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Genetic K-Means Cluster based Network Design for Energy Efficient Wireless Sensor Networks

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Abstract: *In the recent years, the technology of wireless sensor networks has gained a lot of importance. Wireless sensor networks are a special case of ad-hoc wireless networks. A wireless sensor network is a collection of sensor nodes that communicate through wireless links to work together to carry out functions. Proposed methodology present a novel routing protocol for multipath energy efficient routing over sensor network that encapsulate advantage of two different predefine method in order to overcome their limitation. First K-means and second one is Genetic Algorithm. Proposed protocol tries to provide supplement support to lower energy node at heavy traffic by higher energy node from lower traffic of network. In this work Genetic Algorithm and the K-Means approach has been use as a hybrid approach to find the Resident potential energy field and swap node from resident potential energy field to depth potential energy field. This approach helps to enhance the network survival. The simulation results also provide the batter results as compare to previous approach. The technique was tested through simulations for different distributions of nodes. Under all the evaluated scenarios, the technique demonstrates excellent performance as compare to existing one.*

Keywords: *Sensor Network, K-means, Genetic Algorithm, Life time of network.*

1. INTRODUCTION

In recent years, Wireless Sensor Networks (WSNs) are applied in many areas, such as environment monitoring, medical treatment, traffic control and target tracking, etc. However, the limited and irreplaceable battery power of each sensor node have hindered the development of WSNs. Making use of sensor node's energy to prolong the networks lifetime is a primary goal when designing WSNs routing protocol. Due to the energy conserving and well expansibility [1], Cluster-based routing protocol has been caused a wide attention.

Among many hierarchical clustering routing protocols, the Low-energy Adaptive Clustering Hierarchy (LEACH)[2] was firstly proposed. On the one hand, compared with the non-clustering routing protocols ,both the energy consumption and the first node dead time have greatly improved, however , the protocol also has many disadvantages, such as the uneven distribution of cluster heads, the election of cluster heads has disregarded the node's residual energy, etc. aiming at the deficiency of LEACH protocol, there are many improved protocols have been proposed, such as LEACH-Centralized(LEACH-C)[3],Power-Efficient Gathering in Sensor Information Systems (PEGASIS)[4], Hybrid Energy-Efficient Distributed Clustering (HEED)[5], Threshold sensitive Energy Efficient sensor Network (TEEN)[6] et al. Among these protocols, mostly belonging to dynamic clustering, As everyone knows, frequently clustering will consume extra energy of sensor nodes, The fuzzy C-means(FCM) clustering routing protocol are considered good solutions to optimize the cluster structure[7], which can improve the network lifetime through minimizing the energy consumption of intraclustering communication. In the literature, protocols such as [8-9], many FCM routing

protocols have been proposed. However, the problem FCM creates is that the noise points ,far but equidistant for the central structure of two clusters, which can nonetheless be given equal membership in both, when it seems far more natural that such points be given very low membership in either cluster. Possibilistic CMeans (PCM)[10] can overcome this problem, which through relaxing the constrains of membership in FCM, to reduce the effect caused by noise points. However, PCM is very sensitive to initializations, and it sometimes generates coincident cluster.

2. ROUTING

Wireless Detector Networks (WSNs) have a few to many of tiny sensor nodes which are used to sense the data, compute the sensed data, and then transmit that data by transreceiver. Many protocols for routing of data, power management which is main issue in WSNs, and data transmission are framed for them, in all this energy consumption or the life span of WSN is a major design issues. There are three types for routing of data which are:- data should be centric, data should be sending hierarchically and third one is location-based data transmission. The main objective of all routing techniques is to get better throughput and to increase lifetime of the detector network. Traditionally routing WSNs is based on topologies. Drawback of using topologies is the regular use of particular path and its sensor node, due to regular use of tracing nodes they become dead and are unable to forward the packets generated by other sensor nodes, these packets then will never reach their destination and are discarded.

Topology

In configuration of WSNs many sensor nodes are dispersed throughout a specific physical area. Actually there is no particular architecture or hierarchy of sensor nodes in WSNs and therefore, the WSNs are considered ad hoc network. As wireless sensor networks are used for particular application so they may be used as separate networks, these networks can be connected to other wireless network to form larger Internet through a base stations which are places where the information send by senor nodes is collected they are having complex and usually have an unlimited power supply. With the recent advancement in wireless detector technologies and ease of their use these networks are deployed for multiple functions like monitoring of area, monitoring of health, monitoring of air/water pollution, forest fire detection, landslide detection etc. the main motive of sensor nodes in WSNs is to sense the area , collect information and send it to the destination for further operations. There are number of routing protocols which are designed for many applications. Most of the routing protocols follow single path strategy in which trough out the life of WSNs single route is followed. In tree based topology data transmitted from root node to its next neighbor sensor node forming a parent child relation. In normal topologies cluster level strategy are used in cluster heads are formed which are responsible for sending to the base stations but all these topologies have some drawbacks and the main issue is the life span of wireless less networks.

3. RELATED WORK

Delaney, D., Russell Higgs, and G. O'Hare [1] on a tree structural routing in WSNs introduced the central concept of neighborhood heuristics (NHs), it is a method in which routing of data and finding location of destination is considered in wholistic manner. The best sensor location is finding out by combining the metrics of presently used sensor nodes and the metrics of its neighbor nodes. The destination node is considered as the central node where all data is collected, the sensor nodes when transmit the data select the best node having good quality alternative routes so that at the time of failure of any sensor node neighbor sensor node route can be followed to transmit the data.

Ghadimi, Euhanna et. al. [2] have proposed Opportunistic Routing in Low Duty-Cycled WSNs. Traditionally data is transmitted in two steps: in first step routing protocol select next sensor node and in second step protocol MAC wait for terminus sensor node to get up to receive the data as WSNs are considered as standalone networks in which nodes get slept when they are not used to increase the life span of the network. So in the paper the authors have introduced ORW, for WSNs. In a Duty cycled setting data packets are forwarded to each neighbor sensor node and sensor node which wakes up first receives the data. This method increases the strength of the WSNs.

Sahin, Dilan et. al. [3] has worked upon a technique applied for the communication system of smart grid. WSNs place an important role to cope up with the problem which is faced by power grid with its low cost deployment characteristics. During bad environmental condition when power grid stops working due to occurrence of fault WSNs are used as they are deployed prior to check the weather condition. In it clusters form as WSNs are deployed to large areas. Each cluster has cluster head sensor nodes under particular cluster has sent data to it, data collected at cluster head is further send to the BS. WSNs are also deployed in power grid to check the fault occur during bad environmental condition. In this regard, this helps in developing of routing protocols for environments of smart grid.

Kwon, Kiwoong et. al. [5] IP WSN is an essential thing for IoT (Internet of Things). There are various routing protocols which are proposed for IP WSNs but they have some issues like point to point traffic in which many processing resources are required to address the problem in P2P traffic stateless P2P routing protocol (SPR) is used in it data packet is delivered to the node having smallest remaining hop count instead of delivering data from parent to child tree route. SPR also provide stateless routing in which it determines the route through hierarchical address and one neighbor information without storing the global route.

Tunca, Can, Sinan Isik, M. Donmez, and Cem Ersoy [6] as we know in tree based routing the knob nearer to the terminus knob lose their batteries faster as compare to other knob and cause the destruction of the network to solve this problem they have proposed a survey upon distributed mobile sink routing method for WSN. In mobile sink routing method Mobile sinks provide load balancing and uniform consumption of the energy in sensor knobs. Mobile sink means that terminus knob is not fixed the location of terminus node in WSN changes as per the energy of its neighboring nodes, but it introduces overheads in measures of packet delivery delay or energy consumption.

Bechkit, Walid et. al. [7] as in tree based routing aim is to send the traffic toward destination node the author of present research use shortest path routing tree (SPT) mechanism. In this mechanism the cost of each path is calculated by summation of the weights alloted to the paths and path with minimum cost is used for transmission of data. In many to one WSN there is a problem so weighted path cost function is used and on the basis of these weights tree is constructed for transmitting the data.

4. PROBLEM STATEMENT

It is seen that most of the previous approaches for chose alternate path directly when any node shout down that dropped performance and have relative higher complexity. As the mobile nodes operate on the limited power of battery therefore it becomes very necessary to develop techniques which can successfully maintaining lesser complexity. The objective of this dissertation is to develop a new approach which can successfully maintain the rout with lesser battery power in order to long survival of Sensor network.

The large number of work has done in order to find another path when node will discharge in the network. Due to this break down the overall performance of network will also decrease with respect to complexity of routing protocol. The objective of this dissertation is to develop a methodology in order to enhance the network survive as long as Possible.

5. PROPOSED ROUTING PROCEDURE

Proposed routing protocol is a proactive node disjoint multipath routing protocol. In proposed routing protocol, WSN is assumed to consist of several steps sti = 1, i 2, ..., l based on the number of hops between the source and destination. The sink is a node St0 zero. Each node can communicate with the receiver node is St1. We assume that a node can communicate with nodes on the same stage Sti Sti Sti and the next step + 1 but cannot communicate with Sti-1 nodes. This avoids looping paths. Initially, all network nodes have a very high value of the hop count with the exception of the receiving node. Initially, all nodes have their residence above the threshold energy level energy. Multiple paths from all nodes to the sink is generated in the construction phase of the road. In the process of building the packages Route (RCON) are exchanged between nodes. Each sensor node transmits the packet once RCON and maintains its own routing table. If there is no path to the sink node through the RCON received packet, then the node processes the packet RCON. If the path to flow from this node is already available

in the routing table of the node, then the number of hops the packet is checked. If the hop number of packets is less than the value of the node and its residual energy jump is greater than the power threshold value, then it is RCON; otherwise the packet is discarded. The node receiving the RCON packet, updates the RCON packet. RCON is updated with incremental number of hops by one, updates the node ID before adding the node identifier in the way. The node receiving the RCON packet updates its routing table as the number of hops and path node to the receiver. Similarly, all nodes in the network receive the RCON packet and update their routing tables. Once they are all multiple paths are generated, the node disjoint multipath identified between the source and destination. When the source node to send the data from the target, extends the FFI trace data between nodes disjoint multipath based and long tail filled fill residual energy. If a path disjoint node fails due to the death of routing node movement or node, it informs the source node through the RERR packet.

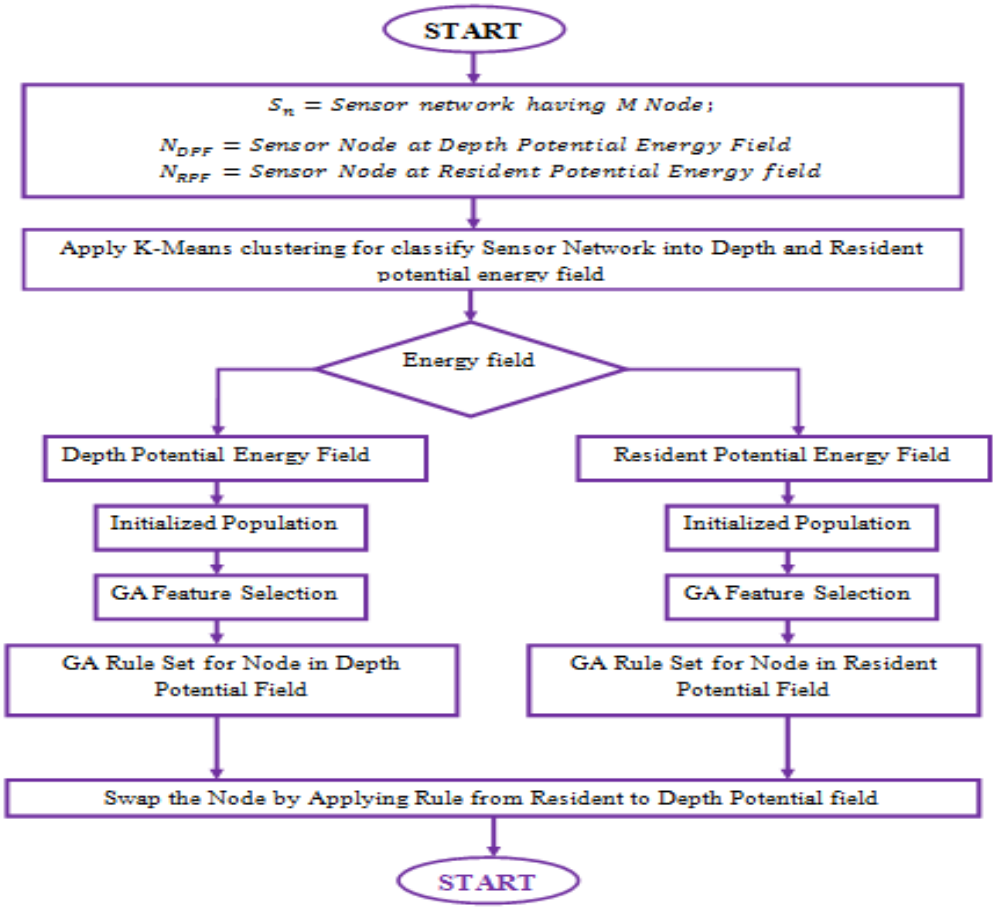


Figure 1 Proposed Methodologies for Sensor Network Life Saving Routing Protocol

The proposed solution is going to provide supplement support the high junction lower energy node with lower junction high energy node. Proposed method used the method of bi-partite graph & swam intelligence for deciding which high energy node provide supplement support to high junction node without break its own connectivity. In proposed methodology as show in figure 1 uses to select node from low traffic area having middle

resident energy limit to provide supplement support low energy node at high traffic zone.

Initially proposed algorithm assume limit of low resident energy node and middle resident energy node. If any node in network degrades their energy limit below low resident energy node then its broadcast node replacement packet. If any neighbors node having energy above middle resident limit and reside in lower traffic region select for providing supplement support.

6. SIMULATION MODEL

In heterogeneous ad hoc networks, each node normally has different capabilities since some nodes are portable devices with limited capacity and battery life, while the others may be stationary or equipped with vehicle. These nodes are not power-constrained and usually have higher capacity than the former one. In this research work, there are two types of nodes which are High-capacity nodes (H-nodes) and General capacity nodes (G-nodes). These two types of nodes have different capacity which are bandwidth and transmission range.

Simulation scenarios are constructed by varying number of nodes. In each scenario, a few nodes approximately 5-20% are included as malicious nodes. For example, if there are totally 50 nodes in the heterogeneous networks, 5 nodes of them are the malicious nodes while other nodes are correct nodes performing good communication practices.

TABLE 2: Simulation Parameters

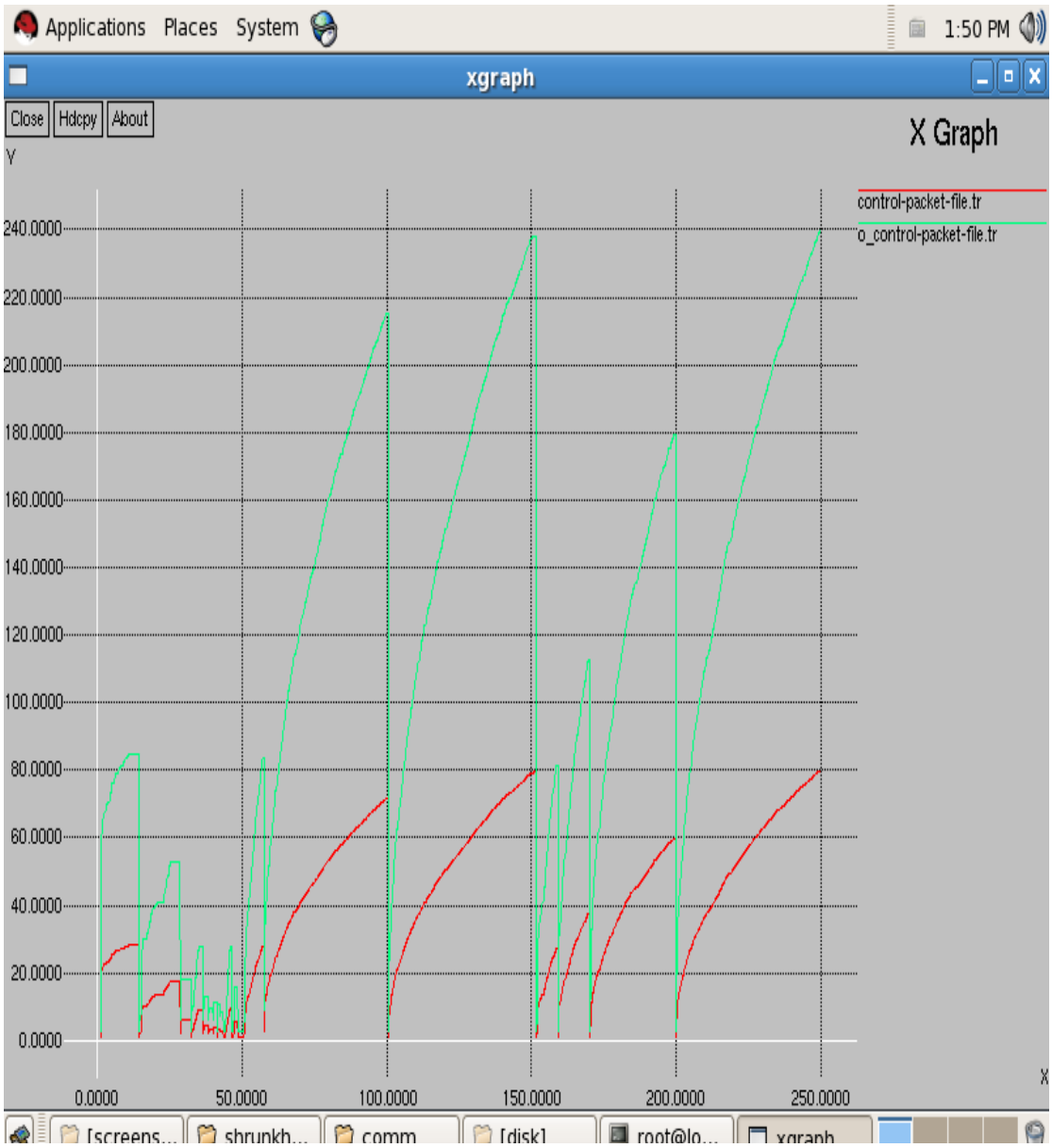
channel type	Channel / WirelessChannel
radio-propagation model	Propagation / TwoRayGround
network interface type	Phy/WirelessPhy
MAC type	Mac/802_11
interface queue type	Queue / DropTail / PriQueue
link layer type	LL
antenna model	Antenna / OmniAntenna
routing protocol	AODV
X dimension of the topography	1080
Y dimension of the topography	1080
max packet in ifq	500
seed for random number gen.	0
simulation time	25
number of mobile nodes	500

7. PERFORMANCE EVALUATION METRICS

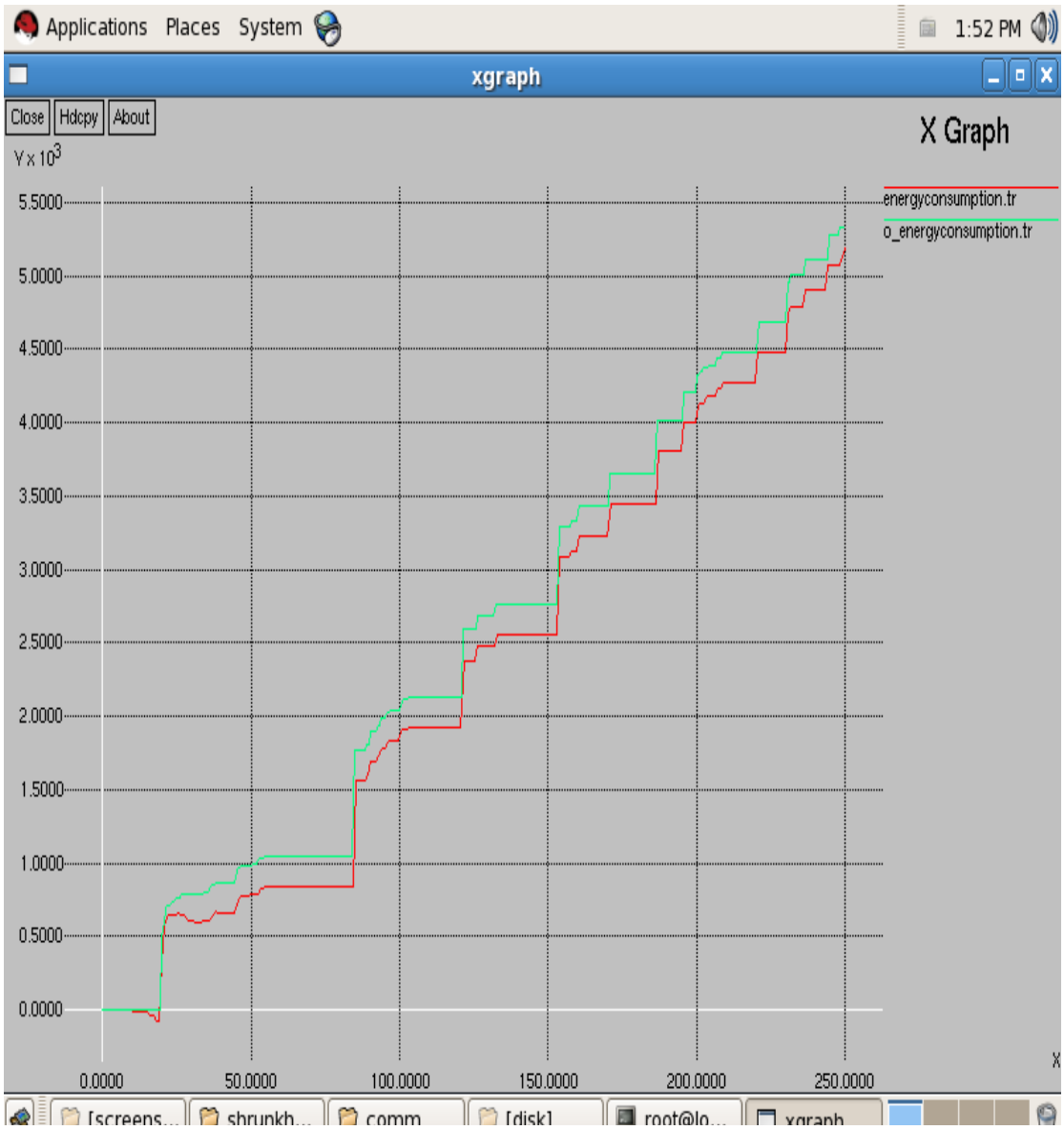
The performance metrics which are used to analyze the performances of routing protocols in heterogeneous ad hoc networks are discussed in the following:

[1]. **Average end-to-end delay:** This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and times and transfer propagation. For any ideal routing protocol it is required that it has lower end to end delay, whereas existing approach by using PF-MHR Based On Potential Field have required higher end to end delay as compare to proposed methodology by using GA- Based On Potential Field.

[2]. **Control packet overhead:** - For any ideal routing protocol it is required that it has lower control packet overhead, whereas existing approach by using PF-MHR Based On Potential Field have required higher control packet as compare to proposed methodology by using GA- Based On Potential Field.



[3]. **Battery Power Consumption:-** Towards Energy saving routing protocol proposed protocol try to move lower energy node towards less traffic and higher energy node towards high traffic and reduce retransmission whereas existing approach only minimized redundant path. Existing approach by using PF-MHR Based On Potential Field have required higher battery power consumption as compare to proposed methodology by using GA- Based On Potential Field.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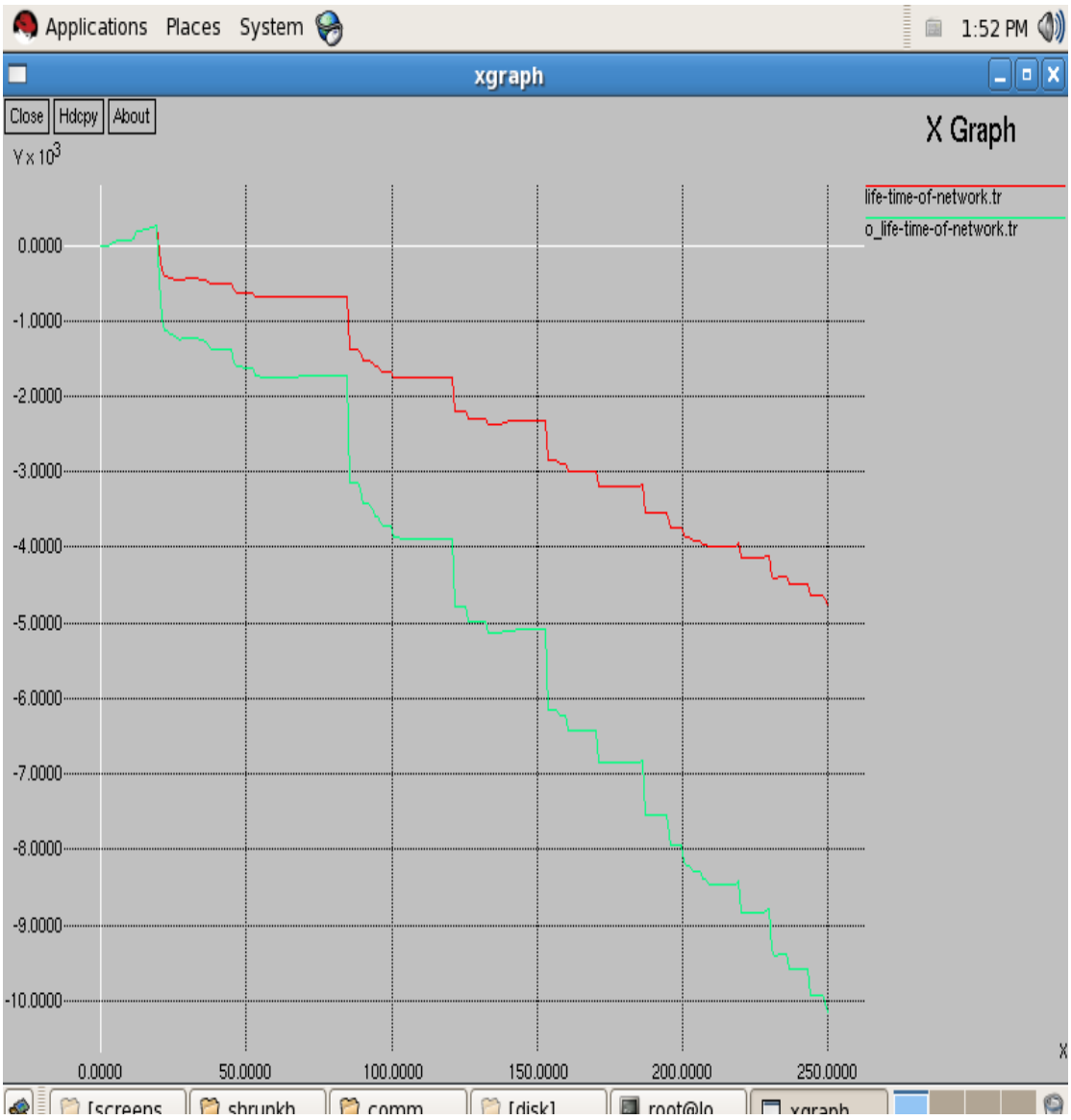

[4]. **Life Time Of Network:-** In any sensor network it is required to have larger survival. Whereas energy utilization is inversely propositional to life time of network. Existing approach having higher energy consumption which lead lower survival. Whereas proposed methodology by using GA- Based on Potential Field required lower energy which lead longer survival.

8. CONCLUSION

In our previous study, multiple disjoint paths are discovered among source and destination. Among the discovered routes, the optimal paths are selected based on bandwidth constraints, delay constraints and path stability.

When any flow request is received, it is initially categorized as real time and non-real time flows where real time flows are given higher priority.

But in proposed work genetic algorithm based multipath QOS routing protocol for traffic splitting in sensor network is to be used which lead to increase packet delivery ratio, speed, throughput of network as compare to existing one.

In this dissertation a novel secure location added data transfer protocol for multipath energy efficient routing over sensor network is presented. This method encapsulate advantage of two different predefine method in order to overcome their limitation. First swam intelligence and second one is bi partite graph. Proposed protocol tries to provide supplement support to lower energy node at heavy traffic by higher energy node from lower traffic of network.

To improve the reliability through redundant paths in the network, it is suggested to have a maximum number of paths between the source and the destination. It is necessary to have a minimum number of nodes in each redundant path. Network reliability is increased in networks multipath disjoint nodes, where each node disjoint path has a maximum number of redundant paths and the minimum number of nodes in each redundant path. In the multi-path network node disjoint, the reliability is very high the performance of proposed technique is depending upon network density and network traffic.

9. FUTURE WORK

The enforced works are often tested for top density of nodes having larger mixture of wired nodes and wireless nodes. The high density networks shall cause the a lot of probabilities of getting higher quantity of traffic and a lot of probabilities of malicious nodes within the network thence the operating of the planned work shall be checked upto nice extent.

In future, this work can even be increased to check on different protocols like DSDV or DSR.

These works are often increased in future to produce a dynamic interface to alter the Greek keys such that in order that network are often safeguarded against the human errors.

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