Expectation – Maximization Clustering using Gaussian Mixture Model For Energy Efficient Routing Protocol in Wireless Sensor Network

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ABSTRACT

The Wireless Sensor Network (WSN) is introduced in order to perform the wireless communication, in which the end users can have the power of movement in the network at anywhere anytime. Routing is a fundamental operation in WSN where a source node transmits a message that is to be disseminated to appropriate nodes in the Network. Nodes in WSN are forming a dynamic topology by that the nodes are continuously changing their location. Efficiency of Route hunting in mobile ad-hoc network is dependent upon blind flooding of route request packets in network. Blind flooding of route request packets lead to increased redundancy over the networks. These data redundancy over the network unnecessarily increase conjunction and traffic over the network. In this paper, node in network are bipartite in two energy over traffic group ie. High traffic area node and low traffic area node. Battery power of high traffic area node is gradually decrease at high rate whereas battery power of low traffic area node are degraded with lower rate. Proposed work use battery power indicator to swap the node from low traffic area to high traffic area to maintain energy level and to maintain longer survival of a network. This methodology is used to select node from little traffic area taking advanced residual energy limit to deliver supplement support to low energy node in high traffic zone. Expectation – Maximization is used to select swapping node from low traffic area having similar characteristics with lower responsibility and lies at minimum hop distance from requesting node. Expectation – Maximization select swapping node with minimum energy overhead which also lead longer survival of network.

Keywords *Wireless Network, Sensor Network, Machine Learning, Clustering, Feature Selection,Energy Efficient, Routing Protocol, Gaussian Mixture Models , Expectation – Maximization*

1. INTRODUCTION

A Wireless Sensor network (WSN) is a temporary network having set of wireless Sensor nodes. These nodes do not use the central access authority, infrastructure and any kind of centralized management system. There are a number of features in Sensor ad hoc networks, like as dynamic network topology, use of limited bandwidth and energy for each node in the network. Sensor ad- hoc network plays a special role for a military operation to ensure communication between the teams, apart from this the state of emergency in the road or places, medical surveillance, etc are also the application of WSN. The main reason is the constant change in the network structure due to the high degree of node mobility. It has developed a number of protocols to accomplish this task.

Some routing protocols DSR and AODV have been used to maintain the route in the network. It should be able to detect and discover the neighbouring nodes, but the transfer of a group of network interfaces WSN is very limited. Therefore, for the exchange of data from the node on the network may be multi-network ”hops are required.” One of the simplest ways to steer is to send packets to the destination

node of the source through the market using geometric information from all network nodes. Get accurate and geometric information is still not easy. Here the node is one of the last extensions of the route by actively identifying all neighbouring nodes asking for information on the shortest route to the destination.The popular delivery mechanism is flooding [1], where each node in the network to re-send a message to all its neighbouring countries when the message is received. Simple and easy to implement flooding and it can be expensive in terms of network performance, one of the main problems in the flood is ”broadcast storm problem.” The results of diffusion problems in high resend the message about the need for redundant operations storm, the network bandwidth contention and collision. Study protocol floods [2] and its result to be rebroadcast can provide 61% additional coverage to average more coverage and only 41% more compared to that already covered the old distribution. Accordingly, it was concluded that the anti-chain antibodies is very expensive and must be used with caution. To overcome this problem, it has been proposed several broadcasting systems [3,4,5]. And these plans are generally divided into two categories; peremptory regimes and probability. The inevitability of using topographic information to construct a virtual backbone network that covers all nodes in network diagrams.

In order to build a virtual skeleton, and exchange of information on contracts, usually about two or immediate neighbors hop. This leads to a large overhead in terms of time and complexity of the setup message and the maintenance of the spine, particularly in the presence of motion. Probability plans, disparity, and vertebral column of the re-built zero during each broadcast. Instant contract whether a broadcast message or not using the information derived only from the broadcast heard the local decision-making posts. These systems smaller head support and the ability to appear in changing environments greater compared to deterministic adjustment systems [3]. However, these diets have the potential reach of the poor as a compromise in exchange for public expenditure. It reduces the optimal transmission protocol, and the maximum time needed to disseminate a message to reach all nodes. The average time for the entire broadcast message needed to access each contract node.

Route selection and maintenance of overhead gradually in the case of routing protocol based on demand, while the costs of these elements vary from one protocol to another. Every time a way of being discovered, and protocols have to perform some form of flood packets applications until the road is access to the destination node. And include maintenance for the reconstruction of the road, especially in a scenario of link failure or node failure.

A number of routing protocols have been proposed using a variety of routing techniques to use in the network from intruders. Dedicated on-demand distance vector routing (AODV) [4], a dynamic source routing (DSR) [5], ordered and temporally routing algorithm (TORA) [6], the location using the orientation (LAR) [7] (in any contract or Find keep on the road when you need the way), and periodically (proactive) protocols such as the distances from destination vector sequences (DSDV) [8] distributed Bellman Ford [9] (in any exchange contract periodic routing information can be while the current always know the road on each hand). In addition, several protocols used both reactive and proactive, as protocol analysis zone mechanism (ZRP) [10], the protocol block-based-routing (CBRP) [11]. The basic idea of routing protocols based on demand is that the source node sends a route request and makes a decision based on guidance received from responding the way, and that can be sent by hand or nodes averages. At the request routing has several advantages such as simplicity, flexibility and health. However, at the request routing algorithms have the disadvantage of increasing public spending per pack. This additional network click View reduces the bandwidth available for data transfer, latency and increases each packet transmission and consumes extra energy in devices to send and receive network. Because of the way the request propagation paths (floods), it is difficult to limit the deployment of unnecessary packets. According to the routing table, the source node knows the track or the next hop to its destination at any time when the road needs. In anticipatory guidance, guidance information is available when needed, resulting in a little delayed by the data transfer. However proactive routing protocols are not suitable for Sensor ad hoc networks, it is also used continuously for much of the network’s capacity to keep the current routing information. Proactive routing protocols tend to distribute topographical changes on a large scale in the network, although the creation / destruction of a new link in one end of the network may not be a big piece of information to another end. Hybrid routing protocols inherit claim to be the best parts of each of the reactive and proactive management protocols.

The main idea of routing protocols is hybrids that limit the scope of the contract using the management and the proactive routing algorithm mode almost from data usually at the forward contract and storing.

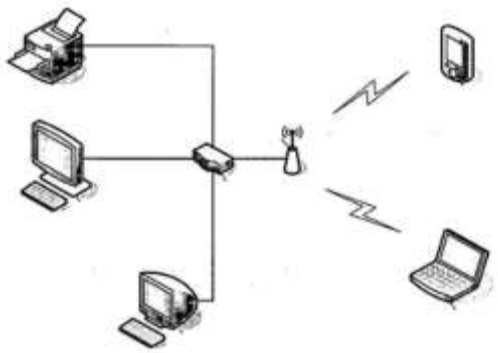

Fig. 1 Wireless network

In network along with traffic control, battery power is also very important issue in wireless network for longer survival of network. There is no centralized power controller for Sensor nodes in Wireless network [12]. If the node has lost its energy at that time it is not practical to substitute its battery over the network.As Sensor nodes operate on limited battery, so the development of techniques that can successfully maintain less complexity becomes very necessary. The objective of this thesis is to grow a new approach that can succeed in maintaining a path with energy efficient nodes. The huge number of work has completed in order to discovery another path while node will release in the network. Owing to this breakdown, the global performances of network will also shrinkage with veneration to complexity of routing protocol. The impartial of this dissertation is to advance a procedure in order to improve the network survival. [13]The routing in WSN is completely dependent on the flooding of routing packets in network by that the nodes energy is wasted in flooding. Due to limited working capacity of Sensor nodes is the major problem in WSN. In WSN the energy is the limited resource because there is a no source is available in network by that the nodes are regain their energy. It means if the node is lost their energy then the battery replacement is only the option to retain the node in network with full capability and the second one option is to utilize the energy of nodes efficiently. The meaning of efficient use of battery power is to reduce the possibility of packet loss and retransmission in network. The routing protocol has no capability to reduce the motion of Sensor nodes that is the major region of link breakage and energy wastage. The energy efficient routing scheme is utilizes the nodes power in communication.

1.1 Sensor Ad-Hoc Network

The proliferation of Sensor computing and communication devices (eg, telephones, laptop computers, digital phones, Sensor digital devices and personal computers or assistance can be worn) leads a revolutionary change in society information we have. We move from the PC era (ie a person by computing device) at the age of ubiquitous computing, which uses the user, at the same time, most electronic platforms in which they can access to all information required whenever and wherever the need arises [2,14,15]. The nature of the devices makes everywhere easy wireless solution for interconnection and consequently the wireless arena was growing rapidly in the last decade. Users can use a Sensor cellular phone to check e-mail and Internet browsing. Travellers with laptops can surf the Internet from airports, railway stations, and Starbucks and other public places.Tourists can use the global positioning system (GPS) stations installed within the car rental to determine the maps and tourist attractions the training site, and researchers can exchange wires and other information by connecting laptops via wireless local area networks wire while attending conferences. At home, users can synchronize data and transfer fi between portable devices and desktops.The Sensor devices smaller, cheaper, more convenient, more powerful, and it also operates several ecological network applications and services, usually fuel the explosive growth of the market for Sensor computing equipment not only. The number of ex agglutination of Internet users and Sensor head of this increase in computer growth [16–18]. Forecasts indicate that in the next two years, the number of Sensor communications, the number of deliveries of yellow flares and Internet radio to

grow after by another 20-50% Anbar [2,8]. With this trend, we can expect that the total number of Internet users via Sensor phone soon surpass that of fixed Internet users – wiFi line.

2. Proposed Methodology

In this paper proposed an Expectation – Maximization (EMcRP) Clustering routing protocol .In EMcRP, node in network are bipartite in two energy over traffic group i.e. High traffic area node and low traffic area node. Battery power of high traffic area node is gradually decrease at high rate whereas battery power of low traffic area node is degraded with lower rate. Proposed work use battery power indicator to swap the node from low traffic area to high traffic area to maintain energy level and to maintain longer survival of a network.

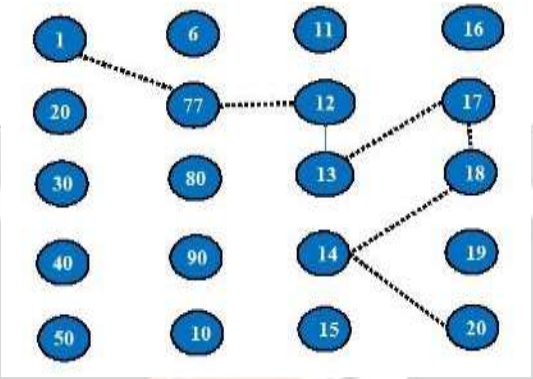

Fig. 2 WSN Scenario with Similar Battery Power Zone

Proposed methodology use a Expectation – Maximization (EM) Clustering using Gaussian Mixture Models (GMM), which not only saves the networks energy, but also makes all nodes survive as long as possible. In the cluster formation phase, an improved Gaussian Mixture algorithm is employed to allocate sensor nodes into clusters, which remains unchanged throughout the networks lifetime. In the new round begin, the cluster heads (CHs) are selected based on the nodes remaining energy and the possible energy consumption of every nodes in clusters, during data communication, a hybrid routing is adopted in the inter-cluster. This methodology is used to select node from little traffic area taking advanced residual energy limit to deliver supplement support to low energy node in high traffic zone. GMM is used to select swapping node from low traffic area having similar characteristics with lower responsibility and lies at minimum hop distance from requesting node. GMM select swapping node with minimum energy overhead which also lead longer survival of network.

2.1 Proposed Routing Procedure

In proposed methodology routing procedure is demonstrated within their help of figure 3,i 4,i 5i and 6.i Blue Color node area used to represent higher energy level node whereas greenlit yellow and light blue Color node area used to lower energy level node. As shown in figure 3i ally their node have same energy Colori code i.e. bluey but after certain time limit node at high traffic area area degrade their energy at switch toy green Color node in figure 3 all their node have same energy Color code i.e. blue but after certain time limit node at high traffic area degraded their energy at switch to green color node .

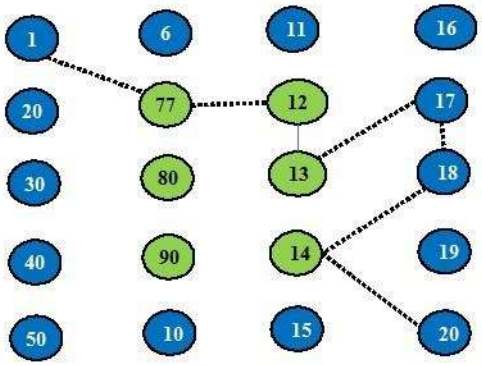

Fig. 3 WSN scenario with different battery power Zone

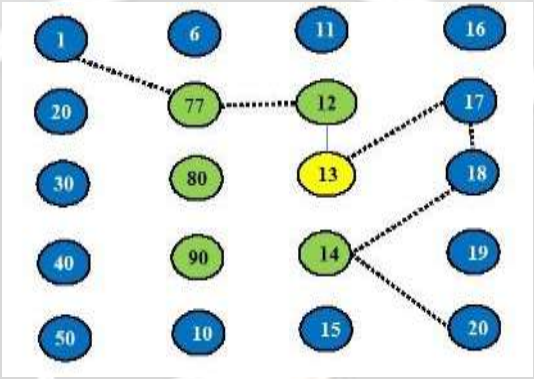

Fig. 4 Node with three different Battery power Zone

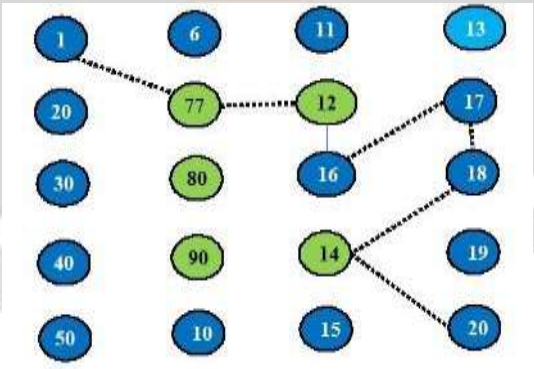

Fig. 5 node with four different battery power zone

2.2 Proposed methodology by using Gaussian Mixture Models

select high reliable similar node having sufficient resident battery power and located as near as possible to requesting node. In presented scenario node 13 become yellow color node as shown in figure 5 and send node replacement packet to all blue color node where node 16 is being selected for swapping and finally swapped and take the responsibility of node 13 with high resident battery power with their respective color code as shown in figure 6. Whereas node 13 change their color code and take the

responsibility of node 16 with light blue color code that indicate node after first replacement and don't being participle in afterwards node replacement request.

2.3 PROPOSED ALGORITHM

In proposed methodology node from high traffic area with lower middle resident energy are get swapped with node from light traffic area with higher resident energy. Where average battery power of node is consider as full battery power at any time i.e show by blue color in figure 2 and half of average battery power node is consider as middle resident energy node and one third of average battery power node is consider as lower resident energy node and ready for replacement if possible. If all the node of network become light blue color then proposed methodology again being started and mark all node as blue again and repeat all process again until all the node get exhausted.

Proposed Algorithm ( )

1: Start
2: Source node calls AODV protocol and broadcast to allneighbor node path towards their destination.
3: Every neighbor node unicast route reply to source with their energy level where apiecenode devoted their node ID.
4: If any node n having node energy less and equal to one third of average node energy then it broadcast node supplement request to neighboring node.
5: All neighbor node reply their status over this request as Nbi reply as Nbri Where i =number of neighbor node participating in swapping
6: Apply Expectation–Maximization (EM) to choose best suited node for replacement and make swapping as For(i = 1 toi = PNbi) A[Nbi] = P(Nbi=0— RN; theta) = 1-P(Nbi=1—RN ;theta) // where RN is requesting node
7: Reply Max A[i] as maximum probability node that choose to be swapping
8: Node A[Nbi] and Node RN share the coordinate with each other by using LAR protocol and swap their coordinates.
9: The main motive of proposed methodology is to distribute the load of work over all the node equally and developed one node rotation policy to handle load over network in order to enhance network survival as shown in algorithm
.
10: stop

3. Result Analysis

The simulation of proposed method has been done in NS-2 with help of OTCL & TCL simulation script file. The performance parameters taken in this research are discussed below.

3.1 Packet delivery ratio: The ratio of the data packets delivered to the destinations to those generated by the traffic sources. For any ideal routing protocol, it is obligatory that it has higher packet delivery ratio.

$$PDR = \frac{Number\ of\ packet\ received}{Number\ of\ packet\ send} * 100$$

In this simulation all the simulation is being carried out with four different mobility level i.e. 25, 50, 75, 100 m/s. Packet delivery ratio is also being check over this mobility level and it is observed that with different mobility packet delivery ratio is being change. Proposed methodology EMcRP is give best performance with 75m/s mobility whereas Existing technique CRP also provide its best performance over same mobility as shown in figure 10 and 11. Whereas on comparative analysis of both the technique EMcRP and CRP it is observed that EMcRP gives higher packet delivery ratio over all the mobility level as shown in figure 12 (a),(b) and 13(c) and (d) with 25, 50, 75 and 100 m/s mobility.

3.2 Throughput: The data loss due to packet drop is reduced as low energy nodes are replaced by high energy nodes. So there is increased rate of successful packet transmission in case of this work compared to CRP.In anynetwork, it is obligatory to have advanced throughput i.e. essential to upsurge rate of positive packet transmission.In data transmission, network throughput is the amount of data moved

successfully from one place to another in a given time period and measured in bits per second.CRP have lower throughput as compare to EMcRP. In this simulation all the simulation is being carried out with four different mobility level i.e. 25, 50, 75, 100 m/s. Throughput is also being check over this mobility level and it is observed that with different mobility Throughput is being change. Proposed methodology EMcRP is give best performance with 25m/s mobility whereas Existing technique CRP also provide its best performance over 75 m/s mobility as shown in figure 14 and 15. Whereas on comparative analysis of both the technique EMcRP and CRP it is observed that EMcRP gives higher throughput over all the mobility level as shown in figure 16 (a),(b) and 17 (c) and (d) with 25, 50, 75 and 100 m/s mobility.

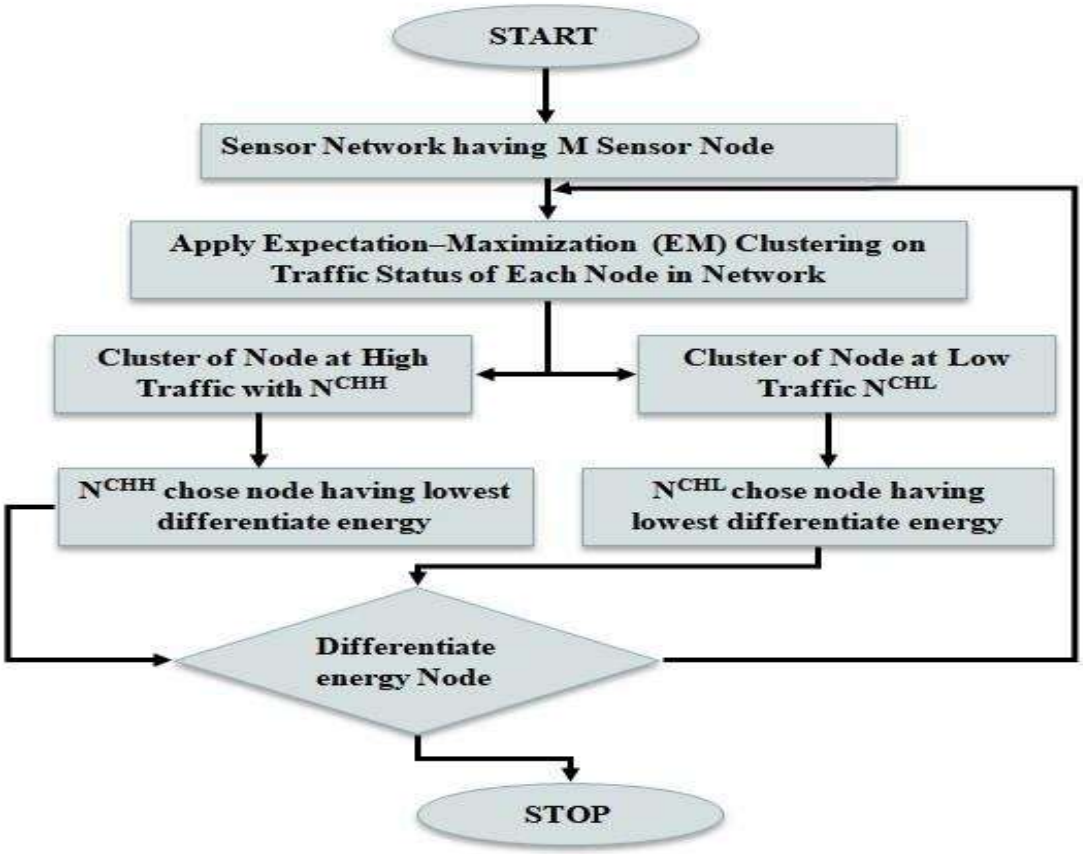

Fig. 6 Proposed Flow Chart for EM Clustering using Gaussian Mixture Models

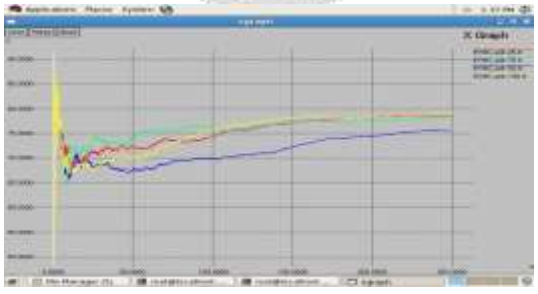

Fig. 7 Packet delivery ratio of EMcRP with varying mobility

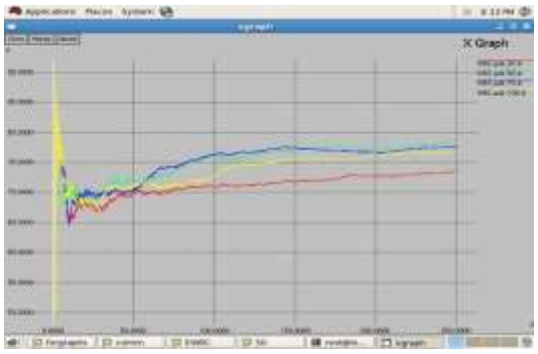

Fig. 8 Packet delivery ratio of CRP with varying mobility

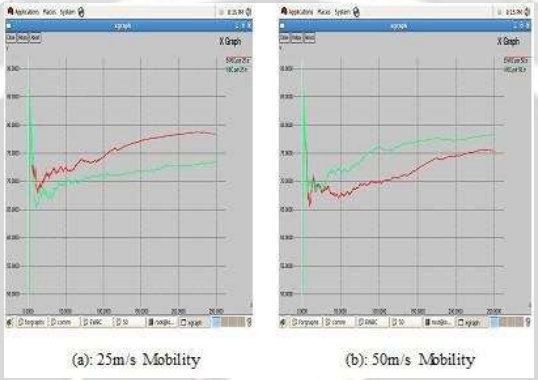

Fig. 9 Packet delivery ratio comparative analysis over different mobility level

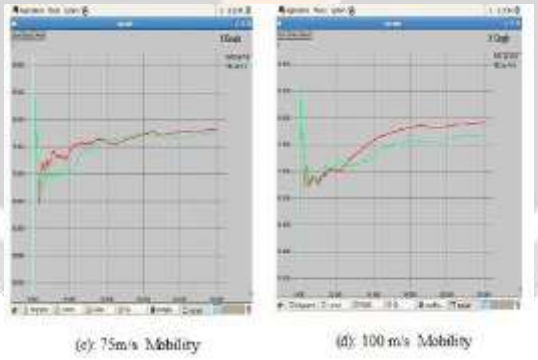

Fig. 10 Packet delivery ratio comparative analysis over different mobility level

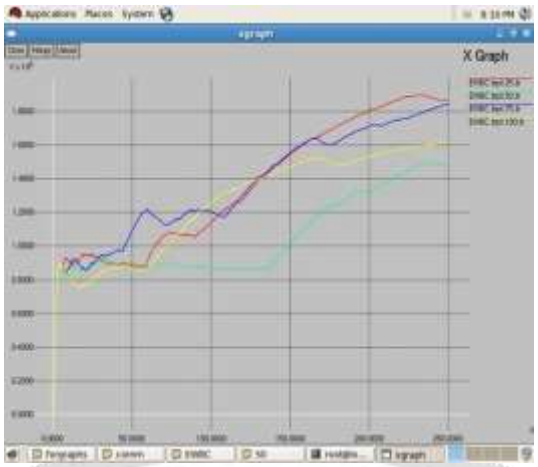

Fig. 11 Throughput of EMcRP with varying mobility

4. Conclusion

This dissertation proposes the protocol for energy efficient routing over WSN. The implemented protocol tries to migrate lower energy node towards less traffic and distribute higher energy node over heavy traf fic section of network. Gaussian Mixture Models is used to check the energy consumed in packet transmission and reception and also used to select a path using neighbor nodes with higher residual energy. Node is selected from low traffic area having higher residual energy limit to deliver supplement support to low energy node in high traffic zone.

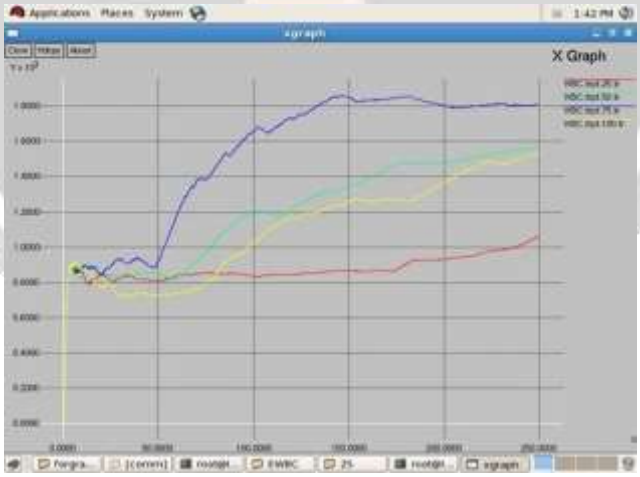

Fig. 12 Throughput of CRP with varying mobility

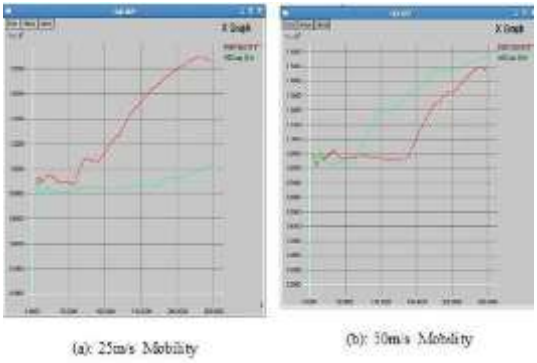

Fig. 13 Throughput comparative analysis over different mobility level

Fig. 13 Throughput comparative analysis over different mobility level

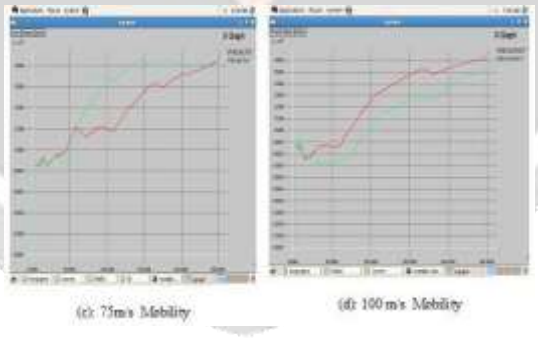

Fig. 14 Throughput comparative analysis over different mobility level

In this work, routing protocols and the energy conservation methods conserve the energy of the active node from depleting. We are balancing the energy consumption in the network and improving the network lifetime.The research work shows enhanced packet delivery ratio and throughput over different mobility level and it is observed that at 75 m/s both the method having higher packet delivery ratio whereas at 25m/s mobility EMcRP achieve higher throughput and at 75m/s CRP achieve its best throughput. But on comparative analysis EMcRP gives better performance over different mobility on both packet delivery ratio and throughput evaluation parameter. The implemented protocol achieves high energy efficiency, as indicated by the simulation results.In future work, the routing protocol can be improved by

taking parameters related to quality of service and data transmission latency and try to identify attack over network that take a benefit of lower energy node as malicious one.

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