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Multiple Sink Placement Strategies by Finding Maximum Cluster of Nodes in Wireless Sensor Networks

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ABSTRACT

Wireless sensor nodes (WSN) are used in networks for sensing and transmitting the information to the control center. In these networks there is a threat of sink failures by continuous power consumption by the sensor nodes .So the efficiency of the sensor nodes is to be taken in account. The fundamental goal of the proposition is to grow new methodologies for giving energy productivity, longer lifetime, fast information conveyance and adaptation to internal failure for WSNs which are primarily utilized for time basic applications like disaster management. This proposal studies the exhibitions of some current calculations and proposes novel calculations for satisfying its target. An answer for the above mentioned issues is proposed by dividing the WSN into little sub-parts and afterward conveying a sink in every parcel in such a way, to the point that it gives longer lifetime and energy proficiency. Sink failure is taken care of here by incorporating nodes in the failed sink's segment into some other allotment. . On the basis of increased lifetime of the sensor nodes we propose two different strategies namely as R-GSP and R-GSP-C. Also the comparison is done with the already available technologies in order to compare the efficiency and the performance of our proposed work.

Keywords: - *WSN*, GSP, R-GSP, R-GSP-C.

I. INTRODUCTION

A Wireless Sensor Network comprises of vast number of low power low cost energy constrained sensors responsible for monitoring and reporting a physical sensation to the sink node where the end user/observer can get to the data.

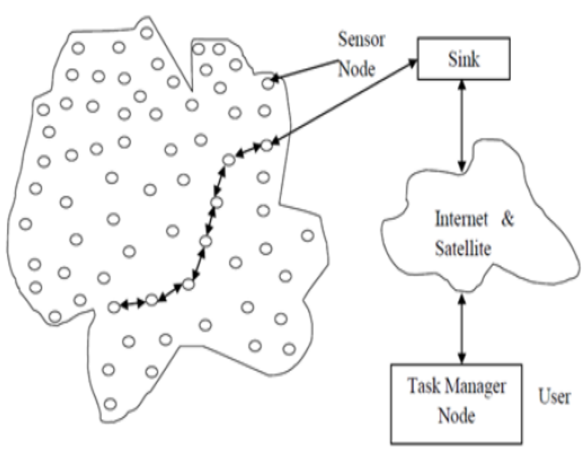


Figure 1 Wireless Sensor Network

WSN requires the association of elements or members that perform different tasks.

The main constrain in the wireless sensor networks is the continuous transmission of the data if the sink is not placed in an economical manner. So this continuous transmission of data leads to the draining of the energy which in turn leaves the nodes dead. So main purpose of our work is to place the sinks in such a ways so that the data is transmitted efficiently in time and energy is not wasted also to minimize the routing overhead.

The various sink placement strategies have been mentioned like CLMP (candidate location for minimum hop), GSP (geographical sink placement).

GSP Algorithm

1). Algorithm for Minimizing the Delay using GSP
Step 1: Deploy uniform random node distribution
i. unknown positions of sensor nodes - GSP or RSP strategy.
(Or)

ii. Known positions of sensor nodes - ISP or GASP strategy.
(Calculate candidate locations)
Step 2: Iteration:
i. place sensor nodes.
ii. Place sink strategy.
iii. Connect all nodes.
iv. Check connectivity of network.
v. choose the nearest sink.
vi. Calculate the maximum delay.
Step 3: Repeat 2 according to the selected sink placement strategy.
Step 4: Select the locations with minimum worst-case delay.
Step 5: GSP strategy runs only a single iteration as the sinks are placed at fixed positions.

CLMH Algorithm

In this algorithm the network is partitioned into number of grid cells. The sink is placed inside the grids by following

1) Finding candidate locations: The sink is placed at the centroid of the grid cells. The centroid of the cells is selected as initial sink positions.
2) Deciding final position: once the candidate locations for each grid cell are determined the final location is selected from these locations. Some candidate locations may be on the boundaries of the grid cells or may be actually shifted to another grid cell while finding the dense region.

The above mentioned two algorithms for sink placements has the disadvantages of more deaths of nodes , less throughput, more energy consumption and more routing overhead .

This paper discusses two algorithms namely R-GSP (Random GSP) & R-GSP-C (random GSP cluster).

R-GSP algorithm

1. Given: a circular sensor field with known radius and transmission ranges of nodes and sinks.
   Definitions: initial locations of sinks, Si, where i = 1, 2, ..., k,
   Nodes Nj , where j = 1, 2, ...,N.
2. Deployment Phase
   (i) Deploy a random node distribution
3. Create rings according to the WSN environment with equivalent radius size.
4. Create 1-hop neighbors set for Si by transmitting a signal and whichever node replies to the signal is collected.
5. Each packet is transferred to the next node depending on the rings number as well as the distance calculated as minimum.
6. Select the best sink, i.e., the one minimizing the maximum worst-case delay.
7. Upon the selection of the best sink from each group,
   (i) Allow Nj to connect to the nearest (i.e., the shortest hop distance) sink
   (ii) Calculate the maximum worst-case delay.

R- GSP-C algorithm

1. Given: a circular sensor field with known radius and transmission ranges of nodes and sinks.

2. Deployment Phase
   (i) Deploy a random node distribution
   (ii) Calculate the number of deployed nodes as well as number of nodes per a specific area. The area can be calculated by dividing the WSN into s 4by4 block, i.e. 16 blocks. Out of 16 blocks, the sinks are placed at only those blocks which have maximum nodes in sequence.
3. Create rings according to the WSN environment with equivalent radius size.
4. Create 1-hop neighbors set for Sink by transmitting a signal and whichever node replies to the signal is collected.
5. Each packet is transferred to the next node depending on the rings number as well as the distance calculated as minimum.
6. Select the best sink, i.e., the one minimizing the maximum worst-case delay.
7. Upon the selection of the best sink from each group,
(i) Allow Nj to connect to the nearest (i.e., the shortest hop distance) sink
(ii) Calculate the maximum worst-case delay.

At last all the four are compared and the results are shown by the simulation diagrams.

II. RELATED WORK

Amar Rasheed et.al (2012) [1] proposed a three tier security technique for authentication and commonly key establishment between sensor nodes and mobile sink. Their technique based on the polynomial pool based key distribution technique significantly improved network pliability to replication attacks on mobile sink associated to the single polynomial pool based key distribution technique. In this work they are using two different key pools and taking less stationary access nodes taking polynomials from mobile pool in network may delay an adversary from collecting data, by placing a simulated mobile sink. Scrutiny states that ten percent of nodes in the network taking a polynomial to be improved. In this work they additional improved the performance of security against the stationary access of node replication attack. In their work they used one way hash chains algorithms.

B.Sudhakar1, K.Sangeetha2, 2014 [2] proposed a system based methodology. Here the sensor field is separated into numerous lattices and the nodes are masterminded as the system focuses. A Mixed-whole number straight programming (MILP) detailing is done in here and an incorporated model of sink area and directing issue is depicted. The arrangement minimizes the aggregate energy utilization and offsets the information stream in the system. Sensor devices are used to collect the environment information. Wireless Sensor Network (WSN) is constructed with a set of data collection units. Base station, sinks and sensor devices are used in the WSN. Power resources, bandwidth and storages are the limitations of the sensor devices. Sink nodes are used to collect data from a group of sensor devices. Many to one traffic pattern based data collection model increases the transmission load to a set of nodes. The traffic pattern based network load problem is referred as hotspot problem. Energy efficient communication protocols and multi-sink systems are used to handle hotspot problems. Static and mobility based sink placement schemes are used to handle data collection process. Mobile sinks are used to increase the network lifetime with delay constraints. Random mobility and controlled mobility models are used in the mobile sinks. In random mobility the sinks are moved randomly within the network. The sinks are deterministically moved across the network is referred as controlled mobility. The network lifetime is managed with the number of nodes and delay values. The Delay bounded Sink Mobility (DeSM) problem is initiated under sensor node allocation to sinks. A polynomial-time optimal algorithm is used for the origin problem. Extended Sink Scheduling Data Routing (E-SSDR) algorithm is used to schedule sink nodes. The mobile sink scheduling scheme is enhanced to support large size networks. Distributed scheduling algorithm is applied to schedule nodes with high scalability. The scheduling scheme is tuned for multiple sink based environment. Delay and energy parameters are integrated in the sink scheduling process.

Bidi Ying et.al (2011) [3] proposed that, wireless have a broadcasting nature so it is easy for a attacker to locate the sink through traffic analysis. Outmoded methods of encryption and authentication are not effective sanctuary of the location privacy of the sink from the global attackers. In this work they introduced (SLPP) the Sink Location Privacy Protection Protocol, this is a protocol designed for the privacy of the sink. In this protocol the effective work is that it can hide the location of the sink effectively.

E. Ilker Oyman and Cem Ersoy [4] proposed that taking into account iterative bunching calculations, for example, k-mean. Here some starting groups are characterized and the sinks are put in the focal point of those bunches, and afterward bunch reshaping happens to permit sensors to pick the closest sink. This strategy is rehashed until the groups are not reshaped any longer. The fundamental target is to enhance the system lifetime. The battery asset of the sensor nodes ought to be overseen capably, so as to delay system lifetime in wireless sensor systems. Also, in substantial scale systems with countless nodes, various sink nodes ought to be conveyed, not just to expand the sensibility of the system, anyhow, likewise to decrease the energy scattering at every node. In this paper, we concentrate on the different sink area issues in infinite scale wireless sensor systems. Diverse issues contingent upon the configuration criteria are exhibited. We consider finding sink nodes to the sensor environment, where we are given a period requirement that expresses the base obliged operational time for the sensor system. We utilize reproduction methods to assess the nature of our answer.

J. Macqueen [5] proposed k-mean grouping calculation for determining new sink areasin view of area data . To start with an iterative calculation called worldwide is introduced which discovers the sink areas taking into account the worldwide information of the system. Given an introductory sink setup, the sinks utilize their worldwide learning to choose which sensors are nearest to them and gap the system into bunches. Next the centroids of these groups are resolved and new areas of sinks are discovered utilizing the scientific model and bunches are recalculated. The procedure rehashes until there is any change in the groups. The paper additionally proposes another iterative calculation, called 1hop which require the area data of the neighboring nodes and approximated areas of the inaccessible nodes for sink organization. For getting the area data of the sensor nodes the calculation depends on message transmission from each sensor node to the sink. The same scientific models is utilized here to determine new sink areas in view of the area data and the methodology emphasizes the length of the sinks quit moving to another position.

Jasmine Norman, 2014, [6] proposed the integration of different wired and wireless access technologies constitute the next generation heterogeneous network. A typical wireless sensor network configuration consists of sensors sensing and transmitting their observation values to some control center, the so-called sink node, which serves as a user interface. Due to the limited transmission range, sensors that are far away from the sink deliver their data through multihop communications. As sensor devices are resource forced, extending the network life time is very crucial to the functioning of the system. In this paper it is proposed to identify a one dominant node based topology in heterogeneous set up. The topology management is proved to be highly energy efficient.

Wint Yi Poe, Jens B. Schmitt, 2009, [12] proposed distinctive sink arrangement methods and their preferences and inconveniences are likewise examined. All these sink situation procedures are essentially proposed for time-discriminating WSN applications, with the exception of stand out known as Random Sink Placement (RSP). RSP is not suitable for time-basic purposes because of the arbitrary arrangement of sinks. RSP can be considered as a lower bound. Among the other proposed systems, in Geographic Sink Placement (GSP) methodology the sinks are put at the focal point of gravity of an area of a circle. In the event of Intelligent Sink Placement (ISP), hopeful areas are dictated by examining every conceivable area and relying upon the quantity of sinks all blends of these applicant areas are identified to locate an ideal sink position. This technique (ISP) is discovered to be an ideal one. In any case, ISP is computationally costly and it is accepted that the area data of the sensor nodes be given by some restriction system. Another calculation, called Genetic Algorithm-based sink situation (GASP) is likewise presented. Wheeze gives a decent heuristic in light of Genetic Algorithm for ideal sink arrangement.

III. PROPOSED SOLUTION

The most obvious problems faced by the existing systems were

1. Single sink, once it is off, the whole system shuts down. To avoid it, we are going to implement number of sinks.
2. Systems having GSP faced the distance traversing problem. These limitations are going to solve by the two strategies; cluster based sink placement and number of ring placement.
3. Routing overhead, which was caused due to the improper traversing path can be reduced by providing minimal distance path for maximum nodes.
4. Number of dead-nodes which was caused due to numerous uses of the same nodes for transferring packets can be minimized by maximum cluster sink strategy.
5. Once the path is fixed for every node, throughput can also be increased.

Our proposed methods R-GSP and R-GSP-C both have different methods to follow. In case of R-GSP, there are rings which have been placed inside WSN and every packet is delivered to the next ring it has on his path and likewise, at the end it reaches its closest sink. The sinks are placed randomly.

On our second method that is R-GSP-C, the packets follow the same procedure as the R-GSP, but this time the sinks are placed at a point in WSN, where there is maximum number of nodes.

The methodology for R-GSP:

2. Given: a circular sensor field with known radius and transmission ranges of nodes and sinks.

Definitions: initial locations of sinks, Si, where i = 1, 2, ..., k,

Nodes Nj , where j = 1, 2, ...,N.

2. Deployment Phase

(i) Deploy a random node distribution

3. Create rings according to the WSN environment with equivalent radius size.

4. Create 1-hop neighbors set for Si by transmitting a signal and whichever node replies to the signal is collected.

5. Each packet is transferred to the next node depending on the rings number as well as the distance calculated as minimum.

6. Select the best sink, i.e., the one minimizing the maximum worst-case delay.

7. Upon the selection of the best sink from each group,

(i) Allow Nj to connect to the nearest (i.e., the shortest hop distance) sink

(ii) Calculate the maximum worst-case delay.

The methodology for R-GSP-C:

1. Given: a circular sensor field with known radius and transmission ranges of nodes and sinks.
2. Deployment Phase
   (i) Deploy a random node distribution
   (ii) Calculate the number of deployed nodes as well as number of nodes per a specific area. The area can be calculated by dividing the WSN into s 4by4 block, i.e. 16 blocks. Out of 16 blocks, the sinks are placed at only those blocks which have maximum nodes in sequence.
3. Create rings according to the WSN environment with equivalent radius size.
4. Create 1-hop neighbors set for Si by transmitting a signal and whichever node replies to the signal is collected.
5. Each packet is transferred to the next node depending on the rings number as well as the distance calculated as minimum.

6. Select the best sink, i.e., the one minimizing the maximum worst-case delay.

7. Upon the selection of the best sink from each group,

(i) Allow Nj to connect to the nearest (i.e., the shortest hop distance) sink

(ii) Calculate the maximum worst-case delay.

The following metrics have been measured in case of each simulation of the strategies.

1) Execution Time: Execution time of each sink placement algorithm

2) Avg. Energy Consumption: Energy consumption for a single event to reach the sink node

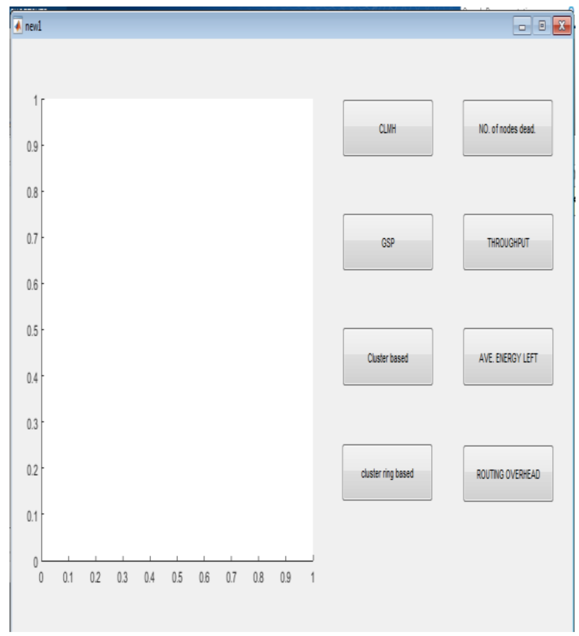
3) First Node Die: Number of rounds before the first node dies.

4) Last Node Die: Number of rounds until the last node dies.

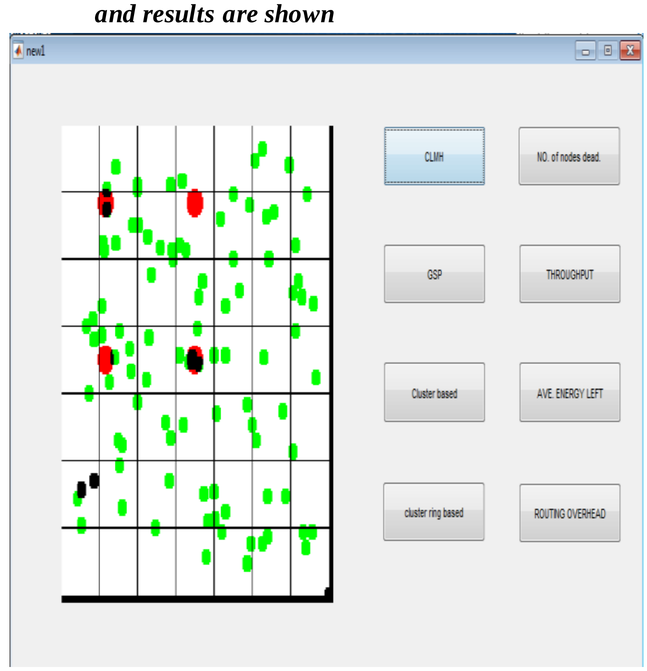
IV. SIMULATION RESULTS

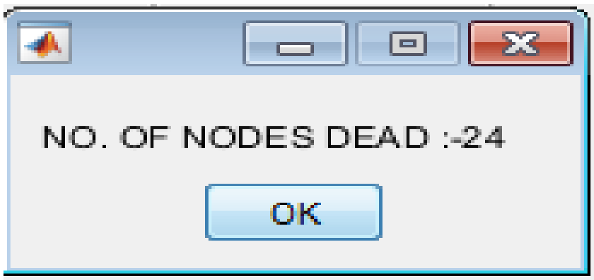
Metrics

1. ***To simulate our approach, we have created a graphical user interface in Matlab R2012a***



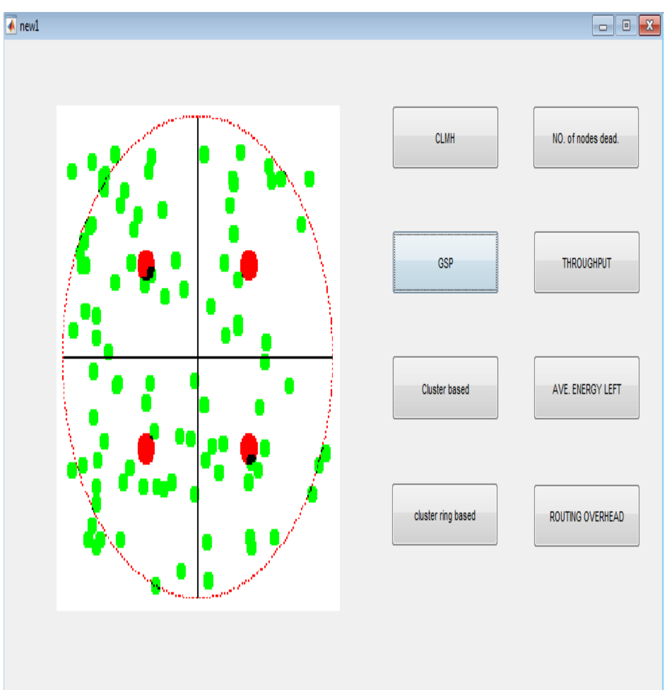
2. ***The previous approach CLMH is implemented and results are shown***

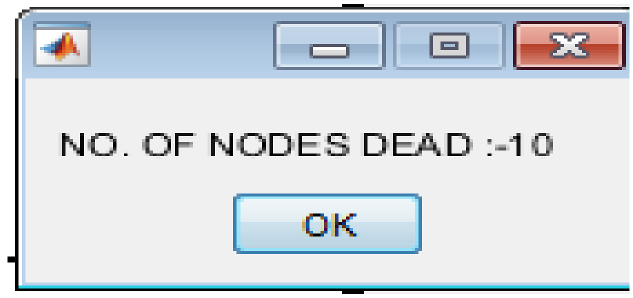





```
Average Balance Energy

ans =

   67.3156

Throughput :

ans =

   90.7191

Routing Overhead :

ans =

    0.7059
```

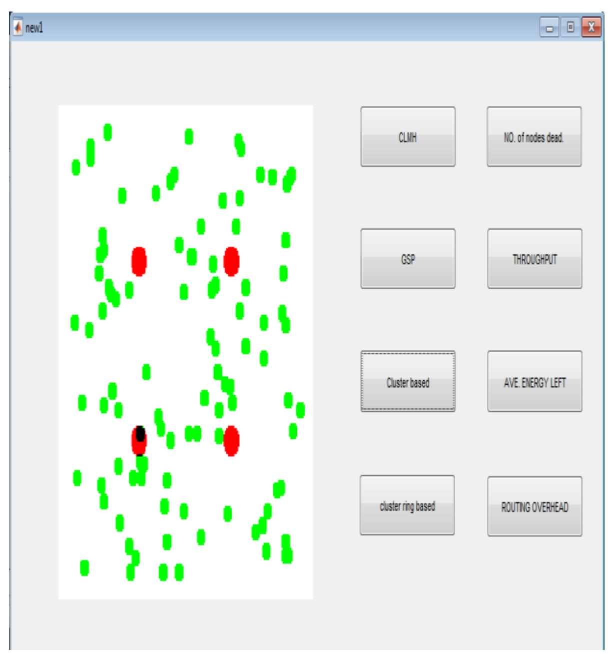
3. Now we have implemented GSP

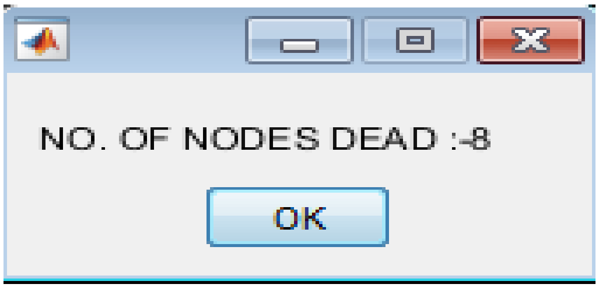





```
Average Balance Energy :

ans =

   47.1449

Throughput :

ans =

   87.9950

Routing Overhead :

ans =

    0.5039
```

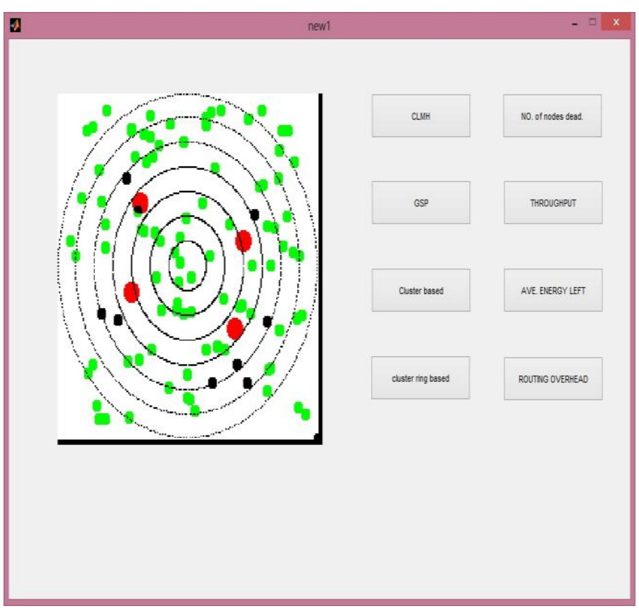
4. Implementing Cluster based approach

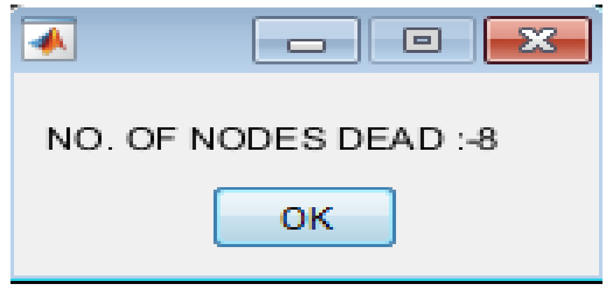





```
Average Balance Energy :

ans =

    78.6359

Throughput :

ans =

    95.1681

Routing Overhead :

ans =

     0.3055
```

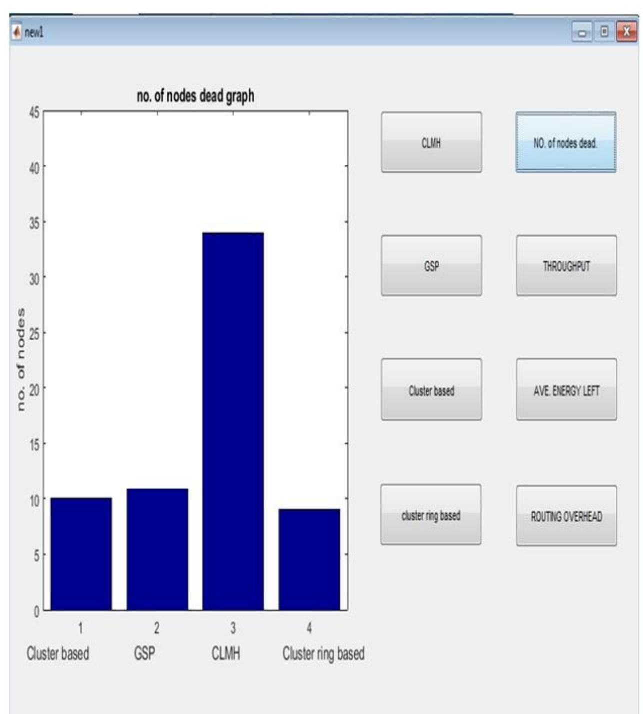
5. Implementing cluster based ring approach



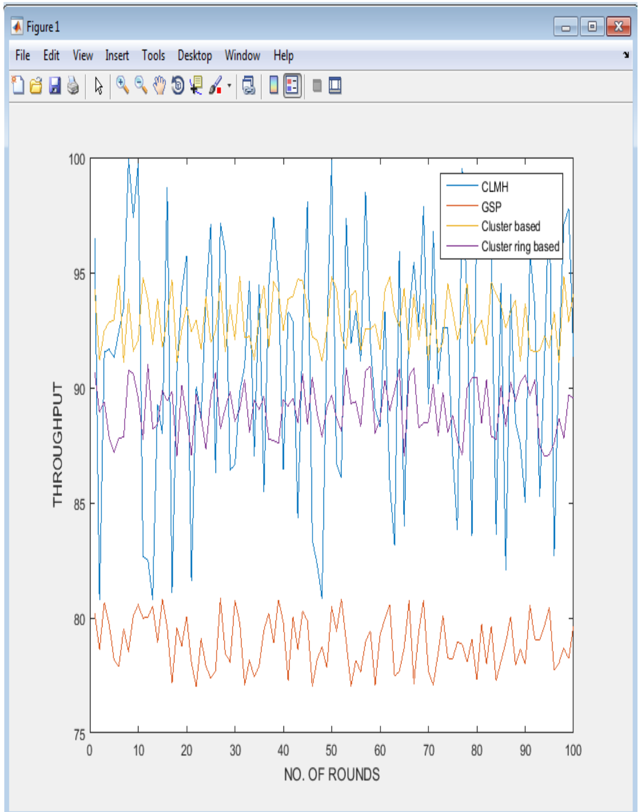



```
Average Balance Energy :

ans =

    85.1426

Throughput :

ans =

    93.8721

Routing Overhead :

ans =

     0.0906
```

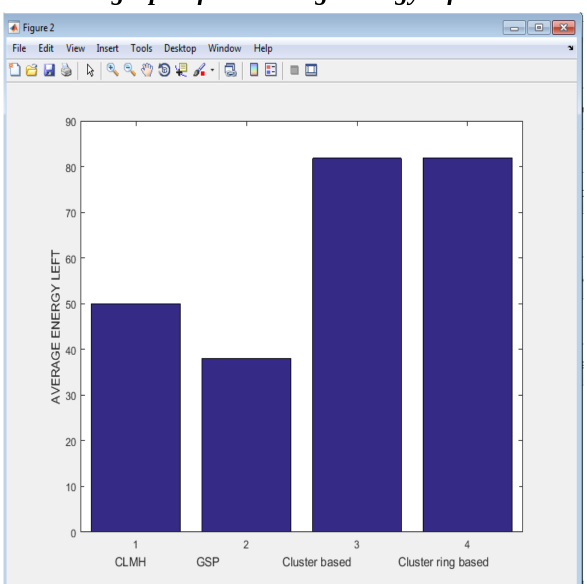
6. Graph of total number of dead nodes



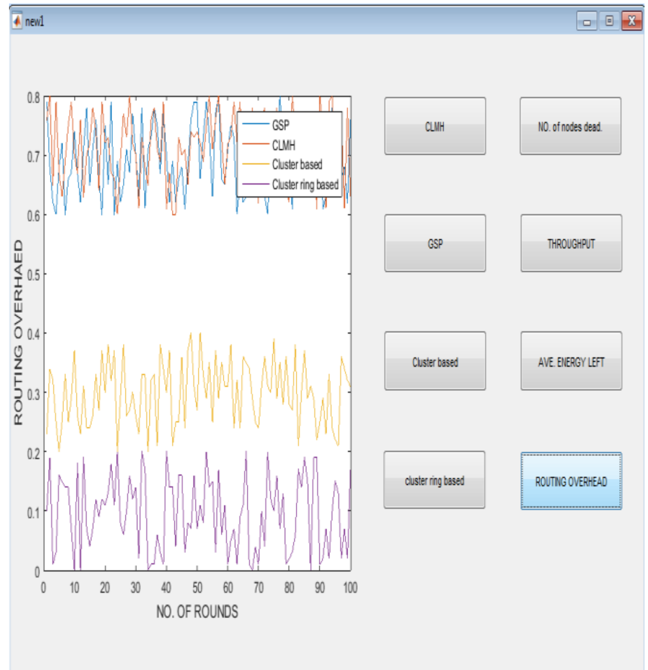
7. Graph of the throughput



8. Bar graph of the average energy left



9. Routing overhead



From the above results, it can be seen that most of the parameters in the cluster ring based approach provides better results than the other ones. In some cases, sometimes the cluster based approach also gives some good results; though our new approach is far better than the others.

V. CONCLUSION AND FUTURE SCOPE

The paper focuses on multiple-sink placement problem in a wireless sensor network. The network is assumed to be partitioned. We proposed two sink placement strategies in the partitioned network. These strategies are compared with existing sink placement strategies

Our work on sink placement is based on path searching of different nodes to its destination. So, as a future work our work can be improved by using more efficient path searching algorithms.

REFERENCES

[1] Amar Rasheed(2012), Student Member, IEEE, and Rabi N. Mahapatra, Senior Member, IEEE, The Three-Tier Security Scheme in Wireless Sensor Networks with Mobile Sinks.

[2] B.Sudhakar1, K.Sangeetha2, 2014 Multi Sink based Data Collection Scheme for Wireless Sensor Networks.

[3] Bidi Ying 1,2(2011), Dimitrios Makrakis1, Hussein T. Mouftah. A Protocol of Sink Location Privacy Protection in Wireless sensor networks.

[4] E. Ilker Oyman and Cem Ersoy ,Multiple Sink Network Design Problem in Large Scale Wireless Sensor Networks

[5] J. Macqueen , Some methods for classification and analysis of multivariate observations .

[6] Jasmine Norman, 2014,International Journal of Computer Science & Engineering Technology (IJCSET).

[7] Jason Lester Hill,2003, System Architecture for Wireless Sensor Networks .

[8] Jennifer Yick, Biswanath Mukherjee, DipakGhosal Department of Computer Science, University of California, Davis, CA 95616, United States, Computer Networks 52 (2008) 2292–2330

[9] Jesse English, Michael Wiacek and Mohamed Younis ,CORE: Coordinated Relocation of Sink Nodes in Wireless Sensor Networks.

[10] Manikanta More, Kayalvizhi Jayavel, 2014, Mobile Sinks for Data Collection with Sink Trail Reactive Protocol in Wireless Sensor Networks.

[11] Samira Niafar and Hadi Shahriar Shahhoseini, 2009, Design a Cross-Layer Integrated MAC and Routing Protocol for Surveillance Systems Using WSNs.

[12] Wint Yi Poe, Jens B. Schmitt, 2009, Sink Placement without Location Information in Large-Scale Wireless Sensor Networks

[13] Wint Yi Poe_, Jens B. Schmitt, 2009, Self-Organized Sink Placement in Large-Scale Wireless Sensor Networks.

[14] Wint Yi Poe, Jens B. Schmitt,Minimising the maximum delay in wireless sensor networks by intelligent sink placements.

[15] Youngyi Liu, Huiyong Yuan, 2014, Non uniform node deployment with mobile sink for wireless multimedia sensor networks.

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