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Research Article

ANALYSIS OF COVERAGE ISSUES IN WIRELESS SENSOR NETWORKS

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ABSTRACT

Wireless sensor networks has grown rapidly as a key area of research and technical as well as commercial development. For more than a decade, there have been tremendous developments in area of electronics and sensors specially. It resulted the rapid deployment of wireless sensor networks as a key solution in variety of applications. Wireless sensor networks are used to monitor a particular area of interest for changes in the parameters like pressure , velocity, displacement etc. Applications of WSNs. Include health, military, environmental, traffic control and many scientific applications. But these have many limitations like power, deployment, routing, security. WSNs. are supposed to be self organised, self healing, self configured and operated even in critical conditions. Many critical conditions like avalanche, fire, earthquake need these easy configured networks to solve the problem. But deployment of nodes in such application is also very tedious because nodes are to be deployed in very large quantity and to be scattered over a geographic area from a distance. Though WSNs. have many interesting area for researchers and developers but one of the major area among them is coverage. Coverage can be defined as a measure of how comfortably and for how long the sensors are able to observe the physical space. In this paper, we are surveying the existing solutions and their utilization to the coverage in WSNs.

INTRODUCTION

Wireless sensor network (WSNs.) are made of many small tiny devices called nodes in general. These nodes have some properties like very small in size, very low power small battery leading to limited energy [1]. Since power is low, nodes have limited RF communication ability. These nodes are generally deployed over an area where physical parameters like displacement, temperature, pressure, velocity, humidity can change, facing any particular environmental incidents. Such incidents can be monitored by small nodes of WSNs. and then the recorded parameter either can be observed and handled (not in general) or can be sent to the network, approaching any central controlling and acting station (very often). Since the nodes have limited resources in terms of memory, battery, processing capability, nodes have to face many challenges in area of deployment, routing, security, location management etc. The main constraint of sensor nodes is their very low finite battery energy, low processing successively which limits the lifetime and the quality of the network [2]. For that reason, the protocols running on sensor networks must consume the resources of the nodes efficiently in order to achieve a longer network lifetime. Data aggregation, Central controlling node selection (cluster head), self healing are another issues with WSN. Since nodes are wireless and mobile obviously,.topology selection, formation and changing the topology dynamically is also one of the serious issues.

Coverage is also one of the major issue while monitoring the specific area of interest. Coverage is usually referred and interpreted as how well a sensor network will monitor a field of interest, resulting better quality of service (QoS)[3]. Better coverage lead better connectivity to provide the better opportunity to travelling of data from source to destination i.e. place where it is being recorded to central controlling and action node. However this smooth and better path is connected with other issues like bandwidth, type of channelling, routing also [4]. However many researchers have been motivated by the fact that WSNs routing was often geography-based, some geography-based secure and efficient Cost-Aware SEcure routing (CASER) protocol for WSNs are proposed. It allows messages to be transmitted using two routing strategies, random walking and deterministic routing, in the same framework[5]. Coverage is the one of the primary evaluation

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metric for a wireless network. It is always better to have the ability of deployment of a network over a larger physical area. It is important to keep in mind that the coverage of the network is not equal to the range of the wireless communication links being used [6]. The use of multi-hop communication techniques can extend the coverage of the network well beyond the range of the radio technology alone.

Coverage in Wsns

Coverage is a measure of the quality of service provided by a sensor network. Due to the attenuation of energy propagation, each sensor node has a sensing gradient, in which the accuracy and probability of sensing and detection attenuate as the distance to the node increases. The total coverage of the whole network can therefore be defined as the union (including possible cooperative signal processing) of all nodes' sensing gradients. It represents how well each point in the sensing field is covered [7]. Coverage is a fundamental issue in a WSN, which determines how well a phenomenon of interest (area or target) is monitored or tracked by sensors. Each sensor node is able to sense the phenomenon in a finite sensing area [8].

Connectivity in Wsns

Connectivity is primarily concerned with delivering the recorded data by help of sensors from the source to the destination (sink node) via RF transmissions medium. Since sensors are very low-cost and low capability devices with limited and weak resources, each sensor node has very limited range of communication as compare with the area they are deployed for monitoring. Hence there have been primary requirement of Multi-hop communications as a sensor cannot reach the sink node directly [5]. Two adjacent sensors are called neighbours if they are within the range of communication of each other's.

The sensor nodes and the transmission paths between the pair of neighbours form the network topology, which can further be required for connectivity requirement. Connectivity not merely represents how well the sensor nodes in the network are "connected" to each other, even well and steady connected with sustained connection links in critical situations. It is a basic feature of a wireless sensor network, for various upper-layer protocols and applications, such as distributed signal processing, data gathering and remote control, require the network to be connected. Since the sensor nodes communicate via wireless medium, a node can only directly talk to those that are in close proximity to itself. If a sensor network is modeled as a graph with sensor nodes as vertices and direct communication links between any two nodes as edges, by a connected network we mean the graph is connected [6].

Issues with Coverage

Solving coverage issue is not alone in a wireless sensor network, since data has to be transmitted to the base station after recording during event. This immediately leads to the lookout for an energy efficient method to solve fully connected coverage problem [9]. Energy limitation is one of the major issue in WSNs. related to design of any solution using tiny nodes. Since power is responsible for smooth operation of a node like processing, connectivity, reliability or sensing , low power capability of node make it weaker in many applications. Many times node can go off with their battery and get failed which results in break of topology formation and results on coverage problem [10]. Tiny nodes can be stolen physically very easily or displaced by wind, earthquake, results in deformation of network topology can also result in coverage. In our surroundings, there are variety of electromagnetic interferences are present which can also be vulnerable to the RF communication system of nodes while maintaining coverage. But whenever any efficient coverage algorithm is to be proposed or have been proposed, power is or was to be taken in the consideration first [11].

As the nodes are deployed in very large number of quantity in any typical application, deployment and then location management of node is also a big issue for the topology formation and maintaining coverage in WSNs., specially when nodes are scattered over an area of application from a distance. After it all, the tiny and cheaper nodes are very less fault tolerant, cannot sustain much in front of any fault or unexpected incident which may cause failure of node partially or completely. It also results on break of network topology or network data gathering and results in vulnerability to maintaining coverage. Environmental conditions are also responsible for either coverage or accuracy of maintaining coverage. If coverage accuracy is less in ratio, it will affect data aggregation and quality of data aggregated remarkably [12]. Node mobility, in some application is also an issue for coverage maintenance problem. Since nodes are mobile either by design or may be displaced by environmental conditions, may cause loosing participation form topology of network and cause coverage problem.

Proposed Solution for Effective Coverage

Area Coverage is a difficult problem to solve with a minimum number of sensor nodes for maximum time duration, especially in wide areas. Among the solutions proposed for this problem there is the deployment with its two types random and deterministic. The disadvantages of deterministic deployment are configured in the Area of Interest (AoI) limitation, and random deployment is configured in the non-equitable distribution of sensor nodes on AoI[13].

We propose ethical configuration of network which is based on assumptions and then action accordingly. In assumption we consider our network is to be formed with following parameters:

Dense deployment of node in specified geographical area with environmental handbook. Node with alternate power backup like solar or crystal solution integrated with it. Nodes must be ready for autonomous formation of the network and must have capability of self healing and self configuration. Here we can concentrate for costly node hardware. Nodes must be application specific. We eliminate general purpose node for our application scenario. Few of central location nodes should discard the redundant recording or receiving of data. It should also not react to the data if not below or beyond the threshold value. Such node must have set with the threshold value set for critical ranges of parameter it is recording or receiving[14].

Actions after Formation of above Network may be follows to Maintain Maximum Possible Coverage

Initially, deployment can also be treated as one of the solution for targeting coverage. But deterministic deployment is not

possible in areas where human intervention is not possible like avalanche prone area. It is hard to deploy the nodes as per choice in terms of location, topology formation in such applications. On the other hand, random deployment is only possible in the terrain that represents the danger and the impossibility of the intervention of the human being[15]. Sensors sense the data and send the recorded parameters further in the network where the parameters are to be analyzed for further action. Since node has no any direct connection with action on the receiving of sensed data it mainly focuses on the sensing of data. During sensing action and transmitting sensed data to further network node has to be live and to be in full coverage of the network. If any abnormal event is not noticed by the nodes or network, it is not accountable to nodes or part of network to be idle and loosing coverage fully or partially. Even it may save energy of nodes and associated network components. Hence our main focus is to make node capable of sensing the data in three modes. Full, Limited and Instant or combination of any of these. Since as per our assumption part, nodes are dense, deployed in perfect environment with alternative power capability and also application specific they are[16]. They theirselves can sustain very high to maintain coverage issue. Secondly combination of our sensing scheme will also prevent the continuous sensing every time resulting prevention of energy of nodes and network components. We also propose the nodes to be deployed in more than one dimensions which may need more number of nodes (all not active altogether) but extra number of nodes may provide backup when any node is failed..

The energy consuming and the coverage with QoS in the network are the two key points in the area of research in wireless sensor network research [17]. The coverage quality will certainly affect the monitoring effectiveness on moving target due to exhausting resources to watch mobility; its behavior characteristic is mainly reflected in the deployment mode of sensor node and then displacement subsequently. The energy consumption of the network is directly proportional to the effective reaction of the sensor nodes in the network but with quick energy consumption, which can may affect the lifetime of the whole network. The coverage quality and the rapid energy consumption mainly depend on the rationality of sensor nodes deployment[18[19]. Hence any solution claiming either fully or close to fully maintained coverage in any typical WSNs. may lead to drastic lose of energy which itself is vulnerable to network itself.

Limitation of the Proposed Solution

Proposed solution does not claim as fully network coverage guarantee all the times and in heterogeneous networks or components. No any fault tolerant architecture has been taken into consideration. Alternative power options are considered to increase network and node lifetime. Nodes are considered to be static initially however in many applications nodes have to be partially or alternatively y or fully mobile (VANET. Scalability, openness of network is also to be considered in future scope if improvement in current solution.

CONCLUSION

Each node of wireless sensor network has a fixed and limited communication range which defines the area in which another node can be located in order to receive data. This is separate from the sensing range which defines the area a node can observe. The two ranges may or many not be equal but are often different. we tried to address many of the issues that factor how coverage can be achieved more by deployment sensor networks nodes with their pre-fixed chosen configurations. In the paper, coverage approaches to enhance the accuracy of coverage are discussed not claiming fully coverage. Paper work is purely based on assumption of nodes and their deployment strategy subsequently. Since we had chosen the application specific nodes rather than general purpose nodes, this solution may be appropriate to some application only.

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