

An Augmented Approach for Cluster head Selection Using Fuzzy Logic in Clustering Hierarchy for WSN

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Abstract - A Wireless Sensor Network (WSN) is a network of large number of small sensor nodes that senses specific parameters associated to environment or process to communicate to Base Station (BS). LEACH is very well known protocol for the WSN. But it has its own drawback. In this paper I have proposed a approach of determining CH with merging three parameters at a time the Residual Energy of node, its vicinity and packet received ratio (PRR) with respect to distance from the Base station. In Proposed I have definite CH by uniting all three parameters and it is decided by the Fuzzy Logic. Fuzzy Logic is very well known method and it can be useful when more than one parameter is taken into deliberation. In this Proposed, I will define certain rules for Fuzzy Logic for better result of Energy Consumption and Life time of network. In my work the CH is decided based on prediction which is calculated in terms of chance. The node is declared as CH when chance of that node is maximum.

Key Words: Hierarchical routing, cluster based routing protocol, LEACH, cluster-head (CH), cluster members, fuzzy logic.

1. INTRODUCTION

Wireless sensor networks (WSNs) are collected of set sensor nodes communicating through wireless channels.[1] So, these types of networks are nowadays used in a wide variety of domains such as Healthcare applications, Environmental applications, Military applications and so on.

Information communication from nodes to BS is the central job in WSNs, thus the network lifetime postponement of WSNs rest on well-organized managing of sensing sensor node power resources. In accumulation, energy-efficient is one of the most design issues in WSNs. Energy in efficient leads to poor performance and short network lifetime of WSNs. clustering algorithm , enhance an operative method to extend the network lifetime of WSNs consequently clustering algorithm based numerous routing protocols are used to decrease consumed energy in gathering and broadcasting data in WSNs.

2. RELATED WORK

Many protocols and methods of routing based on clustering algorithm have been preferred for WSNs; many of them centered on LEACH algorithm try to resolve the

glitches found in the clustering algorithm indeed the cluster heads (CHs) Selection. This section is overview of some routing protocols based on and fuzzy logic approach.

Hierarchical Routing Protocols Based on Clustering

LEACH [1], [2] is a hierarchical routing protocol which selects CHs based on probabilistic model and each node has equivalent opportunity to become a CH. Hierarchical clustering routing protocol, which accepts distributed clustering algorithm where cluster-head rotation method, data aggregation, and data fusion technologies effectively improves the lifetime of network. This protocol works in two phases. These are set up phase and steady state phase.

The LEACH has two phases: the set-up phase and the Steady-state

The Set-up Phase: In this phase CH is elect, On the base of threshold function $T(n)$ value choose CH. $T(n)$ values are among the 0 and 1. If energy value is less than it's become member of cluster and which node have more energy than its have chance to become CH.

Stochastic Threshold

$$T(n) = \begin{cases} p / \left(1 - p \left(r \bmod \frac{1}{p} \right) \right), n \in G \\ 0 & \text{Other wise} \end{cases}$$

Where P is the cluster-head probability G is the set of nodes that never be chosen as cluster-head nodes before $1/p$ round.

The Steady-state: In this phase CHs is collecting info and data which is sensed by the cluster member and then this info is transmit to the base station by CH. In this step data aggregation and data fusion is completed by the CH. However LEACH protocol dispenses the load correspondingly on each cluster head, still there are some problem.

- LEACH apply probabilistic approach to choose CH. So there is a possibility that two CHs are elected which is near to each other, that inclines to drain overall energy in the network.

- More CPU cycles are consumed because in each round, one random number is generated and threshold value is calculated.

- If the elected node is located nearby to the frontier of the network, other nodes could dispel more energy to Transfer the message to CH.

In [4] the Gupta fuzzy Protocol have been proposed, which uses the Fuzzy logic method to choice CHs using three fuzzy factors: energy level, concentration, and centrality, each fuzzy factor alienated into three linguistic values, and one output which is chance, is divided into seven linguistic values. The scheme also utilized 27 IF-THEN rules. The difference between leach and Gupta protocol reclines in the set-up state where the BS needs to gather energy level and position info for each node, and approximation them in designed FIS to calculate the chance value for each node to become a CH.

In CHEF [3] CH is chosen based on two parameters which are proximity distance and energy. The Fuzzy based approach elects the node to be the CH with high energy and locally optimal node. CHEF also selects CHs in every round. The sensor node with great opportunity i.e, with high energy and which is nearby optimum is Selected as a CH. By the use of fuzzy logic, the overhead in selecting Cluster-heads is minimized. CHEF also localized the Cluster-head selection, by which the overhead of centralized process is minimized.

In F-MCHEL [5] CH is selected by exerting fuzzy rules based on energy and proximity of distance. The node which has the extreme residual energy among the CHs is selected as a Master Cluster Head (MCH) and sends the aggregated data to the BS. F-MCHEL is an Enhancement of CHEF. It delivers more network stability as Compared to CHEF. In F-MCHEL, base station has been measured as stationary. This protocol provides higher steadiness, Retro, higher energy strength and lower variability period as compared to LEACH protocol in spite of above of selection of Chief CH and will augment the lifetime of the network and extremely scale back the energy consumption

In [6],in this proposed a protocol which notes three fuzzy parameters such as remaining battery power, mobility, and distance to base station to elect a SCH. but the main disadvantages of this protocol is that when movement increases or decreases, the lifetime of the network remnants constant. Because, mobility indirectly proportional to the distance to BS.

Fuzzy Logic Model

The Fuzzy logic model consists of four modules: a fuzzifier, fuzzy inference engine, fuzzy rules and a defuzzifier. The most widely used fuzzy method Mamdani's Method is used hear. The block diagram of the Fuzzy Inference System is

shown in Figure1. There are four steps required to complete the process.

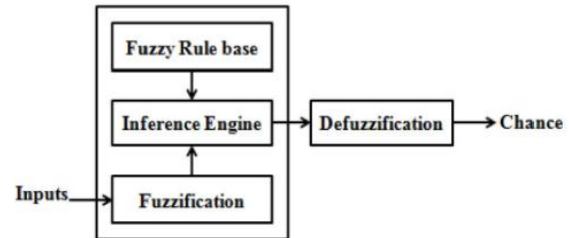


Fig -1: FIS Block diagram

- 1) Fuzzification: In fuzzifier, inputs are given with crisp value and changed into a fuzzy set. This can be achieved by fuzzification.
- 2) Rule evaluation: It stores IF-THEN rule.
- 3) Fuzzy Inference Engine: This engine takes both the input values and IF-THEN rules to simulate the reasoning by which it produces a fuzzy inference.
- 4) Defuzzification: Defuzzifier transforms the fuzzy set into crisp value.

3. PROPOSED APPROACH

Novel approach of deciding CH with combining three parameters at a time the Residual Energy of node, its vicinity and packet received ratio (PRR) with respect to distance from the Base station. In my work I have decided CH by combining all three parameters not only with simple equation and for first time calculation but it is decided by the Fuzzy Logic. I define certain rules for Fuzzy Logic for better result of Energy Consumption and Life time of network.

Stapes:

- 1) CH selection is done using Fuzzy Logic system and percentage value of "chance" to become a CH is calculated for all nodes.
- 2) Chance is calculated based on three parameters of every node, Energy, Vicinity and PRR/Dist. from the BS. These three parameters acts as membership function for FIS. All chance value is ordered in descend manner and among all nodes the nodes with highest value of chance will selected as CH. Selected CHs will advertise their CH status within its advertisement radius.
- 3) Non CH nodes wait for the CH announcement from CHs. Sensor nodes send join request message to chosen CH. If more than one CH announcement is heard by the node it chooses CH to send join request message on bases of minimum distance of node from all CH. If node does not receive any CH announcement form any possible CH it has to

be considered as "orphan" nodes. Such nodes will directly send their data to BS.

4) CH waits for receive join request from cluster members. After receiving join requests from all CM it creates TDMA schedule for all and send it to them. And then work as leach function in steady phase.

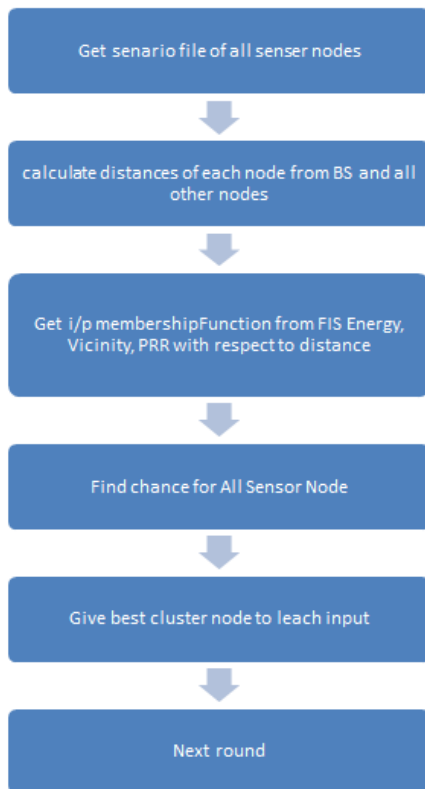


Fig -2 : Proposed diagram

FIS Parameters and Rules

FIS input and output

Three input and one output. We can define input membership function its low, med and high. Membership Function is Energy and vicinity. It range type and linguistic name

Fuzzy variables for the "Energy". There are three fuzzy sets which are high, med and low. Function Range Of Energy is in between 0 to 0.5. The chances to become a CH denote by membership functions. The chances are based on triangular function.

Fuzzy variables for the "Vicinity". There are three fuzzy sets which are high, med and low. Function Range of vicinity is in between 0 to 100.

Fuzzy variables for the "PRR with respect to BS". There are three fuzzy sets which are near, adq and far. Function Range of vicinity is in between 0 to 100.

Output chance function range between 0 to 1 which give nodes possibility to become Cluster head.

Fuzzy Rule

Table shows the fuzzy rule base consists of 33 = 27 rules for Energy, Vicinity and PRR with respect to BS. (Energy) | X | (Vicinity) |X| (PRR) |=27

Table -1: Fuzzy Rule

Sr. no	Energy	Vicinity	PRR from BS	Chances
1	low	low	Near	Small
2	low	low	Adeq	small
3	low	low	Far	vsmall
4	low	mid	Near	small
5	low	mid	Adeq	small
6	low	mid	Far	small
7	low	high	Near	rsmall
8	low	high	Adeq	small
9	low	high	Far	vsmall
10	med	low	Near	rlarge
11	med	low	Adeq	medium
12	med	low	Far	Small
13	med	med	Near	large
14	med	med	Adeq	medium
15	med	med	Far	rsmal
16	med	high	Near	large
17	med	high	Adeq	rlarge
18	med	high	Far	rsmall
19	high	low	Near	rlarge
20	high	low	Adeq	medium
21	high	low	Far	rsmall
22	high	mid	Near	large
23	high	mid	Adeq	rlarge
24	high	mid	Far	medium
25	High	high	Near	vlarge
26	High	high	Adeq	rlarge
27	High	high	Far	medium

4. RESULT AND ANALYSIS

In proposed work is to improve LEACH performance in terms of energy efficiency, system lifetime. I work at Energy, vicinity and PRR with respect to BS. In proposed work is to change in selection of CH as per the defined in proposed which was implemented in scenario of 100 nodes with area covered is 100x100

Table 2: Simulation Scenario

Parameter	Values
Channel Type	Wireless Channel
Antenna	Omni Directional
Routing Protocol	Cluster Based Routing Protocol (LEACH)
Total Number of Nodes	100
Initial Energy of Node	0.5Joule
One Node (BS)	Infinite Energy
BS Location	(50,175)
Changing clusters	every 20 seconds

Performance Analysis Of No. Of Round vs Energy Consumed

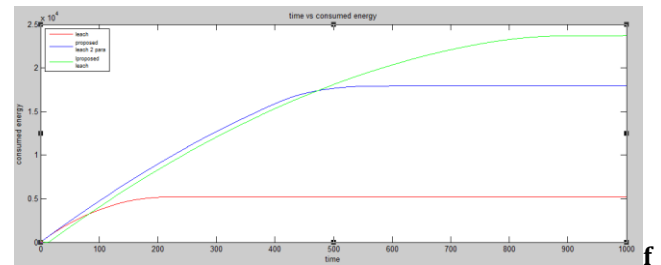


Fig:5 No. Of Round v/s Energy Consumed

COMPARISON GRAPH BETWEEN LEACH AND PROPOSED

In Simulation graph RED line represent LEACH, BLUE line represent proposed output with fuzzy two input energy and vicinity, GREEN line represent proposed output with fuzzy three input energy, vicinity and PRR with respect to BS.

5. CONCLUSIONS

In varieties of the applications in day to day life is developing with the field of Wireless Sensor Networks. But these applications are energy constraint because of not efficiently utilization of routing protocol. For improvement of hybrid proposed algorithm is implemented in MATLAB in which the CH selection is based on the residual energy, vicinity and PRR with respect to BS . Where the results obtained proved that the performance of this proposed is give better output.

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Performance Analysis Of No. Of Round vs Alive Node

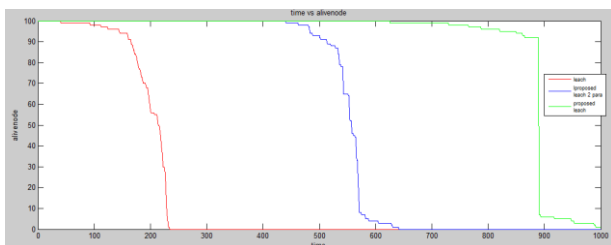


Fig-3 No.Of Round v/s Alive node

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Performance Analysis Of No. Of Round vs Amount of Data

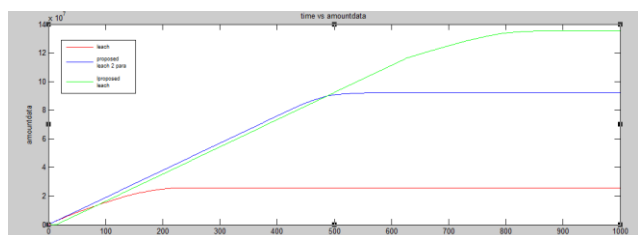


Fig:4 No.Of Round v/s Amount data

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