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Wireless Sensor Network Design Considerations

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ABSTRACT

Abstract- Wireless Sensor Network (WSN) is a challenging area and key technology consisting of a number of sensor nodes deployed in the region for the data gathering task. The sensors are equipped with wireless interfaces through which they communicate with each other and form a network. WSN plays an important role in the field of military applications, natural disaster, health care monitoring, agriculture, pollution control, fire detection in forest etc. WSN has resource constrained property so aim is to utilize efficient energy during data transmission from target to the base station. The coverage and connectivity is an important issue in the WSN, avoid coverage and connectivity issues the ROI (Region of Interest) is fully covered and supervised by at least one sensor in the sensor network. In the paper aim to provide the different component and characteristic of the wireless sensor network. Different types of wireless sensor networks, types of coverage, important research issues and challenges are also discussed.

Keywords: Coverage, Region of Interest, Wireless Sensor Network, Sensing Unit.

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INTRODUCTION

WSN have numerous advantages over conventional networking solutions such as lower costs, scalability reliability and ease of deployment that enable their user in a wide range of diverse applications. The recent development in technology the sensors become smarter, smaller and cheaper. In the military applications the sensors nodes are used to detect the troop movements of enemies. In natural disaster sensors sense and detect the environment forecast in advance. The sensors are used in hospitals for monitoring medical history of the patient. The extensive growth in the field of WSN applications likes rapidly grows multi-billion altar markets. Sensor nodes consist of the following components known as Sensing Unit, Communication Unit, Processing Unit, and Storage Unit as shown in the Fig.1.

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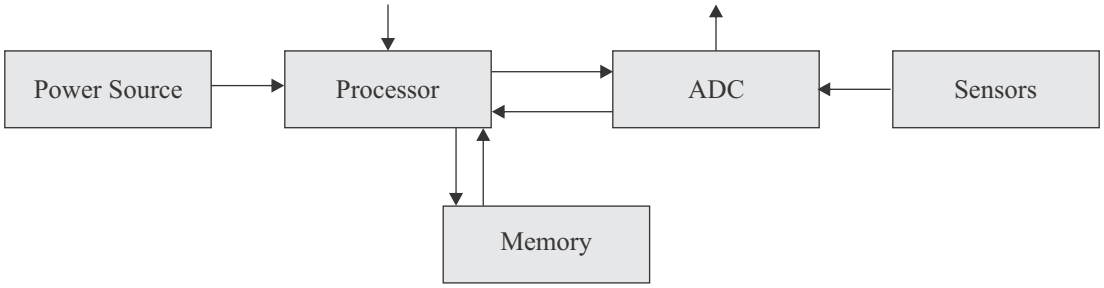

Fig.1 Components of WSN

Sensing Unit

The task of the sensing unit is to measure and sense the ambient state of information from environmental phenomenon and transform it into an electrical signal. There are two types of a sensor mode in the WSN: active and passive sensor nodes. An active sensor is a sensing device which requires an external source of power to operate while in passive sensor it simply detects the objects and responds immediately as input sensing the information from physical condition.

Sensing Region

The sensing region is the feasible distance from the source node to the ROI where the target must be covered by the sensor. Case 1 (For Target or Point Coverage) — Consider sensor S_i located in position (x_i, y_i) with radius S_r and target or point (P) is located in position (x_p, y_p) respectively. Then.

$$d(P, S_i) = \left| x_p — x_i \right|^2 + 1 \left| y_p - y_i \right|^2$$

Where the Euclidean distance between the point (P) and the sensor node can be represented by d(P, S_i) and is said to be covered by the sensor (S_i) if and only if $d(P,S_i) \leq S_r$.

Case 2 (For Area Coverage) — Consider an area (A) which is said to be covered by the sensor (Si) if and only if all the targets or points (P) in the area (A) are covered by the sensor (S_i) [15] [16].

Communication Unit

The responsibility of the communication unit in WSN is to transmit and receive data and control packets. On the basis of communication property modes of communications, it defined as one way or two ways. From the literature review it is observed that multi-hops communication is reliable for large scale WSNs as it utilizes less consumption of energy.

Communication Region

The Communication range (Cr) in WSN is determined as the extreme. Euclidean distance from one sax node to other source node exists in the ROI. Two sensors S_i and S_j are said to be communicating directly with each other if their Euclidean distance is less than the C_r of the sensor.

Processing Unit

The processing unit is built within the microcontroller and is responsible for interacting with the other component in the network. The processor can exist in any one of the four states: off state, sleep state, an idle state and active state. Depending on the tasks sensor nodes have different types of processor like communication processor, low power digital signal processor etc.

Storage Unit

The main function of the storage unit is to save the sensory data and instruction sets. Typically sensors nodes have low …… and small storage unit. Storage unit consists of static random access memory, read only memory and random access memory [1] [2][3]. Section I describes the WSN and its various important components. Section H discusses the literature review done by various authors. Section III discusses the characteristic of wireless sensor network, different types of the wireless sensor network and coverage methods. Section IV important challenges and issues are discussed. Section V includes the conclusion and future scope.

Literature Review

Narayan et al. [4] proposed a protocol which uses radius and residual energy as function to solve the average problem in the wireless sensor network. By using Sleep and Wakeup protocol improves the life time of the network. The proposed protocol reduces the overlapping by 51.5 percentage and the life time of network increases around 50 percentage.

Chaturvedi et al. [5] proposed EECP protocol utilizes an efficient mechanism to increase the performance and throughput of the network. It reduces the number of transmission by mixing the packets to various sources to intermediate nodes. The protocol improves the number of transmission, consumption of energy and performance of network by 63 percentage, 62 percentage and 61 percentage respectively.

Yadav et al.[6] discussed LEACH, APTEEN and CHEF clustering protocols The coverage problem arises when the sizes of network increases .The node localization is one of the important problem which is solved by PSO algorithm and optimal path selection problem is solved by using ACO algorithm.

Maurya et al. [7] proposed RBHR protocol in which region based clustering mechanism is used for the deployment of nodes in the different region area on the basis of their energy levels and hybrid routing technique us used for the data transmission. The propose protocol performs better results compare to SEP protocols and improve throughput and life time of the network.

Chaturvedi et al. [8] proposed a hybrid scheduling protocols for the target coverage in the wireless sensor network The protocol monitors the target by probabilistic coverage model, node contribution and trust values. The AHP and probabilistic coverage model is used for the optimal observation probability in the sensing 3d communication of the nodes. The protocols use Fuzzy logic techniques to activate the nodes in the set covers and enhance the performance and life time of the network about 200 percentage.

Chaturvedi et al. [9] discussed the coverage and enhancing the life time of network is importantproblem in the wireless sensor network. The EECP protocol is introduced to solve the coverage problem and improves the life time of network by utilizing scheduling mechanism and trust values. The new ceramic clustering mechanism in the protocol is used on the basis of residual energy, distance and degree of the nodes.

Characteristics of WSN

- Less power consumption leads to increase the network lifetime and optimal utilization of resources low duty cycle operation in the WSN.
- By utilizing distributed sensing properly, sensor

can survive in the hazardous environment. The strength of signal and range of the radio is not affected by scattering process. Reflection is used to avoid data redundancy and reduce unnecessary power consumption in the network which improves the network lifetime of WSN.

- The short-range communication is convenient and reliable while large range commutation covers point to point approach requires high bandwidth and transmission power and causes eaves dropping in WSN.

- For the error correction and detection in communication, flow control and error control techniques are used in WSN.

Types of Wireless Sensor Network

Terrestrial WSN:

In the Terrestrial type the deployment of sensor nodes in the target area is achieved through preplanned manner instead of random way. In this type classification of WSN, the deployments of the sensor nodes are stable and more reliable compared to others. The preplanned fashion deployment of the sensor nodes are placed in 2D, 3D and Grid placement etc. The advantage of this scheme is that the nodes can active for longer time and have less error prone.

Underground WSN:

In underground WSN the deployment of nodes are very difficult and requires skilled planning. These types of deployment schemes are costly in terms of hardware, software configuration and for transmission of the data also. The additional sink node is established for transmitting the information. It is very difficult to recharge the battery in the underground WSN.

Under Water WSN:

The approximate a of the total area on earth is covered with water. In this type of schemes sensor nodes and vehicles are deployed under the water. The deployment is very difficult and costly because of unstructured behaviors of land which causes serious problems affected by underwater animals, earthquakes etc. In underground water WSN there is limited bandwidth as well as battery power too, so there is need for optimal utilization resources in underwater deployment scheme. In this type of scheme sensor nodes are deployed in pre-planned and sparse fashion.

Multimedia WSN:

The multimedia WSN is for multimedia objects like audio, video imaging etc. It consists of sensors which require high bandwidth, power as well as link quality. In this type of scheme the cost of sensor deployment is less and integrated with cameras and microphones. To achieve effective coverage sensor nodes are organized in pre-design fashion.

Mobile WSN:

In mobile WSN sensors can move to any place in the Grid and sense the objects from the physical environment. This type of WSN scheme is more reliable than static sensor networks. This type of sensor is used for habitat monitoring, object tracking, surveillance of military troops movement. Some important challenges of these types of schemes are the localization problem. In this schemes the sensors are not pre aware of deployment and self-configuration property etc..

Types of Coverage

The Coverage is an important Quality of Service (QoS) metric for the estimation of how well the

desired target area is monitored. The coverage of sensor is dependent on sensing capabilities which may be either static or probabilistic. The problem of coverage and connectivity arises due to the limited sensing and communication range, so the network must follow the strategy to overcome this problem. To solve the coverage problem it is important that the distance among the sensor nodes is neither too close so that their sensing capability is not fully exploited nor too distant so that there may be a possibility of Coverage Hole. Therefore, aim is to solve the coverage problem so that the above-discussed parameters are satisfied. The different types of coverage as follows: Area Coverage. Target Coverage or Point Coverage, Barrier Coverage, Path Coverage, Blanket Coverage or Full Coverage, Sleep Coverage, Sweep Coverage.

Area Coverage:

The area coverage maximizes the area detection rate in the entire region by usingthe mobile node strategy. The area coverage is energy efficient random coverage. Thisis also called as connected random coverage. A network is said to connect if any active node cape communicated with any other active node. It the communication range is twice less than the sensing range, then coverage implies connectivity.

Target Coverage:-

In the target coverage few sensor nodes move to the target by using the exact location to achieve the full coverage. The objective of point or target coverage is to cover a set of points or target. There are two types of point coverage first one is known as random point coverage and second is known as deterministic point coverage. In random point coverage every point is covered by at least one sensor at all times. A deterministic point coverage every point must be covered by at least one sensor at all times in a deterministic manner.

Barrier Coverage:

The main issue is the barrier coverage is to find a point in the path after the deployment of the sensor nodes. Then the sensor nodes move to the intended point or location and link to other sensors in the barrier coverage. A barrier coverage is said to be one barrier coverage if it is covered by at least one sensor. Similarly, it is said two barriers if it is covered by two sensors and so on. Path coverage is an important application of WSN and with the help of path coverage we can monitor as well as detect the path of an object.

In Blanket coverage every single point in the ROI is covered by at least one sensor node. The Sleep schedule is an important application of the WSN to enhance the lifetime of the network. In WSN instead of continuous monitoring periodic monitoring is preferred.

Research Issue and challenges in Wireless Sensor Network

The important issue of the coverage is to yield optimal coverage. This ensures that the target should lies within the sensing area of the sensor nodes. There are various challenges and issues such as methodology to deploy the nodes, types of sensor nodes which are going to deploy, mobility in sensor nodes, the dimension of the ROI, continuous connectivity in the network and enhancement of the network lifetime by using a minimum number of sensor nodes. The random deployment, sensing and detection model in the WSN is also one of the important challenges and issues in WSNs.

Energy:-

One of the important issues in WSN is the energy

problem. Most of the energy is consumed in WSN in hardware operation, software processors and their transmitting power. The data aggregation also plays a significant role in the conservation of energy in the sin network. The Redundant data are reduced while transmitting the data to base station and it also reduces the number of data transmission.

Harsh Environment Condition:-

In harsh environment condition sensor holes get damaged and corrupted due to high humidity, interference, collision, dust and highly corrosive environment etc. The information is not transmitted to other sensor nodes in the given region.

Quality of Service:-

Quality of Service is calculated on the basis of quality of service provided by sensor network to users. The behaviors of holes in wireless sensor network are dynamic because at a particular movement of time any number of sensor nodes can join and leave. Due to the above problem traffic is increasing or decreasing drastically in the network.

Security:-

Security measures in WSN is to ensure confidentially and integrity of data. It plays very important role because wireless network is placed in military surveillance for observing troops moments of enemies, alarms in hospital, buildings. airports etc. Confidentiality means securing the private data while transmitting from sensor node to the base station. Integrity means data should remain same at all place.

Hardware and Software Issues:-

Sensor hole is the integration of sensor and Mote. The sensor is the fundamental unit of the sensor mote. A mote comprises of battery, processor and analog to digital converter. Use of flash memory is preferable over memory chips having additional properties like non-volatile, cheaper and easily programmable. Utilization of power in an efficient way increases the network life time. Switch off the power when not in use. Embedded battery production circuit is used for over charge and discharge problem.

Self-Management:-

Wireless Sensor Network is an integration of multiple sensors nodes deployed in statically fashion in the given area. The failures of nodes occur commonly in wireless sensor network due to breakage of communication failures and corrupted data etc. These failures of nodes lead to frequent change in the topology of the sensor network. It is a very tedious job of the redeployed sensor to adopt in new changing environments. When a sensor node is deployed in a region it must have the following properties like adaptability, self-configuration and separated in an autonomous manner.

Decentralized Management:-

Wireless Sensor Network consists of different types of sensor nodes and also have different level of energies. So it is a very difficult task to make all these different types of sensor nodes relies on central approach. This is the job of the sensor nodes to cooperate with neighbor's nodes and make information available from them instead of getting from the global channel. Due to this reason decentralized algorithm does not performs well but in terms of energy constraints this is better than the centralized approach.

Localization:-

Localization is an important issue in the wireless sensor network. Localization has no global addressing mechanism therefore it is difficult to manage in WSN. Localization is a procedure in which the physical locations of the sensor nodes are determined after they have been deployed. Localization helps in the expansion of energy efficient routing protocol.

Network Layer:-

It helps in the identification of the paths which gives energy efficient transmission. The aim of the routing protocol is to provide efficient communication based on different heterogeneity levels of nodes.

Transport Layer:-

In transport layer end to end transmission of nodes take place within the network. The location of nodes is not predefined thus it makes an end to end transmission efficient.

Data aggregation and Data dissemination:-

Data aggregations help to provide energy efficient transmission. This is a mechanism used in the sensor node to reduce the data redundancy. The data dissemination is a two-step process for routing the queries in the sensor network. The first step is to process the data for routing the queries requested by the neighbor sensors. In the second step requested response is send to the source node by the node having the requested data. The main task of this procedure is to improve the latency, consume the energy resources, improves the quality of service in terms of bandwidth utilization, data accuracy and end to end delay.

Deployment:-

For achieving better performance, the sensor nodes should be placed in an efficient Dinner. The most important issue of coverage is to yield optimal coverage. This ensures that the sensing area should be covered by minimum number of sensor nodes. There are various issues in the coverage such as random deployment, sensing and detection model.

In WSNs the main problem occurs due to randomly deployed sensor nodes. When the size of WSN is very vast and not accessible by human, then the deployment is done by using some vehicles like aircraft etc. in a randomized way. The random deployment within the sensor network may be either continuous or grid based. The sensing model of sensor nodes is either unit disk-based or non-unit disk based. Unit disk-based sensing model ensures the static sensing range and the sensor nodes are able to sense intended features within its disk range. Contrary to unit disk based, the non-unit disk model has probabilistic sensing range.

Coverage problem:-

One of the. most important problems in WSN is the coverage problem. In this problem aim is to deploy or activate the sensors nodes to cover the whole area with minimum numbers of sensor nodes.

CONCLUSION AND FUTURE WORK

In this paper authors have discussed the importance of wireless sensor network which influence our daily life such as natural disaster, health care monitoring, agriculture, air pollution control, fire detection in forest etc. The primary issues of wireless sensor network system are discussed in the paper. Different types of coverage models (such as Area. Target and Barrier coverage), coverage challenges and issues are also discussed. The

coverage problem has a greater influence on the efficiency and lifetime of the network. In current scenarios most of the researchers concentrate only on a network having static sensor nodes but under some scenarios like a battlefield, there is need to change the position of sensor whenever required or to follow some instructions. This is required because of continuous sensing is required without having human interference in such cases_ In the future clustering mechanism will introduce for QoS in wireless sensor network. Moreover to develop a novel method to solve the multi-objective problem of energy conservation, node localization, optimal coverage and best route identification is our future work.

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