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Fuzzy Based Routing by using Local as Well as Global Information in WSN

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Abstract

WSN is a wireless network formed by a large number of sensors, including thermal, pressure or accelerator sensors, to name a few. These sensors can sense and detect the environmental statistics, including temperature, pressure, movement, etc. Within the network, the sensors are referred to as nodes. A fuzzy logic is unique in that it is able to simultaneously handle numerical data and linguistic knowledge. It is non linear mapping of input data (feature) vector into a scalar output i.e. it maps numbers into numbers. Static Three-Dimensional Fuzzy Routing Based on the Receiving Probability (SFRRP) in wireless sensor networks is an inferential routing protocol that uses a fuzzy procedure to find an appropriate path for transmitting the data packets from the sender nodes toward the base station. SFRRP does not generate any controlling packet for route discovery. In this way, the traffic load of the network is reduced, the energy consumption of the nodes decreased, the network life and data delivery ratio considerably enhanced, and the data packets delivered to the base station in an acceptable time. The research modifies the existing SFRRP routing procedure in WSN. In the existing technique the only local information is used to transfer the data from source node to the destination node. The proposed work modifies the existing work by using the global information along with the local information to transfer the data from source to destination. In addition to it, proposed system increases the fuzzy rules. The existing system proposes the fuzzy only on the basis of the 2 put variables. While the proposed system proposes 181 fuzzy rules on the basis of three input variables i.e. number of neighbour, distance from destination and energy level of the node.

Keywords: *Wireless Sensor Network, Fuzzy, SFRRP.*

I. Introduction

Wireless sensor networks (WSNs) are ideal candidates for applications to report detected events of interest, such as military surveillance and forest fire monitoring. A WSN comprises battery-powered senor nodes with extremely limited processing capabilities. With a narrow radio communication range, a sensor node wirelessly sends messages to a base station via a multihop path. However, the multi-hop routing of WSNs often becomes the target of malicious attacks. An attacker may tamper nodes physically, create traffic collision with seemingly valid transmission, drop or misdirect messages in routes, or jam the communication channel by creating radio interference.[1]

A wireless sensor network (**WSN**) in its simplest form can be defined as a network of (possibly low-size and low complex) devices denoted as nodes that can sense the environment and communicate the information gathered from the monitored field through wireless links; the data is forwarded, possibly via multiple hops relaying, to a sink that can use it locally, or is connected to other networks (e.g., the Internet) through a gateway [2].

- The nodes can be stationary or moving.
- They can be aware of their location or not.
- They can be homogeneous or not.

II. Fuzzy

A fuzzy logic is unique in that it is able to simultaneously handle numerical data and linguistic knowledge. It is non linear mapping of input data (feature) vector into a scalar output i.e. It maps numbers into numbers. Fuzzy set theory and fuzzy logic establish the specifics of the nonlinear mapping.

This tutorial paper provides guided tour through those aspects of fuzzy sets and fuzzy logic that are necessary to synthesize afls. It does this by starting with crisp set theory and dual logic and demonstrating how both can b extended to their fuzzy counterparts. Because engineering systems are, for most part causal, we improve causality as a constraint on development of the fls. Doing this lets us steer down very special and widely used tributary of the fl literature, one that is valuable for engineering applications of fl but may not be as valuable for non engineering applications.[3]

After synthesizing a fls, we demonstrate that it can be expressed mathematically as a linear combination of fuzzy basis functions, and is a nonlinear universal function approximate, a property that it shares with feed forward neural networks. The fuzzy basis function expansion is very powerful because its basis function can be derived from either numerical data or linguistic knowledge, both of which can be cast into the forms of if-then rules. To date, a fls is the only approximation method that is able to incorporate both types of knowledge in a unified mathematical manner.[3]

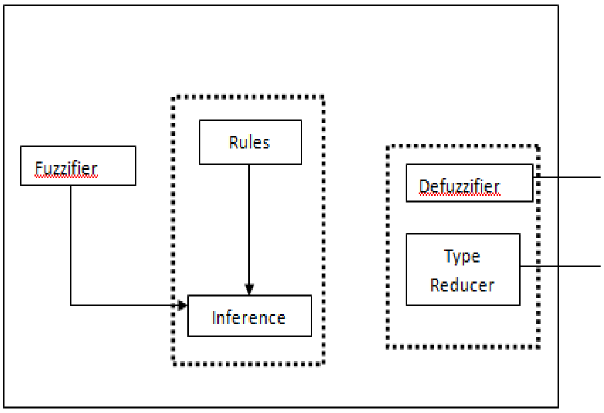

Figure 1: Type-2 Fuzzy Logic System

A fls that is widely used in fuzzy logic controllers and signal processing applications. A fls maps crisp inputs into crisp outputs. It contain four components:- rules , fuzzifier, inference engine, and defuzzyfier. Once the rules have been established, a fls can be viewed as a mapping from input to outputs and this mapping can be expressed quantitatively as y=f(x). Rules may be provided by experts (you may be such a person) or can be extracted from numerical data. In either case, engineering rules are expressed as a collection of if-then statements, e.g., "if u_1 is very warm and u_2 is quite low, then turn v somewhat to the right." This one rule reveals that we will need an understand of: 1) linguistic variables versus numerical values of variable (e.g., very warm versus 36∘ c);2) quantifying linguistic variables(e.g., u_1 may have a finite number of linguistic terms associated with it, ranging from extremely cold), which is done using fuzzy membership functions; 3) logical connections for linguistic variable (e.g., "and," "or" etc.); and 4) implications, i.e., "if a then b." additionally, we will need to understand how to combine more than one rule.[4]

The fuzzifier maps crisp numbers into fuzzy sets. It is needed in order to activate rules which are in terms of linguistic variable, which have fuzzy sets associated with them.[4] The inference engine of the fls maps fuzzy sets into fuzzy sets. It handles the way in which rules are combined. Just as we humans use many different fuzzy logic inferential procedures. Only a very small number of them are actually being used in engineering applications of fl. In many application, crisp numbers must be obtained at the output of a fls. The defuzzifier maps output sets into crisp numbers.[4]

III. Static Three-Dimensional Fuzzy Routing Based On The Receiving Probability (SFRRP)

The current routing protocols are not smart; they find the transmission paths according to the routing table or routing discovery using the global information of the network. In the routing table, network nodes have to maintain the discovered paths. Moreover, the paths have to be recovered and updated as some of the paths can be broken. There upon, route discovery causes increasing network traffic, while decreasing the network lifetime. To solve these potential problems, a new routing protocol called the Static Three-Dimensional Fuzzy Routing Based on the Receiving Probability (SFRRP) in wireless sensor networks is studied. The protocol is an inferential routing protocol that uses a fuzzy procedure to find an appropriate path for transmitting the data packets from the sender nodes toward the base station. When a sensor node has a sensed data or a buffered data packet that should be transmitted to the base station, it chooses one of its neighbors called the selected node by the fuzzy system for forwarding the packet through that node. To choose the appropriate node from its neighbors, the sender node needs only the local information on its neighbors instead of the global information of the network. Therefore, SFRRP does not generate any controlling packet for route discovery. In this way, the traffic load of the network is reduced, the energy consumption of the nodes decreased, the network life and data delivery ratio considerably enhanced, and the data packets delivered to the base station in an acceptable time [5].

1. The Network Model

The protocol considers a sensor network that consists of a base station and some sensor nodes that are energy constrained immobile nodes and are deployed randomly in a complex region. It is considered that sensor nodes are not grouped into clusters or trees. Furthermore, most nodes cannot send the packet to base station directly, e.g., there exist obstacles or weak signals of sensor nodes. In this region, the sensors communicate with each other by short-haul radio communication, and most of the nodes cannot transmit their data packets to the base station directly. Thus, they are required to transmit the packets using hop-to-hop delivery.

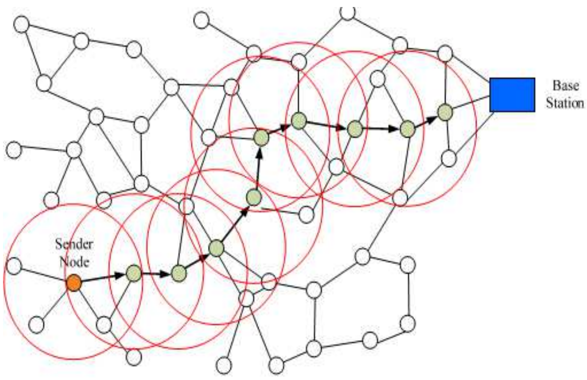

Figure 2: A Network Model to Route the Data Packets By Static Three-Dimensional Fuzzy

2. Data Packet Format

In this system, every data packet consists of seven main elements. Every element explains one of the data packet features.

IV. Proposed Technique

In the existing technique the only local information is used to transfer the data from source node to the destination node. The proposed work modifies the existing work by using the global information along with the local information to transfer the data from source to destination. In addition to it, proposed system increases the fuzzy rules. The existing system proposes the fuzzy only on the basis of the 2 put variables. While the proposed system proposes 181 fuzzy rules on the basis of three input variables i.e. number of neighbour, distance from destination and energy level of the node. This process improves the SFRRP scheme and uses the global information to transfer the data to destination as shown in figure 3.

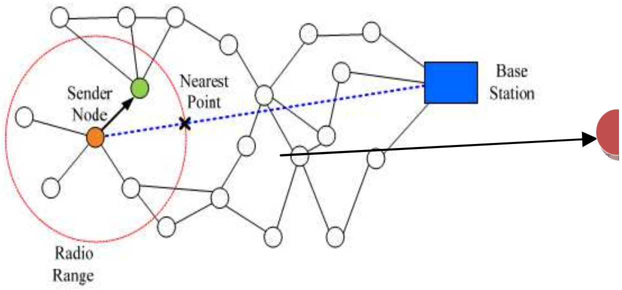

Figure 3: Routing using proposed Technique

The proposed work used the fuzzy rules, the membership functions of these input variables are shown in following figures:

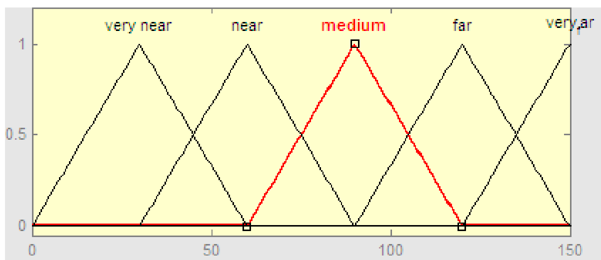

Figure 4: Membership Function For Input Distance

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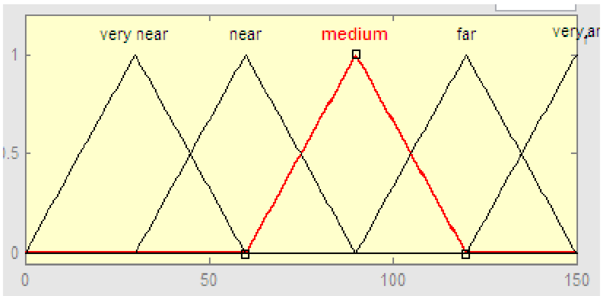

Figure 5: Membership Function Of Number Of Neighbour

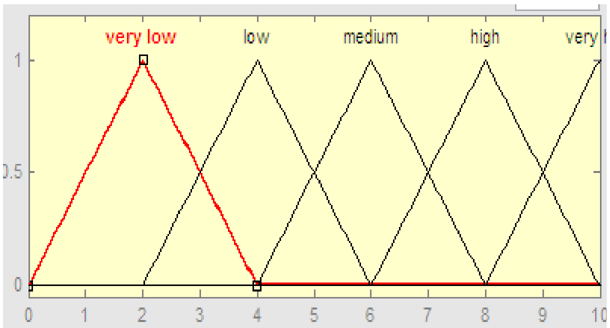

Figure 6: Membership function of Energy Level

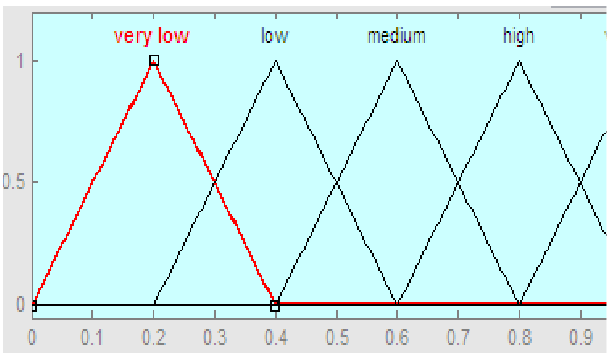

Figure 7: Membership Function Of Probability Of Selection

The proposed technique can be easily understood by the following algorithm.

1. Select Source S and Destination D.
2. For i=1:N
3. For j=1:N
4. Dist(I,j) =sqrt((x(i)-x(j))^2 +(y(i)-y(j))^2)
5. End
6. End
7. Current=S
8. While current ~= D
9. Select neighbor f S say N
10. If N already visited
11. Then N=select neighbor of destination
12. else
13. Calculate probability of selection = fuzzy(distance , energy ,number of neighbor)
14. If probability of selection <0.40
15. N=select neighbor of destination
16. End if
17. End if
18. Current =N
19. End while

The proposed algorithm can be implemented using the MATLAB. The MATLAB doesn't contain any toolbox for the WSN. The m file coding is done to design the WSN. The comparison is done the different size networks by using the parameters average time consume, energy left and the throughput.

The results can be verified by the various run of the existing and proposed algorithm on same scenario. The results of the existing and proposed algorithm are shown in the following tables:

Table1: Parameters Analysis of Existing Algorithm

Run time	Time Consumed	Energy left	Throughput
1	.3212	108	3.1131
2	.2139	96	4.6745
3	.4526	94	2.2094
4	.3259	101	3.0684
5	.2212	110	4.5217
6	.3168	115	3.1563
7	.3286	101	3.0432
8	.2110	134	4.7394
9	.3302	101	3.0289

Table 2: Performance Analysis of Proposed Algorithm

Run time	Time Consumed	Energy left	Throughput
1	.1174	112	8.5170
2	.1215	96	8.2300
3	.1257	106	7.9545
4	.1148	116	8.7086
5	.1183	117	8.4506
6	.1194	124	8.3731
7	.1186	112	8.4305
8	.1399	134	7.1501
9	.1295	112	7.7228

The results can be analysed graphically as follow:

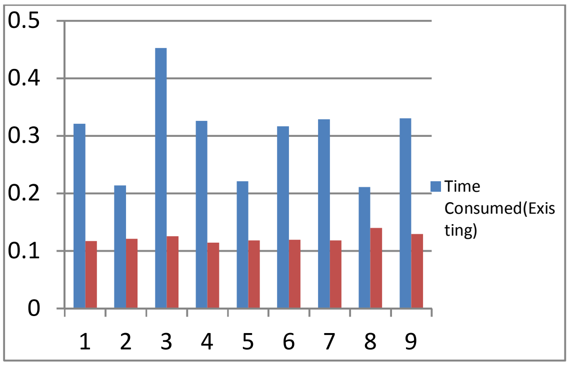

Figure8: Comparison of Time Consumed of Existing and Proposed

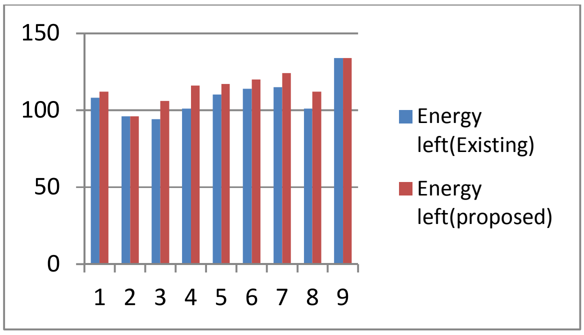

Figure 9: Comparison of Energy Left of Existing And Proposed

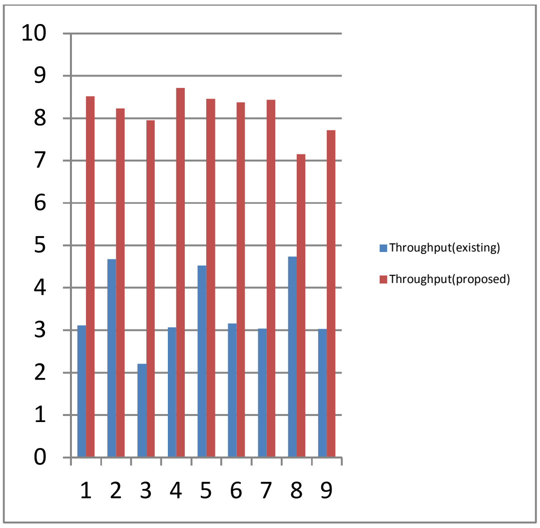

Figure 10: Comparison Of Throughput Of Existing And Proposed

The simulation result shows that proposed algorithm is better than the existing algorithm. The analysis is done using the throughput, energy left and the time consumed. The proposed algorithm consumes less time and less energy. The throughput of the proposed algorithm is better than the existing algorithm. The better throughput and less time and energy saving confirms the better performance of the proposed algorithm as compared to the existing algorithms.

V. Conclusion

The simulation result shows that proposed algorithm is better than the existing algorithm. The analysis is done using the throughput, energy left and the time consumed. The proposed algorithm consumes less time and less energy. The throughput of the proposed algorithm is better than the existing algorithm. The better throughput and less time and energy saving confirms the better performance of the proposed algorithm as compared to the existing algorithms. In future work: the proposed algorithm can be extended to increase the security.

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