

SHORTEST PATH BASED GEOGRAPHIC ROUTING IN CLUSTERED WIRELESS SENSOR NETWORK

*¹Ms.Deepika A.R. , *² Mr. Hariharan P.

*¹M.Phil Research Scholar, Department of Computer Science, Adhiparasakthi College of Arts and Science (Autonomous), Kalavai, TamilNadu, India

*²Assisant Professor, Department of Computer Science, Adhiparasakthi College of Arts and Science (Autonomous), Kalavai, TamilNadu, India

-----***-----

Abstract - An important issue in wireless sensor networks (WSNs) is to dynamically organize the sensors into a wireless network and route the sensory data from sensors to a sink. Clustering in WSNs is an effective technique for prolonging the network lifetime. In most of the traditional routing in clustered WSNs assumes that there is no obstacle in a field of interest. Although it is not a realistic assumption, it eliminates the effects of obstacles in routing the sensory data. Here, we first propose a clustering technique in WSNs named energy-efficient homogeneous clustering that periodically selects the cluster heads according to a hybrid of their residual energy and a secondary parameter, such as the utility of the sensor to its neighbors. In this way, the selected cluster heads have equal number of neighbors and residual energy. We then present a route optimization technique in clustered WSNs among obstacles using Dual algorithm. By using this technique we can discovery route even when an obstacle occurs. The route will be the best shortest path. Our work reduces the average hop count, packet delay, and energy-consumption of WSNs and extends the lifetime of sensor.

Key Words: wireless sensor network (WSN), cluster, route optimization

I. INTRODUCTION

A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. Sensor nodes can be partitioned into a number of small groups, which is known as clusters. These are the organizational unit for wireless sensor networks. Each cluster has the coordinator, called cluster head (CH). In a clustering scheme the sensor nodes in a WSN are divided into different virtual groups, and they are allocated geographically adjacent into the same cluster according to some set of rules. The cluster heads can consolidate the data and send it to the data center as a single packet, thus reducing the overhead. Clustering has advantages for reducing useful energy consumption by improving bandwidth utilization, reducing wasteful energy consumption by reducing overhead. Most of the algorithm aims to extend the network lifetime by balancing energy consumption among nodes and by distributing the load among different nodes from time to time.

A. OUR CONTRIBUTION

In this paper, we propose the following:

- ❖ We propose an EHC technique in WSNs that periodically selects CHs according to their residual energy and the utility of the sensor to its neighbors. The main difference between existing clustering techniques and EHC technique is the utility of the CHs in WSNs. In the EHC technique, a sensor becomes a CH if the utility of the sensor is higher than its neighbors.
- ❖ By using EHC technique, we can extend the lifetime of sensor.
- ❖ Different from the existing work, a CH in EHC technique has maximum eleven neighboring CHs and does not make any assumptions about the density of sensors. The worst case processing time and space complexities of EHC technique is

$O(1)$ per sensor.

- ❖ We present a route optimization technique in clustered WSNs among obstacles using DUAL(Diffusing Update Algorithm) algorithm.

II. RELATED WORK

A) Group connectivity model for industrial wireless sensor networks

It is a recent trend to consider wireless sensor networks in harsh industrial environments. With actual deployment of wireless sensor networks, it would be desirable to make a concrete deployment plan regarding connectivity's and to place sensors by grouping them according to the planned deployment points, even more in case of targeting multiple objects to be sensed and monitored in harsh environments. The connectedness of groups as well as individual sensors is important specifically for real-time data acquisitions and even more if there are no external communication links among these groups. In this paper, we focus on the connectivity of sensor groups, rather than the individual sensors only, and propose a novel *group connectivity model* so as to analyze group connectivity and to make a concrete deployment plan of sensor groups with regard to the internal distribution of sensors and group positions. We believe that the proposed model should be useful in planning the deployment of wireless sensor networks in harsh industrial environments where running wires is less practical and also prohibitively expensive.

B) Fuzzy-logic-based clustering approach for wireless sensor networks using energy predication

In order to overcome the problem of the limited power of the sensor battery and thus prolonging the lifetime of a Wireless Sensor Network (WSN), many routing algorithms were proposed to gather and forward the sensed data to the base station. One of the most well-known routing algorithms that were proposed in the last years is the LEACH protocol. It is a dynamic cluster-based routing protocol that divides the network lifetime to rounds where each round is composed of two phases: setup and steady state. The key factor of each round is the number of nodes that will act as cluster heads (CHs). Each CH is responsible for collecting the sensed data from the sensor nodes that are in the same cluster and then forwarding the aggregated data to the base station. In this paper we suggest FL-LEACH protocol that employs fuzzy logic in order to determine the number of CHs that should be used in the WSN. FL-LEACH is a fuzzy inference system that depends on two variables: number of nodes in the network and nodes density. Assuming uniform

distribution of the nodes over the sensor field, the novelty of the proposed approach is in its ability to determine the number of CHs without getting other information about the network. Matlab simulation is used to show the effectiveness of the FL-LEACH protocol compared with other protocols, such as the pure LEACH and the genetic-based protocol, LEACH-GA. Simulation results have shown that FL-LEACH outperforms LEACH and LEACH-GA in terms of network lifetime.

C) A general self-organized tree-based energy-balance routing protocol for wireless sensor network

Wireless sensor network (WSN) is a system composed of a large number of low-cost micro-sensors. This network is used to collect and send various kinds of messages to a base station (BS). WSN consists of low-cost nodes with limited battery power, and the battery replacement is not easy for WSN with thousands of physically embedded nodes, which means energy efficient routing protocol should be employed to offer a long-life work time. To achieve the aim, we need not only to minimize total energy consumption but also to balance WSN load. Researchers have proposed many protocols such as LEACH, HEED, PEGASIS, TBC and PEDAP. In this paper, we propose a General Self-Organized Tree-Based Energy-Balance routing protocol (GSTEB) which builds a routing tree using a process where, for each round, BS assigns a root node and broadcasts this selection to all sensor nodes. Subsequently, each node selects its parent by considering only itself and its neighbors' information, thus making GSTEB a dynamic protocol. Simulation results show that GSTEB has a better performance than other protocols in balancing energy consumption, thus prolonging the lifetime of WSN.

Advantages

- Improved More Efficient Packet Delivery Ratio
- Detecting And Preventing Attacks
- Reduce Routing Overhead

Disadvantages

- No Improved Security Features
- Increase Routing Overhead

III IMPLEMENTATION OF TECHNIQUES

Network Configuration

Sensor nodes are randomly distributed in the sensing field. In this project we are using wireless sensor network. In this network, the nodes are static and fixed. The sensor nodes are sense the information and then send to the server. If the source node sends the packet, it will send through the intermediate node. The nodes are

communicates only within the communication range. So, we have to find the node's communication range. A network consists of N sensors, deployed at random uniformly in a FoI among obstacles. The sensors are stationary and powered by the batteries. We assume the *binary disc communication* model in which a sensor, denoted by s , can communicate with other sensors within the disc of radius C centered at s . Two sensors i and j can communicate with each other directly and are known as *neighbors* if the Euclidean distance between them is not more than C . The number of neighboring CHs of a CH is said to be the *CH degree*.

Energy-Efficient Homogeneous Clustering

In this module, we first propose EHC technique and then describe its properties. EHC works in the following two steps to form a clustered WSN:

Initial cluster head election: The goal of this step is to elect the CHs in a distributed manner. At the beginning of each round, sensor i picks a random number in $(0, 1)$. If the random number is less than P , then sensor i is a CH-candidate. With this mechanism, approximately k of N sensors are elected as CH-candidates. The random number does not depend on the previous round. Advertisement contention occurs when multiple CH-candidates advertise at the same time. To resolve the contention, we use a randomized back-off delay.

Connected network formation: We elect more CHs to ensure that the CHs can form a connected network, since ICHs are not connected. A Non-Cluster Head sensor (NCH) is elected as a CH, denoted by Gateway CH (GCH), if two or more neighboring ICHs are not connected.

A CH represents either a GCH or ICH. Preference is given to the NCHs which have higher amount of residual energy and maximum number of neighboring CHs.

We estimate the randomized back-off delay to resolve the advertisement contention for selecting GCHs.

The sensor which has the highest value of the residual energy becomes the CH. The residual energy is calculated using the formula given below

$$RE = E_{init} - (PT_x * NT)$$

Where,

RE → Residual Energy

E_{init} → Initial Energy

PT_x → Transmission Power

NT → Number of transmission

During the reformation of clusters, the cluster head is changed along with the members affiliated to it. Clustering provides resource utilization and minimizes energy consumption in WSNs by reducing the number of sensor nodes that take part in long distance transmission. In WSN the primary concern is the energy efficiency in order to extend the utility of the network.

Route Optimization Technique

The goal of a route optimization technique is to achieve a path from the source to the sink but we also want to achieve the goal at a minimum cost, *i.e.* shortest path in terms of hop counts among obstacles. Most of the literature on routing in WSNs does not have any special treatment for the obstacles in a FoI. In this module, we propose DUAL (Diffusing Update Algorithm) in clustered WSNs that optimizes the path length during data transmission without any extra overhead.

Cluster Heads Selection

Same as, the threshold of cluster heads is set in Equation as follows:

$$T(n) = \{P1 - P[rmod(1/P)] \text{ if } n \in G, \text{ otherwise}$$

where P is a ratio of cluster heads among all sensors, $1/P$ is the expected number of nodes in one cluster, r is the index of the current round and G is the set of nodes that have not been cluster heads in the last $rmod(1/P)$ rounds.

In our proposed algorithm, we consider the network to be heterogeneous, where there are m percentages advanced nodes which have the additional energy factor (α) in itself compared with normal nodes. In to deal with this kind of heterogeneous sensor network, SEP has been proposed, and discussed in detail. With these advanced and normal nodes, this kind of heterogeneous layout has no effect on the density of the network. Hence, the previous set of P_{opt} has no need to change. We assume the initial energy to be E_0 . The energy of advanced node in our proposed sensor network is $E_0 \cdot (1 + \alpha)$. The total energy of new Heterogeneous network is calculated:

$$N \cdot (1 - m) E_0 + N \cdot m \cdot E_0 (1 + \alpha) = N \cdot E_0 \cdot (1 + \alpha m)$$

Hence, the total energy increases by $(1 + \alpha \cdot m)$ times. Virtually there are $n \cdot (1 + \alpha \cdot m)$ nodes with energy equal to the initial energy of a normal node. Based on equations of probabilities for advanced and normal nodes, which discussed in detail in, we improved the selection method with the residual energy of certain sensor nodes. As is shown in Equation, the weighed probability for normal nodes is:

$$P_{nrm} = P_{opt} + \alpha \cdot m \cdot E_{residual} / E_0$$

where P_{opt} is the optical percentage of cluster head, α is the factor of additional energy, m is the percentage of advanced nodes, $E_{residual}$ is the energy left in sensor nodes after certain rounds, and E_0 is the initial energy of any nodes.

ALGORITHM IMPLEMENTATION

Cluster formation

We elect more CHs to ensure that the CHs can form a connected network, since ICHs are not connected. A Non-Cluster Head sensor (NCH) is elected as a CH, denoted by Gateway CH (GCH), if two or more neighboring ICHs are not connected. The randomized back-off delay for a NCH i is denoted by,

$$\text{delay}_{2i} = \left(\frac{E_{init} - E_i}{E_{init}} + \frac{5 - |n_i|}{5} + R \right) \times |n_i|T$$

Thus, a NCH with the higher residual energy and a number of neighboring ICHs will be elected as a GCH with high probability among neighboring GCH-candidates. If a NCH i wants to associate with a CH j , where j has a minimum CH degree in n_i , i sends an associate message (denoted by $Casso(j, i, n_i)$) to j and receives a subsequent confirmation message (denoted by $Cconf(i, j, n_j)$) from j . A NCH updates information of neighbor i whenever it receives $Cconf(j, i, n_i)$ message from i .

An isolated sensor will become a CH. Therefore, each sensor in WSN is either a CH or a member of a cluster. All CHs are connected is the second property of connected WSNs. If a sensor has two or more neighboring ICHs, which are not connected, the sensor will become a GCH. In a connected clustered WSN is that each NCH has exact one CH. That each NCH allows to associates with only one CH.

Procedure: Cluster Formation

- Output:** GCH;
1 if i is a CH **then**
2 if receive $Casso(i, j, n_j)$ message from a NCH j **then**
3 Send $Cconf(j, i, n_i)$ message to j ;
4 if receive $Cadve(j, E_j, n_j)$ message from a GCH j **then**
5 Add j in neighbor list n_i ;
6 Send $Cconf(j, i, n_i)$ message to j ;

IV. SYSTEM IMPLEMENTATION

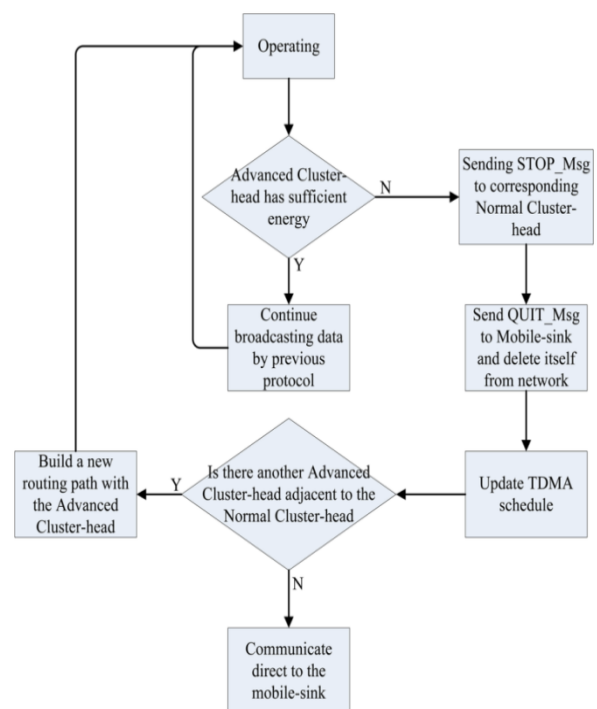
Network simulator 2 is used as the simulation tool in this project. NS was chosen as the simulator partly because of the range of features it provides and partly because it has an open source code that can be modified and extended.

NETWORK SIMULATOR (NS)

Network simulator (NS) is an object-oriented,

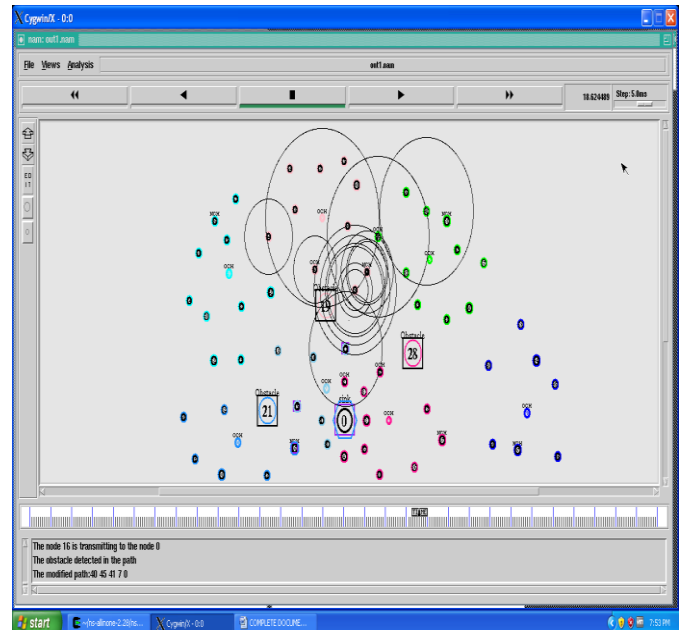
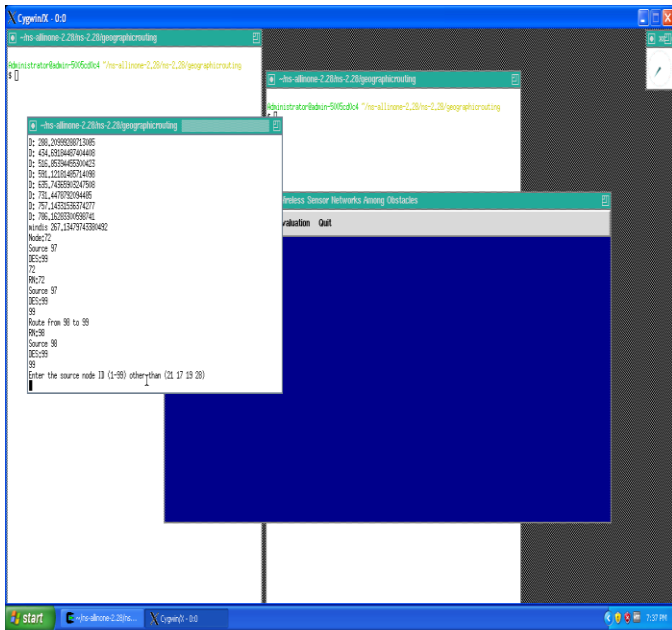
discrete event simulator for networking research. NS provides substantial support for simulation of TCP, routing and multicast protocols over wired and wireless networks. The simulator is a result of an ongoing effort of research and developed. Even though there is a considerable confidence in NS, it is not a polished product yet and bugs are being discovered and corrected continuously.

NS is written in C++, with an OTcl1 interpreter as a command and configuration interface. The C++ part, which is fast to run but slower to change, is used for detailed protocol implementation. The OTcl part, on the other hand, which runs much slower but can be changed very fast quickly, is used for simulation configuration. One of the advantages of this split-language program approach is that it allows for fast generation of large scenarios. To simply use the simulator, it is sufficient to know OTcl. On the other hand, one disadvantage is that modifying and extending the simulator requires programming and debugging in both languages.



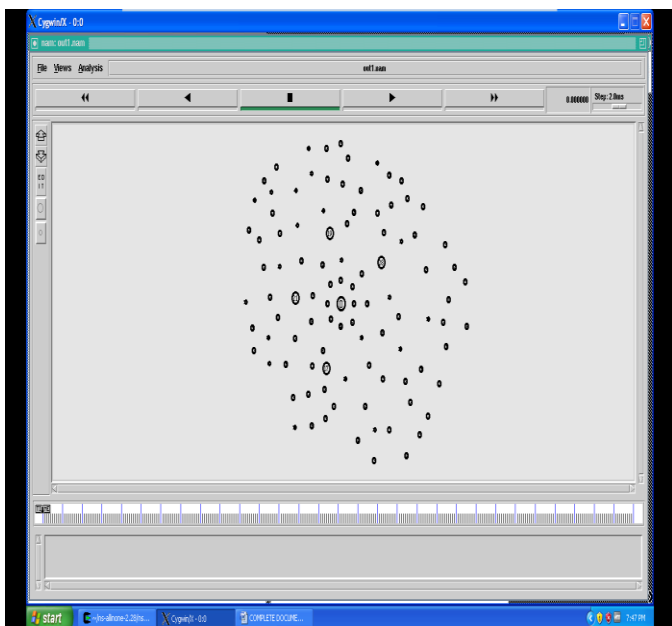
In this section, we construct a routing tree based on cluster heads set which have been elected and the communication procedures are, During the broadcasting phase, each cluster head broadcasts an advertisement message (ADV_Msg) and its ID, location and type to sensors within its range using carrier-sense multiple access mechanism. Each normal cluster head will record the ID and location of an advanced cluster head with the strongest received signal strength (RSS).

EVALUATION RESULT:

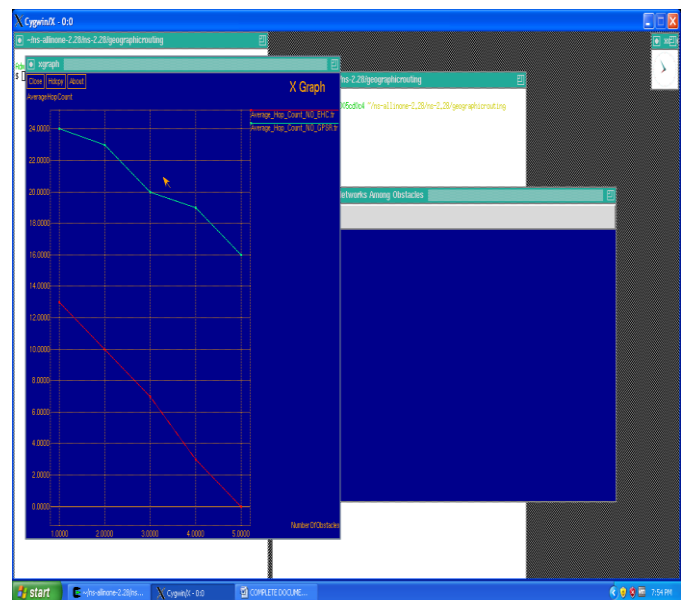


A.AVERAGE HOP COUNT

The hop count refers to the number of intermediate devices through which data must pass between source and destination. Each time packets are passed to the next device, a hop occurs. Hop count is therefore a basic measurement of distance in a network.



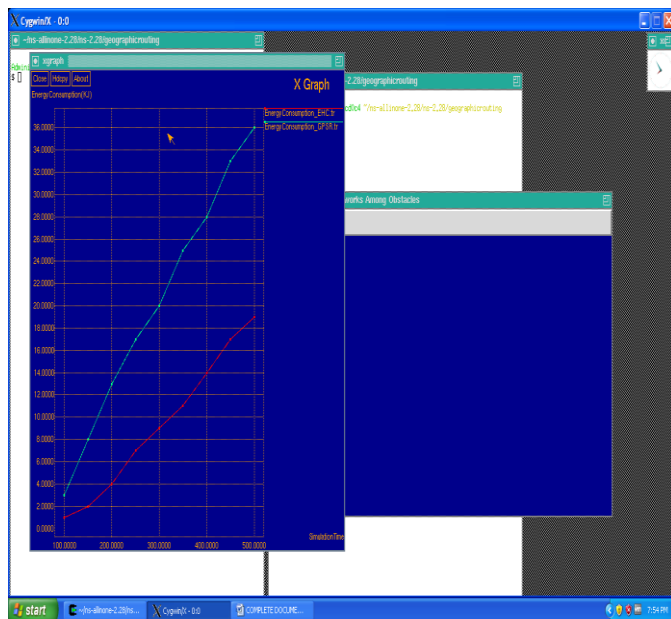
proposes gradient routing with two-hop information for industrial wireless sensor networks to enhance real-time performance with energy efficiency. Two-hop information routing is adopted from the two-hop velocity-based routing, and the proposed routing algorithm is based on the number of hops to the sink instead of distance. Additionally, an acknowledgment control scheme reduces energy consumption and computational complexity. The simulation results show a reduction in end-to-end delay and enhanced energy efficiency.



B.ENERGY CONSUMPTION

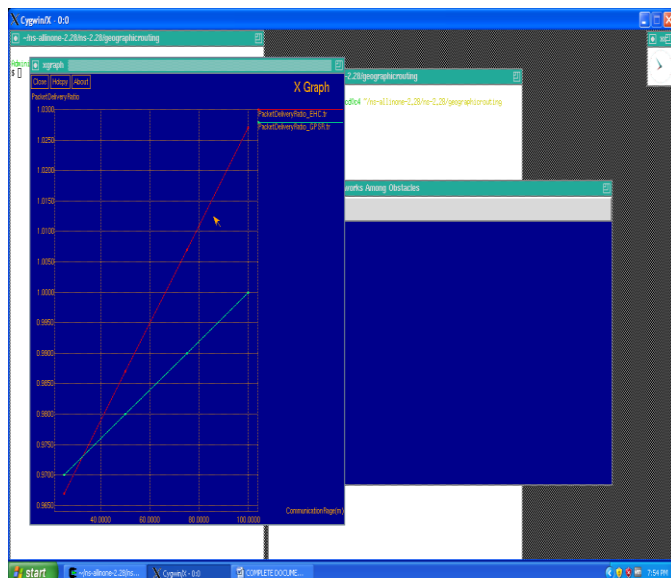
Energy consumption means consumption in energy or power. It can be concluded that when EHC is not used, all the sensors remain active to provide the routing for a short duration. This is because a geographical routing

without route optimization technique requires more number of the average hop count for routing the packets.



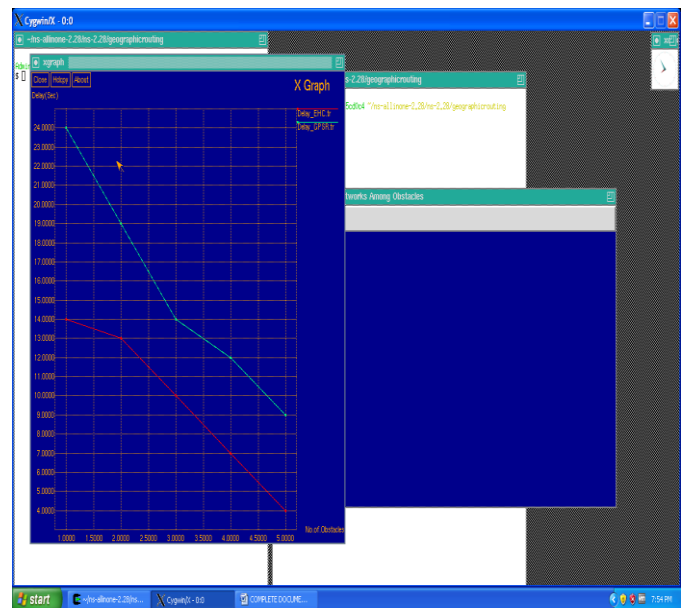
C. PACKET DELIVERY RATIO

The packet delivery ratio of a flow is the ratio of the number of packets that are received by the sink over packets submitted to the network by the source.



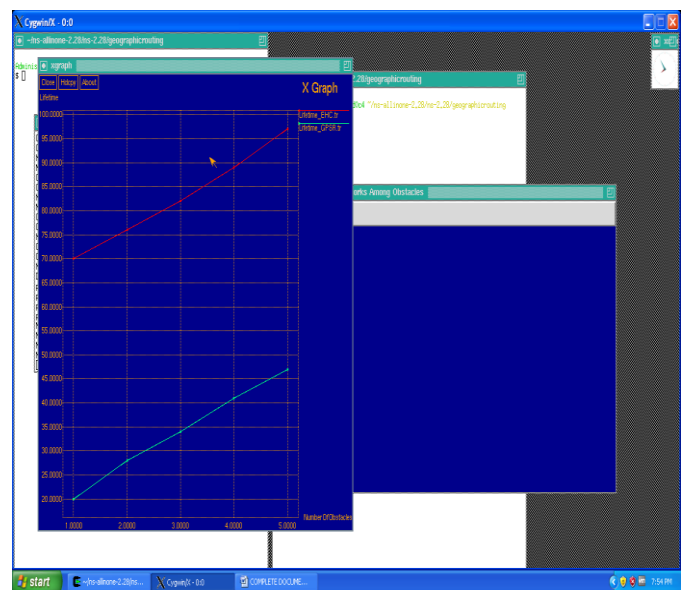
D. DELAY

Delay is the measurement of the time for the packet to reach its destination beyond the described time. Two sensors *i* and *j* can communicate with each other directly and are known as neighbors if the Euclidean distance between them is not more than *C*. The number of neighboring CHs of a CH is said to be the CH degree.



E. Lifetime

In EHC, only CHs remain active to provide the routing and therefore prolongs the lifetime of WSNs. Power consumption should be minimized since it determine the lifetime of network.



V CONCLUSION

In this paper, we proposed a distributed approach to determine if a sensor in WSNs is a CH to meet the desired connectivity requirements. We mainly focused on energy-efficient clustered WSNs to prolong the lifetime of WSNs. We also proposed a technique to optimize the routing path among obstacles in clustered WSNs. We simulated the performance of the proposed EHC and ROT for different network scenarios and demonstrated that the Energy consumption and average hop count in WSNs are reduced due to the clustering of sensors and optimization

of routing path, hence the lifetime of WSNs is increased. The results demonstrated that the geometry and location of the obstacles should be considered to compute an optimized routing path.

FUTURE ENHANCEMENT

In future, to reduce the energy consumption for route discovery, we can propose a new route discovery method. In this method, the source node calculates a circle around the location of destination node which gives the list of destination's neighbor nodes. The source node defines its forwarding zone (a cone) to be the region enclosed by an angle whose vertex is at source node's location and whose sides are tangent to the circle calculated for destination. Source node sends a RREQ packet for destination to all its neighbors in the forwarding zone. Each of these neighbors forward the RREQ packets accordingly. When destination receives the RREQ packets, it will send the RREP packets back to the source node. If source node does not receive an RREP within a time period due to any obstacle in the forwarding zone, then source node resorts to a recovery procedure.

REFERENCES:

1. J. H. Lee, T. Kwon, and J. Song, "Group connectivity model for industrial wireless sensor networks," *IEEE Trans. Ind. Electron.*, vol. 57, no. 5, pp. 1835–1844, May 2010.
2. J.-S. Lee and W.-L. Cheng, "Fuzzy-logic-based clustering approach for wireless sensor networks using energy predication," *IEEE Sensors J.*, vol. 12, no. 9, pp. 2891–2897, Sep. 2012.
3. Z. Ha, J. Wu, J. Zhang, L. Liu, and K. Tian, "A general self-organized tree-based energy-balance routing protocol for wireless sensor network," *IEEE Trans. Nucl. Sci.*, vol. 61, no. 2, pp. 732–740, Apr. 2014.
4. D. C. Hoang, P. Yadav, R. Kumar, and S. Panda, "Real-time implementation of a harmony search algorithm-based clustering protocol for energy-efficient wireless sensor networks," *IEEE Trans. Ind. Informat.*, vol. 10, no. 1, pp. 774–783, Feb. 2014.
5. M. Tarhani, Y. S. Kaviani, and S. Siavoshi, "SEECH: Scalable energy efficient clustering hierarchy protocol in wireless sensor networks," *IEEE Sensors J.*, vol. 14, no. 11, pp. 3944–3954, Nov. 2014.
6. P. T. A. Quang and D.-S. Kim, "Enhancing real-time delivery of gradient routing for industrial wireless sensor networks," *IEEE Trans. Ind. Informat.*, vol. 8, no. 1, pp. 61–68, Feb. 2012.
7. J. Niu, L. Cheng, Y. Gu, L. Shu, and S. K. Das, "R3E: Reliable reactive routing enhancement for

wireless sensor networks," *IEEE Trans. Ind. Informat.*, vol. 10, no. 1, pp. 784–794, Feb. 2014.