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Fuzzy Logic Based Clustering in Wireless Sensor Networks

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ABSTRACT: 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. To conquer this issue, current researchers have triggered the proposition of many numerous clustering algorithms. 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. By using fuzzy logic we propose a clustering algorithm to handle uncertain level decision better other models. We also use XOR encoding and decoding as a mechanism not only for enhancing energy efficiency but also for reducing the end-to-end-delay. XOR-based coding works on a hop-by-hop basis, i.e. packets encoded by a node are decoded by its neighbour's. The idea is that each node can combine packets using bitwise XOR operations in order to produce an encoded packet. We implement our proposed work using ns2 and measure its performance.

KEYWORDS: Wireless Sensor Network, ns-2, Fuzzy Logic Clustering, Performance.

I.INTRODUCTION

Wireless sensor network has been used in many fields for monitoring and recording several conditions. A wireless sensor network is mainly made of two which is Base station(BS) and the distributer sensor nodes which communicate with the environment. These distributed sensor nodes are responsible for sensing, processing the data and to communicate the data to the base station. The Base station in turn receiving the data processes them to provide the data to the receiver.

The direct transmission of data over some distance requires more time and energy, thus clustering has been introduced to reduce the usage of energy in transferring the same amount of data to the same distance with number of sub stages in between the transfer.Even though the clustering technique has been used, the energy efficient communication has become most difficult to achieve in Wireless Sensor Networks(WSNs). Because these clustering algorithms were affected by many factors which mainly involves energy and distance. Thus the clustering algorithm which is concerned with energy efficiency will be more efficient for the transmission, since the optimal clustering solution will be scaling each parameter by weight corresponding to its influence on dissipated energy and network lifetime.

Fuzzy interference system has become an efficient tool which combines all the parameters to give a better performance results. In WSNs, Fuzzy based clustering helps for energy efficient routing protocols. Also network coding acts as a mechanism not only for enhancing energy efficiency but also for reducing end to end delay in transmission of the data over wireless sensor networks(WSNs).

II.LITERATURE REVIEW

LEACH is the spearheading and the most referenced HRP. It accomplishes a huge exhibition with respect to WSN valuable lifetime and energy utilization adjusting. LEACH is a conveyed bunch based HRP that uses randomized pivot of CHs dependent on a probabilistic limit to despair the energy load equally among the sensors in the system. LEACH C (LEACH-Centralized) is one of the most mainstream variants of LEACH. It is a group based unified methodology in which the CH election race and circulation over the WSN are constrained by the BS utilizing recreated strengthening. LEACH C use nodes remaining energies and position from the BS. LEACH C has better execution over LEACH in helpful system lifetime and energy dispersal.

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HEED (Hybrid Energy Efficient Distributed Bunching) occasionally performs grouping of WSN and CH determination for each bunch dependent on nodes lingering energy as an essential parameter and the closeness of an offered hub to its neighbours as an optional parameter. Regard accomplishes uniform CH circulation over the system, builds organize adaptability and lifetime, parties load on sensor nodes. Simulation results demonstrate the adequacy of HEED in delaying system lifetime and supporting adaptable information total.

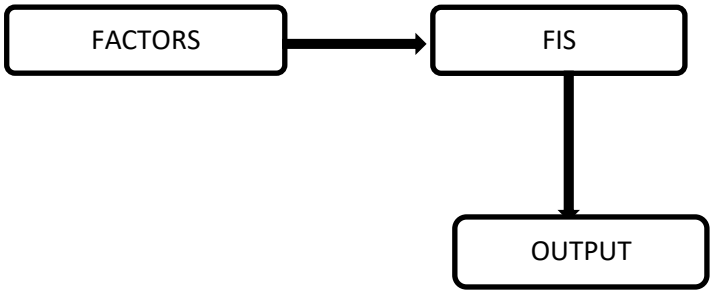
PEGASIS (Power Efficient Gathering in Sensor Information Systems) is a chain based HRP, where every node discusses just with a nearby neighbour to lessen energy spent per round by transmitting to the BS in adjusts. PEGASIS outflanks LEACH by 100-300% when 1%, 20%, half and 100% of hubs bite the dust for various system size and topologies.

In TEEN, it arranges sensor networks as proactive or reactive systems dependent on their utilization mode. In receptive mode, nodes react promptly to the progressions of relevant parameters of intrigue, while sensor nodes in proactive mode react to the progressions of applicable parameters of intrigue occasionally. TEEN is a energy efficient routing protocol for WSN. It diminishes pointless or excess transmissions. TEEN beats existing regular WSN conventions in energy efficiency.

APTEEN as an augmentation to TEEN for both transmitting periodic data and responding to time basic circumstances. Additionally, it presents QOS prerequisites for the on-time queries by least defer utilizing the TDMA plan with an exceptional time slot task.

III.PROPOSED WORK

The proposed fuzzy model has been used to accomplish optimal clustering. The cluster head (CH) election and clustering technique is done by this fuzzy model. But CH is influenced by various factors by wireless sensor networks. To get an efficient outcome, they must be combined thus FIS (Fuzzy Interface System) plays an important part to its effectiveness in CH election. For this, we first need to identify the factors that have influence on CH election.



The Technique used for CH election which is influenced by many factors influences the lifetime of the network. Those factors are considered as linguistic variables. Energy consumed by CHs, Total energy consumed by non-CH nodes or distribution of energy consumption through nodes has its effects on network lifetime.

The Technique used for scaling of these variables values is min-max normalization. After the values are calculated, the variables nodes are scattered based on their relative positions. Thus the CH has been identified with the values that are normalized which are used to assign maximum value sensor node. Remaining sensor nodes are placed according to their occurrences based on their priority.

NORMALIZED VALUE(X) = [NODE(X) – MINIMUM(X)]/ [MAXIMUM(X) – MINIMUM(X)] eq.1

REMAINING ENERGY:

Network lifetime which is enhanced by the CH, the sensor node with more energy isgot through balanced energy consumption using WSN nodes. The Equation (1) normalizes energy in which X indicates the variable, node(X) is current node energy, minimum(X) and maximum(X) are the values that are minimum and maximum of all nodes in the network.

The node with the lowest remaining energy is considered as zero whereas the highest is 100 while for the rest of the nodes are assumed to be between the highest and lowest value nodes.

DISTANCE FROM BS:

The consumed energy depends upon on the distance between CHs and the base station. Because if the distance between the CHs and the base station is small, the energy consumed will be small. Sensor nodes that are close to base station that that are farther have high chance of being CHs.

Base station distance is normalized in a percentage value with the value from equation (1) using distance between farther one and base station (i.e) minimum(X) refers the distance between nearest node and BS whereas maximum(X) refers the distance between farther node and BS and Node(X) is the distance of the current node from BS.

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LOCATION SUITABILITY:

This is used to measure the suitability of node location as CH with respect to neighbouring node within a given range. CH node in a location with low total communication is a suitable location for the node. The total energy consumed by the sensor nodes that are around the current node in a given range is averaged to give location suitable of all nodes.

DENSITY:

CHs with more number of neighbour nodes improve the consumption of energy through high opportunity for the communication that CHs with the less number of neighbour nodes, which also reduces the total locally consumed energy.

It is given by normalizing the number of nodes in a given range from the equation (1). Here node(X) gives the density of the current node, Maximum(X) and Minimum(X) gives the maximum density value and minimum density value of all nodes in a range respectively.

NEIGHBOURING NODES COMPACTION:

Distribution of all the neighbour nodes around the current node determines the compaction. More the number of nodes closer around the current node, higher the degree of compaction which in turn decreases the total energy consumption. It is calculated as a ratio with number of nodes in first region to that of in the second region.

Equation (1) is used to normalize the compaction, where node(X) is compaction value, Minimum(X) and maximum(X) indicates minimum compaction value and maximum compaction value of all nodes.

IV.CLUSTERING TECHNIQUE

FL-NC-EEC/D strategy utilizes the previously mentioned fuzzy model for CH election. It controls the circulation of CHs dependent on deciding and authoring a specific least detachment separation between CHs to ensure this dispersion. Each CH must be a long way from the nearest CH by the distance d, as a base. The distance d is versatile relying upon the elements of the WSN, number of nodes and CHs rate.

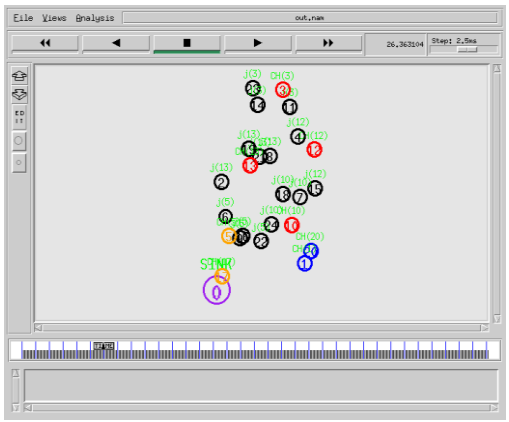

Fig.1 LIST OF CLUSTER NODES AND NODES

The fig.1 defines the nodes that are cluster head (CH) and the nodes that are under those cluster head.

The Clustering depends on constraining a minimum detachment separation between CHs. Its starts by choosing CHs utilizing the proposed fuzzy interference system clarified already based on isolating CHs by distance d and finishes the framing bunches by mapping every hub n to the nearest CHs.

V.PERFORMANCE EVALUATION

We performed the calculation in c++ and awk utilizing the fuzzylite library in ns-2. It is utilized to reproduce and assess similarly the efficiency of proposed approach regarding lifetime and energy remaining and balancing the energy against the notable clustering algorithm LEACH.

PERFORMANCE METRICES:

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We considered the measurements of lifetime and all out expended energy to assess the plans and techniques proposed by this exploration similarly. In any case, utilizing the absolute devoured energy per round to quantify energy efficiency may not be an exact measure for lifetime assessment.

This is on the grounds that the complete vitality may be kept up by a little level of hubs, while every single other hub were drained or the all other kept up energy may be less, however is disseminated over a bigger level of hubs.

So as to pass judgement on the energy efficiency of the WSN bunching method precisely, we propose an approach to quantify how a lot of the grouping procedure can keep up of the staying complete vitality dispersed similarly through hubs. On the off chance that it figures out how to keep that all other outstanding energy appropriated more equally, then more hubs will be live for additional rounds.

To the best of our insight, this measurement of uniformity for the dissemination of residual vitality through the hubs is utilized here for the first time. Besides, we utilize the network coding for increase energy efficiency and decrease the delay of delivery of data through the WSN.

NETWORK CODING:

Network coding is used for energy efficiency and also to reduce the end to end delay in delivering the data through the network. The data to be send by the sender gets encoded while sending and it is decoded by the receiver after receiving the data.

For example, if we are sending two files of size 10 bytes after encoding the two files into one we get a single packet of size 11 or 12 bytes so we can send this single file rather than sending two file of 20 bytes totally. The receiver can decode the single file to two 10 bytes files.

Since the packet size will be small, more packets can be transferred. While the receiver can receiver can receive more files in less number of time and can decode it to multiple files. Thus network coding helps to increase data delivery and decrease the end to end delay of data as well as override of data while transferring over the network.

FL-NC-EEC/D EVALUATION:

The thought behind increasing or maintaining the system lifetime is efficiently managing energy through minimizing the total energy consumed and adjusting it among the other sensors.

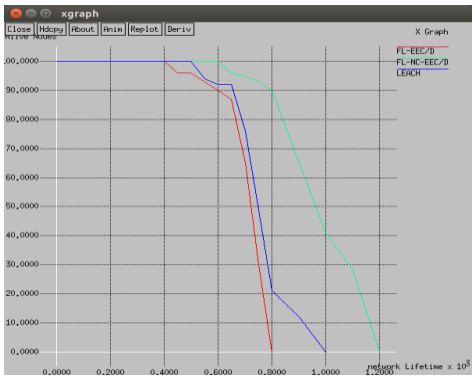

Fig.2ALIVE NODES

The Fig.2 shows number of nodes alive during each period of communication with comparison to LEACH, FL-EEC/D and FL-NC-EEC/D.

In addition, reducing the total consumed energy without adjusting the nodes energy reservation will not really bring about better system lifetime. It is progressively imperative to limit the differences between energies remaining with those nodes in network.

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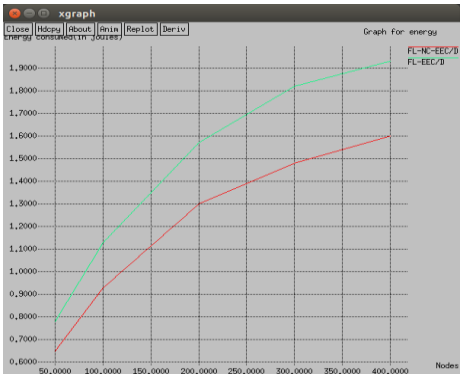

Fig.3 TOTAL CONSUMED ENERGY

The Fig.3 explains the amount of energy that has been consumed during the communication between the nodes over the network.

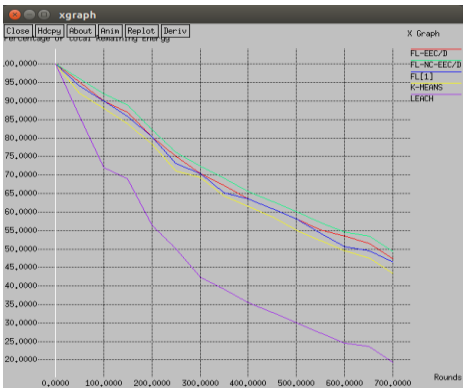

Fig.4 TOTAL REMAINING ENERGY

This Fig.4 explains the total remaining energy after the overall communication is over through the network.

VI.CONCLUSION AND FUTURE WORK

FISs are the best decision for building viable bunching calculations/procedures for energy efficient directing conventions in WSN, because of its high capacity of joining and successfully mixing input parameters to create appropriate choices about CH choices. To accomplish the most ideal consequences of energy efficient directing conventions in WSN, it is prescribed to use each parameter affecting the energy efficiency of the WSN steering convention. Moreover, it is prescribed to in cooperate them in a manner that reflects the degree to which every influence the energy efficiency of the WSN.

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