

Design and Development of Low Cost Wireless Sensor Network (WSN) Based Home Automation

Thangavel Bhuvaneshwari*, Chem Wei Boon

Faculty of Engineering and Technology, Multimedia University, Melaka
Jalan Ayer Keroh Lama, 75450 Melaka, Malaysia.

*Corresponding e-mail: t.bhuvaneshwari@mmu.edu.my

Keywords: WSN, home automation, zigbee

ABSTRACT – The objective of this paper is to design and develop a low cost WSN home automation. The system designed has to monitor and control the light, fan, gas leakage and intrusion in home environment wirelessly. The microcontroller and sensors communicate through the ZigBee (XBee) device. The graphical user interface (GUI) designed so that the user can monitor and control the light, fan, fire, gas leakage and intrusion in home environment wirelessly. This GUI also alerts the user when the home is on fire or intruded. The prototype developed is tested and verified for its functionality.

INTRODUCTION

Automation or automatic control is the application of voluntary control frameworks in the operation of machineries without human intervention. It includes an extremely expansive scope of innovations including wireless systems, expert systems, and robotics and communication systems. Home automation or smart home is a house that is equipped with automatic devices such as light, fan, and alarm.

Home automation is not just an idea anymore; it has been getting better along with the advancement in technology. In year 1989, Nikola Tesla invented remote control which sent radio waves to control a small boat [1]. Elshafee and Hamed [2] stated that Wi-Fi system can be used in home automation system in which transmission and reception of data had been performed through a same radio frequency communication channel. Ekshinge and Santosh [3] stated that a wireless sensor network ZigBee is used to manage the smart home. This smart home divides the sensors into two different slaves operated by ARM7 microcontroller. Alkar et al [4] stated that PC acts as a master terminal to monitor the status of the slave nodes. Hirekhan [5] stated a web-based home automation system. The server received all the data, so that the user is able to monitor the sensor's condition at computer through local network. ZigBee coordinator connects all the sensors in the smart home and these data will upload to the server.

H.Kaur and Sharma [6] stated that are many protocols for home automation. The most common protocols are X10, INSTEON, ZigBee, Z-Wave and BLUETOOTH. ZigBee is one of the device used to create smart home that improves our life. ZigBee is categorised as low cost, low power consumption wireless networks. It operates based

on the IEEE 802.15.4 standard for wireless personal area network. ZigBee is affordable and safe.

METHODOLOGY

This design of WSN based home automation system used Atmega328p microcontroller, PC, GUI and ZigBee as the transmission medium. The hardware part consists of two slave nodes and a master node. The data from the slave nodes sent to the microcontroller in master node for processing. Figure.1 shows the developed prototype. Four different functions are included in GUI design for controlling and monitoring the light, fan, gas leakage and intrusion. All the GUI functions can operate simultaneously. The automatic mode allows the users to monitor their home when they are away. Manual mode helps the user to turn-off the appliances like fan or light on their own. Figure.2 shows the GUI for LED.

When the GUI is in automatic mode, the LED will turn-on automatically when LDR sensor light intensity is less than 350LUX. Similarly, the fan is set to pre-set alert temperature of 30 degree Celsius. When the LM35 sensor measured temperature more than this pre-set temperature, fan will be turn-on automatically. The MQ2 sensor detects the leakage of combustible gases greater than 200PPM; the buzzer will alert the user. The PIR sensor alert the user when there is an intrusion detected. This Sensor can be turn-off when the user is at home and turn-on when he is away.

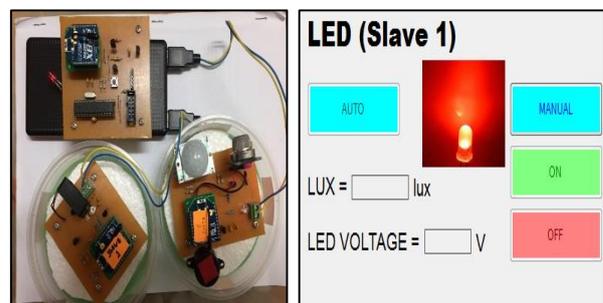


Figure- 1 Prototype of a Master and 2 slave nodes.
Figure- 2 GUI developed for Light testing system.

RESULTS AND DISCUSSION

In an open area of the living room, the test experiments are conducted for 1 minute. They are four tests namely, LED test, fan test, gas sensor test and intrusion test.

Light test: Initially the light intensity in the room is 400 LUX. The sequence of the light test are as follows: A

cloth covered the LDR sensor at the 12th second and removed at the 17th second. A torch light kept near the LDR at the 21st second and turned off at the 31st second. Finally, covered again at the 39th second and uncovered at the 45th second. The graph shown in Figure.3 is the response of the test performed. **Fan test:** The initial room temperature is 26°C. At the 9th second, a candle was burnt next to the LM35 sensor. Then at the 23rd second, it is off. At the 31st second, a paper was burnt next to the LM35 sensor. Finally, at the 39th second it is off. The graph shown in Figure.4 is the response of the test performed.

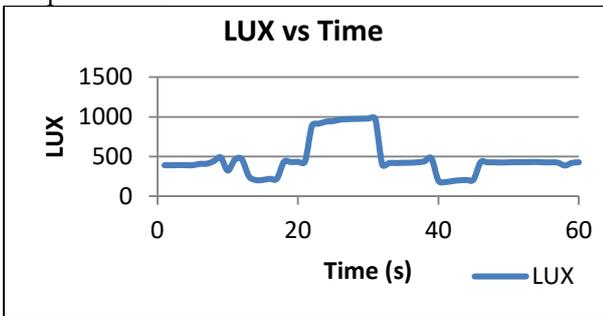


Figure: 3 Light Test

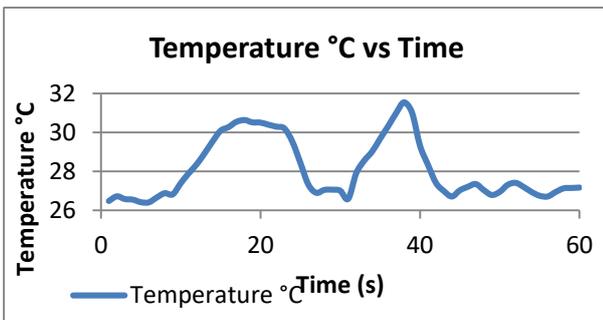


Figure: 4 Fan test

Gas leakage Test: The initial gas leakage detected is about 20 ppm. At 11th second, a little of butane gas was released for 2 seconds. Then at the 23rd second, plenty of butane gas released for 2 seconds. Finally, at the 43rd second, plenty of butane gas released for 4 seconds. The graph shown in figure.5 is the response of the test performed. **Intrusion detection test:** The initial condition had no intrusion. First at 4th second, a man passed by the living room. At the 13th second, another man passed by the living room. Then at the 22nd second, two men passed by the living room. Finally at the 39th second, a man passed by the living room in a faster speed. The graph shown in figure.6 is the response of the test performed.

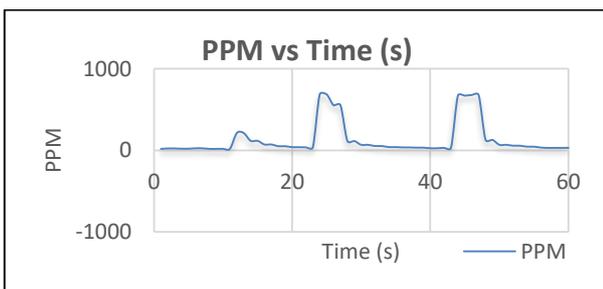


Figure: 5 Gas leakage test

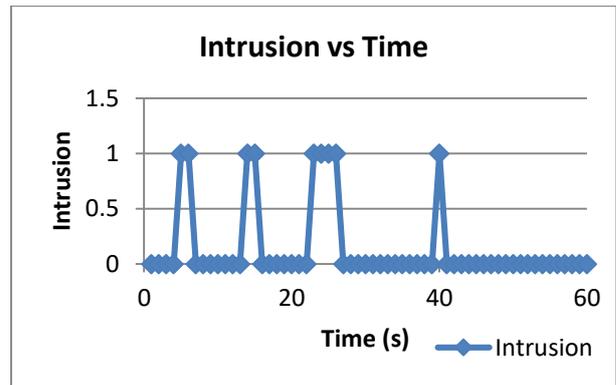


Figure: 6 Intrusion detection test

CONCLUSION

The prototyped of WSN based home automation system is developed. Through the experimental studies, verified the functionality of the design. Graphs are plotted for the experimental results. The proposed design is the low cost design since the total budget is less than RM 500.

REFERENCES

- [1] Buckingham, A. (2017). *The history of home automation from the beginning*. Retrieved from Betanews: <http://betanews.com/2015/08/24/the-history-of-home-automation-from-the-beginning>
- [2] ElShafee, A., & Hamed, K. A. (2012). Design and implementation of a WIFI based home automation system. *World academy of science, engineering and technology* 68, 2177-2180.
- [3] Ekshinge, M. J. V., & Sonavane, S. S. (2014). Smart Home Management Using Wireless Sensor Network. *International Journal Communication Engineering of Advanced Research in Electronics* 3, 453-457.
- [4] Alkar, A. Z., Gecim, H. S., & Guney, M. (2010). Web based ZigBee enabled home automation system. *13th International Conference on Network-Based Information Systems (NBIS)*, 290-296.
- [5] Suryatale, S. N., & Hirekhan, S. R. (2015). Wireless Sensor Network Based Intelligent Home Implementing Using Arduino and Zigbee. *International Journal of Advanced Computing and Electronics Technology (IJACET)*, 38-43.
- [6] Kaur, H., & Sharma, S. (2013). A comparative study of wireless technologies: zigbee, bluetooth le, enocean, wavenis, insteon and uwb. In *Proceedings of the International Conference on Recent Trends in Computing and Communication Engineering (RTCCE'13)*.