A New Era of Wireless Sensor Networks

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ABSTRACT

Wireless sensor networks have emerged as a central new area in wireless technology. It is one of the leading technology trends in the coming decades has posed various unique challenges to the researchers. Sensor networks create a lot of new and exciting application areas for remote sensing due to characteristics as flexibility, little cost, fault tolerance, high sensing fidelity and rapid deployment. In this paper, we discuss about the wireless sensor network approach. We also exhibit the different applications of wireless sensor network in real world.

Keywords: *Industrial Process Control, Structured Monitoring and Wireless Networks***.**

I. INTRODUCTION

Wireless senor networks are potentially one of the most used technologies of this century. All the advancement in wireless communications and electronics has enabled the improvement of low–cost, low–power, multifunctional mini devices for utilize in many applications. The arrangement of these factors has changed the practical use of utilizing a sensor network consisting of a large number of smart sensors.

A sensor network is composed of a huge number of sensor nodes which consist of sensing, data processing along with communication capabilities [1]. A wireless sensor network basically supervises physical or environmental situations such as pressure, temperature or pollutants etc. at unusual areas. Such sensor networks are likely to be widely deployed in a vast variety of environments for commercial, civil and military use such as vehicle tracking, climate and habitat monitoring and acoustic data gathering. The key restrictions of wireless sensor networks are the storage, power and processing.

As WSN contains a large number of small nodes. Nodes are compact and automated devices. A sensor node is a device that has battery power, processor memory transceiver and sensing device. Examples of sensor node are berkeley MICA Mote [2].

WSN has following special characteristics [3]:

1. Limited energy, computation power, Memory, external storage, and communication capability.
2. Very flexible within the reception area.
3. Tightly coupled with their environments.
4. Quite cheap networking infrastructures possible.
5. Sensor nodes are usually accessible after deployment, which makes the physical attack much easier.

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Although several protocols and algorithms have been planned for traditional wireless Ad hoc networks, they are not well suited for the unique feature and application requirements of sensor networks. To illustrate this point, the differences between sensor networks and Ad hoc networks [4] are outlined below:

1. The number of sensor nodes in a sensor network can be some orders of magnitude higher than the nodes in an Ad hoc network.
2. The topology of a wireless sensor network changes very frequently.
3. Sensor nodes are densely deployed.
4. Sensor nodes are prone to failures.
5. Sensor nodes mainly use broadcast communication paradigm whereas mainly Ad hoc networks are based on point-to-point communications.

Rest of the paper is organized as follows: section II includes the complete sensor networks communication architecture. In section III we discussed about the different applications area of WSN. Whole work is summarized in section IV. Finally, the paper concludes with section V.

II. SENSOR NETWORKS COMMUNICATION ARCHITECTURE

In a standard wireless sensor network we see following network components:

1. **Field Devices-** These are accumulated in the process and must be able of routing packets on behalf of supplementary devices [5].
2. **Gateway or Access points-** It permits the data link between host application and field devices.
3. **Network Manager-** It responsible for configuration of the network, scheduling communication between devices, management of the routing tables and monitoring and reporting the health of the network.
4. **Security Manager-** It is used for the generation, storage and management of keys.

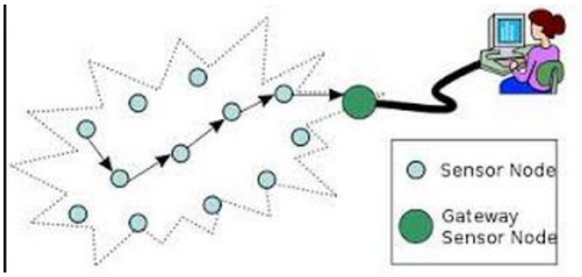

Fig. 1: WSN Architecture

These nodes are scattered in a sensor field. Each of these nodes has the capabilities to gather data and route data back to the sink and the end users.

The sink may converse with the task manager mind using Internet or satellite. The protocol stack used by the sink and every sensor node is specified in Figure. This protocol stack combines power and routing awareness, integrates data with networking protocols, communicates power efficiently through the wireless medium, and encourages cooperative efforts of nodes.

The protocol stack consists of the application layer, transport layer, network layer, data link layer, physical layer, power management plane, mobility management plane and task management plane.

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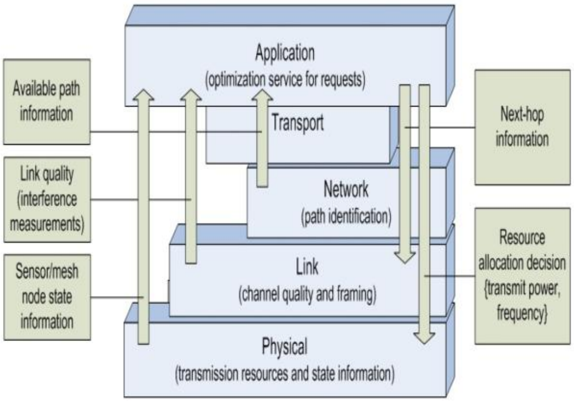

Fig. 2: The Sensor Networks Protocol Stack

Different kind old application software can be built and used on the application layer. The transport layer assists to maintain the flow of data of the sensor networks application requires it. Network layer think about of routing the data supplied to the transport layer. As the environmental is noisy and sensor nodes can be movable, the MAC protocol must be power alert and able to reduce collision with neighbors broadcast [6]. The physical layer addresses the requirements of a simple but robust modulation, transmission and receiving techniques. Power mobility and task management planes watch the power, movement, and task allocation among the sensor nodes. These planes help the sensor nodes manage the sensing task and lower the overall power utilization. The power management plane manages how a sensor node uses its power, the mobility management plane sense and registers the movement of sensor nodes, Task management plane balances and schedules the sensing tasks given to a particular region, not all sensor nodes in that region are compulsory to execute the sensing task at the similar time. These management planes are needed, so that sensor node scan work together in a power efficiently way, route data in a mobile sensor network, a share resources between sensor nodes. Without them, all sensor nodes will just work independently [7].

III. WIRELESS SENSOR NETWORKS APPLICATIONS

Today, wireless sensor networks have found their way into a broad variety of applications and systems with greatly varying requirements and characteristics.

It can be used for industrial process control, health applications, continuous sensing, event detection, location sensing and limited control of actuators, the concept of micro-sensing and wireless connection of these nodes promises many innovative application areas. We categorize the applications into military, environment, home and other commercial areas.

Home Intelligence

Wireless sensor networks are used to provide more suitable and smart living environments for human beings. It is being used to remotely read utility meters in a home like water, gas, electricity and then send the readings to a remote centre through wireless communication.

Defense

Wireless sensor networks are used for military command, communication, computing control, surveillance, intelligence, reconnaissance and targeting systems [5]. The fast deployment, self organization and fault tolerance characteristics of wireless sensor networks make them extremely promising sensing technique for military.

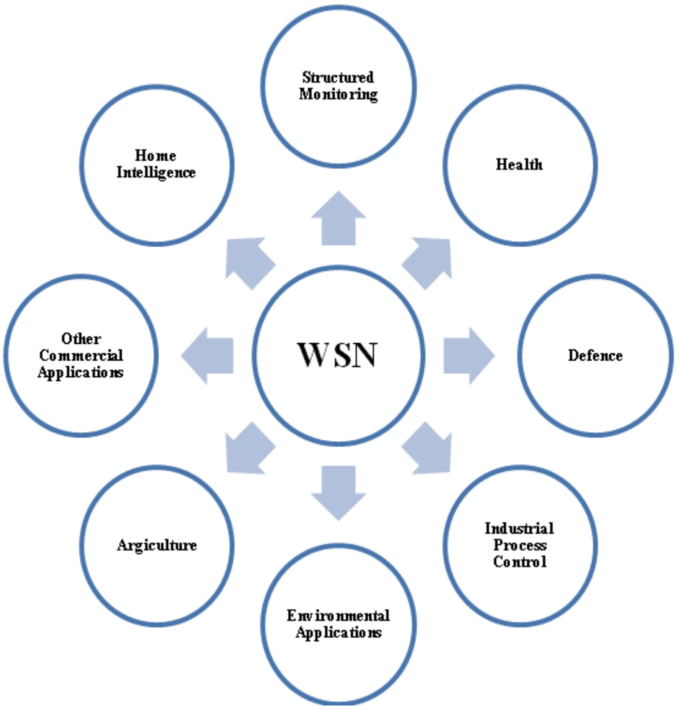

Fig.3. Applications of WSN

Industrial Process Control

To monitor manufacturing process or the condition of manufacturing equipment. For example, chemical plants or oil refiners can use sensors to monitor the condition of their miles of pipelines.

Environmental Applications

For tracking the movements of small animals, birds and insects; [3] watching environmental conditions that affects crops and livestock; macro instruments for large-scale each monitoring; [5] chemical/biological earth and environmental monitoring in marine, soil, [6] and atmospheric contexts, [8] forest fire detection, biocomplexity mapping of the environment a pollution study.

Agriculture

It frees the farmer from the maintenance of wiring in a difficult environment. Gravity feed water systems can be monitored using pressure transmitters to monitor water tank levels, pumps can be controlled using wireless I/O devices and water use can be measured and wirelessly transmitted back to a central control center for billing. Irrigation automation enables more efficient water use and reduces waste. [9]

Structural Monitoring

It is used to monitor the movement within buildings and infrastructure such as bridges, flyovers, embankments, tunnels etc. enabling Engineering practices to monitor assets remotely without the need for costly site visits, as well as having the advantage of daily data, whereas traditionally this data was collected weekly or monthly, using physical site visits, involving either road or rail closure in some cases. [9].

Health Applications

It provides the interfaces for the health applications for the disabled; integrated patient monitoring; diagnostics; monitoring the movements and internal processes of insects or other small animals; drug administration in hospitals and tracking and monitoring doctors and patients within a hospital.

Other Commercial Applications

The commercial applications such as monitoring material fatigue; managing inventory; for monitor the product quality; constructing smart office spaces; [3] building virtual keyboards; environmental control in office buildings; robot control and guidance in automatic manufacturing environments; interactive museums; [5] factory process control and automation monitoring disaster area; machine diagnosis; transportation; factory instrumentation; smart structures with sensor nodes embedded inside; [6] local control of actuators; detection; and instrumentation of semiconductor processing chambers.

IV. SUMMARIZATION

Sr. No.	Area	Application	Reference
1	**Home Intelligence**	• living environments • meter reading in a home (water, gas, electricity)	[6]
2	**Defense**	• Military Command, • Communication • Computing Control • Surveillance • Intelligence • Reconnaissance • Targeting Systems	[6]
3	**Industrial Process Control**	• Chemical Plants • Oil Refiners • Monitor the condition of their miles of pipelines.	[8]
4	**Environmental applications**	• Tracking animals, birds and insects. • Watching environmental conditions • Chemical/biological earth and environmental • monitoring in marine, soil, and atmospheric contexts, • Forest fire detection, • Biocomplexity mapping of the environment a pollution study	[2][8]
5	**Agriculture**	• Monitoring gravity feed water systems • Monitor water tank levels, • Controlling water pumps	[11]
6	**Structural Monitoring**	• Monitoring the buildings and infrastructure such as bridges, flyovers, embankments, tunnels etc. • Monitor assets remotely	[11]
7	**Health applications**	• Diagnostics. • tracking and monitoring doctors and patients	[10]
8	**Other Commercial Applications**	• Inventory Control • Constructing Smart Office Spaces • Building Virtual Keyboards • Robot Control • Automatic Manufacturing Environments • Factory Process Control • Machine Diagnosis • Transportation • Factory Instrumentation • Local Control Of Actuators	[2]

V. CONCLUSION

In this paper, we discussed about the wireless sensor networks and their technologies. In this we carried out the result that now the control systems; monitoring systems and others tracking devices wireless sensor network is playing the vital role. The most broad and adaptable deployments of wireless sensing networks demand that batteries be deployed.

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