An Extensive Review on Density, Distance and Energy based Clustering Algorithm for Data Aggregation in Wireless Sensor Networks

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Abstract-One of the most essential thought in outlining sensor nodes in a wireless sensor network for drawing out the network lifetime by limiting energy utilization. The quantity of cluster and the dispersion of cluster heads (CHs) dependably have a noteworthy effect on the network execution. Separation and Density based clustering algorithm can extraordinarily enhance energy effectiveness of WSNs on the grounds that it embraces a multi-bounce communication in each cluster. WSNs are for the most part in view of communication inside any network the way that makes the utilization of energy being referred to. The transmissions and gatherings prompt power squander. To oversee and decrease these squanders, the bundles booking and their dissemination inside the network are to be profoundly considered in the wireless communication. To do as such, an data aggregation algorithm ought to be all around composed. data aggregation strategies in Wireless Sensor Networks and build up another data aggregation protocols.

Keywords-Wireless Sensor network, Data aggregation, Energy Clustering, Density.

I. INTRODUCTION

A wireless sensor network consists of a large number of devices, known sensors capable of collecting information from its environment, such as humidity, light, temperature, etc, by using sensors that embody these node devices. Besides these, there are also relay nodes to take charge of routing the data to the base station, is connected to a computer that can communicate to the outside via the Internet or a local area network (LAN).

The sensor nodes are scattered throughout the network in different types of topologies, explain that later will be explained later, depending on the application.

Typically, a WSN consists of hundreds or thousands of wireless sensor nodes and a sink node, where the sensor nodes own the ability of sensing, processing, communicating, and transmitting. As shown in Fig. 1.1, these sensor nodes sense the environmental factors (temperature, humidity, pressure, motion and other physical variables), communicate with each other, and transmit information. The sink node, like a base station, is deployed to collect the information. The small, distributed, and feasible sensor nodes accelerate the development of WSN. As shown in Fig. 1.2, there are varieties of applications benefiting from WSNs, such as building monitoring, health care, smart agriculture, military surveillance, environment monitoring and detection issue.

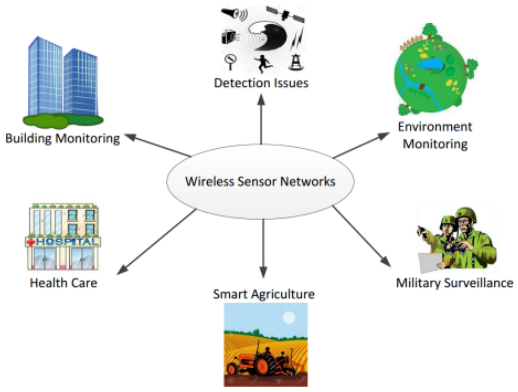

Fig. 1: Versatile applications based on Wireless Sensor Networks.

However, due to the limited battery power of sensor nodes, the network lifetime and performance are restricted. Meanwhile, in several applications (e.g. temperature monitoring), sensor nodes are prone to transmit redundant or correlated information to the sink, which wastes the bandwidth, thereby wasting the network capacity and accelerating the battery depletion. Therefore, how to save energy and network capacity are central challenges for researchers regarding this field of research.

By investigating energy consumption in one sensor node, author found that the major power drain occurs from wireless communication. Thus in order to save energy, a reasonable solution is to reduce the communication activity. Data aggregation, which can reduce communication by reducing the number of data packets transmitted in the network, is considered as a fundamental way to save energy.

Data Aggregation

Data aggregation is defined as the process of summarizing and combining sensor data in order to reduce the amount of data transmission in the network. With the aim of reducing power consumption, data aggregation is the global process of gathering and routing information

through a multi-hop network and processing data at intermediate nodes. It attempts to collect the most critical and important data from the sensors nodes and make it available to the Base Station in an energy efficient manner with minimum data latency and minimum possible bandwidth.

Without the use of data aggregation in a WSN, sensor nodes will report all the raw data 2 to the sink. While these data tend to be redundant or correlated, leading to several drawbacks: 1) the redundant data is no sense for the application, 2) the chances of network congestion increase dramatically, 3) the network capacity is wasted, 4) energy consumption increases correspondingly. By previous studies, temporal and spatial correlations are often based on the raw data. For a given sensor node, temporal correlation exists in the data collected at different time instants, while spatial correlation occurs when the data is collected from the neighboring sensor nodes.

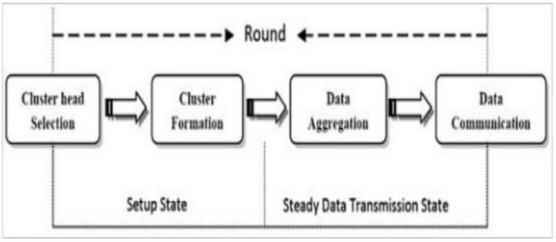

Fig. 2: Block diagram of data aggregation in WSN.

Energy Clustering in Wireless Sensor Networks

In clustering, the sensor nodes are partitioned into different clusters. Each cluster is managed by a node referred as cluster head (CH) and other nodes are referred as cluster nodes. Cluster nodes do not communicate directly with the sink node. They have to pass the collected data to the cluster head. Cluster head will aggregate the data, received from cluster nodes and transmits it to the base station. Thus minimizes the energy consumption and number of messages communicated to base station. Also number of active nodes in communication is reduced. Ultimate result of clustering the sensor nodes is prolonged network lifetime.

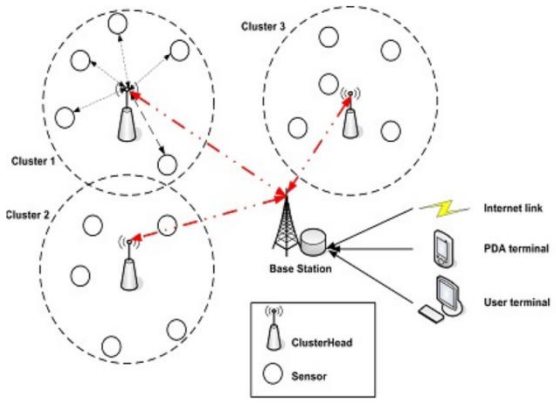

Fig. 3 Clustered Sensor Network.

Sensor Node: It is the core component of wireless sensor network. It has the capability of sensing, processing, routing, etc.

Cluster Head: The Cluster head (CH) is considered as a leader for that specific cluster. And it is responsible for different activities carried out in the cluster, such as data aggregation, data transmission to base station, scheduling in the cluster, etc.

Base Station: Base station is considered as a main data collection node for the entire sensor network. It is the bridge (via communication link) between the sensor network and the end user. Normally this node is considered as a node with no power constraints.

Cluster: It is the organizational unit of the network, created to simplify the communication in the sensor network.

II. LITERATURE SURVEY

Sr. No.	Title	Author	Year	Approach
1	Density, distance and energy based clustering algorithm for data aggregation in wireless sensor networks	H. Lin, R. Xie and L. Wei	2017	In this research work, authors propose a new clustering method called Density, Distance and Energy based Clustering (DDEC) to improve network performance
2	Distributed Data Aggregation Scheduling in Multi-Channel and Multi-Power Wireless Sensor Networks	M. Ren, J. Li, L. Guo, X. Li and W. Fan	2017	This research work proposes a cluster-based distributed data aggregation scheduling algorithm, distributed multi-power and multi-channel (DMPMC), that can minimize the data aggregation latency in multi-channel and multi-power WSNs.
3	An efficient cluster head selection strategy for provisioning fairness in wireless sensor networks	A. Karmaker, M. M. Hasan, S. S. Moni and M. S. Alam,	2016	To select fair and balanced cluster head for cross layer protocol in wireless sensor network, a novel scheme is proposed in this research work.

4	Data Aggregation Scheduling in Wireless Sensor Networks under SINR,	X. Sun, J. Yu and T. Song	2016	In this study, we propose efficient algorithms to decrease data aggregation delay under physical interference model, that is, the SINR (signal to interference plus noise ratio) model.
5	ICBEENISH: Inter cluster data aggregation balanced energy efficient network integrated super heterogeneous protocol for wireless sensor networks	S. Mahajan and V. K. Banga	2015	Wireless sensor networks (WSNs) are increasingly becoming preferred in global applications. Due to the top features of the resource-constrained and battery-aware sensors;
6	A Lightweight Secure Data Aggregation Technique for Wireless Sensor Network,	S. M. M. Rahman et al	2014	Wireless sensor network (WSN) consists of resource constraint sensor nodes where nodes (sensors) send data to the base station/sink node and communicate with each other by either forming a cluster or without forming a cluster.
7	Rotation-based privacy-preserving data aggregation in wireless sensor networks	X. Zhang, H. Chen, K. Wang, H. Peng, Y. Fan and D. Li	2014	authors propose in this study a privacy-preserving data aggregation protocol in wireless sensor networks. Compared to the previous research, our protocol protects the actual data from other nodes based on a rotation scheme while reducing communication overhead dramatically.

H. Lin, R. Xie and L. Wei [1] Wireless sensor networks (WSNs) are wireless networks which consist of distributed sensor nodes monitoring physical and environmental conditions. Due to the energy limit of sensor nodes, prolonging lifetime of wireless sensor networks (WSNs) is a big challenge. In this work, we propose a new clustering method called Density, Distance and Energy based Clustering (DDEC) to improve network performance. DDEC partitions the network into clusters with similar member number, so as to achieve load balancing. Then a cluster head is selected for each cluster based on three criteria: residual energy, distance and density, which achieves to minimize intra-communication cost and prolong cluster lifetime. In our performance analysis, author compare DDEC with another clustering method called DDCHS. The results show that DDEC outperforms DDCHS in terms of alive node number and energy consumption.

M. Ren, J. Li, L. Guo, X. Li and W. Fan [2] Large amounts of sensor data are frequently generated and streamed from sensors deployed on various buildings, in forests or in other application areas. In many of these areas, one difficulty is managing the velocity and volume of the big sensor data while still providing low time latency support for data analysis. Data aggregation can reduce the volume of big sensor data. However, data aggregation is a fundamental yet time-consuming operation in wireless sensor networks (WSNs), particularly in high-density WSNs. Therefore, researchers have started focusing on minimizing the latency of data aggregation, which has been proven to be an NP-hard problem. This research work proposes a cluster-based distributed data aggregation scheduling algorithm, distributed multi-power and multi-channel (DMPMC), that can minimize the data aggregation latency in multi-channel and multi-power WSNs. To save energy, low transmission power is used for packet transmissions inside a cluster, and high power is used for packet transmissions among clusters. Simulations are conducted to compare DMPMC with the best centralized algorithm in a single channel, named E-PAS, the best distributed algorithm in a single channel, named CLU-DDAS, and the best algorithm in multi-channels, named multi-channel. The results show that the DMPMC algorithm proposed in this research work achieves the lowest average latency.

A. Karmaker, M. M. Hasan, S. S. Moni and M. S. Alam [3] To select fair and balanced cluster head for cross layer protocol in wireless sensor network, a novel scheme is proposed in this study. Because LEACH-C and its most of the variants select cluster head by considering energy and distance as a crucial parameter, it can reduce energy consumption of nodes but fail to create balanced cluster. According to the requirement of fair CH selection, we consider residual energy, number of neighbor nodes and one hop neighbor information. The proposed algorithm not only save significant amount of energy but also cover every region of the sensing area in a balanced manner. athors evaluate our proposed protocol with two recent clustering Approach, one is distributed and another is centralized approach. Matlab simulation result shows that the significant performance improvement over the related schemes achieved by proposed protocol in terms of First Node Death (FND), Last Node Death (LND) and energy consumption.

X. Sun, J. Yu and T. Song [4] Data aggregation is an essential operation in various applications of wireless sensor networks (WSNs), where sensor nodes sense information and forward the sensing data to a sink node via multi-hop wireless communications. Most existing data aggregation algorithms were based on protocol interference model, which were not practical in real schemes. In this research work, author propose efficient algorithms to decrease data aggregation delay under physical interference model, that is, the SINR (signal to interference plus noise ratio) model. Firstly, authors apply previous distributed minimum spanning tree (MST) construction method to form a MST under SINR model. Secondly, authors propose a link scheduling algorithm DALS by gird partition, and finally author combine MST and DALS into data aggregation algorithm DA with node states transition. author theoretically prove that the aggregation scheduling algorithm is θ-approximation with $\theta = K2\Gamma$ and obtain the latency of DA $O(H\Delta)$, where K is a positive integer depended on α, β and $\Gamma = [Pmax(2\sqrt{2}+1)\alpha/N\beta 2(1-1/K\alpha)]$ is a constant. H is the height of MST and Δ is the maximum node degree in G(V, E).

S. Mahajan and V. K. Banga [5] Wireless sensor networks (WSNs) are increasingly becoming preferred in global applications. Due to the top features of the resource-constrained and battery-aware sensors; in WSNs energy use has found to be a key fascinating subject of research. WSNs composed of battery-powered nodes that happen to be connected with the base station to help for several measures and also task. Since sensor nodes will be battery-powered i.e. can become useless after the usage of the battery which is also referred to as duration of WSNs. Therefore, utilizing the power in well-organized way may end up in prolonging the time of the WSNs. In BEENISH i.e. well known multi-level heterogeneous energy aware protocol, ultra-super nodes are mainly selected as CH as evaluate to super, advance and normal nodes and so, on. This way energy consumed by all nodes is similarly distributed. But BEENISH has neglected the use of inter cluster data aggregation which may cause flooding. So to overcome this problem a new inter cluster data aggregation based BEENISH protocol will be proposed. This proposed method accomplishes longer stability, life time plus more useful announcements in comparison with some other protocols like BEENISH.

S. M. M. Rahman et al., [6] Wireless sensor network (WSN) consists of resource constraint sensor nodes where nodes (sensors) send data to the base station/sink node and communicate with each other by either forming a cluster or without forming a cluster. Data aggregation in WSN takes place at the responsible nodes (aggregators) in a cluster before sending data to the base station, based on the query that is received from the base station. Thus data aggregation reduces energy consumption of the nodes due to minimized communication. As a result, the life time of the individual sensors prolong in the case of aggregation compared to the data transmission that occurs without performing aggregation. One of the major security challenges for data aggregation in WSN is that the aggregators expose clear data at the aggregation level. Therefore, this aggregation level is vulnerable to attacks by intruders. Existing research has addressed this problem and proposed solutions by considering static node topology of WSN. However, in WSN the nodes can either be static or dynamic. Therefore, the existing approaches do not tackle the security issues that arise in dynamic node WSN. The proposed research aims to explore this problem and propose solutions based on a cryptographic approach.

X. Zhang, H. Chen, K. Wang, H. Peng, Y. Fan and D. Li [7] Wireless Sensor Network is an important part of the Internet of Things. Data privacy preservation in wireless sensor networks is extremely urgent and challenging. To address this problem, we propose in this study a privacy-preserving data aggregation protocol in wireless sensor networks. Compared to the previous research, our protocol protects the actual data from other nodes based on a rotation scheme while reducing communication overhead dramatically. The protocol achieves accurate aggregation results.Finally, theoretical analysis and simulation results confirm the high privacy and efficiency of our proposal.

III. PROBLEM IDENTIFICATION

Data aggregation is a key mechanism to reduce energy in WSNs. However, there are still some challenges needed to be overcome, in order to improve the performance of data aggregation .In the existing contributions, several aggregation schemes rely on the raw data to group sensor nodes, in order to aggregate information. However, abnormal data often appears in raw data. Thus the data instability definitely impacts the performance of such schemes. In addition, several aggregation functions are specified for a certain data (e.g. temperature data) or a type of network property (e.g. grid network), which limits the adaptively of these functions. Therefore, we are motivated to propose data- independent and property-independent aggregation solutions.

IV. CONCLUSION

In wireless sensor networks, clustering algorithms are broadly utilized and these are the most mainstream directing systems that can adequately oversee network energy utilization through information conglomeration. The choice of bunch heads is a standout amongst the most

critical worries in WSNs. Every sensor nodes may want to transmit information specifically to the sink hub without having any additional correspondence with neighbor hubs. Be that as it may, it brings about more energy utilization for moving information in the network. In this work author have studied the past research works which for the most part centers around energy effective clustering head choice algorithms for wireless sensor networks and author have efficiently examined a couple of separation and thickness based bunch head determination algorithms in profound, and thought about these distinctive plans based some essential measurements.

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