A SURVEY ON METAHEURISTIC OPTIMISATION BASED CLUSTERING IN WSN

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ABSTRACT

Wireless Sensor Networks (WSNs) are standard wireless ad hoc network which can gather, integrate and send data autonomously. The LEACH's(Lower Energy Adaptive Clustering Hierarchy)Cluster Head (CH) selection procedure is improved by the Lower Energy Adaptive Clustering Hierarchy (E-LEACH) with energy consciousness. When selecting the best Cluster Heads for WSNs, evolutionary techniques consider positional data and residual energy.A general approximation approach that runs in polynomial time should be utilized to solve Non-deterministic Polynomial(NP)hard problemof optimal CH selection.By carefully choosing the CHs for each cluster, the research aims to increase the network longevity and energy efficiency. For resolving problems of this kind, a general approximation algorithm with polynomial timeis to be utilised. Finding such a problem and arriving at a nearly perfect answer is difficult. By optimization, the symmetry of every network link and its energy efficiency have been guaranteed. Since the optimization is NP hard, the majority of the network parameters are additive in character. For instance, the end-to-end delay in WSN for multi hop networks iscumulative in nature. The issue of the local optima with regard to the selection of the CH utilising hybrid approaches has been addressedin this research.

KEYWORDS:WSNs,LEACH,CH,E-LEACH

1. INTRODUCTION

The Wireless Sensor Networks (WSNs) are a class of sensor node networks that can wirelessly interact over short distances and are multifunctional, inexpensive, low-power, and compact. WSNs have sensor nodes that are randomly placed throughout their area of interest and canbe used extensively to carry out monitoringand surveillance tasks. With WSNs, for example, energy efficiency and network longevity have been among the most crucial challenges because the sensor nodes had to be powered by the battery, which had to be placed in a way that was typically challenging.There are many elements that have influenced the architecture of the sensor network.These components are essential because they will serve as a guide for developing the protocol or algorithm for sensor networks and because they are used to compare various schemes.

Error Tolerance: Due to a lack of electricity, physical harm, or outside interference, some sensor nodes may malfunction or become blocked. A sensor node failure won't affect the sensor network's total failure. This issue will

be error tolerant and dependable. Fault tolerance is the ability to keep the entire network working without being affected by node failure.

Scalability: There may be a few to several thousand sensor nodes actually distributed to monitor the event. This use suggests that this number could also reach exceedingly high values. These novel schemes can utilize the high density base of the sensor nodes and will operate if there are nodes.

Manufacturing costs: In order to justify the cost of such networks, it will be essential to keep the price of each sensor node as low as possible because these sensor networks consist of a large number of sensor nodes.

Hardware Constraints: The hardware limitations of the sensor node are made up of four distinct components: the sensing node, the processor unit, the transceiver unit, and its power unit. Applications requiring additional components, such as tracking systems, mobilizers, or power generators, might use this.

Network Topology: Due to the enormous number of vulnerable sensor nodes that are inaccessible and unsupervised and are prone to failure, maintaining the topology would be especially challenging.

Environment: For the geographically isolated places, the sensor nodes will be placed densely either near or inside the event being watched, allowing them to operate unattended.

Power Requirements: A wireless sensor node is a small electrical device that requires a finite amount of power (around 0.5 Ah, 1.2 V). Depending on the purpose,it may be impossible to replace the power supplies, and the sensor node's lifespan will be strongly correlated with the battery's lifespan.

1.1 CLUSTERING IN WSN

By grouping the sensor nodes within a number of clusters, each of which has a CH, a technique known as clustering can be used to increase the scalability of a sensor network. This CH will be predesigned by a network designer or will be voted by the network sensors. The scalability of these sensor networks will be improved by the clustering techniques by tackling two problems with mobility and size. They may differ depending on their general design and the node deployment strategies that rely on the properties of the CH node.There are many members of the cluster that, based on the application, can act as a CH and have a lot of energy sources. Clustering approach decreases the consumption of energy and provides some stability to the WSNs.For all the diverse networks,There are numerous proposed protocols, and the majority of the more recent ones have been created for the networks based on their average energy, location, density,and residual energy.

One of two methods:dispersed or centralized can be used to coordinate the complete clustering process.In the first scenario, each sensor node will execute a unique algorithm to become the CH. The WSNs often use a large number of sensors, sometimes up to thousands. The initial stage in this phase will involve randomly placing the sensor nodes within a square region and computing the residual energy for the sensor nodes. The nodes with residual energy above their average are selected as the CH. The nodes that are closest to the CH will create the groups. The WSNs with a continuous data flow have proved significantly better suited for the clusteredrouting techniques. The LEACH is a well- liked clustering protocol that suggests an additional two-phase operation based on a single-tier network by employing clusters. Another cluster-based protocol used is Power-Efficient Gathering in Sensor Information Systems (PEGASIS), and LEACH with Centralized (LEACH-C) is another addition to the LEACH protocol that increases energy economy. The Low-Energy Fixed Clustering (LEFC), another highly effective clustering method designed for WSNs, makes use of the local information contained in nods. Since the sensor nodes that are usually deployed will have an increase in node size and system cost that may not be appropriate for all applications, it is essential to know the sensor node placements before implementing the LEACH-C, PEGASIS, and LEFC even though they have higher performance. (Karaboga et al. 2012).

1.2 METAHEURISTIC OPTIMISATION APPROACH

Finding a vector within a function that has an optimal solution will be the goal of a heuristic optimization method, and all feasible values will be taken into account. Most of the time, algorithms are used to solve problems. To categorize this, it is simple to consider the nature of these algorithms and their optimization algorithms, which are further divided into two categories, such as the deterministic algorithms and the stochastic algorithms. Up until a point where hill climbing makes a strong attempt to create a similar set of solutions, the algorithms use gradients; at that point, iterations begin from a new point. The stochastic algorithms won't employ the gradients to produce alternative solutions at the same time. Heuristic and metaheuristic stochastic algorithms are the two main categories of stochastic algorithms. Several nature-inspired algorithms have recently been developed that effectively solve the contemporary, nonlinear, global optimization issues.

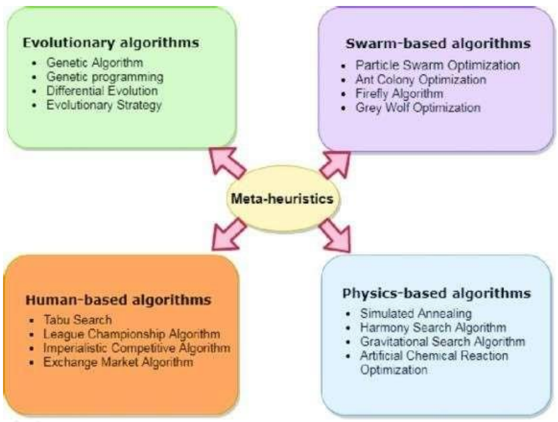

FIGURE1- METAHEURISTICS ALGORITHM

The worldwide search and the local search will both be balanced to some extent by each of the 26 metaheuristic algorithms. These nature-inspired algorithms have been used to solve all NP-hard issues, including Uninhabited Combat Air Vehicle (UCAV) path planning, test-sheet composition, WSN deployment, and geotechnical and transport engineering. In the 1950s and 1960s, all the computer scientists had investigated the chances of being able to comprehend the evolution to be a tool of optimization and this was possible to develop one subsetof a gradient free techniques that are termed the Genetic Algorithms (the GA). Since then, additional meta-heuristic algorithms have emerged, including Differential Evolution (DE), Particle Swarm Optimization (PSO), Biogeography Based Optimization (BBO), Harmony Search (HS), and, more recently, the Bat Algorithm (BA), which was motivated by bats' echolocation behavior.

2.SURVEY ON OPTIMISATION IN WSN

Hu et al. have proposed an effective routing recovery protocol that creates and optimizes an alternative route using the Endocrine Cooperative Particle Swarm Optimization Algorithm (ECPSOA) (2015).

The multi-swarm evolution equation in this case determines the particle's route of mutation, and the endocrine mechanism increases its diversity. This can improve the algorithm's precision and convergence speed while also enhancing the effectiveness of worldwide search.Using this method, the alternate path with the best QoS characteristics can be chosen from the source to the sink nodes. When there are numerous mobile sink nodes present, the routing protocol that has been presented has improved in strength and can also adapt to topological changes more quickly.

Sasi and Sivanandam conducted a study on cryptography that utilised optimization approaches for safe communications (2013). Several optimization algorithms have been proposed for generating encryption keys.Ant Colony Optimization methods uses this to generate the keys needed to encrypt the text and is based on key generation. The ACO method is used to create the encryption keys. To assure security in WSNs, this survey has carefully examined the problems with cryptographic optimization techniques. Performance of different approaches is compared using factors including runtime, battery life, and the maximum amount of keys stored.The most keys that can be kept in the Ant Colony Optimization-based key creation for Novel Stream Cipher Cryptosystem 256, Fast and Secure Stream Cipher 256, and RC4 256 keys is 52. An enhanced PSO-Based Clustering Energy Optimization (EPSO-CEO) method for WSNs has been suggested by Vimalarani et al. (2016). To minimize the amount of power required by the WSN in this scenario, the PSO algorithm is used for clustering and CH selection. Performance indicators have been assessed, and the results are contrasted with those of competing algorithms,to validate the decrease in energy use. Yildiz et al. have developed a new MIL framework for maximising the networklongevity utilizing the node level method (2016).For decreasing the MIP model complexity in large networks, two polynomial time heuristic techniques have been presented. The speed improvements broughton by node level strategy and heuristic methods have been looked at throughparameter space exploration.

2.2 SURVEY ON HYBRID OPTIMISATION IN WSN

According to Wang et al. (2016), a brand-new meta-heuristic CS and krill herd CSKH technique is useful for handling global optimization problems. The CS algorithm's output, the KU/KA operator, has been merged with the KH algorithm, and the CSKH has also been tested on numerical optimization issues. The KH algorithm has been described in depth, and in order to improve it, the KU operator has been used during the KU process to change the krill. The CSKH selection method, which replaces both the original KH and CS, is greedy. Sujatha & Siddappa have proposed a hybrid optimal technique employing Dynamic Weight PSO (DWPSO), Linearization Method (LM), and Differential Evolution (DE) algorithms (2017). This could improve the localisation of the WSN. By reducing the square error of the estimated and measured closeness between its neighbouring anchor node and unknown node, DWPSO can achieve localization accuracy superior to LM. This increased localization precision was attained by combining the DWPSO and DE algorithms to increase localization accuracy. According to the findings of the simulation, DWPSO outperforms LM in terms of stability performance, localization accuracy, and localization error. The hybrid GA-PSO optimization methodology, bacterial foraging optimization (BFO), GA, and PSO were among the optimization techniques that Kaur and Sohi investigated. (2018). Prior to combining GA and PSO, optimization methods like BFO, PSO, and GA are used on WSN individually. The current approach includes GA optimization and load balancing.

However, in this case, hybridization of GA and PSO is only one strategy that is taken into consideration. The comparisons have been analysed to see which approaches work best for extending network life and reducing WSN end-to-end delay so that packets can be delivered successfully with a lower error rate, which would reduce the likelihood of the node failing.

Hybrid GA-Firefly Localization Algorithm (GA-FFLA), Hybrid DE-Firefly Localization Algorithm (DE-FFLA), and Hybrid PSO-Firefly Localization Algorithm are three unique hybrid algorithms based on firefly that were proposed by Sridevi Ponmalar et al. (2017). (PSO-FFLA). They have been examined, 24designed, and put into practise to optimise localization mistake. Based on the accuracy of time, location, the quantity of iterations needed, and the difficulty of achieving the necessary accuracy, a number of localization problems have been compared. All of the algorithms have full estimation accuracy.However, there are modifications in the requirements in terms of number of fireflies coupled with changes in temporal complexity and the number of iterations that are needed.

3.CONCLUSION

The fundamental ideas and architectural layout of WSN, together with sensor nodes, its most crucial component, were explored in this survey. The survey work transitioned from the WSN classifications, applications, and challenges to the communication strategies. Along with the numerous forms ofoptimization technique and its properties, a wide range of clustering mechanisms have alsobeen covered.

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