Review on Coverage and Connectivity in Underwater Wireless Sensor Networks

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Abstract- One of the current trends of the wireless communication is the underwater communication .The two most fundamental problems in underwater sensor network are sensing coverage and network connectivity. The coverage problem reflects how well a sensor network is tracked or monitored by sensors. An underwater wireless sensor networks is the emerging field that is having the challenges in each field such as the deployment of nodes, routing, floating movement of sensors etc. The characteristics of underwater wireless sensor networks are fundamentally different from that of terrestrial networks. In Underwater wireless sensor network each node monitor one target .For the connectivity of nodes use DFS (Depth first search) algorithm and for coverage use distributed coverage algorithm.

Keywords- Connectivity, coverage, DFS (Depth first search), DCA (Distributed coverage algorithm)

I. INTRODUCTION

An underwater sensor network is one of the major emerging technologies that require the data transmission at high rate with higher reliability ratio. These kind of network needs the equal concern for the architectural definitions as well as the algorithmic enhancements. While defining these kind of network, the concern is required while selecting the sensors based on the type of surface, the type of link, control center, control parameters etc. These networks needs the regular monitoring of network because of continuous change is possible as the sensors are having floating movement and relatively need to analyze the energy definitions, requirement, consumption etc. It also needs to analyze based on type of communication, type of channel etc. The two most important requirements in sensor networks are efficient resource management and provide reliable QoS.

The issue in Underwater Wireless Sensor Networks is the coverage problem .The coverage problem is dependent on the coverage model of individual sensor and the locations of the deployed sensor nodes. Sensor coverage model can be considered as a measure of the quality of service of sensor's sensing function and is subject to a wide range of interpretations due to a large variety of sensors and applications. In the literature, a widely used sensor coverage model is the sensing disk model where a sensor can cover a disk centered at itself with a radius equal to a fixed sensing range. Network sensing coverage on the other hand can be considered as a collective measure of the quality of service provided by sensor nodes at different geographical locations. In many cases, we may interpret the coverage concept as a non-negative mapping between the space points and the sensor nodes. In depth first search (DFS) Each node A, upon receiving the message for the first time, sorts all its neighbors according to a criteria, such as their distance to destination, and uses that order in DFS algorithm The DFS based routing algorithm performs DFS search in a given graph in distributed way. Initially all the nodes are colored white (unvisited) the sender start sending message and mark node as gray (visited)

The DFS based routing algorithm performs DFS search in a given graph in distributed way. The property that enables its use in routing is the fact that DFS creates a path in the graph without making any jumps from a node to another node that is not it's neighbor. In DFS based algorithm, nodes are 'colored' as white or gray (because of distributed behavior of our algorithm, the third color is not needed). Initially all nodes are white (that is, if message id is not found in local memory, white color is assumed). The process of visiting nodes coincides with sending messages between nodes. There is always only one copy of message in the graph, and thus a path is created. The sender node S begins routing and colors itself as a gray node. Gray nodes are nodes that are visited (that is, they received message at least once). Each message that is sent from a node B to a node A has one bit that indicates whether the message is forwarded or returned. Node A receiving the message then acts according to that bit. White node A, upon receiving forwarded message for the first time, changes its color to gray, and orders its neighbors according to distance from destination (the neighbors which are closer to destination are preferred). The only exception is that node B, that sent message to A, is ignored. Thus node A should memorize, together with the message id, also neighbor B that forwarded that message. The message is then forwarded to the first choice C among neighbors. If there is no choice, message is returned to B. Gray node A, upon receiving forwarded message from any node B, will reject the message immediately. That is, the message will be immediately returned to B. If node A sends message to node B, and node B rejects the message, it is counted as two hops in the simulation (A to B and B back to A). Gray node A, upon receiving a returned message from node C, will forward the message to the next choice E in its sorted list of neighbors, if such a neighbor exists. If A has no more neighbors in its list, message will be returned to the neighbor B which sent the message to A (and which was memorized for that purpose). Fig.1 gives an example of a DFS routing path for the following graph: Figure1.

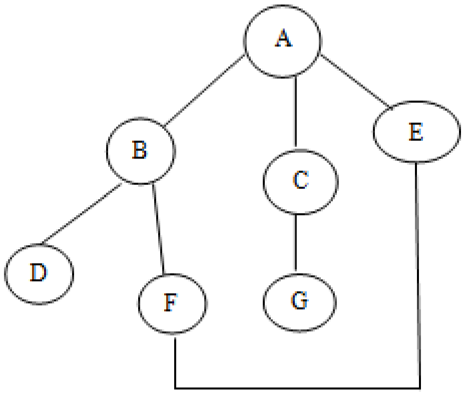

Figure1. DFS Graph

DFS Graph a depth-first search starting at A, assuming that the left edges in the shown graph are chosen before right edges, and assuming the search remembers previously-visited nodes and will not repeat them (since this is a small graph), will visit the nodes in the following order: A, B, D, F, E, C, G. Performing the same search without remembering previously visited nodes results in visiting nodes in the order A, B, D, F, E, A, B, D, F, E, etc. forever, caught in the A, B, D, F, E cycle and never reaching C or G. Iterative deepening prevents this loop and will reach the following nodes on the following depths, assuming it proceeds left-to-right as above:

>>0: A

>>1: A (repeated), B, C, E (Note that iterative deepening has now seen C, when a conventional depth-first search did not.)

>>2: A, B, D, F, C, G, E, F (Note that it still sees C, but that it came later. Also note that it sees E via a different path, and loops back to F twice.)

>>3: A, B, D, F, E, C, G, E, F, B

For this graph,[1] as more depth is added, the two cycles "ABFE" and "AEFB" will simply get longer before the algorithm gives up and tries another branch. Wireless sensors can be either deterministic placed or randomly deployed in a sensor field. Deterministic sensor placement can be applied to a small to medium sensor network in a friend environment. When the network size is large or the sensor field is remote and hostile, random sensor deployment might be the only choice, e.g., scattered from an aircraft. It has been shown that a critical sensor density exists beyond which a sensor field can be completely covered almost surely in every random deployment [5]. To guarantee complete coverage in one random deployment, it is often assumed that the number of scattered sensors is more than that required by the critical sensor density. However, this normally requires a great number of sensor nodes to be deployed another way to improve network coverage is to leverage mobile sensor nodes

II. RELATED WORK

In Year 2010, GholamAli Yaghoubi performed a work," Connectivity Issue in Wireless Sensor Networks by Using Depth-First Search and Genetic Algorithm". In this paper, Author consider wireless sensor networks satisfying the case that each node either monitors one target or is just for connection. Author want to use the fewer nodes in connectivity. Author aim this goal by using DFS and on -- off operation, that due to less consuming energy[3].

In Year 2010, Nauman Aslam performed a work," Distributed Coverage and Connectivity in Three Dimensional Wireless Sensor Networks". This paper investigates coverage and connectivity issues for Wireless Sensor Networks (WSNs) under three dimensional deployment scenarios. Author exploit the inherent redundancy in WSN deployment by finding an optimal set of sensor nodes that can cover the 3D deployment region efficiently while maintaining the network connectivity. In this regard Author propose a distributed coverage algorithm

(DCA) that allows sensor nodes to form a 1-covered topology by exchanging messages based on the local information[7].

In Year 2011, Yinian Mao performed a work," Coordinated Sensor Deployment for Improving Secure Communications and Sensing Coverage". In this paper, Author show that the system performance on these aspects depends closely on how the sensors are deployed in the field, and on how the sensor locations can be adjusted after the initial deployment. For static sensor deployment, Author investigate the hexagon and square lattice topology and analyze their impact on secure connectivity and sensing coverage. Author propose two new sensor location updating algorithms, the VFSec and the Weighted Centroid algorithm, to jointly optimize sensing coverage and secure connectivity [10].

In Year 2003, Chi-Fu Huang performed a work," The Coverage Problem in a Wireless Sensor Network". In this paper, Author formulate this problem as a decision problem, whose goal is to determine whether every point in the service area of the sensor network is covered by at least k sensors, where k is a predefined value. The sensing ranges of sensors can be unit disks or non-unit disks. Author present polynomial-time algorithms, in terms of the number of sensors, that can be easily translated to distributed protocols[2].

In Year 2012, Ashwinkumar Badanidiyuru performed a work," Approximating Low-Dimensional Coverage Problems". Author study the complexity of the maximum coverage problem, restricted to set systems of bounded VC-dimension. Author also present an improved upper bound on the approximation ratio of the greedy algorithm in special cases of the problem, including when the sets have bounded cardinality and when they are two-dimensional half spaces. Complementing these positive results, Author show that when the sets are four-dimensional half spaces neither the greedy algorithm nor local search is capable of improving the worst-case approximation ratio of 1 - 1/e that the greedy algorithm achieves on arbitrary instances of maximum coverage[1].

In Year 2012, Vikram P. Munishwar performed a work," Coverage Management for Mobile Targets in Visual Sensor Networks". In this paper, Author propose several policies for automatic control of the cameras with a goal of coverage maximization for mobile targets. Author study these policies using important performance metrics such as coverage gain, adaptability, scalability, and energy consumption. For most of the scenarios, Author found that the protocols that take into account non-local information and have self-adapting parameters outperform the protocols that are either purely local or purely global and have non-adaptive parameters [9].

In Year 2006, Vijay Chandrasekhar performed a work," Localization in Underwater Sensor Networks — Survey and Challenges". This paper explores the different localization algorithms that are relevant to underwater sensor networks, and the challenges in meeting the requirements posed by emerging applications for such networks [8].

In Year 2006, Muzammil Hussain performed a work," Distributed Localization in Cluttered Underwater environments". In this paper, Author considers the application of distributed localization techniques to cluttered environments and assess their performance. Author also investigate how to place robots in a multi-hop network to improve the accuracy of position estimation in the far-fetched regions of the tank, when distributed localization is used [6].

In Year 2007, Melike Erol performed a work," Localization with Dive'N'Rise (DNR) Beacons for Underwater Acoustic Sensor Networks". In this paper, Author addresses the localization issue in Underwater Sensor Networks (UWSNs). Author propose Dive'N'Rise(DNR) Positioning, the novel idea of using DNR beacons for localization. Author analyze localization success and error for static and mobile UWSNs[5].

III. NETWORK MODEL AND DEFINITIONS

1. Communication Range: A sphere based communication ranged is assumed where each active sensor has a communication range of rc. For reliable communication the distance between two active sensor is required to be less than or equal to rc.

2. Sensing Region: The sphere based sensing region $\mathcal{R}i$ of a sensor Si located at point $\mathbb{X}$ with coordinates xi,,zi is the collection of all points where a target Γi is reliably detected by sensor Si.

3. Underwater networks may also be *mobile* Mobility is useful to maximize sensor coverage with limited hardware, but It raises challenges for localization and maintaining a connected network.

4.The target location is called *hotspot*, denoted by HS.

IV. DISTRIBUTED COVERAGE ALGORITHM

The main objective of this algorithm is to select a set of sensor nodes such that each point of interest in the monitoring region is covered by at least one sensor node.[2]

The algorithm consists of three parts.

1. When sensor nodes boot (immediately after deployment in the monitoring region) the initial network discovery process starts and sensor nodes broadcast a 'Start' message at time"T1". When time "T1" expires, each node compiles a list of its one-hop neighbors. Each node then calculates a probability

(referred as “Active Probability”) by simply generating a random value between 0 and 1 to become an “Active Node”.

2. Each node compares its “Active Probability” to a pre-defined value p. If the computed value of “Active Probability” is less than p, it changes it status to “Active Node” and broadcasts an acknowledgement message to its neighbors within range r.The acknowledgement message contains the value of its computed probability at time “*T2*” . When the timer expires a list of active node messages (ANM) is build using information such as node id and “Active Probability”. The ANM is sorted with respect to “Active Probability” in decreasing order. If the entry and the head of ANM have a lower value than the nodes computed probability, the sensor node changes its status to “Final Active” and broadcasts a notification message. Any ties are broken in favor of the sensor node with higher node id.
3. All nodes check if they received “Final Active” message. Any node that did not receive this message changes its status to become “Final Active”.

V. CONCLUSION

The DFS algorithm use to achieve connectivity and consume less energy. The DCA algorithm provide a solution to the problem of selecting a minimum set of nodes from random deployment such that nodes remain connected while maximizing the coverage. The key feature of the algorithm is its simplicity and ability to be executed in a distributed manner. Sensor nodes executing this algorithm exchange messages with their one-hop neighbors to decide the nodes in the active cover set

VI. FUTURE SCOPE

The work is about to identify the minimum and effective connectivity to cover N Targets by using M cover nodes. The work will improve the reliability over the network because in such network GPS is not present that each target will be covered by more than one cover nodes.

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