RESEARCH ARTICLE

COMPREHENSIVE STUDY OF THE APPLICATIONS OF WIRELESS SENSOR NETWORK

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ABSTRACT— Wireless Sensor Network is installation of a large number of sensors connected to each other to capture data and to send it from one node to another node until it reaches the sink node. Sensors are deployed to measure different parameters of the system. They have good potential for long term applications and ability to transform human lives in many different aspects.

KEYWORDS—Applications, Architecture, Protocol, Wireless Sensor Network, WSN

INTRODUCTION

A sensor network is defined as a collection of a large number of sensor nodes which are low in cost, consume less power and multi-functional in nature. The sensor nodes are highly distributed either inside or nearby the system which is under study. These nodes are very small in size and consist of components for sensing, data processing and communication etc. The placement of these nodes can be random inside the system. It means that protocols of sensor networks and its algorithms must possess self-organizing abilities in inaccessible areas [1]. A wireless sensor network (WSN) or sometimes called a wireless sensor and actor network (WSAN) are spatially distributed autonomous sensors to monitor physical conditions, such as temperature, pressure, sound etc. and to cooperatively pass their data through the network to a main location. The more modern networks are able to pass data in two ways i.e. bidirectional and they also enable control of sensor activity. The development of wireless sensor networks was started for the military applications like battlefield surveillance and today these sensor networks are used in many applications related to industry and consumer applications [2]. This paper tries to explore the important applications of wireless sensor network.

WSN ARCHITECTURE

In Wireless sensor network, the nodes are deployed in a sensor field as shown in below in figure 1 [4]. Each of the nodes has the capability to collect and send data to the sink. The sink node sends this data to the end users.
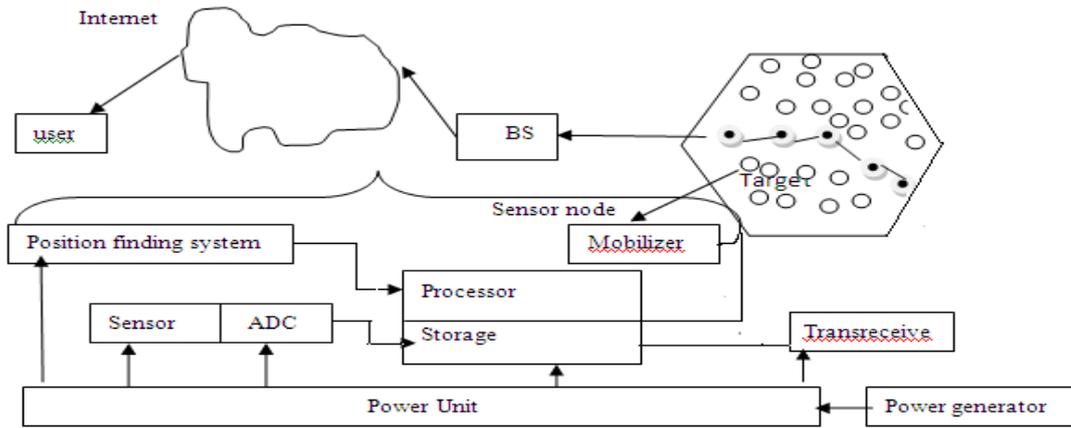
Figure 1: Sensor network architecture [5]

The protocol stack combines power and routing awareness, integrates data with networking protocols, and communicates power efficiently through the wireless medium. The protocol stack consists of the application, transport, network, data link, physical layer, power management plane, mobility management plane and task management plane. Depending on the sensing task, different types of applications software can be built and use on the application layer. The transport layer helps to maintain the flow of data if the sensor networks application requires it. The network layer takes care of routing the data supplied by the transport layer. Since the environment is noisy and sensor nodes can be mobile, the MAC protocol must be power aware and able to minimize collision with neighbours broadcast. The physical layer addresses the needs of the simple but robust modulation, transmission and receiving techniques. In addition, the power, mobility and task management planes monitor the power, movement and task distribution among the sensor nodes. These planes help the sensor nodes coordinate the sensing task and lower the overall power consumption [4].

WIRELESS SENSOR NETWORK APPLICATIONS
Sensor networks may consist of many different types of sensors such as seismic, low sampling rate magnetic, visual, thermal, infra-red, acoustic and radar, which are able to monitor a wide variety of ambient conditions. Sensor nodes can be used for continuous sensing and event detection. The concept of wireless connection of these nodes and their ability of micro sensing promise many new application areas. The different applications of sensor networks are as listed below.

Military Applications
Wireless sensor networks are used by military command for communication, computing, intelligence, surveillance etc. They find it useful because of the rapid deployment, fault tolerance and self-organization characteristics of sensor networks. Since sensor networks are based on dense deployment, disposable and low cost sensor nodes so destruction of some nodes by the enemy does not affect military applications. This makes sensor networks concept a better approach for battlefield. Various other military applications of sensor networks are   monitoring friendly forces, equipment and ammunition etc.

Home Applications
The sensor nodes can play very important role in appliances which we use in our daily life like vacuum cleaners, microwave ovens, refrigerators and ACs. The sensor nodes inside the domestic devices can interact with each other and with an external network via the internet or satellite. They allow people to manage home devices locally and remotely with ease.

Area Monitoring

It is an important application of WSN to monitor an area for particular purpose like area used by military is monitored to keep an eye on the intrusion of army and for civilians use sensor can be put around the gas pipelines for protection.

Health care monitoring

Health care is very important area where sensor nodes play an important role in providing important parameters about our health. There are two ways to use sensors.

- Body implant sensors
- Body proximity sensors

The first type of sensor is inserted into the human body to get data while body proximity sensors are kept outside the body to get vital parameters by just having contact with the body. The list of health monitoring activities carried out by sensors is as given below:-

i. Cancer Detection
ii. Glucose Level Monitoring
iii. Asthma
iv. Preventing Medical Accidents
v. Cardiovascular Diseases
vi. Alzheimer and depression monitoring
vii. Elderly People Monitoring
viii. Stroke and post stroke
ix. Artificial Retina
x. Home Monitoring
xi. Heart Rate Monitoring
xii. Vital sign monitoring
xiii. Life shirt
xiv. E Watch

Environmental or Earth sensing

There are lots of applications for monitoring environmental parameters, some of these are as given below:-

i. Air pollution monitoring

   Air pollution can be monitored by deploying ad hoc wireless sensors in different parts of the city which measure the amount of dangerous gases.

ii. Forest fire detection

   Wireless sensor networks can play an important role in forest fire detection by measuring temperature, humidity and gases produced in the forest due to fire. It helps in early detection and which results in early control of fire.

iii. Landslide detection

   The detection of landslide occurrence before it happens is a very useful application of WSN to save lives and property in landslide prone area. Sensors can detect very slightest movement in the soil and other parameters concerned with this phenomenon.

iv. Water quality monitoring

Water quality monitoring is very complex activity which can be carried out with the help of WSN to measure the different properties of water in dams, rivers, lakes, oceans and underground water. WSN helps in deployment of monitoring stations in locations of difficult access, without the need of manual data retrieval.

v. Natural disaster prevention

Wireless sensor networks can be very helpful to reduce the damages caused as a result of natural disasters like floods. Wireless nodes can monitor the water levels of rivers in real time.

vi. Chemical agent detection

The chemical agent sensor systems can play very important part in chemical agent detections as a counter terrorism efforts.

Industrial monitoring

Industrial monitoring is very important for the smooth functioning of the industrial process. It can be carried out with the help of WSN. The important areas of industrial monitoring are

i. Machine health monitoring

Wireless sensor networks have been developed for machinery health monitoring. The sensors can be placed in locations difficult to reach with a wired system, such as rotating machinery and untethered vehicles.

ii. Data logging

Wireless sensor can be used over conventional loggers for the collection of data for monitoring of environmental information. This can be as simple as the monitoring of the temperature in a fridge to the level of water in overflow tanks in nuclear power plants. The statistical information can then be used to analyze how systems have been working.

iii. Water monitoring

Monitoring the quality and level of water includes many activities such as checking the quality of underground or surface water and ensuring a country's water infrastructure for the benefit of both human and animal. It may be used to protect the wastage of water.

iv. Structural Health Monitoring

Civil infrastructure can be easily monitored by using Wireless sensor networks. It also helps to keep an eye on the geo-physical processes in real time by using sensors.

v. Entertainment Industry

Wireless sensor networks are also used in music technology, for example to sense live performers, and transmit the sensor data to a central computer which then plays back sound or visuals in sync with the music.

Precision agriculture

It is very important application of WSN in the field of agriculture to precisely use fertilizer, pesticides, irrigation when it is needed and where it is needed [6].The Precision farming system has the following parts [7]:

i. Sensing agricultural parameters.
ii. Identification of sensing location and data gathering.
iii. Transferring data from crop field to control station for decision making.
iv. Actuation and Control decision based on sensed data.

Other applications
Some of the commercial applications are monitoring material fatigue; building virtual keyboards; managing inventory; monitoring product quality; constructing smart office spaces ; environmental control in office buildings ; robot control and guidance in automatic manufacturing environment; interactive toys ; interactive museums ; factory process control and automation; monitoring disaster area; smart structures with sensor nodes embedded inside; machine diagnosis; transportation; factory instrumentation; local control of actuators ; detecting and monitoring car thefts; vehicle detection and tracking; and instrumentation of semiconductor processing chambers, rotating machinery, wind tunnels and anechoic chambers[3].

CONCLUSIONS
This paper discussed different aspects of wireless sensor network and applications of sensor network in real life, architecture used to make network and important concepts used in passing data and parameters of the system from one node to another node. The wireless sensor network has great potential for numerous applications in future so this paper will be helpful for scholars to carry forward research in this particular area.

REFERENCES

[1]   Neha Singh, R. L. (2012). Wireless Sensor Networks: Architecture, Protocols, Simulator Tools. International Journal of Advanced Research in Computer Science and Software Engineering, 229-233.

[2]   http://en.wikipedia.org/wiki/Wireless_sensor_network

[3]   Rajashree V.Biradar, V.C.Patil, Dr. S.R. Sawant , Dr. R.R. Mudholkar, Classification and Comparison of Routing Protocols in Wireless Sensor Networks, Special Issue on Ubiquitous computing Security systems.

[4]   Luis Javeir Garcia Villalba, Ana Lucila Sandoval Oroco Alicia Trivino Cabera and Claudia Jacy Barenco Abbas, routing Protocols in Wireless Sensor Networks, Sensors 2009.

[5]   Shio Kumar Singh, M P Singh, and D K Singh (2010) Routing Protocols in Wireless Sensor Networks. –A Survey. International Journal of Computer Science & Engineering Survey (IJCSES) Vol.1, No.2, November 2010

[6]   Antoine Bagula, "APPLICATIONS OF WIRELESS SENSOR NETWORKS" Feb. 2012

[7]   Manijeh Keshtgary, Amene Deljoo," An Efficient Wireless Sensor Network for Precision Agriculture", Canadian Journal on Multimedia and Wireless Networks, Vol. 3, No. 1, January 2012