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Performance evaluation of Energy-aware routing algorithm for wireless sensor networks.

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Abstract
Wireless Sensor Networks (WSNs) have many sensor nodes having restricted battery power which transmit sensed data to the Base Station that requires high energy consumption. Numerous routing protocols have already been proposed in this regard getting energy efficiency in heterogeneous situations. Though, each protocol is inappropriate for heterogeneous WSNs. Efficiency of WSNs declines as varying the heterogeneity of sensor nodes. This paper has evaluated the performance of Energy efficient routing protocol (ERA) under numerous scenarios. MATLAB tool is employed for experimental purpose. The comparison indicates that the ERA has quite effective results over other protocols.

IndexTerms— WSNs, ERA, Network lifetime, energy.

INTRODUCTION

1.1 Overview

A wireless sensor network (WSN) comprises of hundreds to thousands of low-power multi-functional sensor nodes, carrying out work within an unattended environment, and having sensing, computation and communication capabilities. The fundamental facets of a node certainly are a sensor unit, an ADC (Analog to Digital Converter), a CPU (Central processing unit), a power unit and also a communication unit. Sensor nodes are micro-electro-mechanical systems (MEMS) that create calculable a reaction to a modification of some physical condition like temperature and pressure. Sensor sense or assess the physical data with the location to become monitored. The repetitive analog signal sensed through the sensors is digitized by an analog-to-digital converter and brought to controllers for further processing. Sensor nodes are of smaller size, use extremely low energy, are operated in high volumetric densities, which enable it to be independent and adaptive towards environment. A Wireless Sensor Network structure is shown in Figure 1.1.

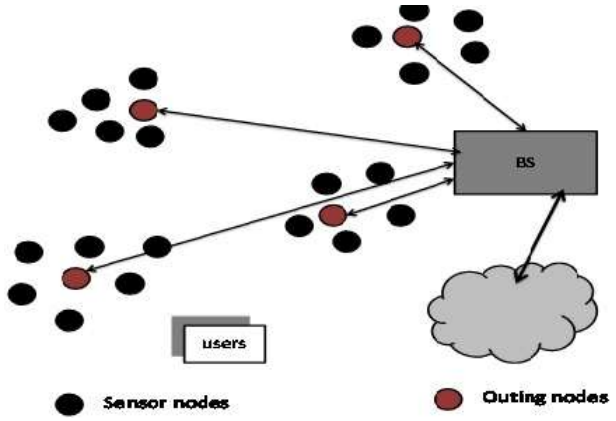

Figure.1.1. A wireless sensor network structure.

The spatial density of sensor nodes within the field could be around 20 nodes/ m^3. As wireless sensor nodes are usually smaller electronic gadgets they might only be ready having a restricted power source. Each sensor node posesses certain element of exposure for the purpose it could and properly report the precise quantity so it should be observing. Some reasons for power consumption in sensors are: (a) signal sampling and conversion of physical signals to electrical ones; (b) signal conditioning, and (c) analog-to-digital conversion.

1.2 DATA AGGREGATION TECHNIQUE

In typical WSNs, sensor nodes are usuallyresource-constrained and battery-limited. Just to save lots of resources and energy, data need to be aggregated to avoid overwhelming selection of traffic within the network. There were extensive give attentions to data aggregation schemes in sensor networks. The objective of data aggregation is the fact eliminates redundant data transmission and enhances the duration of energy in wireless sensor network. Data aggregation is the process of only one or a number of sensors then collects the detection is considered a consequence of other sensor. The collected data must be by sensor to ease burden before they're towards base station or sink. The wireless sensor network has consisted three various kinds of nodes: Simple regular sensor nodes, aggregator node and querier.

Regular sensor nodes sense data packet through the environmental surroundings and send towards the aggregator nodes basically these aggregator nodes collect data from multiple sensor owned by the network, aggregates the data packet with a couple aggregation functions like sum, average, count, max min and sends aggregates cause upper aggregator node or possibly the querier node who generate the query. It might be the base station or sometimes an additional user having permission to keep in touch with the network. Data transmission between sensor nodes, aggregators combined with querier consumes large amount of energy in wireless sensor network.

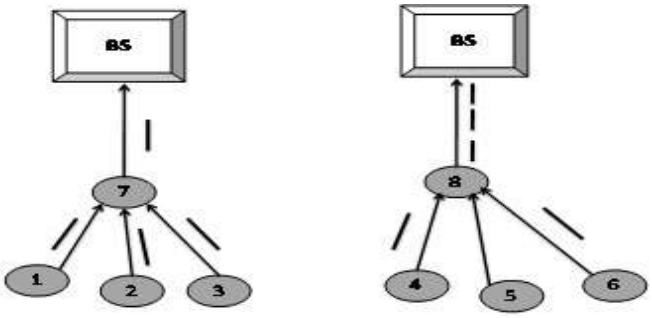

Figure.1.2. Data aggregation model and Non-data aggregation model.

Figure above contain two models, the original one is data aggregation model And the next reason is non data aggregation type of which sensor nodes 1, 2, 3,4,5,6 are regular nodes that collecting data packet and reporting reduce it towards the top of nodes where sensor nodes 7, 8 are aggregators that perform sensing and aggregating along the exact same time. In this kind of aggregation model 4 data packet travelled through the entire network and a certain data packet is transmitted towards base station (sink) along with other non data aggregation model also 4 data packet travelled across the network and the thing data packets are brought to the base station (sink), means by utilizing data aggregation process we decrease the quantity of data packet transmission and furthermore save energy in the sensor node inside wireless sensor network. By making usage of data aggregation to enhance the duration of wireless sensor network. Sink possess a data packet with energy-efficient manner with minimum data latency. So data latency is vital in several applying wireless sensor network as an example environment monitoring, health, monitoring, from where in fact th freshness of information can be quite a necessary factor. This really is important to be able to develop energy-efficient data-aggregation algorithms so as that network lifetime is enhanced. There are many kinds of data aggregation approaches to WSN:

1. Cluster-Based Approach: In energy-constrained sensor networks of enormous size, it could be inefficient for sensors to provide the data instantly to the sink. Cluster based approach is hierarchical approach. In cluster-based approach, whole network is divided in to numerous clusters. Each cluster possesses a cluster-head which is obviously selected among cluster members. Cluster-heads do the role of aggregator which aggregate data received from cluster members locally and transmit the cause base station (sink). Recently, several cluster-based network organization and data-aggregation protocols have already been completely proposed for anyone wireless sensor network. Figure 1.3 shows a cluster-based sensor network organization. The cluster heads can communicate with the sink directly via long range transmissions or multi hopping through other cluster heads.

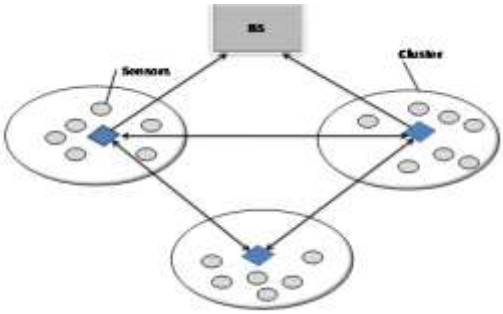

Figure.1.3 Cluster based sensor network.
The arrows indicate wireless communication links.

2. Tree-Based Approach: The tree based method is defining aggregation from constructing an aggregation tree. The sort

of tree is minimum spanning tree, sink node consider to become a root and Source node consider as leaves. Information flowing of information start out with leaves node as much as root means sink (base station). Drawback to the strategy, like wireless sensor network are often not away from totally failure, in the event there's data packet loss at any higher amount of tree, the outcome is going to be lost not restricted to single level except for whole related sub tree as well. This strategy is suitable for designing optimal aggregation techniques.

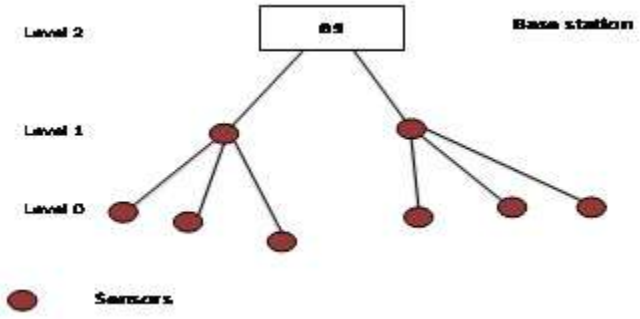

Figure 1.4 Tree-based Data aggregation in WSNs.

3. Hybrid-Based Approach: Hybrid approach followed between tree and cluster based scheme. In this, the important point's aggregation structure can adjust in respect with particular network situation and by some performance statistics.

LITERATURE SURVEY

ShaoJie Tang et al. [1] have represented that the features of using mobile sink to prolong sensor network lifetime has been well recognized. However, few provably theoretical results remain has been developed due to the complexity due to time-dependent network topology. The optimum routing technique for the static sensor network has been investigated. Several motions stratify for the mobile sink(s) has been proposed to gather real time data from static sensor network, with desire to to increase the network lifetime. An even more realistic model has been considered where in fact the moving speed and path for mobile sinks are constrained. Zhang Jingchen [2] has been proposed that centered on LEACH protocol, improvement is manufactured and the improved protocol DCDA-LEACH have proposed. DCDA-LEACH makes improvements to LEACH with data correlation and data aggregation because the core, introducing the considering regionalization. It divides the nodes into regions ahead of the relevant characteristics of the information to enhance the information correlation level within the clusters .Clustering process works together the regional restrictions to improve data aggregation efficiency and reduce energy consumption. Multi-skip routing has been utilized to lessen the numerous cluster-heads which keep in touch with base station directly. The protocol, therefore, can balance the node energy and prolong the network life.RabindraBista et al. [3] has been concentrated that numerous WSN applications require privacy of the sampled data during transmission from the origin nodes to a data collecting device, say a problem server. Providing an efficient data aggregation scheme with preserving data privacy features a challenging problem in WSNs. Even though the secure data aggregation in WSNs has been well studied, as an example PDA (Privacy preserving Data Aggregation), which targets protecting sensor data not merely from adversaries but in addition from the participating trusted sensor nodes. However, PDA is suffering from two problems. The initial one has high communication cost as a result of unnecessary traffics in the network during data transmissions. The next one has high computation cost as a result of usage of expensive technique to customize sensor data. To eliminate the difficulties, a fresh private data aggregation scheme for WSNs has been proposed. The proposed scheme applies the additive property of complex numbers so that they may combine sensor data and preserve data privacy during transmissions to the query server.Haitao Xiao et al. [4] have focused mainly that WSN has deployed today to monitor the surroundings, but their own health status has relatively opaque to network administrators. In bridge diagnosis system, it develops a WSN to gather the vibration data of bridge. In past field bridge diagnosis experiment, node failure and data packets loss always occurred in the WSN and cannot be detected. It causes some collected data is broken and cannot be employed to analyze the health status of bridge. Moreover, in field experiment it is often always difficult to create the location of nodes to be sure the standard of link has been good. The situation of monitoring the healthiness of| nodes, the standard oflinks and the healthiness of bridge diagnosis data from active end-to-end measurements in WSNs has been discussed. DAMS (Distributed data Aggregation active Monitoring System), provides failure detection and symptom alerts, while being economical in the use of energy and bandwidth. To manage to improve the performance of active monitoring method it uses distributed data aggregation to reduce the number of communication and energy consumption. The monitoring system contains three functions, monitoring the healthiness of nodes, monitoring the hyperlink quality and monitoring the healthiness of

bridge diagnosis data. Key performance measures of this technique include high detection accuracy (low false alarm probabilities), high responsiveness (low response latency), low energy consumption and low complexity. The machine in the WSN developed for bridge diagnosis has been debugged.Zanjani and Monsefi [5] has been discussed that among critical issues in WSN, some required more limitations over the look and implementation of an optimum WSN like channel capacity, resiliency, energy saving due to the| limited option of energy in wireless nodes, data privacy and confidentiality. A widely employed energy-saving technique has to work with data aggregation. Data aggregation can numerous transmitted packets within the network and prolongs the battery life. In return, data redundancy has needed for secured transmission and privacy in interference limited and noisy environment. A much secured data aggregation method for WSN has been proposed which ensures that information of most live nodes inside the network has been accessible inside the sink node with the minimum redundancy. In this, data of most live nodes stored in the sink has accessible inside the sink if the wireless channel has been polluted with noise and interference.David Hasenfratz et al. [6] shows that energy harvesting has been steadily gaining curiosity about the WSN community. As opposed to minimizing the vitality consumption and maximizing a networks operational time, the main challenge in energy harvesting sensor networks has to maximise the utility of the application form susceptible to the harvested energy. The major challenge has to maximise the data delivery rates by exploiting the spatial variations of environmental energy. While there exists a multiplicity of energy-aware routing protocols for sensor networks without energy harvesting capabilities, only a tiny amount of routing protocols have been published which explicitly account fully for energy harvesting. In this, they analyze and compare three state-of-the-art routing algorithms.Dr. G. T. Rajul et al. [7] has been presents the WSN for environmental monitoring with optimized lifetime. The node have equipped with multi mode sensors for sensing different environmental parameters. An efficient using power has been essential site in order to networks for long duration, hence it is often needed to lessen data traffic inside sensor networks, reduce level of data that require to send to sink. The goal of studying different strategies to increase the WSN lifetime, including routing, data aggregation, data accuracy and energy consumption has been discussed. The key idea has to define a multi-metrics protocol that considers the rest of the energy within sensor nodes, data aggregation and data accuracy. Liehuang Zhu et al. [8] have now been concentrated mainly that WSNs includes a data-centric network wherever the querier has been mostly worried about the statistical aggregates (MAX/MIN, SUM, AVERAGE). Several protocols have now been proposed for provably secure tree-based in network data aggregation in WSN. Though, all protocols suffer from high communication overhead or long network delay when sending off-path values to each sensor node to independently verify that its own data has been added into the ultimate aggregation result. Considering that the off-path distribution phase has the dominating factor, it certainly has been essential to optimize this phase and save energy to boost the time of network. A novel integrity preserving protocol Energy Efficient and Integrity-Preserving Aggregation Protocol (E2IPAP) for tree-based sensor networks has been proposed, which aims use a new approach for result-checking and reduce communication overhead. Nie et al. [9] have represented that limited energy has been among the countless principal challenges in WSNs. In the effective use of Structural Health Monitoring (SHM), overwhelming data provision has another big problem. Data aggregation condenses raw data into useful information and reduces redundant data transmissions. Thus, significant energy and data storage have saved, and tasks may be completed more efficiently. Though, it features anontrivial problem to arrange the different data aggregation techniques into a built-in architecture on a distributed WSN. Cluster-based data aggregation architecture has been proposed to facilitate application development for efficient SHM. Cluster-based data aggregation mechanism can save energy and optimize the distribution of computing tasks. Sheng-Chih Huang et al. [10**]** has been discussed that due to the successful development of WSNs and solar power generation technology, along with the continuous progress of the semiconductor industry, solar cell photoelectrical conversion efficiency has increased accordingly, causing the trouble of solar power generation systems to gradually decrease. Rising environmental protection awareness results in the increasingly popular usage of solar power. WSNs has generally deployed in remote environments to detect environmental information, which includes been then transferred back to the sink node. Because the wireless sensor nodes have battery powered, the operation of nodes have subject to energy restrictions. To prolong the lifetime of WSNs, this integrates wireless sensor node with solar power generation technology allow wireless sensor nodes to obtain energy by sunlight. An energy-aware routing mechanism have placed on select routes with sufficient energy to transfer the info, thus, extending battery lifetime, and enhancing the chance of sustainable survival of nodes. Mathapati et al.

[11] are suffering from a fresh energy efficient routing protocol called an Energy Efficient Reliable Routing Protocol (EERDAT) for WSN by data aggregation technique. Data aggregation has been utilized to gather and aggregate data within an energy-efficient manner so that network lifetime has been improved. Data aggregation protocol eliminates redundant data transmission. Power consumption has an important feature to be considered in the info aggregation that features a small resource and perhaps they're irreplaceable. Apart from power consumption, reliability has also major concern within data aggregation. It also designs an EERDAT for WSN. Tamilselvan et al. [12] has been concentrated that WSN has great application value and view in the fields of military, agriculture, environmental monitoring, medical health, industry, intelligent transportation and so on. The operation of WSN has been usual under low traffic loads. But in casing of an emergency condition, like fire bust out huge level of data has been generated and brought to the sink. Such type of situations results in severe channel collision and hence decreases the communication throughput in medium access control (MAC) protocols. Therefore, data aggregation has been situating forward as necessary standard for eliminating the redundancy. This data aggregation technique is known as the centre at nearest source approach. Eu et al. [13] have discussed the main advantage of using mobile sink to create longer sensor network lifetime has been well accepted. However, some provable theoretical results remain has been developed because of the complexity cause by time-dependent network topology. The perfect routing technique for the static sensor network has been investigated. A variety of motions stratify for the mobile sink(s) to gather real time data from static sensor network, with desire to to maximize the network lifetime has been proposed. Especially, consider further realistic model where the moving speed and path for mobile sinks has been controlled.Ramjee Prasad et al. [14] has been discussed that fundamental challenge in design of WSNs have a proper usage of resources that has been started. Among the countless significant challenges in this has to maximize the bandwidth consumption in data gathering from sensor nodes and forward to sink. The key design objective needs to utilize the available bandwidth expertly to reduced packet delivery ratio combined with throughput. Bandwidth Efficient Heterogeneity aware Cluster based Data Aggregation (BHCDA) algorithm present the explanation for the efficient data gathering in network aggregation. It considers the network with heterogeneous nodes when it comes to energy and mobile sink to aggregate the information packets. It embodies the perfect approach by Intra and inter-cluster aggregation on the randomly distributed nodes with variable data generation rate while routing data to sink. It uses the correlation of data within the packet used for applying the aggregation function on data generated by nodes. Adel Mounir Said et al. [15] have explained that sensor networks have problems with incomplete dependence on protocols that deliver sensor data in an energy-efficient manner to the sink. The technique gathers sensors data in a dimension packet fit for transmission. A fresh Effective Data Aggregation Protocol (DAP) has been proposed to cut back the vitality consumption in WSNs, which prolong the network lifetime. This work has been employed in network aggregation method of distribute the processing everywhere over the aggregation road to avoid unbalanced power consumption on specific nodes until they run out. Wu et al. [16] have represented that long-established routing protocols has no longer right for the vitality harvesting-wireless sensor networks (EH-WSN), that has been powered by the vitality harvested from environment as opposed to batteries. As opposed to minimize the vitality consumption and maximize the network lifetime, the main challenge in EH-WSN has to maximize its working performance in energy harvesting constraint. A main power efficient routing algorithm energy harvesting genetic-based unequal clustering-optimal adaptive performance routing algorithm (EHGUC-OAPR) has been proposed which contain two part: (i) Energy Harvesting Genetic-based Unequal Clustering Algorithm (EHGUC) and (ii) Optimal Adaptive Performance Routing Algorithm (OAPR). DnyaneshwarMantri [17] has been focused on the application base WSN environment, energy and bandwidth of the sensor that has precious resource and requires taking efficiently. Data aggregation at the sink via individual node cause flooding of the information which outcomes maximum energy consumption. To minimize this issue, estimate the group base data aggregation method, where grouping of nodes base on accessible data and correlation in the intra-cluster along with grouping of cluster heads at the network level help lessen the vitality consumption that has been proposed. The proposed method use additive and divisible data aggregation function at cluster head (CH) as in network processing to diminish energy consumption. CH transmits aggregate information to remote sink and cluster head nodes transmit data to CH. H. Ghaffarzadeh et al. [18] In this paper, a centralized approach for clustering and data transmission mechanism is proposed that optimizes the power consumption and hence time of the network. The mechanism is made up of two phases. In the first phase, a mechanism predicated on a centralized cluster head selection that utilizes

information such as for instance nodes residual energies and their locations in the network is proposed in order to select the absolute most appropriate candidates as cluster heads. In the next phase, the idea of a ‘‘window size"is introduced where minimization of the amount of cluster head changes of a node and consequently maximization of the network lifetime is considered. Simulation results validate that the proposed mechanism does effectively reduce data traffic and therefore increases network lifetime. T. Amgoth et al. [19] have proposed an energy aware routing algorithm for cluster based WSNs in this paper. The algorithm is based on a clever strategy of cluster head (CH) selection, residual energy of the CHs and the intra-cluster distance for cluster formation. To facilitate data routing, a directed virtual backbone of CHs is constructed which is rooted at the sink. The proposed algorithm can be demonstrated to balance energy use of the CHs during data routing process. They proved that the algorithm achieves constant message and linear time complexity. They've also tested the proposed algorithm extensively. The experimental results reveal that the algorithm outperforms other existing algorithms with regards to network lifetime, energy consumption and other parameters.

RESULTS

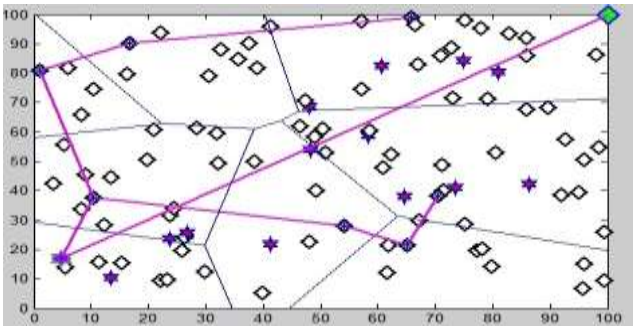

FIG2: Representing Initial Configuration **.**

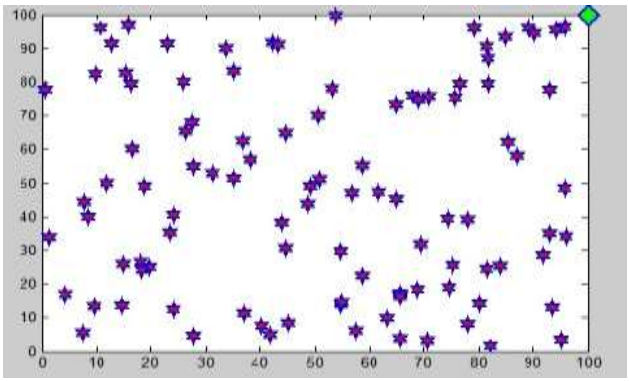

FIG3: Representing All Sensor Nodes dies.

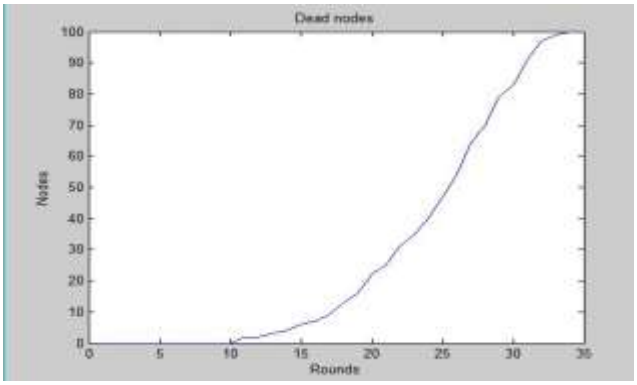

Fig4: Representing Dead Nodes.

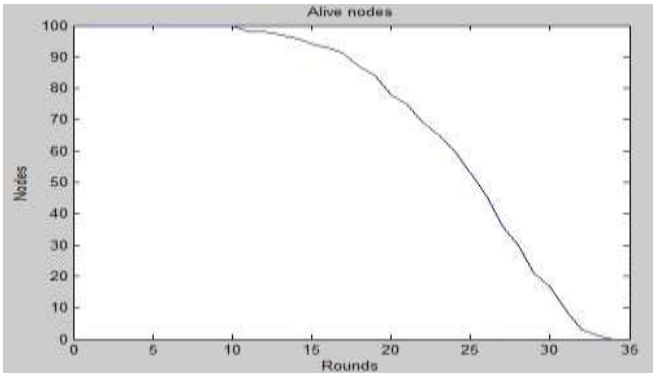

FIG5 : Representing Alive Nodes.

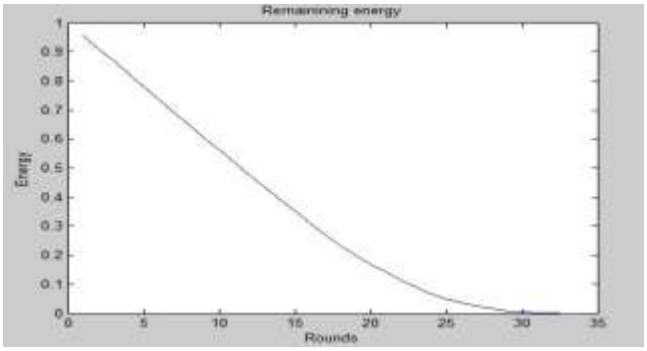

FIG6:Representing remaining energy of nodes.

CONCLUSION AND FUTURE WORK

This paper has evaluated and compares the well-known WSNS energy efficient protocol. although era shows quite significant results over existing WSNS protocols but it's neglected the usage of WAITING time of node to become CHS. so may some nodes won't become CHS for quite a long time even they've more confidence to become CHS. so to overcome this issue in not too distant future we uses minimum allowed distance (MDCH) and waiting nodes between two CHS to divide the sensor field among clusters in the most efficient way. MDCH could have capability to overcome the issue of the too small and too high cluster heads.

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