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An energy efficient routing protocol for WSNs by HEED protocol

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Abstract: *Wireless Sensor Networks can accumulate decisive and precise information in inaccessible and precarious environments, and can be utilized in Military Affairs, National Defence, Environmental Monitor, Industrial Control, Traffic Management, Smart Home, Medical Care, and many more. The sensors whose resources are inadequate are inexpensive, and rely upon the battery for supplying electricity, so it is very important for routing to conveniently make use of its power. Earlier, for wireless sensor networks an energy-efficient SHAC (Single-Hop Active Clustering) approach was proposed. This algorithm has mainly three parts. First, a timer mechanism was introduced to choose tentative cluster-heads. Second, a cost function was proposed for balancing efficiently energy of each node. Lastly, active clustering algorithm was proposed. During both numerical results and theoretical analysis, it is depicted that with such algorithm the lifetime of the network can be increased considerably compared to the other clustering protocols namely LEACH-C and EECS. Single Hop Active Clustering may extend the lifespan of the network by up to 50 percent as compared to EECS.*

I. INTRODUCTION

A mobile wireless sensor network (MWSN) consists of sensor nodes that move from one region to another. These mobile nodes play a significant role in communication in even unreachable places too like of Antarctica. In day to day life also mobile nodes act as basic need in terms of cell phones. The location extraction of these mobile nodes is one of the requirements for data transmission and operating over those nodes. WSNs are deliberated one of the best sources for monitoring inaccessible fields and detracting conditions which are out of range from human's viewpoint. For optimal distribution of energy among sensor nodes, in order to enhance network life time, suitable protocols and applications should be developed.

The rapid developments and technological advances in Micro Electromechanical System and wireless communication, has made possible the development and deployment of large scale wireless sensor networks. Wireless sensor network consists of hundreds to several thousands of small sensor nodes scattered throughout an area of interest. The potential applications of sensor networks are highly varied, such as environmental monitoring, target tracking, and battlefield surveillance. Sensors in such a network are equipped with sensing, data processing and radio transmission units. Distinguished from traditional wireless networks, sensor networks are characterized by severe power, computation, and memory constraints. Due to the strict energy constraints, energy efficiency for extending network lifetime is one of the most important topics. Sensor nodes are likely to be battery powered, and it is often very difficult to change or recharge batteries for these nodes. Prolonging network lifetime for these nodes is a critical issue. Therefore, all aspects of the node, from hardware to the protocols, must be designed to be extremely energy efficient.

HEED Algorithm

Hybrid Energy-Efficient Distributed (HEED) clustering protocol is a multi-hop clustering algorithm in wireless sensor network. In this model, CH is selected on the basis of two factors namely; communication cost and residual energy. The residual energy can be calculated, if the energy burning per bit for sensing, processing, and communication is known where communication cost refers to the size of cluster and power levels. A node with highest average residual energy is chosen as a head of cluster CH and then newly selected CH is endured only the time employed for process of clustering and network working. The probability of a node which to be selected as the Cluster Head (CH_{prob}) can be estimated as,

$CH_{prob} = C_{prob} X (E_{residual} / E_{max})$

The important features of this protocol are as follows:

1) HEED distribution of energy extends the career of the nodes with the network hence securing the neighbouring node.
2) HEED does not require special node efficiency like location-alertness.
3) HEED does not create assumptions about node distribution. The nodes also automatically modernize their nearby resident sets in multi-hop networks by regularly sending and receiving messages. It operates correctly even when nodes are not meshed.
4) The nodes solely desire local (neighbourhood) information to form the clusters.

LEACH Algorithm

LEACH could be a class-conscious protocol within which most nodes transmit to cluster heads, and also the cluster heads mixture and compresses the information and forwards it to the bottom station (sink). Every node uses a random formula at every spherical to work out whether or not it'll become a cluster head during this spherical. LEACH assumes that every node incorporates a radio powerful enough to directly reach the bottom station or the closest cluster head, however that mistreatment this radio at full power all the time would waste energy. Nodes that are cluster heads cannot become cluster heads once more for P rounds, wherever P is that the desired proportion of cluster heads. Thereafter, every node incorporates a 1/P likelihood of turning into a cluster head once more. At the top of every spherical, every node that's not a cluster head selects the highest cluster head and joins that cluster. The cluster head then creates a schedule for every node in its cluster to transmit its knowledge.

II. LITERATURE REVIEW

This section described the analysis work that has been completed in recent years. Image compression is the ultimate favourable field of research within which assemble the interest of all analysts. A literature review goes on the far side inquiry of report or information and it co-relates the identification and affiliation of relationships among the literature and research field.

Gholami, M.R et al. [12] proposed the study of the received signal strength-based localization problem when the transmit ability or path-loss protector is not known. The equivalent highest-likelihood estimator (MLE) poses a difficult non convex optimization problem. To avoid the difficulty in solving the MLE, they used suitable approximations and formulate the localization problem as a general trust region sub problem, which can be solved exactly under mild conditions. Simulation developments exhibit a encouraging achievement for the planned methods, which also have reasonable complexities compared to existing approaches.

Patwari, N et al. [13] describe the measurement-based applied mathematics models helpful to explain time-of-arrival (TOA), angle-of-arrival (AOA), and received-signal-strength (RSS) measurements in wireless sensing element networks. Band and ultra-wideband (UWB) measurements, and RF and acoustic media also are mentioned. Mistreatment the models, the authors have shown the calculation of a Cramer-Rao certain (CRB) on the placement estimation exactitude attainable for a given set of measurements. The article in short surveys an oversized and growing body of sensing element localization algorithms. This text is meant to emphasise the essential applied mathematics signal process background necessary to know the progressive and to create progress within the new and mostly open areas of sensing element network localization analysis.

Chen Meng et al. [14] proposed a novel approach to the source localization and tracking problem in wireless sensor networks. By applying mini max approximation and semi definite relaxation, they transform the traditionally nonlinear and non convex problem into convex optimization issues for 2 distinct source localization models involving measured distance and received signal strength. Based on the problem transformation, they developed a fast low-complexity semi definite programming (SDP) algorithmic rule for 2 distinct source localization models. Their algorithm can either be used to estimate the source position or can be utilized to initialize the final non convex maximum likelihood algorithm.

Ouyang, R.W et al. [15] proposed convex estimators specifically for the RSS-based localization problems. Both non cooperative and cooperative methods are treated. They initiated within the non cooperative RSS-based localization problem and derive a non convex estimator that estimates the ML estimator but has no logarithm in the residual. Next, they applied the semi definite relaxation scheme to the copied non convex estimator and generate a convex estimator. To further improve the estimation performance, they append the ML estimator to the convex estimator with the result by the convex estimator as the initial point. They then extend these techniques to the cooperative localization problem. The corresponding Cramer-Rao lower bounds (CRLB) are derived as performance benchmarks. Their proposed convex estimators comply they with the RSS measurement model, and imitation outcomes evidently determine their admirable performance for RSS-based wireless localization.

Gang Wang et al, [16] proposed a new approach to the localization problem in wireless sensor networks using

received-signal-strength (RSS) measurements. The problem was reformulated under the equivalent exponential transformation of the conventional path loss measurement model and the unscented transformation (UT), and is approximately approached by the maximum likelihood (ML) parameter estimation, which they refer to as the weighted least squares (WLS) approach. This formulation is used for sensor node localization in both non cooperative and cooperative scenarios. Simulation results confirm the effectiveness of the strategy for both outdoor and indoor surroundings.

III. METHODOLOGY

The methodology which is followed in this research use mathematical modelling and MATLAB as simulation tool to analyze the performance of the proposed approach and to obtain the comparison with all the existing methods. Following are phases of the methodology.

Phase 1: Firstly the code is developed for the GUI and after that for the creation of the mobile sensor nodes and cluster heads in the editor window of the MATLAB.

Phase 2: After initializing the nodes, clustering is performed that means partitioning the nodes into groups, each one with a cluster head and some ordinary nodes as its members. The task of being a cluster head is rotated among sensors in each data gathering round to distribute the energy consumption across the network.

Phase 3: After cluster-heads are selected, assign each node to particular cluster-head. It is important to balance energy consumption in area around the cluster-head.

Phase 4: After that code is developed for the HEED (Hybrid Energy-Efficient Distributed) clustering protocol.

Phase 5: Finally develop the code for the calculation of the performances and the comparison of implementation on the basis of stability, throughput and network life-time.

IV. EXPERIMENTAL RESULTS

In this section, we perform experiments to verify the efficiency of our approach.

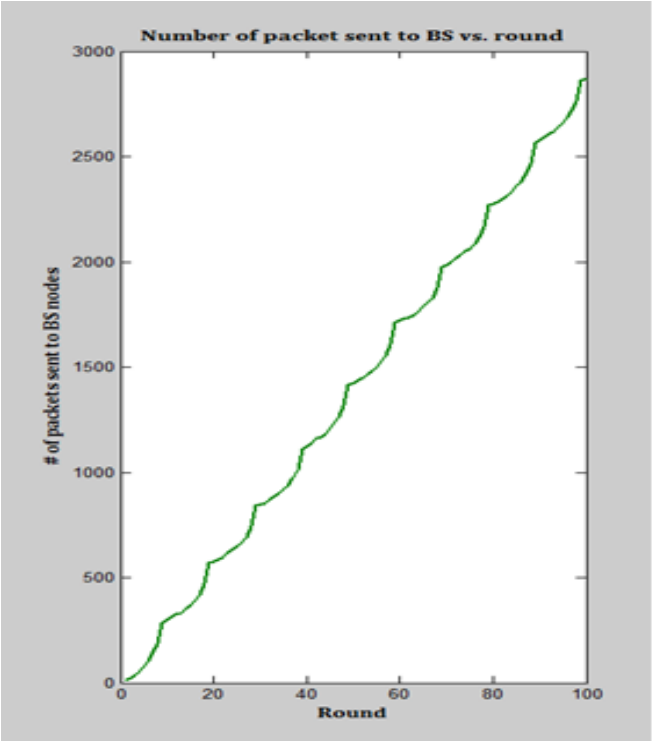

Figure 1: Number of packets sent to BS vs. round

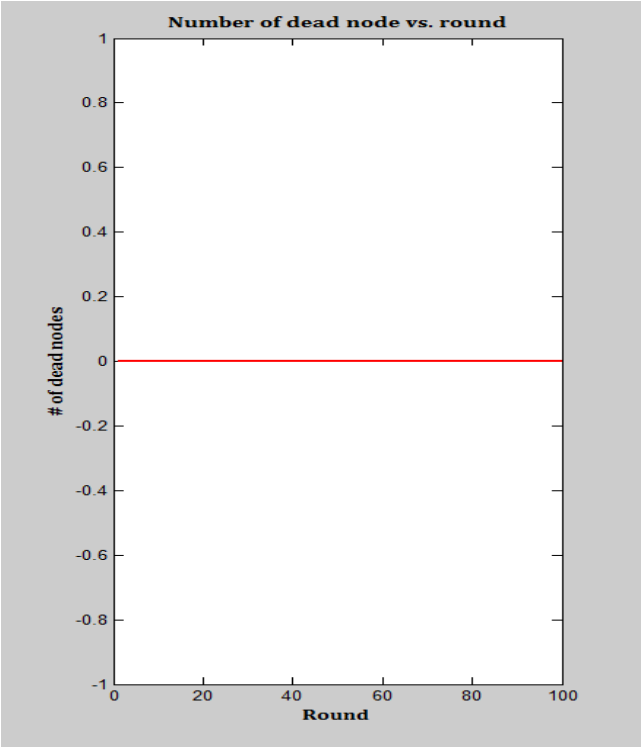

Figure 2: Number of dead node vs. round

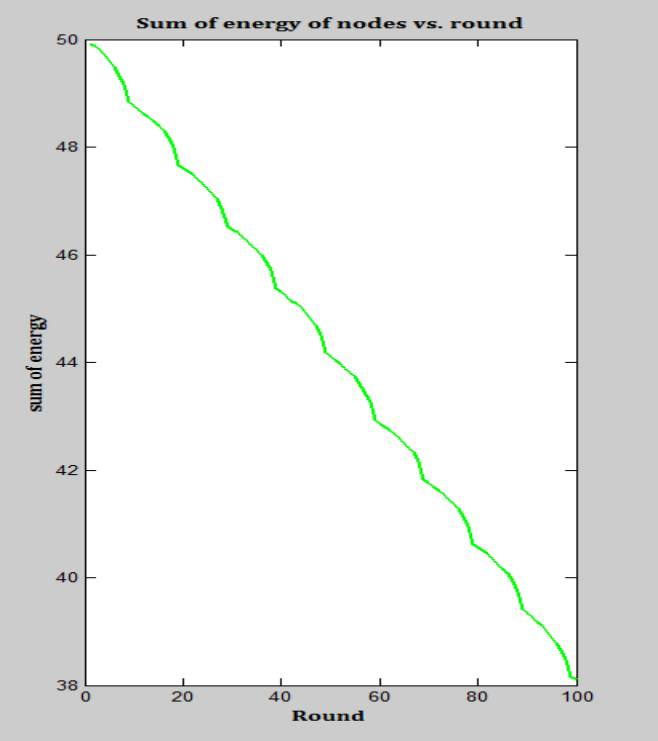

Figure 3: Sum of energy of nodes vs. round

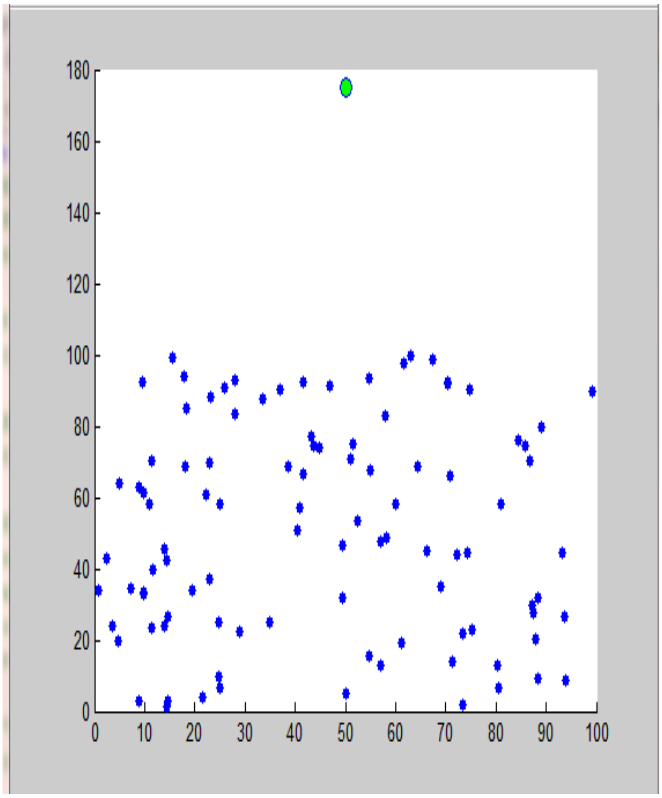

Figure 4

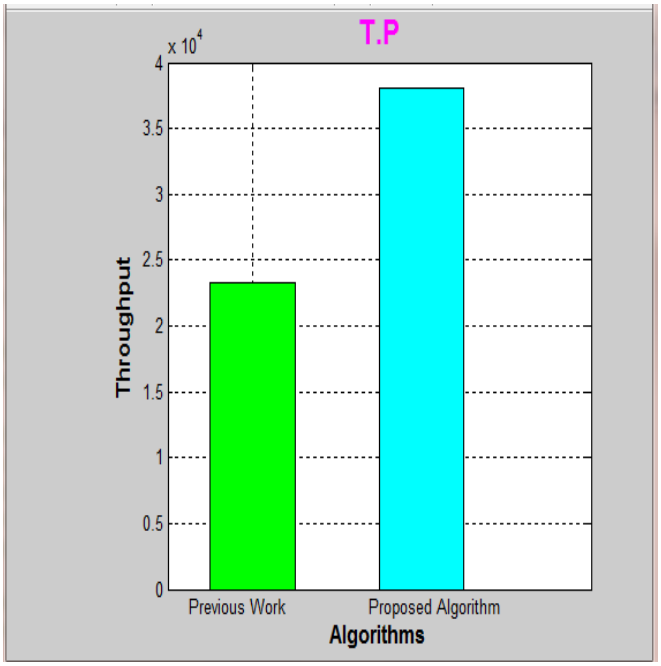

Figure 5: Graph of Throughput b/w Previous & Proposed Algorithm

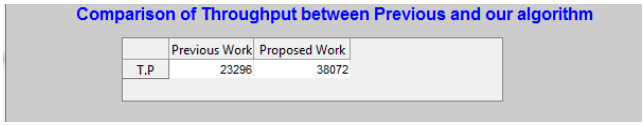

Figure 6: Comparison of Throughput b/w Previous & Our Algorithm

V. CONCLUSION

Many prospected clustering protocols for wireless sensor networks aimed at suitable energy utilization. Load balancing among sensor node is of key importance and it strictly depicts network life-time. In both homogenous and heterogeneous networks, protocol design should be capable of best distribution. Every routing protocol has certain advantages, and also limitations. The main aim of this work is to enhance existing protocol such that more robust and optimized results can be achieved. Q-LEACH is good selection but it is not appropriate to enhance coverage region. There is demand for increasing the network lifetime. HEED routing protocol is an energy efficient algorithm which will provide good stability along with prolonged lifetime of the network.

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