INTRODUCTION

1.1 Wireless Sensor Network

A wireless sensor network (WSNs) is a wireless network consisting of spatially distributed autonomous devices using sensors to cooperatively monitor physical or environmental conditions. The applications for WSNs are used in many industrial and civilian application areas, including industrial process monitoring and control, machine health monitoring, environment and habitat monitoring, healthcare applications, home automation, and traffic control. [1][2]

In this project WSNs is used as monitoring system. A WSNs is scattered in a region where it is meant to collect data through its sensor nodes. In area monitoring, the WSNs is deployed over a region where some phenomenon is to be monitored. As an example, a large quantity of sensor nodes could be deployed over a different place. When the sensors detect the event being monitored, the event needs to be reported to one of the base stations, which can take appropriate action (e.g. send data to PC(personal computer)) . The base stations are one or more distinguished components of the WSN with much more computational, energy and communication resources. They act as a gateway between sensor nodes and the end user. Sensor nodes consists of a *processing unit* with limited computational power and limited memory, *sensors* (including specific conditioning circuitry), a *communication device* (transceivers), and a power source.

1.2 Data Handler (PC)

Data handler is a main role in the WSNs system. The data handler commonly develop by utilized software such likes e.g. visual C++, Visual Basic or Visual C#. With the visualization graphical its convenience to analyze the changing of monitoring data from sensor nodes and also preview it's into graphical form.Data handler also capabilities to handle and manage all message from nodes with network configuration selective. In this project, data handler was deployed using PC as main tools to enable the collection and analyzing sensing data. The tool was chosen as a GUI with deployed Visual C# as manage the data through the star network configuration. Generally, Visual C# is relative easy to learn for anyone, small, fast and flexible object-oriented language. It's software to create applications that are efficient, robust, fault-tolerant, and exception-safe.

1.3 Star Network Topology

Star network are one of the simplest and common forms of communication topologies [3] and deployed in this research study. All nodes of the star topology are connected to a single and central hub/sink/gateway, which is logically (and/or physically) at the centre/middle of the network as shown in Figure 1. The centre hub can be either base station or a gateway that directly connected and communicate with base station. Defer with others network topologies, when communication link is cut in star topology, it only affects one node. However, if the hub shut down, all delivered message from sensor nodes will be destroyed.

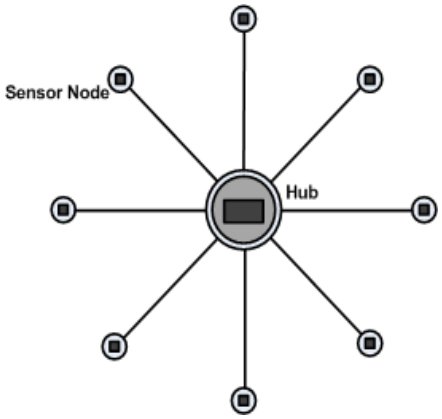

Figure 1: Network Configuration of Star Topology

1.4 Humidex

Over the years, several measures have been proposed to relate various combinations of temperature and humidity into single number to approximate what hot, humid weather feels like to the average person. The Humidex is the most familiar to Canadians and the Humidex formula is based on the work of J.M. Masterton and F. A. Richardson 1979. It's a standard for Canada but widely used around the world. It is one the most used discomfort indexes useful to evaluate how current temperature and RH can affect the discomfort sensation and cause health danger for the population [4]. It is calculated with a series of complex formula using a combination of temperature and humidity levels to provide an indication of the degree of discomfort or measurement of perceived heat that will be experienced by the average person (Masterton, J.M. and Richardson, F. A., 1979). Humidex values correspond to the following degree of comfort as shown in Table 1.

The Humidex can be expressed with the combination of air temperature, T_{air} and also dew point temperature.

TABLE 1
COMFORT LEVEL OF HUMIDEX RANGE

Humidex (H)	Degree of Comfort
H ≤ 29	Comfortable
30 ≤ H ≤ 39	Some Discomfort
40 ≤ H ≤ 44	Great Discomfort
45 ≤ H ≤ 54	Dangerous
H ≥ 55	Heat Stroke Imminent

The humidex formula is determine by

$$H = T_{air} + \left[\frac{5}{9}(e - 10)\right] \quad (1)$$

$$e = (6.11) \times exp^{\left[(5417.7530)\cdot\left(\left(\frac{1}{273.16} - \frac{1}{Dp_K}\right)\right)\right]} \quad (2)$$

Hence, Dew Point formula is

$$Dp = \frac{\lambda\left[\frac{\beta \cdot T}{\lambda + T} + \ln\left[\frac{RH}{100}\right]\right]}{\beta - \left[\frac{\beta \cdot T}{\lambda + T} + \ln\left[\frac{RH}{100}\right]\right]} \quad (3)$$

Insert the Magnus parameter given by β = 17.62 and λ = 243.12 ºC

2.0 METHODOLOGY

2.1 Initializing State of Base Station

Typically, the main part in initializing state is serial port configuration part to enable communication to the transceiver module. The serial port configuration consist same concept with HyperTerminal of PC configuration with comport, transmission line speed, data bits, standard parity and stop bits selection. The system begins to monitor sensor nodes data when the open button enabled and trigger to receiving state.

2.2 Receiving State of Base Station

The basic execution concept of receiving state enable, when the serial port buffer consists data. The even handler was opted to trigger to other function which is related to its execution operations. Figure 2 shows the program flow when the serial buffer contained information .With effectively applied delay provided into the sensor nodes able the base station to monitor and analyzed receiving data and, avoid overlapping data process and error.

The maximum read buffer size the provided in the system to hold data is 4096 byte longs. The read buffer function in the C# language capable to read out the total byte receives in the serial port. Each byte receive will convert into character and mix the character to produce string. Each time converting, the "CountByte" decrease with one and stop converting when the integers become zero. The program flow invokes the analyzed state and stores the receiving data temporarily for further analyzed.

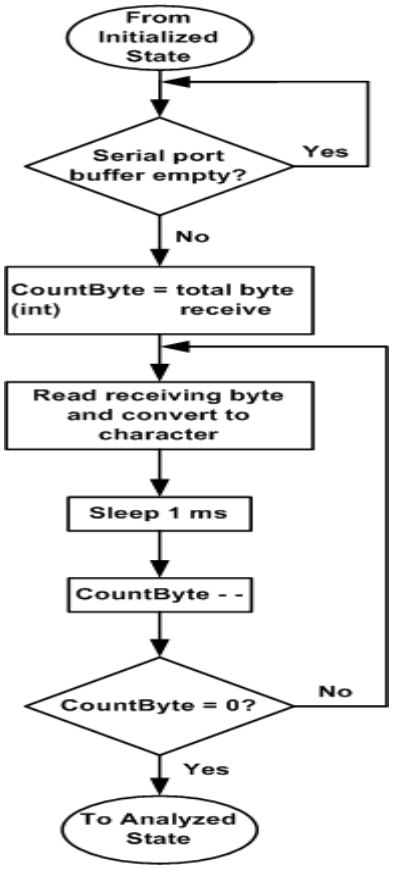

Figure 2: Flow Chart of Data handler Receiving Program

2.3 Analyzed State of Base Station

The analyzing state of program flow in base station consists the analyzing parameter such temperature and humidity measurement from three sensor nodes which divided into three places in the lab. The indoor air continuously monitors for every one hour until 24 hours and the data were send to base station through traditional star network configuration.

The data that transmit from sensor nodes consists of temperature and humidity measurement value. Typically at sensor node, the voltage was converted into digital form with +5 V as voltage reference and transmitted the ASCII representation of its decimal value. Thus, this value analyzed at base station by convert into voltage through multiplication with decimal value of ADC with the ratio of Vref and ADC resolution. The valuable voltage represents the detection from sensor and analyzed the detection to corresponding sensors such temperature as Celsius reading and humidity as percentage of relative humidity, %RH measurement. All the information from analyzed including temperature and humidity was push into storage state to store data temporarily for further analysis.

2.4 Store State of Base Station

Each receiving data temporarily storage in the random access memory and keep the data as long as power activated. When the base station start to monitor the incoming information from sensor nodes, the GUI environment for data storages was generated and prepared to store data after finished analyzing state. Typically all information with parameter measurement temperature and humidity separated into different region of sensor nodes and end up to three days of monitoring procedures.

3.0 Result And Discusion

Figure 3 shows the monitoring results of air temperature that provided from each sensor nodes. The air temperature in Research Assistance laboratory (SNode 1) moving stable at 27 ºC ± 1 ºC from the first hour until the end of hours. The indoor air temperature in Mechatronics laboratory (SNode 2) is not stable compare to the other laboratories. The minimum air temperature in this laboratory is 24 ºC and it's slowly increase to 27 ºC. Different condition is identifying in Advance Signal Processing (ASP) laboratory (SNode 3) where it have more stable air temperature. During hour 11, the air temperature is increasing slowly from 25 ºC to 26 ºC. Then, the air temperature is decreasing slowly to 24 ºC at hour 17 and keeps on stable until the end of hours.

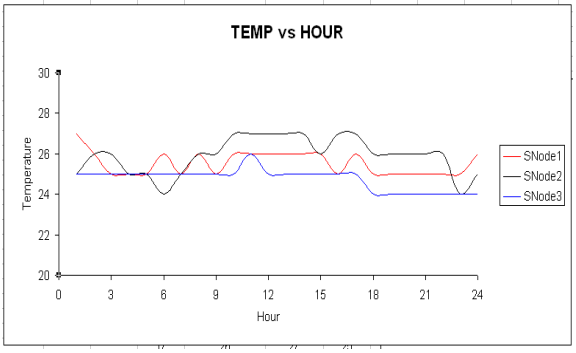

Figure 3: Air Temperature, versus Hour at Research Assistance, Mechatronics and Advance Signal Processing (ASP) Laboratories

Figure 4 represent the relative humidity (RH) results for each sensor node at monitoring place. The result shows the SNode 1 and SNode 2 gives stable RH values which is between 63% to 71% even the air temperature provided between 24 ºC to 27ºC for all hours. The possibility of laboratories include in the degree of discomfort environment is higher. The percentage of RH at SNode 3 increasing from 59% and reach maximum which is 65% at hour 13. The percentage of RH then slowly decreases and reaches to 60% at the end hours.

Generally, all the sensor node at laboratories provide the RH values more than 50% which are the laboratory environment possible getting wet and discomfort.

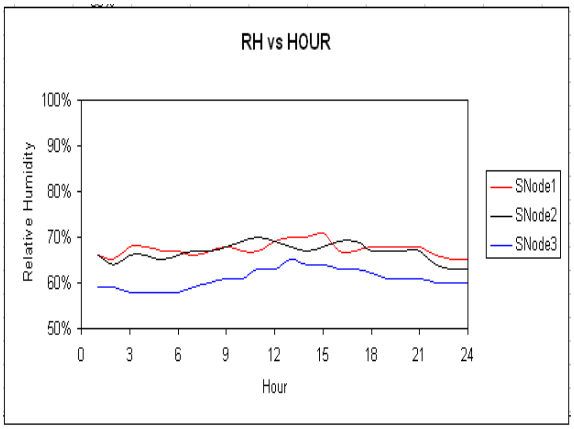

Figure 4: RH versus Hour at Research Assistance, Mechatronics and Advance Signal Processing (ASP) Laboratories

Figure 5,6, and 7 shows the relationship of dew point versus air temperature(Temp) and RH for each laboratory. The air temperature and percentage of relative humidity from sensor nodes (Node 1, 2 and 3) was takes to despite the alteration of dew point. All the results from each laboratory shows that it obey the dew point concept where, the dew point must be lower than the current air temperature and if the air temperature near to dew point or equal, the relative humidity will reach to maximum value or vice versa.

Generally each laboratory possesses with stable air temperature and different scatter of RH cause by the influence of outdoor weather. All the laboratories possess higher than 50% of moisture.

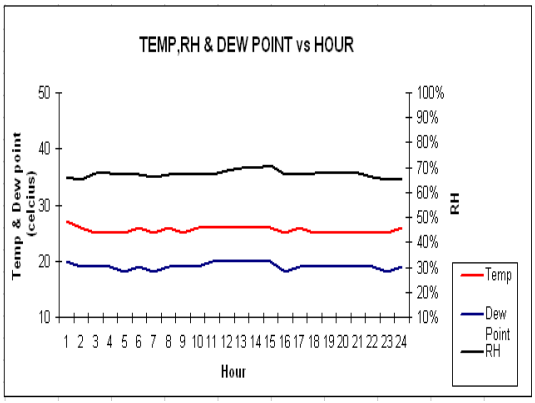

Figure 5: Relationship of Dew Point between Air Temperature and RH at Research Assistance Laboratory

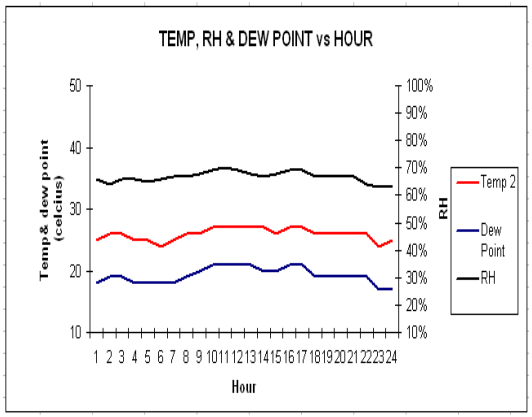

Figure 6: Relationship of Dew Point between Air Temperature and RH at Mechatronics Laboratory

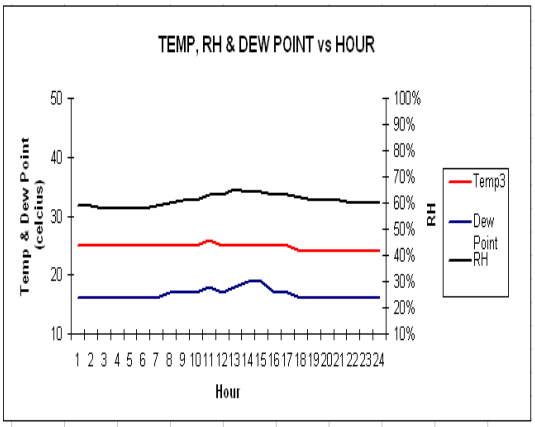

Figure 7: Relationship of Dew Point between Air Temperature and RH at Advance Signal Processing Laboratory

Figure 8, 9 and 10 shows the Humidex index values based on percentage of RH and air temperature for each monitoring laboratory. The results show that Research Assistance laboratory is in “some discomfort” region. But, for Mechatronics and Advance Signal Processing (ASP) laboratories, the result shows there is unstable humidex index occurred during monitoring hours. Sometimes the laboratories are in “comfort” and “some discomfort” region. In addition it also shows that all monitoring laboratory consists with higher moisture that increase the Humidex index to reach discomfort region.

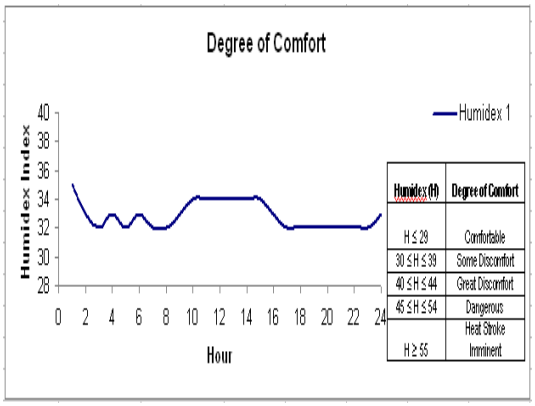

Figure 8: Humidex Index Value based on RH and Air Temperature at Research Assistance Laboratory

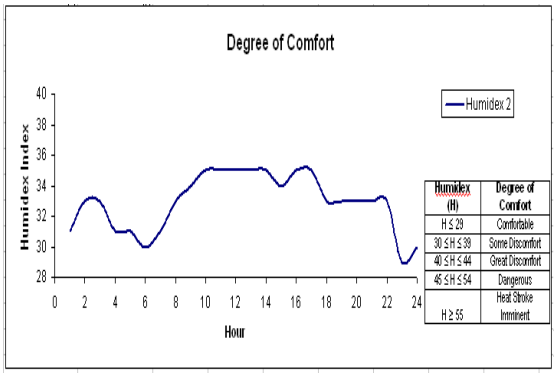

Figure 9: Humidex Index Value based on RH and Air Temperature at Mechatronics Laboratory

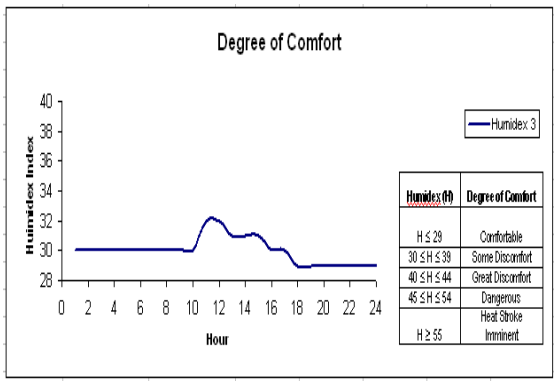

Figure 10: Humidex Index Value based on RH and Air Temperature at Advance Signal Processing (ASP) Laboratory

4.0 CONCLUSION

A design data handler in wireless system network has been successful developed for handle data from sensor which is air temperature and humidity value. These data have been calculated such as dew point and Humidex index values to measure typical environment condition and degree of comfort. Each data such as temperature and humidity was analyzed and examined to determine ability and performance. Data delivering through wireless with star network which have been applied at Research Assistance, Mechatronics, Advance Signal Processing laboratories at Mara University of Technology Malaysia. The data was successfully received up to 24 hours to the base station.

5.0 FUTURE WORK

Alternatively, all data are recommended to transfer in database table. The database software such as SQL database is a program that can store large amounts of information in an organized format that's easily accessible through scripting languages. A database is composed of one or more tables, each of which contains a list of *things*. The delivering data will store in the table and can be saving in computer. The data can't be lost although without power activated.

6.0 ACKNOWLEDGEMENT

The author is very grateful to the main project supervisor in UiTM Pulau Pinang, Encik Mohaiyedin Bin Idris and co-supervisor Encik Fairul Nazmie Bin Osman for their guidance and support throughout this time in completing this project. Not forgetting the author's colleagues that spend time together without fail lending hands and idea in order for this project to be fulfilled.

7.0 REFERENCES

[1] Mauri Kuorilehto, Mikko Kohvakka and Jukka Suhonen, "Low Energy Wireless Sensor Networks in Practice," John Wiley & Sons, Ltd 2007,ch.2,pp.11-12

[2] Carlos de Morais Cordeiro and Dharma Prakash Agrawal, "Ad Hoc & Sensor Networks", World Scientific Publishing CO.Pte.Ltd, ch.8,pp.429-437

[3] Shrestha, A. and Liudong,X. (2007). APerformance Comparison of Different Topologies for Wireless Sensor Networks. IEEE Conference on Technologies for Homeland Security p.280-285

[4] David Philips, The Canadian Encyclopedia [Online] Available at http://www.thecanadianencyclopedia.com