I J C T A, 9(24), 2016, pp. 375-383 ISSN: 0974-5572

A Novel Density Based K-means for Hybrid unequal Clustering in Heterogeneous Wireless Sensor Network with Mobile Sink

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ABSTRACT

Optimize energy in Wireless Sensor Network has been considered an important problem. To solve these various approaches have been presented in literature of which clustering and multi-hopping is the most popular one. Almost all protocols can be classified as either static or dynamic protocols. This paper proposes a novel Hybrid Unequal Clustering Technique for wireless sensor network aided by mobile sink approach. The clusters are found dynamically after certain iterations considering power, residual energy, distance from sink etc and maintained for some epochs. The algorithm is aided by a novel concept of mobile sink where the sink moves to the area having maximum data transmissions and optimal path of the sink is found out. The clustering is done using a novel density based K-means clustering technique and the results are compared and are found to be quite encouraging.

Keywords: Wireless Sensor Network, Hybrid Clustering, Mobile Sink, K-means

1. INTRODUCTION

Clustering is one amongst the foremost widespread unsupervised learning techniques (i.e. used for connecting the precipitating gap between input and output observation). The procedure to organize objects into teams known as clustering whose members is homogeneous in some ways". Essentially, clustering is to discover the interior set of untagged data. Clustering, have the tendency to systemize the data in the framework of packets or it can be termed as clusters. There are diverse clustering approaches like Test case prioritization approach programmed cases to be test in sequence to prolong their effectiveness, consistent with some benchmark. Prioritization of test case includes the recognition of the proper trial cases. The motivation of this approach is to encounter some implementation goals like rate of fault detection, increase the effectiveness etc. Fault detection rate is employed to gauge how quickly faults are identified inside the method of testing.

These days wireless sensor networks (WSN) have the flexibility to control neglected in hard environments within which only human admittance and observance can't be simply programmed or manage efficiency or even not possible least a bit. Depending on these crucial assumptions, in several vital WSN applications the sensing nodes are typically positioned in unsystematic way within the space of interest by comparatively unrestricted means (i.e., drizzled by a helicopter) and they develops a network in wireless ad hoc fashion. Moreover, considering the whole space that must be coated, small time span of the battery energy of the sensing nodes and therefore the risk of getting destructive nodes throughout positioning process, massive populations of sensing nodes are presumed; there is a natural risk that hundreds or even thousands of sensing nodes are concerned. Additionally, nodes using sensors in this type of environments are usually energy restricted and their batteries typically cannot be recharged again and again. Consequently, it's decided that functional energy-aware routing and information assembling protocols provide high flexibility ought to be applied so that that network period is conserved sufficiently high in this kind of environments. Normally,

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assembling sensing nodes into clusters has been extensively adopted by the analysis community to satisfy objective related to higher flexibility and usually accomplish excessive energy effectiveness and increases lifetime of the network in wide-ranging WSN environments. The relating hierarchical routing and protocols for assembling the information implicit clustered organization of the sensing nodes so that information integration and aggregation are feasible, so resulting to important energy savings. Within the hierarchical framework networks every cluster incorporates a leader that is additionally known as cluster head (CH) and typically executes special responsibilities that are integration and aggregation, and a number of other usual sensing nodes (SN) which are not elected as cluster heads known as members. The cluster arrangement method eventually results hierarchy of two-level wherever the CH nodes construct the upper level and therefore the member nodes other than CH form the lower level. The sensing nodes systematically broadcast their information to the consequent sensing nodes elected as CH. The CH nodes clump the information (therefore decreasing the entire variety of relayed packets) and transfer them to the base headquarters or base station (BS) either directly or via intermediary announcement with alternative CH nodes. Although, as a result nodes act as a CH send all the information related to time to upper distances than the usual nodes, logically they consume energy at very high rates. A standard resolution to balance the energy utilization between all the sensing nodes of the network is to systematically re-select latest CHs (thus rotating the CH role between all the nodes over time) in every cluster.

The paper describes the various sections. Section II describes the varied works surveyed in the literature regarding this field and a large-scale survey of a couple papers is provided. Section III provides a mathematical form to the problem statement and section IV discusses about proposed system. Section V shows the results and discussion and lastly section VI concludes with a concise discussion on the works that may be done in future.

2. RELATED WORK

Lingyun Yuan et al. [1] proposed an approach for data gathering and event tracking depends on mobile element for clustered wireless sensor network to save the energy and to reduce the network delay. In this paper author uses multi hop communication to transmit the information to the mobile sink and hops are decided by remaining energy and the path loss. Every cluster head is provided with a mobile sink, which consumes more energy compared to c/s model.

R. Rajeshwari1 et al. [2] presented an Energy Efficient Clustering algorithm in Wireless Sensor Networks by making use of Mobile Sink. Sensor networks are combination of sensor nodes which collectively sense the data and send it to the base station. The proposed work is well organized data compression technology is capable of shrinking the volume of the transmitted data and forwards it to towards the sink with mobility. This paper makes use of routing for mobile and information gathering methods are used, which conserve the energy and remove the redundant data.

Babar Nazir et al. [3] presented Mobile Sink Protocol for routing (MSRP) which is used to overcome the problem of hot spot and to increase the lifetime of the clustered Sensor Network. The results of simulation shows that sink mobility strategy perform better than static sink and several number of sink in terms of delivery ratio of packets and throughput.

Lanny Sitanayah et al. [4] proposed Poster response for emergency protocol MAC (ER-MAC) in Sensing element Networks. This protocol is a hybrid of CSMA schedule and TDMA schedule. Proposed emergency response MAC protocol used for emergency replies in sensing networks.

Guoliang Xing et al. [5] proposed rendezvous form of approach for utilizing mobile components to collect sensed data under timely restrictions. In this approach some of the nodes acts as rendezvous points which gets the data from origin and then send that data to the mobile components, when they come in the vicinity of the rendezvous nodes. The proposed approach remarkably reduces energy utilization of the network and scales the density of the network, speed of the mobile component, and deadline numbers.

Chaurasiya et al. [6] an energy-balanced life of network intensifying clustering (EBLEC) has been presented. In this work clustering method in WSN is proposed where cluster heads are elected depending on their comparative involvement of the nodes; enlarge the lifetime of the network by stabilizing the energy consumption.

Zhao, et al. [7] Energy-saving Topology Control Algorithm for increasing the Lifetime of the proposed network with concept of mobile sink has been presented. In this paper a heuristic topography control rule with time complexness O(n(m+n)log n) is proposed by making use of greedy policy with programming dynamically.

Krishnan et al. [8] proposed an information gathering clustering approach which is an effective method by making use of several mobile base stations for Heterogeneous WSN. In the proposed work, information gathering make use of TDMA slots depends on clustering pattern which in turn useful to attain an effective gathering data approach and the traffic within the cluster is decreased using data gathering.

Jose et al. [9] proposed a new scheme for energy improvement in wireless sensor networks. In this paper an introduction to the two well accepted bio motivated techniques ABC and PSO for optimization are specified. The novel proposed strategy with mobile sink is compared with the ABC approach and the results of simulation shows that the proposed scheme is effective in context to delays of average packet and the life of the network.

Malathi et al. [10] proposed a hybrid unequal clustering algorithm to increase the network lifetime, reduce the clustering overhead and to avoid the hot spot problem. In this proposed algorithm hybrid is a combination of static and dynamic algorithm. Simulation results shows that proposed algorithm increases network lifetime and conserves more energy compared to other algorithms.

3. PROBLEM STATEMENT

There is a problem faced by LEACH, is the possibility of nodes selected as a cluster head is equal. The motive of using LEACH is that every node is provided with equivalent times for which they live, the reason is that it decreases the loss of packets. This protocol operates well under homogeneous networks, and in case of heterogeneous networks it does not perform well and the nodes in this network have uneven energies in the beginning. In case of heterogeneous networks the steadiness period decreases and the unsteadiness period increases.

Few researchers have strive many approaches that depends upon unequal clustering protocol for routing in wireless sensor networks (UCR), it assemble the nodes in the form of clusters bearing unequal sizes. Cluster head which is nearer to base station having cluster of small size than the farther one, because they are very far from the base station; as a result the energy used to transmit the cluster to cluster information is saved. Though there are some pitfalls in UCR when it comes to cluster head selection if the distance of the base station is significantly distant from the sensing nodes and also the distant nodes having high energy than other nodes. It is difficult for UCR under this situation to select the best cluster head, which in turn does not solve the problem of hot spot. Hence, the task is to combine UCR with addition re - cluster node each level using multi-hop communication to produce a new algorithm known as Hybrid Unequal Protocol for Routing (HUCR) which is required to be used in this thesis.

Another main problem address in this paper is how to increase the network's lifetime. A concept of Mobile Sinks (MSs) needs to be developed to attain superior results for balancing energy consumed by sensing nodes. But determination of the path of the mobile sink is not an easy task and an algorithmic approach need to be taken to find the best optimal path.

4. PROPOSED METHODOLOGY

The paper attempts to solve the problem occur in wireless sensor networks for information gathering. The solution regarding the problem in this paper involves the development of a K-means Clustering algorithm

based on density for dynamic unequal clustering in every iteration while a concept of mobile sink has been introduced. The path of the mobile sink will be found out for best performance of the system. The sink mobility plays a vital job in the overall performance of the system. The proposed hybrid algorithm will find the optimal path for the current round of data gathering so that the mobile sink is in the place where the probability of data collection is the most. This will increase the network lifetime of the overall system and will also prevent the hotspot problem and reduce packet delivery ratio. The radio model of energy transmission will be utilized in the paper. Some assumptions are prepared for the proposed model.

ASSUMPTIONS:

1. N × N unit area is considered with M number of nodes.
2. Proposed network consider heterogeneous nodes.
3. Initially three levels of energy are considered i.e. normal nodes, advance nodes and super advance nodes.
4. All heterogeneous nodes are motionless but the sink is mobile.
5. Cluster head performs the function of data gathering and data compression.

Density-based K-means Clustering algorithm plays a vital responsibility to recognize complex non-convex clusters depend on the density. Numbers of points in an area, those points that are closely packed to each other, may group together and those points whose nearest neighbors are so far away, marking as outlier. At data mining conference, this algorithm was awarded the test of time award in 2014. Density reachability and density connectivity are two basic concept used in this algorithm.

In Density reachability, assume two points are there i.e. q and p. If p is the point which is placed within the bound of Euclidean distance "ε" from point q, which has adequate number of points in their neighbors that lies between distance ε then point p is supposed to be density reachable from a point q. In context to Density Connectivity, if there is a point r that has adequate number of points in neighbors and together points p and q are the point's lies between the å distances then these points are density connected. Therefore, if point q adjacent to point r, where point r is adjacent to point s, point s is adjacent to point t and finally point t is adjacent to p which implies that point q is adjacent to point p.

Steps of DBK mean clustering algorithm:

Suppose X = {x1, x2, x3... xn} data points set. Distance denoted by "ε" (eps) and minimum points denoted by minPts is the two parameters.

Step 1: Begin with random initial point which is not visited

Step 2: Discover all the adjacent points of initial points using Euclidean distance "eps".

Step 3: If number of adjacent points is larger than or equal to minPts, then the initial point and its adjacent points are added to the cluster. Hence, initial point is marked as visited.

Step 4: If number of adjacent points is lesser than minPts, then these points are marked as disruption.

Step 5: Points which are not visited before is recollected and process it further to make it a component of either cluster or disruption.

Step 6: Iterate Step 2, till all points are visited.

All the nodes will be considered as stationary except that of the sink which will be given mobility, which helps to enlarge the proposed network lifetime and decrease delivery ratio of network.

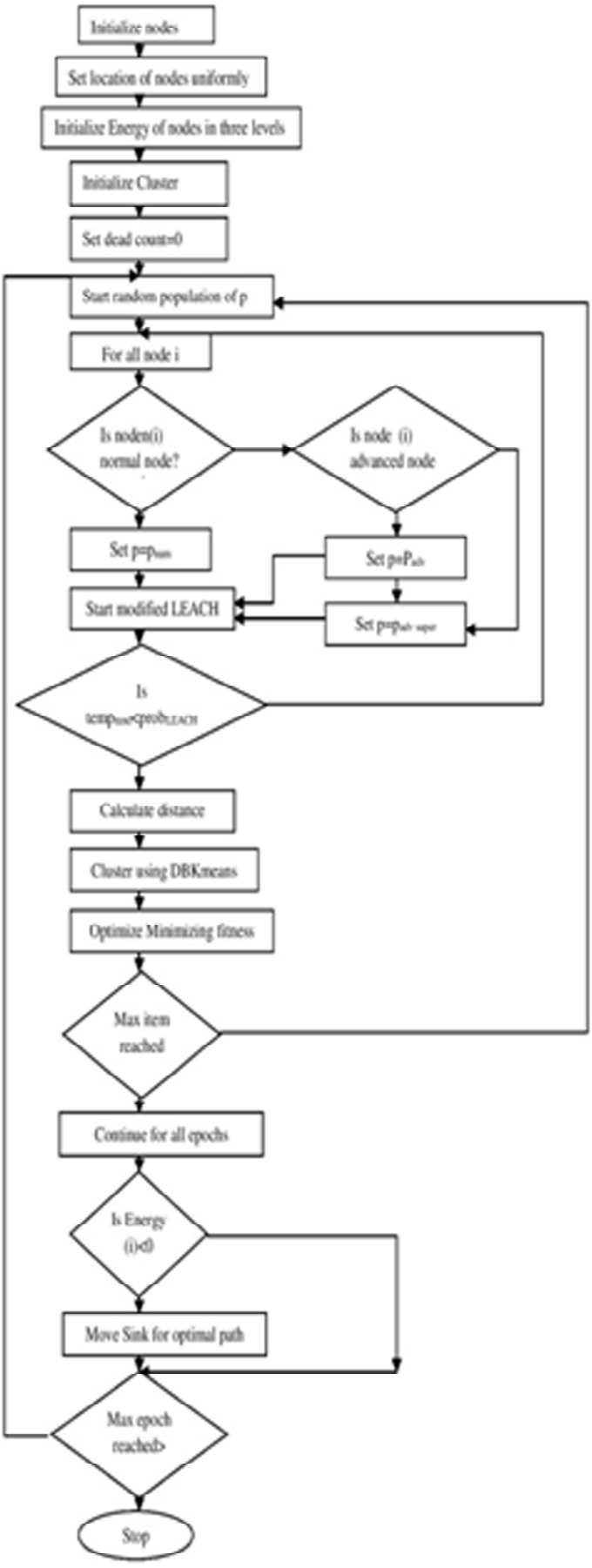

Figure 1: Flow chart of proposed algorithm

5. RESULTS

The simulation is done for 100 number of sensing nodes which are scattered consistently in an area of 100×100. All nodes are provided with primary energies sets. For energy utilization radio model is considered. The simulation of the proposed work is done on a PC with MATLAB R2012b and having specification with a RAM of 4 GB, and processor is of 2.7 GHz.

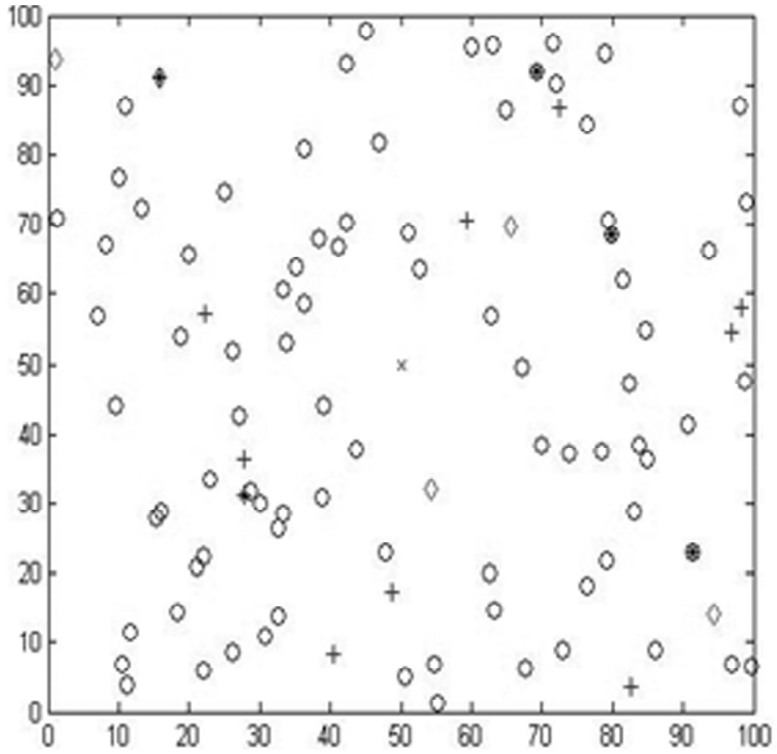

Figure 2: Node distribution

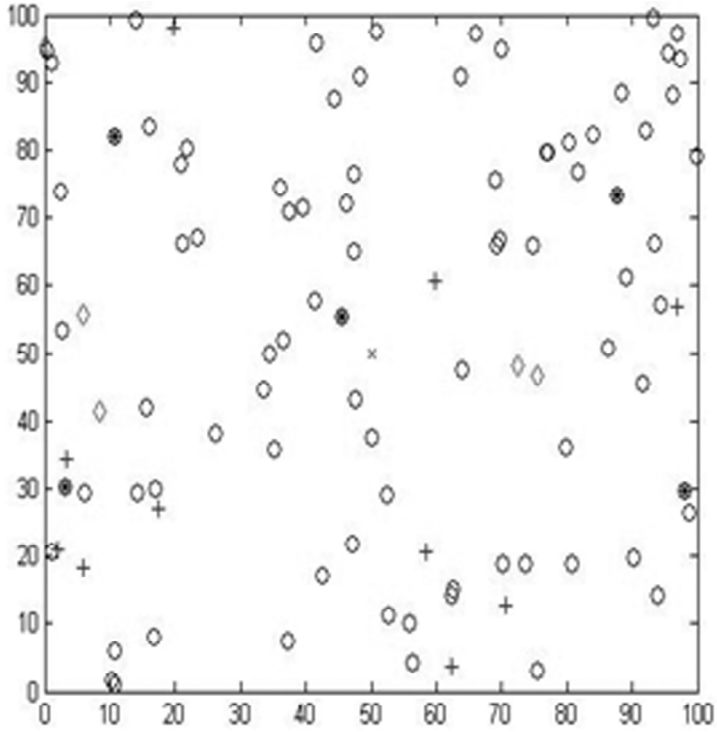

Figure 3: Distribution of nodes after 30 rounds

Figure 3 shows a variety of nodes dispersed in an area of 100 × 100. The simulation of the proposed work iterates for 200 epochs. In simulation scenario different nodes represented by different shapes. 'o' denotes the normal nodes where an advance nodes having energy higher than normal nodes are denoted by '+' and finally super advance nodes denoted by 'Δ' having energy more than advance nodes. Particular node which turn into cluster just once is denoted by '*'. As epoch increases than there is also increase in nodes flattering as cluster head.

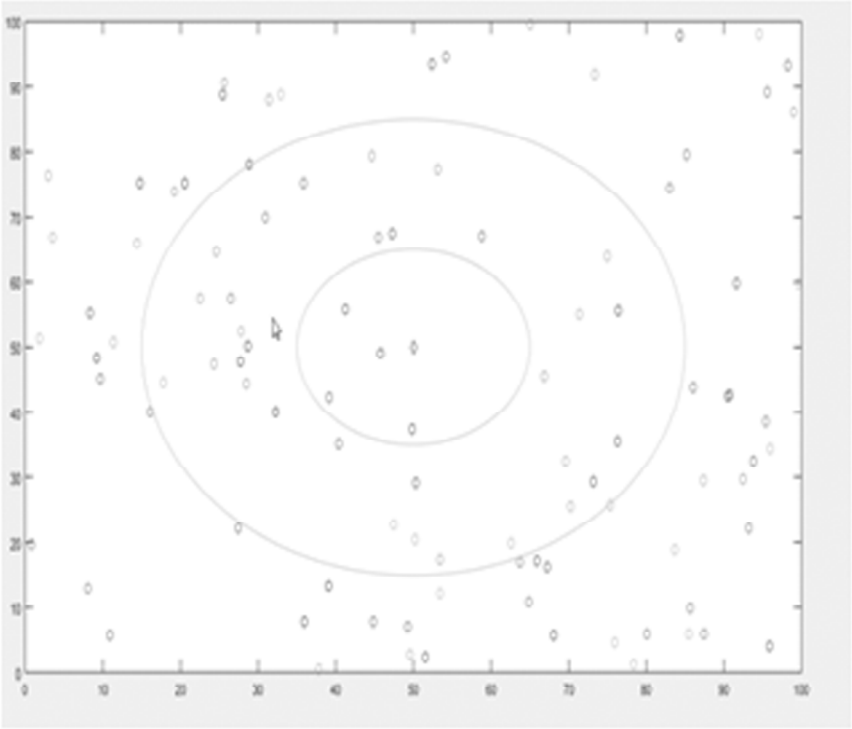

Figure 4: Node distribution with clustering

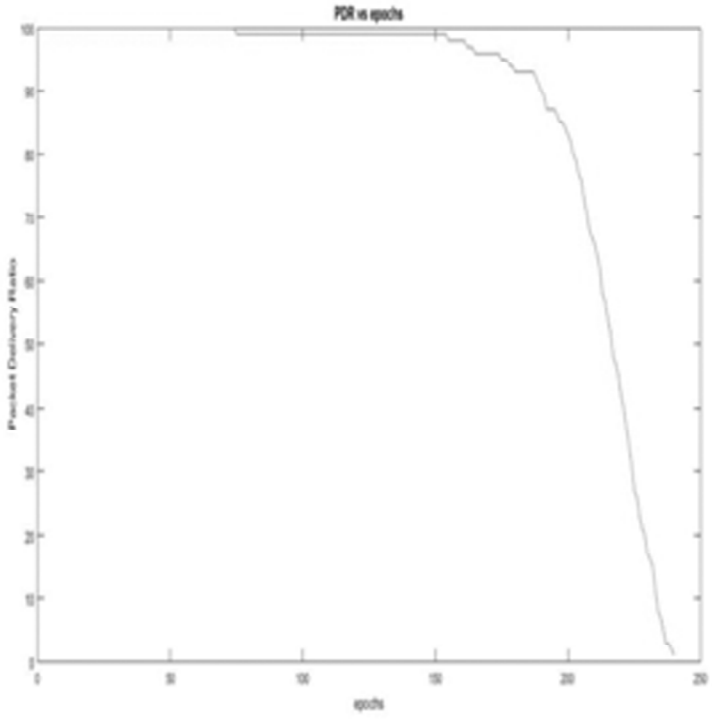

Figure 5: Proposed method packet delivery ratio

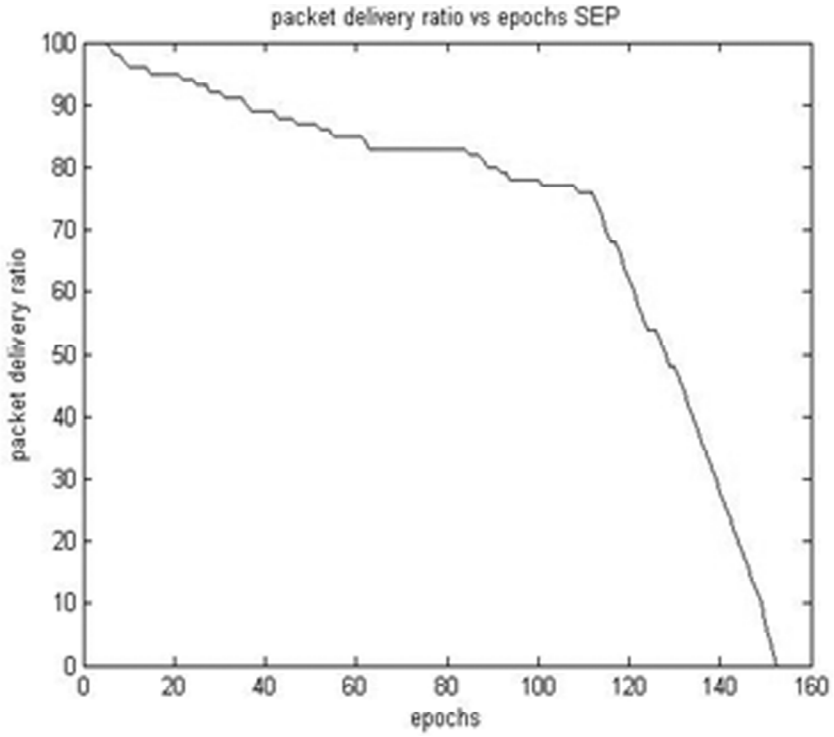

Figure 6: Without Sink Elongation Protocol Packet Delivery Ratio

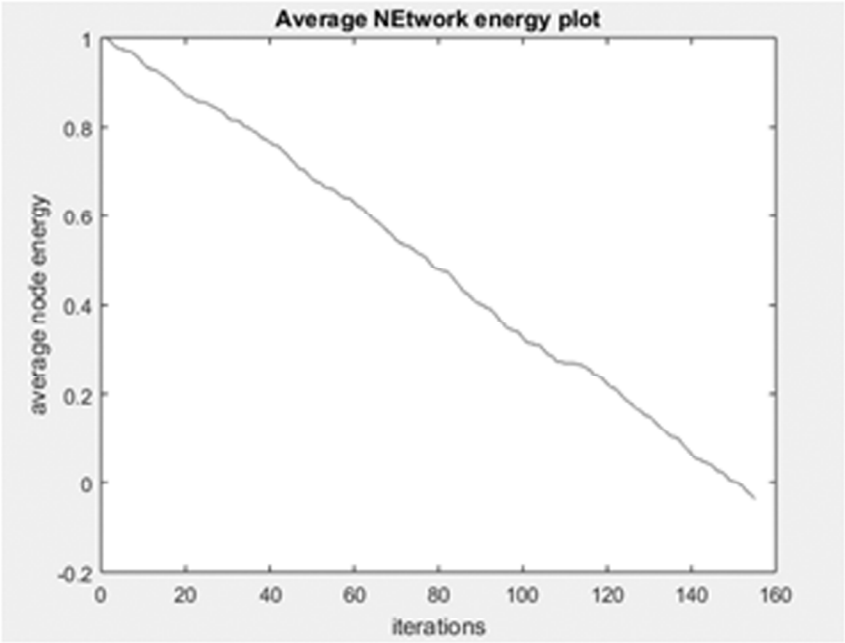

Figure 7: Average Node Energy

As shown in Figure 5, in context to stability period, packet delivery ratio is almost 85%. This fortifies an even and consistent procedure of the network. Once packet delivery ratio is compared to without using mobile sink protocol as shown in Figure 6, it shows that there is a remarkable enhancement in flexibility interval because in our proposed work the delivery ratio of the packets begin to decrease at very low rate and vigorously when comparison is done without our technique. Figure 7 represents Average node energy which is 1 at the beginning. This energy decreases as iterations increases and becomes to a minimum level at around 155 iterations.

6. CONCLUSION

Simulation results of proposed algorithm shows that it performs well in context of delivery ratio and increases the proposed network stability. The stability interval of the network is extremely vital because the likelihood of data packet loss begin to increase when the huge numbers of nodes start failing. The packet delivery ratio starts diminishing in case of scenario without sink elongation protocol but the PDR goes done sharply after long time which increases the lifetime of the network. Also the energy decreases with time but only becomes zero after a long time. The sharp decrease in the curves represents better stability. To simulate the network only 100 nodes are considered. Furthermore in future we may increase the number of nodes to more than 100 nodes or even for scattered networks.

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