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A Min-Max Inspired Intelligent Approach to Perform Load balancing in Wireless Network

Harvinder Singh, Narwal Sarita
HCTM Technical Campus
(Haryana ,India)

***Abstract*— A Sensor area network can be a vast network with thousands of nodes and because of this the work load over the network increases in terms of transmitted signals. In the grid network, one side contains the transmitters and other side contains the transceivers. As the generic approach the routing algorithm will use the shortest path approach for transmitting data over the network. In such type of network, the load increases on some center node in the network. In this paper, we design load balancing algorithm for grid wireless sensor network .We assume an All to All communication mode in an N × N grid sensor network. We explore routing algorithms which balances the load by using the min max approach. In this proposed approach the nodes being used are some clustered head or some intelligent node that can perform a decision making. In this host based system each node will collect the information about neighboring nodes and perform the decision making respective to minimum or maximum load and data transmission and perform an intelligent decision.**

Keywords*— Load balancing, routing protocols, shortest path routing, sensor network.

I. INTRODUCTION

WIRELESS sensor networks are vulnerable to many types of security attacks, including false data injection, data forgery, and eaves dropping. Sensor nodes can be compromised by intruders, and the compromised nodes can distort data integrity by injecting false data. The transmission of false data depletes the constrained battery power and degrades the band-width utilization. False data can be injected by compromised sensor nodes in various ways, including data aggregation and relaying. Because data aggregation is essential to reduce data redundancy and/or to improve data accuracy, false data detection is critical to the provision of data integrity and efficient utilization of battery power and bandwidth. In addition to false data detection, data confidentiality is required by many sensor network applications to provide safeguard against eavesdropping.

This proposed work integrates the detection of false data with data aggregation and confidentiality. Data confidentiality prefers data to be encrypted at the source node and decrypted at the destination. However, data aggregation techniques usually require any encrypted sensor data to be decrypted at data aggregators for aggregation. The existing false data detection algorithms address neither data aggregation nor confidentiality. Although they could be modified easily to support data confidentiality, it is a challenge for them to support the data aggregation that alters data. For instance, the basic idea behind the false data detection algorithm is to form pairs of sensor nodes such that one pairmate computes a message authentication code (MAC) of forwarded data and the other pairmate later verifies the data using the MAC. Data aggregation is implemented in wireless sensor networks to eliminate data redundancy, reduce data transmission, and improve data accuracy. Data aggregation results in better bandwidth and battery utilization which enhances the network lifetime because communication constitutes 70% of the total energy consumption of the network. Although data aggregation is very useful, it could cause some security problems because a compromised data aggregator may inject false data during data aggregation. When data aggregation is allowed, the false data detection technique should determine correctly whether any data alteration is due to data aggregation or false data injection. A joint data aggregation and false data detection technique has to ensure that data are altered by data aggregation only.

Wireless Sensor Networks have emerged as an important area in wireless technology. In the near future, the wireless sensor networks are expected to consists of thousands of inexpensive nodes, each having sensing capability with limited computational power which enables us to deploy a large-scale sensor network.

A wireless network consists of tiny devices which monitor physical or environmental conditions such as temperature, pressure, motion or pollutants at different areas. Such sensor networks are expected to be widely deployed in a vast variety of environments for commercial, civil, and military applications such as surveillance, vehicle tracking, climate and habitat monitoring, intelligence, medical, and acoustic data gathering.

This proposed work presents a dynamic model of wireless sensor networks (WSNs) and its application to sensor node fault detection. Recurrent neural networks (NNs) are used to model a sensor node. Use of NN give high accuracy and data aggregation reduce memory overhead. The model is based on a new structure of a back propagation-type NN. It increases the life time of the sensor nodes.

Data aggregation techniques explore how the data is to be routed in the network as well as the processing method that are applied on the packets received by a node. They have a great impact on the energy consumption of nodes and thus on network efficiency by reducing number of transmission or length of packet. Elena Fosolo et al in [3] defines the in-network aggregation process as follows: “In-network aggregation is the global process of gathering and routing information through a multi-hop network, processing data at intermediate nodes with the objective of reducing resource consumption (in particular energy), thereby increasing network lifetime.”

We would like to present an algorithm that performs data aggregation within a cluster and thus reducing the load of aggregation at cluster-head to provide energy efficiency for maximizing network lifetime.

II LITERATURE SURVEY

A. Algorithm developed in artificial neural network can be easily developed to wireless sensor network platforms and can satisfy the requirement for sensor networks like: simple parallel distributed computation distributed storage, data robustness & auto classification of sensor readings, fault tolerance & low computation. Neural networks can help through dimensionality reduction obtain from the outputs of the neural networks clustering algorithms, leads to lower communication cost & energy saving. The other reason to use neural network based methods in WSNs is the analogy between WSNs & ANNs. As authors strongly believe that ANNs exhibit exactly the same architecture WSNs since neural networks compared to sensor nodes & communications corresponds to radio links classification techniques.

B. Cluster based routing are most frequently used energy efficient routing protocols in WSNs which avoid single gateway architecture through developing of network into several clusters, while cluster head of each cluster play the role of a local base station.

C. The main concern in Wireless Sensor Networks is how to handle with their limited energy resources. The performance of Wireless Sensor Networks strongly depends on their lifetime. As a result, Dynamic Power Management approaches with the purpose of reduction of energy consumption in sensor nodes, after deployment and designing of the network, have drawn attentions of many research studies. Recently, there have been a strong interest to use intelligent tools especially Neural Networks in energy efficient approaches of Wireless Sensor Networks, due to their simple parallel distributed computation, distributed storage, data robustness, auto-classification of sensor nodes and sensor reading. Dimensionality reduction and prediction of sensor data obtained simply from the outputs of the neural-networks algorithms can lead to lower communication costs and energy conservation. All these characteristics show great analogy and compatibility between wireless sensor networks and neural networks.

D. Energy conservation is the most important concern in Wireless Sensor Networks applications which should be considered in all aspects of these networks. Neural Networks as intelligent tools show great compatibility with WSN's characteristics and can be applied in different energy conservation schemes of them.

E. The most important application of neural networks in WSNs can be summarized to sensor data prediction, sensor fusion, path discovery, sensor data classification and nodes clustering which all lead to less communication cost and energy conservation in WSNs. Another classification for neural network based methods can be according to neural network topologies that applied such as Self Organizing Maps, Back propagation neural networks, recurrent neural networks, Radial Basis Functions etc. However, Self Organizing Map neural networks show more applications in WSN platforms. As future work, more studies are required on different types of neural network topologies and training algorithms which would be more compatible with WSNs platforms in the terms of lower computation time. A primary constraint in wireless sensor networks (WSNs) is obtaining reliable and prolonged network operation with power-limited sensor nodes. There is an exciting new wave in sensor applications-wireless sensor networking- which enables sensors and actuators to be deployed independent of costs and physical constraints of wiring[31]. For a wireless sensor network to deliver real world benefits, it must support the following requirements in deployment: scalability, reliability, responsiveness, power efficiency and mobility.

F. In this new approach an intelligent analysis is used to process the structure of a wireless sensor network (WSN) and produce some information which can be used to improve the performance of WSNs' management application[16]. Wireless sensor networks need to be managed in different ways; e.g. power consumption of each sensor, efficient data routing without redundancy, sensing and data sending interval control, etc. The random distribution of wireless sensors, numerous variables which affect WSN's operation and the uncertainty of different algorithms (such as sensors' self-localization) give a fuzzy nature to WSNs [3, 4]. Considering this fuzzy nature and numerous details, a neural network is an ideal tool to be used to cover these details which are so hard to be explicitly discovered and modelled

G. Even if their resources in terms of energy, memory, computational power and bandwidth are strictly limited, sensor networks have proved their huge viability in the real world, being just a matter of time until this kind of networks will be standardized and used broadly in the field. One of the important problems that are related to the use of wireless sensor networks in harsh environments is the gap in their security.

III ROUTING PROTOCOLS IN SENSOR NETWORKS

Low Energy Adaptive Clustering Hierarchy (LEACH): LEACH [3] is a clustering-based protocol. It consists of cluster-heads to distribute the load among the sensor nodes in the network. It consists of localized coordination to improve the scalability and robustness, It uses data fusion to reduce the amount of information transmitted between sensor nodes and a sink, and It uses randomized rotation of cluster-heads to avoid the energy depletion of selected cluster-heads.

Power - Efficient Gathering in Sensor Information Systems(PEGASIS): PEGASIS [3] is a chain-based power efficient protocol based on LEACH. In this all nodes have location information about all other nodes and all of them has the capability to transmit the data to the base station directly. All sensor nodes are immobile[3].

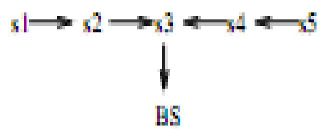

Fig. 1 Token passing approach in PEGASIS[3]

Sensor Protocol for Information Via Negotiation(SPIN): SPIN [3] is a family of protocols that efficiently spread information among sensor nodes in an energy-constrained sensor network. It has three types of messages, ADV, REQ, and DATA. Before sending a DATA message, the sensor node broadcasts an ADV message containing a descriptor (i.e., meta-data) of the DATA, as shown in step 1 of Fig. 4 If a neighbour is interested in the data, it sends a REQ message for the DATA and DATA is sent to this neighbour sensor node, as shown in steps 2 and 3 of Fig. 4, respectively. The neighbour sensor node then repeats this process, as illustrated in steps 4, 5, and 6 of Fig. 4. As a result, the sensor nodes in the entire sensor network that are interested in the data will get a copy.

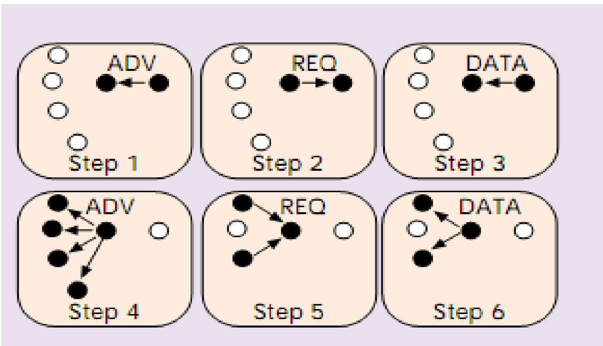

Fig 2 The SPIN protocol[3]

Existing Routing scheme

Several authors in papers [4], [5], [6], [7], [8],[9], [10],[11],[12] have addressed the issue of routing in sensor networks. Barett et al. in [4] developed an algorithm which would reduce the flooding in the network. Flooding is an old technique that can also be used for routing in sensor networks. In flooding, each node receiving a data packet repeats at every node by broadcasting, unless it reaches the destination node as shown in Fig 5. In this paper, they reduce flooding by reducing the number of re-transmissions. Each node forwards received packet with constant probability to all of its neighbours . In this consecutive duplicates are dropped.

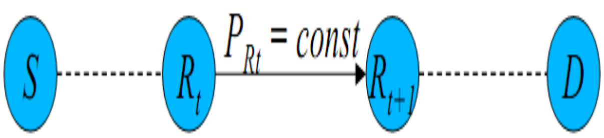

Fig 3. gossip based approach[4]

Instead of this kind of message flooding, Bhaskar Krishnamachari [5]proposed an algorithm based on data centric routing .Two routing models are used as shown in Fig 4.

Address-centric(AC) Routing : Each source independently send data to sink (source 1 routing the data labelled “1” through node A, and source 2 routing the data labelled “2” through nodes C and B) [5].

Data-centric (DC) Routing: In the data centric-approach, the data from the two sources is aggregated at node B, and the combined data (labelled “1+2”) is sent from B to the sink[5].

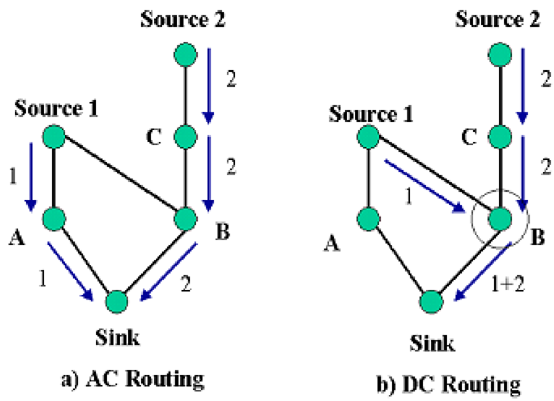

Fig 4. Illustration of AC versus DC routing[5]

Intanagonwiwat,proposed directed diffusion routing strategy in[6] In this sinks broadcast interest to neighbours interests are coached by neighbours then gradients are set up pointing back to where interests came from. Once a source receives an interest, it routes measurements along gradients. Gradients from Source (S) to Sink (N) are initially small and increased during reinforcement then data can be delivered along reinforced path. In [7], David et al. propose a refinement to the directed diffusion algorithm proposed in [7], named Rumor routing the idea is to create event paths. In this way, when a query is generated it can be sent on a random walk until it finds the event path; instead of flooding it throughout the network. It’s a set of long lived agent that create paths. It inform nodes along it routes if it encounter any event. Servetto et al. recently proposed in [8], a routing algorithm which reduces the load on the central node in a single source–single destination communication. It divides the network into expansion and compression phases. Sensor nodes belong to different diagonals of the grid. During expansion phase, the load per node decreases with the increase of number of nodes on diagonal. During the compression phase, the reverse process proceeds, and with the decrease in number of nodes on each diagonal, the load per node increases. . In another paper [9],Stefan et al. analyze the reliability of the system in the case of node failures. The reliability of the system can be increased by providing several paths from source to destination and sending the same packet through these paths it increases. In this it analysis the mechanism through which the tradeoff between traffic and reliability can be controlled by splitting in K sub packets. Fan Ye[10],proposed in this paper describe TTDD, a Two-Tier Data Dissemination approach that provides scalable and efficient data delivery

to multiple mobile sinks. Each data source in TTDD builds a grid structure which enables mobile sinks to continuously receive data .In this sensor nodes are stationary and location-aware to construct and maintain the grid structures with low overhead. Badr and Podar[11] proposed a zig-zag routing policy and showed its efficiently for shortest-path routing on grid networks with independent link failures . Sanjay Shakkottai[12] proposed an unreliable wireless sensor grid-network with n nodes placed in a square of unit area. It indicates that, when n is large, even if each node is highly unreliable and the transmission power is small, we can still maintain connectivity with coverage All the routing algorithms mentioned in [4], [5],[6], [7], [8],[9] [10], [11], [12] do not address the protocol performance in Al l to Al l communication mode.

IV PROPOSED SCHEME

Wireless sensor networks are increasingly gaining importance in various time critical applications. Generally, greedy approach is followed by the sensing devices for data transmission. Hence, transmission of large amount of data packets again and again increases the load on the centre nodes causes formation of holes which leds to the depletion of node due to limited power.

We consider grid network where each sensor node can transfer data to any of the other sensor node or we can say we have a grid format in which one side contains the transceivers and other side contains the transmitters, as the data flow over the network according to the basic routing algorithm the shortest path is followed, with the static routing it passes the data from some center sensor node. This center node can be single for smaller network or it can be many in case of clustered approach. As the load on this center node increases, the packet loss started, as we know a sensor node has fix power to work on, as the load exceeds it starts behaving abnormally and start packet loss

and energy loss while the corner nodes are less utilized. This uneven load distribution results in heavily loaded nodes to discharge faster when compared to others. This causes few over-utilized nodes which fail and result in formation of holes in network, resulting in increase of failed messages in the network.

V TERMINOLOGY

- A static Network is a network with no node failures.
- A dynamic Network is a network with failed nodes.
- All to All communication phase is a mode in which all the nodes in the network send and receive messages from all the other nodes in the network.
- Success-ratio is defined as the fraction of messages that reach their destination under node failure under shortest path routing

The primary focus of this research is to develop into deterministic routing strategies which perform better load balancing of the mesh in an all to all communication scenario, using shortest paths than existing strategies.

VI PROPOSED ALGORITHM

To avoid the congestion in case of center node we are representing this research work. as we can in this node each node can transfer data to its neighbour node. each node of the network is defined along with some parameters.

1. Minimum load on a node
2. Maximum load on a node
3. M-size buffer
4. Transmission speed
5. Forwarding speed

The proposed approach is a host based approach in which each node is an intelligent approach and it can perform some kind of decision making regarding the route decision. the decision will be taken to move on next node using min-max algorithm.

The decision parameter basically depend on the load on the next possible node. it will also estimate the packet ratio along with current load. as the load on this node increases, the packet loss started, as we know a node has fix power to work on, as the load exceeds it starts behaving abnormally and start packet loss and energy loss. while the corner nodes are less utilized. this uneven load distribution results in heavily loaded nodes to discharge faster when compared to others. this causes few over-utilized nodes which fail and result in formation of holes in network, resulting in increase of failed messages in the network. a routing strategy developed should be such that it load balances the network and prevents the formation of holes.

The main objectives that we are going to cover in this proposed approach is

a) Mitigating the overall load within network
b) Rrepresenting the intelligent node that can perform its on decision making while forwarding the data packet.
c) Comparison of the above approach with existing one

The proposed algorithm for the specified approach is

Algorithm:

- Information is gathered and search executed at sink
- Starts with initial admissible state (all nodes are CH's)
- Single node states are iteratively modified and accepted if:
- New state is admissible (meet all constraints)
- New state is not in list
- Goal is to move to lower cost states, unless you cannot
- Visited states go into the list (short-term memory to prevent cycles and local minima)
- After Imax iterations, the algorithm is complete and the configuration is applied
- Network resets after period T, algorithm is re-execute

IV. CONCLUSIONS

The proposed work is about to resolve the load from the center node and distribute it over the network by using the min-max algorithm. As the load will be distributed it will resolve the congestion problem and give better results in terms of accuracy and efficiency.

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