Overview of Strategies and Metrics of Node Deployment in WSN
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Abstract—Today Wireless Sensor Network are being useful in various civilian applications like habitat monitoring, vehicle tracking, earthquake observation, forest surveillance or health care applications and building surveillance. Node deployment is a fundamental issue that is to be solved in Wireless Sensor Networks. A proper node deployment system is not only decreases the network cost but also increases degree, coverage and lifetime of a WSN. In this paper, random and deterministic node deployment for large-scale WSN under the following metrics coverage, energy consumption and worst case delay are discussed with three challenges uniform random, a square grid and Tri-Hexagon Tiling (THT) node deployment. In this paper various WSN node deployment modes are discussed and a literature work of various node placement algorithm is presented.

Key words: WSN, Sensor Nodes, Coverage, Energy Consumption, Worst Case Delay, Node Deployment

I. INTRODUCTION
Wireless Sensor Network consists of group of low cost, low power, multifunctional and small size distributed sensor network. The latest technology development achieved in microelectronic, network and communication. It was developed by military application like robotic exploration, health monitoring application, forecasting system, monitoring of human physiological data etc. For example in military WSN can be to monitor any activity. It has different types of wireless network application fields such as Bluetooth, cellular network and wireless LAN. The Day by day use of WSN has increased and at the same time it faces the problem of energy constraints in terms of limited battery lifetime. A WSN consists of sensor nodes that are able to perform sensing, computation and transmission. (Gayarti Devi, 2016)A WSN composed by hundreds or thousands of sensing nodes with shorter distance between adjacent nodes and low application data rate. The data is progressed possibly via multiple hops to a sink that can use it locally or it is connected to new networks (e.g., the Internet) over a gateway. They can be responsive of their position or not. Sensors are typically used to study the physical environmental behaviour like temperature, pressure, sound, moisture, vibration and changes in the health parameter of person. Energy consumption in a transmission in WSN is directly quantity to square or forth power of the distance from source to destination node. Sink is a class and function designed to receive incoming events from another object and function. It is implemented in C++ and java. It can be measured the end point or output point. There are many different network and nodes that want to connect to each other. They need to get manage at every level of transaction. Hence, the wide networks have strictly follow the managerial node for continuous or periodic survey and awareness of these nodes. These nodes are called as Data Sink.

The advantages and disadvantages of wireless sensor networks can be summarized as follows:

A. Advantages:
- Network systems can be done without fixed infrastructure.
- It can contain new devices at any time.
- It can be accessed through a centralized monitor.
- The cost is cheap.
- Avoids a lot of wiring.
- Infrastructure

B. Disadvantages:
- Comparatively low speed of statement.
- More complex to configure than a wired network.
- Cost is large
- Life of nodes
- Energy life
- Less secure

Fig. 1: Wireless Sensor Network
The three performance metrics are: coverage, energy consumption and worst case delay.

- Coverage: For the following type of application the data accuracy must be target for the minimum K- coverage and for inconsistent network rather than focusing on minimum k-coverage. We analyse the relative frequency of exactly k-coverage point by using k-coverage map of the network. Hence, the measure typical of k-coverage and the standard deviation of accurately k-covered points.
- Energy consumption: Since the most demanding issues in WSN is energy it is essential to optimize energy consumption in numerous ways. Energy consumption can be reduced by using proper node deployment scheme and enhance the lifetime of WSN.
- Worst case delay: Usually the maximum acceptable messages transfer delay must be surrounded in order to enable time – sensitive application of WSN. By using the sensor network calculus, we measure the worst case end to end delay for each flow and discover the maximum worst case delay in the sensor field.

The rest of paper is organized as follows: In section 1 basic introduction of WSN has been discussed. Section 2 gives review of related work, section 3 gives an overview about deployment and its types. Section 4 includes conclusion about node deployment model. The required reference for this paper are included in section 5.
II. RELATED WORK

(L.Lloyd, 2007) Author solved the problem of single-tiered and two-tiered relay node placement in WSN. First, we were presented a polynomial time approximation ratio is between 6 and 7. Secondly, they given a framework for a combined similarity algorithm for the minimum geometric disk and Steiner minimum tree with minimum number of Steiner points and limited edge length problem. The best algorithm of constant (5+€) approximation algorithm and randomized approximation algorithm was (4.5+€).

(Jena M., 2012) PSO algorithm was used to address node placement algorithm. Node placement was an important task in wireless sensor network (WSNs). It was a comparatively current heuristics search method that was based on collaborative behaviour and swarming in biological population. It was like Genetic algorithm shared among their population member to enhance processes used a combination of deterministic and probabilistic rules. The PSO was developed by Kennedy and Eberhart in 1995, it is motivated by social behaviour of bird flocking or fish schooling. It is a simple, effective and computation efficient optimization algorithm. This algorithm has been used in various distribution networks, military applications and environmental monitoring. It is a based method for solving discrete and continuous optimization problem. It is a computational technique that optimizes a problem by iteratively. It trying to improve a candidate solution with regard to a given measures of quality. It solves a problem by having very large spaces of candidate solutions and moving these elements around in the search space giving to simple mathematical methods completed the particles position and velocity.

(O. Banimelhem, 2013) Proposed a genetic algorithm which is based on finding optimal or near optimal solution for Coverage Hole Problem. The author defines the situation when a group of sensing nodes do not work properly and do not sense the data and communication then it is a problem of hole in the network (Rakesh Kumar, 2013). The performance of the network are affected or degraded by the holes in the network. Thus, the point of area coverage place an important role in sensor networks and there connectivity.

(Jena, 2013) Proposed multi-objective ACO based multi-objective methodology for node placement. The authors considered a fixed wireless network of sensors of different operating modes for a 2D grid based deployment. Their approach decided which sensors should be active, which one should operate as cluster-in-active charge and whether each of the remaining active normal nodes should have medium or low transmission range. The writers concluded that it is better to operate a relatively high number of sensors and realize lower energy consumption for communication resolutions than having less active sensors with therefore larger energy consumption.

(Pratyay Kulia, 2014) Proposed a novel differential evolution based clustering algorithm for wireless sensor network called DECA. The main objective of DECA is to execute the network lifetime of WSN by energy consumption of sensor nodes and cluster head (CH). We have also resulting an efficient fitness function for approach network lifetime. The fitness function take care of energy consumption of sensor nodes and gateway. This result show the algorithm faster than the traditional DE and GA. The better work of exiting algorithm like DE and GA, LBC and GLBC in terms of network life, energy consumption and decrease the number of sensor nodes.

(Y. Bendigeri, 2015) Proposed work was intended to concentrate on different placement of nodes like random, grid and circular based scenario of a network that was worked to save the energy consumed by the network on par with sensor nodes and increase the network lifetime. It was found that random deployment strategies cover less area with more number of nodes that are deployed with unable distances which results in more utilization of energy. In Grid and circular deployment network node are deployed at equal distances have cover larger area with less number. Proved by energy utilization will be less with increase in network lifetime.

<table>
<thead>
<tr>
<th>Problem domain</th>
<th>PSO</th>
<th>ACO</th>
<th>GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimal node deployment</td>
<td>Centralized nature.</td>
<td>Distributed nature of ACO.</td>
<td>Good for random deterministic node deployment.</td>
</tr>
<tr>
<td></td>
<td>PSO minimize.</td>
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<td></td>
<td>Coverage holes of stationary in area.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data aggregation</td>
<td>It is quit suitable for PSO</td>
<td>Largescale and dynamic.</td>
<td>Suitable only for minimum number routing data to the base station.</td>
</tr>
<tr>
<td>Energy-efficient clustering and Routing</td>
<td>Performance better. Selected CH node (high energy node). Find optimal efficient in each round.</td>
<td>Lifetime network and data delivery to Base station- maximize.</td>
<td>Number of predefined cluster help to reduce overall distance in minimum.</td>
</tr>
</tbody>
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Table 1: Comparison

III. DEPLOYMENT

It can be process consists of several organized activities with possible transition between them. It can be defined as any type of installation, e.g. active a new network connection, build a server, and install a software etc. Deploy can be defined as the process of installation of any software, a new network or server, to organize the environment potentially...
or manage them strategically. The word implementation is sometimes used to mean the same thing.

A. Types of Deployment

Mainly two types of deployments in WSN are:

1) Static Deployment

In static deployment is no changes of location of the sensor nodes in the WSN. It can be further categorized into deterministic and randomly deployment.

2) Dynamic Deployment

Dynamic deployment is a strategy to get the maximum performance in WSN to attain better performance sensor nodes automatically move to a proper location and start working various algorithms for dynamic deployment strategies are

- Virtual force algorithm
- Virtual force oriented particles algorithm
- Particle swarm optimization

B. Node Deployment Models

The design phase of WSN, designer knows the number of sensor nodes, n, that are deployed in either deterministic or random. Three node deployment strategies are:

- Uniform Random
- Square Grid
- Tri-Hexagon Tiling (THT)

1) Uniform Random

Every sensor is being placed at any point in a given field with equal probability. Example of this technique is scattering the nodes from an aeroplane on different location. In (Devi, 2015) it is asked that a URD outperforms both grid and Poisson distribution deployment for k-coverages. The Poisson distribution can be used number of events occurs such as distance, area and volume. If the author has described certain random variables that count the number of occurrences during a specific time interval of given length. He stated that expected number of occurrences in this interval is \( \lambda \), and there are exactly k-occurrences (k=0, 1, 2, ...).

2) Square Grid

The grid layouts can be a square or hexagon or equilateral triangle, etc. Uses a design process which is based over a unit square. The WSN is grid based deployment has a good coverage performance. Thus the generally view of random node deployment in circular, square and rectangular field is shown in figure 2. The length of a unit square d

![Fig. 2: Overall view of Square grid](image)

![Fig. 3: The overall view of Square Grid Deployment for Circular Field](image)

Where each of the n grid points hosts a sensor i.e. we place one sensor at each grid point, which is shown in figure 3.

3) Tri-Hexagon Tiling (THT)

It is based on tiling. A tiling is the layer of the integrated plane with shapes that do not overlap any gap. Tiling are also called tessellations. In tiling every vertex uses the same set of regular polygons. A regular polygon have the same side lengths and interior angles. The two dimensional plane uses the triangle and hexagon in semi-regular tiling, are called 3-6-3-6 Tri-Hexagon.

IV. CONCLUSION

WSN is one of the developing research area. It is composed of many homogeneous and heterogeneous sensors. It consists of various sensor nodes that are able to perform identifying, computation and transmission. There is comparative of PSO, ACO and GA. The performance metrics such as coverage, energy consumption and worst case and strategies of node deployment model are discussed.

REFERENCES