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A Diplomatic Data Collection in Wireless Sensor Networks using MLEACH Algorithm

A. Rehash Rushmi Pavitra[1*], E. Srie Vidhya Janani[2]

[1*]Research Scholar, Anna University Regional Campus, Madurai, Tamilnadu, India
[2]Assistant Professor, Anna University Regional Campus, Madurai, Tamilnadu, India

Corresponding Author: rushmiips@gmail.com

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Abstract— Wireless Sensor Networks entitled with Mobile Sinks (WSN-MSs) based routing schemes have been extensively explored to prolong the network lifetime. Data collection is an important issue for sensor nodes as they have limited energy, various routing have been proposed earlier for data collection of both homogeneous and heterogeneous networks. In this research paper, we propose Diplomatic Data collection using Mutated LEACH (DDC-ML) Routing protocol for (WSN-MSs) ensures maximum throughput, minimum delay and packet loss rate. Clustering is an effective approach to increase energy efficient data transmission. The behaviour of our proposed technique is the node that takes the role of Cluster Head (CH) supposing of CH dies. So CH is based on maximum energy. Thus, the proposed activities minimize the overall energy consumption of the network and periodically increase the data transferred to Base Station (BS). Ultimately, DDC-ML performs better than the selected existing techniques in terms of the chosen performance metrics thereby outperforming in large scale sensor networks.

Keywords—Wireless Sensor Networks, Routing protocols, Clustering, Data Collection, Mobile Sink.

I. INTRODUCTION

Generous number of wireless sensor nodes well organized with BS form a intermix network called WSNs. Node which are equipped with a processor, transceiver, GPS, memory and battery [2]. The sensor nodes aim is to collect the data at standard interval, then turn around the data into digital signal and ultimately send the signal to the sink or BS via radio waves. WSN must be scalable, self-configurable, robust and secure. Different types of sensor nodes are infrared, seismic, visual, radar, thermal, acoustic and many others; which develops their application area. Some applications of WSN are military applications, environmental monitoring, health monitoring, home and communication applications [1]. One of the major issues in MS enabled WSN is data collection.

Two communication modes in WSN-MSs (i) a sensor node can either send its data directly to a sink, (ii) or it can send data via multi-hop or hop-by-hop transmission [3]. In considered sensor nodes are randomly expanded in the field for sensing environmental aspects. After gathering data these nodes are supposed to transmit it for further processing. During sensing and transmission of data nodes consume energy, because they have limited energy resources (batteries connected to them). Sensor node throughput, transmission delay and packet loss rate are the factors of prime focus in data collection. Furthermore, clustering schemes are introduced to save nodes energy and can also used to perform data aggregation which combines data from source nodes into set of valid information [4].

Similar to LEACH, DDC-ML is also based on the homogenous set of nodes. The proposed scheme objective is to maximize the lifetime, energy efficient and throughput of the network. After sensor nodes deployment information distributing among the CH and BS by means of MS is carried out with the help of link estimation mechanism. Particularly, simulation results manifest that DDC-ML can achieve significant perform improvements in terms of End-to-End delay, Throughput, Packet loss rate and accessible to implement. This makes DDC-ML more systematic.

The rest of the paper is organized as in section II related work is provided; Section III contains brief description of the proposed (DDC-ML). Section IV takes the discussions of simulation results into consideration. Section V ends the research work.

II. RELATED WORK

A. Clustering Protocols

Clustering is the activeness [5] of formulating sets of identical phenenomenon. To enlarge throughput and network lifetime of WSN, clustering scheme was popularized. Routing scheme based on clustering mechanisms, A Hybrid Energy Efficient Distributed clustering (HEED) works on the basis of residual energy and intra-cluster communication cost to make a node CH [7]. Every CH in the network access uniformly distributed. The obstacle in this method is that it elects extra CH and consumes more energy, so overhead is considerably increases.

Probabilistic clustering algorithm called Energy Efficient Hierarchical Clustering (EEHC) [6] here each sensor node determines whether it can become CH or not, when it became CH it communicates to all its neighbour nodes. Moreover, if a node is not a CH if it receives communication message becomes a representative of CH.

K-Means algorithm is proposed in [9], where the selection standard for a CH is based on (i) Euclidian distances (ii) Residual energies of nodes. Clustering is executed by distributed approach, so even if a single node fails in scattered environment it cannot damage other nodes. The performance fails in centralized structure; in addition it leads to more chances of packet loss.

Low Energy Adaptive Clustering Hierarchy (LEACH) [8] is a classical hierarchical routing algorithm. The purpose is to select nodes as CH in such a way that every other node gets a chance to become CH. It involves two phases (i) Set up phase (ii) Steady up phase. In set up phase clusters are assembled and a CH is picked for several clusters and in steady phase total collected data by CH is transmitted to BS. The algorithm declines in case of large examined sensor networks; likewise it does not consider initial energy as a part to designate CH.

B. Sink Action Strategies

In [10], the authors considered the design of using mobile sink for WSNs. The mobile sinks called Data MULEs (Mobile Ubiquitous LAN Extension) move frequently through the networks to collect data in their short range and sent it to the BS. MULEs are allowed to communicate with each node to develop system performance. When MULEs will appear then the definite time cannot known by the sensor nodes. So the movements of MULEs cannot be concluded.

Query-based data collection was proposed in [11] which a query packet is inserted by the MS and forwarded to the appropriate area, and the acknowledgement is returned to the MS through multi-hop communication. Overview of this technique has five phases (i) Querying at the right time (ii) Routing the query packet (iii) Data aggregation (iv) Routing the response packet (v) Response packet delivery. Two nodes in them are notifying and chasing node. The response packet hast to report into the chasing node, which points to increase both the delivery latency and storage overhead.

A novel data collection scheme called Maximum Amount Shortest Path (MASP) is developed as an integer linear programming problem to generate subdivision of possible solutions and then progress the total amount of data packets [12]. In this technique the initial state is originated by the two dimensional binary matrix, where the initial value may consist of infeasible solutions. Simultaneously fitness and unfitness value is to be calculated; here the fitness value is to extract creator and unfitness value is used in crossover technique.

Lifetime maximization was treated by the authors in [13] as governed to the delay and energy constraints. Where each sensor node can hold off the communication of data until the sink is at the stop state. Exclusive delay tolerance level, sink node fulfil one round of visit to all the ending in time units, and then repeat the process with another round. The same process is continuous that the two nodes randomly visit to the same stops.

In [14] the authors proposed a data collection energy rescuing scheme for the WSN, based on Graph theory. The mission of the scheme is to be use limited energy in process of data collection. The sensors are of battery powered, Where energy saving is an important concern in WSN.

The authors in [15] intended a data origin in Two-Tier Data Dissemination (TTDD) proactively frames a grid infrastructure which permits MS to continuously receive data within a limited unit only. To communicates with other sensor nodes along short range trustee. Each sensor nodes is known to own locations. The propagation nodes are constantly distributed to form a reliable grid infrastructure.

III. SYSTEM MODEL

A. Basic Assumptions

We make some basic assumptions as follows

- Sensor nodes are uniform and each node has a solitary ID.
- There exists a multi-hop routing protocol. Here, DDC-ML routing protocol is used.
- MS is initialized with a non-zero value and it can move from one locality to another spontaneously.

B. Network Model

We infer that sensor nodes gather information of activity from the surrounding environments and send these data to the CHs. CH aggregates the data and sends to BS. Figure 1 demonstrates the network model, where MS can move on the internal of the network.

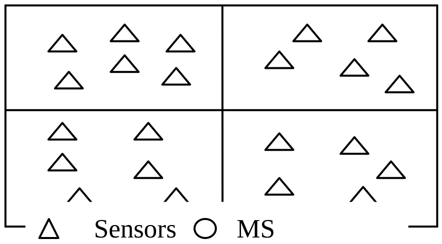

Figure 1

C. Energy Model

Formerly nodes are deployed in the network field, to determine the energy consumed to broadcast 1-bit data over an area a. The CH generates a random number N and correlates it with the threshold value Th. There are two probable cases,

Case 1(N>Th): Receives data from the CH.

Case 2 (N≤Th): Transmits data to the BS.

Moreover, the energy model is shown in figure 2 to provide more accuracy.

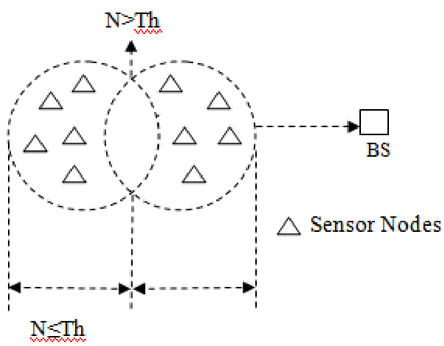

Figure 2 Energy model

IV. PROPOSED SCHEMES: DDC-ML

Systematic routing protocol is the one which absorbs minimum energy and maximum data collection. Minimum energy consumption pointed towards prolonged network lifetime. Maximum data collection is effective in capturing the appropriate information from the whole network field. Owing to data is to be transferred from sensor nodes to the BS there will be an increase in delay, which makes the lifetime of the sensor network to reduce phenomenally. Various analyses have proposed such things as in [16]. To overcome this trusty routing protocol called DDC-ML is exploited.

In the proposed technique, the network is further divided into five phases; (1) Network system (2) Creation of sectors (3) CH selection (4) Link estimation (5) Data update, specifics about each phase are examined in the following subsections.

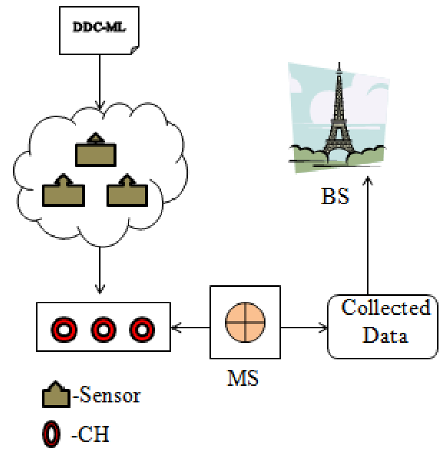

Figure 3 Key theme for the DDC-ML

A. Network System

To develop a large scale WSN the factor that affects the high throughput data collection in WSN-MS is to be focused [17]. Sensor node is also capable of identifying their neighbour nodes to form a network. The nodes in a WSN have information about their physical environment then node x calculates the weight w for each of its current neighbour node y. Secondly finding a neighbour node with maximum weight. If a node comprises maximum weight then send a pairing request to neighbour nodes after receiving reply from neighbour, node is to be selected as a paired node. Definitely send information to all other nodes in the network.

Algorithm 1 Node Arrangements

// All nodes perform following

Input: x(t), y(t) are the sensor nodes;

Fixed MS = NOT NULL;

Sensor node x calculates the weight w for its neighbour node y;

Weight w, y ⟵ x;

Finding a node with maximum weight;

For (node y: maximum weight) send (Pairing request: node);

End for;

If (node receives pairing request) then

Reply ⟵ Sends request;

Neighbour node x and y are paired nodes;

End if;

B. Creation of sectors

In our protocol, we partition the network in different sectors as shown in figure 4. Basically the total field is partitioned into side-by-side squares. The outer square sector is splitted into 6 sectors. The margins of all sectors are appropriated as:

S1 – (25-50, 50-100)

S2 – (50-75, 50-100)

S3 – (75-100, 50-100)

S4 – (0-25, 0-50)
S5 – (50-75, 0-50)
S6 – (75-100, 0-50)

All sectors accommodate stable number of sensor nodes. Considering sectors S1-S6 enclose 5 nodes respectively. In defined sectors all nodes are uniformly distributed. Hence in the middle BS is positioned.

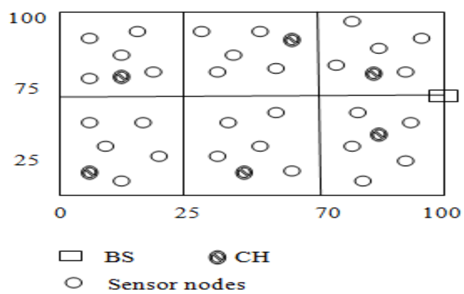

Figure 4 Sectors in DDC-ML

C. CH Selection

Once sensor nodes are arranged in the network field, cluster organization and procedures are section coordinates. In LEACH protocol CHs are elected on probabilistic basis [19]. Mutated LEACH (ML) selects optimal number of CH on the basis of energy and distance [18]. ML protocol by originating CH replacement scheme and dual transmitting power levels, the node with maximum energy that will become a CH of the cluster in case of CH dies. CH collects data and send to BS, for every round the number of alive node is enlarged. All the sectors S1-S6 will follow the same approach of CH selection.

Algorithm 2: Selection of CH in a network
Start CH1, CH2…
Announce first = (MS (0, 1));
CH ID = 1;
While CH, not expired do
If (receive data (announce) and (CH ID = 1) then
CH ID = announce to MS;
State ⟵ (MS TO BS (broadcast data)
End if;
End while;
Else
{
While CH, expired do
CH⟵ ML-CH;
Process continuous;
}
End while;

D. Link Estimation

The uppermost ordered link is named for data transformation [20]. In DDC-ML, the link is estimated based on the acknowledged history. Therefore, the number of data delivered successfully through this link. Data is isolated by $1/n^{th}$ scenario which is forwarded initially as a sample. Depend on the successful delivery of the sample data the original data is forwarded. Thus, the node carries 100 mb of data, we take 1 mb of data and transmitted to BS as a sample, it takes nanoseconds. If it reaches to BS properly then, the link is suitable for transmits the original data.

E. Data Update

Data update, each sensor node maintains the information to store the received data from other sensor nodes. Ultimately total incoming and outgoing information at each section S1-S6 is estimated.

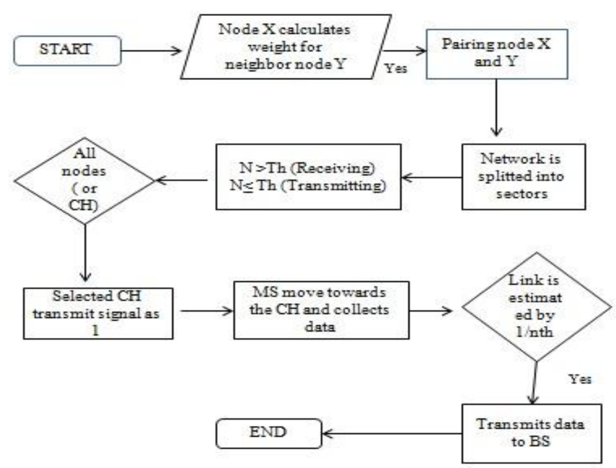

Figure 5 Flow chart of DDC-ML

V. Simulation Results

In this section, we compute the performance of our protocol using MATLAB [21]. The network is considered in terms of throughput, End-to-End delay and packet loss rate. We compared DDC-ML with the existing protocol LEACH. The parameters were specified and a variation of graph were plotted which proved that our protocol DDC-ML outperforms LEACH.

Parameters	Value
Network size	600x600
Number of nodes	200
Sensor nodes initial energy	0.5J
Packet size	34 bytes
Routing protocol	DDC-ML
E_{TX}	50nJ

E_{RX}	50Nj
Sink location	(300m, 300m)
Sink speed	5m/s

Table 1 Parameters used in our simulations

A. Performance Evaluation

This metric measures the average time it takes to forward a data from the source to the destination. If value is high then it means the protocol is not favourable as the network congestion. DDC-ML is compared with the LEACH Figure 6 (a, b). Existing scheme has the higher packet delay because energy usage is not efficient, number of hops for data transmission decreases. DDC-ML is a energy efficient routing protocol are designed based on clustering scheme and it reduces the delay as compared to the existing scheme. The presence of 200 nodes in the network DDC-ML tends to show very less addressing delay.

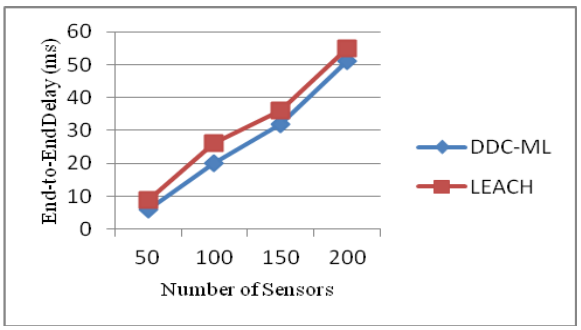

Figure 6 End-to-End Delay (a)

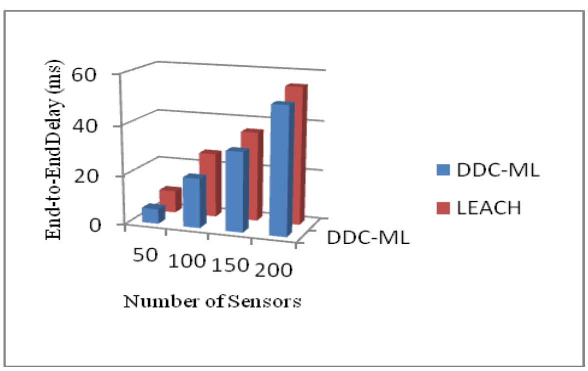

Figure 6 End-to-End Delay (b)

Measures the total data traffic in bits/sec successfully received and forwarded to the higher levels. The relative throughput efficiency of the newly proposed protocols in comparison to their existing scheme is also show in figure 7 (a, b). It is clear that these results show that packets are received at a faster rate for the newly proposed protocols as compared to the existing one due to communication of individual nodes with BS.

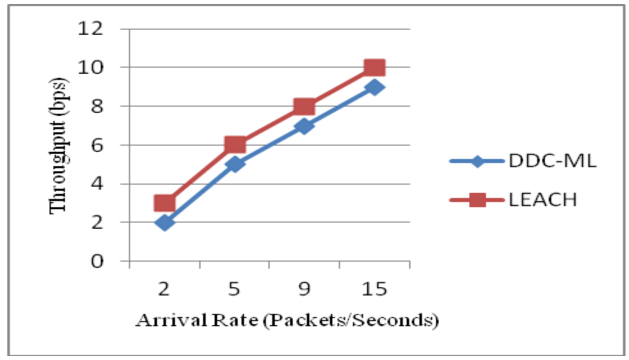

Figure 7 Throughput (a)

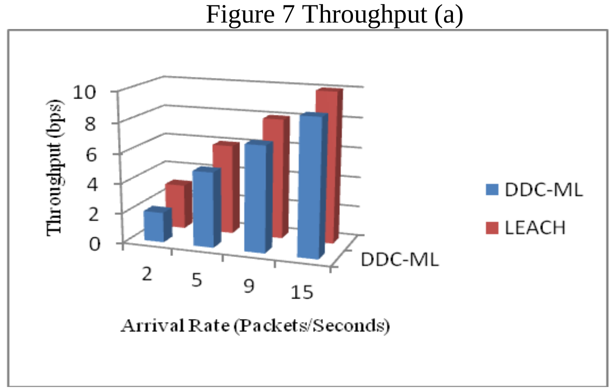

Figure 7 Throughput (b)

Packet loss rate is the total number of lost packets mutually total number of transmitted packets. Figure 8 (a, b) shows the performance of DDC-ML against LEACH in terms of MS speed. When a sensor node communicates remotely to a BS packet loss rate seems to be exponentially high. When a sensor node transmits a data packet to a MS, distance over which packet travels reduces thereby reducing the packet loss rate.

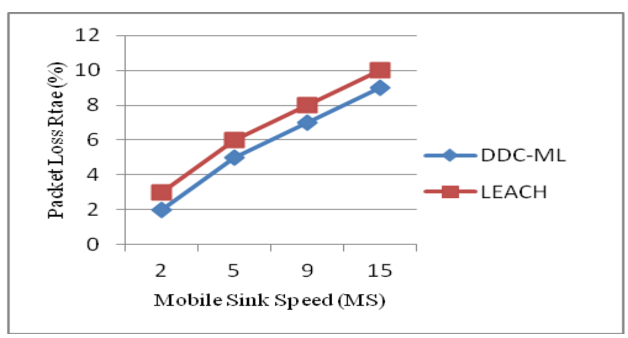

Figure 8 Packet Loss Rate (a)

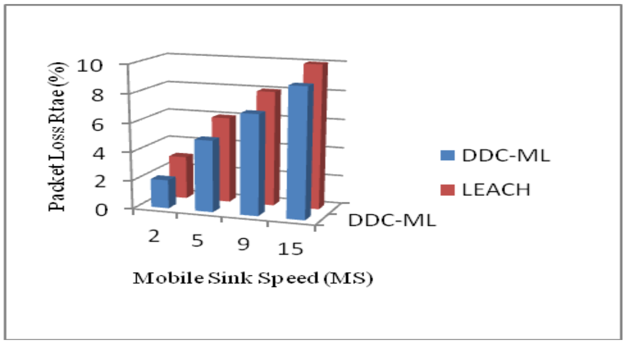

Figure 8 Packet Loss Rate (b)

Completely the analysis it is fair that in the network simulated the proposed technique DDC-ML achieves preferable and it shows efficient routing.

VI. Conclusion

The work concludes with the DDC-ML routing protocol. Simulation results indicate that DDC-ML outperforms LEACH in terms of End-to-End Delay, Throughput and Packet loss rate. For example, LEACH performs in proactive homogeneous background; our proposed scheme originates general selection of CHs on the basis of the maximum energy of the nodes. Furthermore, sensor nodes with maximum weight have suitable data to transmit to MS. More importantly conform to maximum data collection. From simulation results, we conclude that DDC-ML prolongs the network lifetime; achieves approximately 62%, 60%, and 71% improvements in terms of End-to-End Delay, Throughput and Packet rate respectively.

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