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Wireless Sensors Network: An Overview

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Abstract: Combining small sensors in large numbers provides new technological platform called Wireless sensors network. The field of wireless sensor network offers a rich, multi-disciplinary area of research in which a variety of tools and concepts can be employ to address a varied set of applications. Wireless sensor network has its own design and resource constraints. Resource constraints include a limited amount of energy, short communication range, limited processing and storage in each node large number of sensor nodes that combine physical sensing capabilities with networking and computation capabilities. In WSN applications range from environmental control, health care to military environment. In this paper applications of wireless sensor network and various tools available for research in WSN are discussed.

Keywords: WSN, Protocols, Applications, Simulators

I. INTRODUCTION

WSN consists of circulated self-governing sensors to monitor physical or environmental conditions. WSN consist of an array of sensors [8]. Each sensor network node has typically several parts: a radio, transceiver, antenna and microcontroller. The topology of WSN varies from star network, tree to multihop wireless mesh network. The complexity of data routing and processing depends upon topology [7]. WSN systems are based on ZigBee or IEEE 802.15.4 [2] protocols due to low power consumption. The flowing of data ends at special nodes called base station. A Base station links the sensor network to another network to advertise the data sensed for future processing.

One of the biggest problems of sensor network is power consumption. To solve this issue two methods are defined. First method is to introduce aggregation points. This reduces total number of messages exchanged between nodes and saves some energy. Usually aggregation points are ordinary nodes that receive data from neighbouring nodes, execute processing and then forward the filtered data to next hop.

Another method for energy saving is setting the nodes to go idle if they are not needed and wake up when required.

WSN differs from Manets in many ways:

The number of nodes in a WSN can be several orders of magnitude higher than the nodes in an ad hoc network and sensor nodes that are prone to failure are densely deployed. Sensor nodes mainly use broadcast, while most MANETs are based on the Peer-to-Peer (P2P) communication paradigm. Information exchange between end to-end nodes will be rare in WSNs. They are less in power, computational capacity and memory, and may not have global IDs.

II. APPLICATIONS OF WSN

WSN were first implemented in military areas [3].Defence applications have been a driver for research and development in sensors networks [8]. Sensor network consist of different applications are as follows:

A. Military Applications:

WSN can be an integral part of military command, control, and communication, surveillance and targeting system. The characteristics of sensor node such as rapid deployment, self organization and fault tolerance make them very promising sensing technique for military operations. The sensor devices or nodes should provide following services.

1) Monitoring Equipments:

Commanders can constantly monitor the status and condition of equipments. Each equipment can be attached with small sensors that report the status. These reports are gathered in sink nodes and sent to troop leaders. The data can also forwarded to upper levels while being aggregated data with other units.

2) Battlefield Surveillance:

Critical terrains, approach routes, path can be rapidly covered with sensor network and closely watched for the activities of opposing forces. As the operations evolve and new operational plans are prepared, new sensor network can be deployed anytime for battlefield surveillance.

- **Targeting**: Sensor network can be incorporated into guidance systems of intelligent ammunition [4].
- **Battle damage assessment**: Sensor network can be deployed in the target area to collect the battle damage assessment data.

B. Environment Applications:

Some environment applications of sensor network include tracking the movements of birds, insects, monitoring environmental conditions that affect crops and livestock. In indoor environmental monitoring Wireless network was deployed in an office building at Pacific Northwest national laboratory, Richland Washington to survey the advantages and drawbacks of wireless technology in operation of heating, ventilation and air condition (HVAC) systems [5].

1) Air pollution monitoring:

WSN have been deployed in Stockholm, London to monitor the concentration of dangerous gases for citizens.

2) Greenhouse Monitoring:

WSN are also used to control the temperature and humidity levels inside commercial greenhouse, when the temperature and humidity drops below specific levels.

3) Zebra Net:

A WSN is being used to observe the behaviour of wild animals within a spacious habitat (e.g., wild horses, zebras) [7] at the Mpala Research Center in Kenya. ZebraNet is composed of sensor nodes built into zebra collar [1]. Of particular interest is the behaviour of individual animals (e.g., activity patterns of grazing, graze-walking, and fast moving), interactions within a species, interactions among different species (e.g., grouping behaviour and group structure), and the impact of human development on the species. The observation area may be as large as hundreds or even thousands of square kilometres. Animals are equipped with sensor nodes. An integrated GPS receiver is used to obtain estimates of their position and speed of movement. Light sensors are used to give an indication of the current environment. Further sensors (head up or down, body temperature, ambient temperature) are planned for the future. Each node logs readings from its sensors every three minutes. Whenever a node enters the communication range of another node, the sensor readings and the identities of the sensor nodes are exchanged [7]. At regular intervals, a mobile base station moves through the observation area and collects the recorded data from the animals it passes.

4) Landslide Detection:

WSN are used to detect the slight movements of soil and change in various parameters that may occur before hand sliding.

C. Industrial Monitoring:

1) Machine health monitoring:

WSN have been developed for the maintenance of machinery. In wired system, the installation of enough sensors is often limited by cost of wiring .Rotating machinery, hazardous or restricted area can now reach with wireless sensors.

D. Water Monitoring:

1) Agriculture:

WSN is used in agriculture application to monitor water tank levels, pumps. Irrigation automation enable more efficient water use and reduce its wastage.

E. Structure Monitoring:

WSN can be used to monitor the movement within building and infrastructure such as bridges, flyovers, tunnels. The monitoring with help of WSN is more accurate than any visual inspection.

F. Health Applications:

Wireless sensors are used to monitor patient physiological data, to control drug administration track and monitor patients inside a hospital.

Tracking and monitoring doctors and patients inside a hospital: Each patient has small sensor nodes attached to them. Each sensor node has its specific task. e.g. one sensor node may be detecting the heart rate while another is detecting blood pressure.

- Drug administration in hospitals:

If sensor nodes can be attached to medications, the chance of getting and prescribing the wrong meditation to patients can be minimized, because patients will have sensor nodes that identify their allergies and required medications [4].

- Long term nursing home:

It is focus on nursing of old people. They support fall detection, unconsciousness detection. These applications reduce personnel cost and rapid the reaction of emergence situation.

G. Home Application:

As technology advances, smart sensor nodes are buried in appliances, such as microwave, refrigerators, and vacuum cleaners. They allow end users to manage home devices locally and remotely more easily [4].

Along with developing commercial application of sensor network it is not so hard to image that home application will step into our normal life in future. e.g. After one day hard work you come back home. At front door the sensor detect that you are opening the door, and then it will tell the electric kettle to boil some water and air condition to be turned ON. The sensor in the room will be detecting the environment. The AC will turn to sleep mode until all the sensor get right temperature. The light on the corridor are installed with sensor and they can be turned ON or OFF automatically. Even the windows are also attached with vibratory sensors connected to police to against thief.

III. PROTOCOLS OF WSN

Protocol is a set of convention that governs the communication between nodes on a network. A wireless sensor network consists of homogeneous or heterogeneous nodes. On this

basis we classify the protocols whether they are working on flat or hierarchical topology [3]. Various protocols in wireless sensors network are listed below [6].

Table 1: Various Routing Protocols in WSN

Abbreviation	Name	Reference
SPIN	Sensor protocol information via negotiation	[11] [13]
DIRECT DIFFUSION	Direct Diffusion	[12] [14]
RUMOR ROUTING	Rumor Routing	[15]
LEACH	Low energy adaptive cluster hierarchy	[16]
PEGASIS	Power efficient gathering in sensor information system	[17]
TEEN & APTEEN	Threshold sensitive energy efficient sensor network and adaptive TEEN	[18]
GAF	Geographic Adaptive Fidelity	[19]
GEAR	Geographical and energy aware routing	[20]

IV. SIMULATORS FOR WSN

Simulation is the paradigm which allows the simulation of even complex behaviour in the environment. Low cost, easy implementation and practically testing of large networks are benefits of using simulators. There are many different possible platforms for simulation and testing of routing protocols for WSNs [10].

Below is a list of some most popularly used simulators for WSNs. Different aspects like energy efficiency, resources, fault tolerance, simulation scenarios, global behaviour etc. have been compared.

Table 2 : Various Tools available for research in WSN

Simulator's Name	Platform	Description	References
NS-2	C++,OTCL	NS-2 is open source simulator developed in 1989. It supports a wide range of protocols in all layers. NS-2 is the paradigm of reusability. It provides the most complete support of communication protocol models, among non-commercial packages	[9] [21]
OPNET	C++	OPNET provides higher industrial standards and more network examples can be utilized. In an effort to develop a simulation test bed to facilitate short range, fast moving vehicle communications we propose to use OPNET, a paper has been submitted to IEEE ISWCS 06 and are awaiting peer review results. OPNET's MANET, WIRELESS and WLAN models are ideally suited for the new dedicated short distance communication (DSRC) algorithm and IEEE 802.11p protocol development.	[4]
J-Sim	Java	It provides real-time process based simulation. The main benefit of J-sim is its considerable list of supported protocols, including a WSN simulation framework with a very detailed model of WSNs, and a implementation of localization, routing and data diffusion WSN algorithms [6]. J-sim models are easily reusable and interchangeable offering the maximum flexibility.	[22]

TOSSIM	nesC	High degree of accuracy or running the application source code unchanged. Availability of a visualization tool.	[23]
GloMoSim	Parsec	Parallel simulation capability. It is tailored specifically for wireless networks. Availability of a visualization tool.	[24]
Avrora	Java	Can handle networks having up to 10,000 Nodes .Enables validation of time-dependent properties of large-scale networks	[25]
SENS	C++	Platform-independent Users can assemble application-specific environments Defines an environment as a grid of interchangeable tiles.	[26]
EmStar	Linux	It provides a range of runtime environments. It provides the opinion to interface with actual hardware while running simulation.	[27]
(J)Prowler	Mat lab/Java	Probabilistic wireless sensor network simulators. (J)Prowler provides an accurate radio model.	[28]

V. CONCLUSION

WSN is a wireless network consists of nodes using several sensors to monitor physical and environmental conditions such as light, sound, temperature, vibration, pressure etc. In this paper various applications of WSN along with the knowledge of simulators available for the experimental work of WSN are discussed. This paper can be helpful for research scholars who are working in this field. There is currently enormous research potential in the field of WSN.

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