A RSS LOGIC BASED CLUSTERING ALGORITHM FOR WSN TO EXTEND THE NETWORK LIFETIME

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ABSTRACT

Wireless sensor networks (WSN) is the key resource of perception and is widely used in the systems based on Internet of Things (IoT). The smart sensor nodes are used in applications like infrastructure monitoring, medical health care systems, etc. But these nodes are energy constraint devices. Efficient clustering and proper cluster head (CH) selection schemes are required, in order to improve energy saving of sensor nodes. In this paper, dynamic CH selection method (DCHSM) is used where CHs are selected in two phases. This algorithm improves energy saving on large scale thus can be used for IoT applications. Initially, QB Cluster diagram is used to divide the monitoring area in polygonal shaped clusters. Then, CH election is performed in two phases. First class of CH is elected based on perceived probability and the second class is elected on the basis of survival time estimation. Simulation analysis show that DCHSM outperforms the conventional methods in terms of network lifetime.

Keywords- Base Station (BS), Cluster Head (CH), Internet of Things (IoT), Dynamic Cluster Head Selection Method (DCHSM), Voronoi Diagram, Wireless Sensor Network (WSN).

1.INTRODUCTION

For applications from personal electronics to industrial electronics, IoT is the rapidly growing technology, where sensors are connected wirelessly to internet. IoT connects the world with sensing, actuation, networking and cloud computing [1– 3]. The idea of smart world is the outcome of integration of the world with internet. IoT finds application in smart home, smart city, smart automobiles, connected health, connected car, smart grids, industrial internet etc. The Cluster of IoT is WSN. It acts as the dominant infrastructure for sensing, networking and routing [4–6].

Low power and low cost sensor nodes are to be developed for applications in health care monitoring, industrial monitoring, intelligent buildings, military services, wildlife monitoring, wildfire monitoring, and intelligent transportation systems etc. Sizable senor nodes positioned randomly in the monitoring area are webbed together using WSNs. Irrespective of the tough environment, the sensor nodes are responsible to sense the monitoring area. The large scale information gathered by sizable number of sensor nodes are processed and finds application in the field of IoT. Hence, WSN plays as the Cluster of IoT.

The sensor nodes self-organize and tracks the monitoring area vigilantly. For accurate measurements, the nodes should work error free throughout. Batteries are the only source to supply energy to sensor nodes. Sensor nodes spent most of the energy while transmitting and receiving sizable information. Due to the dense condition of environment in which the nodes are deployed, it is difficult to replace the batteries of sensor nodes. In order to improve the lifetime of WSN, it is most important to reduce energy consumption of individual sensor nodes thereby avoiding quick battery drain.

Technical committees conducted several researches on clustering techniques for energy saving in WSN [7]. Direct transmission consumes more power compared to clustering techniques, since every sensor node communicate directly with the BS. In clustering techniques, only the leader elected as the CH of the respective cluster, communicate its information with the BS due to which unnecessary wastage of energy is eliminated to a large extend. The non CH members are responsible only to sense the environment and communicate with the respective CHs. The individual node energy is saved whenever the non CH members are inactive. The data transmission distance of other non CH members are reduced when CHs of the respective cluster alone are responsible to gather the information and send it to

BS. Thus clustering techniques improve energy saving in WSN increasing the network lifetime. In order to improve energy saving of sensor nodes, efficient clustering and proper CH selection techniques are required.

Both distributed and centralized clustering schemes play crucial role in energy saving in WSN. BS holds the prime position in the centralized technique. BS initially collects the energy and location details of each node and utilize these information to form clusters, elect CH, and form the network. Although centralized clustering improves efficiency of network in terms of energy saving, it fails to improve efficiency for large scale network. This is because the BS alone finds it difficult to manage the activities of the many number of sensor nodes deployed in the monitoring area. In distributed clustering technique, the sensor nodes self-organize and are themselves responsible to form clusters, elect CH and form the network and thereby improves efficiency of network in terms of scalability [8].

Researchers are aiming towards improved energy saving in WSNs. Distributed clustering technique is utilized to implement Low energy adaptive clustering hierarchy (LEACH) algorithm. In LEACH algorithm, CH nodes are elected based on predetermined probability [9]. Non CH members monitor the environment and communicate the information it gathered with the CH. CH then process the information and communicate it with the BS. Also the algorithm uses the concept of CH rotation to balance the information traffic among all CH nodes thereby improves the lifetime of WSNs. The algorithm include two phases namely, set up phase and steady state phase. During set up phase, CH is elected and clusters are formed. Steady state phase includes transmission of information. A number is chosen in range of 0 and 1 randomly for each node. If the random number obtained for each node is less than its threshold value then it can hold the position of CH. Proper CH selection schemes are required, in order to improve energy saving of sensor nodes. A deterministic component is added to LEACH algorithm, to develop deterministic LEACH algorithm, which concentrate mainly on CH selection criteria [10]. The deterministic component added to the threshold value improves energy saving of sensor nodes by taking into account the residual energy of individual nodes.

Dynamic clustering is an appropriate solution for large scale data collection in IoT applications. Dynamic clustering gained importance since it balances the traffic load among various CHs [11]. Here periodic rearrangement of clusters attracts technical communities in improving the scalability and energy saving in WSNs.

A two phase clustering algorithm DCHSM is studied in this research work. Initially, polygonal shaped clusters are created using Voronoi diagram [12]. Then CH is elected in two stages. The first class of CH is selected based on the concept of perceived probability and the second class of CH is elected based on survival time estimation algorithm. The work is arranged as: System model is explained in Section II. Simulation analysis is given in Section III following the conclusion in Section IV.

2.Proposed System Methodology

The proposed system is divided into three phases: level assignment mechanism, 2 connected Cluster network formation and finally routing. In first phase, the base station assigns level to each sensor node in the network. In next phase, a 2-connected Cluster network is formed using CHs. In third phase, nodes forward their packets to the lower level nodes based on the weight function as detailed subsequently.

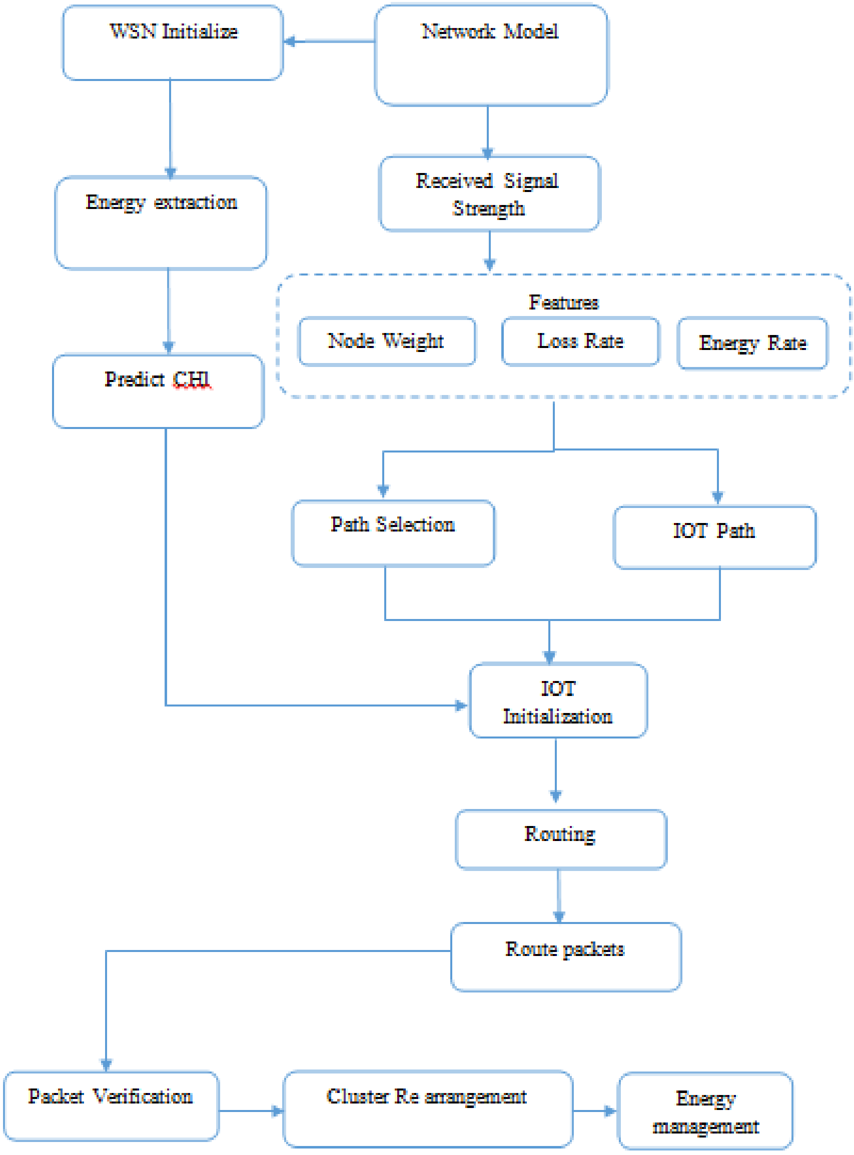

Figure 1: Proposed System Block Diagram

2.1 Level Assignment Mechanism

In this phase, assign level (L) to every node in the network depending on its Distance from the base station. Initially, level of all the nodes is zero including the base station. The total distance between the last nodes from the base station called as the radius of the network. Then applying the weight to the nodes by using the distance from the base station. The nodes which are nearer to the base stations getting higher weight factor .and nodes which are far from the base station getting lower weight factor. Then we are assigning the cluster head using the residual energy and based on the centroid approach, that giving priority to the nodes which is nearer to the base station.

2.2 Connected Cluster Network Formation

In this phase, the Cluster network is formed with CHs in the network. Cluster range (BR) is used to provide Cluster connectivity. Cluster range is the range Between the connected CHs. Here, the cluster heads in level L1 are directly connected to the BS. However, other CHs except nodes in L1 utilize their levels and BR for selecting next hop CHs.

2.3 Weight Based Routing

In this phase, routing is performed where cluster head in a level is only allowed to transmit the packet to a next hop node in next lower level based on a weight function W. Here, the weight function takes residual energy level and link distance into account. The weight function can be derived using the following properties,

2.4 Received Signal Strength Scheme

In the proposed approach, there are three steps to achieve the probabilistic prediction coefficient in order to estimate the link stability for reliable data delivery in the entire network.
The three steps incorporated in the distributed approach for determining the link stability are
a) Estimation of neighbourhood stability based on Energy
b) Estimation of neighbour stability based on link loss
c) Manipulation of lifetime of mobile node

2.5 Cluster Reconfiguration Stage

Network reconfiguration is important to achieve balanced energy consumption and also to reduce the unnecessary networking overhead due to frequent re-clustering. N this procedure, the average residual energy of CHs is compared with Maximum Threshold MAXTH as well as Minimum Threshold MINTH value. It has three possible cases. These are:
1. If the average residual energy of CHs is higher than MAXTH, same forwarder set is used for data forwarding and Re clustering flag is set to 0.
2. If the average energy of CHs is between MAXTH and MINTH , then a new set of forwarder nodes is chosen from the existing CHs and Clustering flag becomes
3. If the average energy is less than MINTH, re-clustering process is invoked in order to select a new set of CHs and Re clustering flag is set to 1.

3. SIMULATION RESULTS AND DISCUSSION

In this section, simulation results on the network loss probabilities of the distributed optimal movement strategy under various setting of buffer sizes and the number of mobile agents as well as different data arrival patterns to the network. In particular, here demonstrate its considerable performance improvement over the standard random walk strategy in which a random walk at the current node moves to any one of its destination nodes. In all these simulations, observe that the network loss probability under our Network coding Algorithm is about 2 times smaller than that of the Distributed optimal Movement Strategy. Note that the network loss probabilities for both the standard random walk strategy and network coding strategy tend to increase with a larger number of sensor nodes (n = 200), since the number of sensor nodes to be covered by a mobile collector itself increases. The amount of reduction in the network loss probability to achieve from Network coding strategy (in comparison with the standard random walk strategy) is much greater than the existing one. For each arrival pattern (or each simulation figure), the data points are obtained by taking the average of the results under 30 different heterogeneous and spatially-correlated data arrival patterns. Expected reasoning behind the Network coding strategy can be applicable for the design of Markovian random walk-based applications sample topologies of each sensor nodes. In all these simulations, observe that the network loss probability under our Network coding Algorithm is about 2 times smaller than that of the Distributed optimal Movement Strategy model. In all cases, coding strategy is consistently better than the standard random walk strategy, and the ratio tends to decrease, implying that our strategy is increasingly more advantageous as the buffer size.

Table 1: Simulation Parameters

PARAMETER	VALUE
Sensor deployment area	1000m x 1000m
Number of nodes	50
Initial energy of node	100 J
Coordinates of base station	(300,720)
Packet size	512kb
Data rate	100kbps

Transceiver energy	31.32 mJ

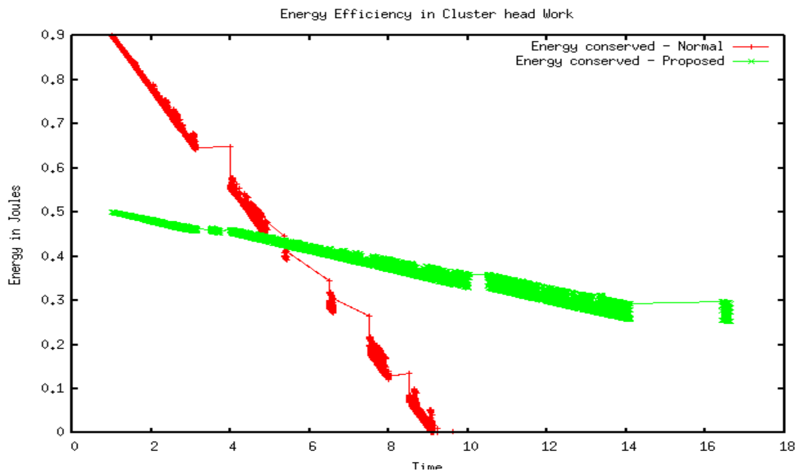

Fig 2- Energy Efficiency

This figure illustrates the results of energy efficiency with simulation time, taking simulation time along the X-axis and energy in joules along the Y-axis. Initially cluster head energy of fuzzy system is decreased whereas cluster head energyproposed system is increased.

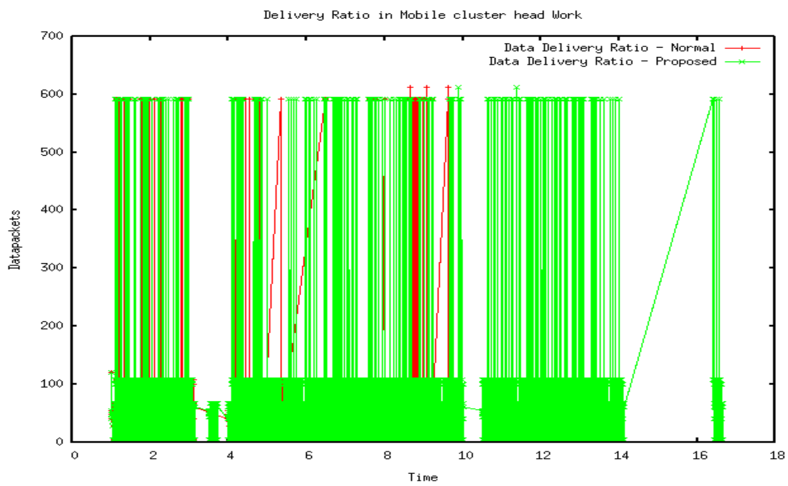

Fig 2-Delivery ratio

In this figure it is proved that, the results of Data Delivery Radio with simulation time, taking simulation time along the X-axis and Data Delivery Radio along the Y-axis. From figure number of delivery packets is increased compared to the distributed optimal movement strategy(Existing system).

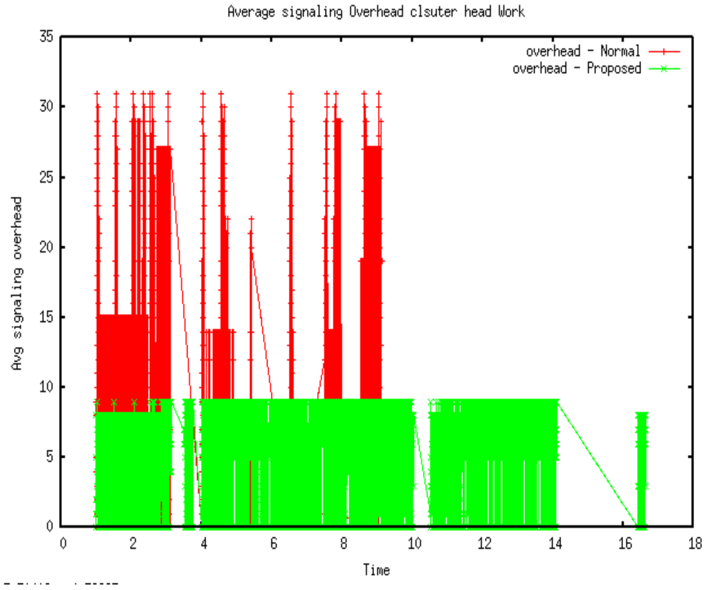

Fig 3 – Average signalling overhead

This Figure describes the results of Average signalling overhead with simulation time, taking simulation time along the X-axis and Average signalling overhead along the Y-axis. From the figure it is observed that, signalling overhead over the entire network is comparably lower than the existing work.

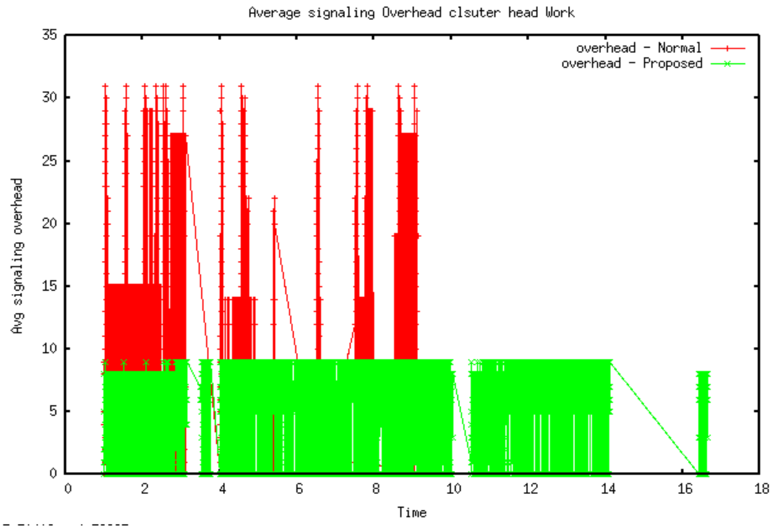

Fig 4-Number of live nodes

From the figure it is concluded that the results of Number of live node with simulation time, taking simulation time along the X-axis and Number of live node along the Y-axis. From the figure, it is observed that, the maximum number of live node is increased in proposed system compared to existing system.

6. Conclusion

In this effort, we have experimented the performance of DCHSM in WSN. Initially QB Cluster diagram is used to obtain Rectangular shaped clusters. CHs are selected in two different phases. Outcomes for 100 nodes when tested for 2000 iterations shows that DCHSM improves the residual energy in WSN by 5.70% compared to LEACH and 5.58% compared to Deterministic LEACH. Hence DCHSM improves energy saving and increases the network lifetime. The experiment is not tested for sizable nodes. Later, the same can be tested for sizable sensor nodes. Besides, simple energy models are used in the algorithm, which finds inappropriate for technical applications.

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