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ENHANCING ENGERY FOR SENSOR NETWORKS THROUGH EVOLUTION AND CLIQUE BASED ALGORITHM

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Abstract: Wireless Sensor Networks (WSNs) are becoming an essential part of many application environments that are used in military and civilians. A sensor network is composed of a large number of sensor nodes, which are densely deployed either inside the phenomenon or very close to it. One of the most important features in WSNs belongs to the limited battery of sensor nodes. When battery-powered wireless sensor nodes are placed in a specific field, it is difficult to replace their batteries or supply additional energy. Furthermore, if one sensor node consumes completely its energy, part of the network may disconnect.This algorithm includes the inter cluster communication when using evolution algorithm. This research starts from preparation of nodes in communication space and calculate the range of clique of all node present in preparation space of nodes in WSN.When we applies RSSI (Received Signal Strength Indication) for the formation of clusters. RSSI facilitates the event of ranging and positioning technologies in wireless sensor networks (WSN), it becomes more and more vital to seek out a mathematical model which may accurately describe the link between the RSSI values and distance.This technique is more specified for activating the node of network which was not focusedin earlier techinue as well as introducing the clique to each node forminimizing the energy constraints.Further it should beready to modify parameters in keeping with the modification of environment by itself, and even be able to reduce error farthest. Any evolution algorithm for applying to activate the cluster head as an optimization technique to enhance the performance of the cluster head election procedure. Especially, Evolution Algorithm (EA) is defined as search algorithms that use the mechanics of natural process and evolutions such as reproduction, gene crossover, and mutation as their problem-solving method. The results aren't guaranteed to return up with a generation that contains a higher fitness value but by performing totally different evolution operations, the likelihood of achieving the required results is increased.
Key Words: Evolution Algorithm, WSN, Clustering, Clique, Fitness Function

I. INTRODUCTION

Wireless sensor networks (WSNs) constitute the foundation of a broad range of applications related to national security, surveillance, military, health care, and environmental monitoring. One important class of WSNs is wireless ad-hoc sensor networks, characterized by an ad-hoc or random sensor deployment method, where the sensor location is not known a priori. This feature is required when individual sensor placement is infeasible, such as battlefield or disaster areas. Generally, more sensors are deployed than required (compared with the optimal placement) to perform the proposed task; this compensates for the lack of exact positioning and improves fault tolerance. The characteristics of a sensor network include limited resources, large and dense networks, and a dynamic topology. An important issue in sensor networks is power scarcity, driven in part by battery size and weight limitations. Mechanisms that optimize sensor energy utilization have a great impact on prolonging the network lifetime. Power saving techniques can generally be classified in two categories: scheduling the sensor nodes to alternate between active and sleep mode, and adjusting the transmission or sensing range of the wireless nodes. In this paper we deal with both methods. We design a scheduling mechanism in which only some of the sensors are active, while all other sensors are in sleep mode. Also, for each sensor in the set, the goal is to have a minimum sensing range while meeting the application requirements. One of the main design considerations in cluster-based wireless sensor networks are cluster head election and cluster formation. A cluster size with a large number of member nodes leads to a small number of clusters in the network improving the efficiency of intercluster communication. On the other hand, cluster size with a small number of member nodes leads to increased number of clusters in the network which requires a backbone with a large number of cluster heads and gateways (cluster member linking two different cluster heads) to route the packet for inter-cluster communications [1]. Energy efficiency of clustering protocols can be considered through two different approaches which is the number of clusters formed or the number of members per clusters (cluster size). In context of cluster-based topology, cluster size is related to number of neighbours connected to a cluster head which is defined as node degree and can be referred to as the number of member nodes per cluster. Most of the existing methods control the cluster size with admission or rejection policies during the cluster formation which can be based on the strongest received signal Strength [2]. Our proposed method of controlling the number of members per cluster is through transmission power control algorithm [3].This paper considers the fundamental question of what is the cluster size that gives minimum energy dissipation while maintaining network connectivity. Connectivity can be determined by number of neighbors a node has (node degree) [4]. Node degree is a local property that can be checked by each node to achieve global network property such as connectivity [5]. Connectivity is an important property in wireless sensor networks that enables data to be forwarded or exchanged between nodes in the network. Nodes can communicate among themselves to route each others' data packets if there exists a path between any two pairs of nodes. Connectivity depends on the number of nodes per unit area and their transmission range. The correct setting of nodes' transmission range is an important consideration for network lifetime [6]. By increasing the transmission power of a node, more nodes can be reached via direct link. Increasing the transmission range can improve connectivity but on the other hand can lead to higher interference, more data collision, and higher energy consumption [7]. Reducing to low transmission power may result in some nodes getting isolated without having any link to other nodes. Connectivity in terms of node degree has been studied by [4, 8, 9]. Node degree is also regarded as one of the important and convenient metrics to measure connectivity of wireless ad hoc networks [10, 11]. It has been shown that the average node degree for an almost fully connected random network of node located randomly using uniform distribution is in the range of 6 to 10 [8].

1.2 INTRODUCTION TO LEACH &CBCR FOR WSN

The core idea of LEACH protocol is to divide the whole wireless sensor networks into several clusters. The cluster head node is randomly selected, the opportunity of each node to be selected as cluster head is equal, and energy consumption of whole network is averaged. Therefore, LEACH can prolong network life-cycle. LEACH algorithm is cyclical, it provides a conception of round. LEACH protocol runs with many rounds. Each round contains two states: cluster setup state and steady state. In cluster setup state, it forms cluster in self-adaptive mode; in steady state, it transfers data. The time of second state is usually longer than the time of first state for saving the protocol payload.

The selection of cluster head depends on decision made 0 and 1. If the number is less than a threshold, the node becomes a cluster head for the current round. Using this threshold, each node will be a cluster head at some point within 1/p rounds. Nodes that have been cluster heads cannot become cluster heads for a second time for 1/p -1 rounds. After that, each node has a 1/p probability of becoming a cluster head in every round. At the end of every round, every normal node that is not a cluster head select the nearest cluster head and joins that cluster to transmit data. The cluster heads combine and compress the data and forward it to the base station, therefore it extends the life span of major nodes.

In this algorithm, the energy consumption will allocate approximately uniformly among all nodes and the non-head nodes are turning off as much as possible. LEACH assumes that all nodes are in range of wireless transmission of the base station which is not the case in many sensor deployments. 5% of the total nodes play as cluster heads in every round.

Time Division Multiple Access (TDMA) is deployed for better management and scheduling. LEACH is one of the most popular clustering algorithms used in WSNs to increase the network lifetime. LEACH is an adaptive, self organizing and clustering protocol.It introduces the concept of Rounds.LEACH assumes that the BS is fixed and located far from the sensors, all sensor nodes are homogenous and have limited energy source, sensors can sense the environment at a fixed rate and can communicate among each other, and sensors can directly communicate with BS. The idea of LEACH is to organize the nodes into clusters to distribute the energy among the sensor nodes in the network, and in each cluster there is an elected node called a cluster head (CH)Due to the sensors limited power, the network lifetime is a major concern; specially, for applications of wireless sensor networks in harsh environments. Hence, energy efficient routing mechanisms and adaptive clustering schemes are developed to prolong the network lifetime.

1.3 CLIQUE TECHNIQUE IN WSN

A clique-based algorithm that refines the measurements using the redundancy in groups of interconnected nodes. This greatly improves the accuracy of localization comparing to algorithms not using cliques. The other contribution is elaborating the peer-to-peer localization algorithm that is self-organizing. This algorithm uses the angle and range measurements in order to pass a 3-D reference system in the peer-to-peer mode, between two nodes, without any precalibration and without using earth-gravity. In this section, this technique gives the background for the techniques that can be used as angular and ranging measurement methods in the DV-exchange localization method. This also specify limitations of the localization methods of significant importance to this work which were not mentioned in the introduction.

A. Spatial measurements

DV-exchange method is based on the measurements of distance and angle between sensors (nodes). The methods for obtaining these quantities in the peer-to-peer mode can be Time of Arrival (ToA) and Angle of Arrival (AoA). In this work, the technique assume using antenna arrays for obtaining these quantities, but technique base on the assumption that we are given the values of angles and distance with some error without analyzing the performance of a particular measurement technique.

B. Localization techniques

Positioning method efficiently overcoming the problem of an unknown propagation model in tunnels. It uses a neural network to learn the response fingerprint of a sensor being in a certain location in the tunnel. Nevertheless, similar methods cannot be used in the self organized, training-less system like the one under consideration in this work. This is so because the method aims at localizing mobile sensors in the known environment. In contrast, the operating environment considered in this work is not known in advance.

II. RELETED WORK

WSNs are constituted of small sensors with specialized applications and limitations designed for specific purposes. The applications are divided into military, commercial, and medical applications. Among military applications are communication, command, and intelligence defense networks. Healthcare system for disables in remote areas, smart environment for the elderly, physicians, and medical staff communication networks, and patient surveillance systems are some of medical applications. Moreover, there is a wide range of commercial applications including security systems, fire safety systems, environment pollution monitor systems (chemical, microbial, and nuclear pollutions), vehicle tracking, supervising and controlling systems, traffic control system, and natural disasters studies (e.g., earthquake and flood) [1]. Wide range of applications has resulted in development of variety of protocols which include plenty of flexible parameters. At any rate, some parameters, due to their wide range of utilization, can be found in several applications (as common parameters) and of great importance. Wireless sensor networks use mobile energy sources and rechargeable batteries, and due to technological limitations, these batteries can supply energy for a short period of time. Thus, optimum utilization of energy in such networks is of great importance [2]. Necessity of data integrity in WNSs due to support continuous and permanent communication among the sensors has made the lifetime another important parameter in WSNs. The present study surveys some specific parameters throughout different operational stages of WSNs. In general, operational stages of classic WSNs are divided into node placement, network coverage, clustering, and data aggregation. In [2] concept of distributed topology control algorithm to conserve energy is introduced. In this paper localized distributed Topology control algorithm is presented. It calculates optimal transmission power to active network connectivity. It reduces node transmission power to cover nearest neighbor. A node uses only the locally available information to determine nodes. Majority of work has been done on fault tolerant topology control algorithm to minimize the total power consumption. It provides k-vertex connectivity between two vertices. Michaela Cardei et al [7] propose new architecture to achieve minimum energy consumption by using k-approximation, centralized greedy, distributed and localized algorithm. It provides reliable data gathering infrastructure from sensors to super node. Andrew Ka-Ho Leung and Yu Kwong Kwok [15] have proposed a new localized Application driven Topology Control Protocol. This scheme is designed for a wireless P2P file sharing network. Their proposed scheme is based on enhancing the lifetime and effectiveness of file sharing among peers. Authors tried to achieve an efficient connectivity among mobile devices in order to better serve the file sharing application. Their designed protocol consists of two component 1) Adjancy set construction (ASC) 2) Community base Asynchronous wakeup (CAW). WalteneguDargie et al (2010) proposed topology Control protocol [1]. The developed protocol enables nodes to exhaust their energy fairly. This paper proposes algorithm based on eligibility and efficiency of nodes. In this paper, authors presented a shortest path and energy-efficient topology control algorithm[4].The algorithm tries to preserve shortest path connecting itself to nearby nodes and the minimum-energy paths. Research work carried out by [16] authors examines the price of ignorance in topology control in cognitive network with power and spectral efficiency objective. They proposed distributed algorithm that, if radio posses global knowledge, minimize both the maximum transmit power and spectral footprint of the network. They showed that while local knowledge has little effect on the maximum transmission power used by the network, it has the significant effect on the spectral performance. They have presented an approach for achieving end to end objective through learning and reasoning. For dynamic networks, as radios join the network, more knowledge provides better spectral performance. When radio leaves the network, some ignorance in the network results into better performance.

III. INTRODUCTION TO ALL TECHNIQUES AND ALGORITHMS

A. Evolution Algorithm

Evolution Algorithm EA) is a heuristic search technique that mimics the process of natural evolution. This heuristic is routinely used to generate useful solutions to optimization problems and search engines. Evolution algorithms belong to the larger class of evolutionary algorithms (EA), the solutions to optimization problems using techniques inspired by natural evolution to generate as inheritance, mutation, selection and crossover. This research investigates the data collecting spanning trees with higher energy efficiency.The proposed algorithm always tries to achieve a proper route that balances the data load over the network. An algorithm that ensures a balance of residual energy among the nodes increases lifetime of the network.

B. INTRODUCTION TO CLUSTERING

Clustering is one of the important methods for prolonging the network lifetime in wireless sensor networks (WSNs). It involves grouping of sensor nodes into clusters and electing cluster heads (CHs) for all the clusters. CHs collect the data from respective cluster's nodes and forward the aggregated data to base station. Figure 1 shows on the basis of proposed technique the life time of the Wireless sensor network can be enhanced due to the low energy consumption

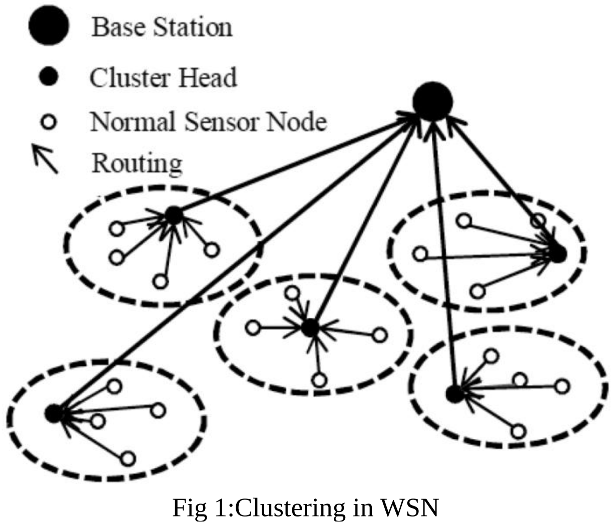

Fig 1:Clustering in WSN

Clusterting Technique reduces the complexity of communication with the help of maser node and slave node within the cluster. Now, now the Master node has solely responsibility to communicate the base station.

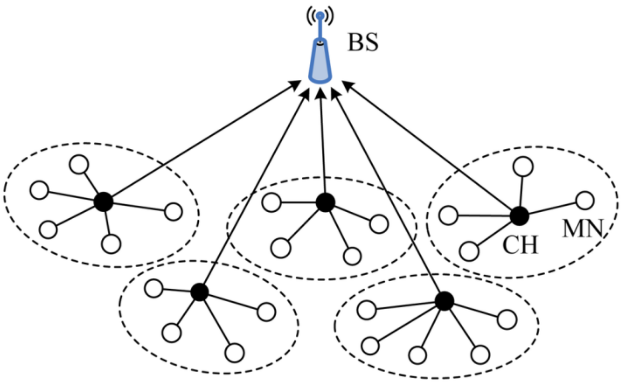

Fig 2: A sample of cluster based WSN.

C. INTRODUCTION TO CBCR

We propose a CBCR (Clique Based Clustering and Routing) protocol to minimize the energy dissipation in sensor networks. It is a clustering based protocol that forms non-overlapping clusters of size where n is the maximum cluster size. By exchanging information of single-hop neighbors, all sensor nodes in the network are grouped into a number of disjoint cliques, in which all the nodes can directly communicate with each other. Among all the nodes in a cluster, the node with maximum energy becomes cluster head. The key features of CBCR are: self-configuration and localized coordination, maximum energy cluster head, periodical rotation of cluster head, hierarchical forwarding, load balance, fault tolerance and scalability.

D. INTRODUCTION TO CLUQUE

Our detailing utilizes one of the conventions from to parcel system into groups (1s). The figure underneath delineates a system in which every club is a solitary jump sub system. Every inner circle is a solitary jump system. Every group head knows the halfway interruption discovery frameworks of its single-bounce neighbors. There is a case of half breed grouping: the primary stage demonstrates a case of bunching in inner circles. The second stage demonstrates the various leveled bunching of G'.

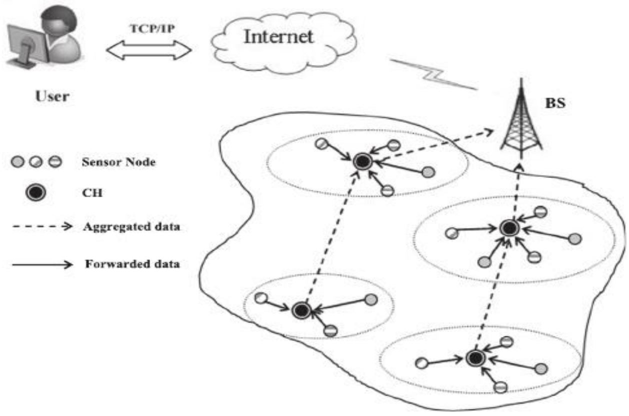

Figure 3: Single Hop Sub Network in Clique

3.4.1 Clustering Procedure in Cliques

The sensors run one of the protocols in to create cliques like clusters. We assume that this phase yields k cliques (clusters), hence k cluster heads named CH $_{clique\text{-}I}$, $1 \leq i \leq k$, for the cluster head of clique i.

3.4.2 Analysis of the Energy Consumption

The energy model used here is similar to that used by most existing energy-efficient clusteing model

$$E = ET + ER = a \times (e_t + e_{amp} \times d^n) + a \times a_r$$

Where, ET and ER are the energy consumptions of transmitting and receiving data items respectively. The energy dissipated in operating the transmitter radio, transmitter amplifier and receiver radio are expressed by e_t, e_{amp} and r_e respectively. And d is the distance between nodes and n is the parameter of the power attenuation with $2 \leq n \leq 4$.

3.4.3 Reducing Power Consumption during Clustering in Cliques

Our approach is based on energy-efficient clustering algorithm in which the cluster head is located in the central area of the cluster. Here, since each cluster is a clique, each sensor is at one hop to the cluster head. This contributes to use less energy for transmission to and from the cluster head, comparatively to multi hop clustering.

E. SIMULATION PARAMETERS

Parameter	Value
Network Size	[100 100];
Number Of Sensor Nodes	100
Sensor Node Deployment	Uniform Random
Percentage Of Cluster Head	5
Data_Packet_Size	=128
Energy_Th	10e-3
Eelec	=50e-9
Efs	=10e-12
Eda	=5e-9
Mobility Model	Random Way Point Model
Data_Packet_Size	=128
Broadcast_Packet_Size	=24
Transimission_Range	=20
Zoom	=10
Communication Radius	d0=87.71

IV. CONCLUSION AND FUTURE WORK

Moreover, it outperforms the previous protocols in terms of energy dissipation rate, network lifetime and stability period in both homogeneous and heterogeneous cases. Further we can compare it with TEEN, SEP, E-SEP, Adv-LEACH, and ADV-TEEN

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