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MOBILE SINK BASED COVERAGE AND CONNECTIVITY TO MAXIMIZE NETWORK LIFETIME OF WIRELESS SENSOR NETWORK

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ABSTRACT

Wireless sensor network is a wireless network that consists of base station and numbers of nodes (wireless sensors).These networks are used to monitor physical or environmental conditions like sound, pressure, temperature and cooperatively pass data through the network to a main location. Coverage usually explains how well a sensor network will monitor a field of interest. It can be thought of as a measure of quality of service. In addition to coverage, it is important for a sensor network to maintain connectivity. In this paper, a meridian cover tree (MCT) algorithm is proposed which is used to enhance the coverage as well as the connectivity of each sensing node by dynamically forming routing cover trees. The nodes in each disjoint set is able to monitor all the discrete point of interests. The discrete point of interests sense the data and transmit to the cluster head which gets the data from the disjoint sets of sensor node and transmit it to the peak point. Mobile sink collects the data directly from the polling point, so that energy consumption among node is reduced and network lifetime is improved. The simulation is done using network simulator-2 and graph is plotted between time vs. packet loss and throughput and energy drained and message inter arrival time.

Keywords: *coverage and connectivity, disjoint set, mobile sink, packet loss.*

INTRODUCTION

Wireless sensor network is a wireless network that consists of many spatially-distributed sensor devices for monitoring physical or environmental condition and cooperatively passing their data through the network to a main location. WSNs can be classified into two types: structured and unstructured. An unstructured WSN is one that contains a dense collection of nodes deployed in a random manner. The network is left unattended to perform monitoring and reporting functions. Some constraints are: limited energy, short communication range, low bandwidth, limited storage and processing capabilities in each node. A sensor node typically consists of five main parts: one or more sensors gather data from the environment. The central unit in the form of a microprocessor manages the tasks. A transceiver (included in the communication module) communicates with the environment and a memory is used to store temporary data or data generated during processing. The energy supplies all parts through battery. To assure a sufficiently long network lifetime, energy efficiency in all parts of the network is crucial. The position of sensor nodes need not be engineered or pre-determined. This allows random deployment in inaccessible terrains or disaster relief operations. The number of sensor nodes in a sensor network can be several orders of magnitude higher than the nodes in an ad hoc network. Sensor nodes mainly use broadcast communication paradigm whereas most ad hoc networks are based on point-to-point communications. Sensor nodes are limited in power, computational capabilities, and memory. Sensor nodes may not have global identification (ID) because of the large amount of overhead and large number of sensors. The wide range of application areas will make sensor networks an integral part of our lives in the future. However, realization of sensor networks needs to satisfy several constraints such as scalability, cost, hardware, topology change, environment and power consumption. Since these constraints are highly tight and specific for sensor networks, new wireless adhoc networking protocols are required.

The coverage and connectivity preservation issues explain how well a sensor network will monitor a field of interest. It measures of quality of service. Coverage can be measured in different ways depending on the application. Connectivity can be defined as the ability of the sensor nodes to reach the data sink. If there is no available route from a sensor node to the data sink then the data collected by that node cannot be processed. Each node has a communication range which defines the area in which another node can be located in order to receive data. This separates from the sensing range which defines the area a node can observe. The two ranges may be equal but are often different. Here, the main objective is to cover an area (also referred sometimes as region).Each point in the region needs to be monitored by at least one sensor. The most important factor to be considered in the development of a coverage scheme is that of energy constraints.

In this coverage approach, disjoint set covers are formed as a subset of sensors that is capable of covering the entire field of interest by itself. Only the particular subset of sensors active at a given time and other sensors are in sleep mode in order to preserve the energy. This approach of turning off the necessary sensors not only extends the network lifetime but also maintains the necessary coverage while conserving energy of the sensors in the networks. The scheduling approach is to determine timing of activation and inactivation of the each node while maintaining coverage. By doing so network lifetime is maintained. Such a problem with non-disjoint formation is proved to be non deterministic polynomial (NP)-Complete problem. The nodes in each cover set able to monitor all the DPOIs. The activation of cover sets alternatively, the coverage and network lifetime is achieved.

RELATED WORK

Many clustering protocols for typical WSNs, which Composed of static sensor nodes and a static sink have appeared in the literature [1]–[3].An extensive series of studies concerning with the aforementioned compound problem have been proposed [9]–[13]. For example, Cardei and Cardei [10] proposed the *Connected Set Covers* (CSC) problem that aims at finding a maximum number of cover sets such that every sensor node to be activated is connected to the BS and proved its NP-Completeness. To cope with the CSC problem, they employed two centralized algorithm: an integer programming based heuristic (IP-CSC) and a breadth-first search based heuristic (Greedy-CSC). For practical implementation, another distributed heuristic was also presented (named Distr-CSC). Ostovari et al. [11] presented a distributed method for connected point coverage. The node was able to decide whether it can serve as a sensing node after a specific waiting time interval or act as a relaying node in the constructed *Modified Virtual Robust Spanning Tree* (MVRST). Instead of using the distance between nodes to evaluate the edge cost in the MST, the MVRST took the hop count into account in the evaluation of edge costs. Compared with the approach presented in [10], the authors claimed that the MVRST can cover all DPOIs using less sensor node and has a lower average data loss rate. Except

for both studies in [10] and [11] mentioned to deal with the CSC problem based on the *Minimum Spanning Tree* (MST).

Zhao and Gurusamy [9] developed an approximation algorithm with a distributed version, named *Communication Weighted Greedy Cover* (CWGC), to maximize the number of cover sets. Specifically, they constructed cover trees that had three properties: 1) Each leaf of the tree was a sensing node; 2) The root of the tree was the sink node; 3) Every DPOI could be monitored by at least one sensing node in the tree. Then the operational time interval of each cover tree could be maximized by finding a minimum sum of the link weights from every node to the BS. Although the CWGC had a better performance on the extension of network lifetime as compared to the study in [4], the CWGC did not include any policy regarding the poorly covered DPOIs (i.e., critical DPOIs). Because the critical DPOIs are closely relevant to the upper bound of network lifetime, it is necessary to apply efficient mechanisms to the sensor nodes (named critical nodes) that cover the critical DPOIs. With the scheduling optimization for these critical nodes, Zorbas and Douligeris [26] further showed that the network lifetime can be effectively prolonged. They presented the *Optimized Connected Coverage Heuristic* (OCCH) to generate the connected cover sets, where the critical nodes would not serve as relaying nodes by assigning different weights to edges between nodes.

In fact, other nodes responsible for relaying data are also as important as the critical nodes, especially for the nodes which are much closer to the critical nodes. This is because the sensed data will not be sent back to the BS without the relaying nodes. Hence, it is necessary to evenly impose the traffic burden on the relaying nodes to guarantee the connectivity of WSNs, i.e., *load balance* must be achieved. However, as described in the aforementioned literature review, most of the existing studies in exploring the connected cover sets ignored the issue of the load balance of WSNs. Thus, in this exiting method, we developed a novel *Meridian Cover Tree algorithm* (MCT) to preserve the coverage as well as the connectivity of WSNs by constructing a maximum number of *cover trees*. During operation of WSNs, the proposed MCT is able to activate fewer sensor nodes to maintain coverage and connectivity while balancing the traffic burden of nodes. The remaining nodes are inactive to reduce energy consumption.

WSNs with mobile sinks have attracted a lot of attention recently [4]–[8]. In [4] authors developed an Intelligent Agent-based Routing (IAR) protocol to guarantee efficient data delivery to sink and reduces signal overhead. The idea of IAR selects some sensors as agents. Then, the sink moves near an agent and receives data if it is in the range of the agent, and if not, the sink chooses a sensor as a temporary relay node which receives data from agent and forwards it to sink. Authors in [5] formulated the distance constrained mobile sink problem as a mixed integer linear programming and devised a novel heuristic to find an optimal sojourn tour for the sink based on maximizing the sum of sojourn times during the tour. Mobile Sink based Routing Protocol (MSRP) for prolonging the network lifetime in clustered WSN has been addressed in [6]. In MSRP, the sink moves to CHs having higher energy in the clustered network to collect sensed data from them. In this paper, we use a control mobile sink guided based on minimizing the dissipated energy of all sensor nodes. In this case, the sensors surrounding the sink change over time, giving the chance to all sensors in the network to act as data relays to the mobile sink and thus balancing the load among all nodes.

MERIDIAN COVER TREE ALGORITHM

The goal of the MCT problem is to construct several connected cover trees. By doing so, a longer network lifetime and full coverage can be acquired. The MCT problem is a complicated NP-Complete problem, so finding a sub optimal solution is a generic approach in order to decrease the time of computation. The proposed MCT is used to find a maximum number of disjoint sets of nodes, which can be achieved by one of the sensor nodes (such as the sink node). In each disjoint set, the nodes are able to monitor all the DPOIs together. That is, the MCT algorithm focuses on dealing with the full coverage preservation issue. Moreover, the PLB strategy is used to figure out the appropriate path from each node to the BS after the disjoint sets are initiated. For each possible transmission path from a given node to the candidate parent nodes, the PLB strategy will assign different probabilities in order to more uniformly distribute the load.

Fig.1 shows the flowchart of the proposed MCT algorithm. First, the family of the disjoint sets (defined as DS), *S*, and *P* are initialized after a WSN is given to the MCT (step 1). Then, the set of available nodes, *Sa*, is generated by eliminating the unavailable nodes without covering any DPOIs from *S* (step 2). From *Sa*, the OCR heuristic will explore as many disjoint sets (*Ci*) of nodes as possible until the nodes in *Sa* cannot be selected to group a new independent disjoint set (step 3 to step 5).

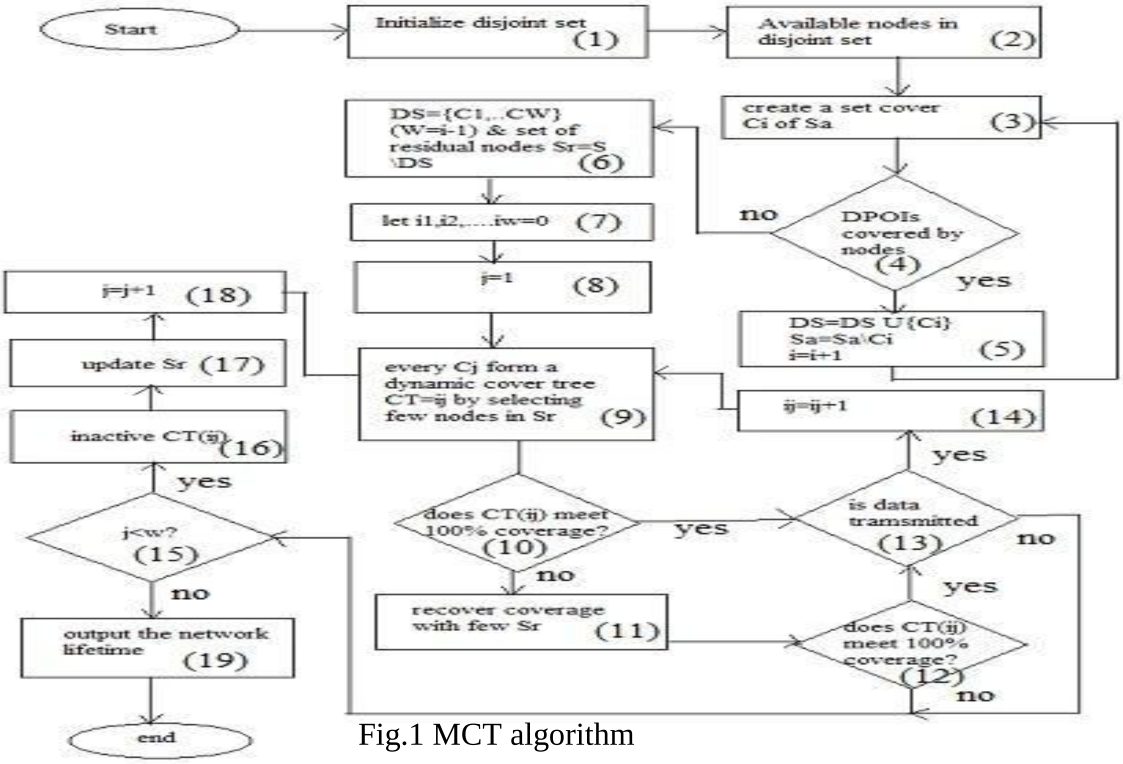

Fig.1 MCT algorithm

This exploring process for disjoint sets carried out by the MCT will divide the set of Sa into several mutual exclusive subsets, i.e., $Ci \cap Cj =\{Ø\}$, and $i= j$. Every disjoint set Ci of nodes are able to monitor all the DPOIs together. With a consideration of full coverage, after the exploring process, we can acquire a collection of subsets of the available nodes (Sa), $DS =\{C1,C2,...,Cw\}$, which will be notified to every member in DS.

Afterwards, we can obtain a set residual nodes by $S\ rsd =S\backslash DS$. The nodes in $Srsd$ are supposed to be turned into a sleeping mode to conserve energy and then become active again by receiving a wake-up beacon. In the next stage, both the sets of $Srsd$ and DS are used to construct corresponding dynamic cover trees. And the corresponding operational period of each dynamic cover tree, i.e., the set of $\{\tau1,\tau2,...,\tau w\}$, is computed. At the beginning of this stage, each element of $\{\tau1,\tau2,...,\tau w\}$, is initialized to be zero (step 7). Afterwards, every $\tau j\ (1 \leq j \leq w)$ is estimated per time unit (e.g., one second) by determining whether the constructed treelike topology $CT(\tau j)$ is able to achieve 1) full coverage and 2) BS-connectivity (step 9 to step 18). It means that all the events occurring at the DPOIs must be detected by the sensing nodes in $CT(\tau j)$ and reported to the BS. If $CT(\tau j\ )$ does not maintain full coverage, the nodes performing MCT will try to recover the lost coverage by activating some possible neighbor nodes in $Srsd$ (step 11). If both full coverage(step 12) and the BS-connectivity of $CT(\tau j)$ (step 13) are achieved, the operational period τj will be updated with an increment of one second (step 14). On the other hand, if the full-coverage monitoring fails, which means that either full coverage or BS connectivity is not connected anymore, the currently on duty dynamic cover tree $CT(\tau j\ )$ will be inactivated (step 16), and the remaining available nodes of $CT(\tau j)$ will be added to $Srsd$ and hibernate after receiving the sleeping message (step 17). Then the next unused dynamic cover tree $CT(\tau j+1)$ will be initiated (step 18). The nodes causing full-coverage monitoring failure will send the notification message of set change to the whole WSN. The iteration (step 9 to step 18) will be continuously performed and terminated when all nodes in the disjoint sets run out of energy. Finally, the network lifetime is obtained by summing all the τj $(1 \leq j \leq w)$ (step 19). Due to the limited energy as well as computation ability of sensor nodes, it is necessary to develop a flexible and efficient mechanism to manage the WSN while preventing wasting energy. We will illustrate the characteristics of the proposed MCT in the following subsection, and specify how the MCT maximizes the network lifetime while preserving both full coverage and BS-connectivity.

1) Dynamic Recovery for the Lost Coverage and BS-Connectivity of Sensing Nodes: Many factors may influence the normal operation of WSNs, including weather change, man-made interference, etc., so it is necessary to employ a mechanism to recover the normal operating condition after initiating the WSN. When full coverage fails, the nodes reserved in the set of residual nodes *Srsd* will be used to recover the lost coverage of DPOIs (step 11) by the COR heuristic. The node set *Srsd* contains both the remaining nodes excluded from all the disjoint sets (step 6) and the currently available nodes, which comes from the original members in the deactivated disjoint sets (step 16 and 17). The nodes without sufficient energy to maintain a normal operation are eliminated from *Srsd*. Moreover, these nodes in Srsd are also viewed as the candidate nodes to be selected as the relaying nodes. By this way, the network lifetime of maintaining full coverage can be extended efficiently.

2) Allowance of Connection between Nodes in the Same Tier: If the node always transmits the sensed data to a specific node, the parent node will have a heavier burden and rapidly exhaust its energy, which further makes the transmission path invalid. The invalid transmission path may cause the full coverage monitoring to fail. In order to avoid such a situation, the sensor nodes need to establish connections with available neighbor nodes in the same tier if it has only one candidate parent node. Note that, the nodes are said to be in the same tier if they have the same hop count number to the BS. In this paper, the hop count from every sensor node to the BS is viewed as the node's tier number in a routing tree. By increasing the possible connections with the neighbor nodes in the same tier, the transmission congestion caused by a relaying node can be avoided.

3) Minimize the Size of Every Disjoint Set: Malfunction and energy depletion of sensing nodes will drastically decrease the network lifetime and the possibility of maintaining full coverage. Therefore, it is necessary to utilize sensing nodes in an efficient way. Moreover, it is also important to avoid node redundancy when performing monitoring tasks. In this study, the proposed MCLCT selects as fewer nodes as possible and assigns them into the disjoint sets using the COR heuristic. Only necessary sensing nodes will be activated during the operation in order to reduce energy waste. On the other hand, using fewer sensor nodes to organize the disjoint sets is able to leave more nodes to the reserve pool Srsd, and then the likelihood of recovering the lost coverage will increase.

4) Load Balance among Nodes within the Same Tier for Each Dynamic Cover Tree: For a tree like topology, the sensed data is always transmitted toward the BS, following the direction from the high tier to the low tier. Starting from a sensing node to the BS, the nodes in each transmission path will choose the best candidate parent nodes to relay data. In this study, the proposed MCT will employ the PLB strategy to determine the probability that a node attempts to transmit its data to each candidate parent node. When the nodes try to choose the best candidate parent nodes via the PLB strategy, they a help construct the overall dynamic cover tree. Thus, the network hot spot and congestion can be avoided, and a longer network lifetime can be assured.

5) Avoid Simultaneously Playing Double Roles of a Sensing and a Relaying Node: As mentioned earlier, the limited energy of nodes need to be reserved as much as possible, especially for the sensing nodes. As a result, the node operations consuming much energy are prevented. In the constructed dynamic cover tree, the sensing nodes focus on monitoring DPOIs without performing other extra operations like packet transferring. On the other hand, the relaying nodes are merely responsible for transferring the sensed data received from other sensing nodes. Each node plays one role at one time, either a sensing node or a relaying node.

The dynamic cover tree $T(\tau)$ consists of three sensing nodes used to monitor three DPOIs, $p1, p2, p3$, and eight relaying nodes used to transfer the sensed data. In detail, $s1$, $s10$, and $s11$ form the disjoint set; $s2$, $s3$, $s4$, $s5$, $s6$, $s7$, $s8$, and $s9$ form the set $Srsd$. First, the connection between $s9$ and $s10$ is established since $s10$ has a sole candidate parent node $(s7)$ in the lower tier (tier 2). We suppose that the sensing node and relaying node (i.e., $s1$ and $s7$) will deplete their own energy. Under such a situation, the MCT will conduct a coverage recovery process (step 10 to step 11) because the p1 cannot be covered, which is caused by the malfunction of $s1$. The new topology of $T(\tau)$ at $\tau+1$. We know that the nodes5 originally serving as a relaying node (a member of the set of $Srsd$) would be changed to serve as a sensing node at $\tau+ 1$, because its coverage coincides with that of s1. Moreover, without connecting to $s10$ at $\tau+ 1$, the sensed data of $s10$ will not be transferred to the BS. Through the dynamic compensation mechanism of the MCT for coverage and connectivity, the roles of sensor nodes can be well determined.

The proposed MCT algorithm is used to find a maximum number of disjoint sets and to attain the load balance among the nodes by adjusting the transmission probabilities. The nodes in each disjoint set Ci are collectively monitor all the DPOIs. According to the architecture of dynamic cover tree, the sensing nodes are located at every leave. The sensing nodes are used to monitor the DPOIs and send out the sensed data. By doing so, the energy consumption of the sensing nodes will be small without performing a relaying task.

First, we use an individual coverage set $I(si)$ P to depict the coverage range of DPOIs for each sensor node $s\ i$, and $i = 1, 2,...n$, which can be evaluated in the beginning of a WSN. We assume that all the coverage sets are known by each node through a broadcasting process. Moreover, we let $Iu(S)$ denote the union of several $I(sk)$, and $k = 1, 2,...q$, where $S\text{`}=\{ s1,s2,...,sq\}$ and $q \leq n$. Therefore, we know that the union of these individual coverage sets $I(sk)$, where $k = 1, 2,...q$, corresponds to the set of entire DPOIs, P, if a group of nodes ($S$`) are able to cooperatively achieve the full coverage of DPOIs, i.e., $Iu(S)= I(s1)\ I(s2)...\ I(sq)= P$. Then, according to the individual coverage sets, employs a rapid exploring process to continuously select appropriate nodes into a newly formed disjoint set Ci until Ci meets the full coverage requirement. By successively performing the rapid exploring process, we obtain a number of disjoint sets within a period.

When several disjoint sets, for searching a new set will become shorter and shorter because the solution space will become smaller after removing some nodes from Sa. And iterate the searching process for disjoint sets until the residual nodes in Sa cannot provide full coverage anymore. Therefore, such an exploring process for disjoint sets performs more efficiently than many existing metaheuristics, which are not suitable for the practical operations of WSNs.

The dying sensing node sd is able to determine a wake-up list (W) of neighbor nodes $(Snei)$. Afterwards, it will broadcast a wake-up signal to awake these neighbor nodes according to the wake-up list. Thus, the lost coverage of DPOIs $(Ploss)$ caused by the dying sensing nodes can be regained, and the network lifetime under full coverage can also be effectively extended. $Ploss$ can be estimated by

$Ploss = P \setminus Iu(S \setminus sd).$

Due to the limited energy of sensor nodes, it is necessary to utilize their energy efficiently, which is especially crucial for the sensing nodes. According to the energy consumption model adopted in this study, the sensing nodes consume the majority of energy to carry out transmitting their sensed data rather than sensing the DPOIs. Specifically, the energy consumption of nodes in transmitting exponentially proportional to the Euclidean distance between two sensor nodes. That is, the transmission distance should be inversely exponentially proportional to the forwarding probability, because the shorter transmission path is preferred. Thus, we use square of the ratio of node's residual energy to transmission distance to represent the weight of a one-hop transmission path between a parent node and a children node, i.e., $\alpha = 2$. After normalizing the weights of paths, the forwarding probabilities can be obtained. According to [13], we know that the more residual energy a candidate parent node has and the closer the locations of a node and its candidate parent node are, the higher forwarding probability that the node will transmit its data to its candidate parent node. Note that, in addition, the weights will significantly increase when the ratio of residual energy to the transmission distance increase slightly due to the exponential factor α of 2.

For the relaying nodes without performing sensing tasks, they are responsible for transferring the sensed data received from the descendants. Load balance is the key concern in this study when relaying the data to candidate parent nodes. Hence, we allow the forwarding probability to be dynamically adjusted according to the estimated possible load of the candidate parent node. The probability that a candidate parent node with a heavier expected load performs data relay tasks should decrease. By contrast, the probability that a candidate parent node with a lighter expected load performs data transfer tasks should increase. Before introducing the forwarding probability for the relaying node, we normalize the residual energy of the candidate parent nodes using their expected loads. Involved with the expected load, the weight of the one-hop transmission path from the relaying node sk to its candidate parent node srh $Prt(sk)$ at τ. Here, in order to enhance load balance among candidate parent nodes, we let $\beta = 4$ according to our practical experience after repeated experiments.
According to (14), we further calculate the weight deviation for every candidate parent node. $Dev(x)$ represents the deviation of x , and weight represents the mean of transmission paths weights to all the candidate parent nodes of sk , respectively. Note that we use $minDev$ to denote the minimum one among all the weight deviations of candidate parent nods in $Prt\ (sk)$. Afterwards, the forwarding probability to candidate parent nodes srh $Prt(sk)$ of the relaying node sk .
The forwarding probability that sk attempts to relay data to a candidate parent node srh with a larger positive weight deviation will be high. By contrast, the forwarding probability that $s\ k$ attempts to transfer data to srh with a larger negative weight deviation will be smaller. Meanwhile, a tendency of load balance can be found when sk chooses the best one from the candidate parent nodes to relay data,

because of the use of weight deviations. Depending on serving as either a sensing node or a relaying node, the forwarding probabilities [11] or [15] for candidate parent nodes can be computed. Such an approach of probability assignment is suitable for WSNs since it can be independently performed on every sensor node instead of on a centralized node or a BS with a higher computation capability and unlimited resource. In the beginning of the construction of the dynamic cover tree, every sensor node will own a tier number (i.e., hop count number) through a simple broadcasting approach. The nodes in the vicinity of the BS have a smaller tier number. With the "tier" information, the forwarding probability and expected load will be updated in accordance with the decreasing order of tier number.

The forwarding probability of each node si for every candidate parent node equals to a given number, which is related to the number of candidate parent nodes, i.e., $\tilde{P}(si, srj, \tau) = 1 / |Prt(s\ i)|$, $srj\ Prt\ (si)$. Firstly, the forwarding probabilities of sensing nodes are updated. At the same time, the expected loads of their candidate parent nodes contributed by these sensing nodes are also computed. Secondly, the relaying nodes are then grafted bottom- to-top onto the relaying nodes that are located in lower tiers. For the relaying nodes in the same tier, the nodes with more candidate parent nodes will be grafted first. The calculation loop is executed repeatedly until all the nodes are grafted completely. The transmission probability calculation and load estimation of nodes can be conducted at a fixed period, depending upon the sampling rate of a given WSN. A high frequent update is needed when applications are subjected to security issues in order to obtain better surveillance quality. Here, we assume that update is done once per second. After every calculation, if a node attempts to send the sensed data to the BS, it will generate a random number RND (0, 1) to determine which candidate parent node is chosen as an active one using the approach of roulette wheel selection. Following the process, the sensed data can be transferred to the BS by the chosen nodes.

RESULT AND COMPARISION

In this section, we present the simulation results regarding the performance of the proposed MCT based mobile sink is compared with previously mentioned algorithms, which include CWGC [9], Greedy-CSC [10], GIECC [12], OCCH-badness [13], and OCCH-critical [13]. The energy consumption model used in these studies is the same as what we used in this paper, and all the simulations are carried out on the NETWORK SIMULATOR-2 platform. From this Fig.2 lifetime of the WSN using AAI with an initial energy of 23 joules is about 16 seconds. Comparing with exiting work energy loss is low.

g.2 Energy drained vs. Time

Packet loss occurs when one or more packets of data traveling across a sensor network fail to reach their destination. From fig.3 the packet loss is low comparing with existing one.

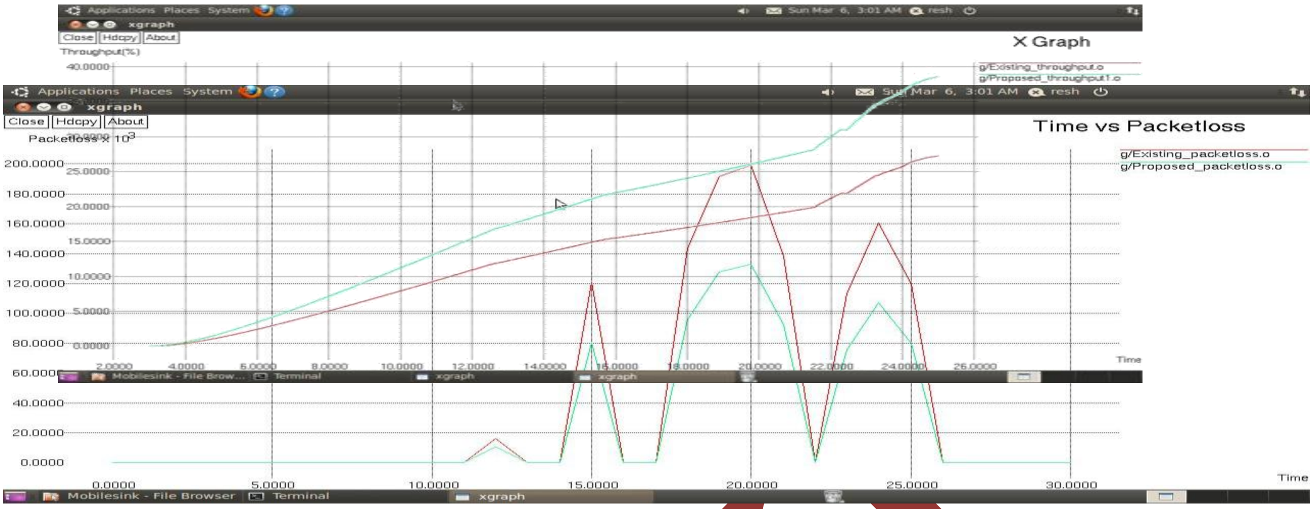

Fig.3 time vs. packet loss

Throughput refers to how much data can be transferred from one location to another in given period. From Fig.4 it is understood that time increases as throughput of the network decreases. comparing with existing one throughput is decreased.

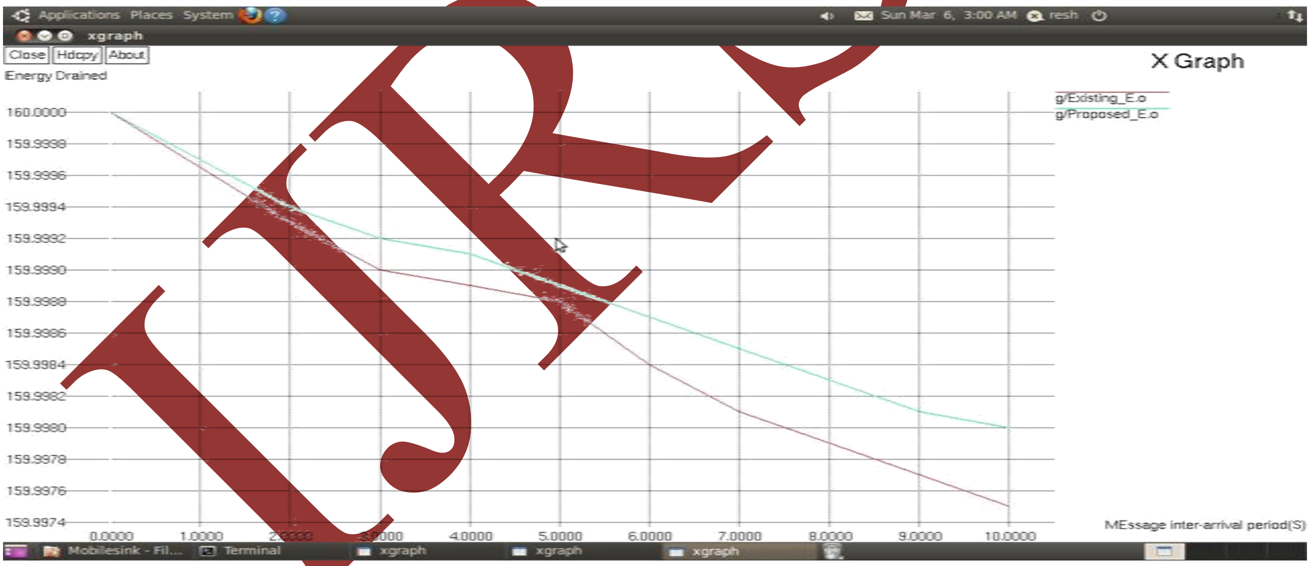

Fig.4 time vs. throughput

CONCLUSION

In this paper, Meridian Cover Tree (MCT) algorithm with mobile sink is proposed achieve to coverage as well as the BS-connectivity of each sensing node. The goal of the MCT algorithm is to sustain full sensing coverage and connectivity of WSNs for a long time. The proposed MCT algorithm is used to find a maximum number of discrete points of interest (DPOIs) using global information. At the same time, each cover set comprises only a minimum number of sensing nodes and determines the best parent node to relay sensed data using local information among neighbor while achieving even energy consumption of nodes. The control mobile sink that guided based on minimizing the dissipated energy increases the robustness and the ability of the proposed protocol to deliver packets to the destination. The simulation is done using Network Simulator-2 and the graph is plotted between time vs. packet loss, energy drained and throughput, From the graph, it is shown that packet loss decreases as time decreases. The sink is kept movable, so that packet loss is reduced. The performance of the network is improved.

REFERENCES

[1].W. B. Heinzelman, A. P. Chandrakasan, and H. Balakrishnan, “An application-specific protocol architecture for wireless microsensor networks,” IEEE Trans. Wireless Commun., vol. 1, no. 4, pp. 660–670, Oct. 2002.

[2].J.-L. Liu and C. V. Ravishankar, “LEACH-GA: Genetic algorithm-based energy- efficient adaptive clustering protocol for wireless sensor networks,” Int. J. Mach. Learn. Comput., vol. 1, no. 1, pp. 79– 85, Apr. 2011.

[3].K. G. Vijayvargiya and V. Shrivastava, “An amend implementation on LEACH protocol based on energy hierarchy,” Int. J. Current Eng. Technol., vol. 2, no. 4, pp. 427–431, Dec. 2012.

[4].J.-W. Kim, J.-S. In, K. Hur, J.-W. Kim, and D.-S. Eom, “An intelligent agent-based routing structure for mobile sinks in WSNs,” IEEE Trans. Consum. Electron., vol. 56, no. 4, pp. 2310–2316, Nov. 2010.

[5].W. Liang, J. Luo, and X. Xu, “Prolonging network lifetime via a controlled mobile sink in wireless sensor networks,” in Proc. IEEE GLOBECOM, Miami, FL, USA, Dec. 2010, pp. 1–[6].B. Nazir and H. Hasbullah, “Mobile sink based routing protocol (MSRP) for prolonging network lifetime in clustered wireless sensor network,” in Proc. ICCAIE, Kuala Lumpur, Malaysia, Dec. 2010, pp. 624–629.

[7].S. Mottaghi and M. R. Zahabi, “Optimizing LEACH clustering algorithm with mobile sink and rendezvous nodes,” AEU-Int. J. Electron. Commun., vol. 69, no. 2, pp. 507–514, Feb. 2014. [8].M. R. Jafri, N. Javaid, A. Javaid, and Z. A. Khan, “Maximizing the lifetime of multi-chain PEGASIS using sink mobility,” World Appl. Sci. J., vol. 21, no. 9, pp. 1283–1289, Mar. 2013.

[9].Q. Zhao and M. Gurusamy, “Lifetime maximization for connected target coverage in wireless sensor networks,” IEEE/ACM Trans. Netw., vol. 16, no. 6, pp. 1378–1391, Dec. 2008.

[10].I.Cardei and M. Cardei, “Energy-efficient connected-coverage in wireless sensor networks,” Int. J. Sensor Netw., vol. 3, no. 3, pp. 201–210, Jun. 2008.

[11].P. Ostovari, M. Dehghan, and J. Wu, “Connected point coverage in wireless sensor networks using robust spanning trees,” in Proc. 31st Int. Conf. Distrib. Comput. Syst. Workshops (ICDSC), Jun. 2011, pp. 287–293.

[12].N. Jaggi and A. A. Abouzeid, “Energy-efficient connected coverage in wireless sensor networks,” in Proc. 4th Asian Int. Mobile Comput. Conf. (AMOC), 2006, pp. 77–86.

[13].D. Zorbas and C. Douligeris, “Connected coverage in WSNs based on critical targets,” Comput. Netw., vol. 55, no. 6, pp. 1412–1425, Apr. 2011.

[14].B. B. Misra, A. K. Nayak, and S. C. Rai, “Achieving energy efficiency by self-adjusting sensing

range and positioning in wireless sensor networks," in Proc. World Congr. Inform. Commun. Technol. (WICT), Oct./Nov. 2012, pp. 531–536.

[15].T. Rappaport, Wireless Communications: Principles & Practice. Englewood Cliffs, NJ, USA: Prentice-Hall, 1996.

[16].W. B. Heinzelman, A. P. Chandrakasan, and H. Balakrishnan, "An application-specific protocol architecture for wireless microsensor networks," IEEE Trans. Wireless Commun., vol. 1, no. 4, pp. 660–670, Oct. 2002.