

A Survey on Wireless Sensor Networks and Their Applications

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Abstract:-

Wireless sensor network is emerging field because of its wide applications. It is a wireless network which subsist a group of small sensor nodes which communicate through radio interface. These sensor nodes are composed of sensing, computation, communication and power as four basic elements. Many routing, power management, and data dissemination protocols have been specifically designed for WSNs where energy awareness is an essential design issue. But limited energy, communication capability, storage and bandwidth are the main resource constraints. The network should have self-organizing capabilities as the positions of individual nodes are not predetermined. The flexibility, fault tolerance, high sensing fidelity, low cost, and rapid deployment characteristics of sensor networks create many new and exciting application areas for remote sensing. Our survey is based on various aspects of wireless sensor networks. In this paper we also discussed various types of WSNs and their applications.

Keywords:- WSN, Sensor nodes, Applications, Ad hoc networks

I. INTRODUCTION

Wireless ad-hoc sensor networks have recently emerged as a premier research topic. They have great long-term economic potential, ability to transform our lives, and pose many new system-building challenges. Sensor networks also pose a number of new conceptual and optimization problems. Some, such as location, deployment, and tracking, are fundamental issues, in that many applications rely on them for needed information.

A wireless sensor network composed of hundreds to thousands of sensor nodes with much shorter distance between adjacent nodes and low application data rate.

In recent years WSN becomes emerging field in wide range of applications like health monitoring applications, environmental observation, forecasting system, battlefield surveillance, robotic exploration, monitoring of human physiological data etc. The sensors can be deployed at various places with different usages and each have different capability to sense different attributes like temperature, moisture, pressure humidity etc. But these sensors have limited power sources and also it is not cost effective to recharge the batteries. The batteries are usually irreplaceable. Therefore, there lifetime will depends on respective batteries of sensors. So the life time of wireless sensor network can be prolonged by using effective energy balancing methods.

Wireless sensors have become an excellent tool for military applications involving intrusion detection, perimeter monitoring, information gathering and smart logistics support in an unknown deployed area. Some other applications: sensor-based personal health monitor, location detection with sensor networks and movement detection.

II. ARCHITECTURE OF WIRELESS SENSOR NETWORK

WSN architecture includes both a hardware platform and operating system designed. TinyOS [2] is a component based operating system designed to run in resource constraint wireless device. The major components of WSN are :-

- Sensor Field: The area in which sensor nodes are deployed.
- Sensor Nodes: Sensor nodes are the sensors which are responsible for gather information and routing this information back to a sink.

- Sink: It is also a sensor node which performs a special task of receiving, processing and storing data from other sensor nodes. This node is responsible for reduction of messages need to be sent and also reduce the energy requirements.
- Task Manager (Base Station): It is a centralized point of control within the network used to extract information from the network and passes control information back to the network.

III. ARCHITECTURE OF WIRELESS SENSOR NODE

A Sensor is a tiny device which is based on micro sensor technologies with low signal processing capability, low computation power and low bandwidth. Main Components of wireless sensor node :

- Sensor Unit
- Processing Unit
- Radio Transceiver
- Battery
- Analog to Digital Convertor
- Location Finder
- Mobilizer

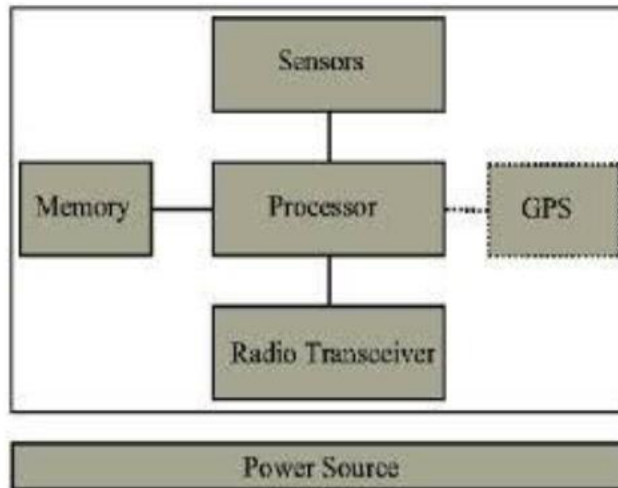


Fig.1.WSN Node Architecture

IV. SENSOR NETWORKS APPLICATIONS:

Sensor networks may consist of many different types of sensors such as seismic, low sampling rate magnetic, thermal, visual, infrared, acoustic and radar, which are able to monitor a wide variety of ambient conditions that include the following [23]:

- temperature,
- humidity,
- vehicular movement,
- lightning condition,
- pressure,
- soil makeup,
- noise levels,
- the presence or absence of certain kinds of objects,
- the current characteristics such as speed, direction, and size of an object.

Sensor nodes can be used for continuous sensing, event detection, event ID, location sensing, and local control of actuators. The concept of micro-sensing and wireless connection of these nodes promise many new application areas. We categorize the applications into military, environment, health, home and other commercial areas. It is possible to expand this classification with more categories such as space exploration, chemical processing and disaster relief.

Sensor Nodes are mainly used in many applications. Some of them are,

- Military Applications
- Environmental Applications
- Health Applications

- Home Applications
- Other Commercial Applications

V. TYPES OF WIRELESS SENSOR NETWORKS

Categorization of sensor networks on the basis of interfaces in which nodes are deployed:

A. Underwater Wireless sensor network:

In this sensor network sensor nodes are deployed under water. Sensor nodes communicate through acoustic waves. Underwater wireless communication today is expensive, sparsely deployed, typically communicating directly to a base-station over long ranges rather than with each other [4]. This network is difficult to establish due to limited bandwidth, long propagation delay and signal fading problem. Applications: - Seismic monitoring: A promising application for underwater Sensor networks is seismic monitoring for oil extraction from underwater. - Equipment Monitoring and Control: Underwater equipment monitoring is a second example application. Ideally, underwater equipment will include monitoring support when it is deployed, possibly associated with tethered power and communications, thus our approaches are not necessary.

B. Underground Wireless sensor network:

This network is basically established under the ground and used to monitor the underground situations. It is a challenge to communicate via this network due to signal losses and high attenuation. In this network communication is carried out through electromagnetic waves. Underground sensors are expensive because the special components should be used for reliable communication through interfaces like soil rocks, water and other minerals. This type of WSN is also very expensive.

Applications:

- Earthquake and landslide monitoring
- Intruder detection
- Environment monitoring
- Assisted navigation
- Infrastructure maintenance
- Sports field maintenance

C. Earthbound Wireless sensor network:

This type of networks also called terrestrial WSNs. This network is cheaper to deploy than the above two. In this thousands of nodes are deployed in ad hoc or in a pre planned manner. In former case nodes are placed randomly into target area while in latter there can be grid, optimal, 2D, 3D placements.

Applications:

- Military applications

- Environmental Monitoring
- Security
- Node tracking system
- Medical applications
- Industrial application
- Monitoring of human physiological data
- Forecasting

D. Mobile Wireless Sensor Network:

In this type of network once the nodes are deployed they move to gather the information. And sensor node has ability to reposition and organize itself in network. Localization, self organizations, navigation and control, coverage, energy, maintenance, data process etc. are main features of mobile WSNs.

Applications:

- Sensors can be attached to people for health monitoring, which may include heart rate, blood pressure etc [5].
- Animals can have sensors attached to them in order to track their movements for migration patterns, feeding habits or other research purposes [6].
- Sensors may also be attached to unmanned aerial vehicles (UAVs) for surveillance or environment mapping [7].

E. Multi-media Wireless sensor networks:

These are used to monitor and track events in the form of multimedia. These networks consist of a number of low cost sensors equipped with cameras and microphones. Main features of multi-media WSNs are high bandwidth/low energy, Quality of service, filtering, data processing and compressing techniques.

Applications:

- Traffic monitoring
- Pollution control
- Smart healthcare
- Disaster/Emergency response
- Smart Environmental sensing

F. Wireless Nano sensor network:

The concept is based on integrated machines at the nano scale, which interact on cooperative basis by means of wireless communications. At the present stage, the design of the protocol suite for wireless nano sensor networks represents a fundamental issue to address for accelerating the deployment process of such a technology [8].

VI. CHALLENGES

A. Energy Support-Most important restraint in a WSN is limited energy support of sensor nodes. Since sensor nodes are deployed in adhoc manner and after deployment they left unattended. So initial battery power is the main source of their lifetime survival. Once sensor nodes are deployed they could not be

recharged. So today to establish an energy efficient wireless sensor network is a great issue and a challenge.

B. Fault Tolerance-Sensor nodes are prone to failure because of unattended environment. A sensor node may fail due to hardware or software problem or energy exhaustion. If a few of sensor nodes fail, working protocol should handle this type of fault tolerance.

C. Ad-Hoc Deployment-Sensor nodes are distributed randomly in required monitoring field. For example –for monitoring forest activities sensor nodes are dropped from the plane. Then sensor nodes itself create connections with other nodes and form an infrastructure. Hence new standards and protocols should be developed to maintain this type of ad-hoc network.

D. In Real Time Environment-WSN deal with real world environments. In many cases, sensor data must be delivered within time constraints so that appropriate observations can be made or actions taken. Very few results exist to date regarding meeting real-time requirements in WSN.

E. Wireless Channel-The wireless channel is unreliable in nature, and a number of phenomena can prevent a transmitted packet from reaching a receiver. One such phenomenon is interference. If two independent transmitters transmit on the same channel such that their signals overlap, they may corrupt each other's signal at a receiver's radio. This requires the transmitter to re-transmit, at the cost of additional time and energy. So to maintain efficient wireless channel is a great challenge today.

VII. CONCLUSION

Wireless Sensor Network is one of the emerging fields in research area. The flexibility, fault tolerance, high sensing fidelity, low-cost and rapid deployment characteristics of sensor networks create many new and exciting application areas for remote sensing. In the future, this wide range of application areas will make sensor networks an integral part of our lives. Wireless sensor network has a remarkable feature to monitor environmental and physical conditions. In this paper we discussed various aspects of wireless sensor networks and also discussed various types of WSNs and their applications. In the future, the wide range of application areas will make sensor networks an integral part of our lives. We also discussed how it is differ from traditional wireless networks. Wireless sensor network has bright future in the field of networking because it continually providing us solutions for many monitoring problems. Also we can conclude that to make the Wireless sensor network energy efficient is one of the great areas for future work.

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