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Meta Heuristic Kha – Cuckoo Search Optimization Algorithm For Energy Efficient Wireless Sensor Network

R. Rajalakshmi[1], T.V. Ananthan[2]
[1] Research Scholar, Dr. MGR Educational Research Institute University
[2]Professor Dr.MGR Educational Research Institute University

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Abstract
Wireless Sensor network (WSN) is a complex distributed network which encompass huge amount of nodes for data sensing particular region. In WSN energy efficiency is the major constraints since it operates on battery power including individual node in the network. To achieve energy efficiency in WSN existing approaches adopt clustering through which among group of node individual node is selected as cluster head (CH) for whole cluster. The selected CH performs the task of processing and computation process of entire cluster which in turns reduces the energy consumption of the whole cluster. In WSN clustering has been implemented through data aggregation scheme for balancing energy consumption of particular hub in the senor system for productive data transmission. The existing WSN uses various techniques for achieving energy efficiency like Harmony Search Algorithm (HAS), Particle Swarm Optimization (PSO) and LEACH (Low Energy Adaptive Clustering Hierarchy) algorithm. Those existing algorithm exhibits local search and trade-off in exploration – exploration constraints in the WSN individually. To combine the advantage of existing approaches and to achieve faster convergence speed hybrid optimization technique has been evolved. In this paper proposed a novel hybrid optimization algorithm for achieving energy efficiency in the WSN. The proposed meta- heuristic hybrid optimization algorithm combines Krill-Heard Algorithm (KHA) and Cuckoo Search Algorithm (CSA) for achieving energy efficiency. Energy efficiency of the network is achieved by selecting appropriate cluster head in the network through fitness function of the proposed hybrid approach. The proposed hybrid optimization algorithm is implemented in LEACH protocol for energy efficient cluster head selection. The simulated results of proposed hybrid KHA – CSA algorithm exhibits an improved performance than the existing approaches.

Keywords: *Krill-Heard Algorithm (KHA), Cuckoo Search Algorithm (CSA), Hybrid Algorithm, Wireless Sensor Network (WSN), Cluster Head (CH), Energy Efficiency.*

INTRODUCTION:

Wireless Sensor Networks (WSN) has risen as a vital and mainstream method for providing pervasive computing to different applications. Since the WSN makes utilization of tiny sensor nodes that keep running on battery, their vitality (energy) must be optimally used (T. Shankar et al., 2016). A wireless sensor network is a very multifarious distributed system containing immense number of tiny wireless sensor nodes and base station (BS).

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Every WSN comprises of sensor, processor, memory, RF transceiver (radio), peripherals and power supply unit (battery) (Akyildiz, Su W et al., 2002). These WSN are conveyed over a geographical territory in an adhoc fusion for an occasion discovery and observe data for different encompassing conditions. The WSN could gather this real time information to design the environment with more intelligence (Handy M et al., 2002).Designing systematic methodologies to gather information from an extensive number of spatially distributed nodes is critical for an expansive range of wireless sensor–actuator systems (Archer et al., 2009; Rajagopalan and Varshney, 2006). Ordinarily, the nodes in such systems have constrained resources and must convey through low power, low bandwidth, wireless connections (Hill et al., 2004). Information from these nodes must be gathered at one more collection points (CPs). On account of the resources, bandwidth and limit constraints in the system, it is infeasible for every node to send its data straightforwardly to the CPs. Rather, it is important to recognize intermediate nodes that can aggregate or compress the information before sending them to the CPs (Karthikeyan T et al., 2019). Because of successful information aggregation approach WSN is additionally focus on disaster administration, such as, torrent cautioning, tremor checking, surge anticipating and pipeline observing system. The rapid development, self-association and adaptation to non-critical failure attributes of sensor networks make them an exceptionally encouraging detecting strategy for military applications (Muruganathan Siva D et al., 2005; Zhang Zhenghao et al., 2008). Since WSN needs to work on resources compelled environment, either changing or energizing batteries is an unmanageable task. Indeed, even the failure of single node because of low energy can prostrate the whole system. Henceforth this issue constrained the academic researchers for developing up an energy proficient protocol centering nodes and network level (Zong Ziliang et al., 2011). In the network level an assortment of energy proficient routing protocol were produced in the late years (Wei Dali et al ., 2011; Chang, Ju, 2012; Jayasuruthi et al., 2018). The routing protocols in WSN are classified under three principle heads: data centric protocol, location based protocols and hierarchical protocols (G. Kannan and T. Sree Renga Raja, 2015).

In conventional methodologies clustering is one of the traditional methodologies for energy proficient transmission of information from sensor node to cluster head (I.F.Akyildiz, et al., 2002; Heinzelman, et al., 2002; Z.M. Geem, et al., 2001;J.Kennedy,et al., 1995, Umamaheswaran, S, et al., 2011). Clustering is the progression toward partitioning the geological range into trifling segments and allocating one node as a head for the cluster, termed as Cluster Head (CH) (Mao Ye, et al., 2006). It is mutual practice to utilize various types of nodes, which have diverse levels of resources, in practical system. A Cluster Head (CH) is a resource rich node that can accumulate data from nodes in its neighborhood, compress the data and forward the information to the CPs. A CH and the node from which the CH gathers data are collectively alluded to as a cluster. In such systems, data accumulation can be performed in two levels; in the initial level, CHs collects the data from their cluster and in the second level, CHs send compacted information to the

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CPs (Rajagopalan andVarshney,2006). While this methodology is instinctive, it is practical only when we can balance the QoS inside a cluster with that accomplished at the system level. For instance, given an static compression proportion at the CHs, we may expect that as the quantity of nodes in a cluster escalations, the quantity of messages from the CHs will also increases. In any case, subsequent to the nodes in a cluster share a typical broadcast domain, congestion effects apparent and decline the quantity of messages received at the CHs. In this manner, the issues of identifying the location of CHs and consequently the span of the cluster in the system are perplexing and incorporate tradeoffs between the Quality of Service (QoS) accomplished at the level of the cluster and at the level of the system. The assortment of the cluster head plays a vital role for vitality effective data transmission. In viable network, the cluster head is changed during definite iteration for better performance (P. Bhaskar, et al., 2008). The number of cluster heads inside the network and the amount of nodes per cluster can be variable or altered based on the application scenario. Cluster heads can also form a second level network, i.e. creating another level of grading or they can just pass on the data to the base station (C. Blum, et al., 2003). During the technique for clustering, there exit's couple of restrictions, such as, extra overhead amid CH selection and dishonorable assignment of cluster construction process. These confinements reduces the lifespan of sensor nodes. This inspired numerous researchers to examine different aspects like, fitting CH determination, low power conventions (Jacques Bahi et al., 2014; Keontaek Lee, et al., 2014), network establishment and routing protocol (Tarachand Amgoth et al., 2014; Zhengmao Ye, et al., 2014; M. Emre Keskin, et al., 2014)of WSN.

For deciphering enhancement issue in existing wireless sensor correspondence hereditary streamlining algorithm has evolved. Genetic algorithm (GA) (Goldberg, D.E..et al., 2006; Gen, M and Cheng, R.. 1999) is a randomized search and optimization method and is widely utilized for solving streamlining issues that have expansive number of conceivable solutions. GA depends on survival of fittest hypothesis. GA begins with a set of conceivable solutions called initial population which is produced arbitrarily. Every individual resolution is called chromosome. Length of every chromosome must be same. A fitness function computes wellness estimation value of every chromosome. Chromosome with high wellness value is nearer to optimal solution. Two parent chromosomes are chosen for hybrid to create two posterity. Mutation is connected to arbitrarily choose chromosome to acquire a better solution. Crossover and transformation create next population. Few best wellness value chromosome of previous population are additionally chosen in new generated population to guarantee that the new generation is at least as fit as the previous. This procedure is known as elitism. This whole procedure is repeated until some ceasing criteria are not coordinated. In circumstances where the search for an optimal solution becomes exhaustive, we incline to pick meta-heuristic algorithm (C. Blum, et al., 2003). For meta-heuristic algorithm to be productive, it needs to cover the solution space

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where there is worldwide optimum and ought to generate new and improved solutions. Likewise, the meta-heuristic algorithm should escape from the local optimum. In literature, there are meta-heuristic algorithm, for example, Krill Heard Optimization algorithm and Cuckoo Search that aim at global improvement (Exploration) and algorithms like Simulated Annealing (SA) and Harmony Search Algorithm (HSA) that get restricted to the indigenous optima (Exploitation) (Xin-She Yang., 2012; Xin-She Yang, et al., 2014; Lei Zhang, et al., 2011; Lei Zhang and Fengchun Tian., 2014). For better solution, there must be a harmony between the investigation and the exploitation. This motivated us in combining the predominant meta-heuristic algorithm, specifically, HSA and PSO.

The elucidation aimed at the predominant execution of the proposed hybrid KHA-Cuckoo Search algorithm than the current algorithm is streamlined as follows:

- In the hybrid KHA-Cuckoo Search, with the conventionality of KHA, it permits the particles to move starting with one area then onto the next by upgrading the position and speed toward the end of each round.
- As KHA confront high dimensional optimization limitations, it's hard to discover each conceivable area of the search space. Under such circumstances, Cuckoo is used that has the high seeking computational capacity. It gives another approach to produce particles that creates a new vector after considering all of the current vectors.
- The Cuckoo has the constraint of being confined to just a specific region. This is being eradicated in KHA, which moves starting with one area then onto the next in search for an optimal solution but still faces the issue of exploration and abuse in high dimensional issues and takes a longer time to accomplish a local maxima or minima.
- Hence, the proposed hybrid approach makes utilization of high seeking effectiveness of Cuckoo combined with the dynamic nature of KHA.

The rest of the paper is sorted out as follows: Section 2 portrays the works related with heuristic protocols, clustering algorithm and meta-heuristic algorithm. Session 3 describes the WSN model. The hybrid KHA-Cuckoo Search algorithm is given in Section 4. The results and discourse of the proposed and existing algorithm are portrayed in Section 5 and the Section 6 finalizes the discoveries of the proposed algorithm.

RELATED WORKS

This segment takes the benefits of respected preceding work in WSN hierarchical clustering conventions which are essentially focused to enhance the network lifetime. Low Energy Adaptive Clustering Hierarchy (LEACH) proposed in (Shalini A et al., 2018) is a standout amongst the most well-known hierarchical routing protocols intended to aggregate and propagate information to the base station. LEACH obtains vitality productivity by dividing the nodes into clusters. The LEACH works on rounds where each round contained setup stage and consistent state stage. During setup stage the sensor nodes will choose a unsystematic number somewhere around 0 and 1. If this unsymmetrical number is underneath the threshold esteem T(n), then the comparing sensor node will act as a cluster head amid the given period called a round. LEACH dispenses the role of cluster head among the associate nodes in the cluster based on threshold esteem, which is figured by the accompanying formula:

$$T(n)=\begin{cases}\dfrac{P}{1-p^{*}\left(r \mod \dfrac{1}{P}\right)} & \text{if } n\in G\\ 0 & \text{Otherwise}\end{cases} \qquad (1)$$

Where P is the anticipated % of cluster heads, r is contemporary round and G is the arrangement of nodes that have not been CH in the last 1/P sequences. Amid firm state phase the elected CH makes a TDMA schedule and appoints a time slot for every member node for information transmission. After a particular time period the system returns into the setup stage to select the new CH. This methodology chooses the cluster head based on a foreordained likelihood and does not follow any energy effective component while electing T(n). LEACH-Centralized (LEACH-C) utilizes centralized algorithm for the determination CH and the same steady state phase as LEACH (Heinzelman W, et al., 2002). In the setup phase, the base station gathers the position and energy level of the sensor nodes and the node having greater energy than mediocre energy of all sensor nodes would be chosen as CH. Since this methodology considers the energy level of sensor nodes while selecting the CH, there might be a more noteworthy possibility of selected CH is far from BS which devour more energy when the correspondence amongst BS and CH.

Vinoth Kumar et al 2019 presents a protocol, HEED (Hybrid Energy-Efficient Distributed Clustering), that occasionally chooses cluster head according to the enduring energy. The author don't make any assumptions about the incidence of infrastructure or about node capabilities, other than the accessibility of multiple power levels in sensor nodes. However the proposed algorithms support only for build a two-level chain of command and requirement for multilevel progression.

Yu et al., 2007 present a new energy effective dynamic clustering technique which deals with every node assesses the number of active nodes in real-time and calculates its prime possibility of turning into a cluster head by observing the conventional signal power from its neighboring nodes. The author also established energy efficient and power aware (EEPA) routing algorithm and lifetime is contrasted with AODV, MTE and MRE routing protocol.

Dhilip Kumar V et al., 2018 propose a bunch based energy effective sending strategy which guarantees that while various nodes in a cluster get a packet, only one node among them is chosen to send the acknowledgement back. The binary exponential backoff algorithm was utilized to choose the node.

Kannan.G et al,, 2015, present RSSI based energy distributed intra cluster routing procedures and are not concentrated around inter cluster routing. The algorithm has expanded energy efficiency up to 17%. Likewise, the algorithm was veteran with TOSSIM test system and did not include any real time gadgets to ration the signal quality. The probabilistic clustering algorithm described above are thinking about the two imperative parameters, such as distance among the nodes and remaining energy of the nodes. The majority of the present clustering algorithm test results were delivered based on the stimulation results and being absence of real time behaviors. In this report real tentative setup was developed to calculate the distance between the sensor nodes and incorporated with the stimulation parameter to validate the proposed DCHS schemes.

K.Maithili, et al., 2018 an itemized study has been done on the traditional protocols, such as Direct Diffusion (DD), Energy Aware Routing (EAR), etc., location based protocols such as Geographic and Energy-Aware Routing (GEAR), Energy-Ware WSN Geographic Routing Protocol (EAGRP), and etc., hierarchical protocol, such as Low-Energy Adaptive Clustering Hierarchy (LEACH), Balanced-clustering Energy-Efficient Hierarchical Routing Protocol (BCEE) (Xiaoyan Cui and Zhao Liu., 2009) and swarm based hierarchical protocol, such as, Multi-sink Swarm-based Routing Protocol (MSRP), Probabilistic Zonal and Swarm-inspired System for Wild Fire Detection (PZSWFD), and so on.. It has been found that the utilization of swarm based hierarchical protocol is promising in enhancing the energy effectiveness of sensor nodes. The authors in (Shanmuga sundaram Thilagavathi et al., 2015) has proposed an enhanced Binary Particle Swarm Optimization (BPSO) algorithm with amended associated commanding set that uses leftover energy for disclosure of optimal number of cluster and cluster head. Although this technique enhances the quantity of clusters, the quantity of nodes alive and enduring mediocre energy is decreased to zero beyond 800 rounds. The authors in (Pratyay Kuila, et al., 2013) have distinguished the extra energy utilization at cluster head because of improper development of clusters in WSN. This leads to quick bereavement of cluster head as they are surplus with extensive number of sensor nodes. Consequently, they propose a improved differential evolution (DE) based clustering algorithm to enhance the lifetime of the cluster head in WSN.

Pratyay Kuila, et al., (2014) have projected a hybrid algorithm to amplify the lifetime of sensor nodes in WSN. Here, the hybrid procedure consolidates two routing techniques, namely, flush multihop routing and progressive multihop routing. The author in (Ahmed E.A.A et al., 2012) collective the ant colony optimization with greedy migration system to enhance the life time of sensor nodes under energy gap issue in grid based WSN. In any case, the hybrid strategies in (Jiang Zhu, et al., 2015) don't consider the clustering in WSN. A hybrid clustering procedure named Hybrid Distributed Hierarchical Agglomerative Clustering (H-DHAC) has been proposed in (Xuxun Liu, et al., 2014) that joins quantitative location and binary qualitative connectivity of data in

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clustering. In any case, the number of alive nodes begins diminishing as the number of rounds achieves 600.

Background

To accomplish energy proficiency in WSN topology based sensor system is considered which are expressed as follows: The mesh topologies we consider are acquired by inserting the hubs in a system, N, on a 2D-Basegrid. Every location on 2D-Basegrid is distinguished by a unique requested pair (m, n). The distance between two successive location on the grid, i.e., between location (m, n) and (m, n+1) or between area (m, n) and (m+1, n), is b. An embedding capacity assigns location on 2D-Base grid and a transmission range to every node, $n_i \in N$,

$$\in_q : n_i \to (K \times K \times M)$$
(2)

Such that every node installed on the 2D-Base grid has q neighbors as delineated in Fig. 1.

By changing the area of the nodes in the 2D-Base grid and the transmission range of every node, we get different mesh topologies in which q = 3, 4, 6 and 8. These mesh topologies are easier to scrutinize than general topologies and QoS results obtained to represents the upper limits for what can be accomplished in general topologies utilizing comparable strategies (Mamidisetty et al., 2009).

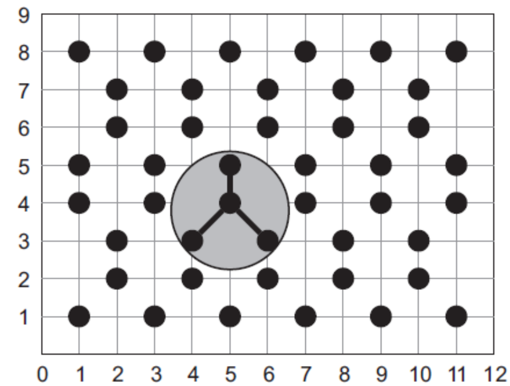

Figure 1. The gray circle around the center node represents its transmission range. Every node has three neighbors using above mentioned functions

Network Model & Assumptions

To actualize the proposed hybrid approach mesh topology based sensor system has been established and subsequent suspicions are made in this exploration. In this segment we portray our network scenario (fig. 2). The suspicions made are as following:

- The sensor network is thought to be a circular geographic area with the sink S, situated at coordinate (0, 0), and radius R_s .
- The sensors are consistently sent in the sensing territory A_s. In addition, the quantity of sensor hubs is appropriated by 2-dimensional Poisson point process with ρ as the expected thickness of A_c..
- The cluster covers circular area with its cluster head at the middle o with radius R.

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- There are total k clusters in the sensor system. Further, inferable from the uniform node distribution technique, we can calculate an estimation for the cluster radius, R :

$$k \times A_c = A_S \Rightarrow k \times \pi R^2 = \pi R_s^2 \qquad (3)$$

$$R = \frac{R_S}{\sqrt{K}}$$

- The base station (or sink) intermittently sends a solicitation to the cluster head to transfer the samples collected by the sensors (fig. 3). On accepting the solicitation, the cluster head telecasts an information gathering-sign to all its cluster individuals.

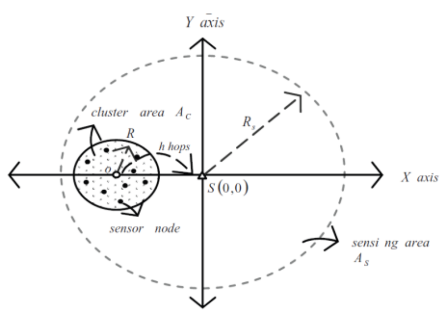

Figure 2: Scenario for Network

- In our commitment we have applied Krill Heard enhancement in clustered sensor system, the nodes in the system are stationery. The aim is to discover streamlined position for cluster head, i.e. the nearest node to the center of mass(COM). The mass center of a cluster is the mid-position of the sensor appropriation within the cluster. Such restriction for cluster head would ultimately minimize the mediocre distance secured by the sensors to transmit information to the cluster head. In this manner, the swarm knowledge considers N focuses on particles around the COM range and iterates in search of best location.
- Moreover, the haste of the molecule is thought to be the rate at which the position of the molecule is changed (shifted). Additionally, the sensor node closest to any unit is connected with the node's residual energy (molecule vitality) and head count. These parameters are utilized during the assessment of the objective purpose for every molecule in all iterations.

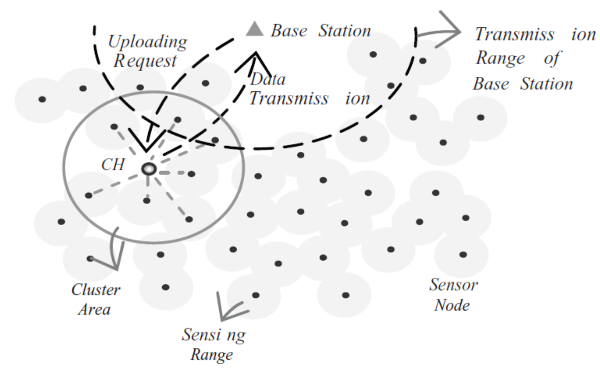

Figure 3: Process of data uploading

ALGORITHM OVERVIEW

To accomplish energy proficient methodology this research built up a meta-heuristic streamlining algorithm for CH determination. For accomplishing energy productivity KHA and CSA are chosen this area gives overview and process stream of the chose streamlining algorithm. The essential idea behind that intelligent optimization algorithm is based on the possibility exchange approach beginning from preliminary solution it searches down a most flexible arrangement. In KHA closest neighbor of the individual krill has been calculated utilizing successful fitness capacity as a part of the aggregate population of the system (Mukherjee, An., and Mukherjee, V., 2016). The issue exist with KHA is deciding final result is not a simple assignment hence performance of Krill devours long running time with numerous iterations consequently there is a chance of expansions in reenactment time of the system (Guo, L et al., 2014). CSA is another meta-heuristic advancement technique (Ehsan Afzalan et al., 2014; M. Basu and A. Chowdhury., 2013) motivated from the obligate brood parasitism of some cuckoo species by laying their eggs in the nests of different feathered birds of different species. At the point when the host feathered bird find an outsider egg in their nest, they can discard it or simply abandon their nest and construct another one somewhere else. The CSA idealized such rearing conduct in combination with Levy flights behavior of a few birds and fruit flies for applying to different constrained improvement issues.

Krill is one of the finest-inspected classes of marine creature. The krill groups are collection with no similar direction of existing on time sizes of hours to days and space sizes of 10s to 100s of meters. One of the key characteristics of this species is its ability to shape enormous swarms. The KH calculates imitates the intentional activities of krill. At whatever point predators, for instance, seals, penguins or seabirds, ambush krill, they discard singular krill (Mukherjee, An., and Mukherjee, V., 2015).

$$N_i^{new} = N^{\max}\alpha_i + \omega_n N_i^{old} \quad (4)$$

$$\alpha_i = \alpha_i^{local} + \alpha_i^{target} \quad (5)$$

Also, N_{max} is the best prompted speed, ω_n is the idleness weight of the movement incited in the reach [0,1], Ni_{old} is the last movement actuated, α_i^{local} is the local effect provided by the neighbors and α_i^{target} is the objective caption impact gave by the best krill individual as indicated by the deliberate estimations of the extreme instigated speed.

Existing cuckoo search algorithm (CSA) is another meta-heuristic advancement strategy technique (Ehsan Afzalan et al., 2014; Ruhin Kouser R.,et al 2018) roused from the obligate brood parasitism of some cuckoo species by laying their eggs in the nest of different feathered creatures of different species. At the point when the host bird finds an outsider egg in their nest, they can discard it or simply abandon their nest and manufacture another one somewhere else. The CSA idealized such rearing conduct in blend with Levy flights conduct of a few birds and fruit flies for applying to different obliged enhancement issues. The issue control variables, u, are created and randomly instated between their minimum and maximum cutoff points for a given introductory populace (N),

$$V_{m,n}^{l} = V_{m,\min} + rand_{m,n}(0,1).\left(V_{m,\max} - V_{m,\min}\right) \quad (6)$$

Where, m speaks to the variables identified with the i^{th} populace in t^{th} emphasis. Subsequently, the i^{th} populace in $(t+1)^{th}$ cycle is

$$V_n^{t+1} = V_n^t + Q_{m,n} \times \alpha \oplus Levy(\lambda) \quad (7)$$

where, $Q_{m,n} = V_{m,n}^{l} - V_{best}^{l}$ is the step size; $m = 1,2,......j$;where j is total load in the wireless sensor network and $n = 1,2,......N.V_{best}^{l}$ best is the global best solution in t^{th} iteration. The levy flight operation is

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$$Levy(\lambda)=\left|\frac{\Gamma(1+\lambda)\times\sin\left(\frac{\pi\lambda}{2}\right)}{\Gamma\left(\frac{1+\lambda}{2}\right)\times\lambda\times 2^{\left(\frac{\lambda-1}{2}\right)}}\right|;\ 1<\lambda\leq 3 \quad (8)$$

Where, λ is the distribution factor $(0.3\leq\lambda\leq 1.99)$, and $\Gamma(.)$ is the gamma distribution function. After each iteration, the threshold and energy level of individual node is updated with the new population, what's more, load stream examination, utilizing the Newton Raphson (NR) strategy, provides the node with highest energy level, line power streams and framework misfortune. The destinations, i.e., era fuel cost, emission, and total power losses, are evaluated for a given populace. The arrangement that minimizes the objective(s) is considered the best solution.

PROPOSED HYBRID ALGORITHM

The established hybrid optimization algorithm is executed in LEACH protocol for assessing the execution of the developed hybrid optimization algorithm. In LEACH (Low-Energy Adaptive Clustering Hierarchy) protocol the information is sent to the cluster heads who in turns forward the same to the sink node after aggregating. The rounds in the LEACH operation are separated into two namely - a set-up stage and steady state phase. The execution of the proposed hybrid KHA-CSA calculation in LEACH is expressed in this section. The procedure flow of the proposed hybrid algorithm for energy proficient cluster head determination is recorded in this segment. Association of the cluster is done in the set-up phase and the information is sent to their cluster heads in the consistent state phase. Cluster Heads repeats after each P rounds, where P is the rate of the cluster heads. Consequently each round has 1/P probability of turning into a cluster head in each round, .A node that is not a cluster head chooses another cluster head that is nearest to it toward the end of each round and joins that bunch head. Head than makes a schedule for every node to transmit the information.

Conventional optimization algorithm can't oblige non-direct objective function. Meta-heuristic methodologies have been created to solve non-straight, non-continuous and non-convex objective functions. Besides, hybridization can possibly accelerate the exploration and locate the optimum solution rapidly. Hybrid algorithm, consolidating two or more distinctive techniques, is a promising examination field and many satisfactory enhancement results have been reported such as exactness, convergence velocity and robustness in taking care of bigger systems etc.. In such manner, the arithmetic hybrid operation can be utilized to upgrade the newly generated population and consequently the answer for pace up the convergence, which can enhance exploitation of the algorithm. The current Levy flight administrator in CSA can control the exploration of the arrangements, to balance exploration and exploitation processes, we consider the hybrid operation, which diminishes the differences of the issue and hence the last best arrangement will be acquired in less iterations. We call this the hybrid CSA (HCSA) enhancement. The mathematical representation of the hybrid operation is (V Kumar et al., 2018).

$$V_{m,n}^{t+1}(new)=(1-\lambda)\times v_{best}^{t}+\lambda\times v_{m,n}^{t+1} \quad (9)$$

Where λ is a random number between 0 and 1. After calculating the new population using Eq. (7), this population is modified using Eq. (9). The remaining processes of identifying the best solutions from the population and calculating a new levy flight administrator are

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then performed for a predefined number of iterations.

Proposed Algorithm Cluster Head Selection Algorithm

The anticipated technique selects the most appropriate node as cluster head, where the eligibility criteria for cluster head is as follows. The eligible node for the CH should have

1. Threshold value above average of all the participating nodes.

2. Maximum energy available.

3. Maximum throughput.

4. Least distance from the sink node.

5. It should not have failed in the last N transactions.

STEPS IN HYBRID ALGORITHM

The steps adopted in energy efficient cluster head selection are listed as follows:

1. Initialize the population.
2. Calculate threshold energy of the initialized population using Eq. (6).
3. Update the energy level and location of the individual node in network.
4. Identify the node with highest energy level.
5. Update the population using Eq (7) after calculating Levy Flight by Eq. (8).
6. Update the new CH using crossover Operation in Eq. (9).
7. Repeat step 3 to 6 for identifying Cluster head in the network.

The process of proposed hybrid KHA-CSA algorithm for cluster head selection is elaborated as follows:

Step 1: Finding the eligible nodes

1. *for all the nodes in a cluster*
2. ***if** node = already (CH)*
3. *go to next node*
4. *check the node status in memory table*
5. ***if** nodestatus= fail (trans id)*
6. ***then** go next node*
7. *else node can be selected*
8. *move to step 3*
9. *refresh*
10. *check for node availability for n sec*
11. ***if** Node Available*
12. *Continue*
13. ***Else** select the subsequent Cluster Head*

Step 2: Computing the Typical Threshold (Thavg) of the network

Before electing any node as a CH we take into account its threshold value. If this value is above the average that is set for the network, only then the node participates in the next race.

1. ***for** each node in cluster C1….CN*
2. *calculate threshold*

$$Th(n) = \text{Prob}1\text{- Prob}\left(r \bmod \frac{1}{\text{Prob}}\right)$$

3. *select all the nodes having the standards above the threshold significance by calculating the*

4. *average threshold*

$$Th(avg)=\frac{\sum Th(n)}{n}$$

5. *If* $Th(n)>=Th(avg)$
6. *put in (ListHigh)*
7. ***else** Put in (ListLow)*

Step 3: Calculating the Available Energy

1. ***for** all the nodes in the ListHigh*
2. *Energy = Power * Time*
3. ***calculate** the available energy of each node*
4. *Eavail = Current Energy / Maximum Energy*
5. ***create** a List Eavail sort in plunging order.*

Step 4: Calculating Minimum Distance and Throughput

1. ***for** the first node in Eavailsort*
2. ***calculate** minimum distance using LEACH-MP*

$$Throughput(TP)=\frac{Size\ of\ the\ Packet}{Transmission\ Time}$$

3. *node=CH*
4. ***if** 2 nodes have same energy*
5. *Node with min dist = CH*
6. ***if** 2 nodes have same energy and same minimum distance*
7. *Node with max throughput=**CH***

ENERGY CONSUMPTION ANALYSIS

The main goal of this research is to build up a energy effective cluster head selection in WSN. This segment provides energy utilization model considered for examining proposed hybrid KHA-CSA algorithm for cluster head choice in the WSN. In WSN, nodes are sent arbitrarily, i.e. positions of nodes are not pre-designed. Most of the energy of nodes is disseminated because of communication between two nodes and it relies on upon the distance between them. Both sending and receiving of data expends energy. For sending m bit data over a distance k, the aggregate energy devoured by a node is as per the following. In this paper, energy utilization model for wireless communication as follows, wireless communication module has the capacity of power control, the minimum energy can be utilized to send information to the receiver, every k bit of data sent to the distance d will the measure of energy of:

$$E_{Tx}(k,d)=\begin{cases}E_e\times k+E_{fs}\times k\times d^2\left(d<d_{crossover}\right)\\E_e\times k+E_{mp}\times k\times d^4\left(d\geq d_{crossover}\right)\end{cases} \quad (10)$$

Where k stands for the dipatching binary digits, d is the sending distance, $d_{crossover}$ is the threshold of sending distance. In the event that the distance is under d0, power enhancer will utilize the free space loss model; if the distance is more than d0, it will utilize multi-way fading model.

Where $d_{crossover}$ is hybrid distance, while the energy utilization for getting that message is given by:

$$E_{Rx}(k)=k\times E_e \quad (11)$$

Considered system model for proposed plan expect energy required for running the transmitter and receiver electronic hardware E_{elec} as 50nJ/piece and for adequate SNR required energy for transmitter amplifier with the expectation of free space engendering E_{fs} as 100pJ/piece/m2 and for two ray ground E_{amp} as 0.0013pJ/piece/m4. The hybrid distance $d_{crossover}$ is viewed as 87m.

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Simulation Environment and Discussion

NS2 (Hepburn, M., 2016) simulation package is utilized to compute the routine of the proposed EECMRP protocol and compare with QMRP. Arbitrary way point portability model is been utilized. 512 bytes each in addition to header of various layer has been produced as consistent bit rate. We will utilize the model of wireless communication revealed in segment four. In the simulation, Wireless Sensor Networks made by 100 nodes, nodes arbitrarily appropriated in a 100m × 100m area. The fundamental parameters of the Wireless Sensor Network model are: the preliminary energy for every node is 0.5J, population scale is: Q=30, c1=c2= 2, w=0.9. The rand will be given arbitrarily amid the processing. Assessment elements: $\alpha 1=0.25, \alpha 2=0.\ 3, \alpha 3=0.25, \alpha 4=0.2$. To test the efficiency of the algorithm, this article will analyze the Master-slave cluster head algorithm with LEACH protocol and the Enhanced LEACH algorithm with proposed hybrid calculation.

Evaluation

The accompanying measurements are being assesses

- Average delay: Is the distinction in time between the source and the destination.
- E2E delay: Time taken by a packet to exchange over a system from source to destination.
- Loss: packet misfortune happens when more number of packet go over a system or if a system fails or if there is congestion in system. Packet misfortune is figured by rate of packet sent.
- Packet conveyance: To send a packet the sender must know the full, IP location of the beneficiary. System topology is utilized to give the MAC location of the packet.
- Throughput: the successful rate of message conveyance.
- Routing overhead: the metadata and the system routing data send by an application. A part of accessible transmission capacity is been utilized.

RESULTS AND DISCUSSIONS

The developed hybrid KHA-CSA algorithm is implemented in LEACH protocol for performance evaluation. The LEACH protocol consists of set-up phase and steady-state phase in second phase which is steady-state phase of the protocol the proposed hybrid algorithm KHA-CSA is examined. The results show that after the implementation of hybrid KHA-CSA algorithm, starting from the operation of the network to the initial node through the rounds of death and the KHA-CSA longer than LEACH, the network lifetime has been renewed. The results obtained for hybrid optimization approach is comparatively examined with existing approaches like LEACH and enhanced LEACH. The results obtained through the simulation of developed hybrid KHA-CSA are stated as further:

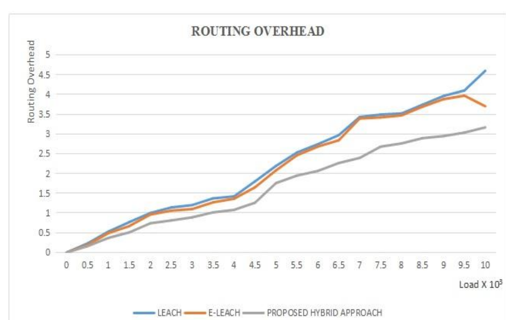

Figure 4: Routing Overhead

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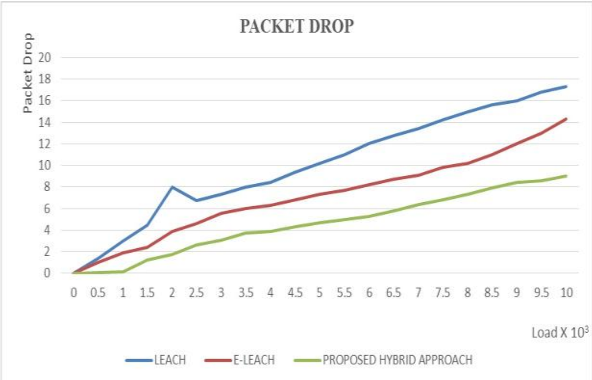

Figure 5: Packet Drop

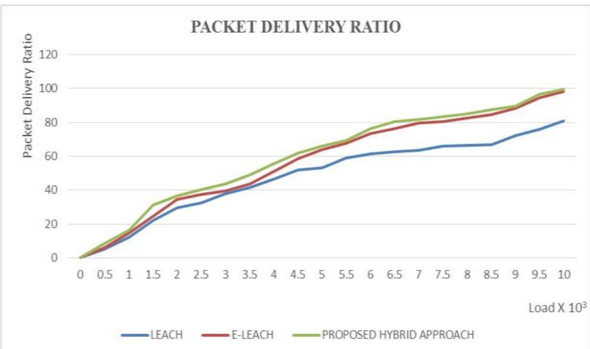

Figure 6: Packet Delivery Ratio

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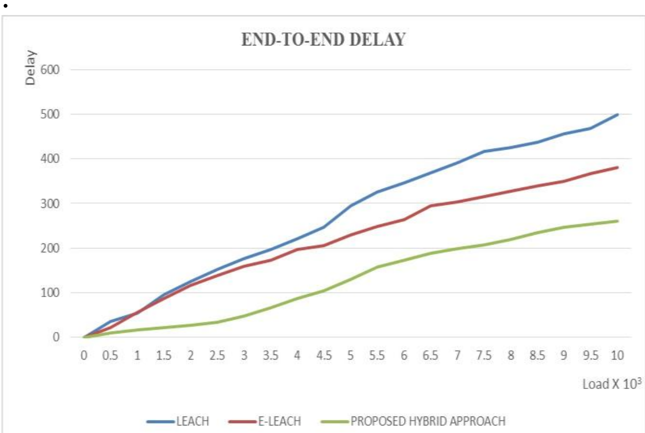

Figure 7: End-to-End Delay

The figure 4 demonstrates the comparison plot of routing overhead of the proposed hybrid algorithm with LEACH and enhanced LEACH algorithm. Through the analysis of the routing overhead it is observed that when load in the wireless sensor network is increased routing overhead of the system is increased.

From the analysis of routing overhead the existing approaches like LEACH achieves the maximum overhead rate of 4.6 and enhanced LEACH provides 3.6. The maximum routing overhead obtained by proposed hybrid KHA-CSA algorithm is 3.1 which is comparatively lesser than other approaches hence it is concluded that proposed approach significantly reduces the routing overhead of the wireless sensor network.

To evaluate the successful transmission of packet in the wireless sensor network for proposed hybrid KHA-CSA algorithm packet drop ratio is evaluated which is graphically shown in figure 5.

The packet drop ratio for the LEACH protocol is achieved at the rate of 17% and enhanced LEACH protocol provides the packet drop ratio at the rate of 14%. The proposed hybrid approach exhibits minimum packet drop ratio for entire load in the network. Packet drop ratio achieved by proposed hybrid KHA-CSA algorithm is 8.2% which is drastically lesser than the other approaches from which it is concluded that proposed hybrid KHA-CSA minimizes the packet drop ratio in the network.

The figure 6 shows the comparison plot of packet delivery ratio of the LEACH, enhanced LEACH and Proposed hybrid KHA-CSA algorithm. The simulated results describes that packet delivery ratio increases with increase in load of the wireless sensor network. There is gradual loss in delivery of data when the simulation time increases. By using hybrid KHA – CSA the PDR value varies between 96.7%-98% when the stimulation time varies from 10to50ms. When compared with LEACH and enhanced

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LEACH the PDR percentage is higher in hybrid KHA-CSA algorithm. Similarly fig.7, the end-to end delay is measured for hybrid KHA-CSA algorithm through analysis it is observed that when increases the end to end delay time of the protocol also increases. The proposed KHA_CSA algorithm is more efficient when compared with the LEACH and enhanced LEACH.

Conclusion

Wireless Sensor network (WSN) is a complex distributed network which encompass huge amount of nodes for data with limited batter resources. To achieve energy efficiency in WSN existing approaches adopt clustering for achieving energy efficiency through cluster head selection. The selected CH performs the task of processing and computation process of entire cluster which in turns reduces the energy consumption of the whole cluster. In WSN clustering has been implemented through data aggregation scheme for balancing energy consumption of the individual node in the senor network for efficient data transmission. A novel hybrid optimization algorithm for achieving the energy efficiency in the WSN is proposed in this paper. The proposed meta- heuristic hybrid optimization algorithm combines Krill-Heard Algorithm (KHA) and Cuckoo Search Algorithm (CSA) for achieving energy efficiency. Energy efficiency of the network is achieved by selecting appropriate cluster head in the network through fitness function of the proposed hybrid approach. The proposed hybrid optimization algorithm is implemented in LEACH protocol for energy efficient cluster head selection. The simulated results of proposed hybrid KHA – CSA algorithm exhibits an improved performance than the existing approaches.

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