Efficient Network Lifetime Clustering Algorithm in Wireless Sensor Network using Partial Swarm Optimization based Enhanced Type-2 Fuzzy Logic System

Ajay Kumar Malik[1], Raj Lakshmi Shukla[2]
[1]M.tech Scholar, [2]Assistant Professor
IEC-CET, Greater Noida, UP, India.

Abstract - In this paper we study and implement Efficient Lifetime Clustering Algorithm in Wireless Sensor Network Using Partial Swarm Optimization Based Enhanced Type-2 Fuzzy Logic System**.** The Wireless sensor network is built of nodes. In WSN cluster head is most powerful process to develop a network lifetime, scalability, and packet delivery ratio and energy efficiency. Fuzzy logic system is rules-based systems that use the theory of fuzzy set and fuzzy logic. Nowadays many applications are using fuzzy logic system to represent knowledge in a closer way to how human are thinking. Fuzzy set is given a degree of membership function. In the existing system, cluster head is elected by using type-2 fuzzy logic system. Type-2 fuzzy logic system are rules based fuzzy system that are similar to type-1 fuzzy logic system in terms of the structured and components only difference are that type-2 fuzzy logic system has an extra output process component called type-reducer before defuzzification. Our proposed system is based on design computationally efficient type-reducers using partial swarm optimization (PSO). The concept of system is known as Enhanced Type-2 fuzzy logic system. Results are presented to demonstrate that the proposed type-reducing algorithm has lower computational cost and may provide better performance than FLSs that employ existing type-reducers.

Keywords - WSN, Type-1 fuzzy logic system, Type-2 fuzzy logic system, Partial Swarm Optimization, Enhanced Type-2 fuzzy logic system

I. INTRODUCTION

In conventional LEACH protocol, adopts 1) Randomized probabilistic model 2) Local information for data transfer 3) Low energy media access control 4) Application specific data processing such as aggregation or compression etc. But in practice, it is not advisable to consider only the probabilistic model or one parameter like energy to elect the CH. More parameters like distance to BS, concentration and centrality can be included to elect the CH. The proposed algorithm builds on the top of the principle of LEACH. [1][2] Fuzzy Logic is capable of taking real time decisions with imprecise and incomplete information. It is very simple and flexible to take real time decisions under uncertain environment. [3] Further, T2FL model can handle the uncertainty environment more accurately than T1FL model because the membership degrees of T2FL are themselves fuzzy sets. In general, random uncertainties are related to probabilistic theory and Linguistic randomness is related to fuzzy sets. The power of fuzzy sets changes with different types of fuzzy models such as type-1 to type-n, since they are intended to cope with varying levels of uncertainty. [4][1] In this work, T2FL model is used in view of improving the routing technique by efficiently electing a cluster head. [5] Here, we are using T2FL with particle swarm optimization technique. Lifetime enhancement has always been a crucial issue as most of the wireless sensor networks (WSNs) operate in unattended environment where human access and monitoring are practically infeasible. Clustering is one of the most powerful techniques that can arrange the system operation in associated manner to attend the network scalability, minimize energy consumption, and achieve prolonged network lifetime. [9] [10] To conquer this issue, current researchers have triggered the proposition of many numerous clustering algorithms. [6] However, most of the proposed algorithms overburden the cluster head (CH) during cluster formation. To overcome this problem, many researchers have come up with the idea of fuzzy logic (FL), which is applied in WSN for decision making. These algorithms focus on the efficiency of CH, which could be adoptive, flexible, and intelligent enough to distribute the load among the sensor nodes that can enhance the network lifetime. But unfortunately, most of the algorithms use type-1 FL (T1FL) model. [7][8] In this paper, we propose a clustering algorithm on the basis of interval type-2 FL model, expecting to handle uncertain level decision better than T1FL model.

II. IMPLEMENTATION

Scale and density of deployment, environmental uncertainties, and constraints in energy, memory, bandwidth, and computing resources pose serious challenges to the developers of WSNs. Issues of the node deployment, localization, energy-aware clustering and data aggregation are often formulated as optimization problems. Most analytical methods suffer from lack of convergence to the final solutions. PSO has been a popular technique used to solve optimization problems in WSNs due to its simplicity, high quality of solution, fast convergence and reduced computational burden. new cost function to select the best cluster heads that combine the various criteria affecting the energy efficiency of cluster heads and cluster heads rotation among the nodes. Also, using the proposed algorithm the network coverage is evaluated and compared with some previous methods which have proved better performance and improved network lifetime and energy consumption.

PSO was developed by Kennedy and Eberhart. The PSO is inspired by the social behavior of a flock of migrating birds trying to reach an unknown destination [21]. In PSO, each solution is a 'bird' in the flock and is referred to as a 'particle'. A particle is similar to a chromosome (population member) in GAs. As opposed to GAs, in the evolutionary process in the PSO there is no creation of new birds from parent ones. Rather, the birds in the population only change their social behavior and accordingly their movement towards a destination.

The implementation consists of the following:

1. Initialization - The process is initialized with a set of arbitrary particles (solutions), N. To represent the i^{th} particle we use its position as a point in an D-dimensional space. Each particle i monitors three values throughout theprocess which are: its current position (Xi); the best position it reached in previous cycles ($pbest_i$); its flying velocity (V_i)

2. Swarming - In each time interval (cycle), the position of the best particle (gbest) is calculated as the best fitness of all particles. Accordingly, each particle updates its velocity Vi to get closer to the best particle gbest, as follows:

$$V_i^{k+1} = w.\ V_i^k + C_1.rand_1.(pbest_i^k - x_i^k) + C_2.rand_2.(gbest_i^k - x_i^k) \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where w is the weight factor for that iteration; given by:

$$w = w_{max} - (w_{max} - w_{min})/iteration_{max}.\ iteration \quad \ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Also, C1 and C2 are two positive constants named learning factors; rand1 and rand2 are two random functions in the range [0, 1]. As such, using the new velocity Vi, the particle's updated position becomes:

$$X_i^{k+1} = X_i^k + V_i^{k+1} \quad \ldots\ldots\ldots\ldots\ldots\ldots(3)$$

As such, the main parameters used in the PSO technique are: the population size (number of particles), number of generations and the weight factor w. Swarming is done till the termination condition is attained. The algorithm is mentioned below:

- Generate a random population of N solutions or particles
- Repeat
- For each particle, calculate fitness
- Initialize the value of the weight factor(w) for that iteration
- For each particle, set pbest as the best position of that particle.
- Set gbest as the best fitness of all particles.
- For each particle, calculate particle velocity (V).
- Update particle position (X)
- Continue until terminating condition

III. RESULTS

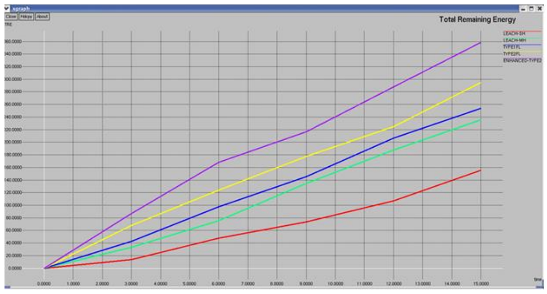

Figure 1: Total Remaining Energy Calculation of the Network

The above figure shows the Total Remaining Energy Calculation of the Network, here shows the total remaining energy calculation is good in enhanced T2FL.

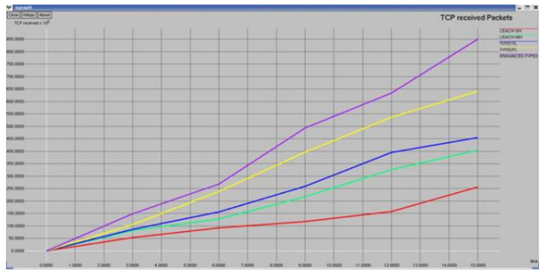

Figure 2: TCP Received Packets Calculation of the Network

The figure 2 shows the TCP Received Packets Calculation of the Network, the packet calculation is much better in enhanced T2FL compared to T1FL and T2FL.

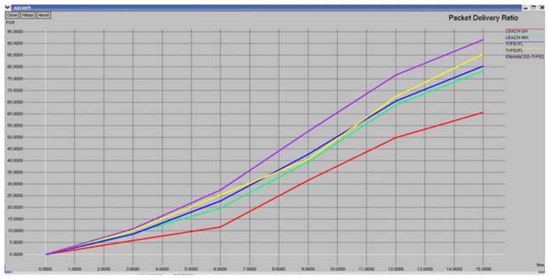

Figure 3: Packet Delivery Ratio Calculation of the Network

The above figure shows the packet delivery ratio calculation of the network, here also the packet delivery ration is much better in enhanced T2FL is compared to T1 and T2FL.

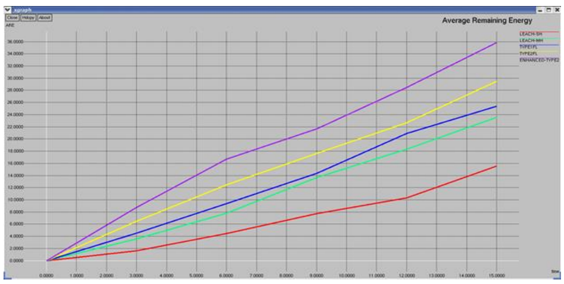

Figure 4: Average Remaining Energy Calculation of the Network

The above figure shows the average remaining energy calculation of the network, the average energy calculation is much better than in enhanced T2FL compared to T1FL and T2FL

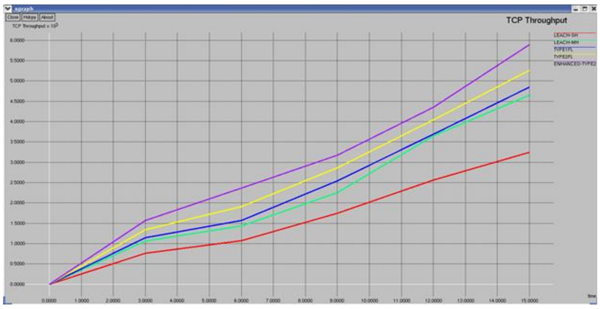

Figure 5: Throughput Calculation of the Network

The above figure shows the throughput calculation of the network. here the throughput calculation is better in enhanced T2FL as compared to T1FL and T2FL

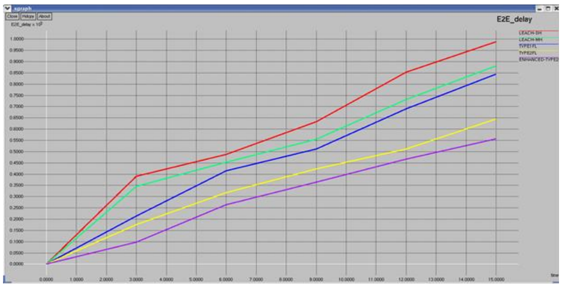

Figure 6: End to End Delay Calculation of the Network

The figure 6 is shows the end to delay calculation of the network, here the delay is more in enhanced T2FL

IV. CONCLUSION

Hence in this paper, we studied Efficient Lifetime Clustering Algorithm In Wireless Sensor Network Using Partial Swarm Optimization Based Enhanced Type-2 Fuzzy Logic System, here we are using PSO algorithms and different techniques to improving the energy ,packet calculation ,delivery ration calculation throughput and end to end delay calculation , PSO in clustering is applied for optimal selection of cluster head to improve the progression in the residual vitality of node by transmitting a data packet to the cluster head which is situated very nearest to the Base station. Thus the power consumption of the CHs is considerably balanced and the lifetime of the system is enhanced. The experimental results have shown that the proposed LEACH performs better than the existing LEACH in terms of system lifetime, stability period and the total data transmission.

V. REFERENCES

[1]. Padmalaya Nayak et al., "Energy Efficient Clustering Algorithm for Multi-Hop Wireless Sensor Network Using Type-2 Fuzzy Logic" IEEE SENSORS JOURNAL, VOL. 17, NO. 14, JULY 15, 2017

[2]. Labisha R.V et al., "Energy Efficient Clustering Algorithms in Wireless Sensor Networks-An Analytical View" Journal of Convergence Information Technology (JCIT) Volume9, Number3, May 2014

[3]. Aziz Mahboub et al., "Performance Evalutionof Energy-Efficient Clustering Algorithms In Wireless Sensor Networks" Journal of Theoretical and Applied Information Technology 20th January 2016. Vol.83. No.2 © 2005 - 2015 JATIT & LLS. All rights reserved

[4]. A.Anusuya et al., "Cooperative Mimo Mac Using Type2 Fuzzy Logic for Wireless Sensor Network" International Conference on Progressive Research in Applied Sciences, Engineering and Technology 65 |Page (ICPRASET 2K18)

[5]. Seema Bandyopadhyay et al., "An Energy Efficient Hierarchical Clustering Algorithm for Wireless Sensor Networks" 0-7803-7753-2/03/$17.00 (C) 2003 IEEE IEEE INFOCOM 2003

[6]. Rania Khadim et al., "An Energy-Efficient Clustering Algorithm for WSN Based on Cluster Head Selection Optimization to Prolong Network Lifetime" International Journal of Future Computer and Communication, Vol. 7, No. 3, September 2018

[7]. Sayyed Hedayat Tarighinejad et al.," Design and Implementation A New Energy Efficient Clustering Algorithm Using the Fuzzy Logic and Genetic Algorithm for Wireless Sensor Networks" International Journal of Mobile Network Communications & Telematics (IJMNCT) Vol. 6, No.2, April 2016

[8]. Phan Thi The et al., "Improving Distributed Energy Efficient Clustering Algorithm to Save Lifetime for Heterogeneous WSN" International Journal of Computer Networks & Communications (IJCNC) Vol.9, No.4, July 2017

[9]. Rajesh. P et al., Modified Energy Efficient Backup Hierarchical Clustering Algorithm Using Residual Energy for Wireless Sensor Network" International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-2, Issue-2, May 2012

[10]. Wei Li Guangting Chen et al., "Energy Efficient Clustering Algorithm in Wireless Sensor Networks" Computer Networks 2002, 38: 393–422