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# A Comprehensive Study and Review on Wireless Sensor Networks, Based on Heterogeneous Energy Distribution & Multizone Algorithm

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**Abstract:** Wireless Sensor Networks(WSNs) is built of "nodes" –from a few to several hundreds or even thousands where each node is node is connected to one ( or sometimes several ) sensors. Sensors nodes having limited power resource which describe sensed data to the base station that requires high energy usage. There are several routing protocols have been proposed in recent years, achieving energy efficiency in heterogeneous scenarios. Still, every protocol is not desirable for heterogeneous wireless sensor networks (WSNs) .In this paper there are algorithms- Distributed energy efficient clustering (DEEC), Developed distributed energy efficient clustering (DDEEC), Enhanced distributed energy efficient clustering (EDEEC) and Threshold distributed energy efficient clustering (TDEEC) which is designed for heterogeneous wireless sensor Networks. In this paper we first discuss performance of heterogeneous wireless sensor networks, which is prolonging the lifetime and stability of the network and throughput .we compare performance of DEEC, DDEC, EDEEC, and TDEEC, for different scenarios of three and multilevel heterogeneous wireless sensor networks.

**Index Term:** Cluster, Head, Residual, Energy, Heterogeneous, Efficient, Wireless, Sensor, Networks.

## I. INTRODUCTION

Recent advances technology developments in the field of micro-electro-mechanical sensor and wireless sensor networks have enabled the development to tiny, low power, low cost sensors having limited processing capability. Wireless sensor includes specification and application and senses the physical environmental such as temperature, humidity, light, sound, vibration etc. These wireless sensor networks are very useful for military surveillance, environmental, traffic, disaster areas [1]. Today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring air pollution monitoring, forest fire detection, landslide detection, water quality monitoring and so on. These sensors are somewhat different from optical fiber sensors and also having different properties from them**[2].**To achieve fault tolerance, these wireless sensor networks have several nodes such as hundreds or even thousands, all the nodes have to send their data towards base station often called as sink. Hierarchical-based routing cluster based routing in which high energy nodes are easily selected during the time of processing and sending data. According to the low energy nodes are used for sensing and send data to the cluster heads. Clustering technique is the key technique for decreasing high energy nodes in which members of cluster select a cluster head (CH).

When long distance present between the nodes and base station (BS), then the direct communication is not possible to the base station due to limited battery as direct communication requires high energy.

Clustering technique enables the wireless sensor networks to work more efficiently. Clustering can be done in two types of networks –homogeneous and heterogeneous networks which are based on energy.

In Homogeneous networks, nodes have same initial energy while in heterogeneous networks nodes have different initial energy .Algorithms designed for homogeneous wireless sensor networks are such as Low-energy adapting clustering Hierarchy (LEACH), Power efficient gathering in sensor information system (PEGASIS), Hybrid energy efficient distributed clustering (HEED) etc. which does not perform well in heterogeneous networks .

In heterogeneous wireless sensor networks algorithms have been proposed such as –Distributed energy efficient clustering (DEEC), Developed distributed energy efficient clustering (DDEEC), Enhanced distributed energy efficient clustering (EDEEC), and Threshold distributed energy efficient clustering (TDEEC) etc[3]. In this paper we describes the performance of heterogeneous wireless sensor networks and also compare the DEEC, DDEEC, EDEEC, and TDEEC for different scenarios. Heterogeneous wireless sensor networks protocols contains three and multilevel networks. In three level networks have normal, advanced and super nodes, super nodes having higher energy level as compare to the normal and advanced nodes. The performance of DEEC, DDEEC containing high energy level difference between normal advanced and super nodes in terms of stability period. Three level heterogeneous WSNs EDEEC and TDEEC, which containing low energy level difference between normal, advanced and super nodes in terms of both stability period and network lifetime.

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The rest of paper is organized as follows: section 2 explains the related work done .section 3 describes the radio energy dissipation model .section 3 and section 4 describes the networks model and also compares the DEEC, DDEEC, EDEEC, and TDEEC for different scenarios. Section 5 gives the performance criteria simulation and discussion .section 6 describes future scope and conclusion.

## II. RELATED WORK

**2000:** Power Efficient Gathering in Sensor Information System (PEGASIS), Hybrid Energy- Efficient Distribution Clustering (HEED) are algorithms designed for homogeneous wireless sensor networks. Clustering algorithm has been proposed for homogeneous WSNs such as low –energy adaptive clustering hierarchy (LEACH), which is introduced by Heinzelman, et al **[4].**
**2001:** Manjeshwar et. al. introduced Threshold sensitive Energy Efficient sensor network protocol (TEEN) . TEEN is not good for application **[5].**
**2002:** Harneet Kour, et. al. introduced LEACH-centralized (LEACH-C), which protocol uses as a centralized clustering algorithm. The Adaptive Threshold sensitive Energy Efficient sensor Network protocol (APTEEN) which architecture is same as TEEN .The main demerits of TEEN and APTEEN are the overhead and complexity of forming clusters **[6].**
**2004:** In homogeneous wireless sensor networks protocols do not perform properly under heterogeneous scenarios because these algorithms are not able to treat nodes differently in terms of their energy. Whereas, Stable Election Protocol (SEP) is introduced in which every sensor node in a heterogeneous two- level hierarchical network independently elects itself elects itself cluster head based on its initial energy. All the nodes belonging to cluster send their data to CH, Where, CH aggregates data and sends the aggregated data to the BS **[7].**
**2006:** Li Qing et. al. worked on DEEC (Distributed energy efficient clustering) which cluster head is on the basis of probability of ratio of residual energy and average energy of the network**[8].**
**2010:** DDEEC (Developed distributed energy efficient clustering) which is designed for multilevel heterogeneous WSNs .EDEEC (Enhanced distributed energy efficient clustering) which is extended three level heterogeneity such as normal advanced and super nodes **[9].**
**2011:** Parul saini and Ajay K Sharma worked on a protocol TDEEC (Threshold distributed energy efficient clusterin ) which selects the cluster head from the high energy nodes also increasing efficiency and lifetime of the network and packets sent to the base station**[10].**

## III. RADIO ENERGY DISSIPATION MODEL

The radio energy model describes radio hardware energy dissipation that L bit message is transmitted a distance d ,the radio expends

$$E_{Tx}(l,d) = \begin{cases} lE_{elec} + l\varepsilon_{fs}d^2, & d < d_0 \\ lE_{elec} + l\varepsilon_{mp}d^4, & d \geq d_0 \end{cases}$$

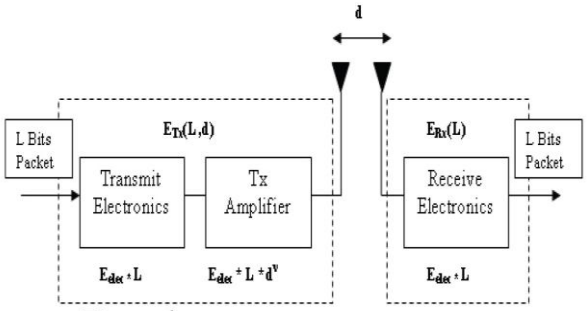

Figure1: Radio Energy DissipationModel

d is the distance between the transmitter and reciver .When distance d is less than threshold $d_0$, the free space model is used; otherwise multipath model is used.where ,$E_{elec}$ is the energy dissipated per bit to run the transmitter and the reciever circuit .The electronis energy , $E_{elec}$ ,depends on digital coding , modulation, filtering etc.

## IV. NETWORK MODEL OF HETEROGENEOUS WIRELESS SENSOR

In this network model, the wireless sensor network is used N number of nodes, which dimension is M x M placed in a network field .Heterogeneous wireless sensor networks algorithms are designed for two level, three level and multilevel heterogeneous wireless sensor networks.
According to two level heterogeneous model WSNs have two nodes such as normal and advanced nodes.
The energy of the normal node $=E_0$
Energy of the advanced node is $=E_0(1+a)$
Nm=number of advanced nodes, where m is the fraction of advanced nodes.
N(1-m)=number of normal nodes
$E_{total}=NE_o(1+am)$
In three levels heterogeneous wireless sensor networks have three nodes such as normal advanced and super nodes. N is total number of nodes.
The energy of the normal node $=E_0$
Energy of the advanced node is $=E_0(1+a)$
Energy of super node is $=E0(1+b)$
$Nmm_0$=total number of super nodes
$Nm(1-m_o)$=total number of advanced nodes
$E_{total} = NE_o(1+m(a+m_ob))$
In multilevel heterogeneous network model that have multiple energy levels.
Multi-level network is given by:

$$E_{total} = \sum_{i=1}^{N} E_0(1+a_i) = E_o(N + \sum_{i=1}^{N} a_i)$$

## V. OVERVIEW OF DEEC, DDEEC, EDEEC, TDEEC FOGENEOUS WIRELESS SENSOR NETWORK:

In distributed energy efficient clustering the method for selection of cluster head is based on initial and residual energy of nodes. $p_i$ is the probability of each node $s_i$ to become cluster head .
Probability of for CH selection in DEEC is follows as:

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$$p_i = p_{opt}\left[1 - \frac{\bar{E}(r) - E_i(r)}{\bar{E}(r)}\right] = p_{opt}\frac{E_i(r)}{E(r)}$$

The average total number of CH during each round is follows as:

$$T(s) = \begin{cases} \dfrac{p}{1 - p.(r \bmod \frac{1}{p})} & if\ s\ \varepsilon\ G \\ 0 & otherwise \end{cases}$$

In developed distributed efficient clustering The selection of cluster head is based on residual energy as implemented in DEEC.
Average probability $p_i$ for cluster head selection used in DDEEC which is given by:

$$p_i = \begin{cases} \dfrac{p_{opt}\,E_i(r)}{(1+am)E(r)} & for\ Nml\ nodes, E_i(r) > Th_{REV} \\ \dfrac{(1+a)p_{opt}\,E_i(r)}{(1+am)E(r)} & \text{for Adv nodes, } E_i(r) > Th_{REV} \\ c\dfrac{(1+a)p_{opt}\,E_i(r)}{(1+am)E(r)} & \text{for Adv, Nml, nodes, } E_i(r) \le Th_{REV} \end{cases}$$

In enhanced distributed energy efficient clustering follows the thought of DEEC and adds another type of node called super nodes to increase heterogeneity. Threshold CH selection three types of node is given as:

$$T(s_i) = \begin{cases} \dfrac{p_i}{1 - p_{i(\text{rmod}\frac{1}{p_i})}} & \text{if } p_i \varepsilon G' \\ \dfrac{p_i}{1 - p_{i(\text{rmod}\frac{1}{p_i})}} & \text{if } p_i \varepsilon G'' \\ \dfrac{p_i}{1 - p_{i(\text{rmod}\frac{1}{p_i})}} & \text{if } p_i \varepsilon G''' \\ 0 & \text{otherwise} \end{cases}$$

Threshold distributed energy efficient clustering (TDEEC) CH selection is same as DEEC; if number is less than threshold then nodes decide to become cluster head .Threshold value is given by:

$$T(s) = \begin{cases} \dfrac{p}{1 - p(\text{rmod}\frac{1}{p})} \\ * \dfrac{\text{residual energy of a node} * k_{opt}}{\text{average energy of the network}} \end{cases}$$

## VI. PERFORMANCE CRITERIA

Performance criteria in wireless sensor used to the evaluation of clustering protocols are lifetime advancement parameter of heterogeneous wireless sensor networks such as number of nodes alive during rounds and data packets received at the base station. These parameters conclude about the stability period, achieving energy efficiency, network lifetime, throughput, energy consumption, data transmit to the base station, and data received by base station and lifetime of wireless sensor networks.

## VII. CONCLUSION AND FUTURE SCOPE

We have discussed in this paper the multi zone algorithms which is designed in heterogeneous wireless sensor networks such as DEEC, DDEEC, TDEEC, EDEEC perform efficiently in different level heterogeneous scenarios in wireless sensor networks .DEEC and DDEEC perform with high energy level difference between normal advanced and super nodes in terms of stability period .However not good performance as compared EDEEC and TDEEC in terms of network lifetime. EDEEC and TDEEC performance well in terms of stability period.

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