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Intelligence Paradigm comparative study using ANN and fuzzy logic with respect to WSN

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***Abstract*—** In this paper, a picture of energy awareness and parameters in Intelligence paradigm of ANN and fuzzy logic with respect to WSNs is explained so that ultimate intelligence like the human can be optimized by the hybrid technique which enables the technology to handle issues in a reliable fashion. An intelligent paradigm of ANN and fuzzy logic features shows its authenticity and adaptation of hybrid approach to achieve more optimized and deterministic result.

Keywords—WSNs(Wireless Sensor Networks), ANN(Artificial Neural Network), and Fuzzylogic

I. INTRODUCTION

WSN consist of the special type of transducers which are present in such a group so that they can communicate among themselves via wireless infrastructure and observation take place and the conditions of the various locations are recorded. WSN are highly distributed and comprise of hundreds or even thousands of small and light weighted sensor node deployed to form a network such that each sensor node can message over the wireless link.

Parameters that are commonly monitored are:-

- Temperature, humidity, pressure, wind, direction, and speed.
- Illumination intensity, vibration intensity, sounds intensity.
- Powerline voltage, chemical concentration pollutants levels, and vital body functions.

Basic components of WSNs:

- An assembly of distributed or localized sensors.
- An interconnecting network.
- A central point for information clustering
- A set of computing recourses at the central point (or beyond) to handle data co-relation.

WSN are networks of typically small battery-powered, wireless devices and posses.

- Onboard processing.
- Communication
- Sensing capabilities.

Node components are:

- Low Power Processor: Limited processing.
- Memory: Limited storage.

Radio: Low power, Low data rate, and Limited range.

- Sensors: Temperature, light etc and cameras and microphones.

II. CLASSIFICATION OF WSNS

Categorization of WSNs is based on the type of sensor nodes deployed to form a network, WSNs are categorized as:

A. Homogeneous:

Formed with identical sensor nodes with the objective to guarantee a specific task, and ensure that all the sensor nodes expire nearly at the same time

B. Heterogeneous:

Formed with more than one type of sensor node, integrated to improve the scalability of WSN at higher bandwidths for advanced applications.

Infrastructure structure model as of WSN are as follows:

A. Unstructured Model:

- Sensor node deployment is dense and random.
- Some regions remain uncovered from sensing.
- Sensor nodes are left unattended.
- Difficult to maintain.

B. Structured Model:

- Sensor nodes deployment is pre-planned.
- No uncovered regions.
- Sensor nodes are regularly monitored.
- Easy to maintain.

III. FUNCTIONAL ASPECTS OF SENSOR NODES

It WSNs operate under varying environmental conditions and their performance is based on the following functional aspects:

- Generic: For control of various sensing activities as well as scheduling data transmission.
- Self Healing: A fault in one sensor node should not impact the operation of the entire network.
- Efficient Communication: Minimum failures and backups control in order to avoid losing the valuable sensed data.
- Flexible Sensing Range: In order to cover a different network area, sensor node should have variable sensing ranges.
- Accuracy: The sensor nodes should collaborate and combine the sensed data to maintain the sensing accuracy.
- Extended Functionality: Besides sensing the sensor nodes must also provide efficient data forwarding service.
- Robustness: If deployed under harsh physical conditions, sensor nodes must operate accurately for long periods of time without any problems.
- Power Consumptions: The sensor nodes are the self-powered and frequent replacement of batteries is not possible hence, the power consumption should be low.

IV. SENSOR NETWORK CHALLENGES

The challenge is to retrieve data fast in a smart way and store efficiently.

A. Wireless Ad-hoc Nature:

- No fixed communication infrastructure.
- In wireless shared medium provide communication restriction between the nodes.
- Problems like unreliable and asymmetric links occur between the nodes.

B. Mobility and Topology Changes:

- Involves WSNs Dynamic scenarios.
- In the network, new nodes may join and old nodes can move out of it.
- Surviving nodes can move in or out of transmission radius of other node and nodes may able to close their functions.
- Node failure and dynamic topology must have robust WSN applications.

C. Energy Limitations

- Nodes have limited energy.
- Maintenance of the batteries is difficult in sensor nodes.
- Maximum power is consumed during communication task.

D. Physical Distribution

- Autonomous computational take place between sensor nodes via messages.
- High communication costs occur when data is distributed among the nodes.
- Global information required by different algorithms which are very expensive.
- Restrained distributed algorithms are highly desirable.

V. INTELLIGENCE PARADIGMS

Intelligence means the study of the design with the help of which intelligent agents can predefine things are used by artificial intelligence, which can open or shut the light or door and can place things from one place to another etc like robots. These given things are always previously stored or trained in the memory of the robot which is utilized at the time of performing the task. Intelligence Paradigms purpose is to

introduce such intelligence in the system network so that it can take decisions by its own intelligence like humans do, like for the better computer system such things are important like flexibility, adaptability, decentralization and fault tolerance.

best solution selected from the set of available options. For the performance improvement of computational tasks and

Table1. Intelligent Paradigms comparative study on the basis of following parameters

Sno.	Parameters	Artificial Neural Network	Fuzzy Logic
1.	Development epoch	1969	1987
2.	State variable	Mixed	Discrete
3.	No of search points	Multi-point	Multi-point
4.	Solution guarantee	Entire solution is obtained rarely.	Appropriate.
5.	Run time	Long	Short
6.	Target problem	• Combinatorial optimization. • Multiobjective optimization.	• Combinatorial optimization • Multiobjective optimization
7.	Features	• Adaptive learning • Self organization • Fault tolerant • Links(Nodes>Weights) • Activation Function(Output)	• Put up system nonlinearity Deterministic • Performs best even with small input • Accurate • Fuzzifier(degree of membership for fuzzy sets) • Inference Engine(rules for final fuzzy solution space) • Defuzzifier(output from fuzzy space)

Table 2. Real to artificial intelligence paradigms in solving various WSN issues using energy conservative schemes.

S.no	Inspired systems	Natural systems	Intelligence Paradigms in WSN energy conservation schemes.
1.	**Artificial Neural Network** Interconnected large number of Processors are present in parallel computing systems and which can solve large challenging variety of computational problems like humans with the help of organizational principles.[1]	**Human brain like structure** E.g. Training, supervisors learning	• Data collection is done for data prediction in time series for forecasting. [2] • Clustering is done for controlling the identified dynamic topology. [3] • Duty of Routing is to control cycling topology. [4] • Energy efficient data acquisition is done by fusion of data. [5] • Security is important in power management MAC protocol. [6]
2.	**Fuzzy logic** Solutions are obtained on the basis of membership functions, fuzzy sets, fuzzy functions and fuzzy arithmetic.[11]	**Shades of Human decisions** E.g. Definitely, probably, Yes, No, may be, likely, certain, possibility, improbable. [11]	• For cycling duty clustering is used. [7] • Scheduling is done for power management in MAC protocol [8] • Routing and security is important for managing power in sleep and wake up protocol [9] • Data collection is done for mobile agent and mobile relay [10]

VI. CONCLUSION

In WSN many issues arise due to energy consumption and routing is one of its such issue in which node deployment take place, energy consumption is high, loss of accuracy of the result, reporting of data methods, node heterogeneity, fault tolerance is low, scalability in nodes, and many of the other issues occurred. Intelligence Paradigms provide such approaches in which various issues in different fields and in WSN are solved. Hybrid techniques can provide the best-suited solution in energy-aware routing and optimization in the field of WSN so the comparative analysis is provided between ANN and fuzzy logic. With the help of Intelligence Paradigm optimized energy aware routing techniques solution are obtained on the basis of its runtime and guarantee of the solution is obtained with optimal problem evaluation so that computation is efficient and better choice for WSN is obtained in energy-aware routing.

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