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PSO - Based Heterogeneous Wireless Sensor Network for IoT Applications: Hybrid Artificial Immune System

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Abstract: A technique for simulating and replicating the intelligence levels of a biological group is known as the Swarm Intelligence (SI) algorithm. Potential parallelism is added to this SI technique to facilitate the real Possibility of solving a number of complex and non-linear problems in terms of resilience, self-adaptation, and search capability. Among the SI algorithms, some optimum solutions are sought after based on specific heuristic information. These algorithms have been used for a variety of optimization issues, including NP, dynamic, and multi-objective issues. The SI is showing a very high promise of numerous IoT-related applications as a result of its increased growth. utilizing algorithms influenced by SI. The PSO is a term for a computer optimization method that is used to solve problems repeatedly while maintaining a high degree of quality. Predictably, the PSO-AIS combo would improve global search and prevent getting sucked into the local optimization process. Numerous optimization issues have seen successful applications. Studies have shown that AI has a variety of alluring immunological qualities that enable evolutionary algorithms that improve local search and further delay early convergence. The population-based swarm intelligence method known as the Hybrid AIS-PSO uses fitness function optimization to carry out the optimization procedure. The primary intention of the hybrid algorithm was to reduce major drawbacks, and they can make some enhancements to speed and accuracy. The work proposed a hybrid Artificial Immune System (AIS)-Particle Swarm Optimization (PSO) based heterogeneous WSN.

Keywords: Swarm Intelligence, Particle Swarm Optimization, Artificial Immune System, Internet of Things.

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1. Introduction

A Multi objective Programming-Based Genetic Algorithm (MPGA) will be used by a parallel GA during the solving process to look for several workable solutions for each group that is running concurrently. The two components of the MPGA are the selection of specific non-critical variables and Improved GA with Fast Non-Dominated Sorting (also known as the IGA-FNS). The method will use the IGA-FNS for the initial portion of the MPGA in order to optimize redundancy and coverage for a certain node group. Here, the IGA-FNS method will be created using modified source code from MATLAB and GA. In terms of achieving a non-differentiable, multi-modal, and non-linear resolution, the PSO is robust and quick. The Artificial Immune System (AIS), which is based on the natural immune system and has a powerful information processing capacity to handle complicated situations, has emerged quickly in modern times [1],[2]. Using the immune system of a living thing, such a human or an animal, this nature-inspired method could solve optimization issues with a lot of reinforcement. Human immune systems will be in charge of maintaining the physiological system's stability, including pathogen defence. Because of the clonal selection algorithm, the AIS's global search capabilities can be improved [3],[4].

2. Literature Review

In order to sort individuals and adopt a new, uniform crossover with individual pruning that can optimize the GA internally, the Fast-Non-Dominated Sorting (FNS) method replaces a single objective function (or fitness function). The parallel approach will first determine whether the group node's coverage can match the lower bound while the nodes are being activated. In the event that this is not viable, the node group will not be able to produce a workable solution, and the parallel algorithm will drop the node group as a whole (Zhang et al. 2020). If this is doable, the parallel algorithm will start with the IGA-FNS method. The GA is taken to be a model consisting of natural systems with parallel implementations viewed with sub-populations that independently evolve along with a rare migration between the sub-populations (Chaibi et al. 2020). By moving the particles about in the search space, the GbLN-PSO algorithm may improve the particles' capacity to find the optimal solution and produce the highest-quality outcomes (Mozamir et al. 2021). Even for a small population, the PSO and AIS (PSO-AIS) was expected to improve global search and prevent getting stuck in the local optima (Bhola et al. 2020). The search technique has been used to characterize the butterflies' true behaviour. Generally, the scent of the other butterflies is what draws them to one another. Later, a butterfly with a stronger scent caused the butterflies to travel randomly in that direction.

Additionally, the butterfly's stimulus intensity was ascertained using the objective function[5] [6],[7]. The node degree, node centrality, distance to neighbours, residual energy, and distance to the BS will all be used by the BOA to determine which of the sensors has the best CH. Maheshwari and colleagues (2021). To examines the literature on techniques and applications that has been published between 2017 and 2019 in a technical taxonomy of the selected content. This includes the hybridization, enhancement, and variations of PSO as well as practical uses of the algorithm that are divided into the following areas: commercial, industrial, smart city, health care, environmental, and general aspects applications. Several technical aspects, such as precision, assessment settings, and suggested case study, are involved in examining the efficacy of various PSO techniques and implementations [8],[9]. Every study that is described has certain important benefits and inevitable disadvantages that are addressed. As a result, some recommendations are given for resolving the shortcomings of those studies as well as emphasizing unresolved problems and potential directions for algorithmic research in the future by the Ahmed G. Gad (2022).

3. Proposed methodology for hybrid AIS-PSO algorithm

The ability of the AIS to prevent population trapping within a local optimum was its primary advantage. The PSO was able to get better, although it might not converge too soon. Therefore, even for a tiny population, it was expected that a combination of the PSO and AIS (PSO-AIS) would improve global search and prevent being stuck in the local optimal[10],[11]. The following are the processes for creating a hybrid PSO-AIS pseudocode: Selection of the PSO's finest particles from half of the original AIS population, N1.
Generation at random of the remaining initial population of the ABS and N2.
A combination of the N1 and N2, as well as the fittest values assessed for every Ab.
Generation of clones through the process of cloning every cell in the AB population.
alteration of the clone population to create an adult clone population.
Every clone in the population has its affinity value evaluated.
The process of selecting the most suitable Ab to be included in the makeup of a new population.
To attain a halting situation, repeat the process.

There is use of the PSO, AIS, and AIS-PSO methods.
Between 500 and 3000 nodes agree on the research. The number of formed clusters,

average packet loss rate, average end-to-end delay, and node in percentage. Table show the 5.1 number of cluster nodes formed in the AIS-PSO

Table 5.1 Number of Clusters Nodes Formed in the AIS-PSO-IoT

Number of Nodes for In Cluster	PSO	AIS	AIS-PSO-IoT
500	16	17	20
750	17	29	22
1000	27	30	23
1250	52	53	24
1500	54	42	26
1750	53	52	27
2000	54	59	31
2250	56	62	29
2500	54	59	30

To compared with 500,750, 1000,1250, 1500,1750 2000, 2500,2250 and 2500 number of nodes, respectively, it can be seen that the AIS-PSO has decreased average end to end delays by 6.19%, 13.49%, 11.03%, 9.68%, 9.86%, & 9.26% for PSO and by 3.10%, 4.18%, 4.04%, 3.08%, 3.32%, & 2.13% for AIS-PSO-IoT.

4. Conclusion

The WSN is an effective interface that connects the Internet of Things to the physical world. One important requirement for dependable and efficient WSN operation is energy conservation. A lot of attention is being paid to energy usage for the important technical problems and resource management potential. The primary goal of this work is to use the heuristic technique to improve CH election in WSN. The distributed technique is based on the energy-efficient two-layer clustering algorithm called LEACH. Every node in this algorithm independently makes judgments for the CH election. The three-layer clustering hierarchy used in the TL-LEACH implementation is built using the dispersed

approach of the LEACH algorithm, in which a random selection of CHs is made. An energy-efficient CH election technique was presented by LEACH-HPR, which made use of the employed the enhanced Prim algorithm to create an routing between clusters in a heterogeneous WSN. By taking into account additional factors in scenarios where nodes are mobile and frequently switch roles based on a small number of practical mobility models, this study can be expanded to CH selection in the future. To reduce computing complexity and use additional meta-heuristic techniques in future work.

Reference

Agrawal, D, WasimQureshi, MH, Pincha, P, Srivastava, P, Agarwal, S, Tiwari, V & Pandey, S 2020, „GWO-C: Grey wolf optimizer-based clustering scheme for WSNs", International Journal of Communication Systems, vol. 33, no. 8, pp. 1-15.

Al-Ani, KW, Abdalkafor, AS & Nassar, AM 2020, „An overview of wireless sensor network and its applications", Indonesian Journal of Electrical Engineering and Computer Science, vol. 17, no. 3, pp. 1480-1486.

Altowaijri, SM 2022, „Efficient Next-Hop Selection in Multi-Hop Routing for IoT Enabled Wireless Sensor Networks", Future Internet, vol. 14, no. 2, p. 35.

Bhola, J,Soni, S & Cheema, GK 2020, „Genetic algorithm based optimized leach protocol for energy efficient wireless sensor networks", Journal of Ambient Intelligence and Humanized Computing, vol. 11, no. 3, pp. 1281-1288.

Chaibi, H, Chehri, A, Saadane, R & Zimmerman, A 2020, „Parallel Genetic Algorithm Decoder Scheme Based on DP-LDPC Codes for Industrial IoT Scenarios",Procedia Computer Science, vol. 176, pp. 3496-3505.

Dowlatshahi, MB, Rafsanjani, MK & Gupta, BB 2023, „An energy aware grouping memetic algorithm to schedule the sensing activity in WSNs-based IoT for smart cities", Applied Soft Computing, vol. 108, 107473.

Jaiswal, K & Anand, V 2021, „A QoS aware optimal node deployment in wireless sensor network using Grey wolf optimization approach for IoT applications", Telecommunication Systems, vol. 78, no. 4, pp. 559-576.

Manchanda, R & Sharma, K 2021, „SSDA: Sleep-Scheduled Data Aggregation in Wireless Sensor Network-Based Internet of Things", In Data Analytics and Management, pp. 793-803. Springer, Singapore.

Mozamir, MS,Bakar, RBA, Din, WISW & Musa, ZB 2021, „Improved GbLN-PSO Algorithm for Indoor Localization in Wireless Sensor Network", Journal of Communications, vol. 16, no. 6.

Pakdel, H & Fotohi, R 2021, „A firefly algorithm for power management in Wireless Sensor Networks (WSNs)", The Journal of Supercomputing, pp. 1-22.

Ramteke, R, Singh, S & Malik, A 2022, „Optimized routing technique for IoT enabled software-defined heterogeneous WSNs using genetic mutation based PSO", Computer Standards & Interfaces, vol. 79, p. 103548

Sankari, BS & Nemani, R 2022, „Squirrel Search Algorithm Based Support Vector Machine for Congestion Control in WSN-IoT", Wireless Personal Communications, pp. 1-16.

Tabassum, A, Sadaf, S, Sinha, D & Das, AK 2020, „Secure anti-void energy-efficient routing (saveer) protocol for wsn-based iot network", In Advances in Computational Intelligence, pp. 129-142. Springer, Singapore.

Vijayalakshmi, K &Anandan, P 2019, „A multi objective Tabu particle swarm optimization for effective cluster head selection in WSN", Cluster computing, vol. 22, no. 5, pp. 12275-12282.

Dr. B. Mahammad Rafee , Prof. Vijayalaxmi Ramesh, Dr. S. Jaber Asan , Dr. Amzad Basha Kolar,Mr. S. Mohammed Zaheed . (2022). A Survey on Implications of Cashless Payments on the Spending Patterns of Urbanites in the Era of Digital India. *International Journal of Early Childhood Special Education (INT-JECS)*, *14*(7), 2040–2048. https://doi.org/10.48047/INTJECSE/V14I7.289

Dr.B.Mahammad Rafee , Dr. Amzad Basha K ,Dr. S.Kareemulla Basha , Dr.C.B. Mohamed Faizal. (2021). Impact of Covid-19 on Agricultural Operations in India: An Overview. *Turkish Online Journal of Qualitative Inquiry (TOJQI)*, *12*(3), 785–797.

M Basha, AP Singh, M Rafi, MI Rani, NM Sharma. (2020). Cointegration and Causal relationship between Pharmaceutical sector and Nifty–An empirical Study. *PalArch's Journal of Archaeology of Egypt/Egyptology*, *17*(6), 8835–8842.

B Mahammad Rafee, A Hidhayathulla. (2015). Relationship between International Crude Oil Price And The Inflation Rate (Cpi) In India From 2011 To 2014. *International Journal of Advance Researach*, *3*(5), 242–250. http://www.journalijar.com/uploads/864_IJAR-5659.pdf

Ambika, Dr.Mahammad Rafee, Dr.Mohammed Arif Pasha. (2020). A Study On Impact Of Artificial Intelligence In Financial Services Of Private Banks In Bangalore. IOSR-JEF, 11(4), 34–38. http://www.iosrjournals.org/iosr-jef/papers/Vol11-Issue4/Series-6/E1104063438.pdf