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DUAL PROBABILITY-BASED ENERGY EFFICIENT CLUSTERING PROTOCOL IN WIRELESS SENSOR NETWORK

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Abstract

Wireless sensor networks, as homogeneous as well as heterogeneous networks of sensors with the ability to sense, process, and communicate, have been increasingly used in various fields, including engineering, health, and the environment, to intelligently monitor remote locations at low cost. Sensors in such networks are responsible for four major tasks: data aggregation, sending and receiving data, and in-network data processing. This paper proposed a dual probability-based function for the optimization of energy in wireless sensor networks. The proposed algorithm works as a fashion of energy in three levels, such as high level, middle level, and low level. The measured energy level connects with lower to upper and upper to lower as modes of active and passive communication and reduces the impact of energy loss during the communication. The proposed algorithms simulate in the MATLAB environment with different simulation scenarios and estimate standard parameters for the evolution of results. The comparative analysis of results suggests that the proposed algorithm is more efficient than existing algorithms.

Keywords: - WSN, Energy Efficient, Probabilistic Model

Introduction

Wireless sensor networks' capability and diversity push the boundaries of communication networks. The wireless sensor network has applications ranging from military to healthcare, agriculture to environmental monitoring. The dynamic and ADHOC utilisation of wireless sensor networks resolves many challenges in real life. The success story of wireless sensor networks depends on the energy factor. The value of energy decides the life of the network and influences other factors in a wireless sensor network [1,2,3]. The device of a wireless sensor is very small in size and the occupied battery of the sensor is not chargeable, so the challenge is to achieve maximum utilisation of energy in a dedicated task. The maximum amount of energy is lost during the searching and selection of the routing path. The routing path of a wireless sensor network is based on the geographical location and divided into three categories, such as flat routing protocol, hierarchical routing protocol, and hybrid routing protocol. The flat area routing protocol is easy to install and maintain, and the loss of energy is very small. But in the case of hierarchical and hybrid routing, the loss of energy is maximised and this decreases the life time of the network. The most famous wireless sensor network is the LEACH protocol

[3,5,6]l. The LEACH protocol is the first routing protocol to focus on the factor of energy constraints for the wireless sensor network. The continuous effort of various research scholars in the optimization of energy factors enhances the life of wireless sensor networks. In the current decade, various upgraded models of the LEACH protocol have been proposed, such as the Q-LEACH and MQ-LEACH Protocols. The clustering-based routing protocol also influences the factor of energy in wireless sensor networks. The cluster-based routing protocol applies the group communication model for the transmission of data in a wireless sensor network. The process of clustering algorithms also suffers from the process of cluster head selection. Cluster head selection is a major challenge in the cluster-based routing protocol. The process of cluster head selection requires more energy during the intercommunication with another cluster head. For the selection of the cluster head, various parameters are applied, such as the estimation of the energy of the cluster node as a source and sink node. The estimation of distance for the communication of cluster heads Distance plays an important role in the life of a network. The near node is more reliable for the communication, and the far node is less reliable than the near node. Despite the various efforts of routing, energy is the main factor in a wireless network. The optimization of energy plays an important role in the wireless sensor network [7,8,9]. The optimization process of energy reduces the residual value of energy and increases the lifetime of wireless sensor networks. The process of optimization is applied in two different modes, such as dynamic programming and swarm intelligence. The swarm intelligence-based optimization algorithm is very efficient in place of the dynamic programming algorithm. The new areas of optimization are machine learning and neural networks. The various authors and research scholars proposed machine learning-based optimization algorithms for the optimization of energy in wireless sensor networks [10,11,12]. The classical set theory is also applied by different authors to the process of optimization. The rest of the articles are organised as in section II. Related work in Section III: Proposed methodology, in Section IV Simulation and Results Analysis, in Section V Conclusion and Future Work.

II. Related work

Balaji, Subramanian Et al. [1] Wireless Sensor Network is a wide area monitoring tools supporting for Scientific Research, Low-power microscopic sensors. WSN uses limited resource memory, computation power, bandwidth, and energy. The Cluster Routing protocol is the best methodologies for energy efficiency in the wireless sensor network. Cluster Routing Protocols are used to form a cluster creation on the selection of cluster head (CH). Then the data packets are sending from one CH to another CH and finally data packets are sent to the base station. Chs are selected by using the setup phase. This system discussed a multi hop transmission, where the data packets are sent from one hop to another hop. Goyal, Nitin Et al. [2] The oceans and rivers remain the least explored frontiers on earth but due to frequent occurrences of disasters or calamities, the researchers have shown keen interest towards underwater monitoring. Underwater Wireless Sensor Networks (UWSN) envisioned as an aquatic medium for variety of applications like oceanographic data collection, disaster management or prevention, assisted navigation, attack protection, and pollution monitoring. Like terrestrial Wireless Sensor Networks (WSN), UWSN consists of sensor nodes that collect the information and pass it to sink, however researchers have to face many challenges in executing the network in aquatic medium. Some of these challenges are mobile sensor nodes, large propagation delays, limited link capacity, and multiple message receptions. In this manuscript, broad survey of issues concerning underwater sensor networks is presented. authors provide an overview of test beds, routing protocols, experimental projects, simulation platforms, tools and analysis that are available with research fraternity. Sanjeevi, P. Et al. [3] In the recent past, the agriculture and farming industry has become the precision network connectivity of sensors with a new dimension of Internet of Things (iot) technology. The cloud computing and wireless sensor network-(WSN) based extensive distance network in iot can be applied to the agriculture and farming industry in a remote area. In this work, authors discussed scalable wireless sensor network architecture for monitoring and control using iot for agriculture and farming in a remote area. Alghamdi, Turki Ali Et al. [4] This work has presented a novel clustering model with optimal CHS by considering four major criterions such as energy, delay, distance and security. The analysis such as convergence analysis, alive node analysis, normalized network energy, delay analysis, risk probability analysis, algorithmic analysis and statistical test has been made. The evaluation results proved that the discussed model attains superior results compared to other models. From the experimental results, the implemented FPU-DA based CHS In WSN was proved to be best considered to other models. Guleria, Kalpna Et al. [5] Sensor nodes are randomly deployed to perform specific area monitoring in geographical region and temporal space. The network connectivity maintenance is a major requirement for accurate event detection with minimum energy consumption. To minimize the energy consumption, various clustering algorithms have been evolved in research studies. But they failed to consider the other performance parameters such as quality of service constraints and the performance level. The initialization of nodes nearer to the base station (BS) as relay nodes reduces the number of relay node participation and increases the performance. Verma, Sandeep Et al. [6] In this work, Improved Dual Hop Routing protocol (IDHR) and Multiple data sink-based Energy Efficient Cluster-based routing protocol (MEEC) are discussed. The Cluster Head (CH) selection in IDHR and MEEC is done by incorporating node density parameter along with other parameters, namely energy and distance between the node and the sink. Inmeec, multiple data sinks are employed to pact with the burden on the relaying nodes involved in data forwarding. The node density factor proves to beadherent for energy preservation of nodes by abating the average communication distance between the nodes and respective CH. Arora, Vishal Kumar Et al. [7] Energy-efficient routing algorithms must handle power-limitation issue of the sensor nodes intelligently to prolong the network life of wireless networks. Accordingly, it is indispensable to collect and exchange the sensor data in an optimized way to reduce energy consumption. Subsequently, an ACO Optimized Self-Organized Tree-Based (AOSTEB) Energy balance algorithm for Wireless Sensor Network has been discussed that discovers an efficient route during intra-cluster communication. AOSTEB scheme operates in three phases: cluster-formation, multi-path creation, and data transmission. During cluster-formation, the desired number of sensor nodes are alleviated to the role of cluster-heads (chs), and the remaining neighboring sensor nodes join the nearest chs to form a cluster. Further, the multiple paths between the CH and member nodes are discovered using Ant Colony Optimization algorithm. Kumar, Naween Et al. [8] In wireless sensor networks (wsns), sensors are equipped with limited power batteries. Data collection from sensors is one of the fundamental tasks in wsns. Maximizing the data collection with minimum energy consumption is one of the major challenging issues in wsns. In this article, authors consider data collection using a mobile sink, where the mobile sink efficiently collects data from nearby sensors while moving along a pre-specified path with constant speed. authors refer this problem as a maximizing Data Gathering with Minimum Energy Consumption (MDGMEC) problem. So far, existing works have heuristic algorithms for MDGMEC problem. Wu, Huafeng Et al. [9] Maritime search and rescue wireless sensor network (MSR-WSN) has been a bedrock to discover the floating target after the shipwreck. In this work, authors first define a sea region of target detection and formulate a clustered topology of MSR-WSN. Second, authors employ the sensor nodes of MSR-WSN to track the collective radio signal emitted by the mobile target. Each node firstly transmits the pre-processed perceived data to the cluster head node. Next, the data fusion centre (DFC) collects a local decision of cluster head node through a binary hypothesis test and works out an accurate global decision. Alarifi, Abdulaziz Et al. [10] Cloud-assisted internet of things (ciot) is backboned by the wireless sensor network (WSN) architecture. A sensor network is an autonomous self-resource constraint collection of internets of things (iot) sensor nodes. The nodes communicate in an ad-hoc fashion to transfer cloud information over the virtual environment. Clustering in wsns helps to improve the quality of the network by controlling energy consumption and improving data gathering accuracy. This improves the service rates of ciot. Optimizing sensor networks through energy and overhead management requires complex clustering algorithms. process was integrated through a reinforcement learning method to improve network lifetime and retain better enduring energy with minimized overhead. Fu, Xiuwen Et al. [11] In this model, the load function is defined on each node according to the real-time number of data packets, and the overload function is defined on the basis of the congestion state of each node. The overloaded node can recover after a certain time delay, instead of being deleted permanently from the network. authors analysed the impact of key parameters and evaluate the performance of several typical clustered routing protocols from the perspective of cascading invulnerability. Tatarnikova, T. M. Et al. [12] This work discussed a simulation model of cauterization of the sensory field created by a wireless sensor network. Effectiveness of clustered wireless sensor network was comparatively evaluated to non-clustered on parameters of residual energy and duration of the network life cycle. The clustering method is based on the idea of an equally probable rotation of the head nodes, taking into account the level of residual energy of the nodes and the distance from the sensory devices to the head node. Zeng, Mengjia Et al. [13] The Low-Efficiency Adaptive Clustering Hierarchical (LEACH) protocol, a hierarchical routing protocol, has the advantage of simple implementation and can effectively balance network loads. However, to date there has been a lack of consideration for its use in heterogeneous energy network environments. To solve this problem, the Energy-Coverage Ratio Clustering Protocol (ECRCP)is discussed, which is based on reducing the energy consumption of the system and utilizing the regional coverage ratio. First, the energy model is designed. Abdulkarem, Mohammed Et al. [14] This article presents a contemporary review of collective experience the researchers have gained from the application of wireless sensor networks for structural health monitoring. Technologies of wired and wireless sensor systems are investigated along with wireless sensor node architecture, functionality, communication technologies, and its popular operating systems. Then, comprehensive summaries for the state-of-the-art academic and commercial wireless platform technologies used in laboratory testbeds and field test deployments for structural health monitoring applications are reviewed and tabulated. Gomathi, R. M. Et al. [15] The splice function detects the sum of energy pertaining to a linked node and also the route having the greatest energy are being taken to forward data to surface position node. In case s surface position node happens to be busy with communication, then it will give an update instruction to the succeeding sub aquatic neighbour nor for taking a substitute surface position node for avoiding loss of data. After that, the subaquatic node will take a substitute surface position node and will advance the particular information on to heap node.

III. Proposed Methodology

The dual probability function measures the same level of energy for the grouping of sensor node to transmit the sensor to sink node. The dual probability measures the energy level of the same node with similar probability for the measuring the level of energy for communication [12, 13, 15].

- $P - DP\ (n)$: measure the probability of sensor nodes of same energy level
- $sink\ probablity\ (level - Dp(n))$ of a sensors node n with respect to another sensor's node $n\ level - prop_k(p,o) = \max\{n - probablity\ (o), n(p,o)\}$ (1)
  where $n(p,o)$ is the similar probability between p and o.
- $sub\ level\ probablity$ (slp) of a sensors node n

$$slp_k(p) = \left(\frac{1}{k}\sum_{o\in N_{(p,k)}} level - prob_k(p,o)\right)^{-1}, \qquad (2)$$

  where $N_{(p,k)}$ is the set of n node of similar probability of energy of n.
- $sink\ node\ energy$ of a sensors node n

$$DP\_OT_k(p) = \frac{1}{k}\sum_{0\in N_{(p,k)}} \frac{slp_k(o)}{slp_k(p)} \qquad (3)$$

Here k is sub set group of sensors node for the same level of energy factor and N is total nodes in environments.

Given $n_t \in \Re^{GP}$ collected at level energy $\in E$, the goal of DP and DP_E is to assign an DP_OT value to n_t, for the value of energy $E < P$ of the n nodes that have been measured up to level energy E . all n sensor level and their corresponding DP_OT values in sink connection of sub groups. Hence measure the energy value of extended energy DP_OT values of new nodes can be calculated. the goal of DP and DP_E is to detect same level for the whole network's communication and not just for the n last sensor nodes where the available sink connection of sub groups is limited to P. DP_E is an extension to DP[7, 9, 12].

DP- Dual Probability

DP_OT- Dual Probability Outer Sensor Node

DP_E – Extension to Dual Probability

ALGORITHM 1. DP_E ESTIMATION

1. Input: a sensors node n_t at level energy e
2. Output: DP_OT value $DP\_OT_{(n_t)}$
3. Estimate $N_{(n_t,k)}$ and $p - probab(n_t)$

4. for all $n \in N_{(n_t,k)}$ do
5. Estimate $level - prob(p_t, o)$ using Equation (1)
6. end for
7. $S_{\text{node}} \leftarrow Pn_{(n_t,k)}$ $\{the\ set\ of\ sink\ node\ n_t\}$
8. for all $n \in S_{\text{node}}$ and $q \in P_{(o,k)}$ do
9. Node $k - prob(o)$ and $level - prob(q, o)$
10. if o $N_{(q,k)}$ then
11. $S_{\text{node}} \leftarrow S_{\text{node}} \cup \{q\}$
12. end if
13. end for
14. for all $o \in S_{\text{node}}$ do
15. Node $slp(o)$ and $DP\_OT(\{Pn_{o,k}\})$
16. end for
17. Estimate $slp_{(n_t)}$ and DP_OTn
18. return DP_OT

IV. Experimental Analysis

To analysed proposed algorithm in wireless sensor network, simulation process carried out in MALTAB tools. The system configuration for simulation windows 10 operating system, 16 GB RAM, 1TB HDD. We consider homogeneous network model for the analysis of algorithm. The scenario of network design as 50, 100, 150 and 200 nodes and different time interval of simulation. To measure standard parameters of network such as PDR, E2E delay and hop counts[20,21,22,23,24,25].

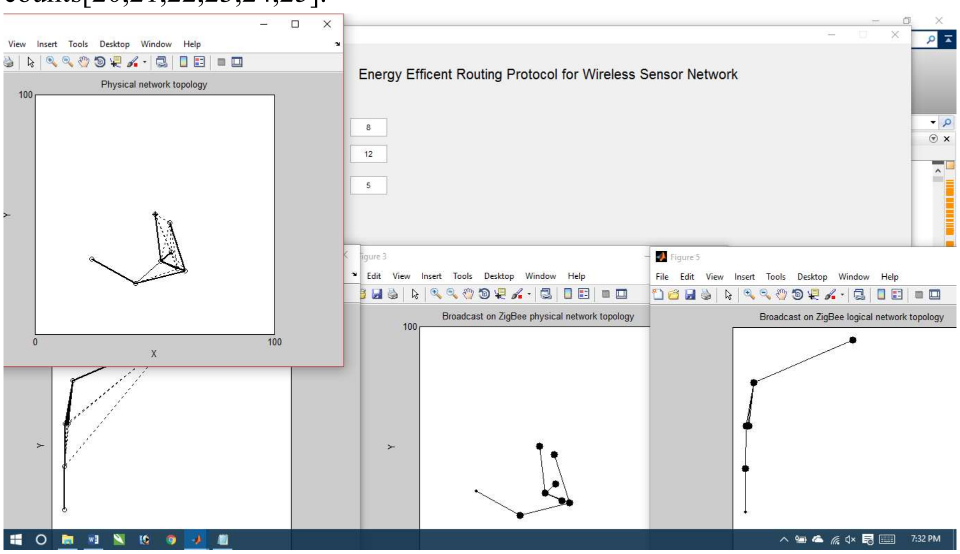

Figure 1: window show that the initial stage of energy efficient routing protocol for wireless sensor network implementation with number of node (8), number of maximum child (12), depth of network (5) input fields and click-on Proposed method button.

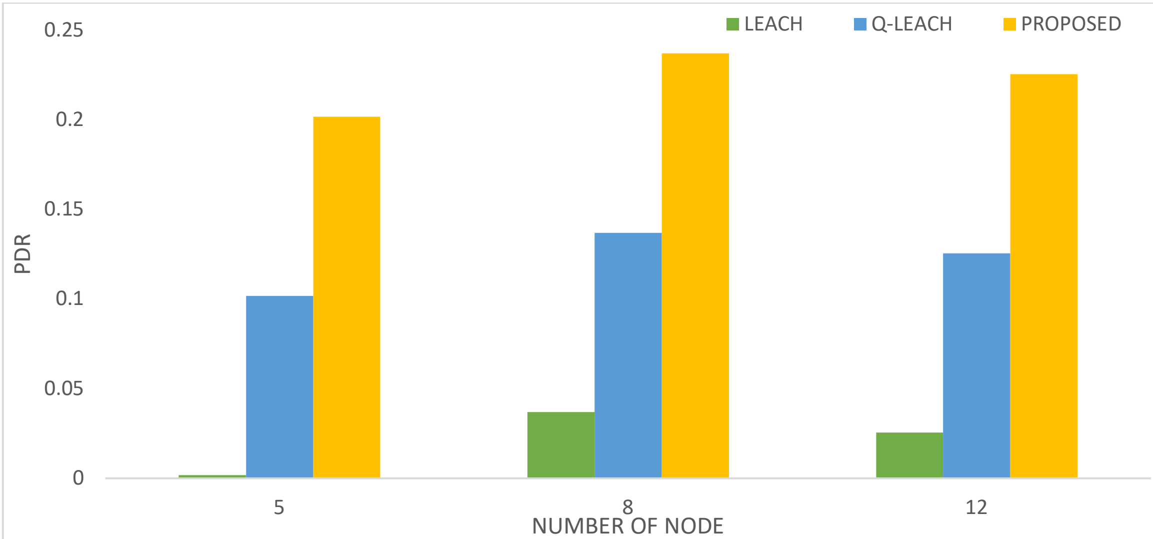

Figure 2: Window show that the Comparative performance analysis for PDR using Leach, Q-Leach and Proposed1 Method with input of number of node is 5, 8, 12, number of child node is 10, 12, 20 and depth of network is 3, 5, 8 sequentially.

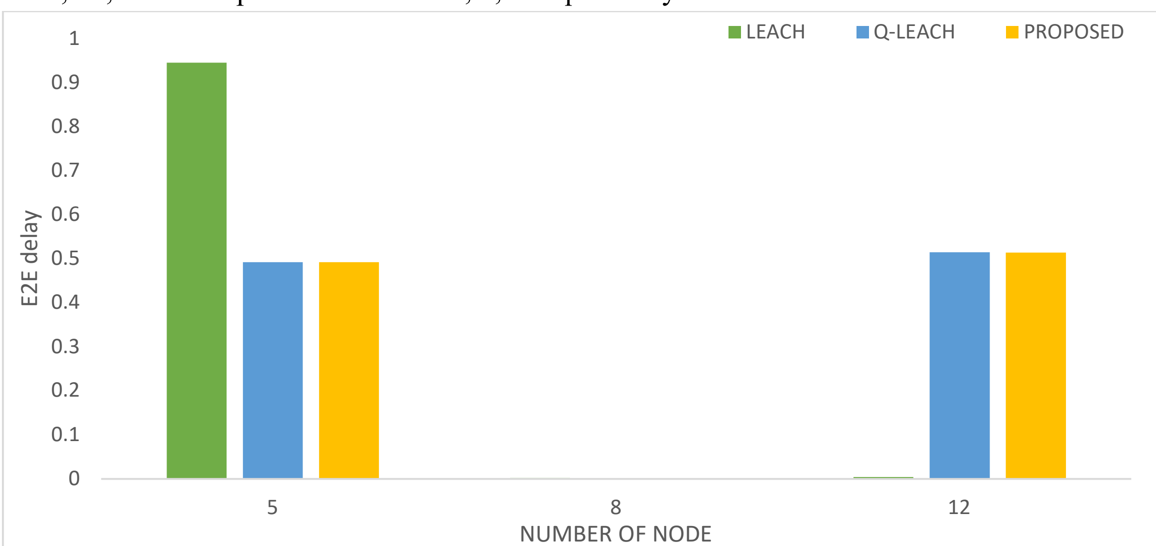

Figure 3: Window show that the Comparative performance analysis for End-to-End delay using Leach, Q-Leach and Proposed1 Method with input of number of nodes is 5, 8, 12, number of child node is 10, 12, 20 and depth of network is 3, 5, 8 sequentially.

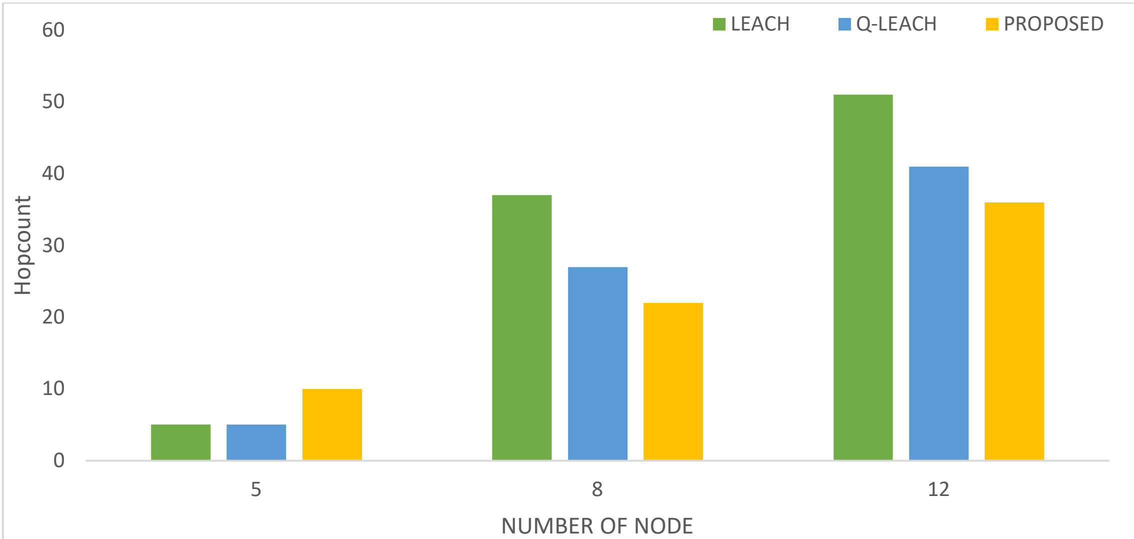

Figure 4: Window show that the Comparative performance analysis for Hop-count using Leach, Q-Leach and Proposed1 Method with input of number of nodes is 5, 8, 12, number of child node is 10, 12, 20 and depth of network is 3, 5, 8 sequentially.

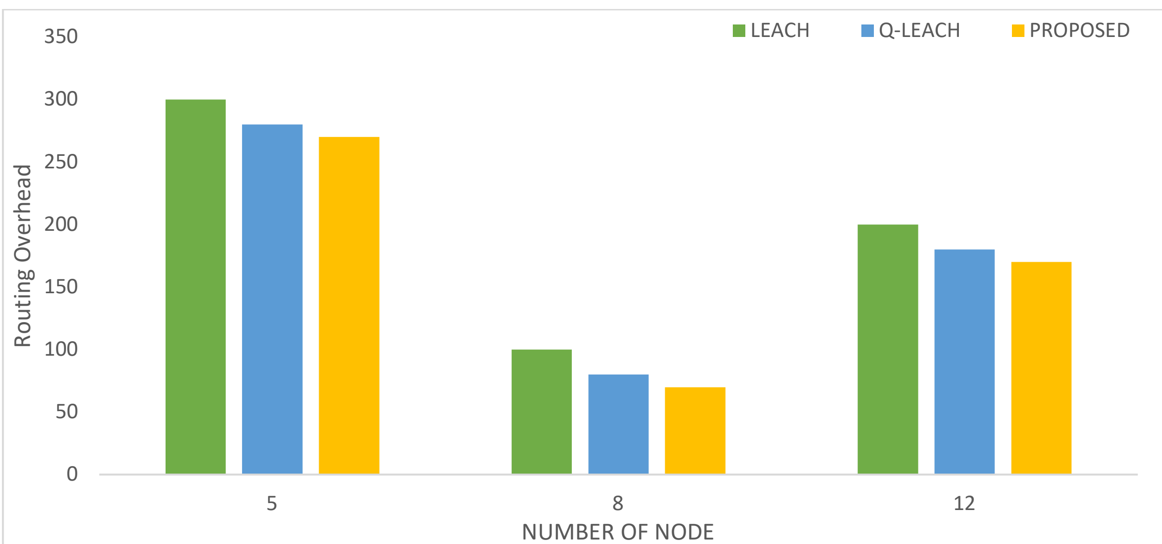

Figure 5: Window show that the Comparative performance analysis for Routing overhead using Leach, Q-Leach and Proposed1 Method with input of number of nodes is 5, 8, 12, number of child node is 10, 12, 20 and depth of network is 3, 5, 8 sequentially.

V. Conclusion & Future Scope

The dual probability-based function measures the expected value of energy for the transmission of data. The dual probability function creates sub group of networks based on energy function. The dual probability-based function changes the operation of energy management in scenario of sensor node data processing. The dual probability function integrates the cloud-based services with sensor network. The dual probability-based function works in the mode of energy level of sub group of sensors node. The subgroup of sensors node drives three level energy factor high, low and average. The level of energy factor decides two decision parameter one is DP and other is DP_OT. The DP decision parameter decides the subgroup of sensors node for the communication of sink nodes. The proposed model M-Q-LEACH estimate communication power loss rate of vehicle ad-hoc network with data powers, form Experimental results we can conclude: Power loss rate of WSNs is affected by many factors, such as flooding of control message protocol. M-Q-LEACH is an accurate model to estimate power loss rate, due to its stable and clear filtration process, its PDF is more accurate, and maximum a posteriori algorithm is less complexity and share good real-time performance. M-Q-LEACH can estimate the communication package loss rate with a smaller error, and can track the tiny change about it. It can be used to grasp the overall characteristics of the communication, support the data transmission control and routing algorithms in network protocol.

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