ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com

International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE)
Vol. 2, Special Issue 14, April 2016.

Novel Weighted Path Switching Data Gathering (NWPSDG) Technique in Wireless Sensor Network for Mobile Sinks

Mr. R.Lakshminarayanan M.E
Assistant Professor /CSE
S R S College of Engineering and Technology
Harur main Road, Kuppanur , Salem 636 122.

Dr. P.Rajendran Ph.D.
Professor / CSE
KIOT
Kakapalayam, Salem

Abstract:

A wireless sensor network consists of small and lightweight sensor nodes that are distributed randomly. These sensor nodes are dispersed over various geographical areas to sense data and the sink nodes are utilized for collecting data from various sensor nodes, thus data gathering is a vital problem in wireless sensor network.The principle objective of data gathering processes it to minimize the delay and to improve the lifetime of the network. Recent research has highlighted the significance of utilizing mobile sink approaches to data gathering which leads to the proposed technique of Novel Weighted Path Switching Data Gathering Techniques(NWPSDG)instead of employing conventional routing algorithm. The use of marble sink for gathering data led to enhanced the network performance in terms of overall energy consumption and life time. In case of mobile sink sensor networks, sink travels the network for collecting data. The mobile node moving closer to the nodes helps in conserving energy as the data is sent over fewer hops, thereby minimizing the number of packets transmitted and results in increasing the network lifetime.

Introduction

Wireless Sensor Networks (WSN) comprise of a huge number of sensor nodes, where every node is associated with one or more sensor(Gopinath,et.al,2014). These nodes create dataand works in a multi-hop design to transfer data from different nodes in a distinguished network. They comprise of sensing, data processing, and communicating components, which bring about the thought of sensor networks focused on collaborative effort on number of nodes. In designing the sensor network, the minimization of energy consumption is a concernedkey challenge (Madhumathy, et.al, 2013). Due to the limitation on energy and the potentially huge geographical coverage of the WSN, gathering the data produced can become an another demanding process.Data gathering is the process which makes the communication between the sensor nodes and the sink to become feasible.The objective of the data gathering approach is to

All Rights Reserved @ 2016 IJARMATE

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com

International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE)
Vol. 2, Special Issue 14, April 2016.

improve the lifetime of the wireless sensor networks and enhance the performance of the network by minimizing the packet drop ratio.The sink mobility is gaining more and more popularity in recent technology of data gathering to achieve better energy efficiency and lifetime performance. In this process, exhibit that allowing sink mobility to be a more efficient methodology as opposed to initiating in reporting data of multi-hop routes to the sink.

The Mobile sink nodes travelling to a certain distance throughout a sensing field can collect processed data from the static sensors in a single-hop or multi-hop transmission manner. In this, the energy can be effectively reduced at sensor nodes near sink nodes, and enables the sensor network to last longer. This technology provides that the energy consumption will grow exponentially with the transmission range using a relatively short transmission distance on average, as the sink nodes choose nodes located at a short distance to communicate(Mohammadreza Eslaminejad,et.al, 2012).This process is equipped to achieve mobility, in which the mobile sinks progress from one location to another location to collect data from sensor and it prevents tracking or detecting on it by adversaries during its data collection phase around the sensorfield. It aims to select a trajectory for mobility, which minimizes the total number of message communication from all static sensor nodes to the mobile sink node (including multi-hop relaying) and thereby reducing the possibility of being detected by the adversaries. The extra energy spent for theoperation and movement of the sink will not affect the overall sensor network lifetime, yet the mobile sink is considered to an external to the network factor(David Fotue, et.al, 2012).

To improve the network performance, in minimizing the delay and increasing the energy consumption, novel weighted path switching data technique has been proposed to data gathering mobile sinks.In this technique three approaches such as SRDM (Short Range Distance-Movement), MREL-R (Minimal Recursive Energy Lag-Routing) and State Switching based data gathering approaches have been employed for gathering data. In Short Range Distance-Movement data gathering is achieved by increasing the transmission range of the source. In Minimal Recursive Energy Lag-Routing clustering approach is used to segregate the node based on their energy level.In this approach a node with high energy is selected as a cluster head and other nodes are connected to it in one hop. The sensor nodes in the network exist in idle listening consumes a significant amount of energy which decreases the lifetime of the node has been proved by various methodologies done on power consumption in WSN(Shuai Gao,et.al,2011). To resolve this issue, the sensor node switches to sleep mode throughout idle times and wake it up at preferred intervals to ensure presence of any data has to become an effective approach to conserve energy in WSN. This process has been formulated by State Switching based data gathering approach, in which the data are transferred to the node by estimating the angular velocity of the node. The advantage of the above techniques is that it provides seamless communication and a packet drop ratio is less.

The remainder of the paper is as follows: in section II previous research work carried out in data gathering has been presented.

All Rights Reserved @ 2016 IJARMATE

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com

International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE)
Vol. 2, Special Issue 14, April 2016.

Section III presents the System model of the proposed approach for effectively utilizing the sink nodes for data gathering resulting in increasing the network lifetime and minimizing the delay.In Section IV Experimental setup and in the Section V Simulation results are presented and finally concludes the paper.

II. Related work:

The author (Jin Wang,et.al,2014) proposes energy efficient distance-aware routing algorithm with multiple mobile sink for WSNs, in which sink nodes will move with a certain speed along the network boundary to collect monitoring data.It focuses on the selection of mobile sink node number and the selection of parking positions, as well as their impact on the performance metrics of network lifetime.In this routing algorithm, sojourn location is chosen for parking positions determined by the nodes' distribution and transmission range. In order to ensure completeness and correctness of forwarded data packets, relay sensors are selected based on the distance factor and energy factor by using of the LEACH protocol for performing the routing process.The Simulation results show that the proposed routing algorithm has better performance than traditional routing in terms of energy consumption.

In the paper(David Forte,et.al,2012) utilized the concept of Energy Conserving Routing Protocol (ECRP), is implemented in MiniSinks (MS) based on route diversity, and sensors in order to optimize the transmission cost of the forwarding scheme.The set of multiple routing paths between MS and sensors is generated to distribute the exhaustive traffic overthe network.The results obtained for a single static sink and mobile sink,shows that this approach achieves better performances such as a packet delivery ratio,throughput, end-to-end delay, network lifetime, residual energy, energy and routing diversityit is not sufficient to guarantee the collection of data from all sensors.

In(Suchita, et.al,2013) dissected the work in sensor network consisting of every node having three subsystems, first sensor subsystem which sense the environment, second processing subsystem which perform local computation on sensed data and third communication subsystem which is responsible for exchanging the messages. In a wireless sensor network, the sensor nodes are distributed in the various geographical areas for sensing the dataand the sink node is used to collect data from different nodes, therefore data collection is an important issue in wireless sensor network.This paper gives the comparative study of different sensor data collection method,sink and mobile sink node data collection method, then it decides which technique is efficient for the data collected from the sensor nodes.It results that the data collection based on the mobile sink node is better than the data collection by using the static sink node.

The author(Po-Liang Lin, et.al, 2012) proposed the work ofAllotment Mechanism which allows the nodes with different data sampling rates to share their memories and extend the overflow deadline in preventing the hotspot problem. The effectiveness of the proposed approach is verified using the GloMoSim network simulator. This paper considers the two algorithms for the deadline constraints, namely the Dominating-Based Minimum Weighted Sum First (DMWSF) algorithmand the Dominating-Based Traveling Salesman

All Rights Reserved @ 2016 IJARMATE

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com

International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE)
Vol. 2, Special Issue 14, April 2016.

Approximation (DTSP) algorithm.The objective is to minimize the number of missed deadlines for a given data sampling rate, or the dual problem, to maximize the data sampling rates without any missed deadlines. The simulated results from this approach incurs fewer buffer overflows than other data-gathering schemes. Moreover, the simulation results of value test suggest that 0.4–0.5 has the least buffer overflow problem, which means that both buffer overflow time and interdistance need to be considered when planning a traverse path for an MS and provides the effectiveness of our proposed approach under unreliable communications conditions.

(Ms.Rubia, et.al, 2014) proposed the work of data gathering schemes for large networks such as Single Hop Data Gathering problem (SHDGP) and mobile data gathering, which is used to increase the lifetime of the network. Single Hop Data Gathering Problem is used to achieve the uniform energy consumption. The mobile data gathering algorithm is used to find the minimal set of points in the sensor network, which serves as data gathering points for mobile networks.After the so many decades of research, there are some unresolved problems like non uniform energy consumption, increased latency, which needs to be resolved.A mobile data collector is introduced, like mobile base station and the proposed scheme improves the scalability. It also solves the intrinsic problems for large homogenous networks. The above scheme is suitable only for the partially connected applications. In large scale applications, there are strict time/distance constraints, yet thelimited bandwidth results in congestion that affects the normal data exchange.

In(Bhat Geetalaxmi Jayram, et.al, 2013) intended the work of data gathering techniques are analyzed in terms of energy conservation, reliability, network lifetime, cost, data latency. The survey is exhibited by dividing the data gathering techniques as static and mobile based on the mobility of the nodes. Hence, most of the data-gathering schemes aim to prolong the lifetime of WSNs by saving power consumption and optimized data transmission.

(Hyung seok kim, et.al, 2005)propose a dynamic Delay-constrained minimum-Energy Dissemination (DEED) plan. A dissemination tree (d-tree) is redesigned in a dispersed manner without recovering the tree starting from scratch, such that the energy consumption of the tree is minimized while fulfilling end-to-end delay schemes.(Ramya, et.al, 2013) propose a technique called Approximate Data Collection, which divides the sensor network into clusters and represent data association on each cluster head. It performs data collection approximate on the sink node according to model parameters uploaded by cluster heads. It can formulate the problem of selecting the minimum subset of sensor nodesand it reduces the amount of message transmission when compared to existing techniques.

III System Model

A. Assumptions:

The following are the reasonable assumption of the proposed network model

- Sensor nodes arefixed, energy requirement and anticipated that will run for quite a while. They find themselves able to wirelessly communicate with neighbors in a short range.

All Rights Reserved @ 2016 IJARMATE

- Instead of developing multi-hop routes to the sink to report data, the remote corresponding capacity utilized as a mobile sink which is prepared to accomplish mobility to enrich with the data collection.
- The mobile sink has an estimation of its current mobility, such as velocity, direction and position, which has much higher communication capability than sensor nodes.
- To decrease the energy consumption and data transmission paths in WSN, the mobile sinks trail from one location to another location using path switching techniques to collect data from sensor nodes increases the lifetime of the node are proved by various studies done on power consumption in WSN.

B. Network scheme:

The WSN has seen a tremendous application in the various aspects in which the nodes are interfaced with the different sensors for monitoring sensory data to special devices (sink) through multi- hop or single-hop communication.To attain increased network lifetime, sensor nodes must enhance their activities in an energy-efficient way so that the rare energy stores are utilized productively. The routing protocols related to the communication module, provides an intelligent utilization of the scarce energy resources.The mobile sink based WSN network architecture differs from the static WSN, in which the sink keeps on moving around/inside the sensor field for proficient data collection(Karthikeyan,et.al,2012).To enhance network lifetime and data conveyance, asolution is proposed that is based on a network model.

This modelis framed by all the sensor nodes, while mobile sinks being acting as data gatherers and a static base-station for data collection (Shuai Gao, et.al, 2011).The sink versatility is received and various mobile sinks approach the sensor nodes in distinctive networkcoverage subsequently structuring clusters around themselves. Consequently, mobile sinks for single-hop sensor nodes, collects the data from them and sends to the base-station which results in attaining communication between them. Moreover, for guaranteed data gathering in a multi-hop manner, the proposed scheme focuses on sinks' velocity, thereby ensuring long network coverage time between sensor nodes and mobile sinks. Using this network scheme shown in Fig 1,the traditional routing is optimized such that the next hop node in the network coverage is selected on the basis of its relative distance and direction to the sink by using the distance and state switching based data gathering(Shuai Gao,et.al,2011). The residual energy leveland enabling the communication between the sensor nodes can be achieved by residual energy level based data gathering technique.These data gathering techniques achieve improved network lifetime and high packet delivery ratios by employing multiple mobile sinks the reduced results in increased data delivery and minimization of delay between the data packets.Here, for the given network of N nodes data collected d_{ij} in the sink is maximum. Thus the d_{ij} is data sent by node n_i and n_j, s is the mobile sink then the total data(d_{tot}) collected by the sink in time t with in the cluster is given as:

$$d_{tot} = \sum_{i=0}^{N} + s_i^n + d_{ij}(t)$$

(1)

All Rights Reserved @ 2016 IJARMATE

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com

International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE)
Vol. 2, Special Issue 14, April 2016.

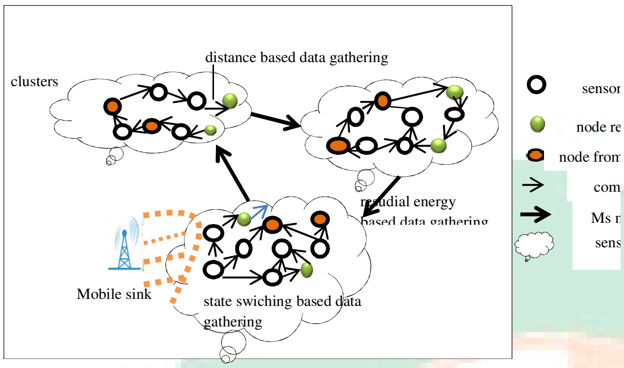

Fig 1: Network scheme

C. Novel Weighted Path Switching Data Gathering Techniques(NWPSDG):

The data gathering process can be achieved by the weighted path switching techniques where the sink follows a constrained path,such as a straight line, peripheryor visits only a selected subset of nodes in the sensor field for data collection and it is given by

$$\sum_{j\in m_{lk}} d_{ij}^{l_k,m} = d_{tot} + \sum_{j\in m_{lk}} d_{ij}^{l_k,m}, \forall_{i\in m_{lk}} \quad (2)$$

Where m_{lk} represent the set of sensor nodes whose minimum transmission hops to m^{th} sink node do not exceed k, when m^{th} sink node stays at location l_k, $d_{ij}^{l_k,m}$ represents the data transmission from node i to j when the data of node i collect to m^{th} sink node and the m^{th} sink node stays at location l_k. The data transmission in NWPSDG consists of 3 levels for the data gathering techniques are deployed in the scenario are as follows

- State switching based data gathering.
- Distance based data gathering.
- Residual energy based data gathering.

State switching based data gathering.

In the WSN, due to the movement of the sensornodes and multi-hop routing, a state switching is introduced for the route discovery in wireless sensor networks (WSN). The node in the network frequently switches them into a sleep state and occasionally wake-up state to check the process of sending the data to the sink, to perk up the network lifetime in WSN. In order to minimize the energy consumption, the state switching based data gathering for sleep/wake-up process in WSN possess four states as: Active, Passive, Sleep and Dead state and it is shown in fig 2. In the WSN, for a node to switch its state for the second node, the communicating node must be within its coverage region.Reactive Mobile State switching algorithm has been proposed for this state switching data gathering and nodes within the network communicate with one another through radio links. This method starts from the mobile sinks in the sensor network enter the field and terminates when the nodes possess the dead state. During data gathering is there is no route for establishing communication between the nodes,the reactive routing protocol will arrange to establish such a route as it is explored as an routes on-demand.

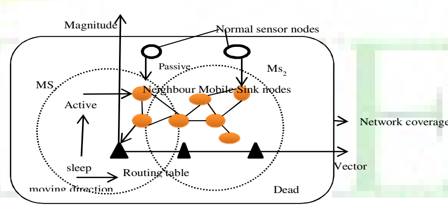

Fig 2: State switching based data gathering

All Rights Reserved @ 2016 IJARMATE

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com

International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE)
Vol. 2, Special Issue 14, April 2016.

RMSS (Reactive Mobile State switching algorithm):

Step 1:For each node, compute its angular velocity with respect to its vector and magnitude and observe the ceasing node's mobility energy.

Step 2:When a node requests communication, enables RMSS (switch from sleep to active state only) where it holds the reply as long as the node appears in the communication range.

Step 3:Once the node is under coverage, send a reply (from active state) and update the active RT. When the node leaves the broadcast range, invokes RMSS and move the state from active to sleep.

Step 4:Before moving to sleep state, pass the RT(Routing table) information to the next possible node that is located in the direction of the moving node.Repeat the process through various stationary or mobile sinks and nodes to service the mobile node.when the communication exists between different mobile sink nodes then the state is said to be passive.

Step 5:The number of communicating nodes may change with respect to the angular velocity of the mobile node; lesser the mobility, least is the number of crossing nodes. When the nodes is out of the network coverage, then it is in the dead state.

Distance based data gathering:

The mobile sink nodes in the sensor network after possessing the states switching it is moved to the distance based data gathering where the short range distance movement algorithm has been usedto calculate the node's initial broadcast range.Depending on the broadcasting range, the distance exists between the source node and destination node can be calculated with respect to the power loss(p^2) and the hopping path(p^x).To transmit the data packets(d_p) between the sensor nodes(m_{lk}) within the broadcast range over the distance (d),then the transmission(TX) can be calculated as,

$$B_{TX}(d_p, d) = \begin{cases} d_p E_{dis} + d_p \in_{ps} p^2 & , p < p_0 \\ d_p E_{dis} + d_p \in_{hp} p^x + TX & , p \geq p_0 \end{cases} \qquad (3)$$

Where E_{dis} represents the energy dissipation occurs through the reactive mobile nodes,$\in_{ps}$ and $\in_{hp}$ represents the power loss and hopping path respectively, and to receive the same data packets at theB_{RX}, the same amount of energy dissipation E_{dis} is required as B_{RX}= $d_p E_{dis}$.

SRDM (short range distance movement algorithm)

Step 1:Connect to all the nodes in one hop that are located within the broadcast range.Increase the TX of the source such that its broadcast range is increased.

Step 2:Connect to any new nodes (other than the nodes that are already covered).If any node is in the path of the previously connected node, then switch the path to the longest connected node (one-hop), erasing the previous path.

Step 3:Repeat the same until the mobile node is within the network range while the source node's range is limited to TX power.

Step 4:When the maximum broadcast range is attained and the destination is in out-of-range, then form a cluster from the node that is located on the edge of the source's broadcast range and increase the number of nodes at the edges for every increase in the number of mobile nodes.

Residual energy based data gathering:

The sensor consumes energy in monitoring the environment while transmitting and receiving the data packets in the network.

All Rights Reserved @ 2016 IJARMATE

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com

International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE)
Vol. 2, Special Issue 14, April 2016.

The sensor data gathered from all the mobile sensor sink nodes is on demand and operate on energy limited.In this data gathering,Minimal Recursive Energy Lag-Routing algorithm is used to minimize the energy consumption and increase the lifetime of the network.The resudial energy from source to destination node based on the distance travelled requires a threshold T_v can be defined as

$$T_v = \sqrt{\epsilon_{ps}/\epsilon_{hp}} \quad (4)$$

then the$p_0^2$for the threshold value T_v is given by

$$p_0^2 = \epsilon_{hp}\ p^x \quad (5)$$

MREL-R (Minimal Recursive Energy Lag-Routing algorithm)

Step 1: Segregate the nodes with lesser energy after the transfer is completed and the selected nodes must not fall behind its threshold value.

Step 2: Group these nodes into a single cluster such that one high energy efficient node is chosen as the head and all other nodes (Low energy nodes) are connected to it in one-hop.

Step 3: Use the head to route the mobile nodes for data and for the intermediates (Low energy nodes) to only send and receive data. No routing or broadcast must be enabled for the intermediates.

Step 4: Ensure the link between two low energy nodes is above the transmission threshold level.If the link falls below the threshold level, then disconnect the node from the group and add a new low energy efficient node to activate the link.The process can sustain until all nodes in the group are completely nullified in terms of energy.

In order to improve energy efficiency a cluster formation communication manner is used in the proposed routing algorithm. If the distance d of sensor nodes (m_{lk}) is larger than threshold T_0, it needs to find an head to route the relay node to forward its data. To achieve minmum energy , links between the nodes are chosen based on the relative distance and the residual energy. In order to ensure a better distance and enough minimum energy, distance factor d_f and resudial energy factor $E_f$metrics are used respectively aims in increasing the lifetime of the network , where $E(j)$ is the residual energy of sensor nodes and$l_k$is the current location of mobile sink nodes,r_j is the intermediate node. Distance factor d_f is related to the sum of the distance between source node s_i, and destination node d_j is given by

$$d_f = \frac{d(s_i,d_j)\ \ ^2 + d(r_j,l_k)^2}{\max\left(d(s_i,d_j)\ \ ^2 + d(r_j,l_k)^2\right)} \quad (6)$$

The resudial energy factor is given by

$$E_f = \frac{\max(T_V) - d_f}{\max\left(B_{TX}(d_p,d) + B_{RX}(d_p,d)\right)} \quad (7)$$

To activate the link between the energy sensor nodes, the resudial energy factor become an important for establishing the broadcasting with in the network range resulting in minimizing the number of packets to be transmitted thereby increase the lifetime of the network .

IV Experimental Setup

A. Simulation Evironment and parameters:

All Rights Reserved @ 2016 IJARMATE

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com

International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE)
Vol. 2, Special Issue 14, April 2016.

The Network simulator is used to evaluate the performance of the mobile sink and the proposed algorithm. In a 100 sensor node network with the pay field size of 1000 × 1500 m^2 sensor network, gets randomly distributed and they are static. The initial energy of each sensor node is 100 Joules, and each sensor generates the data packet size of 100 bytes.To provide a network connectivity, the transmission range between the sensor node is 70 to 90 m. Experimental parameters, such as average residual energy, packet delivery ratio, and throughput are used to measure the performance of the proposed data gathering techniques in minimizing the energy consumption and increasing the network lifetime by reducing the packets transmitted.

parameters	Value
E_{dis}	200nJ/bit
	200pJ/bit/m^2
	0.0015pJ/bit/m^4
Threshold	70m
Data packet size	100 bytes

B. Performance Metrics:

Resudial energy:It is the average energy consumed for the transmission of the data and it is given by

(8)

where t be the time required for the mobile sink to visit all the nodes and n be the number of sensors in the network, d_{ij} is the data collected from the sensor nodes. M_{ts} is the maximum time that the sink is stationary, $d_{tot}$is the total message of data collected by the sink with respect to maximum time , E_f is themaximum amount of energy utilized factor for data transmission, and is the average data generation rate.

Packet transmission: It is defined as the number of packets transmitted over the sink nodesby the number of packets gets delayedand it is given by

(9)

V Simulation Results:

A. Minimizing the Energy Consumption:

The initial energy of every node is set as 100J. The average residual energy of nodes in an existing (Maximum amount shortest path) and proposed (Novel Weighted Path Switching data gathering) technique is shown in Fig 3. The energy consumed betweenthe sensor nodes islow in the NWPSDG compared to the MASP. This is because by using the weighted path switching technique, the energy dissipation in sensors is decreased, thereby the energy consumption is minimized to a greater extent.

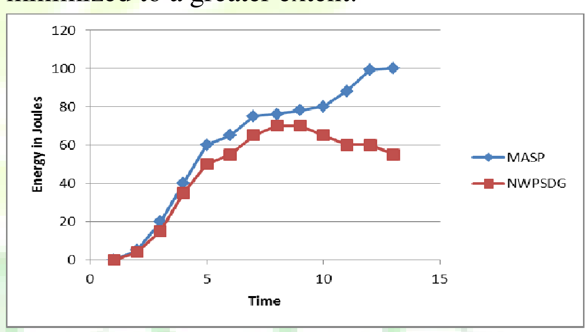

Fig 3: Minimizing the Energy Consumption

B. Increasing the lifetime of the network by reducing the number of packet transmission:

The packet transmission is minimized in the NWPSDG compared to the MASP technique. In the MASP packet transmission is high because of the broadcasting over the

All Rights Reserved @ 2016 IJARMATE

network for network initialization and route set-up and it is shown in Fig 4. The Minimization of the packets transmission results in increasing the lifetime of the network.Thus the NWPSDG technique results in minimizing the energy consumption and extending the network lifetime.

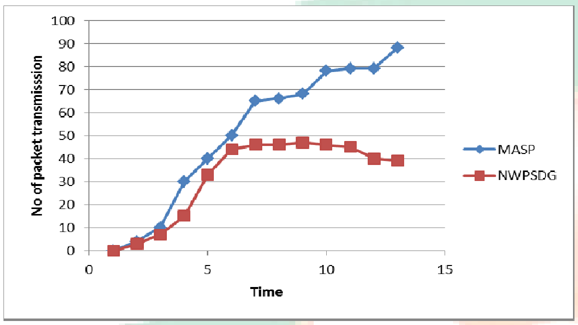

Fig 4: Reducing of packet transmission to increase the lifetime of the network

Conclusion

The research of this paper is focused to design an efficient data collection scheme for the MobileSink based DataGathering technique for WSN. ThisNovelweighted path switching datatechnique(NWPSDG) is considered to maximize the amount of data collected by the mobile sinks and minimize the energy consumption. Initially, state switching data gathering method is used to determinethe startposition of the sink. Then a distance and Resudial energy based data gathering method are usedto determine the data transmission path within the network coverage. To reduce the energy consumption and increasing the lifetime of the network MREL-R,SRDM, RMSS algorithm has been proposed. By simulation results, illustrates that the NWPSDG technique increases energy efficiency and network lifetime by reducing the packet transmission compared to the MASP technique.

References:

Bhat Geetalaxmi Jayram, Ashoka D. V," Merits and Demerits of Existing Energy Efficient Data Gathering Techniques for Wireless Sensor Networks, International Journal of Computer Applications (0975 – 8887),Volume 66– No.9, March 2013.

Gopinath R, Dr. Chandrasekar C, Gowthamarayathirumal P,"Improving Energy Efficiency for Wireless Sensor Network using Fuzzy Logic System,"International Journal of Inventions in Computer Science and Engineering (IJICSE), P-ISSN: 2348-3539,Vol 1 Issue 1 Feb 2014.

Hyung seok kim, Tarek f. Abdelzaher, Wook Hyun Kwon," Dynamic Delay-Constrained Minimum-Energy Dissemination in Wireless Sensor Networks", ACM Transactions on Embedded Computing Systems, Vol. 4, No. 3,Pages 679–706 , August 2005.

Jin Wang, Bin Li , Feng Xia, Chang-Seob Kim and Jeong- Uk Kim," An Energy Efficient Distance-Aware Routing Algorithm with Multiple Mobile Sinks for Wireless Sensor Networks", journals-sensors, ISSN 1424-8220, 18 August 2014.

Karthikeyan S, and Jayashri S," Proficient Data Gathering in Wireless Sensor Network using Mobile Agent", International Conference on Computational Techniques and Mobile Computing (ICCTMC'2012), December 14-15, 2012.

Madhumathy P,Sivakumar, D,"Energy-Efficient Data Collection In Wireless Sensor Networks Using Mobile Sink",Proceedings of ICEECSME, Hyderabad, ISBN: 978-93-82702-40-5, 24th November 2013.

Mohammadreza Eslaminejad, Shukor Abd Razak , Abdul Samad Haji Ismail,"An Energy-Efficient Dual-Sink Algorithm with

All Rights Reserved @ 2016 IJARMATE

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com

International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE)
Vol. 2, Special Issue 14, April 2016.

Role Switching Mechanismfor Event-Driven Wireless Sensor Networks",KSII Transactions on Internet And Information Systems Vol. 6, NO. 10, October 2012.

Po-Liang Lin, Ren-song ko,"An Efficient Data-Gathering Scheme for Heterogeneous Sensor Networks via Mobile Sinks", International Journal of Distributed Sensor Networks Volume (2012), Article ID 296296, 14 pages, 2012.

Rubia R, SivanArulSelvan M," A Survey on Mobile Data Gathering in Wireless Sensor Networks - Bounded Relay ", International Journal of Engineering Trends and Technology (IJETT), Volume 7 Number 5, Jan 2014.

Ramya. D, Ramar C.K," A Robust Scheme for Energy Aware Data Collection for Wireless Sensor Networks", International Journal of Advanced Research in Computer Science & Technology IJARCST, Vol. 2 Issue Special 1 Jan-March 2014.

Shuai Gao, Hongke Zhang, and Sajal K. Das,"Efficient Data Collection in Wireless Sensor Networks with Path-Constrained Mobile Sinks",IEEE Transactions On Mobile Computing, Vol. 10, No. 5, 2011.

All Rights Reserved @ 2016 IJARMATE