SURVEY ON APPLICATIONS OF WIRELESS SENSOR NETWORKS

K.Gayathri [1] & D.Gayathri[1]

ABSTRACT

Wireless Sensor Network is an upcoming technology. This technology attracts still more and more scientific people to find new tasks and interesting problems are arising. Wireless sensor networks consisted of a number of relatively simple, low-cost, low-power components, which provides quite a wide application for different areas of economy. In order to make this development possible, it is very essentially to solve the challenges in this era. This paper, surveys on the applications of sensor networks and highlighted the constraints of wireless sensor networks.

Keywords: sensor nodes, lifetime, applications, constraints.

I. INTRODUCTION

Wireless Sensor Networks (WSN) has gained world-wide attention in recent years due to the advances made in wireless communication, information technologies and electronics field [1]. It provides as a link between the real physical and virtual worlds.

Low-cost, low power, multifunctional sensor nodes are smaller in size and communicate unethered in short distances have been developed due to the recent advances in Micro-Electro-Mechanical Systems (MEMS) and wireless communication [1]. These sensor nodes are scattered in an unattended environment (i.e. sensing field) to sense the physical world. A WSN typically has little or no infrastructure. It consists of a number of sensor nodes (few tens to thousands) working together to monitor a region to obtain data about the location [2]. The information collected by the nodes can be collected by the base station, which can be accessed by the end user through communication satellites.

Normally WSN operates at two levels [9]. One is the network level and the other is node level. The network level is connectivity, routing, communication channel and protocols. Node level is hardware, radio, CPU, sensors and limited energy. The important issues related to node level are limited resource management; concurrency handling, power management and memory management where as issues related to both are inter-node communication, failure handling, heterogeneity and scalability [14].

1.1 Advantages:

- Network setups can be done without fixed infrastructure.

[1]II M.Sc (Computer Science) Karpagam University, Coimbatore

- Elastic if there exists when an ad hoc situation when additional workstation is required.
- Implementation cost is cheap.

1.2 Disadvantages:

- Because of less security hackers can enter the access point and get all the information.
- Low speed compared to a wired network.
- Gets affected by the environs (i.e. the surroundings) easily (walls, microwave, large distances due to signal attenuation, etc.).

1.3 TYPES OF SENSOR NETWORKS

Current WSNs are deployed on land, underground, and underwater. There are five types of WSNs:

- Terrestrial WSN,
- Underground WSN,
- Underwater WSN,
- Multi-media WSN, and
- Mobile WSN

1.4 CHARACTERISTICS of WSN:

A standardized feature of a WSN includes the following. [4]

- Limited power they can harvest or store.
- Ability to cope with node failures (resilience)
- Mobility of nodes.
- Heterogeneity nature of nodes.
- Scalability to large scale of deployment.
- Needs to work in harsh environmental conditions, unattended operation.
- Ease of use.

II. Requirements of Wireless Sensor Networks

The critical requirements of all the applications of wireless sensor networks are the expected lifetime, the need for a long battery life. The sensor nodes have various energy and computational constraints because of their inexpensive nature and the mode of deployment. The lifetime of the nodes greatly depends upon the power consumption in each sensor node. Each node must be designed to manage its local supply of energy in order to maximize total network lifetime. In most of the application scenarios, a majority of the nodes will have to be self powered.

The energy constraints of wireless sensor networks have inspired several energy efficient protocols, designs and algorithms. Efficient power management leads to longer lifetime. The system lifetime can be much extended by applying energy efficient techniques to all the levels of system design. The energy consumption can be reduced based on the system computation aspects.

Next, the coverage is more important in a network. It is always beneficial to have the ability to deploy a network over a larger physical area. The multihop communication increases the coverage. The node's lifetime can be increased when the nodes are utilized in a proper manner. The nodes can be turned off to sleep state, when it is not required. The nodes can be in turn on state only when there is a transmission or receiving of data.

The battery supplies complete power to the sensor nodes and hence it plays a vital role in the lifetime. Batteries are complex devices whose operation depends on many factors like battery dimensions, type of electrode used and the diffusion rate of the active materials in the electrolyte. All these, should be designed in such a way to prolong the battery lifetime.

Sensor network lifetime can be significantly enhanced if the system software, including the operating system (OS), application layer, and network protocols, are all designed to be energy aware [4]. At the core, the OS is a task scheduler, which is responsible for scheduling a given set of tasks to run on the system while ensuring that timing constraints are satisfied. System lifetime can be increased considerably by incorporating energy awareness into the task scheduling process [9].

At the highest level of sensor network, is the issue of how the traffic is maintained from the data source to the sink arises. It is more preferable to spread the data in a more even manner. This general guideline can increase the network lifetime in typical scenarios. The traffic distribution through appropriate routing essentially increases the whole network's lifetime. The protocols and algorithms should be framed for every application.

III. Applications

The ability to add remote sensing points, without the cost of running wires, results in numerous benefits including energy and material savings, process improvements, labor savings and productivity increases [10]. Applications of WSN in different areas are tabulated (table 1.1)

Table1.1 APPLICATIONS OF WSN

APPLICATIONS	AREAS
Military	Monitoring inimical forces
	Monitoring friendly forces and equipment
	Military-theater or battlefield surveillance
	Battle damage assessment
	Targeting Nuclear, biological, and chemical attack detection

Environmental	Microclimates
	Forest fire detection
	Flood detection
	Precision agriculture
Health	Remote monitoring of physiological data
	Tracking and monitoring doctors and patients inside a hospital
	Drug administration
	Elderly assistance
Home	Home automation
	Automated meter reading
	Instrumented environment
Commercial	Environmental control in industrial and office buildings
	Inventory control
	Vehicle tracking and detection
	Traffic flow surveillance

The following section reveals in depth of some of the application.

Habitat monitoring

It delivers ecologists data on localized environmental conditions at the scale of individual organisms to help settle large-scale land-use issues affecting animals, plants and people [12]. Habitat monitoring represents a class of sensor network applications with enormous potential benefits. The environment is instrumented with numerous networked miniature sensors which enable long-term data collection. A sensor's intimate connection with its immediate physical environment allows each sensor to provide localized measurements and detailed information.

Wireless Medical Sensor

Advances in wireless sensor networking have opened up new opportunities in healthcare systems. It replaces the bulky medical equipments with tiny sensors. Some of the areas in which medical systems can be beneficial from wireless sensor networks are like in-home assistance, smart home care and clinical trial.

The smart homes equipped with the wireless sensor networks will benefit both the health care providers and their patients. It relieves patients from regular visits to their doctors. The doctors can get information about patient's health without their physical examination. The patients are provided with comfortable environment at their residences. The

patient can be monitored continuously through the sensors and the data collected from the sensors in a smart home can be stored and it could be recorded. Use of wireless sensor in monitoring movement and fall detection (accelerometer and pressure sensors) detect any unusual activity pattern and inform the care person in charge for necessary follow up. This system provides a safe, sound and secured living environment to the elderly people, especially the old people living alone at home.

Other application is asthma sensor which was developed by Propeller Health. It is an inhaler with a sensor built into it [2]. The sensor tracks environmental conditions that pose possible dangers to asthma sufferers. By keeping track of external conditions as well as how often the person is taking medicine, the device helps to manage asthma and keeps health providers information about disease management.

Pulse Oximeter

Pulse Oximeter (as shown in the figure 1.1) has been used as a medical diagnostic technique and this non-invasive technology is used to reliably assess two key patient health metrics: heart rate (HR) and blood oxygen saturation (SpO2) [6]. These parameters yield critical information, particularly in emergencies when a sudden change in the heart rate or reduction in blood oxygenation can indicate a need for urgent medical intervention. Pulse oximeter can provide advance warning of the onset of hypoxemia even before the patient manifests physical symptoms.

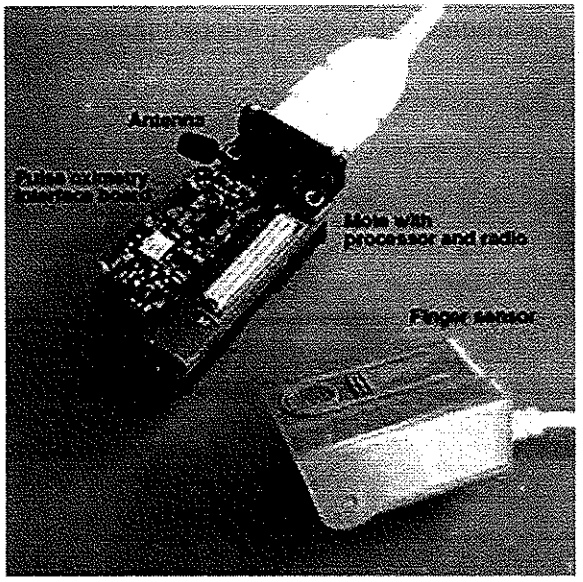

Figure 1.1 : Pulse Oximeter

EKG (ELECTRO CARDIOGRAM) SENSOR

Electrical impulses in the heart originate in the sino atrial node and travel through the heart muscle where they impact electric initiation of systole or contraction of the heart. The electrical waves can be measured at selectively placed electrodes (electrical contacts) on the skin. Electrodes on different sides of the heart measure the activity of different parts of the heart muscle. An EKG displays the voltage between pairs of these electrodes.(as shown in the figure 1.2)

Figure 1.2 : EKG Sensor

Smart Elder Care

Elderly care (as shown in the figure 1.3) or simply eldercare (also known in parts of the English speaking world as aged care), is the fulfillment of the special needs and requirements that are unique to senior citizens. This broad term encompasses such services as assisted living, adult day care, long term care, nursing homes, hospice care, and home care [6]. The importance of WSN is used for monitoring and to find detection such as accelerometer and pressure sensor .It is used to monitor the activities of the elders who are staying individually. Smart elder care detects if any unusual activity it automatically informs to the care person of the particular elder.

Figure 1.3 : Smart Eldercare

Building Sensors

Sensor networks will play a fundamental role in intelligent buildings. a large number of sensors in the building that can monitor human movement further increase the levels of security in the building[7]. Having multiple sensing points can provide greater capability, as is leveraged commonly by sensor arrays such as in radar systems or binocular vision. Sensor networks inside the building should use small and non-intrusive devices. They have relatively low energy consumption at the system level, which implies long lifetime per deployment.

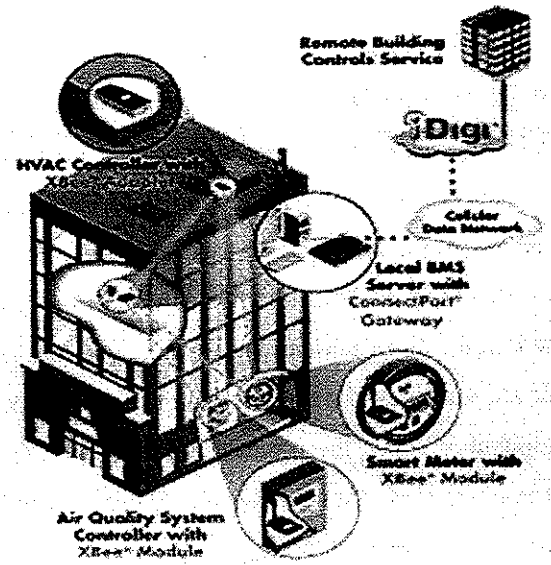

Figure 1.4 : Building Sensor

Military or Border Surveillance Applications

WSNs are becoming an integral part of military command, control, communication and intelligence systems. Sensors can be deployed in a battle field to monitor the presence of forces and vehicles, and track their movements, enabling close surveillance of opposing forces [8].

To monitor the border in real-time with high accuracy and minimize the need for human support, multiple surveillance technologies, are required. Zhi Suna et.al, [15] have introduced a new border patrol system named Border Sense, based on hybrid wireless sensor networks, which can accurately detect and track the

border intrusion with minimum human involvements. Border Sense utilizes the most advanced sensor network technologies, including wireless multimedia sensor networks (WMSNs).

Agriculture and Forestry Monitoring

The need to increase production and the simultaneous efforts to minimize the environmental impact of agricultural production processes and save costs find in sensor systems the best allied tool [11]. The use of sensors helps exploit all available resources appropriately and to apply hazardous products moderately. When nutrients in the soil, humidity, solar radiation, density of weeds and a broad set of factors and data affecting the production are known, this situation improves and the use of chemical products such as fertilizers, herbicides and other pollutants can be reduced considerably. Sensors offer solutions for controlling and monitoring production in forest trees while the same time costs are minimized.

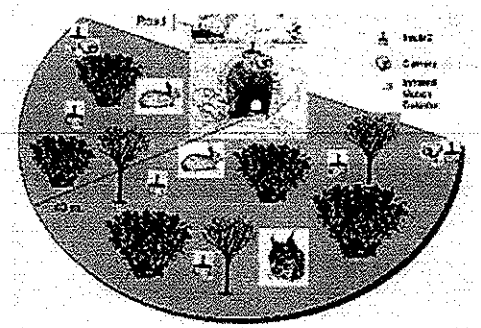

Figure 1.5 : Agriculture and Forestry Monitoring

Image-based sensors are a powerful tool for different purposes, including climate variability and temporal analysis of crop field areas, providing added value for crop production. This kind of sensors can also be used for analysis and quantification of crop damage.

V Conclusion

Wireless sensor networks are constrained on power, processing, storage and size that makes them further complicated than the traditional networks. In this paper, we have discussed about the role of sensor network and their features and its role in real-time applications. In the future, this wide range of application areas will make sensor networks an integral part of our live. This is an interesting, complex and new technology, where still a lot of research has to be done.

Reference

[1] Akyildiz I., W. Su, Y. Sankara subramaniam and E. Cayirci, *"A Survey on Sensor Networks"*, IEEE Communications Magazine, 2002, 40(8): 102 – 114.

[2] Brian Dolan, *"Asthmapolis Secures FDA Clearance for Inhaler Sensor"*, MobileHealthNews.com, 2012.

[3] C.Y. Chong, S. P. Kumar, *"Sensor Networks: Evolution, Opportunities, and Challenges,"* Proceedings of the IEEE, Aug. 2003, Vol. 91, No. 8,, pp. 1247.

[4] Curt Schurgers, Vijay Raghunathan, Sung Park and Mani B. Srivastava, *"Energy-Aware Wireless Micro Sensor Networks"*, IEEE Signal Processing Magazine, 2002, pp.40 – 50.

[5] E. Deborah, G. Ramesh, H. John, and K. Satish, *"Next century challenges: scalable coordination in sensor networks,"* United States, 1999, pp. 263-270.

[6] ErikRosendahi,LillemorLundin-Olsson, *"Prediction of falls among older people in residential care facilities dy the Downton index"*, Aging Clinical and Experimental Research,Vol.15,No 2

[7] W. S. Jang, W. M. Healy and J. S. Miroslaw, *"Wireless Sensor Networks as Part of a Web-Based Building Environmental Monitoring System"*, Automation in Construction, August 2008, Vol. 17, No. 6, pp. 729-736.

[8] Prasanna, S. and Srinivasa Rao, *"An Overview of Wireless Sensor Networks Applications and Security"*, International Journal of Soft Computing and Engineering, 2012.2(2): 2231 – 2307.

[9] Raghunathan V., Spanos and M. B. Srivastava, *"Adaptive Power-Fidelity in Energy Aware Wireless Embedded Systems"*, Proceedings of the 22nd IEEE Real Time Systems Symposium, 2001, 106 – 115.

[10] Reena, Sunil Phulre, and Rekha Pandit, *"Wireless Sensor Network and Its Routing Protocol: A Survey Paper"*, International Journal of Computer Science and Mobile Computing, (IJCSMC), 2013, 2(6): 60 – 64.

[11] Shripad V., Deshpande and P. R. Devale, *"Recent Trends in Using Wireless Sensor Networks in Industrial Environment"*, International Journal of Computer Networking, Volume 2013; 3(3): 11–20

[12] D. C. Steere, A. Baptista, D. McNamee, C. Pu, and J. Walpole, *"Research challenges in environmental observation and forecasting systems"*.

[13] Szewczyk R., E. Osterweil, J. Polastre, M. Hamilton, A. Mainwaring A and D. Estrin D, *"Habitat Monitoring with Sensor Networks"*, Communications of the ACM, Special Issue on Sensor Network, 2004, 47 (6): 34 - 40.

[14] K. K. Tremper and S. J. Barker. *"Pulse oximetry. Anesthesiology"*, The Western Journal of Medicine, 70(1):98– 108, January 1989.

[15] Tarek M.Salem , Sherine M. Abd El-kader, *"Mapping Wireless Sensor Network Applications Requirements to Existing Operating Systems"*, International Journal of Computer Science Issues (IJCSI), 2013,10(5): 258 – 267.

[16] Zhi Suna, Pu Wanga, Mehmet C. Vuranc, Mznah A. Al-Rodhaan, Abdullah M.Al-Dhelaan Ian F. Akyildiza, *"BorderSense: Border patrol through advanced wireless sensor networks"*, Ad Hoc Networks, 2011, 9, 468–477.

Authors' Biography

D.Gayathri studying II.M.Sc Computer Science in Karpagam University.

Her area of interest is computer networks, sensor networks.

K.Gayathri, studying II.M.Sc Computer Science in Karpagam University.

Her area of interest is wireless sensor networks, data communications.