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Implementation of Novel Clustering Approach for WSN using MATLAB Tool

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Abstract: Wireless Sensor nodes have to coordinate among themselves to get information about the physical environment. The information collected by sensor nodes is routed to the Base Station either directly or through other sensor nodes. The Base Station is a fixed node or mobile node, which is capable to connect the sensor network to an infrastructure networks or to the Internet where users can access and process data.

In this paper a centralized protocol for Novel Cluster Head selection in WSN is discussed, which is run at the base station, thus reducing the nodes' energy consumption and in-creasing their life-time. The primary idea is implemented using a fuzzy-logic based selection of Cluster Head from among the nodes of network, which is concluded depending on two parameters, the current energy of the node and the distance of the node from the base station. The protocol is named LEACH-C(ED)-Centralized LEACH based on Energy and Distance, and is run periodically at the base station where a new set of cluster heads are selected at every round, thus distributing the energy load in the network and increasing the network lifetime. The simulation results show that the proposed approach is more effective than the existing LEACH-Centralized protocol.

KEYWORDS: WSN, Cluster Head, micro sensors, network lifetime, LEACH.

INTRODUCTION

Wireless Sensor Networks (WSNs) have gained worldwide attention in recent years which comprises of several sensor nodes that can sense, measure, and gather information from the environment. Due to its energy constraints, the deployments of WSNs will require advance techniques to maintain the network lifetime. A clustering based routing algorithm called Low-Energy Adaptive Clustering Hierarchy (LEACH) was proposed as a solution for energy saving. In order to save energy consumption, the data must be aggregated and then sent to the base station. But in the case of homogeneous sensor network, the cluster-head will soon die which needs to be re-clustered that cause high energy consumption. This paper proposes a concept of associate cluster head selection that reduces the overhead of clustering process, reduce the load over cluster head, avoiding re-clustering and thus reduce the energy consumption within cluster in large-scale and dense sensor networks. The selection of the associate cluster head is based on the distance between the cluster and the base station and on the residual energy of the sensor node in wireless sensor network. In our proposed algorithm introduce a technique that save the energy that is consumed by the sensor nodes during the re-clustering process, so it saves the energy and enhances the lifetime of the sensor network.

The Sensor Node:

Wireless Sensor Networks mainly consists of nodes known as sensors. Sensors are devices with low energy as they operate on battery, having limited memory and processing ability and are designed to survive extreme environmental conditions. These are mostly due to their small size. They are also featured with self-organizing and self-healing power. Three basic parts of a SENSOR NODE can be seen as:

- A sensing subsystem that is used for data capturing from the real world.
- A subsystem for processing that is used for local data processing and storage.
- A subsystem consisting of wireless communication to be used to for data receiving and transmission.

Applications of Wireless Sensor networks: The applications of WSN can be categorized in 3 parts:

a) Object Monitoring

b) Area Monitoring

c) Space and objects Monitoring

Protocols of WSNs: The different layers of communication use various protocols to accomplish their aims. Some of the protocols of the three layers are mentioned below.

1) Transport Layer Protocols:

Cost-Oriented Reliable Transport Protocol (PORT)-To acquire unwavering quality and minimize vitality utilization, a dynamic rate-control and congestion-avoidance transport plan called PORT is utilized as a part of WSN's Transport Layer. PORT minimizes vitality utilization with two plans. To begin with is focused around the sink's provision-based enhancement approach that bolsters back the ideal reporting rates. Second is a generally ideal directing plan as per the reaction of downstream correspondence condition [2]. Congestion Detection and Avoidance (CODA)-CODA comprises of three mechanisms to combat with degree of congestion during event impulses: (i) receiver-based congestion detection; (ii) open-loop hop-by-hop backpressure; and (iii) closed-loop multi-source regulation [3]. Delay Sensitive Transport (DST) - The principle aim of DST protocol is to conveniently and dependably transport occasion characteristics from the sensor led to the sink with least vitality utilization. The convention at the same time addresses blockage control and opportune occasion transport unwavering quality targets in WSNs [4].

Pump Slowly, Fetch Quickly (PSFQ)-An easy, expandable, and reliable trans-port protocol that is modifiable to meet the requirements of emerging depend-able data applications in sensor networks, PSFQ is designed to send data from a source node by sending data at a slower velocity ("pump slowly"), but permit-ting nodes that encounter data loss to regain any missing data from their local immediate neighbors aggressively ("fetch quickly")[5].

Event-to-Sink Reliable Transport (ESRT)- It is a solution for transport developed to accomplish dependable event detection in WSN with least energy expenditure. It contains a congestion control module that does the dual purpose of accomplishing dependability and preserving energy. The algorithms primarily work on the sink, with minimum requirement of resource constrained sensor nodes [6].

2) Network Layer Protocols:

The protocols like Geographic Routing Algorithm (GERA), is evaluated in terms of end to end delay and routing load management done by the protocol [7]. Anchor Location Service (ALS) protocol is based on grid that supplies sink position data in an extensible and optimal fashion and therefore bears location-based routing in large-scale wireless sensor networks. Secure Routing-All the luster based protocols like LEACH, LEACH-C, LEACH-E, LEACH-A, Multi-hop Routing, etc. are secured routing protocols Their efficiency is being constantly improved by researchers. Secure Cell Relay (SCR)- is a routing protocol, immune to various types of attacks on sensor networks, including selective forwarding, sinkhole, wormhole, Sybil, hello coding attacks, etc. SCR is also an optimal energy utilization routing protocol with a ordable security overhead [9].

3) Data-link Layer Protocols:

Z-MAC [10]-This protocol aggregates the strengths of TDMA and CSMA. CC-MAC [11] (Spatial Collaboration based Collaborative MAC)-CC-MAC protocol has two parts: Event MAC (E-MAC) and Network MAC (N-MAC). E-MAC strains out the relation in sensor records while N-MAC gives priority the trans-mission of route-through packets.
Low Power Distributed MAC-This design is mostly for multi-hop WSNs. A set of low power MAC design principles are proposed in the work [12], and a new umber-low power MAC is developed to be broadcast in nature to support extensible, survivable and adaptability requirement of WSNs.

CLUSTERING BASED PROTOCOLS FOR WSN

Grouping calculations for WSNs could be isolated as Centralized cluster calculations and distributed grouping calculations. Distributed clustering systems are again isolated into four sub segments relying upon the sort of cluster, necessity for clusters and parameters utilized for CH determination. The four sub-sections are - Identity based grouping, Iterative, Neighborhood information based and Probabilistic individually [13]. Probabilistic systems for framing clusters in Wireless sensor systems rely on attributed likelihood values for sensor hubs. Low-Energy Adaptive Clustering Hierarchy convention proposed in [14] is such a protocol, giving o set of vitality utilization by arbitrary turn of group heads then ensuring equivalent burden adjusting in one-bounce sensor systems. LEACH-C is focused around transmission of position subtle elements and vitality levels of every sensor hub to base station (BS) and sensor hubs

with vitality level above decided beforehand edge are chosen for getting to be cluster heads by the base station (BS) itself [14].

LEACH has a few drawbacks as mentioned:

- The time duration of setup-phase cannot be determined. The collisions cause too much delay, therefore the sensing service is interrupted. This may cause LEACH to be unstable during the setup phase.
- LEACH Protocol cannot be applied to networks that are used in a gigantic field area, as it utilizes one hop routing in which each sensor node transmits information immediately to the CH, that in turn transfers to the BS.
- The CH nodes in a LEACH round use up a big volume of energy if the locations are far from the BS.
- Leach cannot give assure that CH will be distributed uniformly.
- Leach makes use of dynamic clustering, thus resulting in added overhead such as the CH change, Ch advertising, etc. which increases the energy expense.

DESIGN CHALLENGES & PROPOSED METHOD

Heterogeneous Nodes: The sensor devices deployed in area maybe of various types and they need to collaborate with each other.

Distributed Algorithms: The algorithms should be of distributed type as they are executed on different nodes.

Low Bandwidth Communication: The data should be transferred with least possible bandwidth, between sensor nodes.

OBJECTIVE:

- To develop an effective selection protocol that chooses Cluster Heads based on the geographical location of node and its remaining energy.
- The algorithm is a centralized protocol for Cluster Head selection in WSN, which is run at the base station, thus reducing the nodes' energy consumption and increasing their life-time.
- Improvement on centralized LEACH based on Energy and Distance, which is run periodically at the base station where a new set of cluster heads are selected at every round, thus efficiently distributing the energy load in the network.

PROPOSED METHOD

Clustering approaches that are presently being uses make use of 2 methods: selection of a CH with more left over energy and rotation of CH periodically so that the energy consumption among nodes is distributed and thus the lifetime of network is extended.

The work done is the output of three observations. Firstly the energy expense of a node is dependent on the distance to which the node transmits its energy, because when the distance of transmission is greater than a factor d0 then the energy consumption grows by D^4, the details of which is in the Radio Energy Dissipation model. The second observation is that LEACH-C is more energy efficient than LEACH [8], primarily because LEACH does not generate uniformly distributed clusters in every round and does not consider the nodes' energy and distance from BS. The third observation is that LEACH uses dynamic clustering which results in extra overhead such transmission of advertisement and receiving join requests that reduces the energy consumption gain; whereas this overhead is curbed in LEACH-C in which the Cluster Head selection process is run at Base Station, which is assumed to have infinite energy as compared to nodes' energy. Thus any WSN process run at the BS does not generate energy overhead to the network nodes, except the minimal node information that is communicated to BS by node.

SYSTEM ASSUMPTIONS:

We consider WSN implementations in where sensor nodes are put up in a random order so that the environment is monitored continuously. The data accumulated by sensor nodes is transmitted to a BS situated in exterior of the chosen area. Every sensor node can function either in sensing mode to check the surrounding and send it to the allotted CH or in Cluster Head mode to collect data, squeeze it and send it to the BS. The additional presumptions are as follows:

- The sensor nodes and BS are immobile.
- All the nodes possess the equal energy initially.
- All nodes are given unique identifier.

- The distance among nodes is calculated depending on the received strength of signal.
- All nodes have ability to compute their respective distance from base-station, based on GPS or other location detection scheme.
- All nodes are part of event driven WSN model.

RESULTS AND ANALYSIS

The proposed clustering algorithm LEACH-C(ED), is compared with the basic Centralized Cluster-Head se-lection algorithm LEACH-C. The simulation results prove that the approach selected in the work reveals better performances.

This simulation was deployed using the MATLAB 2013a software. There are 100 nodes. They are spread in a random order in a 100 x 100 area. The values that are used in the first order radio model are shown in Table 1 given below.

Table 1: Configuration Parameters used

Type	Parameter	Value
Network topology	Number of nodes	100
	Expected number of clus-ters	5
	Network coverage	(0, 0) (100, 100) m
Radio Model	Startup energy	2 J
	E_{elec}^{Tx} / E_{elec}^{Rx}	50 nJ/bit
	ϵ_{fs}	10 pJ/bit/m^2
	ϵ_{mp}	0.0013 pJ/bit/m^4
Application	Packet header size	25 bytes
	Data packet size	500 bytes

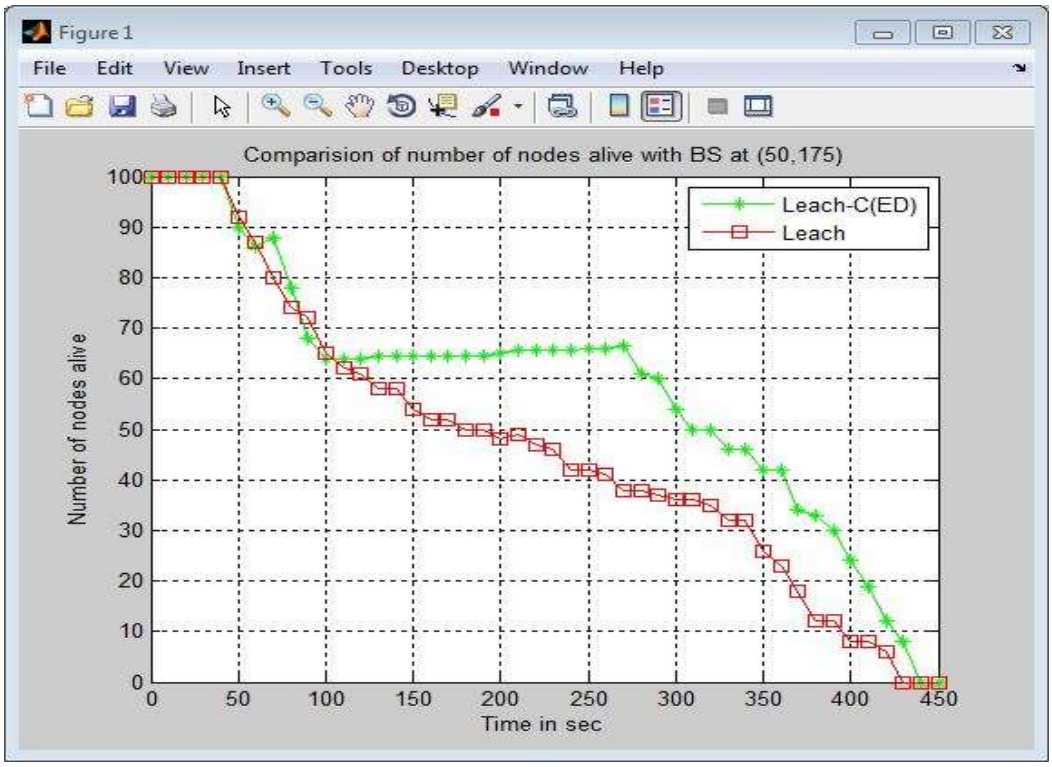

Figure 1: Nodes alive when BS is at (50, 175)

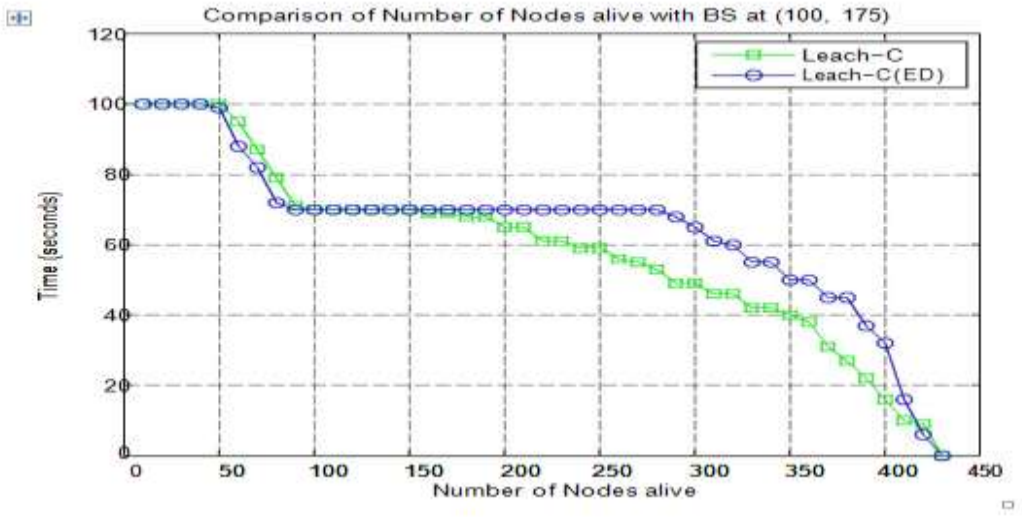

Figure 2: Nodes alive when BS is at (100, 175)

CONCLUSIONS

The main aim of the proposed algorithm is to extend the lifespan of the Wireless Sensor Network by dividing and spreading the load and to improve the NP hard annealing algorithm, to reduce the execution time at the base-station. At any point of time, the overall number of nodes not dead in the WSN of LEACH-C(ED) is greater than number of nodes not dead in LEACH-C, for a fixed Base Station. The Half Life of Network under LEACH-C(ED) is much better than LEACH-C. For a network of 100 nodes with Base Station at (50,175), LEACH-C(ED)'s efficiency is 42.72 % better than LEACH-C, when HNA is compared. It is also observed the while the HNA status of LEACH-C(ED) is much better than LEACH-C, the total energy consumption of both the networks is equivalent. The comparison of HNA Status of LEACH-C(ED) with LEACH-C shows that LEACH-C(ED) performs better than LEACH-C for various Base Station locations taken into consideration. Thus the simulation outputs present that the proposed LEACH-C(ED) is more efficient than the centralized algorithm LEACH-C.

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