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***Research paper***

# A Protocol for The Effective Utilization of Energy in Wireless Sensor Network

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**Abstract**

Energy utilization is an important aspect in any Wireless Sensor Network .The data transmission from various components connected over real-time networks consumes more energy in Wireless Sensor Network. Mainly the task of any network engineer lies in performing an energy efficient, so to reserve the nonrenewable energy supply to sensor nodes. The research convey out effective utilization of energy in wireless sensor networks. It is important to comprise long-term and low-cost monitoring in different WSN application. The network algorithms separated mainly in two parts, first to generate multiple paths and second to switch paths from generated list of paths .Which is implemented as multi-hop-communication so that the battery life of the sensor node may live for long term and low cost of monitoring, which achieve the high lifetime of WSN.

***Keywords***: *AOD; CDS; MRC-PL; STG; VBS;WSN.*

## 1. Introduction

Late innovative development of sensor nodes need aggregative practical approached for the organization over an area to gather the environmental data which will process and send to sink in WSN .There are various application where WSN is used such as climate monitoring, catastrophe management, stock tracking, smart spaces, precision agriculture, habitat monitoring, focus tracking, reconnaissance ,etc. In a nonstop traffic in the multi-hop remote sensor network each and every sensor acts information originator which gather the information at intervals and send to the sink. At the same time, sensor nodes will switch information to the neighbor's node. In significant number of applications, that the sensor nodes are worked on battery-powered, as well as without any other energy resources and recharging facility. Most of the sensor nodes energy will be utilized during the methodology of information exchange. When those node's energy of battery is exhausted, then that node will fail to work and can't communicate to the neighbor nodes. It will leads to reduce the life time of WSN. Subsequently energy efficiency may be an essential issue to decrease aggregate amounts of packet transmissions in the system. The system load, i.e. that downright number for packets on make conveyed of the sink sensor will be more level limited by the coverage constraint. Provided for that bound, it may be self-evident that, each bundle must further strengthening take after those way for least jump to decrease the downright amount from claiming packet transmissions. But, though nodes continuously forward their packets of the sink through base jump paths, nodes closer of the sink will convey heavier movement Furthermore will drain their energy faster, making vitality gaps around the sink. Hence, in multi-hop WSN, solve the challenging issue for the utilization of node's energy uniformly. In this way the system lifetime will be improved. In this proposed work methodologies will gather the information and balance the load of each node which will upgrade the life time of WSN. But working on shortest a path which is not efficient with respect to point of energy usage. Directing packets through more distances alternately more jumps (selecting the different paths) which will be productive for energy perspective. Here, sensor detract choice will forward packets through possible alternate multi-hop technique which will ensure the equal energy equalization. Using productive multiple paths routing protocol (path creation) consumption of WSN will reduces energy and which will enhanced energy is achieved.

## 2. Literature survey

Bandyopadhyay., et al [1]An multi-node system of remote sensors can be used to assemble spatio-temporal samples for physical phenomena and send data to process center. The author determines the spatio-temporal sample rates are collected in network with certain condition for minimizing energy. Author uses collision-free protocol for gathering sensor information would be used to get explanatory effects that get a picture overall of network "around sensor density, energy usage, transient inspecting rates and spatial testing rates for WSN. At more level author looking into lower delay incurred by gathering the data is calculated by $0(k^2n)$ using cluster network. Drawbacks are at sensors transmit at those same control level and consequently have the same transmission rate r. Information traded between two conveying sensors not inside every others' transmission extend is sent. Eventually other sensors every last bit packets transmitted have those same length (in bits) What's more every sensor might just transmit person bundle at once. No information aggregation/compression happens in the sensors sending information starting with other sensors.

Alippi., et al [2] Author describes that energy conservation level is more utilized in communication processes rather that acquiring the nodes and processing in Wireless Sensor Network .But practical application assumption whereas the sensor consume more energy consumption than the radio. So Author designed the algorithm called adaptive sampling algorithm deals mainly with estimation on the online sampling frequencies sensors. The major components of this technique are to manage the sensors energy, this technique will assume policies to make efficient utilization of sensors. The technique is performing on very large set of data and also to get more accuracy level. Study of snow monitoring technique achieved up to 79% samples and these many numbers of samples is reduced in the fixed-rate of traditional approach.

Liang., et al [3] Author explained about the performance of Opportunistic Sensing(OS) on Heterogeneous Sensor Networks (HSN).Nowadays the wireless sensor networks is use to receive the data alternatively, from other nodes , so that here the HSN is monitoring for information integration. The OS will automatically sense the nodes for information processing based on the criteria for signal and after getting the certain signal it will further processes the operational scenario. And work have been designed the algorithm on OS so that it is more efficient scheme of information integration. The main methodology is to correlate the modalities in HSN and based on the lees number of code words. Here the modalities are independently assumed.

Zhao., et al [4] Authors describe about the Wireless Sensor Network (WNS's) applications to involves, low-term ,low-Cost and Actuating. It's observe that it required a node to achieve Quality of Services, lifetime and fault tolerance. The redundant nodes not be necessary for multiple paths communication since less traffic, load and the stable sensors links. They have deployed with the technique called Novel Sleeping Technique .This VBS algorithm designed to extends the lifetime of network by turn off the rest sensor nodes. By this technique it saves the energy of sensor nodes. And this VBS is also called as multiple overlapped backbones.

Shivani Attri[5] The author uses two routing protocol OLSR a proactive routing protocol and reactive routing protocol in proposed work. OPNET 16.0 for is for simulation of performance evaluations like end-to-end delay, network load, and throughput and energy consumption. The results are taken with different environment condition in the networking (By varying number of nodes). The comparison of protocol of DSR with OLSR here results high average throughput, paths for routing are easily predicted as they are characters of proactive routing protocols. Where DRS is Reactive protocol results in very less throughputs and high Energy use.

Alagumuthukrishna., et al [6] The author described about New Backbone Scheduling (NBS) algorithm which will apply, even the sleep schedule algorithm randomly for certain intervals of time i.e. NBS schedules multiple Redundant backbones for random time for that the net energy utilization is evenly distributed among the wireless sensor nodes. Because of this, the energy of the all wireless sensor nodes fully utilized results in increases the lifetime of the network. The rotation of many backbones does surely the energy that consumes because of all sensor nodes are balanced, which completely utilizes the energy and live longer when compared to the existing techniques. The simulation result achieves higher packet delivery ratio and low end to end delay and thus increases the network lifetime. The lifetime of a schedule is the lifetime of the network. Two centralized approximation algorithms with different complexities and performances are implemented. And also approximation algorithm call RLR is added, and so on efficient implementation of NBS is designed .Drawback of this work in the formula which is used for Maximum Lifetime Scheduling problem that fails for infinite change in WSN. CDS which forms the backbone, however, the single backbone does not prolong the network lifetime.

Jagtap., et al [7]The creators say that as much transmission from claiming information must devour least amount of vitality(energy) with expanding lifetime for WSN .Least utilization of battery increments lifetime from claiming to organize. Examining the separate methodologies for expanding the aggregation of WSN. They need to recommend a transmission-scheduling plan that dispenses with collisions totally. That transmission-scheduling plan takes preference about spatial reuse in the remote networking. Hence, this plan could be utilized the point when those organizations need only be deployed and the groups would constantly be shaped. Those sensors could impart their choices to join a specific bunch of its group leader as stated by this calendar .Without wasting whatever energy for retransmitted. Once those group minds need information about every last one of sensors for its cluster, they have inferred an easier certain on the delay incurred to gathering particular case bundle from claiming specimens toward a provided for spatial inspecting rate to multi-hop sensor networks. They found energy utilization camwood make traded-off with the delay incurred done gathering packets from claiming tests at a provided for a spatial rate. These effects empower a organize architect to focus those best tradeoff between sensor density, energy consumption.

Zhang., et al [8] Author's say that briefly regarding scheduling compared between CDS and R-CDS (R-hop Connected Dominating Set using maximum) and implemented new protocol R-hop Connected Partition Lifetime (MRC-PL) to achieve the high lifetime. The R-CDS may be a standout amongst that practically vital test for energy utilization on remote sensor system (WNS's). Work related to an R-hop uses Obligation cycle and Duty Cycle (DC). As CDS uses Duty Cycle those objectives by claiming to prolong the system lifetime. A novel planning is suggested to build various disjoint R-CDS to achieve the lifetime of network. Drawbacks hubs in the system varies from 10 with 100 nodes which is small radiuses network (only for small network).

Malini., et al [9] In this work author presents a novel sleep-scheduling technique called Virtual Backbone Scheduling(VBS). The VBS will generate different Multiple paths are working alternatively to increase the network lifespan of Network. Only forwarded by backbone sensor nodes, and the rest of the sensor nodes turn off their radios to save energy. The VSG, Iterative Local Replacement (ILR) and Schedule Transition Graph (STG) are designed based on the approximation algorithm. Ad-hoc On-Demand Vector (AODV) protocol is used here to find an efficient routing path. To get productive outputs to increase the life of wireless sensor Network.

Ghabri., et al [10] In this work author described regarding new variants about K-means and Travelling salesperson problem built portability protocol, In view of K-means grouping and the estimated result to voyaging salesperson problem by utilizing the straightforward neighborhood look algorithm "2-Opt", have been recommended so as should get constant results once the issue is exasperated. In this work, the point to utilize another system by actualizing calculations utilized to probabilistic combinatorial streamlining issues resolution, for example, accurate techniques. Another system that navigates the portable sink on experience the group focuses as stated by the optimized way. By the usage of a correct determination for this issue utilizing the "branch and bound" system intriguing.

Deepti Sharma [11] The author describes the overall performance evaluation of OLSR and DSR routing protocols. To get performs investigation in wireless sensor network and how these selected algorithms by author will decide which better performed in evaluation using OPNET 16.0 .Considering with the results of throughput, end- to-end delay network load. The results shows while comparing the OLSR and DSR the average throughput, end-to-end delay and load in network. In proposed system OLSR gives better performance and efficient results when compared to DSR routing protocol. Considering in the network with static node environment for different scenarios.

## 3. Proposed methodology

The experimental analysis starts with single sink in Wireless Sensor Network. The proposed algorithm is designed for the sink with n number of sensor nodes placed randomly. In this algorithm sink will be initialized with its neighbor nodes which comes under the radius of the sink. Similarly neighbor nodes will initialized to their neighbor nodes till cover all the nodes that means all nodes will have information of their neighbor nodes which will participate in communication.

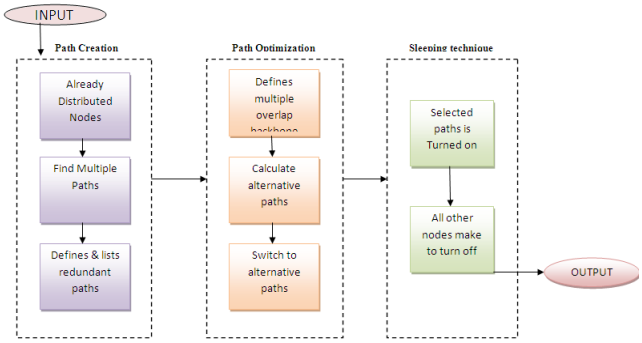


**Fig. 1:** Architecture diagram of the WSN

Above Fig.1 shows the architecture of the proposed system, which will implemented to achieve the objective. Further this work is divided into three modules path generation, path optimization and sleeping techniques as shown in figure1.

### 3.1. Path creation

To generate the paths from source to sink is the major challenge in WSN. To do this work new algorithm is proposed which is the modification of Connected Dominating Sets (CDS) and named as modified CDS (MCDS). This algorithm will give a set of possible paths from source to destination. These paths are called Backbone Network, which is nothing but set of nodes.

### 3.2. Path optimization

Once all the paths are discovered by modified CDS. Schedule Transition Graph(STG) technique is used to select the path randomly for the communication from source to sink.

### 3.3. Sleeping technique:

This technique help to TURN ON or OFF the nodes. Once the path is selected by the path optimization technique for the communication, sleeping algorithm will apply to turn off all the nodes which is not participated in the communication.
Above proposed techniques together named as Modified Virtual Backbone Scheduling (MVBS), the switching between multiple paths is based on the certain criteria like shortest path and threshold energy of the nodes. Optimal path selection of the nodes that should contain minimum amount of energy to communication within the network.

## 4. Proposed algorithm

Proposed work is implemented in the forms of algorithm. Steps are shown below.

1. while(neighbor_nodes _exists) do
2. Implement path creation to identify and select the neighbor nodes.
3. Add selected nodes to the network
4. end while
5. while( networks exists ) do
6. Use Path Optimization to generate paths from source nodes to the sink node
7. For i<=0 to count(paths) do
8. Compare energy of node to energy required to communicate.
9. If(Energy(node) <threshold_value) then
10. Remove nodefrom network
11. end if
12. if (greatest_Energy(node)) then
13. Set path as optimal
14. Put alternative paths to sleep
15. end if
16. end for
17. if(packet_to_end) then
18. Send packets through currently optimal path
19. end if
20. else wait
21. end else
22. Use Sleeping Technique to periodically wake up paths for comparison of energy of paths
23. end while

### 4.1. Path generation

1. ∀ nodes in network
2. while(!node[i] ∈ path AND
3. exists(unassigned_node[i])) do
4. Add node to create backbone
5. if (node[i]->next == sink_node) then
6. break
7. end if
8. Remove node[i] from unassigned nodes
9. End while

The Path creation algorithm is used to construct Modified virtual backbone network in WSN which will balance load and reduce overhead. Having such multiple paths generated will move packets forward directing by routing algorithms. Sleeping algorithm helps to TURN ON only the selected path nodes. Hence, it is imperative to preserve a certain degree energy which is excess as in a before proposed works of their algorithms being used in Wireless Sensor Network for communication.

### 4.2. Path optimization:

1. ∀ paths in network
2. while(greatest(path[i])) do
3. Select path
4. if (path[i]> = threshold_value) then
5. Sleep(paths, path[i])
6. end if
7. elseRemove path from list
8. break
9. end else
10. while(start_time<break_time) do
11. Wait
12. end while
13. Break
14. end while

After generating the several paths form path generation module, next to demonstrate the Maximum Life Backbone Scheduling (MLBS) issue and energy distribution. Each state contains a backbone and the corresponding energy levels. An introductory state as beginning with circular as starting point. Uni-directed backbone move edges interface one state to another. The nodes in the spine of the beginning states expend fixed amounts of energy after each move. No move is allowed after any sensor is expends it full energy.
The MLBS problem is nothing but to discover the longest path, while organizing the sensor nodes. The most extreme number of

rounds like STG can be calculated by isolating the entirety of the beginning energy of all sensors by the least energy consumed in each circular. Each Spine hub expends a fixed sum of energy. The look begins from the starting state and after a backbone move. Each state keeps the largest energy levels of each hub recorded at each step. A path terminates when related energy level gets to be zero way is terminated. When all the ways are ended the longest path can be obtained.

### 4.3. Sleeping technique:

1. ∀ paths in network.
2. while(!(path[i])) do.
3. Turn off path.
4. end while

It is a fine grained sleep-scheduling strategy in which the nodes which does not take an interest in any kind of propagation or data transmission turns off their radios. This is accomplished by creating a Spine for specific Sensor nodes that take an interest in the data transmission. The nodes which are not in the backbone are considered to be in idle state and they turn off their radios in arrange to spare the energy. The radios of the sensors consume large parcel of the energy. Hence we can minimize the energy use here by sparing the energy of sensor, while sensor which is in multiple paths perform the transmission of information and consume energy similarly. The paths which are not use for transmission are turned off without affecting the network transmission hence which uses less energy.

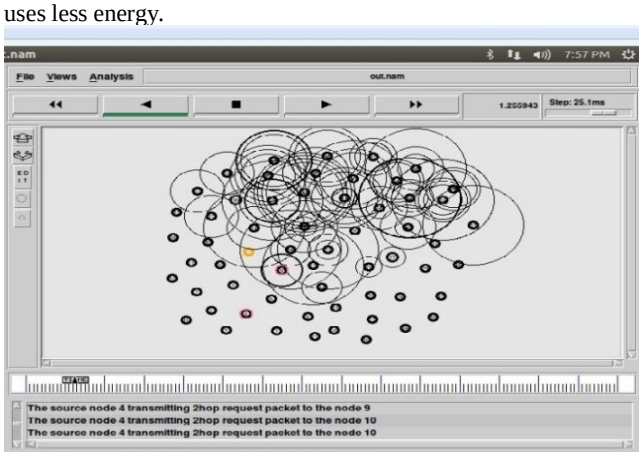


**Fig. 2:** Mobility of the nodes and list of paths.

The NS2 simulations for Wireless Sensor Nodes is shown in above figure2. The configuring of all the neighboring nodes will create multiple paths by path creation algorithm. The algorithm takes the source and destination nodes as input and senses all neighboring nodes and finds the multiple paths seeing to that energy as criteria with proactive nodes and reactive nodes in the network. Here the proposed algorithm checks the neighbors which are in the reachable radius of one hop and neighbors which broadcast from there to other nodes. That is further the algorithm considers the other than the neighbor nodes that is non neighbor nodes. According to the radius of the nodes. The vital part of the algorithm is to find the shortest path in the terms of minimum number of nodes to reach from source to destination. The color indicates the specific path is taken to for path optimized algorithm. If all the nodes have exhausted the energy level then that path is considered as failed else the path will be selected for communication and effective utilization of node's energy in the Wireless Sensor Network.

### 4.4. Optimizing the shortest path:

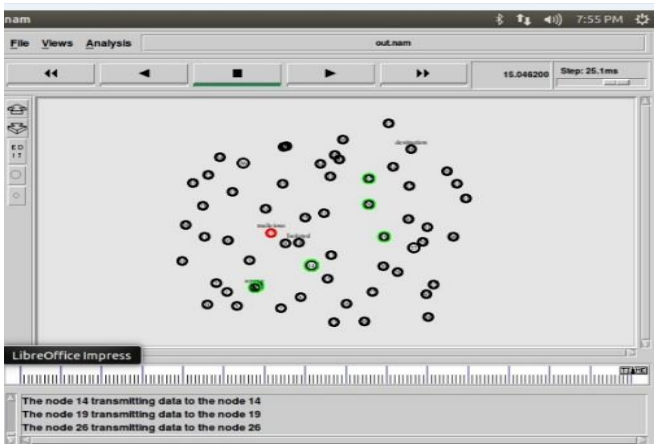


**Fig. 3:** Selected path for communication

The above fig.3 depicts the selected path in the color green for the transmission at last. The obtained nodes in the network is captured with .tcl file which is been shown in the graph in the comparison with multiple paths and multiple edges for Energy consumption. If any malicious node or energy exhausted node is identified than that node color will be changed from blue to red color.

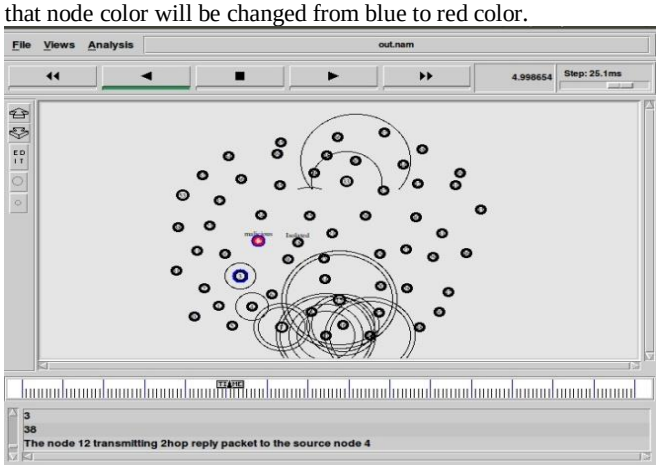


**Fig. 4:** configuring the optimal path.

The above fig.4 shows the configuration of the sensor nodes with their neighbor nodes. It recorded results the identification of the malicious node in red color that means node doesn't have energy for communication or infected node and active node in the blue color.

**Table 1:** The Experimental analysis for the multiple paths, possible edges.

| *Collection of Nodes* | *Multiple Paths* | *Possible Edges* |
|---|---|---|
| 10N | 14 | 15 |
| 20N | 18 | 38 |
| 30N | 21 | 199 |
| 40N | 26 | 329 |
| 50N | 33 | 471 |
| 60N | 45 | 503 |

The above table1 shows results of path creation, path organization which is compared the performance which has better improvement in network lifetime of WSN by generating multiple paths and edges which reduce energy of nodes.

### 4.5. Energy

Experimental results of Energy are shown below in the fig. 5, which clearly indicate that proposed system is better than existing.

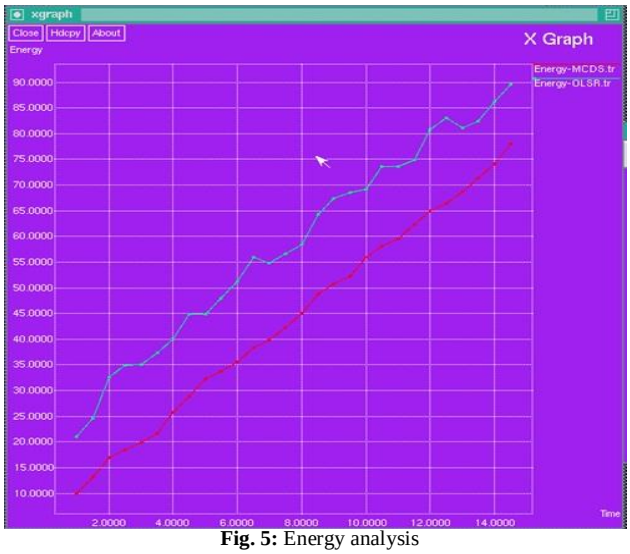


**Fig. 5:** Energy analysis

### 4.6. Throughput

Experimental results of Throughput are shown below in the figure6, which clearly indicate that proposed system having less overhead than existing.

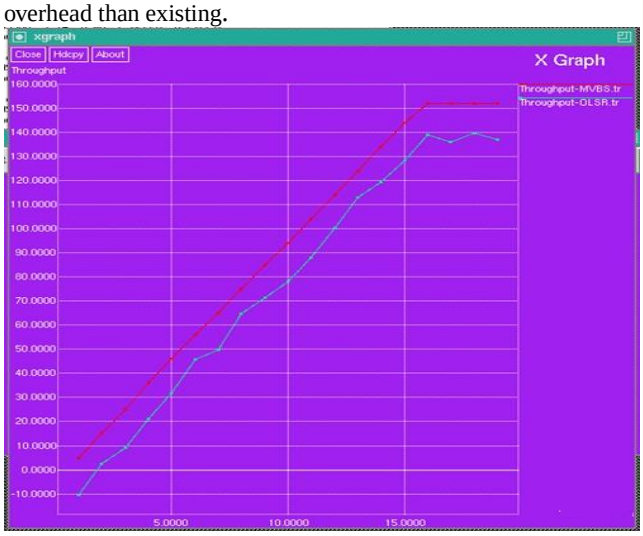


**Fig. 6:** Throughput Analysis

The experimental analysis for Throughput in the WSN is shown in graph in fig. 6.

**Table2:** The Experimental analysis for total number of Round for collection of nodes.

| *Collection of Nodes* | *VBS Rounds* | *NBS Rounds* | *MVBS Rounds* |
|---|---|---|---|
| 10N | 210 | 290 | 400 |
| 20N | 370 | 499 | 454 |
| 30N | 486 | 739 | 593 |
| 40N | 486 | 949 | 789 |
| 50N | 497 | 953 | 876 |
| 60N | 487 | 1167 | 984 |
| 70N | 420 | 1409 | 1071 |
| 80N | 440 | 1502 | 1198 |
| 90N | 449 | 1690 | 1312 |
| 100N | 600 | 1799 | 1420 |

Table 2 is the representation of results found when the experiment analyzed for proposed WSN. In this work communication will not start directly. And it will follow all three algorithms.

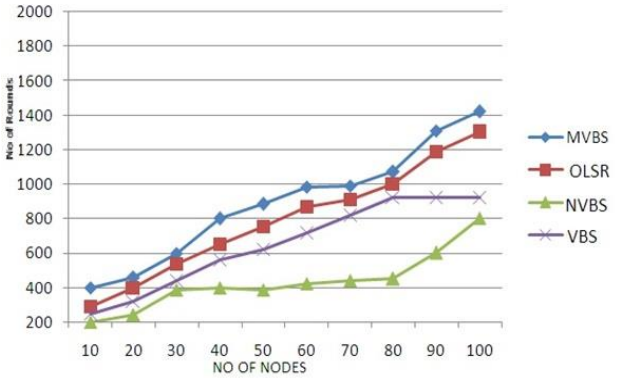


**Fig. 7:** Performance evaluation graph.

The evaluation performance from the fig.7 shows that proposed work MVBS creates more path than existing. The expected results show achieved network life time of WSN with different algorithms. In the graph is proposed algorithm MVBS represents values with more rounds to get multiple paths in each round.

### 4.7. Energy

Experimental results of Energy is shown in the figure 8, which clearly indicate that proposed WSN consumes less energy therefore it will work for high lifetime.

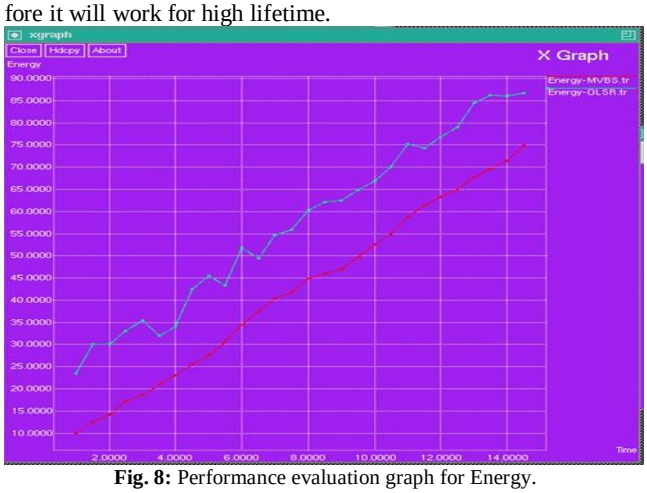


**Fig. 8:** Performance evaluation graph for Energy.

## 5. Conclusion

The proposed system has three phases that improves the lifetime of WSN .Such as path creation,optization and sleeping technique with the effective utilization of energy of each and every redundant nodes in network.It is the implementation of multi-hop,multi-path systems ,in this all nodes will effectively paricipated in the communication which enhance the life time ,reduces the overhed,and increases the troughput in the WSN.

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