A Review & Analysis on Designing issues for Optimizing a Wireless Sensor Network

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Abstract— a Wireless Sensor Network is a collection of sensor nodes organized in a co-operative way. In a sensor node each node has a sensing, communication and computational capabilities. Sensor can be deployed throughout physical space, providing dense sensing quite close to physical phenomena.

In this paper there is a review on WSN challenges in realistic situations where nodes face the problems of the deployment, energy consumption, communication & routing protocols and network security. To overcome these problems we proposed a technique for deployment & discuss communication, routing protocols, network security issue for optimizing the WSN.

Keyword—WSN, **SOM**, **Neural Network**, **communication & Routing protocols**, **Power Consumption**

I. Introduction

WSN stands for Wireless Sensor Network. A wireless sensor network is a group of spatially dispersed and dedicated sensors that communicate with each other wirelessly to monitor physical or environmental conditions. These sensors can be used to collect data about temperature, humidity, pressure, sound, light, motion, and other environmental factors. They can be deployed in various scenarios, such as industrial process monitoring, healthcare, smart homes, and environmental monitoring. Wireless sensor networks (WSNs) are important components of smart cities. Deploying IoT sensors in WSNs is a challenging aspect of network design [1]. Sensor deployment is performed to achieve objectives like increasing coverage, strengthening connectivity,improving robustness, or increasing the lifetime of a given WSN. Wireless Sensor Networks may consist of many different types of sensors such as seismic, low sampling rate magnetic, thermal, visual, infrared, acoustics and radar. They are able to monitor a wide variety of ambient conditions that include temperature, humidity, vehicular Movement, lightning condition, pressure, soil makeup, noise levels, the presence or absence of certain kinds of objects, mechanical stress levels on attached objects, and the current characteristics suchas speed, direction and size of an object.

WSNs are mostly deployed in hostile environments such as volcanoes, flooded regions, and deep oceans where human intervention is not possible for post deployment maintenance, so efforts are being made to enhance its efficiency and durability. Deployment can be classified as manual or random– Random deployment is the result of practical implementation for sensor deployment in battlefields or tough environments, for example, sensors may be air-dropped or launched via artillery. First the sensors are randomly scattered throughout the region [2]. Then, after running SOM algorithm, the sensors will move and distribute according to the probability of events in the target area. Thus we can gather more information with reliability from the region where probability of event is higher.

This paper is organized as follows. In section I, we have discussed an introduction and objectives of the work and Section 2 presents selected designing issues in WSN. In Section 3, SOM description and an algorithm. Section 4 described the various technique for reducing power consumption of nodes. Section 5 describes the different communication protocols in WSN communication. Section 6 gives an overview for routing protocols. Section 7 focus on Network Security concerns. Section 8 deals with selected Routing protocols like EEGAF &

E-BEENISH. Finally, conclusions of the Paper are presented in section 9.

II. Designing issues in WSN

As shown in Fig. 2.1 There are a lot of WSN issues in realistic situations where nodesface the problems of the deployment, energy consumption, routing, network security, localization, limited storage, reliability, scalability, Non-Line of-Sight (NLOS) and radio interference [3].In this paper consideration takes place mainly on the issue of deployment of nodes, Routing protocols & algorithms, power consumption issue of nodes and Network security problems.

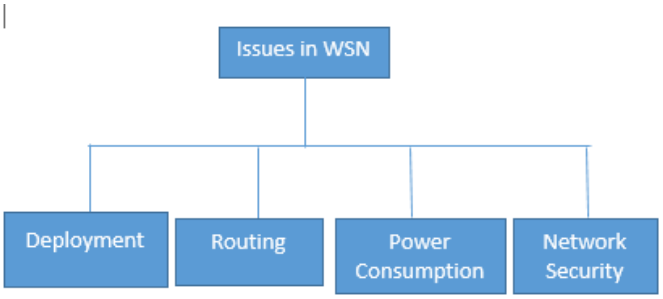


Figure 2.1 Designing issues in WSN

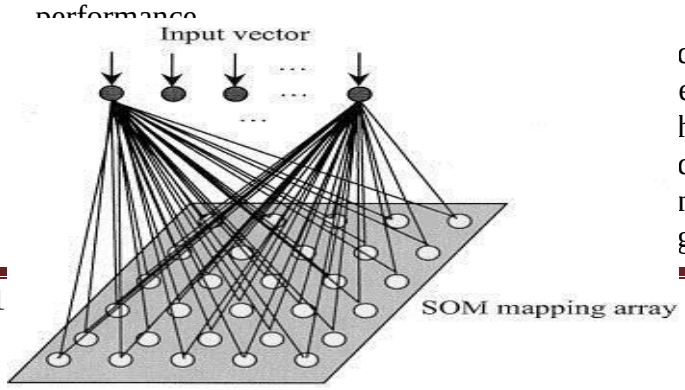
Node deployment is placing sensor nodes that fully covered the target area and ensuring connectivity to the sink node. It is considered one of the most critical problems in implementing WSNs which must meet design specifications, for example, energy consumption, coverage, and connectivity.
Routing represents an essential factor in WSN that ensures data transmission between nodes, routing techniques can include flat routing, hierarchical routing, and location-based routing.
Power consumption is an important factor that must be considered. Scheduling active and sleep modes of sensor nodes after the optimal node deployment minimizes power consumption and prolong the network lifetime.
Also it is an important factor when implementing algorithms in WSNs. Minimizing power consumption per each node (by increasing the network lifetime) can be obtained by decreasing the number of exchanging messages between nodes. In addition, scheduling sleep intervals for redundant nodes, while keeping remaining nodes active to maintain network coverage and connectivity, increase the network lifetime. Besides, decreasing message size transmitted between nodes, selecting the best routing method, and reducing nodes mobility have a good influence in reducing energy in WSN.

Krishnan et al. (1) [4] provided a theoretical calculation of the upper bound for network lifetime using the following Equation:

$$N_{lifetime} = \frac{\sum_{i=1}^{n} c_m(i,j) * l_b(i)}{k_j}$$

Where Kj represents K-coverage with, j = 1, 2, 3 . . . n, cm (i, j) is the coverage matrix and $l_b(i)$ is the lifetime of a sensor battery.

Among the research issues in WSN, security is one of the most challenging. Securing WSN is challenging because of the limited resources of the sensors participating in the network. Moreover, the reliance on wireless communication technology opens the door for various types of security threats and attacks.
Network security is the deployment and monitoring of cyber security solutions to protect your WSN systems from attacks and breaches. It also covers policies surrounding the handling of sensitive information.
A security policy must be able to prevent sensitive information from being modified or retrieved by unauthorized users, but easy enough to administer.
Localization [5] of unknown nodes locations include distance vector hop (DV-Hop) [6], time of arrival (TOA) and received signal strength (RSSI).
Limited storage is a critical problem in WSN that can be resolved with data compression [7] in order to decrease transmitted data size and consequence power consumption per node will be minimized.
Scalability is the network ability to be extended by adding more nodes while maintaining network performance



d e h d n g

(OSR), which outperforms other techniques in scalability and reliability.

Signal strength is a measure of link quality. It utilizes the distance between two nodes to determine node reachability during the communication process. Received signal strength indication (RSSI) describes the strength of a wireless signal and is defined in (2) [9].

$$RSSI = -10 * n * log_{10}(d) + p$$

Where d is the distance from the sensor in meter, n is the propagation constant or path-loss exponent and p is power in reception mode (Dbm).Self-organizing map

Self-Organizing Maps (SOM) are topographic mapswere first introduced by von der Malsburg (1973) and in its present form by Kohonen (1982). SOM is a special neural network that accepts- dimensional input vectors and maps them to the Kohonen layer, in which neurons are organized in a L-dimensional lattice (grid) representing the feature space. Such a lattice characterizes a relative position of neurons with regards to its neighbors that is their topological properties rather than exact geometric locations. The structure of a typical SOMnetwork for 2-D is shown in Figure 3.1.

It has N input nodes and, m-by-m output nodes. Each output node j in the SOFM network has a connection from each input node i and w_{ij} denotes the connection weight between them.

$$Wij\ (t+1) = w_{ij}\ (t) + \mu\ (t)\ (u_i - w_{ij})\ \| u_i - w_{ij} \|\ N\ (j, t)$$

The weights are updated according to this formula. Where w_{ij} is i^{th} the component of the weight vector w (j).η (t)

pattern applied at the input layer , η(t) is the learning rate and N(j,t) is the neighborhood function respectively which is changing in time The learning algorithm captures two essential aspects of the map formation, namely, competition and cooperation between neurons of the Output lattice.

Figure 3.1 Architecture of a SOM Neural Network

COMPETITION

Competition determines the winning neuron, d_{win} whose weight vector is the one closest to the applied input vector. For this purpose the input vector u is compared with each weight vector w_{ij} from the weight matrix W and the index of the winning neuron ηwin is established considering the following formula.

$$\eta_{win} = \text{argminj} \| u - wj \|$$

3.1 COOPERATION

All neurons nj located in a topological neighborhood of the winning neurons will have their weights updated usually with a strength N(j) related to their distance d(j) from the winning neuron, where d(j) can be calculated using the formula

$$d\ (j) = \| pos\ (nj - pos(\eta win)\ \|$$

Where pos (.) is the position of the neuron in the lattice. As the norm city-block distance or Euclidiandistance can be used.

3.2 NEIGHBORHOOD FUNCTION

$$N\ (j, t) = 1 \quad dj \leq D\ (t)$$

$$0 \quad dj > D\ (t)$$

Where N (j, t) is used instead of N (j) since D(t) is a threshold value decreased via a cooling schedule as training progresses. For this neighborhood function the distance is determined considering the distance in the lattice in each dimension, and the one having the maximum value is chosen as d(j). For2-D networks, N(j) corresponds to a square around ηwin having side length=2D (t) +1. The weights of all neurons within this square are

updated with N(j) =1, while the others remaining unchanged. As the training progresses, this neighborhood gets smaller and smaller, resulting in that only the neurons very close to the winner are Updated towards the end of the training. The training ends as remains no more neuron in the neighborhood. Usually, the neighborhood function is chosen as an L-dimensional Gaussian function:

$$N(j,t) = exp\left(\frac{-\mathrm{d}(j)^{-2}}{2\sigma(\mathrm{t})^2}\right)$$

Where σ2 is the variance parameter specifying the spread of the Gaussian function which decreases as the training progresses. Example of a 2-D Gaussian neighborhood function is given in Figure.2.2

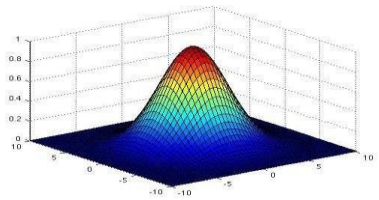


Figure 3.2 Gaussian function

3.3 SOM TRAINING ALGORITHM

1. Assign small random values to weights Wj =[W1j, W2j, ...Wnj]

2. Choose a vector u_k from the training set and apply it as input;

3. Find the winning output node nwin by the following criterion: nwin = argminj ‖u-wj‖ Where ‖.‖ denotes the Euclidean norm and wj is the weight vector connecting input nodes to the output node j;

4. Adjust the weight vectors according to the following update formula:

$$Wij\ (t+1) = w_{ij}\ (t) + \mu\ (t)\ (u_i - w_{ij})\ \|u_i - w_{ij}\|\ N\ (j, t)$$

Where w_{ij} is i^{th} the component of the weight vector$w$ (j).η (t)

5. Repeat Steps 2 through 4 until no significant changes occur in the weights. The learning rate μ(t) is a decaying function of time; it is kept large at the beginning of training and decreased gradually as learning proceed.

III. Power Consumption Issue of WSN

In designing of WSN Many of the challenges revolve around the limited power resources. The size of the nodes limits the size of the battery. The software and hardware design needs to carefully consider the issues of efficient energy use. For instance, data compression might reduce the amount of energy used for radio transmission, but uses additional energy for computation and/or filtering. The energy policy also depends on the application; in some applications, it might be acceptable to turn off a subset of nodes in order to conserve energy while other applications require all nodes operating simultaneously.

Energy consumption is a critical challenge in wireless sensor networks (WSNs), as the sensors are often battery-powered and have limited energy resources. The lifetime of a WSN can be severely impacted by the energy consumption of its nodes, which is why energy efficiency is a crucial aspect in the design of WSNs There are several techniques that can be used to reduce the energy consumption of WSNs, including:

(1):-Duty cycling: This involves turning off the radio of the sensor node during periods of inactivityto conserve energy.

(2):-Power management: By adjusting the transmission power of the radio, the energy consumption of the sensor node can be reduced.

(3):-Data aggregation: This involves collecting and processing data at the intermediate nodes instead of sending all the data to the sink, reducing the amount of data transmitted and thus the energy consumption.

(4): Topology control: This involves optimizing the network topology to reduce energy consumption by minimizing the number of hops between nodes and reducing the distance between nodes.

(5):-Sleep scheduling: This involves putting sensornodes into sleep mode to conserve energy when they are not required to monitor their environment.

Overall, energy consumption is a critical issue in the design and deployment of WSNs, and a range of techniques can be employed to reduce energy consumption and prolong the lifetime of the network.

The sleep scheduling algorithm determines when and for how long a sensor node should be in sleep mode based on the network topology and the application requirements.

In sleep scheduling, the sensor nodes periodically wake up and check if they need to perform any sensing or communication tasks. If there are no tasks to perform, the node goes back to sleep to conserve energy. The duration of the sleep period can be fixed or variable, depending on the network conditions and the application requirements.

Sleep scheduling can be classified into two types: centralized and distributed. In centralized sleep scheduling, a central controller or sink node determines the sleep schedules for all the nodes in the network based on the current network conditions. In distributed sleep scheduling, each sensor node independently decides its own sleep schedule based on local information.

There are several benefits to using sleep scheduling in WSNs, including:

Energy conservation: By putting nodes to sleep when they are not needed, sleep scheduling can significantly reduce the energy consumption of WSNs, which can prolong the lifetime of the network.

Improved network performance: By reducing thenumber of active nodes, sleep scheduling can reduce network congestion and improve network performance.

Adaptability: Sleep scheduling can be adapted to different application requirements and network conditions, allowing for flexible and efficient energy management in WSNs.

However, sleep scheduling can also introduce some challenges, such as increased latency and reduced network connectivity, as nodes may not be available to forward data when they are in sleep mode. Therefore, sleep scheduling should be carefully designed and optimized to balance energy conservation and network performance.

(5):-Energy harvesting: - It is a technique used in wireless sensor networks (WSNs) to supplement or replace the battery power of sensor nodes by using external sources of energy, such as solar, wind, or vibration. Energy harvesting can significantly extend the lifetime of a WSN and reduce the need for frequent battery replacement or recharging.

There are several types of energy harvesting techniques that can be used in WSNs

Solar energy harvesting: This involves using solar panels to capture energy from sunlight and convertit into electrical energy.

Wind energy harvesting: This involves using small wind turbines to capture energy from wind and convert it into electrical energy.

Vibration energy harvesting: This involves using piezoelectric materials that can generate electrical energy from vibrations, such as those produced by machinery or traffic.

Thermal energy harvesting: This involves using thermoelectric generators that can generate electrical energy from temperature differences.

RF energy harvesting: This involves using radio frequency (RF) waves to capture energy from the environment, such as those produced by Wi-Fi or cellular networks.

Energy harvesting can be integrated into the sensor node design or added as an external module to the node. The harvested energy can be used to powerthe node directly or to charge a battery that can be used to power the node when the harvested energyis not sufficient.

Energy harvesting can offer several benefits to WSNs, including:

Extended network lifetime: By supplementing or replacing battery power, energy harvesting can significantly extend the lifetime of a WSN.

Reduced maintenance: Energy harvesting can reduce the need for frequent battery replacement or recharging, reducing maintenance costs and efforts.

Increased sustainability: Energy harvesting can reduce the environmental impact of WSNs by reducing the need for batteries, which can be difficult to dispose of and harmful to the environment.

However, energy harvesting also has some limitations, including the limited amount of energy that can be harvested and the variability of energy availability in the environment. Therefore, energy harvesting should be carefully designed and optimized to balance the energy requirements of the WSN with the available energy in the environment.

IV. Wireless communication protocols

Its play a crucial role in enabling communication between sensor nodes and the sink node in wireless sensor networks (WSNs). There are several wireless communication protocols that are commonly used in WSNs:

(i) :--IEEE 802.15.4: This is a low-power, low-data-rate wireless communication protocol that is commonly used in WSNs. It operates in the 2.4 GHz, 868 MHz, or 915 MHz frequency bands and uses a low-complexity modulation scheme to conserve energy.

(ii) :-ZigBee: This is a low-power, low-data-rate wireless communication protocol that is based on the IEEE 802.15.4 standard. It is designed for applications that require low-latency communication, such as home automation and industrial control.

(iii) :-Bluetooth Low Energy (BLE): This is a low- power, low-data-rate wireless communication protocol that is commonly used in consumer electronics and IoT applications. It operates in the
2.4 GHz frequency band and is designed to provide high-throughput communication with low energy consumption.

(iv) :-Wi-Fi: This is a high-data-rate wireless communication protocol that is commonly used in WSNs for applications that require high-throughput communication, such as video surveillance and multimedia streaming. It operates in the 2.4 GHz or 5 GHz frequency band and uses a high-complexity modulation scheme to achieve high data rates.

(v) :-Lora WAN: This is a low-power, wide-area wireless communication protocol that is designed for long-range communication. It operates in the sub-GHz frequency band and uses a low- complexity modulation scheme to achieve long- range communication with low energy consumption [10].

(vi) :-NB-IoT: This is a cellular-based wireless communication protocol that is designed for IoT applications. It operates in the licensed cellular frequency bands and provides reliable and secure communication with low energy consumption.

The choice of wireless communication protocol in a WSN depends on the application requirements, the network topology, and the energy constraints of the sensor nodes. Some protocols are more suitable for low-power, low-data-rate applications, while others are better suited for high-throughput or long-range communication. The use of the appropriate protocol can significantly improve the performance and energy efficiency of the WSN. Routing protocol

Wireless Sensor Networks (WSN) are a group of small devices called sensors that are distributed over a region to sense and collect data, process it, and send it to a base station or a central node. Routing protocol plays a crucial role in the

communication process of WSNs by determining the most efficient and reliable paths to transmit datafrom the source to the destination [11]. There are several routing protocols used in WSN, some of the most commonly used ones are:

(i):-LEACH (Low Energy Adaptive Clustering Hierarchy): LEACH is a cluster-based routing protocol, which divides the sensor nodes into clusters and rotates the role of cluster head to balance the energy consumption among the nodes. It is a popular protocol for energy-efficient datatransmission in WSN.

(ii):-TEEN (Threshold sensitive Energy Efficient sensor Network protocol): TEEN is an event- driven protocol, where sensor nodes only transmit data when a specific event occurs. It saves energy by eliminating redundant transmissions.

(iii):-SPIN (Sensor Protocols for Information via Negotiation): SPIN is a query-based protocol, which allows nodes to request data from other nodes only when they need it. It reduces the amount of unnecessary data transmission, which helps to save energy.

(iv):-Directed Diffusion: Directed Diffusion is a data-centric protocol, where sensor nodes directly communicate with the sink node through a directed diffusion process. It reduces the number of messages transmitted by eliminating the need for control messages.

(v):-AODV (Ad-hoc On-demand Distance Vector): AODV is a reactive protocol, where nodesonly establish a route when needed. It is a popular protocol for mobile WSNs, where nodes frequently move. These are some of the most commonly used routing protocols in WSNs, and their selection depends on the requirements of the application, such as energy efficiency, delay, reliability, and scalability.

V. Network security

Network security is an important consideration in wireless sensor networks (WSNs) to protect against unauthorized access, data interception, and tampering. Because sensor nodes are often deployed in harsh environments and are vulnerable to physical attacks, security mechanisms must be designed to protect the network against a wide range of threats.

Some of the key security measures that can be used in WSNs include:

Encryption: Data encryption is an essential security measure in WSNs, as it ensures that the data transmitted between the sensor nodes and the sink node is secure and cannot be intercepted by unauthorized parties. Encryption algorithms such as Advanced Encryption Standard (AES) or Lightweight cryptography can be used to provide end-to-end encryption.

(a):-Authentication: Authentication is used to ensure that only authorized nodes can access the network. This is done by using mechanisms such as digital signatures, message authentication codes (MAC), and secure key exchange protocols to authenticate the nodes.

(b)-Access control: Access control is used to control access to the network and limit the actions that each node can perform. This can be achieved using techniques such as role-based access control, attribute-based access control, and access controllists.

(c)-Intrusion detection: Intrusion detection systems can be used to detect and respond to security breaches in the network. This involves monitoring the network traffic for anomalies and

suspicious behavior and taking appropriate action when a breach is detected.

(d)-Physical security: Physical security measures can be used to protect the sensor nodes from physical attacks, such as tampering or theft. This can include using tamper-proof casings, installing the nodes in secure locations, or using surveillance cameras to monitor the nodes.

(e)-Secure communication protocols: Secure communication protocols such as ZigBee Security, 6LoWPAN Security, and IPsec can be used to provide secure communication between the sensor nodes and the sink node.

(f)-Time synchronization: Time synchronization is a critical aspect of WSN security as it helps to prevent attacks such as replay attacks and enables accurate event detection. Time synchronizationprotocols such as RBS and TPSN can be used to synchronize the clocks of the sensor nodes [12].

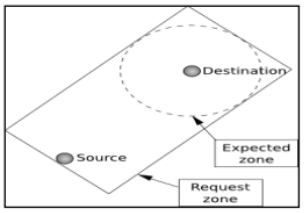
In summary, network security is a critical consideration in WSNs. By using a combination of encryption, authentication, access control, intrusion detection, physical security, and secure communication protocols, designers can create a secure and reliable network that can operate effectively in harsh environments.

VI. Review and analysis in Energy efficient Routing Protocols

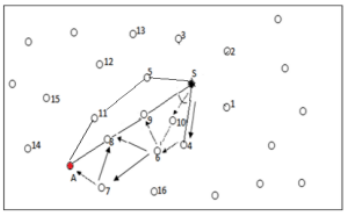
One of the most challenging tasks of mission-critical sensors and sensor networks is the development of energy efficient (EE) routing protocols. In this section three routing algorithm are described-

(A)- EEGAF is used to enhance the discovery stage and reduces the energy utilized by nodes as a part of discovery state & also optimizes the data sending by using location aware multicast data sending protocol called Location Aided Routing (LAR) to decrease consumption of energy by nodes & enhance network lifetime. Execution of this protocol i.e. Energy Efficient Geographic Adaptive Fidelity (EEGAF) protocol is done utilizing MATLAB [13].

EEGAF in which LAR i.e. Location (Area) – Aided Routing is used for data sending phase, it is an location aware routing protocol that uses the location data for enhancing the productivity of routing by diminishing the control overhead. LAR uses flooding; however flooding is confined to a little geological district. LAR assigns two locales a) Expected zone b) Request zone in fig 8.1. The Expected Zone is the district in which the destination node is relied upon to be available. The Request Zone is a topographical district inside which the way discovering control parcels are allowed to be proliferated. They utilize area data to guide directing disclosure and support and in addition bundle sending, consequently empowering the best routing to be chosen, diminishing energy utilization and streamlining the entire network. LAR uses location aided & multicast technique for data sending as shown in Fig 8.2 & Fig 8.4.

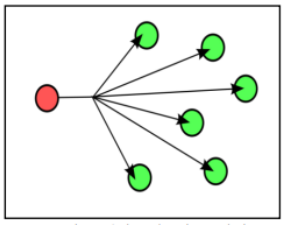


Location-aided routing Figure 8.1

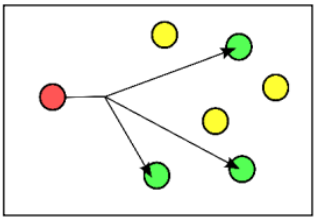


location aided data sending Figure 8.2

Broadcasting in Fig 8.3 is the synchronous transmission of the same message to various beneficiaries. In systems administration, broadcasting happens when a transmitted information bundle is gotten by all system gadgets. Vitality Consumption is more and Security issues may emerge amid broadcasting and lead to information misfortune if a system is assaulted by interlopers. In non-systems administration or electronic television, the term TV signifies the exchange of sound and feature information in the middle of hubs and gadgets.



Broadcasting technique
Figure 8.3



Multicasting technique
Figure 8.4

So, in EEGAF we uses location aware multicast technique as shown in Fig.4 for data sending after the improvement in the discovery phase and both improvements leads to reduction in energy consumption & increase in network lifetime.

(B)- An enhanced balanced energy efficient network- integrated super-heterogeneous (E-BEENISH) routing protocol, by analyzing communication energy consumption of the clusters and a large range of energy levels in heterogeneous WSNs. [14]

Two types of environments are defined as homogeneous and heterogeneous in WSNs [15], [16]. Recently, several heterogeneous routing protocols, low-energy adaptive clustering and energy management have become available [17]–[18]. The stable election protocol (SEP) is the selection probability that the cluster head (CH) is based on the residual energy in each node, which is used to prolong the time interval before the death of the first node [19]. Qing et al. [20] has developed a heterogeneous energy-efficient (EE) clustering scheme distributed for one heterogeneous WSN, referred to as distributed energy efficient clustering (DEEC). The difference between DEEC & SEP is that the CH is selected by the probability of the ratio of the residual energy to the average energy of the network. The time to become the CH depends on the initial energy and residual energy of the node. Saini and Sharma [21] proposed enhanced DEEC (E-DEEC) for three kinds of nodes that extends the lifetime and stability of the network in, which follows the DEEC philosophy and increases heterogeneity through adding another node called super node. In [22], a centralized energy-efficient clustering (CEEC) routing protocol was proposed. The CEEC divides the network into three equal areas, in which nodes with the same energy are distributed in the same area. After analyzing the energy consumption of communication, the cluster and the wide range of energy levels in the heterogeneous WSNs led to proposal of the balanced energy-efficient network integration super heterogeneous (BEENISH) protocol [23], in which it is assumed that the WSNs have four node levels, and that the CH is selected according to the residual energy level of a node.

The E-BEENISH routing protocol assumed that the WSNs have four energy levels, and the CH is selected according to the residual energy level of the node. In WSNs, a large number of energy levels are generated due to the random selection of channels. Therefore, quantifying more energy levels and defining different probabilities for each energy level will result in better performance and improve energy efficiency. For the first time, a four-level heterogeneous network concept with normal nodes, advanced nodes, super-nodes, and ultra-super nodes is used.

The proposed E-BEENISH algorithm operation is divided into three different stages.

(1) Broadcast: - The node selected as the cluster head of the current round will broadcast messages to the remaining nodes. For this stage, the cluster head uses the Carrier Sense Multiple Access (CSMA) MAC protocol [24]. The principle of Carrier Sense Multiple Access/Collision Detection (CSMA/CD) which be applied in the second OSI (Open System Interconnection) layer, is to listen for whether the channel is idle before sending data, and to send data immediately if it is idle. If the channel is busy, CH will wait for a period of time until the end of information transmission. It is determined as a conflict when two or more nodes have made transmission requests at the same time after the transmission of the previous information is finished. If a

conflict is detected, it will immediately stop sending data, wait for a random period of time, and then try again. After this phase is completed, each non-cluster head node determines which cluster it will belong to in this round. The decision is based on the received signal strength of the broadcast.

(2) Set-up Cluster After each node decides which cluster it belongs to, it must notify the cluster head that it will become a member node of the cluster. Each node uses CSMA MAC protocol to send this information back to the cluster head again. At this stage, all cluster head nodes must keep their receivers on.

(3) Data Transmission Once a cluster is created and TDMA (Time Division Multiple Access) scheduling is fixed, data transmission can be performed. Assuming that nodes always have data to send, they will send the data to the cluster head within the allocated transmission time slot. The transmission uses the least amount of energy (the radio of each non-cluster head node can be turned off until the node allocates the transmission time, thus minimizing the energy consumption of these nodes). The cluster head node must keep its receiver on to receive all data from the nodes in the cluster set.

The CH selection hierarchy diagram of the proposed E-BEENISH algorithm based on AHP is shown in Fig-

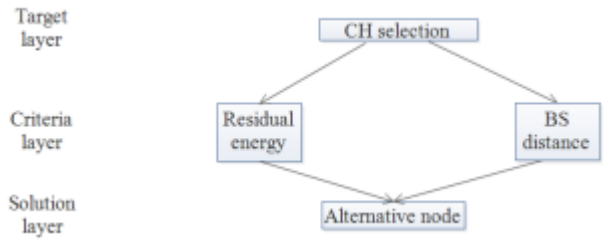


Figure 8.5 CH selection hierarchy diagram

Once the cluster is created and the TDMA schedule fixed, data transfer can begin [25]. Assuming that the node always has data to send, it will send the data to the CH within the allocated transmission slot. Each non-CH node can be turned off until the node allocates the transmission time to minimize the energy consumption of nodes. The CH receiver remains turn on to receive all data from the nodes in the cluster set. The algorithm is shown in Fig-

According to the four-layer heterogeneous algorithm, which takes into account the distance, residual energy, and weight, the CH is selected by comparing the distance between a node and the initial energy of the node. Nodes which are closer to the sink node and have higher initial and residual energy will be selected as CHs.

In this paper, discussed E-BEENISH that uses single-hop communication for four-level heterogeneous WSNs, improving the lifecycle of the WSNs, the number of stable regions and throughput, through an improved new threshold algorithm. Moreover, in order to make full use of the network energy, the ratio of the remaining energy to the global average energy and the ratio of the distance from the member node to the BS and the CH to the BS are weighted as a scheme for selecting the CH.

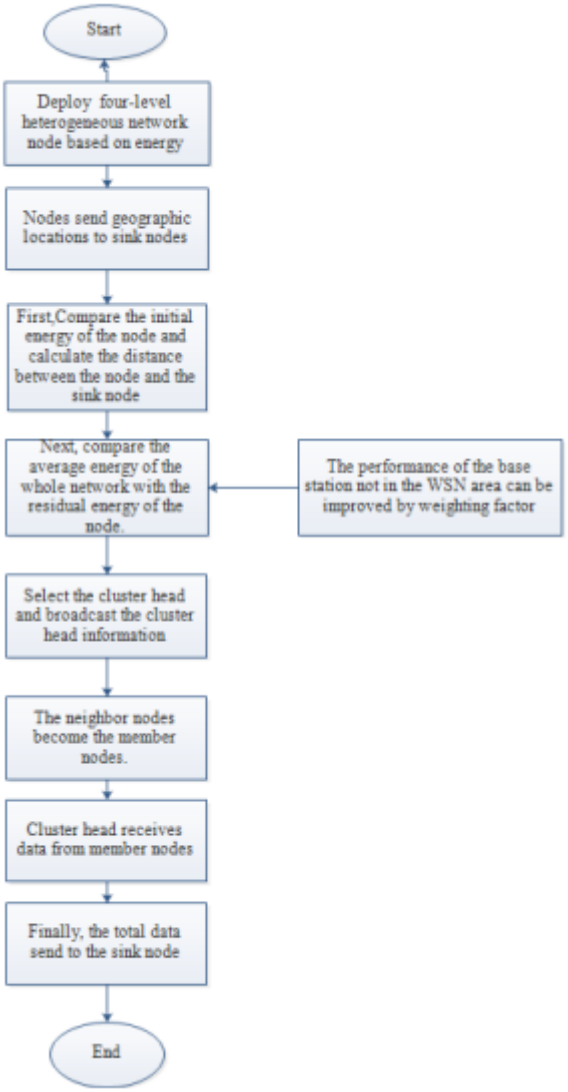


Figure 8.6 a scheme for selecting the member node to the BS and the CH to the BS

(C)- An energy-efficient protocol based on semi- random deployment algorithm ensuring better quality of service and connectivity in wireless sensors networks, a protocol that aims to optimize coverage and network connectivity while minimizing the energy consumption of sensors during information exchange [26].

Assumptions

In this work, it was assumed that:

• The area of interest is a square of side C;

• The area of interest must be divided geographically by Nz sub-areas of dimension L×L and diagonal D as shown in Figure 1;

• Using [27], the number of CHs can be estimated;

• All the sensor have the same sensing range and the same communication radius and are able to know in which sub-area it has been deployed.

First Stage: Area Coverage Procedure

The first stage of our solution consists in covering as much as possible the AoI in order to collect a maximum number of information. To achieve this, we proceed as follows:

• First deploy deterministically the different CHs in the AoI such as d (CHi, CHj) ≤2Rc and such as each CH is placed at the center of its sub-area;

• Static nodes are then randomly deployed in the AoI. The idea here is to allow each sensor to belong to the cluster of a CH;

• Application of ICP [27] to initiate clustering. In ICP, acknowledgments are deleted in order to reduce energy consumption during the clustering process. But in our case, acknowledgments will be allowed in order to permit to each sensor to send an acknowledgment to its CH. So, the clustering process becomes:

– Each CH broadcasts its id to neighbor's sensors;

– If a sensor receives one message from one CH, it becomes a cluster member (CM) of this CH; but if it receives many messages from many CH, it becomes a gateway (GW) node for all the clusters of these CH;

– Sensors can then send an acknowledgment to the CH containing its id, its role (CM or GW) and the identifier of the sub-area in which it is located;

– When a CH receives an acknowledgment, it increments the variable nzc;

– After reception of all acknowledgments, each CH then broadcasts the ordered list of its cluster's members to all its cluster's members with parameters Ti , Ts, Tc and Nc. Thus, each sensor will be able to know its CH and all its neighbors in a cluster.

Second Stage: Node Scheduling Algorithm and Sending Data to the Base Station

In this section, paper describe how the nodes will be scheduled in order to collect and send data to the base station. Since normal nodes and CH are

scheduled differently, thus propose two algorithms that will permit us to manage both CH and normal nodes simultaneously.

Normal Nodes Scheduling Algorithm and Sending Data to the CH

Each node has in its memory the ordered list of its neighbors; so it knows when it should wake up and begin collecting or sending data. According to our notations, a normal node remains awake during Ti. We therefore pose Ti = Ts + Tc. So, a normal node executes these instructions when it is awakened:

1) It starts by computing the next time after which it should be awaken with the formula: Tne=(Nc-1)Ti ;
2) If this node has data collected previously in its memory, it sends it to its CH and waits for an acknowledgment during the time Ts;
3) It remains awake during the time Tc waiting for an event to occur in the AoI;
4) The sensor falls asleep after Ti.

The pseudo-code of our description above is given by the algorithm 2.

Algorithm 2 Normal nodes scheduling algorithm and sending data to the CH

1: Begin
2: Computation of Tne.
3: if node has data in its memory then
4: Sending data to the CH during Ts.
5: Stay awake during Tc.
6: Fall asleep after Ti.
7: end if
8: if node has no data in its memory then
9: Sending data to the base CH during Ti.
10: Fall asleep after Ti .
11: end if
12: End

CH Scheduling Algorithm and Sending Data to the Base Station

Our solution recommends that every TsSB, a CH must send data to the base station. TsSB is computed with the formula: TsSB = Nc*Ts; which means that, after one round of diffusion of its cluster members, it starts sending data to the base station. Before sending these data, the CH starts by executing the second part of the DSMAC algorithm [28] which will permit them to synchronize sensors belonging to the path relying the CH and the base station by sending beacon frames. This will permit us to know all the nodes that will remain awake during the transmission of data to the base station. The CH can then initiate the transmission. Algorithm 3 describes the pseudo-code of this solution

Algorithm 3 CH scheduling algorithm and sending data to the base station

1: Begin
2: i=1.
3: while i ≤ Nc do
4: Waking up every Ti and stay awake during Ts.
5: Receive data from a normal node and send an acknowledgment to this node.
6: T = Ts*i.
7: if T == TsSB then
8: Determining the nodes in charge of forwarding data to the BS.
9: Sending data to the BS.
10: i=1.
11: end if
12: if T 6= TsSB then
13: i=i+1.
14: end if
15: end while
16: End

energy-efficient protocol based on semi-random deployment algorithm ensuring better quality of service and connectivity in wireless sensors networks, a protocol that aims to optimize coverage and network connectivity while minimizing the energy consumption of sensors during information exchange. To solve the problem, our protocol takes place in two phases: we firstly present our approach to guarantee full coverage of the AoI based on both deterministic and random deployment of sensors, and secondly, we use an algorithm similar to the one presented in [29] to schedule normal nodes and CHs during the phase of collecting data in the monitored area and the phase of sending data to the base station. The proposed approach has been compared with several other approaches in the literature in term

of energy consumption, total number of transmissions and average number of packets received by the BS. Experiments show that our solution is better than the other approaches, guarantees connectivity, reduces the number of transmissions and messages and avoids collision of messages

IX.Conclusions

The distributed Wireless Sensor Networks are essential for an effective monitoring and tracking applications. The most important issue in the designing of sensor network is the placement of sensors at suitable points so that we can grab most of the information of the target area. First an algorithm based on neural network has been developed for the given deployment problem. In future approach can be extended to 3 dimensional Wireless Sensor Networks in context to deployment. It can be also optimize the number of sensors which are needed to sense the event distribution in target region. Further since the problem basically concerns with non-uniform event distribution, in this paper there is also discussion about Power consumption issue of sensor nodes, Wireless communication protocols, routing protocols and Network security issue. This paper describe various communication & routing protocols with specification and area of application that can be designed for the wireless sensor networks. Finally there is discussion about Network Security issue & a Review for Routing algorithm, in first technique is used to enhance the discovery stage and reduces the energy utilized by nodes as a part of discovery state. While in Second technique analyze energy consumption of the clusters and a large range of energy levels in heterogeneous WSNs. sothat we can increase our network life time and attain a robust WSN, third technique describes optimize coverage and network connectivity while minimizing the energy consumption of sensors during information exchange.

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