iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 Issue: X Month of publication: October 2017

DOI: http://doi.org/10.22214/ijraset.2017.10209

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue X, October 2017- Available at www.ijraset.com

Tsmehp- Enhancing Efficiency of Wireless Sensor Networks Through Clustered Heterogeneous Protocol

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Abstract: The active research in WSN field is free to improve network lifetime, which is vital. Several algorithms and protocols were developed but best is only one which is clustering algorithms which are increased a lot of significance in increasing the network sensor lifetime of each sensor nodes. In this research paper, a new protocol is developed by using advantageous properties of two different protocols and by removing disadvantage of each protocols which is Threshold Sensitive Stable Election Multi-Path Energy Aware Hierarchical Protocol (TSMEHP). This protocol defines how to choose cluster head (CH) with help of energy model and how optimal number of clusters can be computed, here use three energy levels of heterogeneity, Regular Nodes, Active Nodes, Smart Nodes. This paper proposed algorithm, in which work will be comparing with Seven different protocols namely, ESEP, LEACH, TEEN, SEP, EAMMH and TSEP with some general scenarios. This work will the analysis of simulation results and observations made with all these protocols are presenting overtakes regarding life time of sensing nodes. This protocol uses feather of TSEP and EAMMH protocols. TSEP is also being threshold based protocol with an additional feature of three levels of heterogeneity results in increased stability period and network life even greater than that of TEEN and node dead per round was also decreased. In this paper TSMEHP, responsive routing protocol is proposed where nodes with three different levels of energies. CH choice is grounded, due to 3 levels of heterogeneity and being responsive routing network protocol, it causes increase in constancy period and network life.
Keywords: LEACH, TSAP, IEEE 802.11, Efficiency and Throughput, unicast and broadcast packet, network. EAMMH, TEEN.

I. INTRODUCTION

Improvements in wireless technologies and evolution of low cost sensor nodes have headed to introduction of low power wireless sensor networks. Due to multiple functions and comfort of deployment of the sensor nodes it can be used in various applications such as target tracking, environment monitoring, health care, forest fire detection, inventory control, energy management, surveillance and reconnaissance, and so on [1]. The main responsibility of the sensor nodes in a network is to forward the collected information from the source to the sink for further operations, but the resource boundaries [2], unreliable links between the sensor nodes in combination with the various application demands of different applications make it a difficult task to design an efficient routing algorithm in wireless sensor networks. Planning appropriate routing algorithms for different applications, achieving the different performance demands has been careful as a significant issue in wireless sensor networks. In this situation, many routing algorithms have been planned to improve the performance demands of various applications through the network layer of the wireless sensor networks protocol stack but most of them are founded on routing.

Today, a wireless sensor network is a group of sensor nodes with limited power supply and inhibited computational and broadcasting capability. Because of the limited broadcasting and computational facility, and high density of sensor nodes, promoting of advertisement and data packets are transmission data with multi-hop. Therefore, in the past few years, routing of messages in WSN has been an important area of research. Wireless Technologies based IEEE 802.11 on Wi-Fi system is one of the supreme deployed wireless access technologies around the world.

Reactive routing protocol produces routes only when demanded by source node, unlike to proactive protocols. When a node requires a route to a destination, it initiates a route discovery process within the network. This process is completed once a route is found or all possible routes permutations have been examined [10].

WSN are networks of little battery powered sensor nodes with restricted on-board dispensation, storage and radio competences [3]. Nodes sense and send their information toward a processing center which is called “sink.” The policy of protocols and applications for such WSN networks should be energy aware in order to extend the lifetime of the network, because the standby of the embedded batteries is a very difficult procedure once these nodes have been positioned. Traditional approaches like Direct Transmission and Minimum Transmission Energy [4] do not give assurance for well-balanced supply of the energy load amongst nodes of the sensor network. In Spending Direct Transmission (DT), sensor nodes communicate directly to the sink, as a result node that are remote away from the sink wanted die first [5].

Some protocols are the hierarchical routing protocols which were projected to rise the scalability of the network and make the network energy efficient through node clustering. In this group of protocols all the sensor nodes are grouped into clusters and each cluster will have a cluster head which will be accountable for the collection of data from its cluster nodes, data processing and then promoting the data towards the sink. The geographic Location of the nodes can be obtained directly using Global Positioning System (GPS) devices or indirectly through swapping some information regarding to the signal strengths received at each node. Since the localization needs special hardware support and imposes significant computation overhead, this approach cannot be easily used in resource forced wireless sensor networks. Geographic and Energy-Aware Routing (GEAR) and Geographic Adaptive Fidelity (GAF) can be referred as the geographic routing protocols.

Multipath Routing in Wireless Sensor Networks The limited capacity and transmission competence of multi hop path and high dynamics of wireless links single path method is not able to provide efficient data rate in broadcast in WSN. To overcome these issues now a day's multi-path method is used widely. As mentioned before multi-path routing has established its efficiency to improve the performance of wireless sensor and ad-hoc networks.

II. LITERATURE SURVEY

In this research paper [6] The general IEEE 802.11 WLAN is known to attain relatively small throughput presentation compared to the underlying physical layer (PHY) transmission rate. This is due mostly to the large overheads composed of average access control (MAC) header, PHY preamble/header, backoff time, acknowledgement (ACK) transmission, and some inter-frame spaces (IFSs). Since these overheads are added to each frame transmission, the throughput poverty is comparatively high when the small-size frames are transmitted. In this paper, they present a frame aggregation scheme, which can improve the throughput performance of IEEE 802.11 WLAN. By aggregating small-size frames into a large frame, they can reduce these overheads relatively. The presentation of the frame aggregation is evaluated by both the numerical examination and the actual measurements from the real testbed. Rendering to the measurement results from the real testbed, the frame aggregation can increase the throughput presentation of IEEE 802.11b WLAN by 2 to 3 Mbps, when manifold frames are aggregated.

In this article autho [7] demonstrates wireless sensor network which contains a set of sensor devices that are usually operating on battery power with a limited energy resources and due to the dimensionality of these WSN, replacing the batteries is a complicated task. Thus, energy efficiency is one of the most important issues and designing energy efficient protocols is critical for prolonging the lifetime. In this paper introduces a two routing protocols namely, LEACH and EAMMH in Homogenous and Heterogeneous system supported by simulation scripts, and analysed the results with known metrics such as energy and network lifetime as a major parameter. Author show simulation results using MATLAB, that is the proposed EAMMH in Homogenous and Heterogeneous system significantly reduces energy consumption and increases the total lifetime of the wireless sensor network.

In this research paper [8] Advancement in wireless sensor network (WSN) technology has provided the opportunity of small and minor-cost sensor nodes with potential of sensing various provisions of physical and environmental conditions, data processing, and wireless communication. The importance of diversity of sensing effectiveness is in the excess of application areas. However, the originality of wireless sensor networks requires extra effective approach for data forwarding and processing.

In WSN, the sensor nodes have a restricted transmission range, and their refining and storage potential as well as their energy systems are also restricted. Routing protocols for wireless sensor networks are accountable for maintaining the routes in the network and should create reliable multi-hop communication under certain situations. In this research work, a survey of routing protocols for Wireless Sensor Network there is comparison of strengths. One of the prime design points for a sensor network is maintenance of the energy available in each sensor node. In this work author elaborately compares five renowned routing protocols namely, TEEN, SEP, LEACH and EAMMH, PEGASIS for several general scenarios, and brief analysis of the simulation results was done on known metrics like energy and network lifetime taking in to consideration.

III. PROPOSED TECHNIQUE

Multi-Path Energy Aware Hierarchical phase is broken up into rounds, where each round begins with a set-up phase, when the clusters are organized, it was followed by a steady- state phase, when data transfers to the base station.

A. Neighbor Discovery Phase:

Neighbor discovery phase involves Multi-Path Hierarchical techniques. In which, the Chief path is built with the best possible neighbor (having the minimum Location Factor(LF)) and the Alter path is constructed with the next best neighbor (having the next minimum Location Factor(LF) after the Chief Path Node). The Alter Nodes find one single path towards the source Node and searches its neighbor table for the Node with minimum Location Factor(LF) and will prefer a Chief Node if possible, this is done to converge the path else the path can diverge from its direction toward the source, Next hop is chosen by the following equations 1 and 2 [9].

$$NHop_i = \min(LF_i)$$ Equation-1

$$LF_i = (Loc_{Scr} - Loc_x)\forall x \in Negb_i)$$ Equation-2

Where,
1) LF_i = Set of distance of all the neighbors of $Node_i$ from the source.
2) Loc_{scr} = Location of the source Node,
3) Loc_x = Location of the $Node_x$ and
4) $Negb_i$ = Neighbor set of $Node_i$.

Here it is an incremental approach from the Home to the source. First the Home Node which is itself a Chief Node, selects two neighbors based on the equation 1. Out of these two neighbor Nodes one with the minimum location factor becomes the next Chief Node and the Node with the second minimum location factor becomes the Alter Node and with this step we initialize the multipath construction phase.

In our TSMEHP protocol, this paper discusses about energy model and how optimal number of clusters can be computed, here it uses three energy levels of heterogeneity, Nodes with different energy levels are:
Regular Nodes
Active Nodes
Smart Nodes

Smart Nodes having energy greater than all other Nodes, Active Nodes with energy in between Regular and Smart Nodes while remaining Nodes are Regular Nodes. Active Nodes can be chosen by using l, a fraction of Nodes which are Active Nodes and using the relation that energy of Regular Nodes is µ times more than that of Regular Nodes.

Fraction of Smart Nodes (m) and the additional energy factor between Smart and Regular Nodes (α), Where assumes that each Node knows the total energy of the network to adapt its election probability to become a cluster head (CH) according to its remaining energy [5]. Our approach is to assign a weight to the optimal probability P_{opt}. This weight must be equal to the initial energy of each Node divided by the initial energy of the Regular Nodes. Let us define as P_r the weighted election probability for Regular Nodes and P_s the weighted election probability for the Smart Nodes.

Nearly there are n*(1+α*m) Nodes with energy equal to the initial energy of a Regular Nodes. In direction to maintain the lowest energy consumption in each round within an epoch, the usual number of cluster heads per round per epoch must be constant and equal to n* P_{opt}. In the heterogeneous scenario the average number of cluster heads per round per epoch is equal to n*(1 + α*m) *P_r (because each virtual Node has the initial energy of a Regular Node). The weighed probabilities for Regular and Smart Nodes are, respectively:

$$P_r = \frac{P_{opt}}{1+\alpha*m+l*\mu}$$ Equation -3

Equation -4

Here relace P_{opt} by the weighted probabilities to obtain the threshold that is used to elect the cluster head in each round. We define as T_r the threshold for Regular Nodes and T_s the threshold for Smart Nodes. Thus, for Regular Nodes,

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue X, October 2017- Available at www.ijraset.com

$$T_r = \begin{cases} \frac{P_r}{1-P_r*(Cr*mode\frac{1}{P_r})} & if\ n_r \in G' \\ 0 & otherwise \end{cases}$$ Equation -5

$$T_s = \begin{cases} \frac{P_s}{1-P_s*(Cr*mode\frac{1}{P_s})} & if\ n_s \in G'' \\ 0 & otherwise \end{cases}$$ Equation -6

G′ and G″ are the set of Regular Nodes and set of Smart Nodes that has not become CHs in the last $\frac{1}{P_s}$ respectively, so ensuring that the equations 3 and 4 are working for rounds of the epoch, and T_s is the threshold applied to a population of n*m Smart Nodes. This guarantees that each Smart Node will become a cluster head (CH) exactly once every $\frac{1}{P_{opt}} * \frac{1+\alpha*m}{1+\alpha}$ rounds. Let us define this period as sub-epoch. It is clear that each epoch (let us refer to this epoch as “heterogeneous epoch” in our heterogeneous setting) has (1+α)sub-epochs and as a result, each Smart Node becomes a cluster head exactly (1+α)times within a heterogeneous epoch.

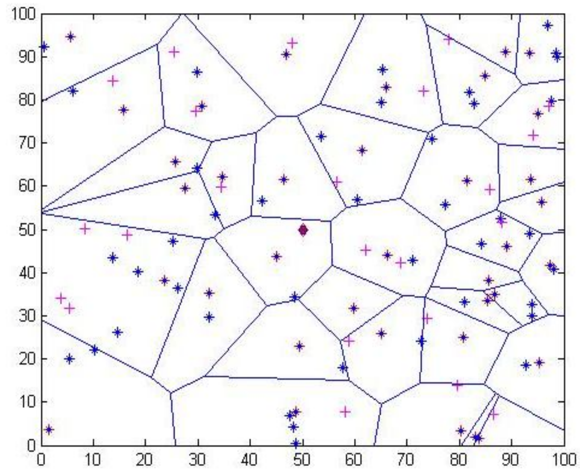

Figure 1: Wireless Sensor Node Field 100 X 100 Meters with Cluster Head Selection

The average number of cluster heads per round per heterogeneous epoch (and sub-epoch) is equal to n*m*Psv. The average number of cluster heads per round per heterogeneous epoch is equal to the average number of cluster heads that are normal Nodes per round per heterogeneous epoch plus the average number of cluster heads that are Smart Nodes per round per sub-epoch. This average number is given by

$$n * P_{opt} = n * (1-m) * Pr + n * m * Ps$$

Equation-7

IV. SIMULATION AND EXPERIMENTATION

This paper aimed at performance evaluation by using MATLAB. Objectives of this research focuses on doing simulations for comparing the performance of Threshold Sensitive Stable Election Multi-path Energy Aware Hierarchical Protocol (TSMEHP), with LEACH, TSEP, ESEP, and TEEN protocols on the root of energy dissipation and durability of network.

A. Performance metrics used in the simulations are:

1) Stability period, the period from the start of the network operation and the first dead node.

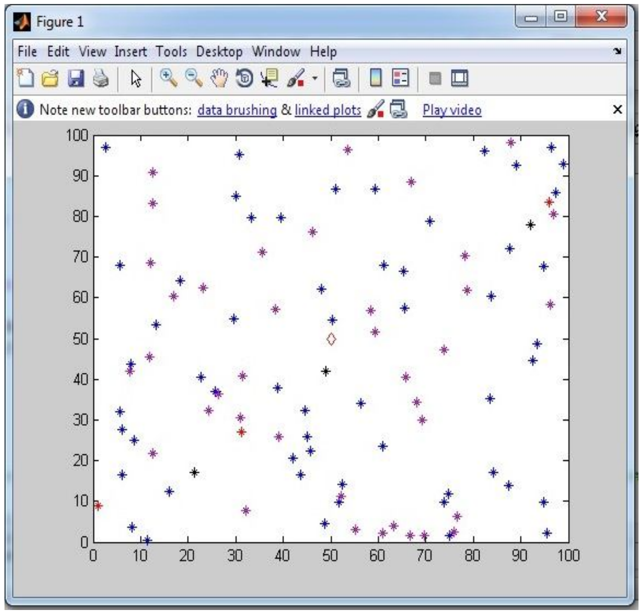

Figure 2: Wireless Sensor Node Field 100 X 100 Meters

A network residing of 100 nodes, sited randomly in a region of M x M and a Base Station BS located in the center is careful.

Table 1: Parameters and setting used in our simulations

S. No	Parameters	Value
1	E_{elect}	50nJ/bit
2	E_{DA}	5nJ/bit/message
3	ε_{fs}	10pJ/bit/m2
4	ε_{mp}	0.0013pJ/bit/m4
5	E_o	0.5J
6	k	4000
7	ρ_{opt}	0.1
8	n	100
9	α	1
10	m	0.1

Firstly, consider the case 1, in which we put α= 1, and m = 0.1 after it we simulate our algorithm and analysis the result which are given below.

In this paper we performed simulations for different values of α and m -

2) For First case α= 1, m = 0.1,

3) For Second case α= 2 and m = 0.2,

4) For Third Case α= 3, m = 0.3.

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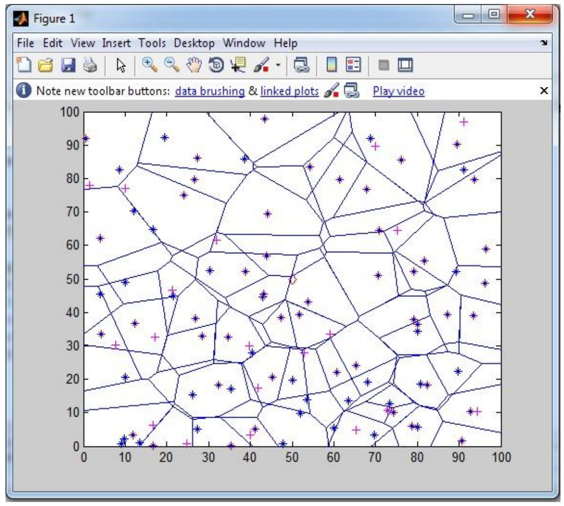

Figure 3: Wireless Sensor Node Field 100 X 100 Meters with Cluster Head Selection where α= 1, m = 0.1

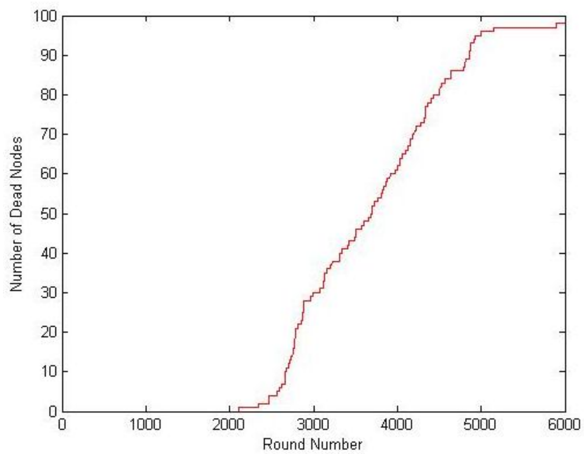

Figure 4: Shows behavior in the presence of heterogeneity with α = 1 and m = 0.1 of Number of dead nodes per Round

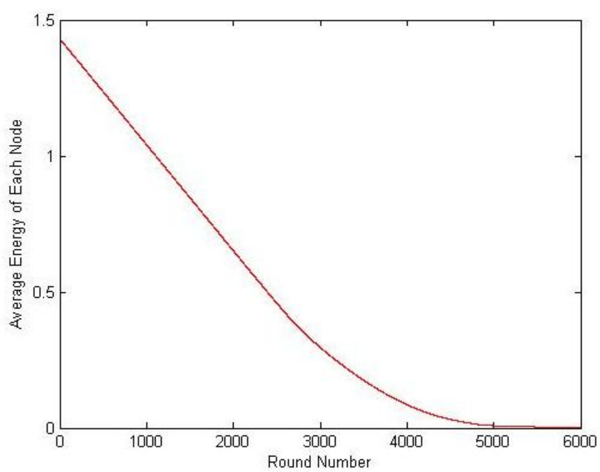

Figure 5: Shows behavior in the presence of heterogeneity with α = 1 and m = 0.1 of Average Energy of each nodes per Round

This is done to observe change in network's stability, life and throughput relative to increase in number of advance nodes and their energies. With reference to equations (3) and (4), p_{opt} = 0.1, is the optimal probability of CHs, we obtained different probabilities for each type of nodes in accordance with different values of α and m. Other parameters used in simulations are shown in Table 1.

By using equations (5), (6), CHs election for Regular and Smart nodes respectively, can be known.
In Case 2, in which we put α= 2, and m = 0.2 after it we simulate our algorithm and analysis the result which are given below.

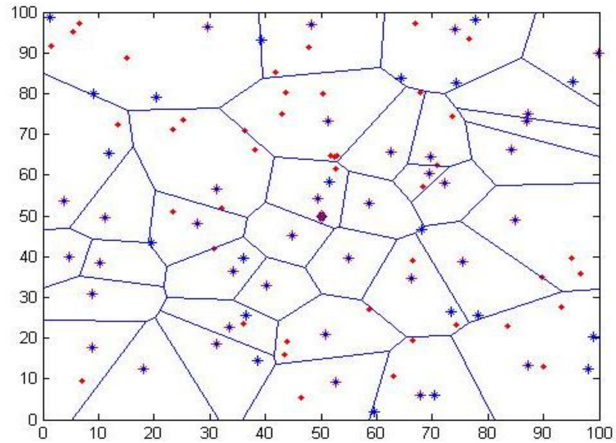

Figure 6: Wireless Sensor Node Field 100 X 100 Meters with Cluster Head Selection where α= 2, m = 0.2

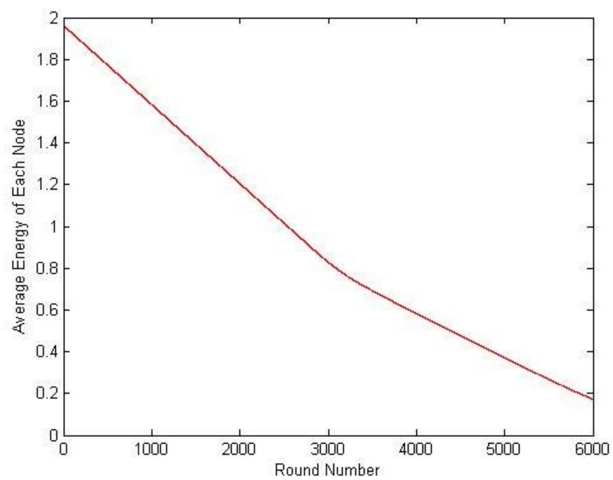

Figure 7: Shows behavior in the presence of heterogeneity with α = 2 and m = 0.2 of Average Energy of each nodes per Round

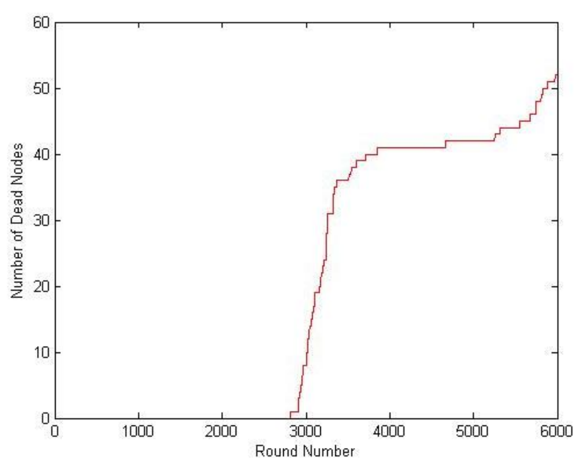

Figure 8: Shows behavior in the presence of heterogeneity with α = 2 and m = 0.2 of Number of dead nodes per Round

Nodes keep on detecting nonstop but transmission is not done frequently, so energy consumption is much more less than that of proactive networks. At time of cluster change, values of de-active threshold, (TR) and (A) are transmitted afresh and so, user can decide how often to sense and what parameters to be detected according to the criticality of detected attribute and application. The user can change the attributes depending on requirement, as attributes are broadcasted at the cluster change time. One of the main trades off of this scheme is that if threshold is not reached, user will not get any information from network and even if one or all the Nodes die, system will not come to know about that. So, it is not useful for those types of applications where a data is required regularly.

While, average number of CHs is same as that of LEACH, SEP, ESEP, TSEP and a good aspect of TSMEHP protocol which is energy dissipation is reduced due to energy heterogeneity. At the start of each round, here takes place the phenomenon of cluster change. In case of TSMEHP protocol, at cluster change time, the CH broadcasts nodes response parameters are given in table 1.

Report Time (TR): During time which reports are being sent by each Node successively.

Attributes (A): The physical parameters about which information is being sent.

Active Threshold (AT): An absolute value of identified attribute beyond which Node will transmit data to CH. As if recognized value becomes equal to or greater than this threshold value, Node turns on its transmitter and sends that information to CH.

In Case 3, in which we put α= 3, and m = 0.3 after it we simulate our algorithm and analysis the result which are given below.

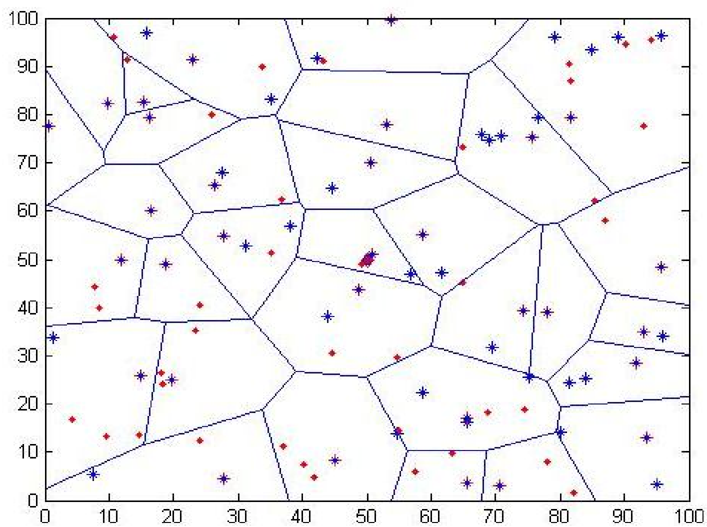

Figure 9: Wireless Sensor Node Field 100 X 100 Meters with Cluster Head Selection where α= 3, m = 0.3

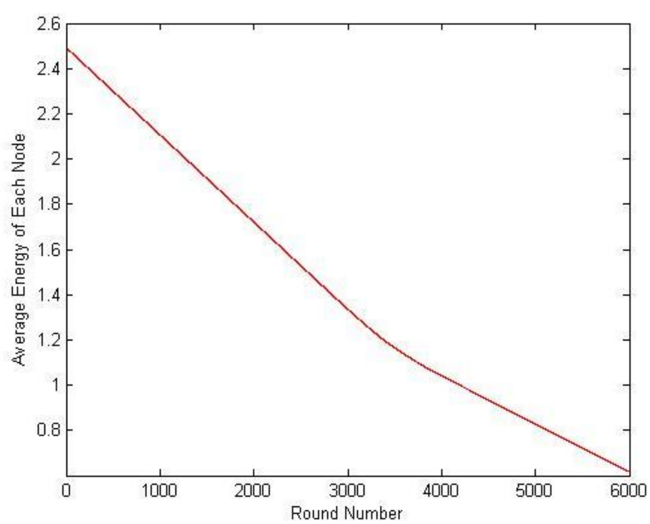

Figure 10: Shows behavior in the presence of heterogeneity with α = 3 and m = 0.3 of Average Energy of each nodes per Round

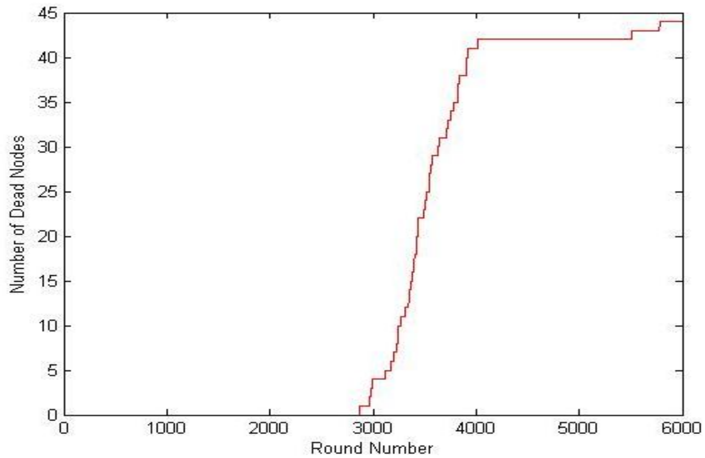

Figure 11: Shows behavior in the presence of heterogeneity with α = 3 and m = 0.3 of Number of dead nodes per Round

This protocol assumes that all nodes keep on detecting environment nonstop. As parameters from attribute set reaches active threshold value, transmitter is turned on and data is transmitted to CH, however this is for the first time when this condition is met.

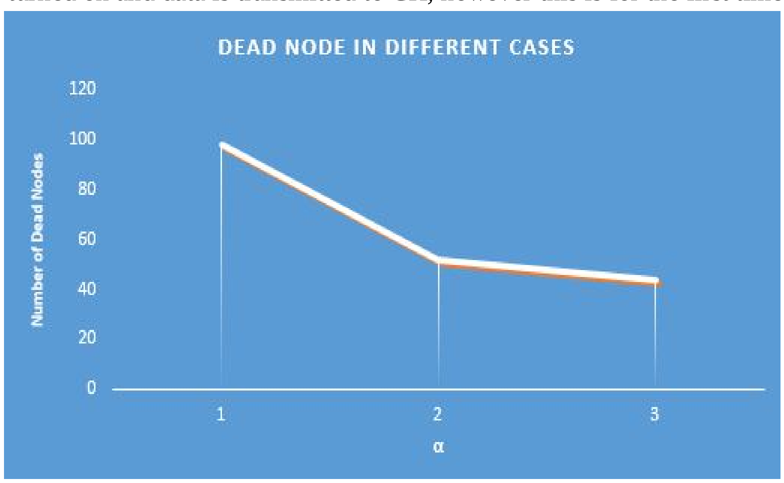

Figure 12: Comparing of numbers of dead nodes in different - different case where α=1, 2, 3 and m = 0.1, 0.2, 0.3 respectively show comparison of protocols SEP, ESEP, TSEP, LEACH,

TEEN, and our proposed protocols TSMEHP regarding dead nodes with relative to number of rounds. Comparing all these protocols, LEACH and SEP being heterogeneous, probability based protocols result in nearby equal stability period and network life.

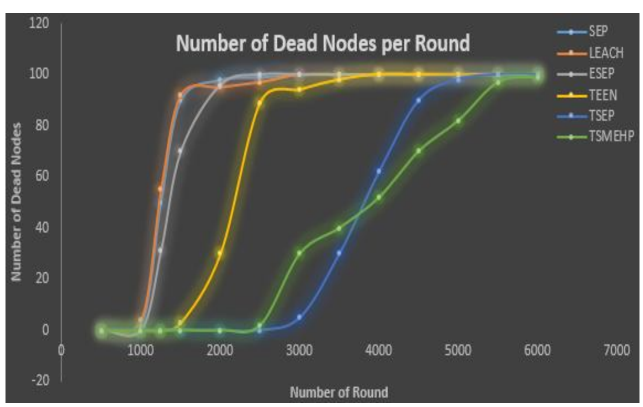

Figure 13: Show Comparison of protocols ESEP, SEP, TSEP, LEACH, TEEN and TSMEH

For instance, in SEP and LEACH, CHs selection is founded on probability, while, if LEACH would be measured with homogeneity then there would be a huge difference. ESEP with 3 levels of heterogeneity and probability based protocol clearly shows better results than LEACH and SEP, as can be decided through equations 3. It is analysis that in TEEN stability period is superior than all other protocols discussed. In the protocol TSEP also being threshold based protocol with an additional feature of three levels of heterogeneity results in increased stability period and network life even greater than that of TEEN and node dead per round was also decreased. But our proposed protocols TSMEHP Nodes keep on sensing and so energy consumption is less than other protocols resulting in increased stability period and network life even greater than that of TSEP and node dead per round was become greater decreased. So, from it is clear that this new proposed protocol TSMEHP is superior than all other protocols discussed.

V. CONCLUSION

This research paper proposed "Threshold Sensitive Stable Election Multi-Path Energy Aware Hierarchical Protocol" (TSMEHP) protocol technique in which every sensor node has three energy levels of heterogeneity ordered network which autonomously selects itself as a cluster head CH based on its initial energy relative to that of other nodes. In this paper the Experimental analysis of simulation results and observations made with all these protocols are presenting overtakes regarding life time of sensing Nodes.

For instance, in SEP and LEACH, CHs selection is founded on probability, while, if LEACH would be measured with homogeneity then there would be a huge difference. ESEP with 3 levels of heterogeneity and probability based protocol clearly shows better results than LEACH and SEP. It is analysis that in TEEN stability period is superior than all other protocols discussed. In the protocol TSEP also being threshold based protocol with an additional feature of three levels of heterogeneity results in increased stability period and network life even greater than that of TEEN and node dead per round was also decreased. In this paper TSMEHP, responsive routing protocol is proposed where nodes with three different levels of energies. CH choice is threshold grounded, due to 3 levels of heterogeneity and being responsive routing network protocol, it causes increase in constancy period and network life. So, our proposed protocols TSMEHP Nodes keep on sensing and so energy consumption is less than other protocols resulting in increased stability period and network life even greater than that of TSEP and node dead per round was become greater decreased. So from it is clear that our proposed protocols TSMEHP is superior than all other protocols discussed.

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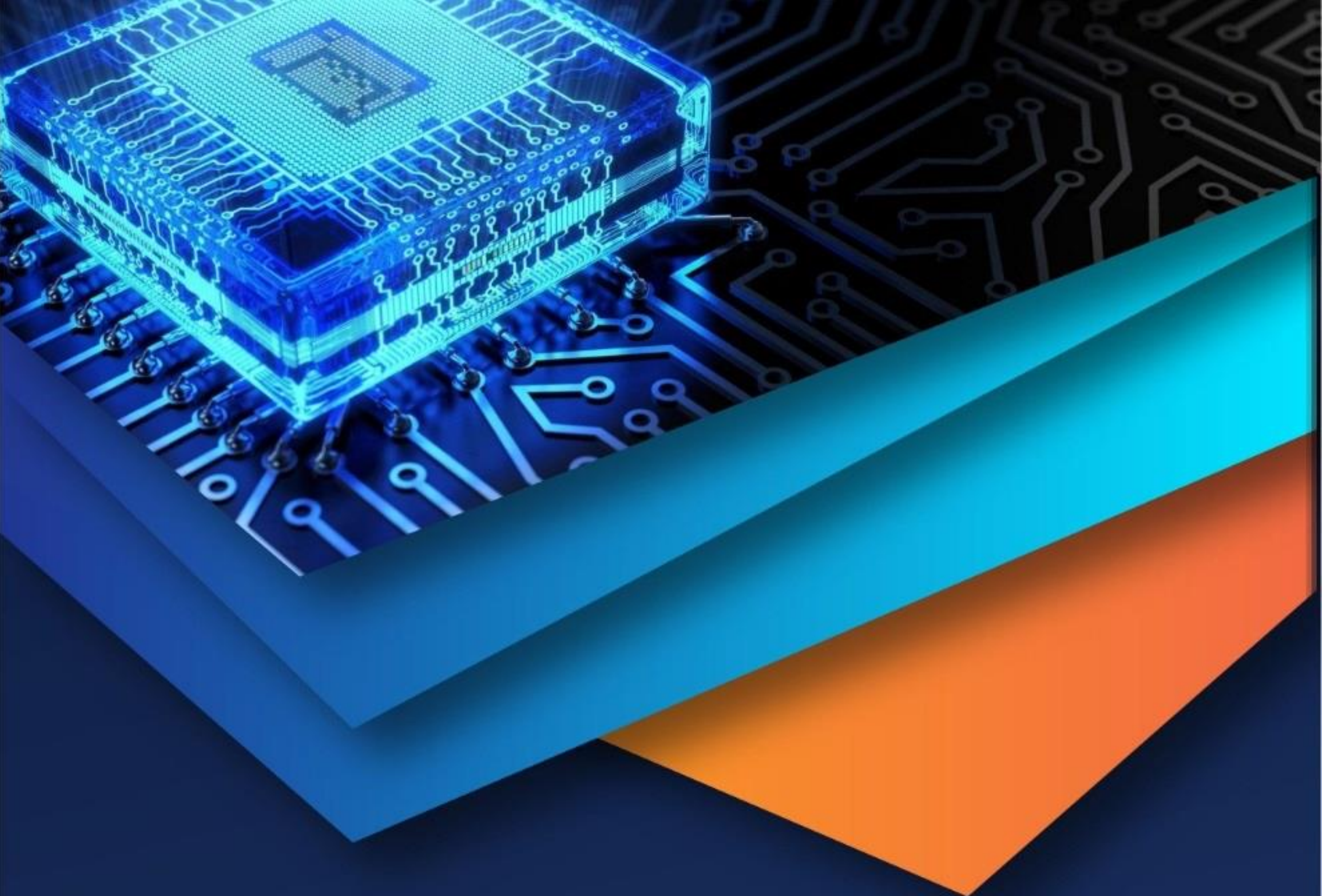

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