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Heuristic Approach Genetic and PSOsense with Type 2 Fuzzy Logic Algorithm based approach in Wireless Sensor Network

Seemant Gupta[1], Mr. Hammadur Rub Ansari [2]

[1]Lingaya's Vidyapeeth, Nachauli, Jasana Road, Old Faridabad, Haryana-121002, India
seemant.gupta2001@gmail.com

[2]Lingaya's Vidyapeeth, Nachauli, Jasana Road, Old Faridabad, Haryana-121002, India
hammadurrubansari23@gmail.com

ABSTRACT

Access points, or "hubs," are used to set up the wireless sensor network. Hubs are the building blocks of wireless sensor networks. When it comes to maximizing a WSN's lifetime, flexibility, packet delivery ratio, and energy economy, the cluster head is the most effective tool at your disposal. Decision-making frameworks that include fuzzy set and fuzzy logic hypotheses are known as fuzzy logic frameworks. Many modern programs use fuzzy logic frameworks to simulate human thought while communicating with the user. The fuzzy set is given a level of work engagement. To defuzzify, type-2 fuzzy logic systems need an extra yield mechanism, the type reducer. We propose a method based on combining heuristic genetic and PSOsense algorithms to create computationally efficient type reducers. The proposed framework is based on a theory known as Enhanced Type-2 fuzzy logic. The results show that, in comparison to FLSs using existing type reducers, the proposed type lowering calculation saves computational expense and has the potential to deliver optimum performance. When employing the enhanced method, performance increases across the board for all computational parameters.

Keywords: FLS, WSN, T2FL, Wireless, Sensor

1.1 INTRODUCTION:

The widespread applications of WSNs present a number of challenges, particularly in hazardous environments, which make it nearly impossible to set up conventional infrastructure-based networks. The small sensor nodes used in WSNs are powered by batteries and can be placed either randomly or in a deterministic pattern. The majority of the time, the failure of a sensor network may be attributed to a variety of common issues, the most prevalent of which are a lack of available energy resources and computing capacity, an open environment, and a wireless connection. Using operating systems, energy-efficient hardware, and communication protocols may help reduce the amount of energy that is used by WSNs, which is an important design concern for these networks. It is vital to have an understanding of the aspects that have an effect on the application in order to build a protocol that is suitable for application. This section will go through a few of the different topics.

Self-Organizing Capability: Sensor networks made up of hundreds of sensor nodes need to be capable of self-organizing in order for them to communicate with one another when they are deployed in distant or hazardous regions where there is no human oversight.

• Network Lifetime: As a consequence of the fact that it is always assumed that the network will continue to operate for a long length of time., all components of the node, ranging from the hardware to the protocols, are required to take into consideration power efficiency.

• Load balancing: in order to ensure the longest possible life for the network It is important for routing algorithms to distribute the load evenly across all sensor nodes.

• Scalability: As the size of the network grows, it is important to avoid having an excessive amount of communication overhead, even if doing so is essential in order to establish a route to the sink.

• Latencies: The data collected by sensor networks is time-sensitive. For instance, a fire fighter may need frequent updates in order to be aware of the current state of the fire, but a soil monitoring system may require data to be generated every few hours.

• Clustering: Clustering sensor nodes meets the scalability criterion and results in enhanced energy efficiency and network lifetime in big circumstances. Clustering sensor nodes also satisfies the demand for scalability. As a result, the qualities of sensor nodes The developers of routing protocols are required to take into consideration a variety of criteria, including application types, architectural limitations, and more.

Low-Energy-Adaptive-Clustering-Hierarchy, and a Centralized Organizational Structure There are two prominent clustering-based routing protocols known as LEACH and LEACH-C. These protocols bring up a number of new opportunities for the creation of protocols.

1) A probabilistic model that uses randomization is implemented by LEACH. 2) Local data transfer information 3) Management of media access with a minimal impact on the environment 4) The processing of data for specialised uses, including aggregation, compression, and other similar operations. On the other hand, in practise, it is not advisable to choose the CH only on the basis of a probabilistic model or a single parameter such as energy. In fact, this approach is frowned upon. The LEACH methodology is the foundation of the approach that has been recommended. Fuzzy logic allows for decisions to be made in real time, even when only incomplete or erroneous evidence is available. The process of making decisions in real time, even in the face of uncertainty, is highly basic and adaptive. In addition, the T2FL model is superior than the T1FL model in terms of its ability to effectively handle an uncertain environment. This is due to the fact that the T2FL are inherently fuzzy sets as membership degrees are involved. The T2FL model is used in this research with the intention of optimising the routing strategy by selecting a cluster leader in the most effective manner possible.

The construction of large-scale wireless sensor networks became possible as a result of developments in wireless communication technology. All of the events are picked up by low-energy sensor nodes that are dispersed across the network, and the data that is gathered from these nodes is then sent into a base station. In the surrounding environment, sensors are used to detect the ambient conditions, and the data are then processed in order to evaluate the situation exactly in position across the sensors. In other words, the sensors work together to create a picture of the environment. A large number of sensor nodes are deployed throughout a large geographical area so that the monitoring may be as precise as possible.

They may be dispersed in a controlled manner or at random, depending on the specific programming of the wireless sensor networks. The sensor nodes will self-organize and begin communicating with one another after being deployed in a directed or random manner. This will occur via the transfer of data that has been observed. Within the next ten to fifteen years, wireless sensor networks will be made available via the internet. This wireless technology provides an exciting limitless capacity in a variety of software domains, such as transportation, crisis management, naval, medical, seismic sensing, environmental, and natural disaster. Other software domains that could benefit from this technology include natural disasters and natural environments.

The use of several wireless gadgets, including mobile phones, laptops, GPS devices, RFID, and other electronic devices, has grown more common, more inexpensive, and more vital in the lives of people living in today's society. The need for networking and communication across various wireless devices has become more important as a result of the proliferation of applications that are one of a kind. In this context, the most recent development is the use of wireless sensor networks.

Cellular networks and wireless local area networks are two examples of kinds of wireless networks that need the presence of infrastructure in order to be set up. These networks are differentiated from other types of ad hoc networks due to the routing of records.

Implementation

It is possible to have a clear view of the cluster head thanks to the strategic placement of the sensor groups (CH). Every sensor area has its own Base Station, which may be found there (BS). Throughout the course of therapy, the placement will be moved around to accommodate the movement of the cluster head. The following characteristics may be seen in WSN models of these types of networks:

Because there are no moving components, there are not going to be any sensors that need to be changed or replaced.

Every sensor node is given a one-of-a-kind ID at the time of deployment, which makes it easier to integrate data that has been collected more than once. Unfortunately, once their energy supply runs out, these sensor nodes will no longer be able to operate properly.

It is not possible to know for definite whether or not the nodes have the capability to dynamically adjust their electrical stage in response to a decrease in the amount of transmission power, but it is reasonable to presume that they do.

Instead of relying on GPS technology to pinpoint their location inside the sensor neighborhood, each sensor node produces a best guess of its function by using all of the power received by the sensors. This allows for a more accurate estimation of the node's role.

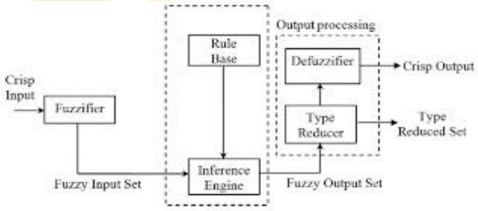

Fig. 1: Implementing-type-2-fuzzy-logic-system

Instead of being a discrete integer between zero and one, the memberships of type-2 fuzzy sets are type-1 fuzzy sets. Type-2 fuzzy sets may be broken down into two distinct categories: interval and generalized type-2 fuzzy sets, fuzzy sets in general, On the other hand, the third dimension is a two-fuzzy-set, which is why it is called universal. This is why it is a dimension. In practice, the generalized form is used less often in type-2 fuzzy sets than the interval form. This is because the interval form is easier to calculate and more straightforward.

$$Type2FL = Principal\ (Type1FL) + FOU$$

In order to choose CH utilizing the T2FL model. In addition, choose CH using a fuzzy version of the if-then-else logic. Within the context of this method, the selection of cluster heads is a more powerful process. In the event that any cluster head suffers an energy loss while the transmission of packets is taking place, a backup cluster head will be triggered.

The type reducer is an essential component that must be included in a type-2 fuzzy logic system. It is the step that comes before the defuzzification method.

The Kennedy-Eberhart Corporation is responsible for the development of PSO. The PSO is modelled after the social behavior of flocks of migrating birds, who are on the lookout for a destination of which they are unsure [21]. Each individual solution in PSO is referred to as a "particle" in the flock, which is synonymous with the term "element" in more conventional forms of the scientific discipline. Individuals in a population are referred to as "particles" when it is claimed that they are indicative of a wider population than the population from whence they came. There is no development of new bird species in the evolutionary process that takes place in the PSO, in contrast to the normal evolutionary process that takes place in the PSO, in which parent species do not give birth to their children. In contrast to this, the only thing that changes is the social behavior of a population as a whole, which is then interpreted as an increase in forward progress towards a certain objective.

• In order to replicate a scenario that may occur in the actual world, construct a population that is made up of N solutions or particles that are chosen at random.

• Repeat the process in order to determine the viability of each particle.

• before beginning, choose a starting value for the weight factor (w) that will be used for this iteration.

• In the case of each particle, the position of that particle that produced the best outcome should be denoted by the letter pbest.

• After that, give it the name gbest so that you can determine the level of fitness that is optimal for all particles.

• determine the speed of each individual particle by computing its velocity (V).

• The particle has arrived at this point at the place X. The program will end when the condition that triggers its termination is satisfied.

It is possible to refer to a generic algorithm as a global heuristic algorithm. This is due to the fact that it causes several individuals to speculate on what the best solution would be. The algorithm has a number of operations, one of which is an implementation of a focused fitness function. The next part will then proceed to outline the fundamental components that make up a standard algorithm. The general structure of the genetic algorithm processes is shown in the diagram that may be seen below.

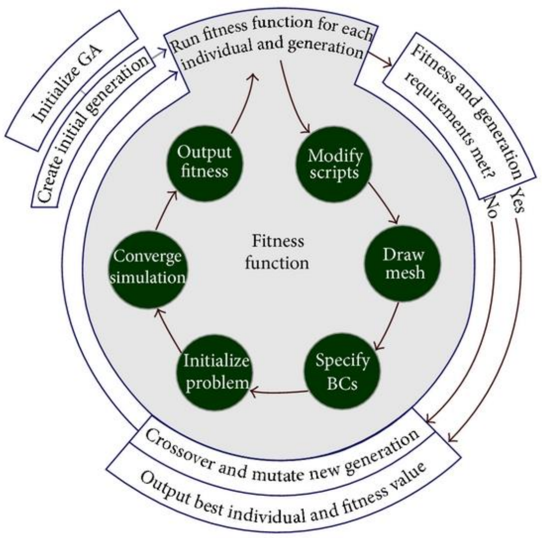

Fig. 2: Genetic Algorithm[10]

Analyzed and evaluated the improved type-2 fuzzy logic system that was recommended in addition to comparing it to a type-1 fuzzy logic system via the use of genetic and PSOsense algorithms. The following criteria were taken into account in the analysis::

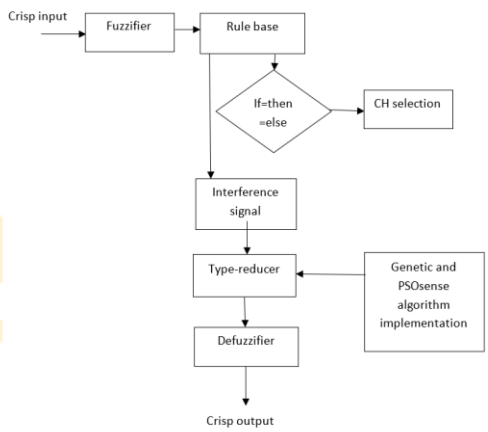

Fig. 3: Performance analysis Flow diagram

The flow diagram for the full implementation is illustrated above in Fig. 3, which illustrates PSO sense and the Genetic Algorithm as a type reducer as the suggested work..

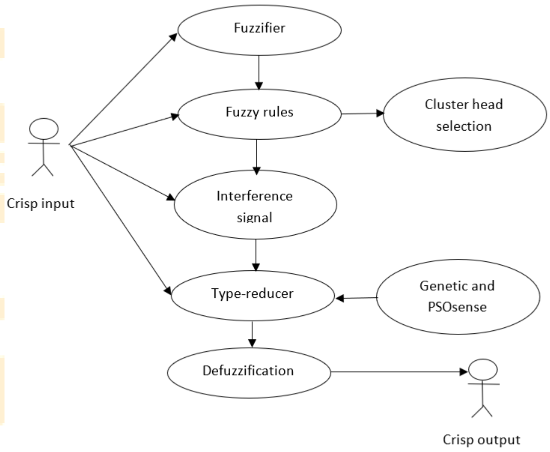

Fig. 4: Use case diagram

The user case diagram of the implementation is shown in Fig. 4 above.

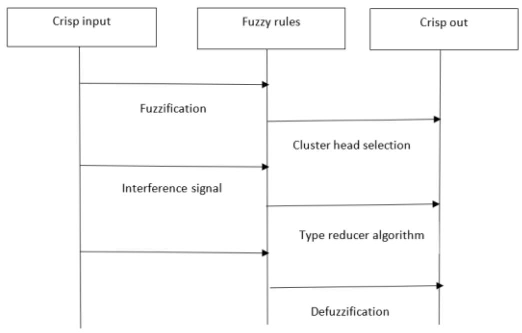

Fig. 5: Sequence diagram

The sequence of set of instructions are shown in the sequence diagram in above Fig. 5.

Results

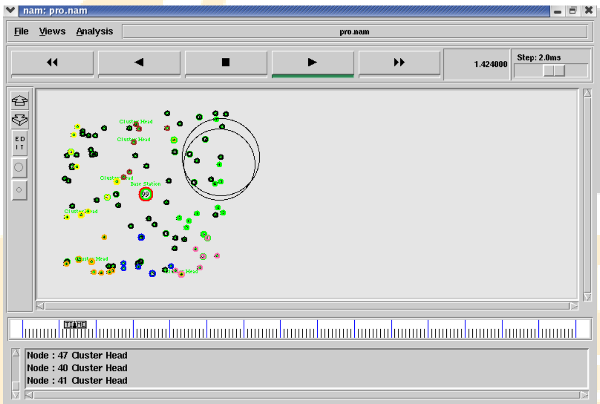

Fig. 6: Simulation Setup

Fig. 6 provides an illustration of the simulation's set up. It reveals that there are a hundred nodes in total. The type reducer procedure is used in order to choose the clusters. The selection of the cluster heads is done in a completely arbitrary manner using t2fl and PSOsense in conjunction with the genetic algorithm..

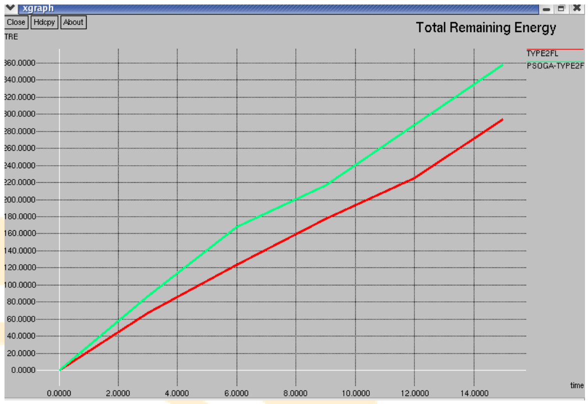

Fig. 7: Simulation Result for Total remaining Energy

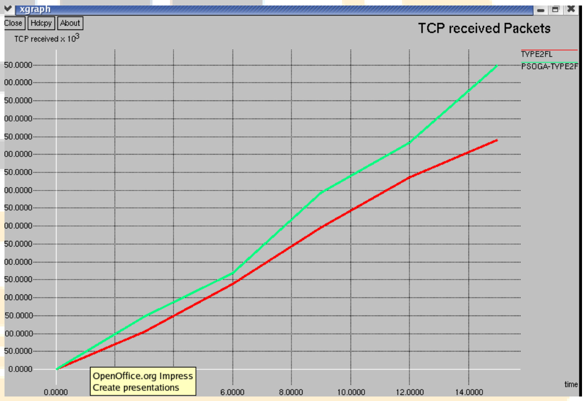

Fig. 8: Simulation Result for TCP Received Packets

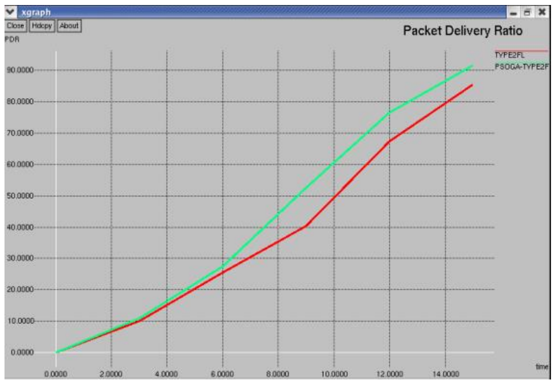

Fig. 9: Simulation Result for Packet Delivery Ratio

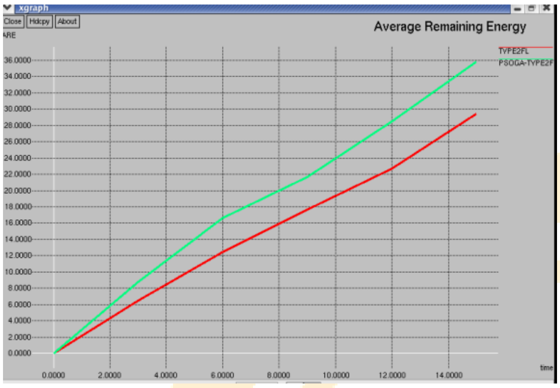

Fig. 10: Simulation Result for Average remaining Energy

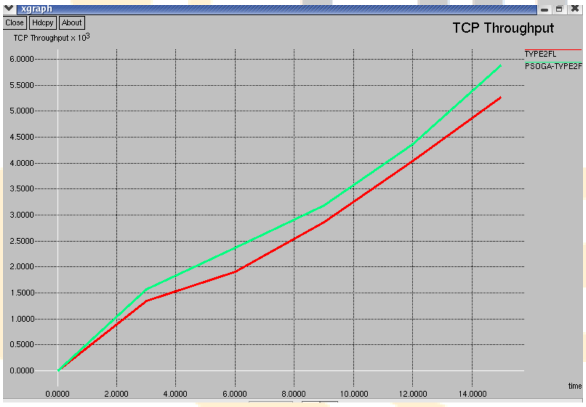

Fig. 11: Simulation Result for Throughput

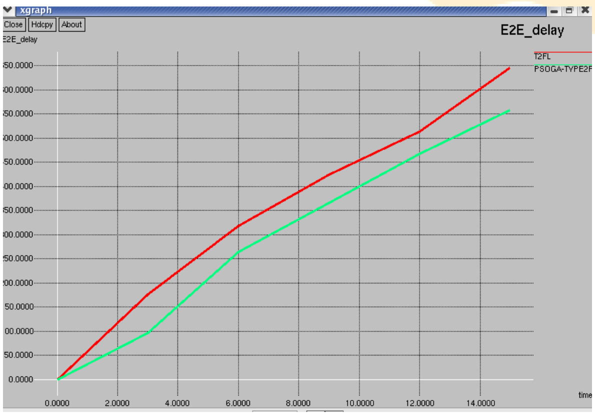

Fig. 12: Simulation Result for End to End Delay

Conclusion:

Wireless sensor networks (WSNs) are groups of sensors that are spread out geographically and have specific jobs. These sensors monitor and collect data about the physical environment and then send it to a central point. WSNs can be used to keep an eye on things like temperature, sound, air quality, humidity, and wind speed. In this thesis, an effort is made to choose cluster heads in the best way possible. It uses a type reducer, which is a part of the heuristic genetic and PSOsense algorithms, as an extra part of the output process. Genetic and PSOsense use these kinds of reducers to make the network last longer, use less energy, and move more data. It is used by networks of wireless sensors that have more than one hop. When compared to the simulation settings used in earlier studies, the simulation results show that the suggested T2FL model is better.

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