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Energy-Efficient Multilevel Heterogeneous Routing Protocol for Wireless Sensor Networks: A Review

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Abstract: Despite multiple potential Wireless Sensor Network (WSN) implementations, there is a main drawback associated with the higher complexities of WSN programming due to its distributed and built-in functionality. Computer agents have been described as a suitable programming model to address this shortcoming. A middleware for the implementation of software agents is widely used in the agent-based method. The fuzzy logic scheme with a mobile agent was described in this article. It is noted that the efficiency of the network decreases as the amount of source nodes rises. This is because several nodes have to be visited by the mobile agent, and the resources used in this method reduces the network output .

Keywords: Wireless sensor network(WSN),Fuzzy logic, Mobile Agent, Energy Efficient.

I. INRODUCTION

Wireless sensor networks are a different kind of network approach that has been constantly changing in recent years. There are a huge amount of sensor nodes in a WSN , and the sensor nodes are normally comprised of battery-powered sensors. But after the node is located, it is hard to recharge. The route absorbs a lot of resources, so it is very necessary to provide a routing scheme for sensor networks. Studies usually presume that the physical location of nodes in the network does not shift in conventional WSN research and disregard the effect on network efficiency of target program variability[2]. Mobile wireless sensor networks have increasingly be a new iteration of application with the advancement of WSN approach.

For several apps, like military, environmental , and health applications, wireless sensor networks (WSNs) have currently been recognised as a promising innovation. A WSN requires the implementation of hundreds or thousands of small sensor nodes that interact wireless connection with each other in an area of interest to feel particular actions[3].

Data-aware, data computing and data connectivity account for the key energy consumption. Data communication's energy usage is the largest [4]. In data transmission, the energy usage for routing is the highest. For the time, WSN energy management research focuses on decreasing the occurrence of contact and an effective routing method.

The mobile agent's primary role is to solve the situation of packet routing after the mobile node moves to a global connection. After the node exits the home connection, the node residing in the home connection agent will obtain the node. The data packet is calculated on the basis of the node-sent registration message, and the data packet is then embedded and sent. The core job to be performed by the mobile agent is therefore to handle the registration message sent by the node[5], collect the data packets sent to the mobile node, and transfer the packet using tunnel processing.

The paper is structured as follows: Section II describes the collection of cluster heads based on Fuzzy logic, Section III illustrates the Mobile Agent literature survey in WSN and Fuzzy, Section IV demonstrates Conclusion.

II. FUZZY LOGIC BASED CLUSTER HEADS SELECTION

Since the implementation specifications could be easily served by sensor nodes, Fuzzy logic is a reasonable solution, although it is capable of improving the overall network performance. Fuzzy logic 's ability goes beyond conventional systems and could be used in several areas of study (statistics, quality control, optimization methods), enabling multidisciplinary methods and changes in performance[6]. In using either energy or distance as the consideration for choosing the CH, there are advantages and disadvantages. The CH review process would be improved through using fuzzy logic to weigh both variables. Depending on the fuzzy rule base structure, the optimum performance was obtained. Thanks to its core framework, the Fuzzy inference technique is used. There are four significant rules in the fuzzy system, as shown below[7]:

- **Fuzzification:** turns the inputs of the device that are crisp elements into fuzzy sets.
- **Rule evaluation :** applies to the fuzzified inputs and assesses them against the backdrop of the fuzzy rules.
- **Aggregate conclusions:** the convergence method of all rules' outputs.
- **Defuzzation:** converts the inference engine's received fuzzy set into a single crisp value.

The circuit diagram of the fuzzy logic control is illustrated in Fig.1. The remaining power sensor node and a different

distance among BS and CH are the fuzzy inputs that go via the mechanism of fuzzification. Depending on the laws set in the fuzzy rule base, the Fuzzy inference engine could modify the inputs from fuzzification.

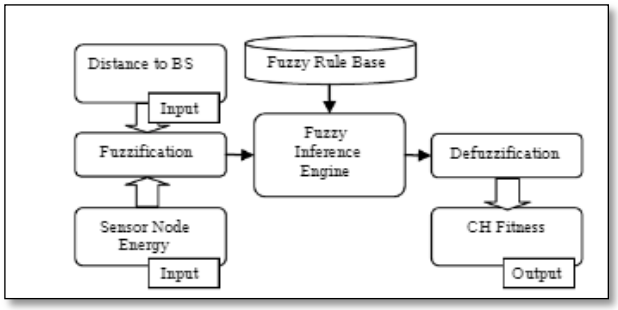

Fig.1. Block Diagram of Fuzzy Logic Control [8]

Eventually, the fuzzy collection extracted from the inference engine works by converting to a simple crisp value in the defuzzification module. The popular centre of region COA is used to measure the crisp value using Eq.(1) here $\mu_A(x)$ indicate to the membership function of the fuzzy sets:

Fitness = $(\int x, \mu_A(x)dx / \int xdx$ (Equation 1)

Fuzzy logic has been used in WSNs to enhance decision-making, minimize resource consumption, and broadly improved efficiency through effective usage, localization, clustering and head choice of clusters, routing, data aggregation, security, respectively[9].

III. LITERATURE SURVEY

Sasirekha et al.,[10] A routing method is introduced cluster-chain mobile agent routing (CCMAR) is suggested in this study to offer enhanced efficiency between the existing ones. The benefits of both the low energy adaptive clustering hierarchy (LEACH) and power-efficient selection in sensor information systems (PEGASIS) are completely exploited. The WSN is divided into a several clusters by CCMAR and runs in two stages. For performance indicators including such energy consumption, transmission delay and network lifetime, the suggested device is modeled and analyzed. The experiments demonstrated that the suggested CCMAR outclasses the energy efficient cluster-chain-based method of LEACH, PEGASIS and other related routing algorithms.

Qadori et al.,[11] In this research, by analyzing three parameters: distance, remaining energy, and amount of neighbors, a fuzzy-based MA migration method (FuMAM) is suggested to define an effective itinerary for an MA. Studies with simulation show that the FuMAM method increases the rate of efficient round-trip MA and network life. In addition , in terms of energy distribution utilization between nodes, the suggested FuMAM represent excellent the comparative protocols.

Brasil et al.,[12] In their success for the WSN application domain, Java-based agent middleware frameworks are compared. In order to evaluate different copies of mapping, experiments are focused on various agent models applied for a given set of middleware frameworks that enable high-level abstraction programming. The findings illustrate the variations in the utilization of resources (CPU , memory and energy) and in the complexity of communication, offering an impression of feasibility for each form of middleware examined, taking into account particular challenges when designing WSN applications.

Zhao et al.,[13] The suggested approach allows some improvements to the Linux kernel, which introduces tunnel encapsulation of network layer data packets. And it sends proxy ARP messages to capture packets destined for mobile nodes on the data link sheet. Research findings from performance simulation indicate that when the location of the node differs, the suggested methodology could still preserve excellent results.

Liu et al.,[14] This research analyzes a hotspot in internet infrastructure research-mobile IP system , and suggests a way to boost network efficiency by integrating mobile agent innovation into wireless sensor networks. A mobile agent functional entity is introduced as per to the specific routing process and guidelines of the Mobile IP layer. In the Linux kernel, which introduces tunnel encapsulation of data packets at the network layer, the suggested technique makes some improvements. And it delivers proxy ARP messages to capture packets destined for mobile nodes on the data link sheet. Research data from performance simulation show that when the location of the node varies, the suggested methodology could still retain great result.

Heng et al.,[15] This article suggests an energy-efficient mobile agent routing (ERS) technique for wireless sensor networks (WSNs). The benefits of clustering and the mobile agent are incorporated by ERS. An optimal route for a mobile agent among the sink and the cluster is achieved by creating a cost function. To shape the route for the mobile agent in a cluster, an enhanced ant colony algorithm (ACA) is introduced. In addition, to increase energy efficiency, a simple approach that switches off redundancy nodes as per the calculation requirement is intended. The simulation outcomes show that , contrasted to conventional methods , the suggested approach could offer low energy consumption and network latency.

Martin et al.,[16] In this article, the Fastest Constant Edge Weights Method is analyzed with stationary edge-Markovian evolving maps with changed parameters over wireless sensor networks with mobile agents. The test results reveal that a rise in the amount of iterations results in a reduce in MSE irrespective of the size of the chart, birth rate p, and death rate q. In addition, it is shown that the method 's output improves as the scale of the graphs is expanded. In addition, an improvement in both the birth-rate p and the death-rate q is shown to obtain greater algorithm efficiency at every version tested and for each size of the chart. A rise in p (when q is maintained) and a decline in q

(when p is maintained) both lead to increased approach efficiency.

Kumar et al.,[17] The mobility of the base station to improve the lifespan of the WSN is mentioned in this study in order to attain greater energy consumption outcomes. Especially in comparison to Leach, Cluster Head Election mechanism using Fuzzy logic (CHEF) in measuring performance by simulation MATLAB software, Here suggest a system that incorporates traveling sinks via fixed-path sink with fuzzy clustering method that results in the suggested method having improved results in terms of network life, stability and packet delivery.

Ning et al.,[18] concentrate on the current U2IoT framework (i.e. unit IoT and ubiquitous IoT) to build a hierarchical authentication system (APHA) based on aggregated-proof for layered networks. Specifically, Firstly, the aggregated theories are developed for several objectives to obtain backward and forward anonymous delivery of information. Secondly, for key exchange, the guided path descriptors, homomorphism functions, and Chebyshev chaotic maps are jointly implemented. finally, to establish hierarchical access control, separate access administrators are appointed. The BAN logic detailed assessment, meanwhile, is conducted to show that the suggested APHA has no apparent security vulnerabilities and is theoretically usable for the U2IoT and other IOT app architectures.

Majeed et al.,[19] To boost the implementation of the re-composition of these clusters in WSNs, a fuzzy-based genetic method has been suggested. GA was used to create optimum fuzzy rules and to tune the final output of the memberships of fuzzy logic. In addition, the ant colony method (ACO) suggested routing the data to the base station (BS) on the shortest path among the heads of the cluster. To get the better effect, all these activities could be viewed as optimization or search procedures within larger address spaces. Short routing as well as less loading balancing in these networks is considered in the work. The findings indicate that the network's lifespan is greater than other strategies and there are good results for load balancing.

Katiyar et. al [20] The Mobile Agent Energy Efficient Data Aggregation (MAEDA) method is proposed to extend the life of the network. Mobile Agent (MA) interacts with wireless sensor networks via this approach. The proposed technique is recognized by the MATLAB platform, the simulated results are very promising and show that MAEDA could save more energy than other current ones in data aggregation and also extended network lifetime. The paper suggested an energy-efficient framework for data aggregation, which uses Mobile Agent (MA) to combine the data. In the approach provided, MA not only supplies the nodes with updated information, but also supplies every node with one optimized parent. This productive data retains only a genuine connection among nodes that creates a network tree structure for further processing. Results have shown that mobile agent (MA) integration with WSN has a big advantage in optimizing network existence.

IV. CONCLUSION

Because of innovations in micro-electromechanical systems (MEMS) using WSN to research and track environments for climate change, wireless sensor networks (WSNs) are being extensively established. Sensors are distributed uniformly over the region of focus on environmental detection to regularly feel the external conditions for a few cycles or even a year. Consequently, it is a difficult problem to expand the network lifespan with reduced battery power. In this article, variables that will impact the lifespan of the wsn will be identified and the analysis of the choice of CH depend on fuzzy logic worked out in the base station (BS) will also be taken out. Energy level and distance to the BS are chosen as fuzzy inputs to choose acceptable CHs that will extend the network first node dies (FND) round and consistent throughput to the BS. But the network output for FuMAM began to decline as the amount of source nodes increased. Even more analysis on the hybrid approach that will increase the efficiency of the fuzzy method network by integrating several other methodology with it.

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