PERFORMANCE OF ENERGY EFFICIENT NETWORK IN WIRELESS SENSOR NETWOR

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Abstract

WSNs have made possible real-time data aggregation and analysis on an unprecedented scale. Naturally, they have attracted attention and garnered widespread appeal towards applications in diverse areas including disaster warning systems, environment monitoring, health care, safety and strategic areas such as defense reconnaissance, surveillance, and intruder detection. In case of nuclear power plant if any small delay occurs for data forwarding due to any node failure may results in severe disaster. Hence effective Topology Control is required to obtain an energy efficient sensor network even if any node fails. An energy efficient topology control using hybrid bio inspired algorithm based cluster head selection is presented in this work.

Key Words:

Clustering in Wireless sensor network(WSN), Cluster, Energy Efficient.

I. Introduction

A wireless network consisting of a large number of small sensors with low-power transceivers can be an effective tool for gathering data in a variety of environments. In terms of routing protocol, there are two different solutions from existing works. One is flat routing, each sensor node plays the same role and sends their data to sink node directly which always results in excessive data redundancy and faster energy consumption. The other is hierarchical routing. In hierarchical routing, the entire network is divided into several clusters. Each cluster consists of some source nodes and a cluster head [1]. Sensor nodes, referred as source nodes, can gather information from the monitoring region and send the sensing information to their corresponding cluster head [2]. The cluster head is elected from all the sensor nodes in a cluster according to some criteria, and is responsible for collecting sensing data from source nods. After receiving data from source nodes, the cluster head also performs data aggregation to reduce the data size before sending data to the sink, which further reduces the power expended for data transfer [3]. Clustering-based routing algorithms are more appropriate and efficient than flat routing algorithms in WSN. Efficient design and implementation of wireless sensor networks has become a hot area of research in recent years, due to the vast potential of sensor networks to enable applications that connect the physical world to the virtual world. By networking large numbers of tiny sensor nodes, it is possible to obtain data about physical phenomena that was difficult or impossible to obtain in more conventional ways. In the coming years, as advances in micro-fabrication technology allow the cost of manufacturing sensor nodes to continue to drop, increasing deployments of wireless sensor networks are expected, with the networks eventually growing to large numbers of nodes. Potential applications for such large-scale wireless sensor networks exist in a variety of fields, including medical monitoring, environmental monitoring, surveillance, home security, military operations, and industrial machine monitoring.

II. Literature Review

[1] A hierarchical network is developed using genetic algorithm. This network controls the network topology without affecting the network properties. In this paper, a two tier WSN developed using GA can be implemented in any hazardous applications. Though genetic algorithm gives an optimized list of cluster heads, there are possibilities of local minima. This could be further improvised by simulated annealing which results in global minima.

[2] A new method which is based on AHYMN approaches and genetic algorithm is represented to choose a cluster head in WSNs in dynamically. Therefore, it is quicker and also more accurate to detect the node with higher energy and to select the cluster head. Moreover, this network has used nodes with heterogeneous characteristics.

[3] On the basis of HBO algorithm, this paper proposes EDCHBO a cluster head selection algorithm for effective cluster head selection. This algorithm considers the energy and distance factor as parameter to improve cluster head selection. Simulation results show that EDC-HBO is more energy efficient than LEACH and UCR protocol.

[4] The hierarchical fuzzy integral is introduced into the scheme in order to make the most criteria that can influence energy efficiency become a single one to determine the

selection of the CHs, which is the main innovation and improvement of the classical algorithms. The simulation results demonstrate that the lifetime and energy efficiency of FAHP is better than other classical algorithms, time synchrony and fault tolerant problems are overcome by using FAHP process it also improves the localization accuracy and efficiency.

[5] The suggested new protocol EDRLEACH is based on clustering with maximum lifetime for wireless sensor networks. It improves LEACH by using a very equally distributed cluster and decreasing the unequal topology of the clusters. The new network protocol can be built on the shortcomings of Leach to try and rectify them.The applications of the new algorithm are immense as the life period has increased considerably.

[6] This paper analyzed that WSNs have special vulnerabilities that do not exist in wire-line networks. Therefore, our protocols can't be simply transferred for wire-line networks to WSNs. Protocols must be designed with low computational power and low energy requirements in mind. In this paper it has been seen some of the protocols that are used, as well as some ways to determine where to check packets, including a new game theoretic approach in which it has been observed that by allowing the attack to have some utility.

[7] This paper is a survey paper which states while designing a security mechanism, we must consider the limited resources of WSNs. Anomaly-based IDSs are lightweight in nature; however they create more false alarms. Signature-based IDSs are suitable for relatively large-sized WSNs; however they have some overheads such as updating and inserting new signatures.

[8] This paper proposes the development of an Intrusion Detection Program (IDP) which could detect known attack patterns. An IDP does not eliminate the use of any preventive mechanism but it works as the last defensive mechanism in securing the system. Three variants of genetic programming techniques namely Linear Genetic Programming (LGP), Multi-Expression Programming (MEP) and Gene Expression Programming (GEP) were evaluated to design IDP.

[9] We consider the problem of cooperative intrusion detection in wireless sensor networks where the nodes are equipped with local detector modules and have to identify the intruder in a distributed fashion. The detector modules issue suspicions about an intrusion in the sensor's neighborhood.

[10] Many intrusion detection system (IDS) have been proposed to secure WSNs. But all these systems operate in a single layer of the OSI model, or do not consider the interaction and collaboration between these layers. Consequently these systems are mostly inefficient and would drain out the WSN. The proposed is experimentally evaluated using the NS simulator to demonstrate its effectiveness in detecting different types of attacks at multiple layers of the OSI model.

[11] In this paper author have illustrated MAC address based intruder tracking system for cluster based wireless sensor networks. This proposed system implements base station based detection and thus is very energy-efficient for early detection and prevention of security threats and attacks. By designing a security system in which the Base Station (BS) keeps track of the security of the Wireless network, high security can be ensured without any significant energy overheads on individual nodes and cluster heads.

[12] In this paper, Sensors are used to sense the temperature, humidity, light, voltage etc in a particular area. Extended Kalman Filter (EKF) mechanism is proposed to filter the false data in sensor network. The false data can be acted by some event namely malicious, emergency event. Malicious event are acted by intruders, and Emergency event are acted by some accident occurrence. Using different aggregation functions (average, sum, max, and min), theoretical threshold value is calculated. Combining Cumulative Summation (CUSUM) and Generalized Likelihood Ratio (GLR) detection sensitivity can be increased. Intrusion Detection Modules (IDM) and System Monitoring Modules (SMM) work together in order to provide intrusion detection capabilities for WSNs.

[13] In this paper, an Advanced Intrusion Detection System has been proposed. It improves the detection rate and efficiency so that almost all the Intrusions can be detected. Also the system is applicable to small, medium as well as large sized networks. That means it gives a wide range of flexibility in detection of Intrusions compared to the other existing systems. Also the energy efficiency and the system life time is greatly improved.

[14] This paper presented in detail a secure routing protocol for WSN which is based on ant colonization technique. Hello packets are used for surrounding neighbor's discovery. This mechanism uses forward ants which collect and increment the reputation values along the path. When compared to other routing protocols such as IACO and LEACH, our proposed routing scheme shows better performance in terms of end to end delay, routing overheads, and data forwarding efficiency.

[15] This paper proposed a model to identify malicious node from real-world datasets within a non WSN. This model ensured the data integrity within LN and BS by deploying a detection engine within the MDC. In simulation, the results show that we can achieve ~95% of detection rates based on

our measured VA using the real data. In terms of the true alarm rate, the proposed algorithm outperforms.

III. Issues in Clustering Technique

We have basically three issues in WSN clustering.

Distance: Distance between nodes plays a crucial role. As distance between the nodes increases the number of nodes in a cluster decreases and it may lead to higher consumption of energy.

Energy: Energy efficiency has been known as the most important issue in research of wireless sensor networks. The energy consumption within a cluster can be reduced by decreasing the number of transmitting messages. Lesser the energy consumption leads to the longer lifetime of network.

Density: The increase in sensors density may overload the network. Such overload might cause latency in communication and inadequate tracking of events.

IV. Clustering Parameter

In WSNs clustering algorithms, it is worth reporting on some important parameters with regard to the whole clustering procedure in WSN.

1. Number of clusters (cluster count): In most recent probabilistic and randomized clustering algorithms the CH election and formation process lead naturally to variable number of clusters. In some published approaches, however, the set of CHs are predetermined and thus the number of clusters is preset. The number of clusters is usually a critical parameter with regard to the efficiency of the total routing protocol.

2. Intracluster communication: In some initial clustering approaches the communication between a sensor and its designated CH is assumed to be direct (one-hop communication).However, multi-hop intracluster communication is often (nowadays) required, i.e., when the communication range of the sensor nodes is limited or the number of sensor nodes is very large and the number of CHs is bounded.

3. Nodes and CH mobility: If we assume stationary sensor nodes and stationary CHs we are normally led to stable clusters with facilitated intracluster and intercluster network management.

4. Nodes types and roles: In some proposed network models (i.e., heterogeneous environments) the CHs are assumed to be equipped with significantly more computation and communication resources than others. In most usual network models (i.e., homogeneous environments) all nodes have the same capabilities and just a subset of the deployed sensors is designated as CHs.

5. Cluster formation methodology:

In most recent approaches, when CHs are just regular sensors nodes and time efficiency is a primary design criterion, clustering is being performed in a distributed manner without coordination.

6.Cluster-head selection: The leader nodes of the clusters (CHs) in some proposed algorithms (mainly for heterogeneous environments) can be preassigned.

7. Algorithm complexity: In most recent algorithms the fast termination of the executed protocol is one of the primary design goals. Thus, the time complexity or convergence rate of most cluster formation procedures proposed nowadays is constant (or just dependent on the number of CHs or the number of hops).

8. Multiple levels: In several published approaches the concept of a multi-level cluster hierarchy is introduced to achieve even better energy distribution and total energy consumption (instead of using only one cluster level).

V. Different Clustering Algorithm For Energy Efficient Clustering In WSN

1. CACC: Clustering Algorithm based on Cell Combination :

A clustering algorithm which based on cell combination for the networks[9]. Sensor nodes are distributed densely and the energy of sensor nodes is always limited. In this clustering algorithm, the monitoring region is divided into hexagonal cells by considering the geographic location information of nodes.

2. VAP-E: Energy-Efficient Clustering :

Virtual Area Partition [10] is an energy efficient clustering algorithm which based on virtual area partition in heterogeneous networks environment where the maximal transmission power of each node may be different. Authors found that VAP-E can balance the load between clusters, enhance the energy efficiency of sensor nodes, prolong the lifetime of networks, and improve the efficiency of communications.

3. FoVs: Overlapped Field of View :

This clustering algorithm for wireless multimedia sensor networks based on overlapped Field of View (FoV) areas [11]. The main contribution of this algorithm is finding the intersection polygon and computing the overlapped areas to establish clusters and determine cluster membership.

4. PDCH: Pegasis Algorithm Improving Based on Double Cluster Head :

An algorithm based on hierarchical chain topology and this algorithm [12] using bottom level cluster head and super level cluster head to improve the load balance. In the hierarchical structure, base station (BS) is the center of a circle. Every node receives the signal from the BS, then according to the signal strength to detect the distance to BS. PDCH outperform to PEGASIS algorithm and it is also useful for large networks.

5. HSA: Harmony Search Algorithms :

This is music based metaherustic optimization algorithm[13] which is analogous with a music improvisation process where musician continue to polish the pitches in order to obtain better harmony. The operation has

two phases: clustering setup and data transmission. This algorithm provides improvement in term of power consumption and network life time over LEACH protocol. With a small network diameter, energy consumption of the network is almost same when using different clustering protocols.

6. Clustering Algorithm Comparison

Sr. No.	Algorithm Name	Scheme	Based
1.	CACCA	Miscellaneous Scheme	Cell Combination For Network
2.	VAP-E	Hierarchical Scheme	Virtual Area Partition
3.	FoVs	Hierarchical Scheme	Overlapped Field Of View
4.	PDCH	Grid Scheme	Double Cluster Head

7. Conclusion

The hierarchical cluster structures facilitate the efficient data gathering and aggregation independent to the growth of the WSN, and generally reduce the total amount of communications as well as the energy spent. We have found that the some energy efficient algorithms increase the network lifetime. Although every effort has been made to provide complete and accurate state of the art survey on energy efficient clustering algorithms.

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