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GREEN ROUTING STRATEGY FOR DYNAMICALLY ARRANGED OMOGENEOUS WSN- MSCT2

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ABSTRACT

Wireless networks play a crucial role in the communication systems nowadays. Wireless networks are being increasingly used in the communication among devices of the most varied types and sizes. User mobility, affordability, flexibility and ease of use are few of many reasons for making them very appealing to new applications and more users everyday. A Wireless Sensor Network (WSN) is composed of sensor nodes spread over the field to sense the data. The sensed data must be gathered & transmitted to Base Station (BS) for end user queries. The used sensor nodes being in- expensive having low computation power & limited energy so are not as much reliable as their expensive macro sensor counter parts but their size and cost enable hundred to thousand of micro sensors to achieve high quality fault tolerant system. In an environment where in each round all sensor nodes have to send data to base station; it is required to effectively utilize energy of sensor nodes so as to increase the life- time of the system. The use of data aggregation & fusion as proposed in LEACH increases system lifetime by a factor of 8 as compared to conventional routing protocols. In this work, our main focus is the static sensors are randomly selected and the base stations have their information all a priori. Basically, the sensors are in direct communication range of each other and can transmit to and receive from the base station. The nodes periodically sense the environment and have always data to send in each round of communication. The nodes fuse/ aggregate the data they receive from the others with their own data, and produce only one packet regardless of how many packets they receive. The problem is to find a routing scheme or an efficient protocol to deliver data packets collected from sensor nodes to the base station. It maximizes the lifetime of the sensor network under the system model given above. However, the definition of quality of service of the sensor network provides is not specified. Secondly, where the nodes are densely deployed, the quality of the system is affected as soon as a significant amount of nodes die, since adjacent nodes record identical or related data. In this case, the lifetime of the network is the time elapsed until half of the nodes or some specified portion of the nodes die. In general terms, the time in rounds where the last node depletes all of its energy defines the lifetime of the overall sensor network. Taking these different possible requirements under consideration, our work provides a proper timing of all deaths for all algorithms in detail as well as chooses the shortest possible path for communication with better memory management scheme and leaves the decision which one to choose to system designers.

Indexing terms/Keywords

MSCT^2, Clustering of Tiers.

Academic Discipline

Computer Science and Engineering

SUBJECT CLASSIFICATION

Energy Efficient Routing Technique for Wireless Sensor Networks.

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INTRODUCTION

A wide variety of expensive and inexpensive sensors are available those are capable of computational task and wireless communication .we are concerned about the inexpensive sensor. A sensor network is basically consists of sensors that will collect useful information from environment depending on the application. Mainly there are two types of sensor network i.e., Micro sensor and macros nor. Micro sensor network consist of many spatially distributed sensors, which are used to monitor various kinds of ambient conditions like temperature, humidity, etc. and then transform them in to electric signal. A sensor is equipped with a radio transceiver, an energy source, a small microcontroller, and a battery which cannot be replaced if sensor is established once. Usually sensors are physically small and inexpensive. Small sensors are not as reliable as more expensive macro sensors, but small size and small cost of an individual sensor, allow production and deployment in large numbers. A wireless sensor network contains hundreds or thousands of these sensor devices that have ability to communicate either directly to the Base Station (BS) or among each other [4]. The nodes in WSNs are usually battery operated sensing devices with limited energy resources.

The main constraint of sensor nodes is very low finite battery energy which limits the lifetime and quality of network, because of this fact the protocols must be designed in a way to efficiently utilize the energy of nodes to prolong the lifetime of the network [4]. Since wireless communication consume significant amount of battery power, sensor nodes should spend as little energy as possible when receiving and transmitting data. Network lifetime can be increased by reducing bandwidth consumption by using local collaboration among nodes & tolerate node failures[1].The data generated by nodes in sensor network is too much for end user to process so methods are required to combine them into a small set of meaningful information.

A simple way is data aggregation (sum, average, min, max, count) from different nods and a more elegant approach is data fusion which can be defined as combination of several unreliable data measurements to produce a more accurate signal by enhancing the common signal & reducing uncorrelated noise. The classification performed on the aggregated data might be performed by human operator or manually.

Routing in WSNs is very challenging due to the specific characteristics that distinguish WSNs from other wireless networks such as wireless ad hoc networks or cellular networks. Many new algorithms have been proposed, taking into consideration the inherent features of WSNs along with the application and architecture requirements.

The proposed approach named as Minimum Spanning based clustering Tier Technique (MSCT2) is based on multi hop data transmission nodes to those neighbor nodes which are connected to it in minimum spanning tree (MST) structure for all the nodes of the network and then a node of Highest energy among highest rank tier will transmit the whole network aggregated data to base Station, we keep on repeating this procedure.

In wireless ad hoc and sensor networks, nodes working only with battery power will die after battery exhaustion. This means that the network has a limited lifetime. One of the main challenges facing the network designers in wireless ad hoc and sensor networks is to maximize the network lifetime. Our work is centered on energy efficient techniques that will prolong network lifetime. Several classes of energy efficient techniques exist. Among them topology control assumes that the MAC layer is able to tune the transmission power of the node. In this work, we do not make such an assumption: the sender always transmits with the maximum transmission power. In the following, we focus on the three other energy efficient classes: energy efficient routing, node activity scheduling and optimization of the volume of data transferred. The specificities of the wireless ad hoc and sensor networks make difficult the design of communication protocols and in particular energy efficient ones. They also lead to favor simple techniques: protocols should induce a low overhead, have minimal memory and computation requirements, etc.

BACKGROUND

The earliest and simple approach was direct transmission in which each sensor node will sense & transmit its data to BS individually. Since base station is located far away from sensor nodes resulting higher transmission cost. Because of this high cost transmission the energy of nodes drain off faster and thus having short system lifetime. In order to solve the problem, clustering based protocols were proposed where a cluster is a group of sensor nodes, with a head node managing all other member nodes. The heads are responsible for coordinating member nodes, gathering data within the clusters, aggregating data and forwarding the aggregated data to the base station.

LEACH [1] is a cluster-based, distributed, autonomous protocol. The algorithm randomly chooses a portion of the sensor nodes as cluster heads, and lets the remaining sensor nodes choose their nearest heads to join. The cluster member's data is transmitted to the head, where the data is aggregated and further forwarded to the base station. The LEACH algorithm reduces the number of nodes that directly communicate with the base station. It also reduces the size of data being transmitted to the base station. Thus, LEACH greatly saves communication energy.

Since the protocol randomly chooses cluster heads in each round, the energy consumption is theoretically evenly distributed among all sensor nodes.

TEEN [10] adopts a similar clustering mechanism as LEACH does. It sets two thresholds, a soft threshold and a hard threshold, during the data collecting stage to further reduce communication traffic.

In the PEGASIS protocol [2], a cluster is a chain based on geographical location. The PEGASIS protocol constructs all sensor nodes into a chain with the shortest length. Sensor nodes only communicate with their adjacent nodes so that they can send data at the lowest power level. In each round, the system randomly chooses a sensor node as the cluster head to communicate with the base station. Therefore, communication traffic is reduced.

The PEDAP protocol [3] further extended the PEGASIS protocol. In the PEDAP protocol, all sensor nodes are constructed into a minimum spanning tree. PEDAP assumes that the base station knows the location information of all sensor nodes, and the base station can predict the remaining energy of any node based on some energy dissipation model. After certain rounds, the base station removes dead sensor nodes and re-computes routing information for the network. In the setup stage, all sensor nodes only need to receive the routing information broadcasted by the base station. Thus, the PEDAP consumes less energy than the LEACH and PEGASIS protocols in the setup stage.

The Multi-tier Trace-back Protocol (MTP) [4] is an extension to the PEGASIS and PEDAP protocols. Under the MTP protocol, each sensor node calculates its distance to the base station by evaluating the signal strength from the base station. Then, the sensor nodes are partitioned into several tiers based on their distances to the base station. Data is forwarded to adjacent tier nodes that are closer to the base station, which is similar to the PEDAP protocol. Eventually, the MTP protocol chooses a node that is closest to the base station to communicate with the base Station, using a mechanism similar to the PEGASIS.

In MSMTP [12] protocol all nodes of the network will transmit the sensed information or aggregated data to their neighbor which are connected in MST structure by multi hop communication. Whole network is divided into three tiers as described in [12]. A node of tier1 having highest energy will transmit network's fused data to base station, and similarly a node of highest energy from lowest possible tier id is selected to transmit data to base station & in this way load is evenly distributed to all nodes of the sensor network. Our MSCT2 is also based on [12,13] with the improvement of having clusters in the Tiers. This improvement will increase the battery lifetime because work overhead on nodes are less now. MSCT2 also using the concept of Multihop relay.

THE SYSTEM MODEL

Network Model

The protocol assumes that 100 sensor nodes are distributed randomly in the network area of diameter 100m. In addition to data aggregation, each node of the network has the capability to transmit data to other sensor nodes as well as to BS. The aim is to transmit the aggregated data to base station with minimum loss of energy which in fact increase system life time in terms of rounds. In this work we consider sensor network environment where:

• Each node periodically senses its nearby environment & likes to send this data to BS.

• Base Station is placed at a fix location.

• Sensor nodes are homogeneous & energy constrained.

• Sensor nodes are dynamic & are uniquely identified time to time.

• Data fusion & aggregation is used to reduce the size of message in the network. We assume that combining n packets of size k results in one packet of size k instead of size nk.

Energy consumption model

Here in this model, the first component reflects the energy consumed by the radio.

The second component presents the energy consumed by the amplifier and depends on the distance between the transmitter and the receiver.

Etransmit = C1(size) + C2(size; d) = C1 size + C2 size d

= size(C1 + C2 d); …………………………..(1)

Where : C1: Energy consumed by the radio of the transmitter to transmit a bit,

C2: Energy consumed by the amplifier to send a bit at a distance of 1 meter,

size: Packet size,

d: Distance between the transmitter and the receiver,

and $0 < \alpha < 6$ values of 2 or 4 are the most frequently used.

Many works about topology control focus on the component proportional to the distance. Equation 1 becomes, when uniformed by the size of the transmitted packet:

Etransmit = C1 + C2. dα

This formula points out the relation between energy consumption and distance. This relation is used intopology control to optimize energy consumption by tuning the transmission power taking in to account the distance between the transmitter and the receiver.

Many other works suppose that the transmissions is done at the maximum power. In other words, the transmitter uses the transmission power such that any receiver at a distance equal to the transmission rage correctly receives the message. Consequently, we can consider the quantity (C1 + C2.dα) as a

constant named C. Hence, the energy dissipated in a transmission by a transmitter is :

Etransmit =Csize where size denotes the packet size in bits.

In our work, we will assume accordingly.

Problem Statement

In this work, our main focus is WSN (wireless sensor networks). The static sensors are randomly selected and the base station has their information all a priori. Basically, the sensors are in direct communication range of each other and can transmit to and receive from the base station. The nodes periodically sense the environment and have always data to send in each round of communication. The nodes fuse/ aggregate the data they receive from the others with their own data, and produce only one packet regardless of how many packets they receive. The problem is to find a routing scheme or an efficient protocol to deliver data packets collected from sensor nodes to the base station. It maximizes the lifetime of the sensor network under the system model given above. However, the definition of quality of service of the sensor network provides is not specified. Secondly, where the nodes are densely deployed, the quality of the system is affected as soon as a significant amount of nodes die, since adjacent nodes record identical or related data. In this case, the lifetime of the network is the time elapsed until half of the nodes or some specified portion of the nodes die. In general terms, the time in rounds where the last node depletes all of its energy defines the lifetime of the overall sensor network. Taking these different possible requirements under consideration, our work provides a proper timing of all deaths for all algorithms in detail as well as chooses the shortest possible path for communication with better memory management scheme and leaves the decision which one to choose to system designers.

Sensor Node Information

MSCT^2 protocol initially partitions all sensor nodes into different tiers, in according to the distance towards the base station. The system assigns a tier ID to each node during the initialization stage. Those sensor nodes having the same tier ID are treated to be in the same tier. They approximately have the same distance towards the base station, and they consume approximately the same energy to communicate with the base station. Nodes closer to the base station are assigned lower tier IDs. Section IV-A describes the details how tier ID are assigned. But due to dynamically arranged wireless sensor nodes after every transaction or sending data units initialization process executes. This process continuous until all nodes dead.

For a sensor node in the proposed system, adjacent nodes with lower tier IDs are called its upper tier nodes (closer to the base station), while adjacent nodes with higher tier IDs are called down tier nodes (farther off the base station), nodes with the same tier ID are called peer nodes (approximately the same distance to the base station). Data trace-back will forward a node's data to its upper tier nodes, where the data is aggregated and further forwarded to even upper nodes. Basic information of a sensor node includes location of node, node ID, tier ID, energy contained by that node, energy threshold defined, distance of node from base station & energy required by the node to transmit data to BS, which is represented in the figure 1.

X	Y	Tier_id	Cluster_id	Node_id	Energy	Threshold	Distance	Transmission energy

Fig 1: Structure of the node

Where X, Y represents the location of the node in the network, node ID is globally assigned and is unique; the tier ID represents the distance towards the base station, and it is determined during the system initialization; energy of node records current remaining energy of the node; Cluster_id represents cluster name in which node resides; the energy threshold is used to decide whether or not the node has enough energy to communicate with the base station, distance contains distance of node from base station, and transmission energy contains amount of energy required to transmit data to BS. Some factors like location of node, node ID and the tier ID, distance, transmission energy are static, remains unchanged during the lifetime of the sensor node. The remaining energy will change during its lifetime. The energy threshold is dynamically set by the base station, which is least energy required by a node to transmit data to BS and is redefined time to time and is half of its previous value.

PROTOCOL DESCRIPTION

Tier Partitioning

The system partition the whole network into three tiers based on the distance from the base station. The least possible distance d1 (from middle of that side which is towards base station) & largest distance d2 (from that corner of the network which is on other side of base station) is calculated, and after their difference is calculated as:

Diff= largest distance – least distance

Now the nodes are assigned tier id based on their distance from base station as: X Y Tier_id Node_id Energy Threshold Distance Transmission energy

For Tier 1, distance is in range d1 & d1+diff/3

For Tier 2, distance is in range d1+diff/3 & d1+2*diff/3

For Tier 3, distance is in range d1+2*diff/3 & d2*Subsubsections*

The heading for subsubsections should be in Arial11-point italic with initial letters capitalized.

Data Transmission to BS

In this protocol, each sensor node forwards its sensed, aggregated data to that neighbor node which is connected to according to Minimum Spanning Tree. Then a node of top most rank will transmit the aggregated data of all nodes of the network to the base station as shown in figure 2 below:

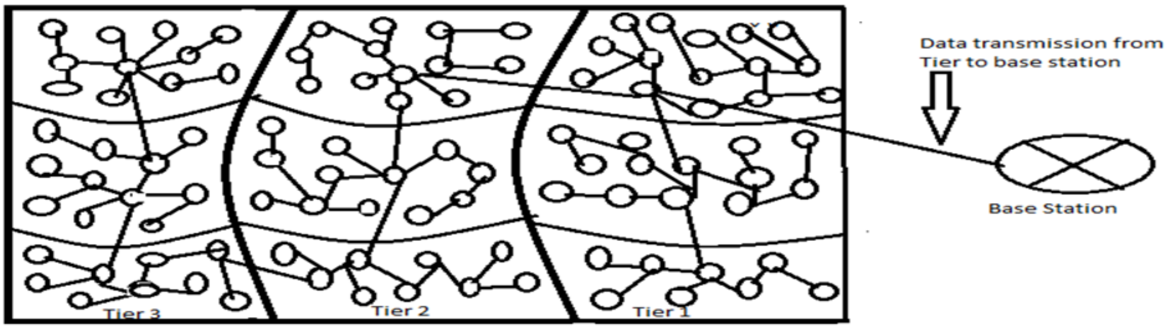

Fig 2. Proposed Architecture when transmission is through tier1 node

Nodes of tier1 continues to transmit aggregated data to base station until all nodes of tier1 have energy greater than defined threshold level, when all nodes of tier1 have energy below threshold energy then nodes of tier2 will transmit data to base station and same procedure will be shifted to nodes of tier3. This procedure is known as TOP TIER SHIFTING.

When all nodes of tier3 have energy below threshold energy then a new threshold is defined. This procedure is continued until threshold goes below dead energy, at that moment all nodes of network are dead so the network is assumed to be dead.

Proposed Algorithm

i. Distribute energy in network area keeping track of their location used to assign tier-id to them with a node closest to BS in tier1 and farthest in tier3, assign initial energy to them & calculate energy required to transmit data to BS and to nodes within network.

ii. All sensor nodes are connected in minimum spanning tree to communicate data within network.

iii. Select a Head node among tier1 of highest energy which will transmit network aggregated data to BS, having energy more than transmission energy.

1. Nodes of a particular Tier are also divided into Clusters.
2. One Cluster head is chosen from each cluster.
3. Nodes of Clusters have to send data to the Cluster head.
4. Clusters head send all fused data to the neighbor Cluster head.

iv. As concern with the Tiers working. Each Tier is having a Tier representative whose working is to send the collected data to the neighbor Tier.

v. Tier head send the collected data to the base station.

vi. We are also using the concept of node activity scheduling using Multipoint relay. As long as nodes are having data to send nodes are on. Otherwise nodes are switched off.

vii. Data collected is transferred from one cluster head to another in Top to bottom and left to right.

viii. Transmit data to BS and deduct energy of Head node, if energy of node is below dead energy then discard that node from network area.

ix. If no node is available in tier1 having energy more than transmission energy then increment tier id by1 and chose a node from tier2 to transmit data to BS.

x. Repeat the procedure to transmit data to BS by incrementing tier-id till and when it reaches to 4 a new threshold is defined and tier-id is set to1.

xi. This new threshold is defined to the level until it goes beyond dead energy of a node, after this value network is considered to be dead.

Observations: 1. By doing this nodes energy is saved .

2. Each time data is transferred new spanning tree is formed.

3. By this arrangement data travel at less nodes

RESULTS

In order to evaluate the performance of MSCT2 , we will simulated it on 100 node network. The simulations will done in c++. The BS is located at (0,-100) in a field of diameter 100m. We will run the simulation to determine the round in which every node is died. Parameters using will be same as that of [3]. Once a node dies it is considered dead for the rest of simulation, and our results expected to show much better system stable lifetime (period when all nodes of network are alive) because it balances energy dissipation among sensor nodes by using all nodes as cluster head with equal priority (highest energy node will serve as head node) thus maximizing stable life time & achieves better results.

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