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Lifetime Enhancement of WSN Using Fuzzy Method and A-Star Algorithm

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Abstract: *Wireless sensor networks (WSNs) are used in many applications to gather sensitive information which is then forwarded to an analysis centre. Resource limitations have to be taken into account when designing a WSN infrastructure. Unbalanced energy consumption is an inherent problem in WSNs, characterized by multihop routing and a many-to-one traffic pattern. This uneven energy dissipation can significantly reduce network lifetime. This thesis proposed a new routing method for WSNs to extend network lifetime using a combination of a fuzzy approach and an A-star algorithm. The proposal is to determine an optimal routing path from the source to the destination by favoring the highest remaining battery power, minimum number of hops, and minimum traffic loads. To demonstrate the effectiveness of the proposed method in terms of balancing energy consumption and maximization of network lifetime, we compare our approach with the A-star search algorithm and fuzzy approach using the same routing criteria in two different topographical areas. Simulation results demonstrate that the network lifetime achieved by the proposed method could be increased to some extent than that obtained by the A-star algorithm and by the fuzzy approach.*

I. Introduction

A sensor network is composed of a large number of sensor nodes that are denselydeployed either inside the phenomenon or very close to it. The position of sensor nodes neednot be engineered or predetermined. This allows random deployment in inaccessible terrainsor disaster relief operations. On the other hand, this also means that sensor network protocolsand algorithms must possess self-organizing capabilities. Another unique feature of sensor networks is the cooperative effort of sensor nodes. Sensor nodes are fitted with an onboardprocessor.

[1] Proposed an optimal routing and data aggregation scheme for wireless sensor networks. The objective was to maximize the network lifetime by jointly optimizing data aggregation and routing. They adopt a model to integrate data aggregation with the underlying routing scheme and present a smoothing approximation function for the optimization problem. The necessary and sufficient conditions for achieving the optimality are derived and a distributed gradient algorithm was designed accordingly.Studied the problem of maximizing network lifetime through balancing energy consumption for uniformly deployed data-gathering sensor networks. They formulated the energy consumption balancing problem as an optimal transmitting data distribution problem by combining the ideas of corona-based network division and mixed-routing strategy together with data aggregation. They first proposed a localized zone-based routing scheme that guarantees balanced energy consumption among nodes within each corona [2].

A method that determines the network resource specifications, i.e., the number of available nodes and their sensing range, according to the required SSC (sensing spatial coverage) and the necessary confidence level. Later on, a novel lifetime criterion which considers the SSC as the WSN effective operation criterion is introduced [3]
[5] M. J. Tsai [2007] proposed to minimize the hop stretch of a routing path (defined as the ratio of the hop distance of a given path to that of the shortest path) in order to reduce the energy cost of end-to-end transmission. The approaches took a different view for prolonging the network-lifetime. They attempt to sustain the availability of the sensors that have less energy by distributing the traffic load to the ones with much residual energy. All of the above-mentioned works focus on improving energy-efficiency using fixed routing paths; nonetheless, due to the lack of path diversity, those nodes traversed by fixed routing paths may drain out their energy quickly.

Topology of WSN is considered in such way that destination node is responsible for collection of data from all the nodes with in communication range [6].the routing pattern is decided by base station. It finds out shortest path and broadcast the data. Finding out the routing pattern under consideration of current level of some criteria regarding each node.

II. Proposed Approach And Design

In new routing technique base station prepares routing pattern and broadcast it amongst all the sensor nodes. A star search algorithm is used to find out shortest path from node to the base station applied to each node. This algorithm makes a tree structure to find shortest path to base station from sensor node.

$$f(n) = NC(n)+(1/MH(n))\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

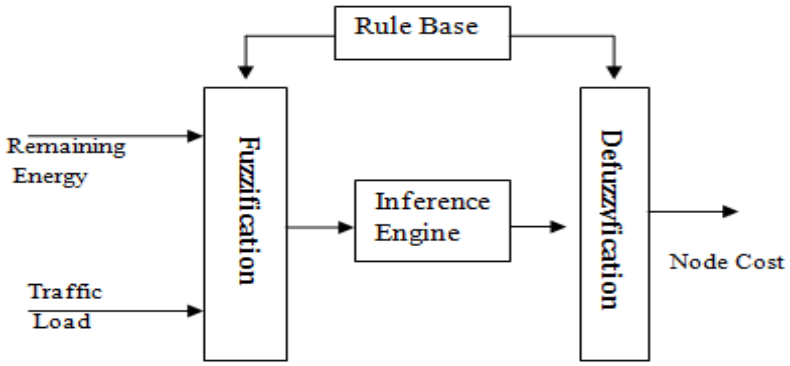


Fig 1: Fuzzy Approach

To demonstrate the effectiveness of the new method in terms of balancing energy consumption, maximizing net- work lifetime, and analyzing important parameters of WSN, simulation results of the new method are compared with those of A-star search algorithm and with those of Fuzzy approach for various number of nodes. The three methods use the same routing criteria namely, the remaining energy, the minimum hop, and the traffic load in selecting the optimal path from the source node to the sink node.

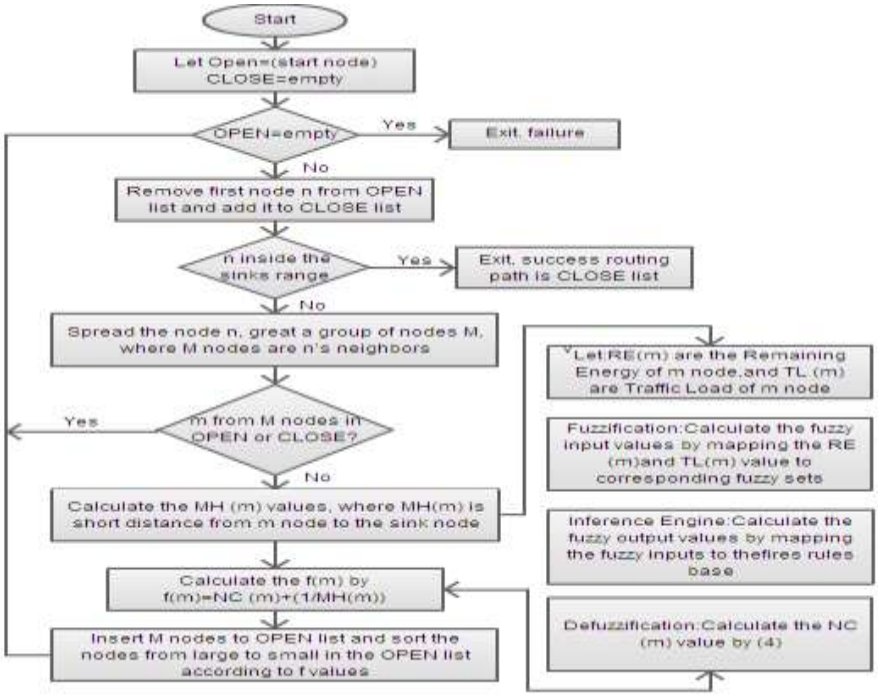


Fig.2. Algorithm

Where NC (n) is the node cost of node n, which takes value [0…1], and can be calculated by the fuzzy approach. The fuzzy approach is considered for the remaining energy and the traffic load of node n to calculate the optimal cost for node n. MH (n) is the short distance from node n to the base station. As a result, the node n that has largest f (n) value will be chosen as the optimal node.

The main part of fuzzy approach in this routing method is to find the optimal value of the node cost NC (n) of node n that depends on the remaining energy RE (n) and the traffic load TL (n) of node n.for Fuzzy approach fuzzified values are processed by the inference engine, which consists of a rule base and various methods to inference the rules. The rule base is simply a series of IF-THEN rules that relate the input fuzzy variables and the output variable using linguistic variables each of which is described by fuzzy set.

After implementation of proposed method using combination of fuzzy approach and A-Star search Algorithm we got to previous some existing methodology like fuzzy and A-Star search Algorithm itself we are getting much better result in terms of lifetime and parameter mentioned above. Some results after implementation are as shown in figure. For this we have consider various number of nodes. For this we have used Ad-hoc on demand vector routing protocol. We have used tool like NS-2 to get simulation result. From all these result we are able to analysed effectiveness of proposed method.

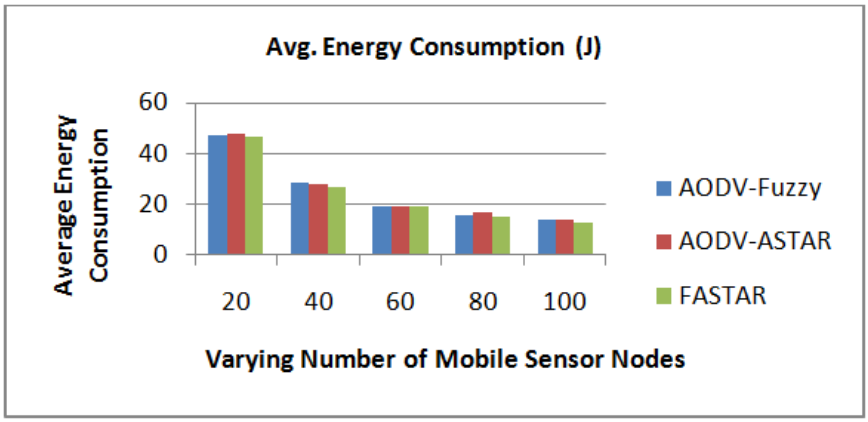
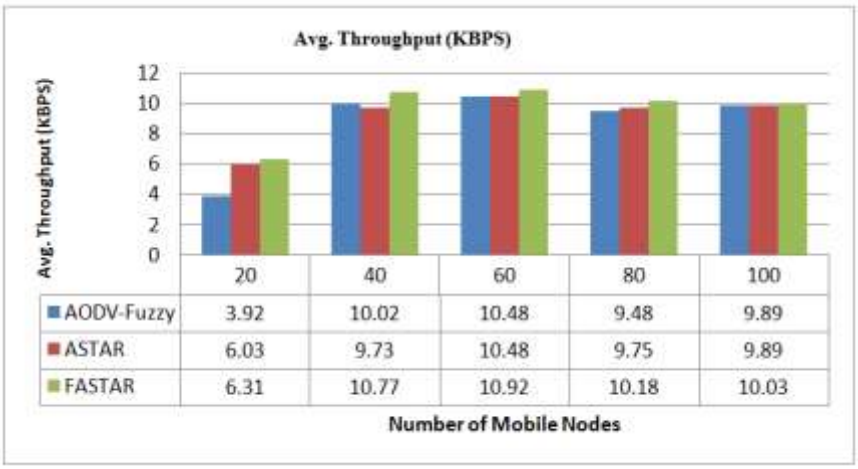


Fig 3: Average Energy Consumption

From above graph we can observed that, we required minimum energy as number of nodes goes on increasing. Lifetime of network depends on energy consumption as it is provided by small inexpensive batteries. So it is clear from above figure less the energy consumption more the lifetime of the network.



	20	40	60	80	100
AODV-Fuzzy	3.92	10.02	10.48	9.48	9.89
ASTAR	6.03	9.73	10.48	9.75	9.89
FASTAR	6.31	10.77	10.92	10.18	10.03

Fig 4: Average Throughput

Above graph showing Average throughput of network of various number of nodes. It is clear from above graph that throughput getting through proposed method is much better than existing method which is necessary for proper communication.

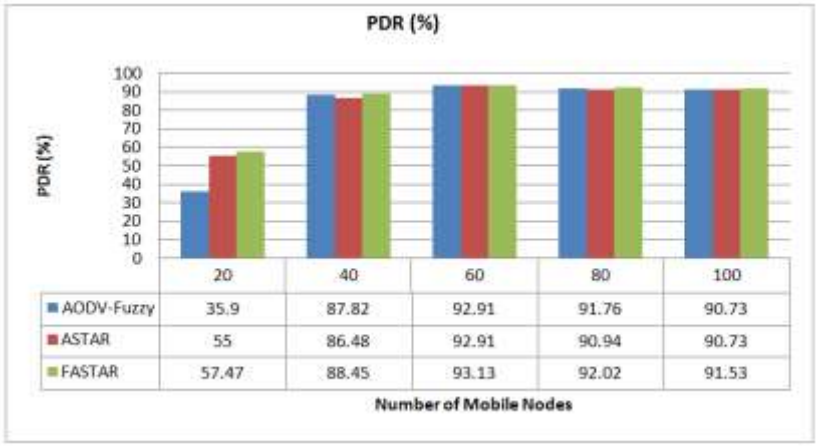


Fig5: Packet Delivery Ratio

Packet Delivery ratio is an important parameter from network point of view to established proper communication between source and destination with proposed method. it is high as compared to existing methods.

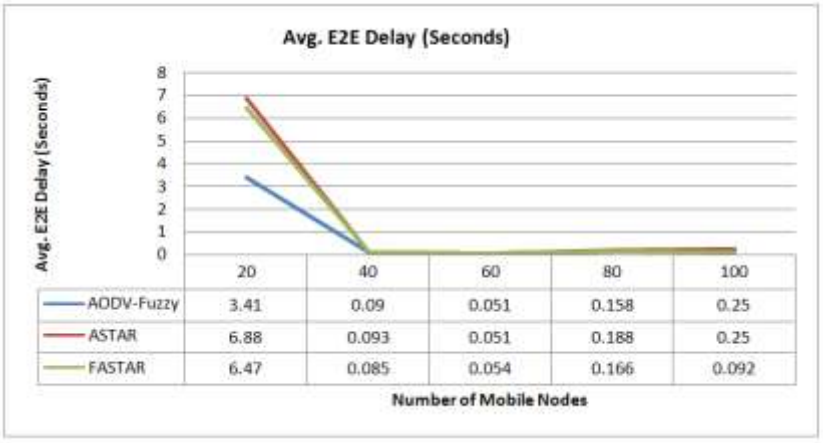


Fig6: Average end to end Delay

III. Conclusion

In wireless sensor network where nodes operate on limited battery power. Efficient utilization of energy is very important. It efficiently route the data through transmission path from node to node we implement new approach which is combination fuzzy and A star algorithm. New approach is capable of finding out the optimal path from source to destination by favoring highest remaining energy, minimum number of nodes and lowest traffic load. After implementation we got the result for energy consumption and various important parameters like Throughput, End to End delay,PDR etc.at the cost of minimizing energy consumption we got improvement in performance of parameters mentioned above to considerable extent which have seen in above graph. In future it would be interesting to see how data loss can be minimized due to overflow of buffer size, to analyzed routing load.

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