Volume 4, Issue 3, March 2014 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

# Maximum Area Coverage in Wireless Sensor Network: A Survey

**Gursharan Kaur[1], Rajdeep Kaur3**
*Computer Science and Engineering*
*[1]SGGSWU, Fatehgarh Sahib, India*

**Amandeep Kaur Virk[2]**
*Computer Science and Engineering*
*[2]Assistant Professor, SGGSWU, Fatehgarh Sahib, India*

***Abstract- Wireless Sensor Networks (WSNs) are particular type of ad-hoc network which consist of number of sensor nodes equipped with a sensor unit, wireless communication unit, a battery power unit and programmable embedded processor. Wireless Sensor Networks have a wide range of applications in Military, Environment and Scientific applications such as vehicle tracking, Habitat monitoring, Earthquake observation and Health monitoring. Coverage is one of the most active areas of research in WSNs. In Wireless sensor network coverage is defined as how long the placed sensors are able to maintain the physical space. In this paper we take a Survey about the research work that has been done in this area.***

***Key words: Wireless Sensor Networks, Coverage, Nodes, Range, Space.***

## i. Introduction:

Wireless Sensor Networks (WSNs) is a distributed system which is composed of tiny, low-cost, battery-operated sensor nodes that collaborate together for the purpose of achieving certain task such as environment monitoring and object tracking [1]. Wireless Sensor Networks (WSNs) are useful for military, environment and scientific applications such as vehicle tracking, habitat monitoring, forest surveillance, earthquake observation, biomedical, building surveillance, monitoring, home automation and many others [2]. A typical large-scale WSN generally consists of one or more sinks (or base stations) and tens or thousands of sensor nodes that have organized themselves into a multi-hop wireless network and deployed either randomly or according to some predefined statistical distribution over a geographical region of interest.[3] Large amount of wireless sensor are deployed on the ground and their data are transmitted back to the base station to provide the necessary monitored information either manually or dynamically without human involvement [4]. Coverage in wireless sensor nodes in the region of interest is one of the key issues in wireless sensor networks. Optimal coverage of nodes is favorably to the maximum possible utilization of the available sensors [8].

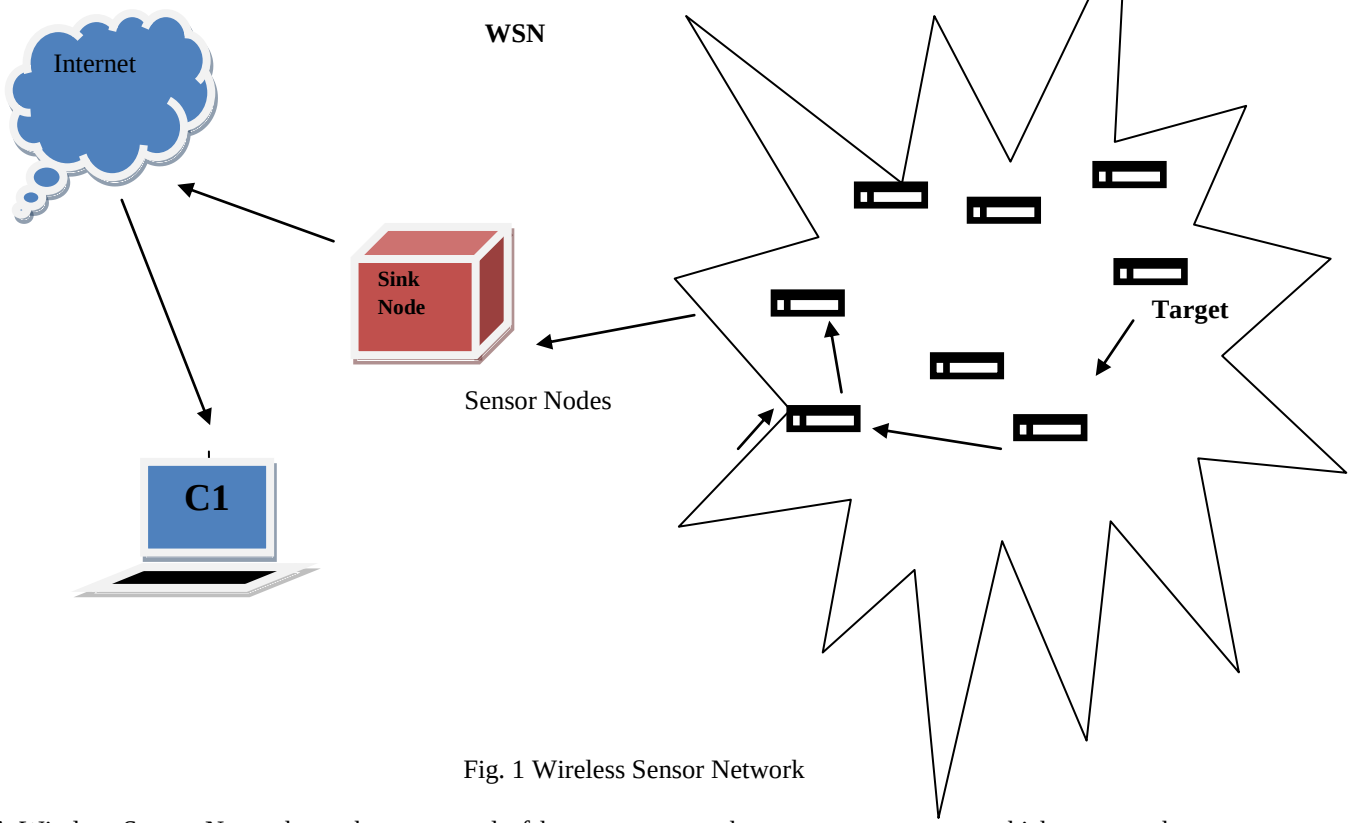


Fig. 1 Wireless Sensor Network

A Wireless Sensor Network can be composed of homogeneous or heterogeneous sensors, which possess the same or different communication and computation capabilities, respectively. Fig 1 shows the heterogeneous sensor network [16].

 

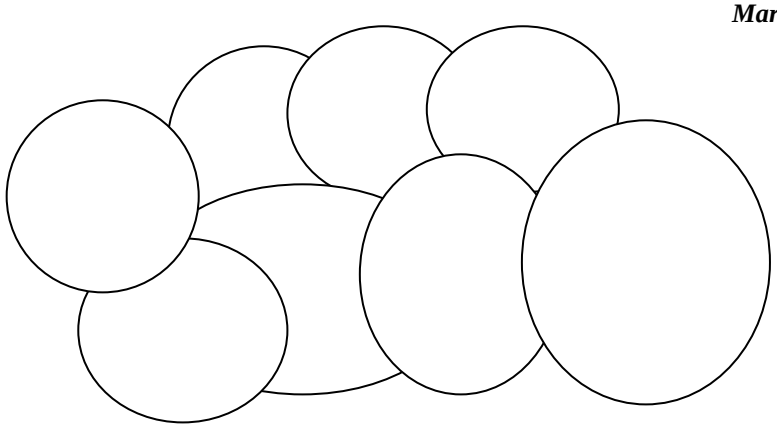

Fig. 2 Heterogeneous sensors

### ii. Related Work

As an important issue in research, the coverage problem has been studied, and many solutions have been proposed. Some solutions focus on pure coverage problems to describe the coverage of wireless ad hoc networks. Some algorithms and protocols are designed for the maximum coverage in WSNs. We surveyed existing methods and their contributions which address various research objectives in the coverage problem. In the following subsections we will present about the algorithms, their assumptions and results.

***Haung et al. in 2003*** [5] introduced k-covered problem so that to determine if every point in a given area is sufficiently covered by at least k-sensors. Author proposes a polynomial-time algorithm in terms of sensors that can be easily translated to distributed protocols. Author have solutions into versions of the coverage problem namely k-UC and k-NC, in a wireless sensor network.

***Ab Aziz nor Azlina Bt. in 2007*** **[6]** studied Particle Swarm Optimization (PSO) and Voronoi Diagram for WSNs Coverage Optimization**.** According to author Coverage problem was a crucial issue in wireless sensor networks. In this paper we propose a new algorithm to optimize sensor coverage using PSO. PSO is a search algorithm which can be used to look for optimal solution in a given search space. It is based on how a flock of birds work together to find food in an area. These birds, directed by the result of their own search and other birds' successes, will move around the search space to find food. The birds were represented in PSO algorithm by a swarm of particles. Voronoi diagram is partition of sites in such a way that points inside a polygon are closer to the site inside the polygon than any other sites. Combination of PSO with voronoi Diagram can be used to optimize the coverage problem in WSN. We conclude that PSO algorithm works better when the number of sensors was high.

***Coskun Vedat in 2008*** **[7]** studied Relocating Sensor Nodes to Maximize Cumulative Connected Coverage WSNs**.** According to author proper usage of power capacity of sensor nodes was important to extract maximum information from the surveillance area and to extend the availability of Wireless Sensors Network. So, a new dynamic relocation algorithm was described called MaxNetLife, which utilizes the total power of each individual sensor node and also relocating sensor nodes to ensure all sensor nodes transmit data sensed to the sink node. Here, deterministic approach was used to deploy sensors where hexagonal grid positions were used to locate and address each sensor nodes. Increasing cumulative connected coverage ratio of wireless sensor network was the main motivation of MaxNetLife algorithm. Following parameters were considered in the MaxNetLife algorithm: Priority, Scarcity, Being comprehensive, Adaptability to change in the mission statement, transfer.

***Bai Xingzhen et al. in 2009*** [8] used Particle Swarm Optimization approach (PSO). PSO was used to maximize the coverage area of mobile sensor networks. The big coverage holes problem arises as network grows. In this proposal work there was a restriction on sensors to move in the limited model during the execution of PSO. The simulation results showed that sensors mobility in the limited region can realize the coverage optimization, which reduced the moving distance greatly.

***Norman Jasmine in 2011*** [9] studied Random Geometric Graphs model (RGG) of large networks such as sensor networks where nodes were represented by the vertices of RGG. Connectivity was based on one dominant set and coverage was based on transmission range and scheduling of the nodes. Results also proved that the given model was energy efficient and was highly feasible.

***Rahmani et al. in 2011*** [10] proposed Genetic algorithm and voronoi diagram to cover the maximum area. Author used voronoi diagram that divide the field into several cells and there holes exists in every cell. To overcome the holes problem genetic algorithm was used. Genetic algorithm was find the best places for additional nodes so that maximum area was covered.

***Khuntia Purnima et al. in 2011*** [11] studied that Wireless Sensor Network in an important field so its contribution is in varities of target specific applications. One active issue in target specific applications is coverage. According to author static nodes are deployed in random manner to monitor required target. The coverage issue could be area coverage, Target coverage and coverage dealing with maximum support/breach path.

 

***Abidin Husna Zainol et al. in 2012*** [12] stated that sensing data has abilities to store data, process data and transmit data that has made WSN to be applied in providing effective surveillance. Optimum sensor node placement in the surveillance area was needed due to limited number of sensor nodes that can be deployed. A central controller constantly monitors coverage performance by analyzing sensor measurements and optimizes AP configuration and ultimately able to improve the coverage robustness also save cost of human intervention.

***ALLA said BEN et al. in 2012*** [13] proposed coverage and connectivity preserving routing protocol (CCPRP) for heterogeneous WSN. CCPRP was used to accommodate connectivity, energy balance and coverage-preservation for sensor nodes. The proposed CCPRP algorithm was able to prolong the network lifetime while retaining a 100% coverage ratio and outperform the existing routing protocol.

***Mahboubi Hamid et al. in 2013*** [14] proposed multiplicatively weighted voronoi diagram to discover holes corresponding to different sensing ranges. According to proposed algorithms each mobile sensor assigns a proper weight to every point in the field, based on the information it receives from static sensors. The mobile sensors then move iteratively to proper locations out of the covered area of static sensors, in such a way that coverage holes of the network were reduced.

***Banimelhem et al. in 2013*** [15] proposed work into three phases-network assumptions, coverage model and genetic algorithm based approach to overcome the holes problem. In network assumption it was assumed that sensor nodes are randomly deployed and the position of base station is stationary. It was also assumed that the numbers of sensor nodes initially deployed are equal to that number of nodes required to achieve full coverage. To achieve optimal coverage Genetic algorithm was used to find the best positions.

***Syan Sandeep et al. in 2013*** [16] introduced Sensor Deployment Algorithm. According to author coverage problem are occurs due to limited sensing range. The Solutions for these problems lies how the sensors with respect to each other are positioned. By using good sensor deployment algorithm gives the maximum coverage of total area and minimum intersection between nodes. So an effective node placement scheme was presented which helps in efficient placement by removing intersection of the sensors range.

***Temel Samil et al. in 2014*** [17] studied a deterministic sensor deployed method based on wavelet transform. It aims to increase the quality of coverage of a wireless sensor network. Another method used was Cat Swarm Optimization (CSO) algorithm, which mimics the behavior of cats. Author modified CSO algorithm so it can be used for sensor deployment problems on 3-D terrains. When author compared the results with delaunay triangulation and Genetic algorithm based methods. The result reveal that CSO based sensor deployment which utilizes the wavelet transform method was a powerful and successful method for sensor deployment on 3-D terrains.

## iii. Conclusion:

Various recent research techniques are surveyed for the maximum coverage area in wireless sensor networks. In the current research work we mainly consider: improving coverage performance of area, path coverage. While maintaining connectivity and maximum coverage area. In Future we may use Genetic algorithm for the efficient placement of minimum number of nodes to cover the maximum area.

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