Enhancement of the Network Lifetime for Mobility Based Clustering Algorithm in WSN

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Abstract

Wireless Sensor Networks (WSN) have important activities in different fields, which Collect information from sensor nodes, which are communicating over wireless channels with restricted resources. Consequently, numerous routing techniques used for energy accomplished process of WSN. Clustering method uses various routing techniques for Energy optimization. Though, several investigates motivated on most effective way of recognized Wireless Sensor Networks routing methods with fuzzy logic scheme. Furthermost of these routing methods haven't well-thought-out the influence of Heterogeneous sensor nodes in expressions of energy possessions. In this paper recommends Mobile Stable Election protocol by Fuzzy Logic system (MSEFP) for dissimilar WSN. In this MSEFP method, selection of Cluster heads in individually round constructed on extreme chance value using fuzzy parameters Residual Energy, Closeness to Sink and Node Area. Simulation consequences illustrations that this MSEFP method continuously conserves additional Energy related to recognized procedures of SEFP and LEACH Mobile in extending the lifespan.

***Keywords*: SEFP; MSEFP; LEACH Mobile; Fuzzy Logic Scheme; lifespan; MWSNs.**

1. INTRODUCTION

Wireless sensor network made up of relating to dispensed independent sensors to notice the presence in the environment including pressure, temperature, vibration, motion, pressure sound and to collective proceed information along the system to a major place. The applications of WSNs primarily centre on environmental monitoring, battle field surveillance, smart home, military, health care applications, security monitoring, adversity position examination, etc. [1,2,3,4,5]. Most of the procedures in Wireless Sensor Networks are focus at minimizing Energy use and increasing system lifespan.

Various Clustering based approaches in WSNs such as LEACH and SEFP.Clustering techniques, Entire area is divided into sub areas (Clusters). Each sub area has a group of nodes and few of selected nodes (Cluster head nodes) identify in each sub area based on extreme energy content of nodes in every round, these Cluster Heads directly communicate with sink (base station) for save Energy in every round to enhance overall Network Lifespan.All Cluster head nodes gather sensed information from all cluster members, assembled it and when transfer it to Base Station.

Enormously broad applications can be possible by using Mobile Wireless Sensor Networks (MWSNs) such as providing Mobility to All nodes in the Network [9].

Various advantages for using Mobile Wireless Sensor Networks Compared to Wireless Sensor Networks, when we include Mobility model to Mobile Wireless Sensor Networks such as Reporting, Connectedness, extensible and reliable of the network, stability the network energy depletion, and expand the system's lifespan [10,11]. In this paper for algorithm to increase the Lifetime of the dissimilar WSNs using fuzzy logic system with mobility.

2. LITERATURE REVIEW

Various Clustering Based Algorithms in Wireless Sensor Networks as Follows
i. LEACH Algorithm

In this algorithm, the nodes establish itself into native clusters, by individual node performing such as cluster head. Entirely member nodes transfer its information toward the cluster head, whereas the cluster head collects information after entirely the cluster associates, accomplishes signal handling gatherings on the information (e.g., information collection), then conveys information to the distant Base Station.

The process in this algorithm is separated into rounds. For individually round commences through setup stage while the clusters are arranged, monitored through SteadyState stage as soon as information are conveyed after the nodes toward the cluster heads then continuously in the direction of the Base Station. Appropriate to reduce overhead, the steady-state stage is extended relate to the set-up stage [6,7].

ii. LEACH Mobile (LEACH M) Algorithm
The LEACH Mobile protocol is appropriate for mobile wireless sensor networks, which offers an extremely adaptive routing scheme to compact with cluster head choice and common topology variations. LEACH Mobile Protocol might be help in flexibility centric wireless sensor network as it orders the hierarchical clustering dynamically without GPS data [12,13,14].

iii. SEFP Algorithm
Stable election by fuzzy parameters method (SEFP) with fuzzy logic scheme intended for diverse Wireless Sensor Networks. The chief persistence of routing method be situated toward progress the system lifespan then predominantly the stability phase of the system. In this method, the node by the extreme chance turn into a cluster head constructed using fuzzy parameters equally residual energy of separately sensor node, closeness to Sink (base station) and Node Area (area distance) is the distances among individual node and more nodes.
SEFP method is additional proficient energy then be supplementary dominant in extending the system lifespan [8].

2.1. *Classification of Mobile Wireless Sensor Networks (MWSNs) as follows*

1) Base Station and All nodes are movable
In this category of system, Both Base Station and the whole nodes are movable and the complete Mobile Wireless Sensor Networks topology remains not stable and hence moderately insecure and it is useful in location wherever the sensor nodes not exist permanent. Illustrations in observing for Oceanic navy security and oil leaks in the marine.

2) Base Stations are stationary; All nodes are moveable
In this category of system, mobile sensor network stands appropriate for the checking of huge regions. While the sensor is positioned on a transport automobile, the Base Stations are situated on together ends of the mode to detect movement positions and the location of automobile. Illustration in Stream contamination watching, everywhere the sensor nodes are arranged beside the stream and the Base Stations are prescribed at the boundaries of the stream, wherever sensor nodes assemble the information such as stream level, the pH rate of the water.

3) Base Stations are moveable, All nodes are stationary**.**
In this category of system is generally broadly usage to smart green house watering, ecological pollution safety observing, Conservation observing, medicinal observing. The main benefit of this category is that the information handling, information communication, directing conservation and reduce the large energy depletion happen in the Base Station [10].

2.2. *Features of Mobile Wireless Sensor Networks*

1) Restricted possessions
Mobile Wireless Sensor Networks consume the identical sensor nodes such as Wireless Sensor Networks. the features of sensor nodes consume small budget, tiny dimensions, restricted energy, packing volume, bound calculating power and announcement competence. The chief gathering of Mobile Wireless Sensor Networks be present toward protect system energy earning, progress system proficiency, and expand the network lifespan.

2) **Higher system dimension**
Mobile Wireless Sensor Networks take many sensor nodes and use for wide range of applications such as accuracy cultivation, forestry fire notice, smart store housing, and animals surrounding observing.

3)Enhanced system arrangement
The sensor nodes arranged in Wireless Sensor Networks by arbitrary delivery in the observing region. The development difficult of the sensor system arrangement is simply resolved by Mobile Wireless Sensor Networks.

4) Complete expenditure of node capability
the mobile base stations in Mobile Wireless Sensor Networks steadiness the system energy and extends the system's lifespan, specifically not in the situation of Stationary Wireless Sensor Networks, wherein data transmission, the energy consumption of the nodes is definite great.

5) Practical applications
Mobile Wireless Sensor Networks offer explanations designed for various useful applications difficulties Altered application surroundings consume changed presentation necessities for Mobile Wireless Sensor Networks. Hence, the hardware scheme, software method conservation, and announcement directing practice project are furthermore changed [10].

3. PROPOSED CONCEPT FOR MOBILE STABLEELECTION PROTOCOL (MSEFP)

This part offers specifics for proposed approach Mobile SEFP (MSEFP), Objective is to extend the lifespan of dissimilar wireless sensor networks (WSNs) through fuzzy logic approach with Base Stations are stationary; All nodes are moveable Type.

3.1. *System assumptions*

Following assumptions for MSEFP method are
i. Some of the sensor nodes in the system are different energy content.
ii. All sensor nodes have mobility after deployment in sensing field.
iii. Cluster head undertakes information gathering, information collecting and information squeeze before sending aggregated information to Base station.
iv. The remoteness concerning Cluster head and sensor node be able to established about the radio signal power.
v. The Stationary Sink is sited by middle of Sensing region.

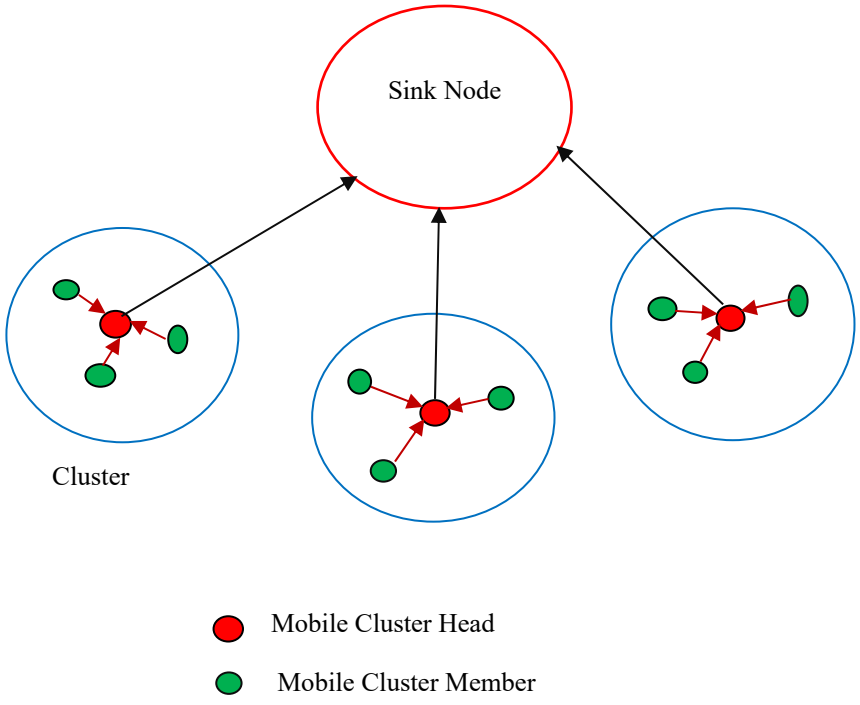

Figure 1: MSEFP Approach in Wireless Sensor Network

MSEFP approach in Wireless Sensor Network as shown in Fig 1. The Mobile measuring device nodes gather intellect data from Sensing region and communicate data toward Fixed Base Station (Sink) through Mobile

Cluster Head nodes. In system, sensing region comprises of the sensor nodes (both normal nodes and advanced nodes).
Energy content of advanced sensor nodes have more energy than normal sensor nodes.

Probability for Normal Sensor Nodes

$$Pnorm=k/(1+aB) \quad (1)$$

Probability for Advanced Sensor Nodes

$$Padvn=k\ (1+a)\ /\ (1+aB) \quad (2)$$

Election of Cluster Heads for Normal Sensor Nodes

$$T(n) \leq Pnorm\ /\ (\ 1-\ Pnorm(r\ mod(1/\ Pnorm))) \quad (3)$$

Election of Cluster Heads for Advanced Sensor Nodes

$$T(n) \leq Padvn\ /\ (\ 1-\ Padvn(r\ mod(1/\ Padvn))) \quad (4)$$

Where, $T(n)$ is a threshold value

3.2. *Fuzzy Inference System (FIS) parameters and Cluster Heads (CHs) selection*

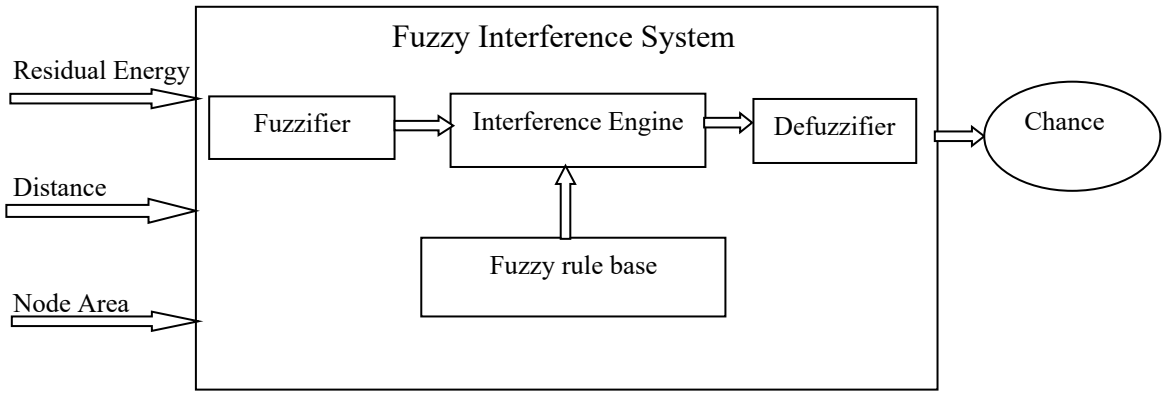

Figure 2: MSEFP Approach for Cluster Head Selection using Fuzzy Inference System.

Figure 2 show the block diagram of MSEFP Approach for FIS Process practiced on all round. Individually round presence together of setup phase and steady state phase. In MSEFP method, The Chance Level can be determined for individual node by means of FIS for selection of Cluster Head node in every Round, both for Advanced and Normal Nodes. FIS comprises of 4 stages Such as
i) fuzzifier, ii) Inference Engine, iii) FIS Procedures and iv) Defuzzifier [15, 16,17,18,19].

To Find, Chance level in MSEFP approach using three input fuzzy parameters such as
1) RESIDUAL ENERGY - variance amongst the initial energy and the exhausted energy.
2) AREA DISTANCE (Closeness to Base Station) - variance amongst base station and a sensor node.
3) NODE AREA-the addition of variance amongst the specific node and other nodes, bounded by system zone.

In MSEFP method, that practice three fuzzy parameters such as residual energy, closeness to Sink and Node Area for Selection of cluster head to enhance system lifespan.

The Residual Energy using fuzzy consideration is shown in figure 3. The verbal (linguistic) principles for Residual Energy of fuzzy group stand high, medium and low. Trapezium association purpose is practiced for high and low, while trilateral association purpose is practiced for medium.

Closeness to Sink using fuzzy consideration is shown in figure 4. The verbal principles for Closeness to Sink of fuzzy group stand far, medium and close. trapezium association purpose is practiced for far and close, while trilateral association purpose is practiced for medium.

Area Distance using fuzzy consideration is shown in figure 5. The verbal principles for Area Distance of fuzzy group stand high, medium and low. trapezium association purpose is practiced for low and high, while trilateral association purpose is practiced for medium. Chance using fuzzy consideration is shown in figure 6.

Additionally, the association purpose of chance stand circulated interested in 9 verbal principles such as VH (Very High), H(High), RH (Rather High), MH (Medium High), M(Medium), ML (Medium Low), RL (Rather Low), L(Low), and VL (Very Low). trapezium association purpose is practiced for VL and VH and whereas trilateral association purpose is practiced for H, RH, MH, M, ML, RL, L.

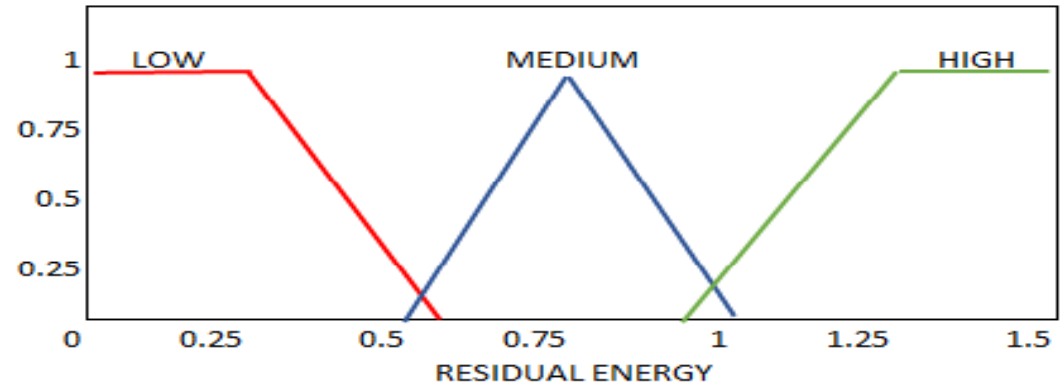

Figure 3: Membership function of Residual Energy

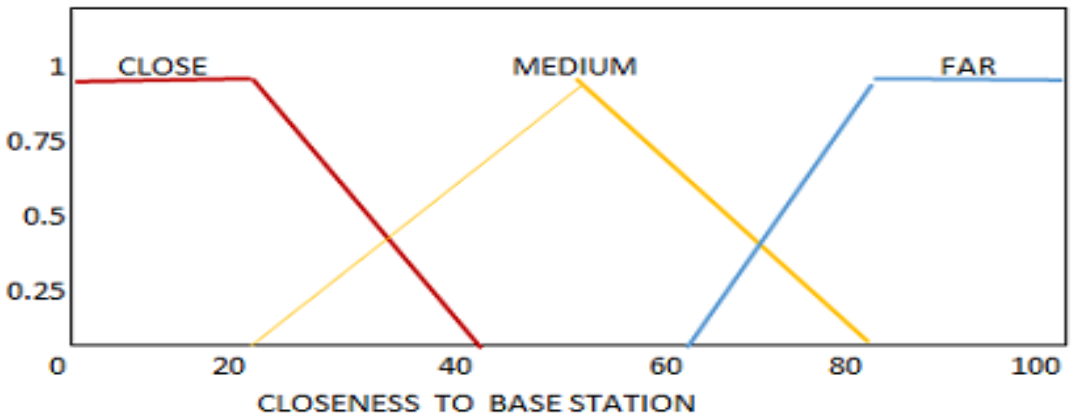

Figure 4: Membership function of Closeness to Base Station

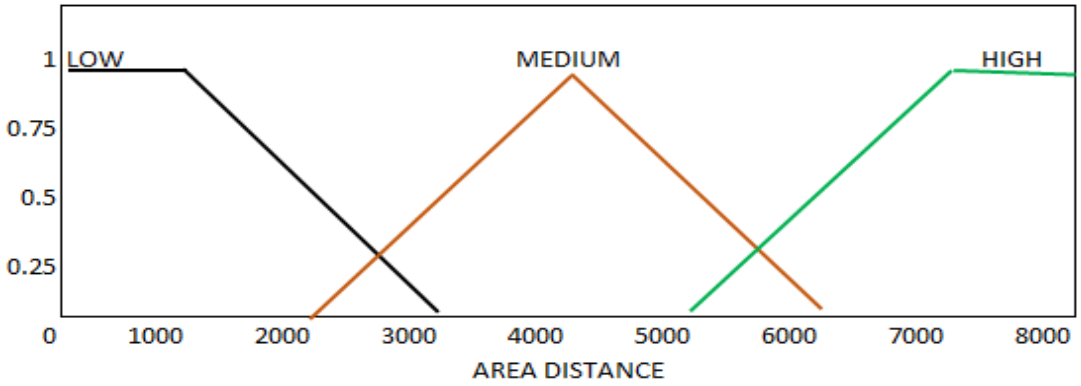

Figure 5: Membership function of Area distance

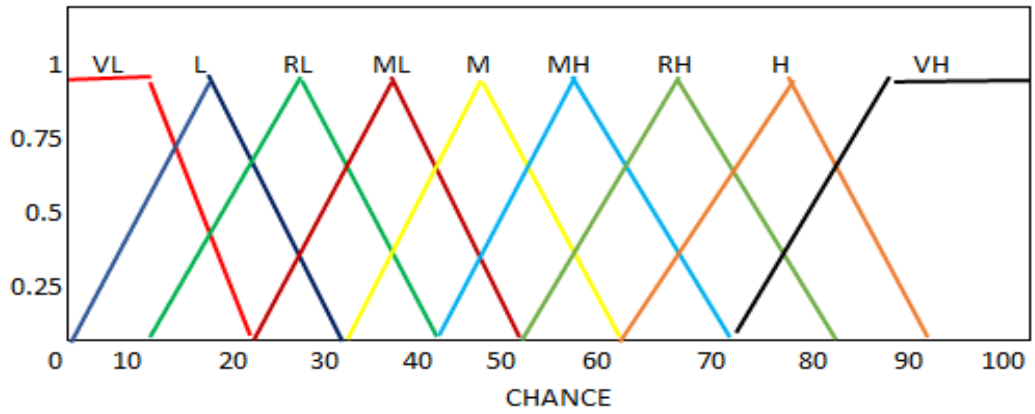

Figure 6: Membership function of Chance

Table 1: Fuzzy Inference System if then Rules

Rule No	Area Distance	Residual Energy	Closeness to Base Station	Chance
1	High	Low	Far	Very Low
2	Medium	Low	Far	Low
3	Low	Low	Far	Rather Low
4	High	Low	Medium	Low
5	Medium	Low	Medium	Rather Low
6	Low	Low	Medium	Medium Low
7	High	Low	Close	Rather Low
8	Medium	Low	Close	Medium Low
9	Low	Low	Close	Medium
10	High	Medium	Far	Rather Low
11	Medium	Medium	Far	Medium Low
12	Low	Medium	Far	Medium
13	High	Medium	Medium	Medium Low
14	Medium	Medium	Medium	Medium
15	Low	Medium	Medium	Medium High
16	High	Medium	Close	Medium
17	Medium	Medium	Close	Medium High
18	Low	Medium	Close	Rather High
19	High	High	Far	Medium
20	Medium	High	Far	Medium High
21	Low	High	Far	Rather High
22	High	High	Medium	Medium High
23	Medium	High	Medium	Rather High
24	Low	High	Medium	High
25	High	High	Close	Rather High
26	Medium	High	Close	High
27	Low	High	Close	Very High

Table 1, referred as Output Chance Levels with 3 Input parameters such as Area Distance, Residual Energy, and Closeness to Base Station with Prearranged Fuzzy Inference System if then Rules to hold the ambiguity. Totally, 27 Output Chance Levels with 3 fuzzy input constraints, separately distributed by 3 verbal changeable, for both normal and advanced sensor nodes. i.e,$3^3 = 27$ for Defuzzification of the chance by Mamdani process and the Center of Area Process in fuzzy inference system.

The figure 7, Explains the flow chart meant for the Proposed SEFP Protocol in each Round regarding the transformed stages.

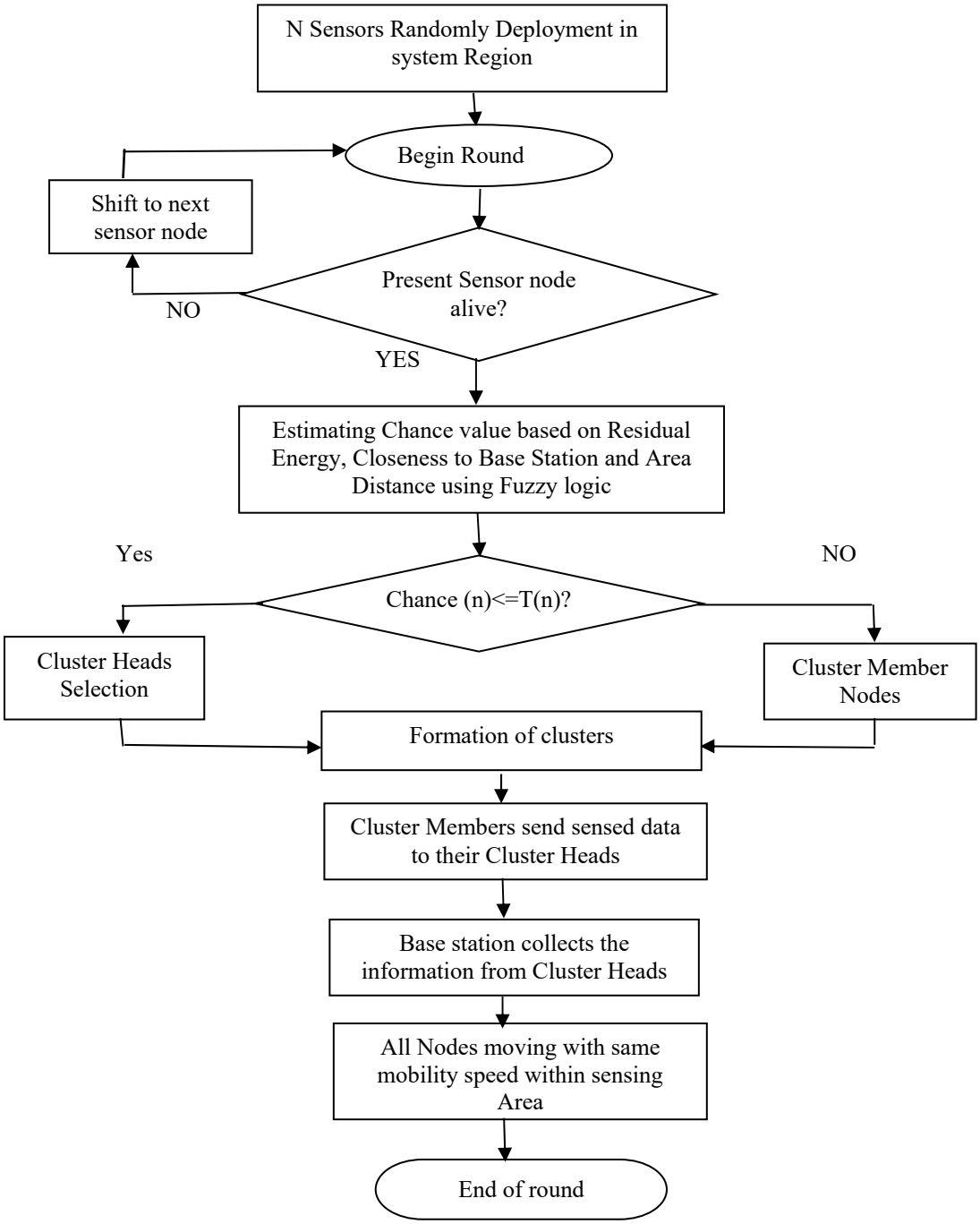

Figure 7: Flow Chart for the proposed MSEFP Protocol

Beginning from arrangement of Sensor Nodes in Sensing Region through system parameters for instance the amount of nodes, dimension of detecting region, the preliminary energy of nodes. For Choice of Cluster Heads can be determined in every round by Estimating Chance Value established on input Values as Area Distance, Residual Energy and Closeness to Base Station by Fuzzy Logic and constructed on Chance Value Associated with T(n) a threshold value then in Every round made Clusters through Mobile Cluster Heads and Mobile Cluster Members Then Send the detected Information to Base Station through Cluster Heads in each round and All Nodes are moving with similar speed within region.

4. Results and Discussions

4.1. *Simulation outcomes*

Comparing the performance of MSEFP Approach by means of MATLAB with SEFP and LEACH M procedures in the dissimilar Wireless Sensor Networks, by n=100 nodes and n=50 nodes casually spread in a 100 x 100 area, the preliminary Energy of Normal node, E_0 as well as preliminary energy of Advanced node, $E_0(a+1)$. The Sink is placed at the midpoint of the detecting ground. Table 2 shows System parameters setting of MSEFP Approach. Considering Same Mobility provided for All nodes (Advanced and Normal Nodes) in MSEFP.

Table 2: System parameters setting

Parameter	**Value**
Energy Consumed by transmitter or receiver circuit, E_{elec}	5 nJ/bit
Constant, a	1
Preliminary Energy of Normal Node, E_0	0.5J
Preliminary Energy of Advanced node E_0 (a+1)	1J
Amplification circuit energy in free space, ϵ_{fs}	10 pJ/bit/m^2
Amplification circuit energy in multipath ϵ_{mp}	0.0013 pJ/bit/m^4
packet size l	4000 bits

Simulation outcomes of proposed MSEFP method with SEFP method be shown in figure 8, figure 9 and figure 10 for 10% of sensor node heterogeneity with n=100 nodes.

The figure 8, show the number of alive nodes versus per round, which is perceived that proposed MSEFP method overtakes SEFP. MSEFP is more proficient than SEFP, we can realize that network lifespan is increased.

The figure 9 show the amount of dead nodes verses per round, which provide a complete understanding into the concert of these procedures, the Table 3 contain brief account of dead sensor nodes of MSEFP and SEFP procedures of 10% of sensor node. from table obviously clarify the constructive impression of the proposed MSEFP method for declining number of dead nodes although procedure rounds advance then hereafter growing the system lifespan. from Table 3, that reveal the Stability Period (First Dead Node) of MSEFP and SEFP procedures are limited to 580 rounds and 574 rounds and Dead of Last node of MSEFP and SEFP are 8960 rounds and 8590 rounds correspondingly 10% of sensor node.
In figure 10, Number of Packets sent to Base Station for MSEFP is extreme improved than that of SEFP.

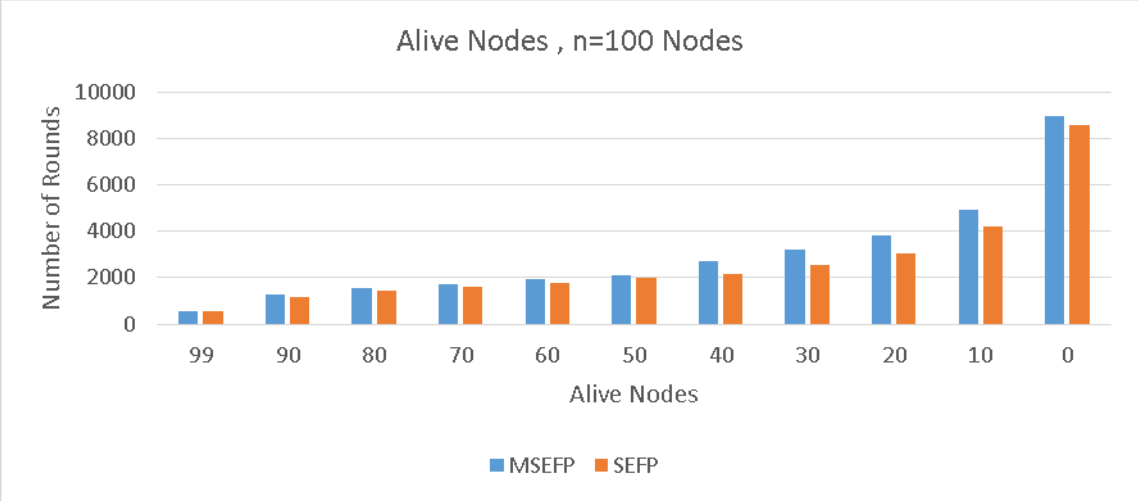

Figure 8: Alive Nodes Verses Rounds

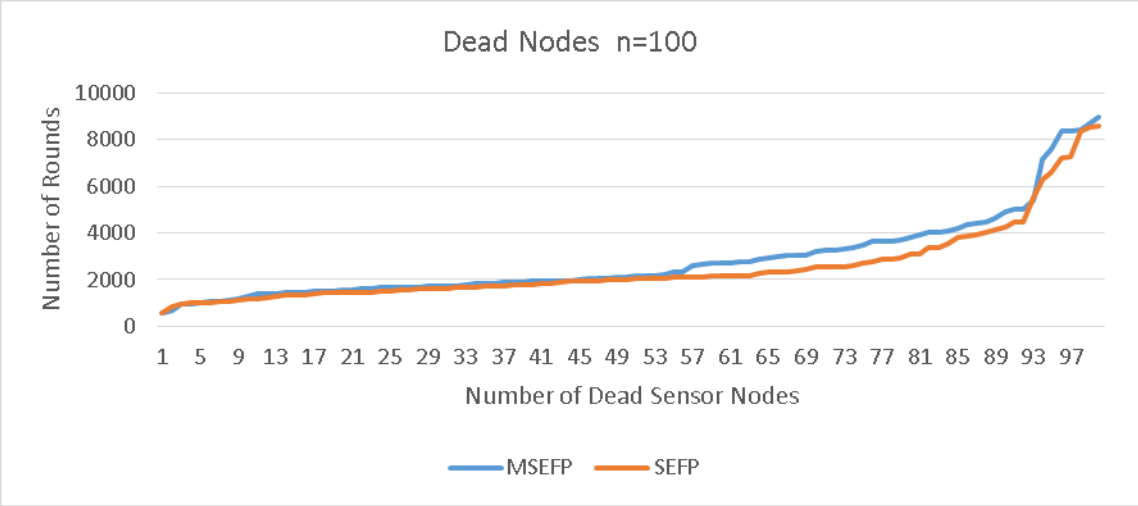

Figure 9: Dead Nodes Verses Rounds

Table 3: Round account of sensor dead nodes

Percentage Dead Nodes	**MSEFP**	**SEFP**
First Node	580	574
Tenth Nodes	1260	1160
Hundredth Nodes	8960	8590

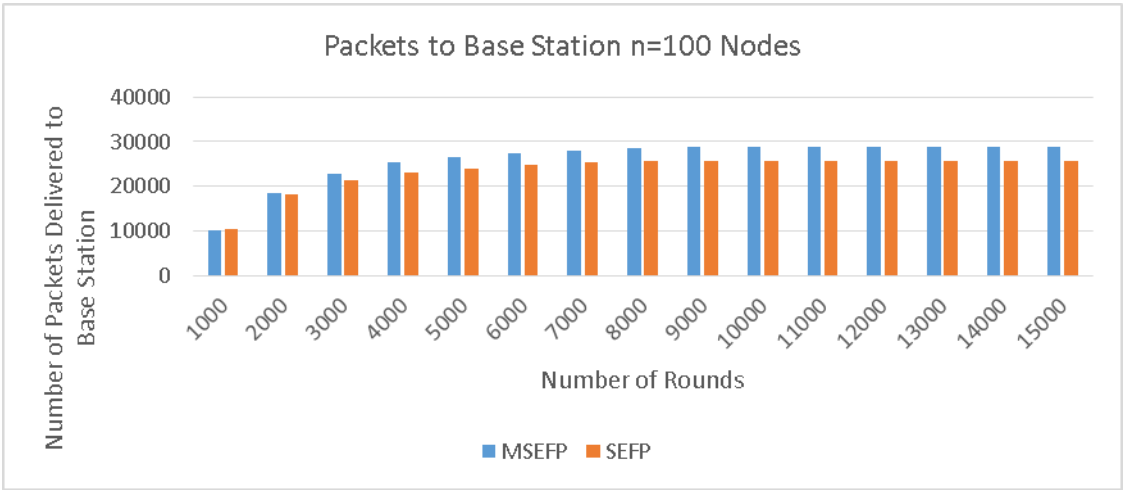

Figure 10: Packets to Base Station Verses Rounds

In figure 11, figure 12 and figure 13 clarify the show of MSEFP method compared to SEFP protocol of both 10% of sensor node heterogeneity with number of Sensor nodes are n=50, respectively.

The figure 11 show the number of alive nodes versus per round, which supposed that MSEFP method extents SEFP. MSEFP is added expert than SEFP, we can understand that network lifetime is improved for MSEFP.

The figure 12 show the amount of dead nodes verses per round. In the table 4 comprise momentary account of dead sensor nodes of MSEFP and SEFP procedures of 10% of sensor node heterogeneity, which expose that the stability period (Dead of first Node) of MSEFP and SEFP are 477 rounds, and 467 rounds and Dead of Last node of MSEFP and SEFP are 9840 rounds and 7320 rounds correspondingly in 10% of sensor nodes.

In figure 13, Shows Packets sent to Base Station for MSEFP and SEFP, we can understand that additional number of Packets sent to Base Station for MSEFP compared to SEFP.

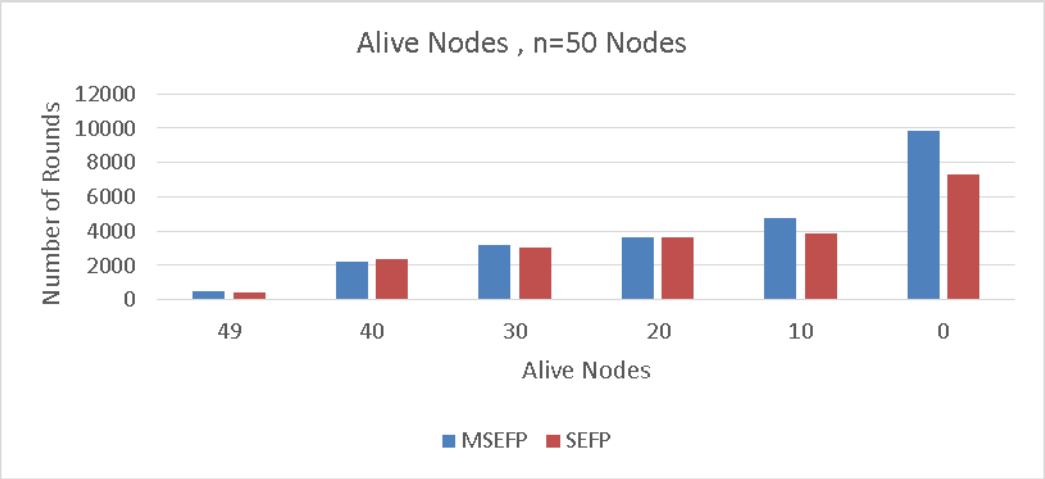

Figure 11: Alive Nodes Verses Rounds

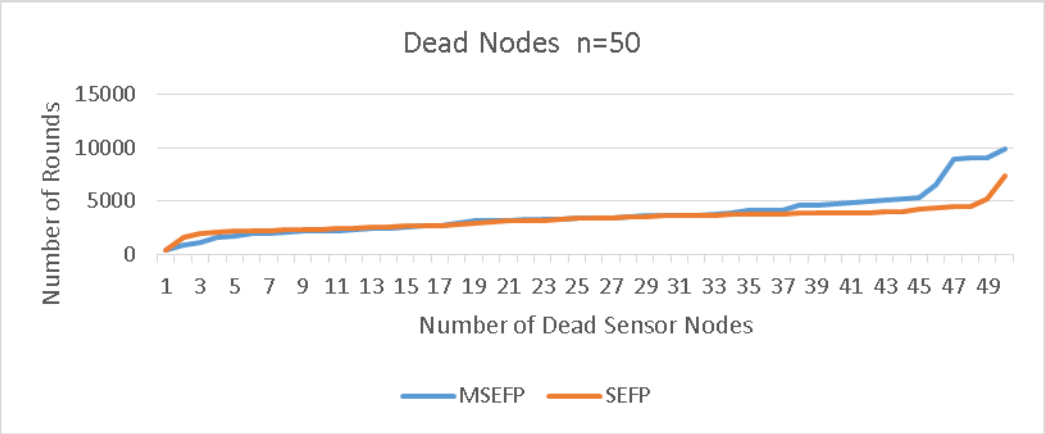

Figure 12: Dead Nodes Verses Rounds

Table 4: Round account of sensor dead nodes

Percentage Dead Nodes	MSEFP	SEFP
First Node	477	467
Tenth Nodes	2209	2399
Fiftieth Nodes	9840	7320

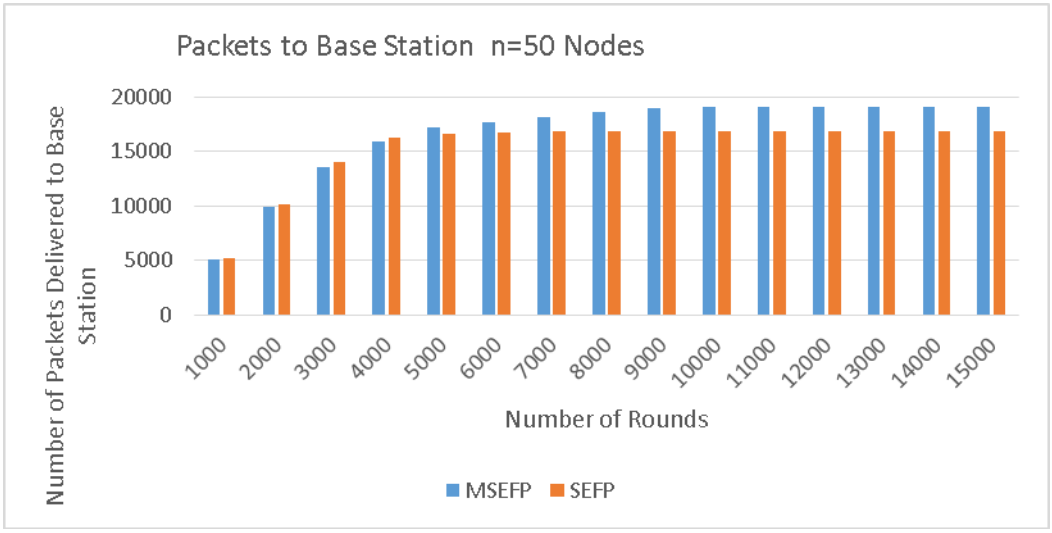

Figure 13: Packets to Base Station Verses Rounds

In figure 14, figure 15 clarify the show of MSEFP method compared to LEACH M protocol of both 10% of sensor node heterogeneity with number of Sensor nodes are n=100, respectively.

The figure 14 shows the number of alive nodes versus per round for MSEFP and LEACH M, we can understand that death Nodes decrease gradually in MSEFP compared to LEACH M so network lifetime is improved for MSEFP related to LEACH M.

The figure 15 show the amount of dead nodes verses per round. Table 5 involve brief interpretation of dead sensor nodes of MSEFP and LEACH M procedures of 10% of sensor node heterogeneity, which description that the stability period (Dead of first Node) of MSEFP and LEACH M are 580 rounds, and 2240 rounds and Dead of Last node of MSEFP and LEACH M are 8960 rounds and 7600 rounds correspondingly in 10% sensor nodes.

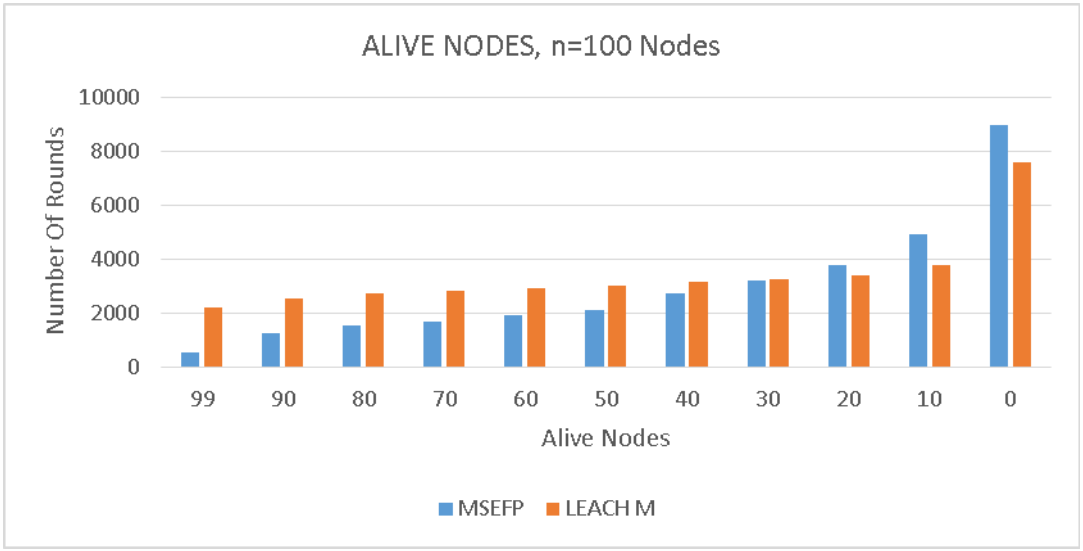

Figure 14: Alive Nodes Verses Rounds

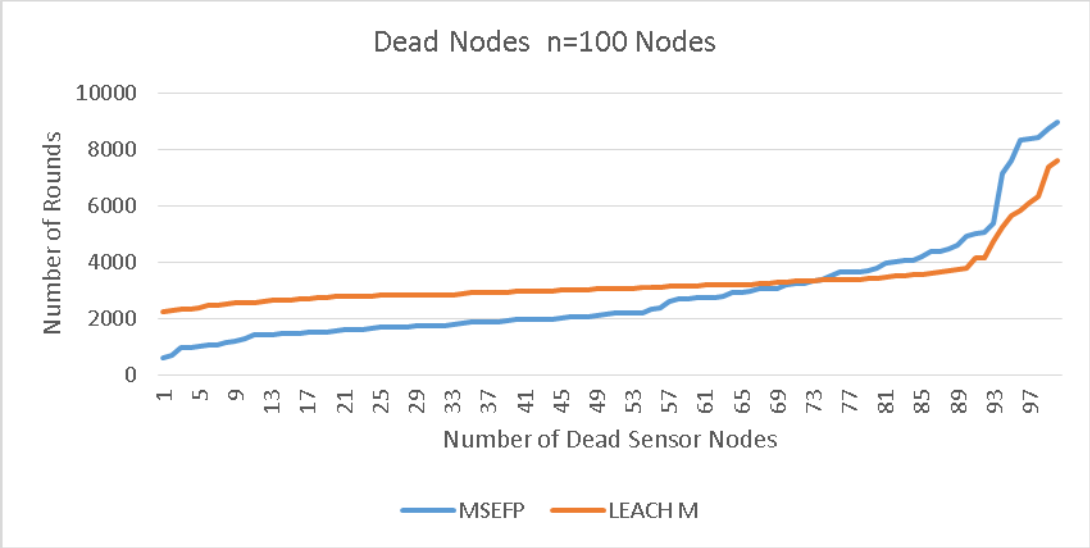

Figure 15: Dead Nodes Verses Rounds

Table 5: Round account of sensor dead nodes

Percentage Dead Nodes	**MSEFP**	**LEACH M**
First Node	580	2240
Tenth Nodes	1260	2559
Hundredth Nodes	8960	7600

In figure 16, figure 17 clarify the show of MSEFP method compared to LEACH M protocol of both 10% of sensor node heterogeneity with number of Sensor nodes are n=50, respectively.

The figure 16 shows the number of alive nodes versus per round for MSEFP and LEACH M, we can recognize that Nodes die decline gradually in MSEFP compared to LEACH M so network lifetime is enhanced for MSEFP associated LEACH M.

The figure 17 show the amount of dead nodes verses per round. Table 6 involve brief interpretation of sensor dead nodes of MSEFP and LEACH M procedures of 10% of sensor node heterogeneity, which description that the stability period (Dead of first Node) of MSEFP and LEACH M are 477 rounds, and 2469 rounds and Dead of Last node of MSEFP and LEACH M are 9840 rounds and 7140 rounds correspondingly in 10% diverse WSN.

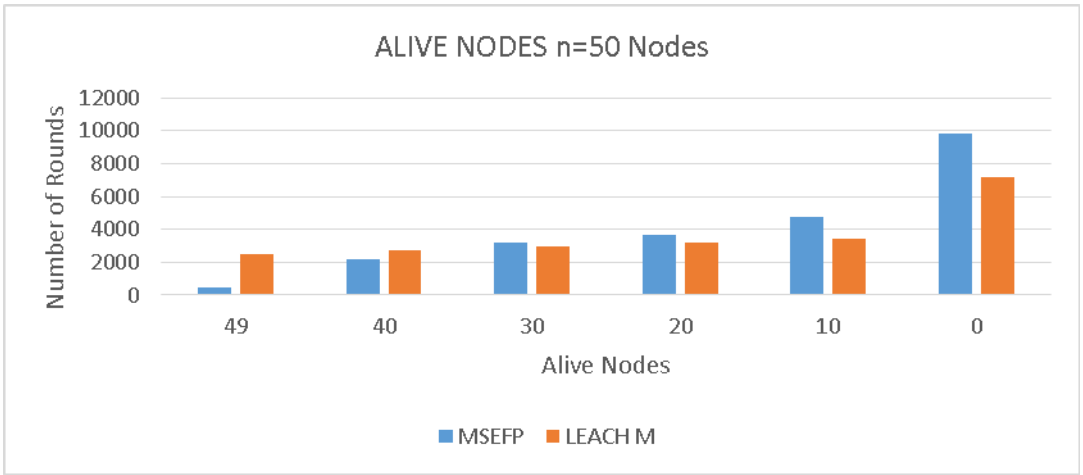

Figure 16: Alive Nodes Verses Rounds

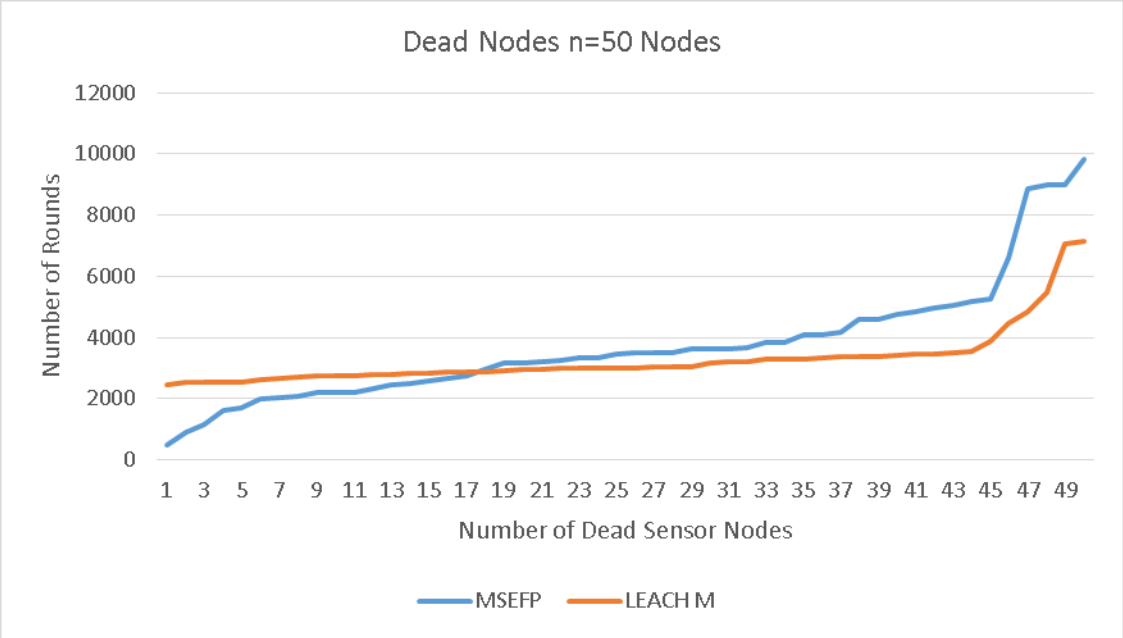

Figure 17: Dead Nodes Verses Rounds

Table 6: Round account of sensor dead nodes

Percentage Dead Nodes	**MSEFP**	**LEACH M**
First Node	477	2469
Tenth Nodes	2209	2759
Fiftieth Nodes	9840	7140

5. CONCLUSION

Network lifespan is the key feature in scheming measures of routing procedures for wireless sensor networks. Grouping technique remain offered such as SEFP, this procedure be determined by energy proficiency remain improved. In this paper, MSEFP method constructed on SEFP algorithm by means of mobility for diverse Wireless Sensor Networks. MSEFP approach provide key resolve to extend the system lifespan. Simulation outcomes accomplish that MSEFP is further efficient energy then extra prevailing in extending the system lifespan related to SEFP and LEACH M Procedures in dissimilar surroundings. In this Paper Proposed MSEFP Algorithm for Fixed Base Station (Sink) and Same Mobility Speed for all Nodes in the Network. As a future work, it can be prolonged for Mobile Base Station (Sink), Different Mobility Speed for all Nodes in the Network, Implement for IOT Based applications and also relate the Enhanced Algorithm by other Clustering Algorithms.

Conflicts of interest

The authors have no conflicts of interest to declare.

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