International Journal of Smart Sensor and Adhoc Network

Volume 2 | Issue 3 Article 3

April 2012

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A FUZZY BASED APPROACH IN MULTIHOP NETWORK

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Abstract- The proposed system utilizes the concept of multi hop communication in Wireless Sensor Networks(WSNs). On the other hand , the single hop communication leads to more power dissipation in the nodes at the time of transmitting sensed data. The proposed system rectifies the above mentioned problem with the multi hop communication among the finite number of nodes to determine the distance for transferring information from source node to base station using the Fuzzy logical method. In a nutshell, the multi hop communication leads the better solution for saving the transmission energy in the wireless environment.

Keywords: *Wireless Sensor Network, Multi hop communication, Fuzzy logic, Fuzzy based multi hop network and transmission energy.*

I. INTRODUCTION

Naturally a Wireless Sensor Network (WSN) is highly distributed one. It consists of three subsystems. They are Sensing subsystems, Processing subsystems and Communication Subsystems. There are many applications like Military, Habitat monitoring, medical applications etc.,. The communication subsystem plays a dominant role in data transmission from a source node to base station. Generally the WSN is error prone in nature. Power supplies are main resource for any WSN.

Once the battery reaches the dead state, the replacement of battery is not possible. Owing to the above mentioned reasons, the effective data transmission with minimal dissipation of energy, utilization is needed. For a reliable data transmission in wireless networks, each node dissipates more power comparatively with wired network.

Basically in wireless network single hop communication leads to more power dissipation in the nodes. The multi hop communication provides the better solution for saving the transmission energy. Due to energy constraints,wireless sensors usually have a limited transmission range ,making multi hop data routing toward the processing node more energy efficient than direct transmission(Single hop)[2].

The multi hop communication is achieved by using the cooperative communication among the nodes. In cooperative communication, each intermediate nodes is used as a relay node, to transfer the information from source node to base station[1].

II. PROPOSED SYSTEM(FM-NETWORK):

The Fuzzy based Multi hop Network (FM-Network) is shown in the figure 1.Let us consider the network with the size of "M" number of nodes. It is randomly distributed in the i x j area in which i represents the length and j represents the breath of the area.

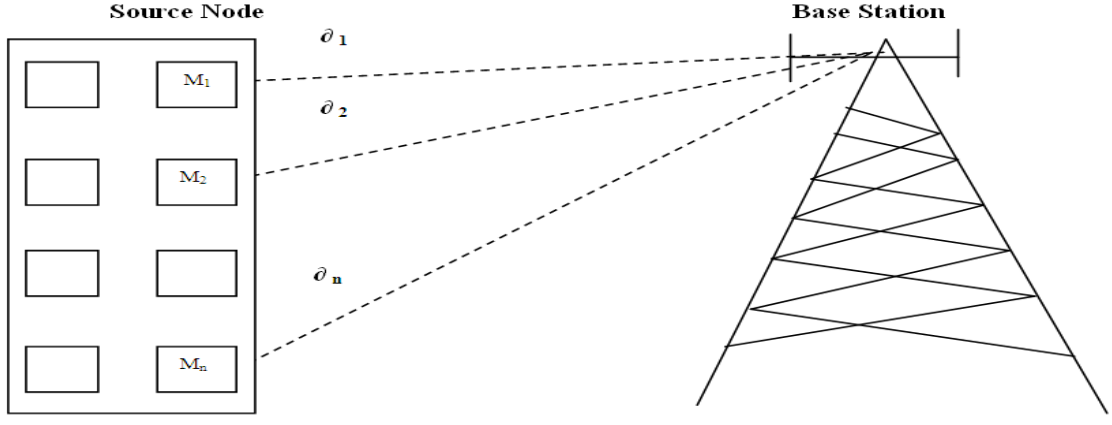

Fig:1 Architecture of the system model

Among these network , each node having ∂_i distance from base station. Each node is represented
V= $\bigcup_{i=1}^{m} (V_i)$ Where $V_i = \{N_{ji}$, here j=1,2,…m

i=1,2,….n} ------ (1)

$N_{ji} = \{x_i / d_b(x_i) = \delta_k\}$ where $d_b(x_i)$ is distance from node to base station and k=1,2….n.

The maximum coverage of the individual node measured from the maximum distance of the particular node from the base station. This distance is used for fixing the base station to cover the maximum transmission.

$$\delta = \text{Max}\{ \delta_1, \delta_2, \delta_3, \delta_4 \ldots\ldots\ldots \delta_n\}. \text{ -------- (2)}$$

Here δ is the maximum distance of the node(s) from the base station.

To obtain the maximum communication with minimum number of transmissions between the source node and base station, by using theuse minimum distance algorithm to find the distance between source node and base station.

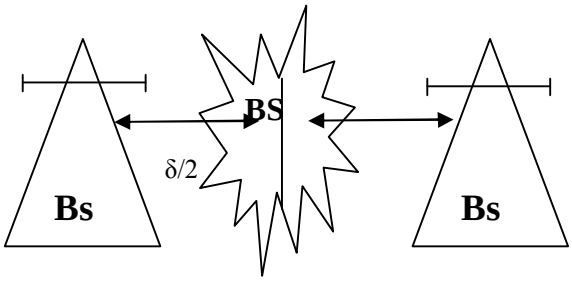

Fig:2 Fixing of Base Station

Fix base station(BS) for different $B_{ij.}$ where i=1,2,……..m and j=1,2,……n.

$$\text{Base station(BS)} = \bigcup_{j=1}^{n} \bigcup_{i=1}^{m} B_{ij} \text{ ---------- (3)}$$

III. Routing Scheme for FM –network:

Multi hop networks use some form of cooperation by enabling intermediate nodes to forward the message from source to destination. Also the destination receives multiple versions of the message from the source, and one (or) more relays and combines these to obtain a more reliable estimate of the transmitted signal as well as higher data rates[1].

Fuzzy logic has been applied in control systems either to improve performance or to avoid in the difficult mathematical problems. Researchers have considered fuzzy logic for bandwidth allocation in broadband networks [7],[8],[11]. By using the fuzzy control to SPIN routing. Fuzzy logic rules are used to determine whether to route messages in an energy efficient route in the network.

These rules depend on the priority of the weights and the traffic congestion in the network. For example, if we wish to discard low importance messages when the network is congested, we would include a rule.

The Fuzzy Logic Controller (FLC) has three inputs namely Speed, Power, Distance and one output namely the routing decision. The rules are expressed in Mamdani form

Ri: IF **X** is A_i and Y is B_j THEN Z is C_k

where **x**, **y** and **z** are linguistic variables representing two process state variables and one control variable (two inputs and one output); A_i ,B_j and C_k are linguistic values (with fuzzy sets specifying their meaning) of the linguistic variables x, y, and z in the universes of discourse U, V, and W, respectively.

The members of the fuzzy controller are explained in Table I.

Table I Members of fuzzy Controller

Speed	Slow	Medium	Fast
	1	2	3
Power	Low	Medium	High
	1	2	3
Distance	Near	Far	-
	1	2	

A fuzzy logic rule as given above is called a fuzzy association. A fuzzy associative memory (FAM) is formed by partitioning the universe of discourse of each condition variable (*Ai* and *Bi* in the above example) according to the level of fuzzy resolution chosen for these antecedents, thereby generating a grid of FAM elements.

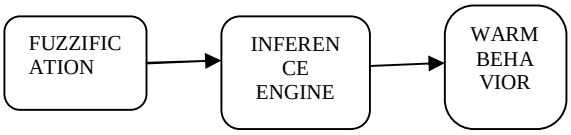

Fig:3 Block diagram of Fuzzy logic controller

The block diagram of fuzzy logic controller is shown in Fig .3.This contains a fuzzication block, inference engine and Swarm intelligent block which is used to optimize the result.

III. 1. FUZZIFICATION:

The crisp inputs to the Fuzzification block are Power, Distance and Speed of the each node.. Each system input is divided into overlapping sets of membership functions, typically 3 to 9 sets per input. The predefined membership functions cover the entire

range of values for an input and will define a degree of truth for every point in the universe of discourse. Note that membership functions may be more complicated in shape with a tradeoff of more complex arithmetic and memory requirements in the fuzzification step.

The fuzzification process uses two basic steps which are repeated for each system input. First, a crisp input must be read and scaled to a value between 0 and 255(for an 8 bit fuzzy engine). Second, the input must be translated to a degree of membership (between 0 and 255) for each input membership function. Here in this case Power, Distance and Speed were read and scaled and are translated to a degree of membership.

Thus, the fuzzification function produces a set of fuzzy inputs by reading a real-time crisp input, scaling it to 8 bits, and assigning a degree or grade for each input membership function defined by the user.

III. 2ALGORITHM

STEP: 1. Finding C_1 , C_2 , C_3 with constrain $C_1 + C_2 + C_3 = 1$.
2.Total $I_v = C_1 D_v + C_2 M_v + C_3 T_v$
3.Apply conditions to get Best, Better, Good, Nominal and Low with specified control limit in I_v.
4.Catagrize the process of fixing network through Network Simulator2 Algorithm.
5.Stop the process.

III.3 .RULE EVALUATION

Fuzzified inputs are processed through a predefined set of rules using a min-max evaluation to form fuzzified outputs. In detail, rules are arranged in an If-then format. If two or more inputs (called antecedents) are all true then an output function (called a consequent) is executed to the degree of the minimum value antecedent. Often times all the rules of a system are displayed in matrix fashion where the consequents are listed for all possible combination pairs of antecedents. Fuzzified outputs are classified into membership sets similar to input membership functions.

According to Chatterjee [13] and Chang [5],[7], the sum I_v is calculated as

$$I_v = c_1 D_v + c_2 M_v + c_3 T_v$$

Where D_v is the Distance between the neighbors, M_v is the Speed, T_v is the Power, I_v is the Cost of the node and C_1, C2, C3 are the Constants and values are given according to the application. Those selected nodes are then given to the swarm [17] behavior block in which the ranking is given to the nodes. Thus the selected path is an energy efficient path.

IV. CONCLUSION:

This paper presents an overview of an architecture for Fuzzy based Multihop network(FM-network).The proposed architecture works in the two phases.First phase fixes the node with base station in the desired level of distance. The second phase routes the information based on fuzzy logic. The architecture proposed in this paper addresses the dissipation of multi hop network.In order to achieve for a transmitter and receiver pair to communicate the required transmitting power changes exponentially with the distance and thus significant energy saving can be achieved by reducing the sensor transmitter and by enabling multi hop communication.

V. ACKNOWLEDGEMENT:

Authors would like to thank the following members specialized in different field Dr.P.GaneshKumar, Prof &Head, Department of Information Technology ,Velammal College of Engineering and Technology, Madurai, India. Dr.Ponnammal Natarajan, Former R&D Director, Anna university, currently working as a Advisior,R&D in Rajalakshmi Engineering College, Chennai, India and Dr.R.Vivekanandan, Assitant Professor, Department of English ,Velammal College of Engineering &Technology, Madurai, India for their constant encouragement and support to complete this project Successfully.

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