Design and Implementation of a Wireless Sensor Networks Application Framework

Mustafa Abdulkadhim
Computer Networks Department,
College of Information engineering,
Nahrain University
Baghdad, Iraq

ABSTRACT
Wireless sensor networks have been seen as one of most important Technologies for the 21st century. As technologies advance and hardware prices drop rapidly, wireless sensor networks will find more promising ground to spread in areas where old networking is insufficient. The foundational concept which applies in a large number of networks might be identified through the simple fact: Sensing features and CPU Power added Radio Trans-mission equals a powerful framework for deploying so many potential applications.

In this paper I will discuss WSN application, the powerful potential of WSN deployment scenarios and how to design and implement an application to monitor a real WSN deployment. The monitoring application will feature a design framework to be used with any WSN system and can be utilized in different scenarios like data centers, hospital and environment monitoring.

Keywords
WSN, Labview, Waspmote, data center

1. INTRODUCTION
Sensors can be considered as hardware devices that generates a measurable response to a difference in a physical status like temperature or humidity. Sensors measure physical data of the condition to be monitored. The continual analog signal generated by the sensors is sampled by an analog – to – digital converter and transferred to processors for further processing. A sensor node usually be small in its size, consume very small energy, operate in high volumetric densities, be autonomous and operate without supervision, and be adaptive to the environment.

2. MILITARY APPLICATIONS
Wireless sensor networks could be used in any branch of the existent military applications such as: targeting, surveillance, vehicle tracking and control, border monitoring and protection. The nature of the WSN from its rapid deployment and mobility make them very convenient for combat and military use. Besides that their low cost nature makes the deployment in a battlefield less costly than deploying the standard military sensors. Also in some battle situations remote monitoring using WSN is vital especially in nuclear, biological, and chemical (NBC) attack reconnaissance and Detection.

3. ENVIRONMENTAL APPLICATIONS:
The promising easy deployment features of WSNs are harnessed in the realization of a different variety of environmental applications. Some of these usages of WSNs include tracking birds flying patterns, animals, and insects; monitoring weather conditions that affect plants and livestock; irrigation; macro instruments for large-scale surface monitoring and planetary exploration; chemical/biological analysis; precision planting; biological, Earth, and environmental monitoring in water, soil, and atmosphere; forest fire alarms; geophysical analysis; flood detection; bio complexity mapping of the earth surface; and pollution studies.

4. HEALTH APPLICATIONS
The achievements in implanted biomedical technology and integrated sensors made the usage of sensor networks for biomedical applications a reality. Some of the applications for sensor networks are the making interfaces for the disabled; integrated patient screening; analysis; drug administration in clinics; monitoring the movements and its processes of bugs or other animals; remote monitoring of human physiological data; and monitoring and tracking doctors and patients inside large hospitals.

5. RELATED WORK
"XBee Wireless Sensor Networks for Temperature Monitoring" by Vongsagon et al submitted to School of Information, Computer, and Communication Technology Sirindhorn International Institute of Technology, Thammasat University. the objective of the project is to monitoring wireless sensor network (WSN) prototype system for temperature in a building, and providing a web user interface for any user to access the current and past temperature readings in different rooms [6].

"Wireless Sensor Networks for Structural Health Monitoring" by S. Kim, Submitted to the Department of Electrical Engineering and Computer Sciences, University of California at Berkeley. The objectives of the project is to use Wireless Sensor Networks (WSN) in designing, implementing and testing of a structural health monitoring system which is an estimation of the state of structural health, or detection of the changes in structure that effect its performance [7].

6. DESIGN
5.1 WSN hardware design considerations
5.1.1 Position of the sensor in the lab
The space, which will stabilize the sensor depends on several key factors that affects the possible susceptibility to the sensor sensitivity.

For example, when measuring the temperature of the room by a wasp mote sensor, the sensor position in the room influenced positively or negatively, depending on the circumstances existing at that location. So the sensor position must be allocated to make sure that the value of the readings

that we receive is the average room temperature and not a particular place in the room in order to be certain that the room temperature is measured correctly.

5.1.2 Parameters to be sensed:

Waspmote is based on a modular architecture. The idea is to integrate only the modules needed in each device. These modules can be changed and expanded according to needs.

The factors used in the measurement in this study are:

– Temperature: which is one of the key factors in our project and it has many applications in the real life one of them that we used in our study is the measurement of A laboratory temperature and showing the result at a remote location. Monitoring the temperature level inside the data center room is critical, so we utilized the RTC sensor to keep the temperature checked at all times.

- Protection: Waspmote contains a built in acceleration sensor LIS3331LDH STMicroelectronics which tells the mote of acceleration differences happened on each one of the 3 axes (X,Y,Z). The integration of this sensor allows the measurement of acceleration on the 3 axes (X, Y, and Z), establishing 4 kind of events: Free Fall, inertial wake up, 6D movement and 6D position. We utilized this sensor to monitor the data center door status and it can issue a warning in case of any breach or unauthorized entry.

7. WSN APPLICATION DESIGN

Our WSN application design contains a GUI that reads a temperature, battery level, and accelerometer for a data center room monitoring is shown below:

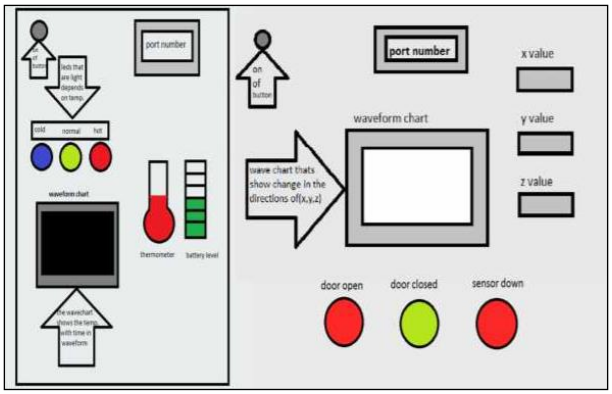

Fig 1: application main design

A temperature design contains thermometer that measures the temperature of a specific location with LEDs that indicate the value of temperature according to a specific range set in the program, and battery level that indicate the charging level in battery. As shown below:

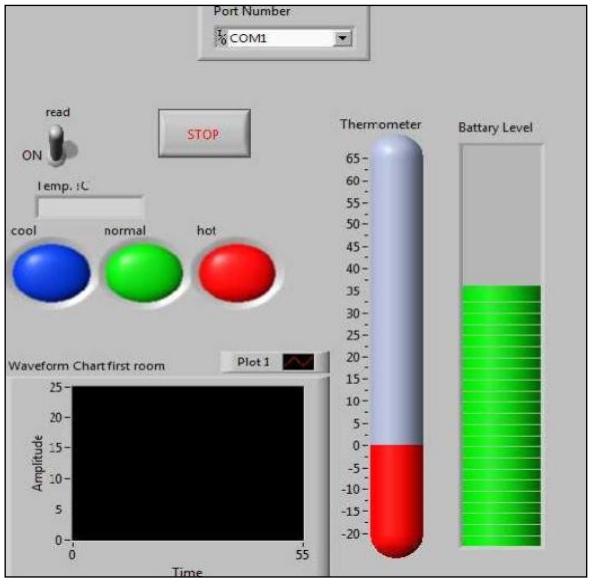

Fig 2: Temperature GUI design

Accelerometer design contains wave graph to show the changes in the directions of (x, y, z axis's), and the value of each one of them. As shown below:

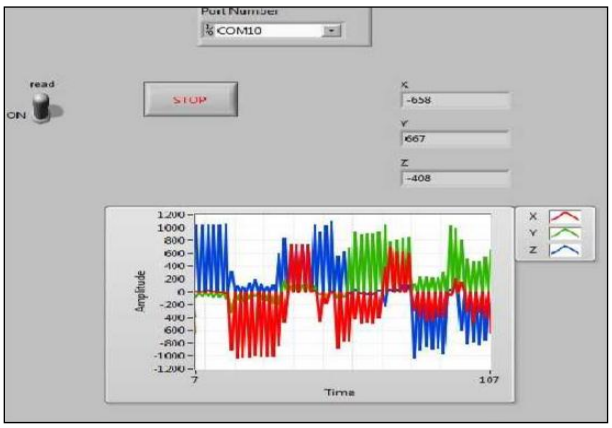

Fig 3: Accelerometer GUI

The complete framework design for WSN shows the whole GUI design about the project that contains a thermometer, battery gage, LEDs, 3d wave form graph is shown below:

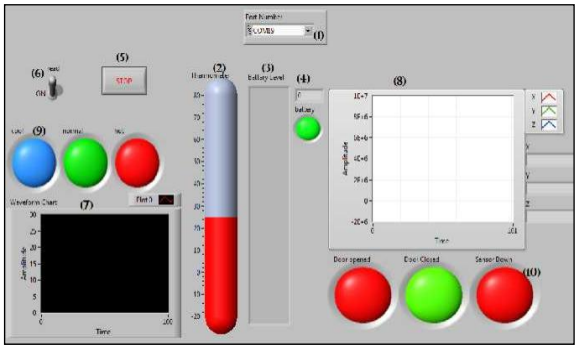

Fig 4: complete application GUI

8. FUTURE ENHANCEMENTS

As a future work the built GUI can be linked and accessed from a web browser so it can be viewed remotely, also richer graphics can enhance the look and feel of the application

although in its current status it still covers all the intended features that was planned in the design phase.

9. REFERENCES

[1] Dimitrios GEORGOULAS, Keith BLOW, Wireless Sensor Network Management and Functionality, 2009.

[2] Wireless sensor networks, Ian F.Akyildiz and Mehmet Can vuran, 2010.

[3] Mieyeville, Mihai Galos, David Navarro," Dynamic Reconfiguration for Software and Hardware Heterogeneous Real- time WSN Fabien" ,2012.

[4] Cooking hacks website, May, 2014: http://www.cooking-hacks.com/documentation/tutorials/waspmote

[5] Libelium, Official website for waspmote kit, May, 2014: http://www.libelium.com/products/waspmote/sensors

[6] Vongsagon Boonsawat, Jurarat Ekchamanonta, Kulwadee Bumrungkhet, and Somsak Kittipiyakul, "XBee Wireless Sensor Networks for Temperature Monitoring,Thammasat University", 2010.

[7] Sukun Kim,"Wireless Sensor Networks for Structural Health Monitoring", University of California at Berkeley, 2005.