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An Algorithm to Design Resilient Energy Routing Protocol for WSN

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Abstract: When applications are tolerant of latency or the bandwidth of the transmitted data is very modest in the beginning, traditional quality of service standards like bounded delay or minimum bandwidth are meaningless. These requirements typically come from multimedia-type applications. Today's WSN systems are capable of managing a very broad range of telecommunications application types, often with only sporadic packet delivery. As a result, determining a WSN's data propagation using a single technique is extremely difficult. However, in scenarios involving routing and energy management, numerous common characteristics and parametric mechanisms of such systems occur. This work focuses on using node attributes with an intelligent choice process that uses fuzzy logic to reduce the key difficulties in choosing nodes for wireless sensor networks' multihop routing. The node attributes are taken into account while evaluating the probability of nodes' data forwarding success rates using straightforward fuzzy rules.

Keyword—Fuzzy Energy Aware Routing Protocol, MEMS, Routing, Clustering, WSN.

1. Introduction:

Wireless Sensor Networks (WSNs) represent a new paradigm in wireless technology drawing significant research attention from diverse fields of engineering. WSN technology is listed in “Top 10 Emerging Technologies” that will change the world. WSNs consist of many sensor nodes. These nodes sense the changes in the physical parameters similar to – pressure, temperature, etc. The data sensed by these nodes are then transmitted to the Base Station (BS) for estimation. WSNs are used for the variety of purposes like military surveillances, habitat monitoring, forest fire detections, and landslide detections.

The main task of many researchers in this field is to develop smart surroundings with the help of WSNs containing thousands of planned or ad-hoc deployed sensors, each capable of detecting ambient conditions like temperature, sound, movements, light, or the presence of particular objects. It is very important to make these sensing nodes as cheap and energy efficient as possible and trust them to obtain high quality results. Hence, to have battery operated sensor nodes is a good option. But despite of their small sizes, these batteries must be capable of giving a longer life to these sensing nodes. The network protocol used must be very efficient to optimize the lifetime of the nodes [5].

We also need to focus on algorithms and physical circuitries that can make maximum out of limited power source. Some of the promising routing algorithms can be categorized into three types as direct transmission algorithms, hop to hop transmission algorithms and cluster based algorithms. In cluster based protocols, most of the energy consumption depends on cluster head selection, cluster formation and the algorithm developed for routing the information.

2. Related work:

The information arriving at base station generally courses through unambiguous arrangement of hubs as it were. These hubs are for the most part situated around the base station and are known as Hotspot hubs. The outcome is speedy battery waste of area of interest hubs bringing about decrease of organization lifetime and making of inclusion openings. This peculiarity is known as Hotspot issue. To bypass the area of interest issue, sensor versatility or sink portability is given to the organization. Subsequently, the traffic is adjusted consistently across the organization. Wang et al. [6] proposed a migration plot for portable sink, for expanding the organization lifetime. The proposed conspire involved leftover energy of sensor hubs for progressively changing the transmission scope of these hubs. Likewise, the sink hub is permitted to move at some predefined focuses in light of most extreme lingering energy of sensor hub. Tashtarian et al. [7] executed sink portability in setting to occasion driven applications. The plan related an ideal single-jump connect where the sink hub catches the quantity of explicit occasion events from a bunch of sensors till a cutoff time is finished. An other most limited way [8] approach utilizes a greatest limit way to send information to the base station. When any hub depletes the battery under a base edge as opposed to setting off a sink migration, substitute potential ways are utilized for handing-off information to sink. At long last, the sink moves when no substitute ways are free.

Asmaa et al. [9] proposed a crossover approach joining sink-further developed energy effective based steering convention with the immediate transmission (DT) convention. This limits the development of sink in order to lessen the information misfortune that happens when sink moves from one area to next. Additionally, versatile sink should invest least energy known as visit time at the assigned stay areas. The outcomes show an improvement in energy effectiveness and organization lifetime when contrasted and both MIEEPB (Mobile Sink further developed energy proficient PEGASIS based steering) and DT conventions. Zone-based sink versatility (ZBSM) concentrated by Prasanth et al. [10] sent the organization into various zones ideally putting the sink utilizing fluffy rationale. The ideal sink position mitigates any organization parcel issue that might emerge. The outcomes give a proof of preferable execution over fixed and irregular portable sink arrangements. Kamran et al. [11] concocted a system for joint streamlining of sink versatility and information conglomeration with design matching for limiting the hub engendering delay, boosting throughput, and limiting the energy utilization. The system recreates the organization with portable sink and thick sending of hubs with heterogenous transmission ranges. This thick arrangement and changing transmission ranges brought about lesser transmissions, better leftover energies, and further developed throughput.

3. Design Principles for WSNS

Appropriate QoS support, energy efficiency, and scalability are important design and optimization goals for wireless sensor networks. But these goals themselves do not provide many hints on how to structure a network such that they are achieved. A few basic principles have emerged, which can be useful when designing networking protocols; the description here follows partially references. Nonetheless, the general advice to always consider the needs of a concrete application hold shere as well – for each of these basic principles, there are examples where following them would result in inferior solutions.

3.1 Distributed organization

Both the scalability and the robustness optimization goal, and to some extent also the other goals, make it imperative to organize the network in a distributed fashion. That means that there should be no centralized entity in charge – such an entity could, for example, control medium access or make routing decisions, similar to the tasks performed by a base station in cellular mobile networks. The disadvantages of such a centralized approach are obvious as it introduces exposed points of failure and is difficult to implement in a radio network, where participants only have limited communication coverage. Rather, the WSNs nodes should arrange the network cooperatively, using various distributed algorithms and protocols. Self-organization is a commonly used term for this principle. When organizing a network in a distributed manner, it's necessary to be aware of potential shortcomings of this approach. In many circumstances, a centralized approach can produce solutions that perform better or require fewer resources (in particular, energy). To combine the advantages, one possibility is to use centralized principles in a localized fashion by dynamically electing, out of the set of equal nodes, specific nodes that assume the responsibilities of a centralized agent, for example, to organize medium access. Such selections yield in a hierarchy, which should be dynamic: The election process should be repeated continuously lest the resources of the elected nodes be over taxed, the elected node runs out of energy, and the robustness disadvantages of such – even only localized – hierarchies manifest themselves. The particular selection criteria and triggering situations for re-election vary considerably, depending on the purpose for which these hierarchies are used.

3.2 In-network processing

When organizing a network in a distributed fashion, the nodes in the network are not only passing on packets or executing application programs, they are also actively involved in taking decisions about how to operate the network. This is a specific form of information processing that happens in the network, but is limited to information about the network itself. It is possible to extend this concept by also taking the concrete data that is to be transported by the network into account in this information processing, making in-network processing a first-rank design principle.

4. Result and Discussion:

We have used the fuzzy inference system to develop the node status evalution system to select the neighbour node best fit for packet transmission as next hop.The details of fuzzy inference system are given below:

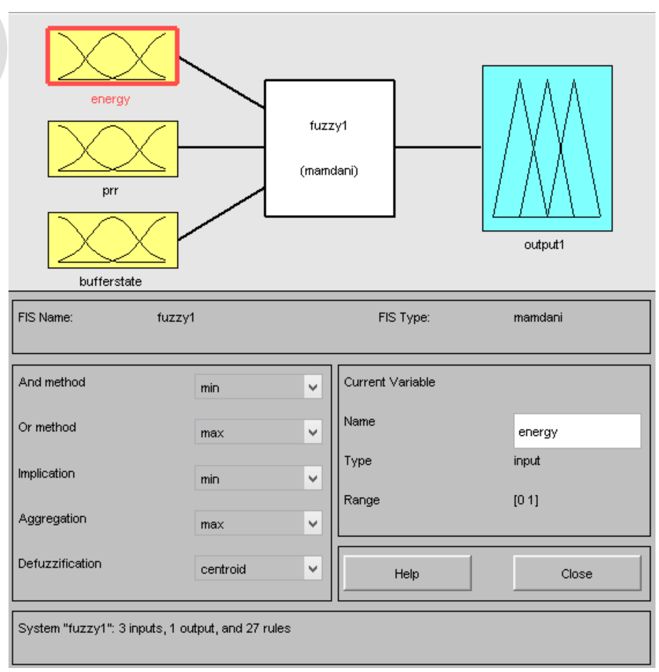

Figure 1: Fuzzy inference system for evaluationof node status.

Figure 1 shows the fuzzy inference system for evaluating the node status. It has three input known as energy ratio, packet receive rate and buffer state and the output is the node status.

The inputs are partitioned using membership functions as shown in figure 2 (a, b & c).

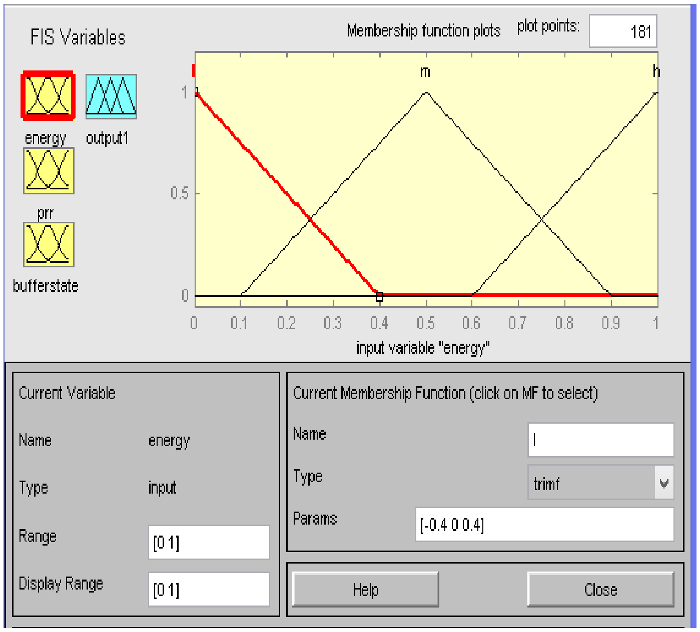

Figure 2a: Member ship function for input 1 energy ratio.

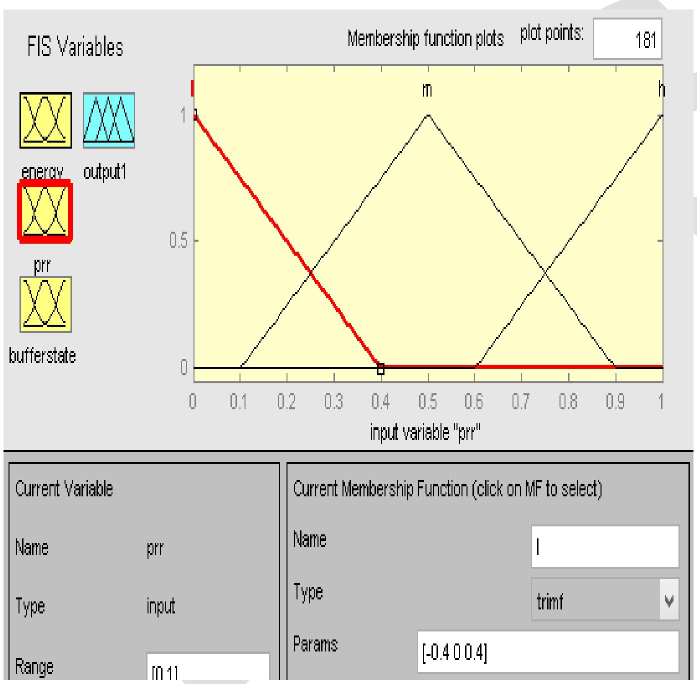

Figure 2b: Membership function for input 2 packet receive ratio.

We can see in figure 2 (a to c) that all three inputs are ratios hence the are varying from 0 to 1 and each input is divide into three equally spaced partitions allotted for LOW, MEDIUM and HIGH values of the input range.

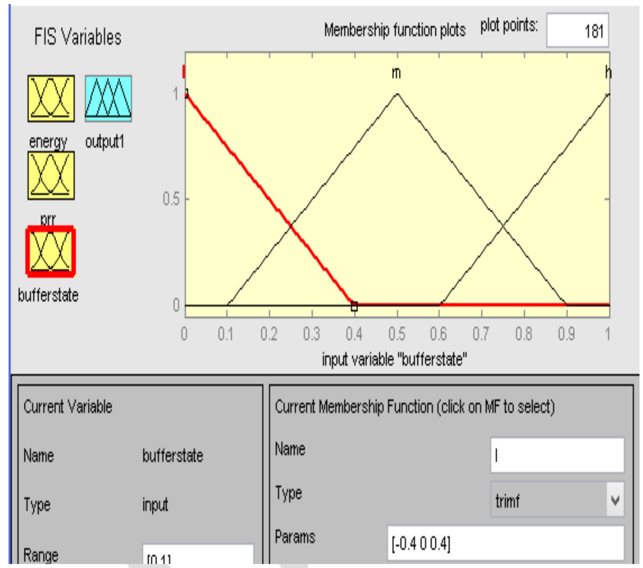

Figure 2c: Membership function for input 3 buffer state ratio.

Table 2: Rule base table for evaluating node status using 3 input

Energy Ratio (Input 1)	**Packet Receive Ratio (Input 2)**	**Buffer State Ratio (Input 3)**	**Node Selectivity Status (Output)**
LOW	LOW	LOW	LOW
LOW	MEDIUM	LOW	LOW
LOW	HIGH	LOW	LOW
LOW	LOW	MEDIUM	LOW
LOW	MEDIUM	MEDIUM	LOW
LOW	HIGH	MEDIUM	HIGH
LOW	LOW	HIGH	LOW
LOW	MEDIUM	HIGH	HIGH
LOW	HIGH	HIGH	HIGH
MEDIUM	LOW	LOW	LOW
MEDIUM	MEDIUM	LOW	HIGH
MEDIUM	HIGH	LOW	HIGH
MEDIUM	LOW	MEDIUM	HIGH
MEDIUM	MEDIUM	MEDIUM	HIGH
MEDIUM	HIGH	MEDIUM	HIGH
MEDIUM	LOW	HIGH	LOW
MEDIUM	MEDIUM	HIGH	HIGH
MEDIUM	HIGH	HIGH	HIGH
HIGH	LOW	LOW	LOW
HIGH	MEDIUM	LOW	HIGH
HIGH	HIGH	LOW	HIGH
HIGH	LOW	MEDIUM	HIGH
HIGH	MEDIUM	MEDIUM	HIGH
HIGH	HIGH	MEDIUM	HIGH
HIGH	LOW	HIGH	HIGH
HIGH	MEDIUM	HIGH	HIGH
HIGH	HIGH	HIGH	HIGH

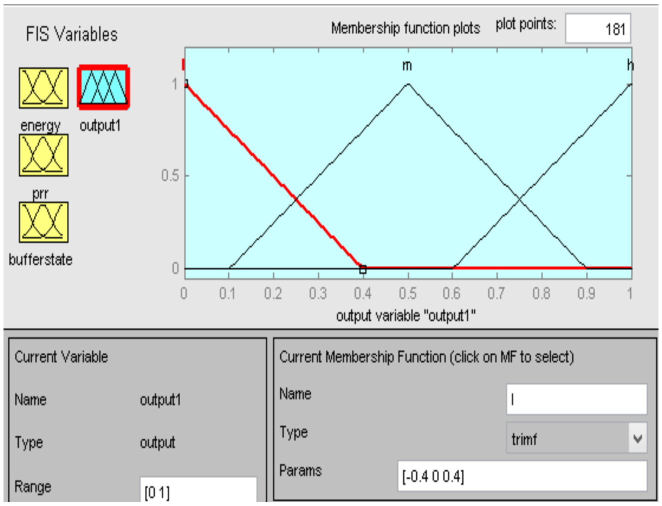

Fig 3: Membership function for output nodestatus.

The above explained fuzzy inference system is used in each round for the nodes input values. In each round the nodes are taken as active node if they are requesting for sending the packets. The request is broadcast to all the neighbouring nodes. For example in a round the active nodes are {1, 4, 7}.Then the algorithm displays the id of active nodes among all 10 m nodes. These nodes are requesting to neighbour nodes for forwarding its data so if the neighbour is ready and its node status fulfills the eligibility threshold then the packet can be forwarded to it.

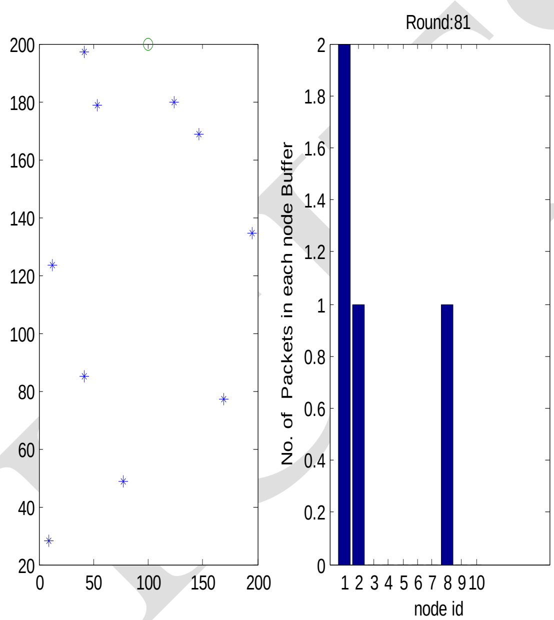

Fig 4: Network distribution and buffer state on configuration when sink is at centre.

5. Conclusion:

This study considers and implements a sensor nodes network in large-scale packet data transmission networks using the MATLAB programming environment. The nodes are believed to be initially powered by scarce and affordable energy sources batteries, with considerations of their longevity. Simulated is a schematic algorithm of the limited-power sensing, processing, and transmission functions of a sensor node. Additionally, it displays the WSN's communication architecture. Based on its objective, the information it now possesses, and its understanding of its processing, communication, and energy resources, each sensor node takes judgments. The nodes in this algorithm are simulated under the presumption that they have the capacity to gather and forward propagate data by systematic routing approach to other nearby nodes and subsequently to an externally placed far away base station or stations that are fixed or mobile nodes with the capability of connecting to the sensor network in order to accomplish the ongoing communication infrastructure or to the internet.

References:

[1]. M. Srbinovska, C. Gavrovski, V. Dimcev, A. Krkoleva, Borozan: Environmental parameters monitoring in precision agriculture using wireless sensor networks. J. Clean. Prod. 88, 297–307 (2015)

[2]. O. Amale, R. Patil, IOT Based rainfall monitoring system using WSN enabled architecture, in Proceedings of the 2019 3rd International Conference on Computing Methodologies & Communication (ICCMC), Erode, India, 27–29 March 2019, pp. 789–791 (2019)

[3]. K. Ghosh, S. Neogy, P.K. Das, Mehta: Intrusion detection at international borders and large military barracks with multi-sink wireless sensor networks: an energy efficient solution. Wirel. Pers. Commun. 2018(98), 1083–1101 (2018)

[4]. R. Ullah, Y. Faheem, B. Kim, Energy and congestion-aware routing metric for smart grid AMI networks in smart city. IEEE Access 2017(5), 13799–13810 (2017)

[5]. Z. Hao, Design of WSN traffic forecasting system with delayed self-sensing. Int. J. Comput. Appl. 2020(42), 30–35 (2020)

[6]. C.F. Wang, J.D. Shih, B.H. Pan, T.Y. Wu, A network lifetime enhancement method for sink relocation and its analysis in wireless sensor networks. IEEE Sens. J. 14(6), 1932–1943 (2014)

[7]. F. Tashtarian, Y.M. Hossein, K. Sohraby, S. Effati, On maximizing the lifetime of wireless sensor networks in event-driven applications with mobile sinks. IEEE Trans. Veh. Technol. 64(7), 3177–3189 (2015)

[8]. M.A. Jawad, F. Mir, Network Lifetime enhancement wireless sensor networks using secure alternate path, in Proceedings of the 2017 International Conference On Wireless Communications, Signal Processing And Networking. WiSPNET , pp. 414–419 (2018)

[9]. A. Rady, M. Shokair, S.M. El-Rabaie1, W. Saad, A. Benaya, Energy -efficient routing protocol based on sink mobility for wireless sensor networks. IET Wirel. Sens. Syst. 9(6), 405–415 (2019)

[10]. A. Prasanth, S. Pavalarajan, Zone-based mobility in wireless sensor networks. Sensor Review. 39(6), 874–880 (2019)
[11]. K. Latif, N. Javaid, I. Ullah, Z. Kaleem, Z. Abbas Malik, L.D. Nguyen, DIEER: delay-intolerant energy-efficient routing with sink mobility in underwater wireless sensor networks. Sensors 20, 3467. https://doi.org/10.3390/s20123467 (2020)
[12]. B. Bhushan, G. Sahoo, E2SR2: an acknowledgement-based mobile sink routing protocol with rechargeable sensors for wireless sensor networks. Wirel. Netw. 25, 2697–2721. https://doi. org/10.1007/s11276-019-01988-7 (2019)
[13]. B.M. Sahoo, T. Amgoth, H.M. Pandey, Particle swarm optimiz ation based energy efficient clustering and sink mobility in heterogeneous wireless sensor network. Ad Hoc Netw. 106, 2020,102237 (2020)