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Hop Selection Optimization to Maximize Lifetime of Wireless Sensor Network

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ABSTRACT

Wireless Sensor Networks (WSNs) has attained wide attention due to availability of low cost and tiny sensor devices. The sensor network has been adopted by various industries and organization for various application needs. The sensor device is composed of resource constrained devices/components and is powered by batteries. The sensor devices are deployed remotely hence preserving the battery is most desired. There has been various clustering protocol have been developed in recent times to improve the energy efficiency of sensor network. The energy degradation of sensor nodes is directly dependent on distance it transmits as a result the energy of nodes closer to cluster head degrades significantly. To address this we present hop based transmission optimization technique for both inter and intra cluster transmission. This work presents a Transceiver Optimization based Hop Selection model (TO_HS) that minimize the power consumption of each sensor device and maximize the energy efficiency of sensor network. Experiment is conducted through simulation and evaluated the performance in terms of energy efficiency and lifetime of sensor network for homogeneous cluster network for various node densities and is compared with LEACH protocol. The outcomes show significant performance improvement over LEACH interm of energy efficiency and lifetime of sensor network.

Keywords - Clustering, Hop, MAC, Physical layer, Transceiver design parameter.

1. INTRODUCTION

WSN has been growing and attained wide interest across various industries in recent times. WSN is been adopted in various industries and organization for varied application use such as for surveillance, environment monitoring etc. The WSN is composed of collection of sensor devices that sense and collects environmental information and sends the sensory information to its nearby sink/base station [1] [2]. The availability of tiny and low cost sensor have resulted, in adoption of WSN in various application services from monitoring forest, tracking movement of animal and human for protection of wild life, disaster management, predicting catastrophic and so on. The component of sensor devices in sensor network is composed of following thing as, a transceiver for communicating among sink/base station and sensor devices, microcontroller for computation purpose, sensors for sensory information extraction form real world and lastly supply of power which are generally battery powered which is shown in Fig. 1.

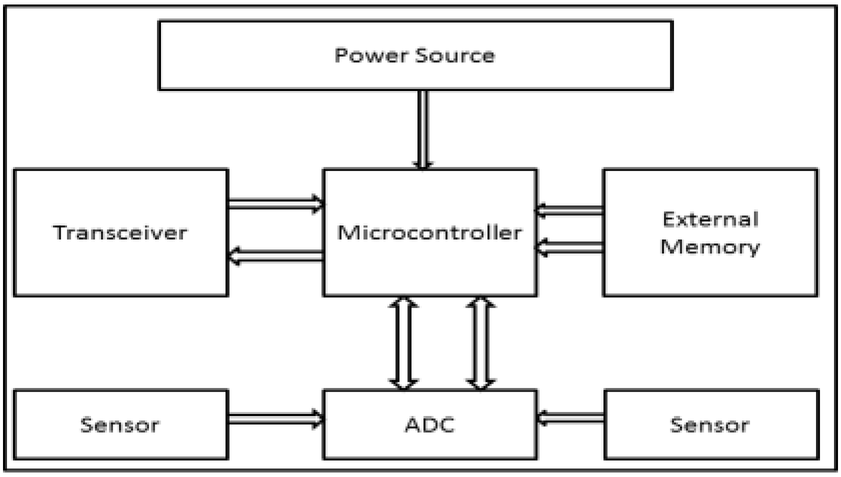

Figure 1. Components of Sensor nodes

Transceiver is one of the major component of sensor devices that operates at certain frequency specific to environmental factors. When designing transceiver circuit the network protocols needs to adopt the power saving mechanism. The transceiver are broadly classified into following state; Transmit State, Receive State, Idle State, Sleep State, Active state and Transition States. In active state, the transceiver is said to be active or in idle state waiting for trigger/command from internal/external source and it is ready for transmission and the transceiver is switched on. The transceiver transmits/receives data from internal/external source. In receive state, the receiver is said to be in active state and start receiving data from faraway located transmitter. In transmit state, the power depletion to transmit packet is largely consumed by amplifier and transmitter electronics. In idle state, the transceiver is said to be in active mode but does not transmit/receive bits of data at present and hence it is considered to be in idle state. In this state major circuitry component of transceiver are switched on/active and rest of the component are switched off. The power consumption of idle state transceiver is almost equal to receive state power consumption. In transition states, the power depletion is due to activation and deactivation function of electronic components. In sleep state, most of the components of transceiver are put into sleep mode/switched off. There is various sleep state mechanism [1] [3] but each mechanism varies in terms of startup energy consumption, number of component switched of and recovery time [4] [5].

Most of existing research has focused on evaluating the performance among self-organization and low energy protocols [6]. The key aspect to improve lifetime of sensor network is to study characteristic of power consumption at sensor device. The main factor that affects the energy consumption of sensor device is due to idle state in the transceiver where sensor devices does not transmit/receives any bits of packet but listening to any new coming packets from other sensor devices. The other factors that affect the energy of sensor devices is due to collision of packets as a result the packets are retransmitted. The data transmission and retransmission in control channel for reception of acknowledge packets further induce power consumption. Therefore it is quiet necessary to reduce energy dissipation per bit of packet to enhance the lifetime of sensor network. To accomplish it the data bit must be transmitted to the sink with in a stipulated time frame which aid in reducing end to end delay. To improve the energy efficiency of sensor network the clustering technique has been adopted by various researchers [7] [8]. In [9] authors presented a centralized clustering for $LEACH$ protocol namely $LEACH - C$ to address the overhead caused at sensor node for cluster head selection. In [10] authors presented residual energy based cluster head selection strategy namely $LEACH - CE$ to improve energy efficiency. In [11] authors presented K-mean based cluster technique for $LEACH$ protocol, $LEACH - CKM$ to optimize the number of cluster formation. In [12] authors presented an energy efficient reliable routing E^2R^2 by adopting multihop based for cluster network which attained significant performance improvement over $MLEACH$ [13]. The drawback of these protocols is that the energy of sensor devices around cluster head depletes very fast as a result reduces lifetime of network.

To address the aforementioned issue this work presents a transceiver optimization based hop node selection strategy for cluster network to reduce energy dissipation of sensor device. The paper organization is as follows: In section II the literature survey is presented. The proposed model is presented in section III. In section IV, the simulation and experimental studies are presented. The concluding and future work is discussed in the last section.

2. LITERATURE SURVEY

There have been several methodologies that have been proposed in recent times in order to improve the energy efficiency of wireless sensor network which are surveyed below.

In [7] [8] authors presented a hierarchical clustering protocol namely $LEACH$, and selection of cluster head in $LEACH$ is as follows. In every round, for a particular sensor device d a random uniform value between 0 and 1 is obtained and the obtained value is compared with the threshold $H(d)$ of corresponded to this sensor devices. If the obtained value is less than $H(d)$, then this sensor devices elect himself as cluster-head in that particular round and the value of the threshold is updated in each and every round. $H(d)$ is calculated as

$$H(d) = \begin{cases} \frac{r}{1 - r \times [\varphi mod(1/r)]}, & if\ d \epsilon \bar{S}; \\ 0, & Otherwise. \end{cases}$$

where r represents mean ratio of cluster head in every round to the total sensor devices, $\varphi, 0 \leq \varphi < \infty,$ is the current round number, and $\bar{S}$ is the collection of sensor devices that has not elected as cluster head of period $1/r$ rounds, that is, rounds $0 \sim 1/r - 1$, rounds $1/r \sim 2/r - 1$, ... and so on. Based on the $H(d)$ equation every sensor device behaves as CH for a particular period in a round. In the next round this sensor devices is removed for cluster head selection candidate.

In [14] authors presented regional aware clustering strategies to address the isolated device problem in sensor network namely ($REAC - IN$). They addressed the energy efficiency issue cluster network due to overhead caused for cluster and cluster head assignment and selection. To address the cluster head selection they presented a weight based cluster head. The cluster head selection is based on residual energy and mean energy of each region of cluster is considered which addresses the distributed clustering energy degradation in communicating with sink/base stations. Simulation of their protocol is conducted and compared with existing strategy such as $LEACH$, $HEED$[15], $DEEC$ [16], $REAC$ for network lifetime analysis shows an improvement of 40% over $LEACH$ protocols.

In [17] authors proposed a dynamic cluster head selection method ($DCHSM$) for WSN. They addressed the sensor network coverage and energy efficiency of sensor devices. They used voronoi diagram to find the cluster head. Their method improves in reducing the data redundancy during transmission and also reduces energy dissipation of sensor devices and also addresses the disproportion of the energy consumption and extending the life time of the network. The lifetime of network is improved by over 50% for $LEACH$, and improved by 30% for $DEEC$, also the survival time of the network is longer than that of Energy-balanced deterministic clustering algorithm (EBDC) and adaptive energy optimized clustering algorithm ($AEOC$), achieving the effectiveness of the network energy consumption, and it has the longest network life time. The re-division of the monitoring area after the death of all the redundant nodes under the same coverage area is not considered here.

In [18], Fuzzy c-means (FCM) is a centralized strategy for cluster formation that uses residual energy and sensor device location to choose the cluster head. It allocates a degree of belonging to every sensor devices for every cluster head rather than being a cluster member of a cluster. This methodology protocol adopts FCM algorithm in order to form cluster that aid in minimizing the spatial distance between the devices which in turn aid in forming a good cluster. The cluster formation is performed by minimizing an objective function, which consists of the degree of belongingness and the distance among the sensor devices and center point of the cluster. The principle used here is based on fuzzy logic in order to obtain the degree of belongingness after it has been calculated. Once the completion of first phase of clustering and data transmission, the present cluster head select a new CH for next phase which depends upon the energy received from every sensor device. The FCM strategy is an efficient way to distribute the sensor devices and the load of the network among the clusters. The experimental result shows the FCM approach achieves better energy efficiency and improved the overall lifetime of network since the mean distance of every sensor device to cluster head is minimized which aid in optimizing the transmission power of non-cluster head sensor devices.

In [19] authors presented a optimization technique to preserve the energy of cluster head. They presented an utility and distributed iterative strategy to address the effect of bandwidth and power. They presented an analytical model of convergence of their optimization technique. They presented an optimal power and bandwidth allocation strategy for relatively large network. Simulation is conducted for various node densities and compared with existing protocol such $LEACH$ and $EECF$ (Energy Efficient Cluster Formation) which attained performance improvement interm of throughput and energy efficiency. The drawback of this protocol is that they did not consider hop based transmissions as a result there exist an energy balancing issues across network.

In [20] authors presented an energy efficient technique to maximize the lifetime of sensor network for heterogeneous network. The presented a clustering-tree topology control algorithm ($CTEF$) to preserve energy of network. The presented a prediction algorithm to predict the mean energy per round considering actual and ideal mean of residual battery power by adopting normalized distribution technique and central limit theorem. The selection of cluster head is considered based on cost function that considers parameter such as link quality, packet loss rate, distance and energy. The non-cluster member joins the cluster based on link quality, packet loss rate and energy. Then the relay nodes are chosen for transmitting data by using multi-hop communication. Simulation is conducted for various energy parameter and evaluated with existing protocol such as $LEACH$, $EDCS$ (efficient and dynamic clustering scheme) [21] and $EDFCM$ (energy dissipation forecast and clustering management) [22] in term of lifetime efficiency. The outcome shows significant performance in terms of lifetime efficiency.

The research survey highlights the benefits and drawback of clustering protocol and how hop based protocol helps in improving the energy efficiency of cluster based sensor network. To address the shortcoming of existing approach this work present an hop selection optimization model for cluster network which is presented in next section below.

3. PROPOSED POWER OPTIMIZATION BASED HOP SELECTION MODEL

To improve the energy efficiency of sensor network this paper presents a hop node selection and transceiver optimization strategy for clustered network. The proposed model consists of two stages; intra cluster stage and inter cluster stage as shown in Fig. 2.

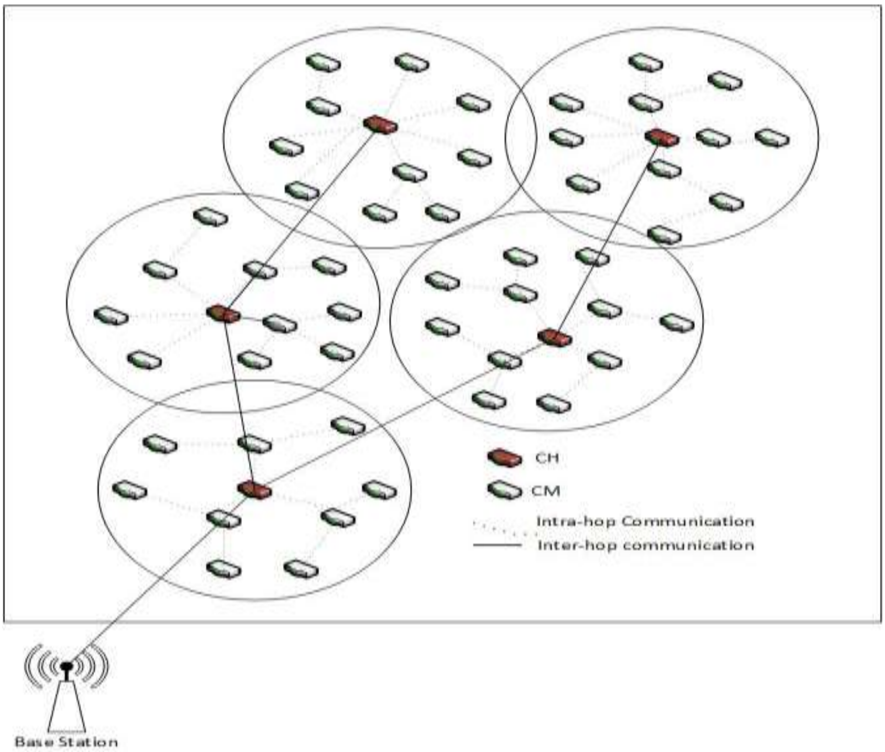

Figure 2. The Architecture of Proposed Model

In intra cluster stage transmission, when a cluster head want to transmit data, it first transmit the data to its member of same cluster for contention of channel access. Once this message is received by the cluster member, the member node of cluster sends acknowledgment to cluster head for communication. Once the acknowledgement is exchanged among cluster members and cluster head, these cluster member nodes and also the receiving cluster member nodes form a set of hop nodes for communication. The hop nodes are selected based on selectivity strategy, i.e. the nodes with high channel access. Therefore the cluster member with high selectivity will be considered as the hop node for transmission.

In inter cluster communication, once the hop nodes are obtained, the source devices transmits the packet to the hop/receiving devices. The hop/receiving devices first decode the data to compute whether the data has minimum channel gain requirement. If this condition is met then the source and the hop devices will concurrently send the data to its intended receiving devices, i.e. to the receiving cluster head.

The modeling of proposed methodology, let consider that the sensor devices can have following communication type, direct communication (DC) and hop communication (HC). Depending on the best energy efficiency criteria, the selection of communication type by source devices is considered. Let E_y be the transceiver power of hop h and E_x be the transceiver power of source devices x, C_y be the receiving device y i.e. the cluster head of the receiving cluster and C_x be the collection of cluster member devices of source devices x i.e. the cluster head of the source/transmitter cluster and the set of candidature hop $C = C_x \cap C_y$. The channels are considered to be symmetric, where the channel from device b to device a is same as vice versa and is unaffected over period M which follows Rayleigh distribution. Let g_{xy} and $g_{xh}, h \in C,$ represent the channel gain among destination devices y and source devices x and among hop device h and its source devices x respectively. Let $g_{hy}, h \in C$, represent the channel gain of hop devices h and its receiving devices y, andσ_{xy}^2, σ_{xh}^2 and σ_{hy}^2 represent the presence of Gaussian noise in wireless channel among sensor devices.

The source devices acquire channel gain information from stage 1 through control channels. The normalized active gain of channel is obtained as follows, $n_{xy} = \frac{|g_{xy}|^2}{\sigma_{xy}^2}$ and$n_{xh} = \frac{|g_{xh}|^2}{\sigma_{xh}^2}$,$n_{hy} = \frac{|g_{hy}|^2}{\sigma_{hy}^2}$, where $g_{a,b} = F_{ab} D_{ab}^{-\beta}$, D_{ab} is displacement among transmitting device a and receiving device b, $F_{ab}$is a constant parameter that depend on radio environmental properties of propagation model, β is the path loss parameter. As mentioned above, the source device x can transmit packet in both time slot through direct link, were as the source device x using hop link will transmit packet using first slot time. Therefore the overall\end-to-end bandwidth for transmission of packet from source devices x to destination devices y in both stages is represented as follows.

$$W_{xy} \begin{cases} R \log\left(1 + e_y^A n_{xy} E_x\right) & , DC\ type \\ \frac{R}{2} \min\left(\log \begin{matrix} \left(1 + e_y^A n_{xy} E_x + e_y^A n_{hy} E_h\right), \\ \log(1 + e_h^A n_{xh} E_x) \end{matrix}\right) & , HC\ type \end{cases} \quad (1)$$

where R represents the base data rate, since transmission consists of two stages the rate is scaled by half. The hop devices type transmission is selected if it satisfies the following condition$\min\left(e_h^A n_{xh}, e_y^A n_{hy}\right) > e_y^A n_{xy}$,else the hop device is set to inactive in hop selection stage. The best hop device based on equation (1) is used for hop device selection

For easiness, we consider $\mathcal{N}_{xy} = \left|g_{xy}\right|^2$,$\mathcal{N}_{xa} = |g_{xa}|^2$,and $\mathcal{N}_{ay} = \left|g_{ay}\right|^2$. The noise variance is normalized to one. For a particular bandwidth W among source and destination the cutoff energy required to transmit data should fulfill,

$$W \leq {}^{1}\!/_{2}\, log_2\left(1 + P_{m'}\mathcal{N}_{xy} + P_{m''}\mathcal{N}_{ay}\right), \tag{2}$$

when device a is considered for hop transmissions. Due to the transmission interval involved among source and hop devices, the element $\frac{1}{2}$ is considered in equation (2). From equation (2), we get

$$P_{m'}\mathcal{N}_{xy} + P_{m''}\mathcal{N}_{ay} \geq (2^{2W} - 1). \tag{3}$$

To decode the signal form source device by the hop device a should fulfill transmission energy as follows,

$${}^{1}\!/_{2}\, log_2\left(1 + P_{m''}\mathcal{N}_{xa}\right) \geq W, \tag{4}$$

which interprets to as follows

$$P_{m'} \geq {}^{(2^{2W} - 1)}\!/_{\mathcal{N}_{xa}}. \tag{5}$$

The optimization problem is carried by each device, for device a is as follows

$$\min_{P_{m'}P_{m''}} O_a\left(P_{m'}, P_{m''}\right) = {}^{C_r}\!/_{W} \cdot \left(P_{m'} + P_{m''}\right) = C_x \cdot \left(P_{m'} + P_{m''}\right) \tag{6}$$

$$\text{Such that} {}^{(2^{2W} - 1)}\!/_{\mathcal{N}_{xa}} \leq P_{m'} \leq P_{\uparrow},$$

$$P_{m'}\mathcal{N}_{xy} + P_{m''}\mathcal{N}_{ay} \geq (2^{2W} - 1),$$
$$0 \leq P_{m''} \leq P_{\uparrow},$$

where $C_x = \frac{C_r}{W}$ data symbol length and C_r is data bit length. The optimization parameter $O_a\left(P_{m'}, P_{m''}\right)$ is proportional to total energy consumed by each packet if device a is chosen as the hop device.

This work considers the source device to take part in transmission. The transceiver optimization of source device is computed. Considering source devices,$\mathcal{N}_{xa}$ and $\mathcal{N}_{ay}$ in equation (6) is substituted by $\mathcal{N}_{xx} = \infty$,and$\mathcal{N}_{xy}$. The transceiver optimization at source devices is as follows:

$$\left(P_{m'}, P_{m''}\right) = \begin{cases} \left(2^{2W} - {}^{1}\!/_{\mathcal{N}_{xy}}, 0\right), & 2^{2W} - {}^{1}\!/_{\mathcal{N}_{xy}} \leq P_{\uparrow} \\ \left(P_{\uparrow}, 2^{2W} - {}^{1}\!/_{\mathcal{N}_{xy}} - P_{\uparrow}\right), & P_{\uparrow} < 2^{2W} - {}^{1}\!/_{\mathcal{N}_{xy}} \leq 2P_{\uparrow} \\ (\infty, \infty), & 2^{2W} - {}^{1}\!/_{\mathcal{N}_{xy}} > 2P_{\uparrow} \end{cases} \tag{7}$$

If the source devices take part in transmission, in first time slot it transmits energy $P_{m'}$ per symbol and in second time slot it transmits energy $P_{m''}$ per symbol. For easiness $P_{m'}$ and $P_{m''}$ is set to ∞, i.e. the source devices will keep silent and will not take part in hop communication contention. The linear programming is used to solve optimization in equation (6). There Hop communication is not used when$\mathcal{N}_{xy} \geq \mathcal{N}_{xa}$, direct transmission of source to destination is carried out. Similarly when$\mathcal{N}_{xy} \geq \mathcal{N}_{xa}$, if it satisfies optimal strategy $\left(P_{m'}, P_{m''}\right)$ by the hop devices, the source devices can obtain improved strategy with lesser $P_{m''}$ and with equivalent$P_{m'}$. The hop device a will be silent and will not take part in transmission either if $\mathcal{N}_{xy} \geq \mathcal{N}_{xa}or\mathcal{N}_{xy} \geq \mathcal{N}_{ay}$.

Let consider that when $\mathcal{N}_{ay} > \mathcal{N}_{xy}and\mathcal{N}_{xa} > \mathcal{N}_{xy}$. The realistic transceiver optimization strategy for sensor device a, when$a \in C_w - \{x\}$, are conditioned as follows

$$(2^{2W}-1)\Big/\mathcal{N}_{xa} \le P_{\uparrow} \tag{8}$$

$$(2^{2W}-1)\Big/\mathcal{N}_{ay}\left(1-\frac{\mathcal{N}_{xy}}{\mathcal{N}_{xa}}\right) \le P_{\uparrow}$$

The optimization based on equation (8), is as follows

$$P_{m'} = (2^{2W}-1)\Big/\mathcal{N}_{xa}\,, \qquad P_{m''} = (2^{2w}-1)\Big/\mathcal{N}_{ay}\left(1-\mathcal{N}_{xy}\Big/\mathcal{N}_{xa}\right). \tag{9}$$

The sensor device a needs to have information of $\mathcal{N}_{xy}$,$\mathcal{N}_{xa}$ and $\mathcal{N}_{ay}$ in order to find transceiver optimization strategy. The sensor device a computes $\mathcal{N}_{ay}$ from destination device through RFT (Ready for Transmission) communication and $\mathcal{N}_{xa}$ from source device through CFT (Contention for Transmission) communication. Therefore to compute $\mathcal{N}_{xy}$, the $\mathcal{N}_{xy}$ is sent through RFT communication. The sensor device a can obtain ideal strategy on $(P_{m'}, P_{m''})$ and its corresponding$O_a(P_{m'}, P_{m''})$. Every sensor device in C_w will take part communication based on their selectivity. The back-off time for transmission is set based on selectivity. The delay m_a in finding set of a^{th} hop candidature sensor devices is as follows

$$m_a = O_a(P_{m'}, P_{m''})\Big/O(P_{\uparrow}, P_{\uparrow})\, M_{\uparrow}, \tag{10}$$

where $O(P_{\uparrow}, P_{\uparrow}) = 2C_x \times P_{\uparrow}$ is self-determined of$a$ and$M_{\uparrow}$ is the contention window for transmission. Therefore the sensor device that meets the condition $O_a(P_{m'}, P_{m''}) \le O(P_{\uparrow}, P_{\uparrow})$get the contention window$[0, M_{\uparrow}]$. The sensor device with least $O_a(P_{m'}, P_{m''}) \le$ will get contention. The eq. (10) is used to compute the delay for hop selection for both inter and intra cluster transmission. The simulation and experimental study of proposed transceiver optimization based energy efficient hop selection model is evaluated and compared with existing methodology in next section below.

4. SIMULATION RESULTS AND ANALYSIS

The environment considered for simulation study is Windows 7 Enterprises, Service Pack 1, 64-bit Intel(R) Core(TM) i5-2310 CPU @ 2.90 GHz processor. 8GB RAM, 1GB NVIDIA CUDA dedicated graphic card. The simulation tool used is SENSORIA simulator [23]. The simulator is designed using dot net framework 4.0 and above and the programming language used is C# which is object oriented programming language that offer rich user interface. We have conducted simulation study for energy efficiency and network lifetime analysis for varied network density size considering homogeneous network and compared our proposed modelTO_HS (Transceiver Optimization based Hop selection)with existing $LEACH$ based protocol and we have varied sensor node size by 400, 600 and 800 and conducted simulation study. The simulation parameter is shown in table 1 below.

TABLE I. SIMULATION PARAMETERS CONSIDERED

Network Parameter	Value
Network Size	30m ×30m
Number of Sensor Devices	400, 600&800
Number of Base Station	1
Initial energy of Sensor Devices	0.1 Joules (j)
Radio Energy Dissipation	50 nj/bit
Data Packets Length	2000 bits
Transmission Speed	100 bit/s
Bandwidth	5000 bit/s
Idle Energy Consumption (Eelec)	50 nj/bit
Amplification Energy (Emp)	100 pJ/bit/m2

The network lifetime is obtained for all sensor node death considering 800 sensor devices. In Fig. 3, we can see that the proposed model performs better than the existing $LEACH$ algorithm in terms of network lifetime efficiency. The experimental result shows that the energy efficiency of the proposed model over the existing $LEACH$.The proposed model improves the lifetime of sensor network by over 82.63% over $LEACH$. In Fig. 4, the energy of $LEACH$protocol is drained to zero when number of rounds is 194 and at same instance the proposed model energy remaining is 70.137 joules.

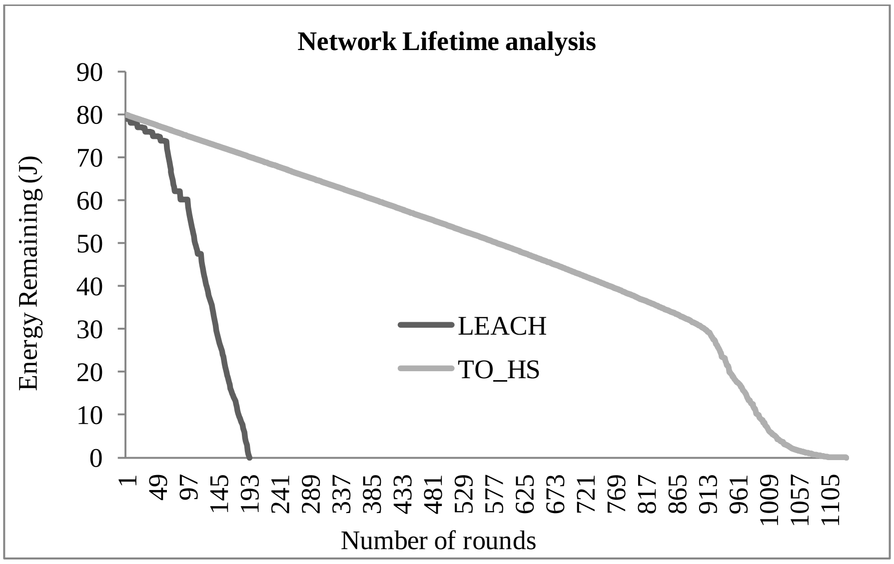

Figure 3. **Network lifetime analysis for 800 nodes**

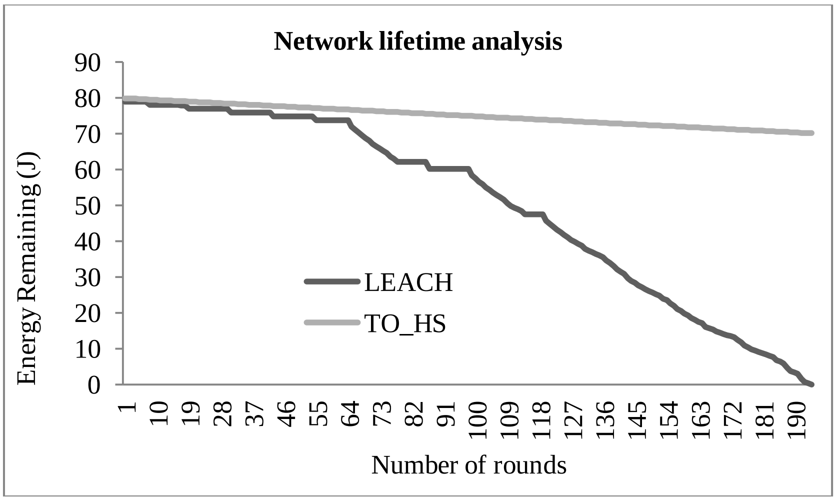

Figure 4. **Network lifetime analysis for 800 nodes**

The energy efficiency is obtained for 40% of sensor node death considering 400, 600 and 800 sensor devices. In Fig. 5, 6 and 7, we can see that the proposed model performs better than the existing $LEACH$ algorithm in terms of energy remaining efficiency. The experimental result shows that the energy efficiency of the proposed model over the existing $LEACH$.The proposed model improves the energy efficiency of sensor network by over 60.05%, 74.41 and 88.64% when sensor nodes equal to 400, 600 and 800 respectively over $LEACH$.

In Fig.8, the lifetime analysis is conducted for 30% sensor device death for 400, 600 and 800 sensor devices. The experimental outcomes shows that the proposed model improves the lifetime of senor network by 79.69%, 82.65% and 88.64% for 400, 600 and 800 sensor devices respectively over $LEACH$ protocol.

From the experimental result we can see that when we increase the sensor device the performance of proposed model get better but the performance of $LEACH$ protocol decreases with increasing number of nodes. The result shows that $LEACH$ protocol is not suitable for large network and the proposed model is adaptive in nature with increase in node density.

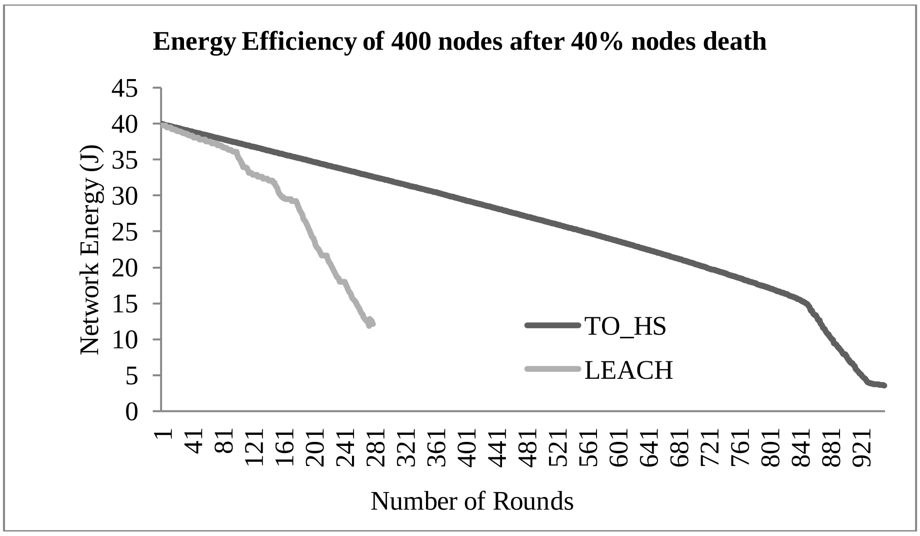

Figure 5. Energy remaining for 400sensor nodes for 40% sensor node death

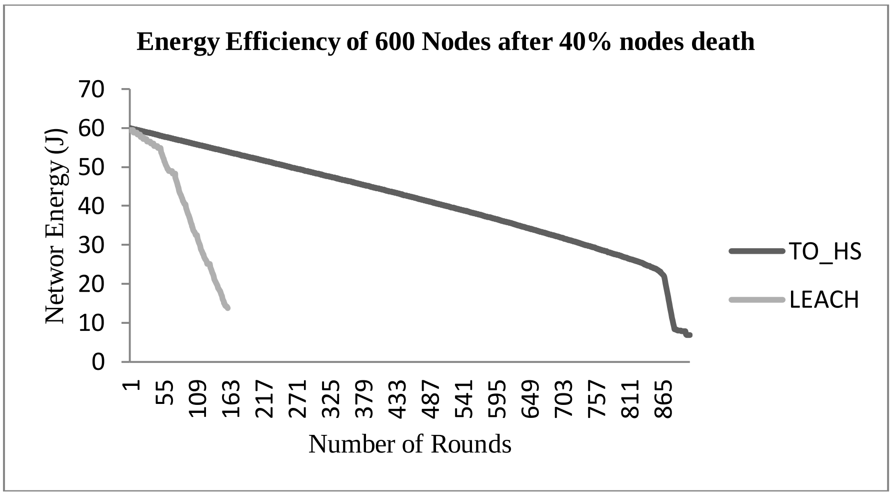

Figure 6. Energy remaining for 600 sensor nodes for 40% sensor node death

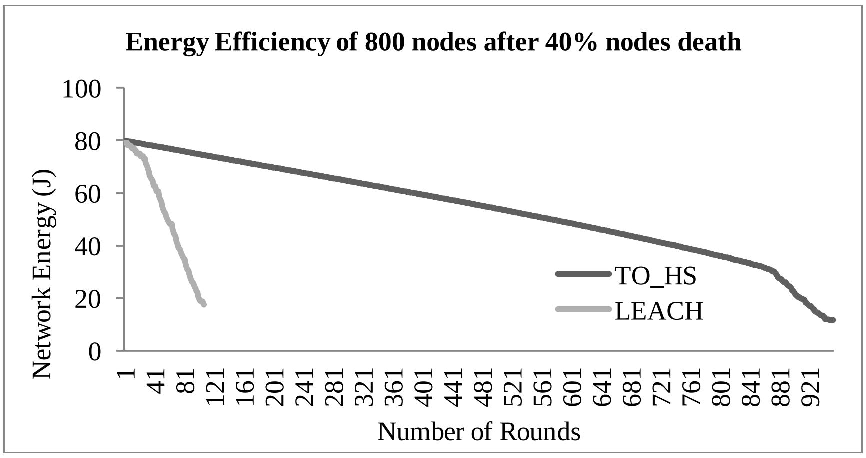

Figure 7. Energy remaining for 800 sensor nodes for 40% sensor node death

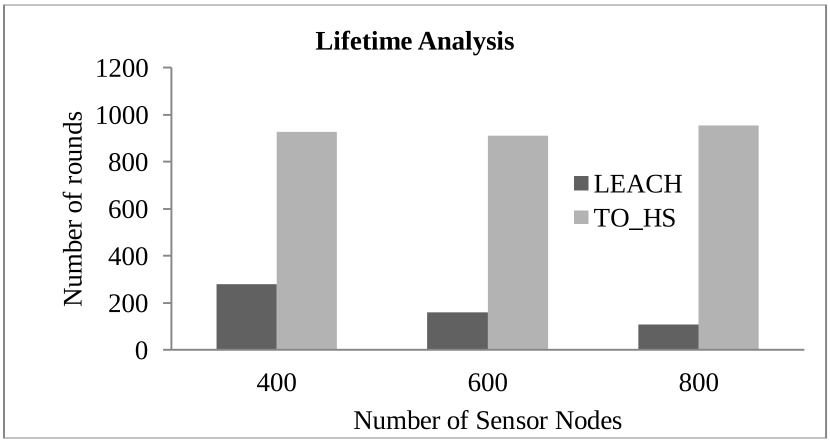

Figure 8. Network lifetime analysis

5. CONCLUSION

In WSN, the clustering methodology played a significant role in enhancing the lifetime of energy starved sensor network. The exiting strategy that is designed by adopting $LEACH$ is not efficient interm of lifetime of sensor network since these protocols degrades the energy of sensor nodes around sink/cluster head node due to amplification. To address the energy efficiency issue of existing approach this work proposed transceiver optimization based hop node selection model for cluster network. Our proposed model TO_HS improves the network lifetime efficiency by 82.63% over $LEACH$ protocols considering 800 sensor devices. Our proposed model improves energy efficiency by 60.05%, 74.41% and 76.74% for 400, 600 and 800 sensor devices respectively over $LEACH$ and lifetime efficiency by 69.68%, 82.65% and 88.64% for 400, 600 and 800 sensor devices respectively over $LEACH$.Experimental results shows that the proposed model performs better than $LEACH$ in terms energy efficiency and lifetime efficiency. The outcome of proposed model shows that it achieves significance performance when compared to E^2R^2 (energy-Efficiency and Reliable Routing)proposed by H. K. Deva Sarma et al. and $CTEF$ (clustering-tree topology control algorithm) proposed by Zhou H B et al. In future work we would develop packet failure based hop selection and transceiver optimization model and conduct simulation study to check the performance of other network parameter such node decay, active rate and communication delay etc.

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