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WSN Node Selection Algorithm for Efficient Routing

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***Abstract*: In WSN system the routing scheme using the sensor nodes are performed in between group of different clusters. The nodes are working for data aggregation from these source nodes they also performs data dissemination and network management and events sensing and information collecting in the neighbourhood. Many clustering topology are proposed in recent years to localize the route with in the clusters. In this paper we have reviewed and compared these topologies to find out the network mechanism which are easier to manage and scalable for getting high quality response with respect to dynamics of the environment.**

Keyword: Wireless Sensor Network, Fuzzy logic aware routing protocol, Residual Energy, Distributed Organisation.

1. Introduction:

Wireless Sensor Network possesses a lot of sensor nodes with limited resource in terms of energy, computation and memory. They are operated by a small battery attached to it. This battery possesses bit initial energy, and in every communication it dissipates some energy.

In as much as the energy of sensor nodes is circumscribed prolonging network life in WSNs is considered to be a vital issue. Therefore, researchers must take into consideration energy consumption in routing protocols of WSNs in order to extend the network life time.

Recent progress and boost in micro electro-mechanical systems (MEMS) and wireless, communications have highlighted the importance of WSNs as significant reporting devices processing capability and memory capacity. WSNs are used in applications like as target tracking, environmental monitoring, house automation and battle field applications. The objective of WSNs is to disperse the information from the source to the sink in multi-hop scheme.

A sensor node basically consists of five main components:

Once more sensors gather data from the environment. The central unit which is in the form of a CPU manages the tasks. A transceiver communicates with the environment and a memory is used to store date enerated during processing or temporary data. The battery provides energy to all parts. Energy efficiency in all parts of the network is very important in order to assure a sufficiently long network lifetime. The three basic functions performed by sensor network are sensing, processing and communication.

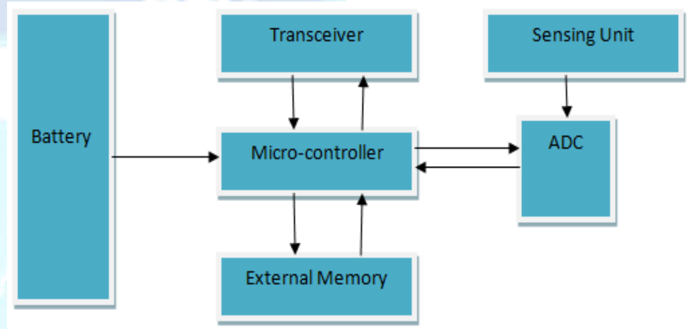

Figure 1: Architecture of a sensor node

The wired sensor networks were being used for various purposes until wireless sensor networks became popular. But due to the factors like high cost of installation, up-gradation, maintenance and infeasibility of wired sensor networks in hostile and remote locations, wireless sensor networks became a favourable alternative. Due to the random deployment of sensor nodes in a wireless sensor network the positions of the sensor nodes need not to be predetermined [2]. Also, the majority of routing algorithms, in WSNs require authentic and real time data forwarding to the sink node. Thus, energy efficiency is considered as a crucial challenge in WSNs.

The periodical choice of the optimal path and the energy hole problem together effects the lifetime of WSNs in the majority of touting algorithms. As a result of these two issues. The network will be partitioned and the WSN will not be able to accomplish its desired function.

2. Applications:

There are several types of sensors such as seismic, visual, low sampling are, magnetic, thermal, acoustic and radar and infrared which are capable of monitor a wide variety of ambient conditions that include the following [3].

Temperature,
Humidity,
Vehicular movement,
Lightning condition,
Pressure,
Noise levels,
Mechanical stress levels on objects that are attached, and
The current characteristics such as speed and size of an object.

Sensor nodes can be used for different purposes like continuous sensing, event detection, event identification, location sensing and local control of actuators. The idea of micro-sensing and wireless connection of these nodes gives rise to many new application areas. We categorize the applications of WSN into military, environment, health, home and various areas. It is possible to expand this assortment with more categories such as exploration of space, chemical processing and disaster relief application.

1. Military application: Wireless sensor networks are an integral part of military command, control communications computation, intelligence, surveillance, reconnaissance and targeting [8]. It enables leader and commander to continuous monitoring the status of friendly troop, the condition and the availability of the equipment's and the ammunition in a battlefield.
2. Environmental applications: The environmental applications of sensor networks are tracking the movements of birds, small animals, and insects, macro instruments for earth and planetary exploration, chemical and biological detection, monitoring environmental circumstances. Because of strategic, random and dense deployment of sensor nodes in forest, sensor nodes can relay the exact and accurate origin of the fire to the end users before the fire is spread uncontrollable [6].
3. Health application: There are number of health applications for sensor networks like monitoring of human physiological data.

Network lifetime is important is important for WSN. It can be defined as the time until the first node runs out of battery. Due to the limited energy supply and the difficulty of recharging the battery.

The network lifetime may be defined as the time until the first sensor in the WSN dies. Sensor lifetime is the amount of time until the sensor runs out of energy. This is given by-

Tk = Initial energy/Energy consumption per unit time.

The network lifetime is given by-

$$T = \min Tk$$

Several techniques for maximizing network lifetime are:
Aggregation,
Clustering,
Scheduling and
Mobile Relays

Network partitioning is the break in the network which makes the topology to split into two or more parts [9].

3. Objective:

The objective is to manage the energy consumption and increase average remaining energy. It is done by finding an optimal path using A* algorithm our intention to forward data packets to the next neighbour node which has residual energy, high packet reception rate and high free buffer. To accomplish this we use aggregated weights of the above mentioned parameters which are the sum of the normalised weights given as:

$$g(n) = \text{Max}\{\alpha Eres(n)/Eini(n) + \beta(Nr(n)/Nt(n)) + \delta(Bf(n)/Bini(n))\}$$

Where, Eres (n) = residual energy of node n
Eini (n) = initial energy of node n
Nr(n) = number of received packets
Nt(n) number of transmitted packets
Bf(n) = fixed free buffer
Bini (n) = initial free buffer
$\alpha+\beta+\delta = 1$
And α, β, δ are weight parameters.

4. Methodology:

A. Sensor Network Scenarios:

1. Types of sources and sinks: A sink is the place where data is needed. There are essentially three options for a sink: It could belong to the sensor network as such and be just another sensor/actuator mode or it could be an entity outside this network. It could also merely a gateway to another larger network such as the Internet, where the real request for the data comes from some node that are at larger distances and only indirectly connected to such a sensor network.

2. Single-hop versus multi-hop networks: Radio communication follows a limitation on the achievable distance between a sender and a receiver which is well known from the main theory of radio communication and the inherent power limitation. Because of this limited distance, the simple, single communication among sources and sink is not always possible, specifically in WSNs, which is intended to cover various ground or that function in difficult radio environment with strong attenuation. To reduce such limited distances, an obvious way out is to use stations, with the data packets taking multi hops from the source to the sink multi-hop routing is more efficient than single hop routing [1, 5]. Because the sensor nodes themselves can act as such relay nodes, foregoing nodes, foregoing the needs for additional equipment.

3. Multiple sinks and sources: Till now, only network with a one source and a one destination have been illustrated. In many cases, there are various sources and/or various sink are there. This case, multiple source should send information to various sinks, where almost or some of the information has to reach all or some of the sinks.

Three types of mobility: In the scenarios discussed above, all participants were stationary. But one of the main virtues of wireless communication is its capability to support mobile participants. In wireless sensor networks, mobility can appear in three main forms:

1. Nodes Mobility: The wireless sensor nodes can be mobile. The meaning of such mobility is highly dependent upon type of application. In face of node mobility, the network has to rearrange itself rapidly enough to be able to perform correctly. It is clear that there are trade-off between the frequency and velocity of nodes movement on the one hand and the energy required to maintain a desired level of functionality in the network on the other hand.
2. Event Mobility: In applications like detection of event and in especially in tracking applications, the reason of the events or the objects which is to be

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tracked can be mobile. In such scenarios, it is important that the observed event is observed by appropriate number of sensors all the time. Hence sensors will wake up around the objects, engaged in higher activity to observe the present object, and then go back to sleep. As the event source moves through the network, it is followed by an area of activity within the network- this has been called the Frisbee model. In particular, event mobility is quite uncommon, compared to previous forms of mobile or wireless networks [10].

3. Sink Mobility: This can be a special case of node mobility, the important aspect is the mobility of an information sink that is not part of the sensor network, for example, a human user requested information via a PDA while walking in an intelligent building. In a simple case, such a requester can interact with the WSN at one point and complete its interactions before moving in. In many cases, consecutive interacts can be treated as separate, unrelated requests. Whether the requester is allowed interactions with any node or only with specific nodes is a design choice for the appropriate protocol layers.

B. Optimization Goals and Figures of Merit: The challenging question is how to optimize a network, how to compare these solution, how to make decision regarding which approach better supports a particular application, and how optimise goal into measurable figure of merit? A few aspects are fairly evident.

a. Quality of service:

1. Event classification error: If it is require to not only detect but also classify the event, the error in classification must be small.
2. Event detection delay: How much delay is between detecting an event and reporting it to any/all interested sinks?
3. Missing report: In application, that require periodic reporting, the probability of undelivered reports should be small.
4. Approximation accuracy: For applications of function approximation (e.g. approximating the temperature as a function of location for a given area), how much is the average/maximum absolute or relative error with respect to the actual function? Similarly, for detection applications, what is the accuracy of edge descriptions, are some at all?
5. Tracking accuracy: Tracking applications must not lose an object to be tracked, the reported location should be as close the real location as possible, and the error should be minimum. Other factors of tracking accuracy are, for example, the sensitivity to sensing gaps.

These are few aspects that is used to optimize the goals.

b. Energy Efficiency: Energy efficiency is rather an umbrella term for many different factors of a system, which should be distinguished carefully to form actual, figure of merit than can be measured. Energy is a precious resource in wireless sensor networks and that energy efficiency should therefore make an evident optimization goal [11]. It is clear that with an arbitrary amount of energy, most of the QoS metrics defined above can be increased almost.

The most common considered aspects are:

1. Energy per correctly received bit: How much energy, counting all sources of energy consumption at all possible intermediate hops, is spent on spent on average to transport one bit of information (payload) from the source to the destination? This metric is often a useful for periodic monitoring application
2. Energy per reported (unique) event: Similarly, how much average energy spent to report one event? Since single event is sometimes reported form different sources, it is normal to normalize this metric to only the special events (redundant information about an already known event does not provide additional information).
3. Network lifetime: The time during which the network is operational or, put another way, the time which it is capable of fulfilling its tasks (beginning from a given amount of stored energy). It is not quite clear, however, when this time finished. Some possible definitions are:
4. Network half-life: When 50% of the nodes run out of energy and stopped operating? Any other fixed percentile is applicable as well.
5. Time to partition: When the first partition of the network in two (or more) separated parts occur. This time can be as early as the death of the first node (if that was in a pivotal position) or occur very late if the network topology is robust.

Obviously, the longer the time are the better does a network performs. More generally, it is also possible to look at the (complementary) distribution of node lifetimes (With what probability does a node survive a given amount of time?) or at the relative survival times of a network (at what time are how many percent of the nodes still operational?). This latter function allows an intuition about many WSN-specific protocols in that they tend to sacrifice long lifetimes in return for an improvement in short lifetime- they “sharpen the drop” as shown in Figure 2. All these parameters can off course only be evaluated under a clear set of assumptions about the energy usage characteristics of a given node, about the actual “load” that the network has to deal with and also about the behaviour of the radio channel.

C. Scalability: The capability of maintaining performance characteristics regardless of the size of the network is referred to as scalability. With WSN potentially consisting of thousands of nodes, scalability is an evidently indispensable requirement. Scalability is ill served by any construct that requires globally consistent state, such as addresses or routing table entries that require to be maintained.

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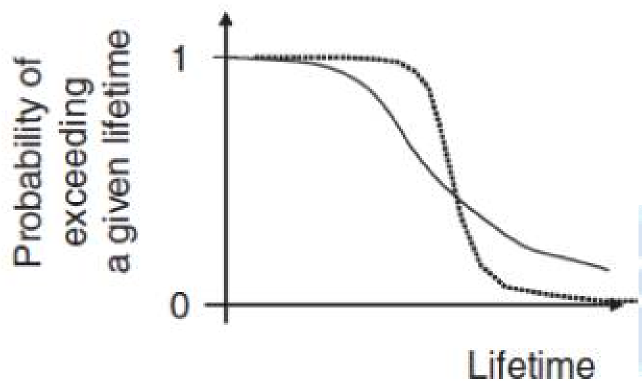

Figure 2: Two probability curves of a node exceeding a given lifetime – the dotted curve trades off better minimal lifetime against reduced maximum lifetime.

D. Robustness: For quality of service wireless sensor networks should also exhibit an appropriate robustness. They should not fail just because a limited number of nodes run out of energy, or because their environment varies and severs present radio links between two nodes if possible, these failures have to be compensated for,

A. **Design principles for WSNS:** Appropriate QoS support, energy efficiency, and scalability are important design and optimization goals for wireless sensor networks. But the goals themselves do not provide any 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.

1. Distributed organization: Both the scalability and the robustness optimization goals, and to some extent also the other goals, make it imperative to organize the network in distributed fashion. The disadvantage 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. In many circumstances, a centralized approach can produce solutions that perform better or require fewer resources. The particular selection criteria and triggering situation for re-election vary considerably, depending on the purpose for which these hierarchies are used.

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.

B. **Proposed Work:**

. Fuzzy Energy Aware Routing Protocol:

We use Fuzzy logic based enhanced A* algorithm [4] to find the optimal path from source node to destination node. At the initial stage each node sends its parameter: residual energy, packet reception rate, node buffer state. Based on these parameters the sink node evaluates the node status by fuzzy rules for the current routing schedule. If the node status of the node is less than the threshold energy it does not participate in the process and network load is balanced. Three input based Fuzzy logic algorithm [7] generates the node status and this is used as cost heuristic function to determine the choice of suitable nodes to find optimal path. Our intention is to forward data packets to the next neighbour node which has high residual energy, high packet reception rate, and high free buffer energy, high packet reception rate and high free buffer.

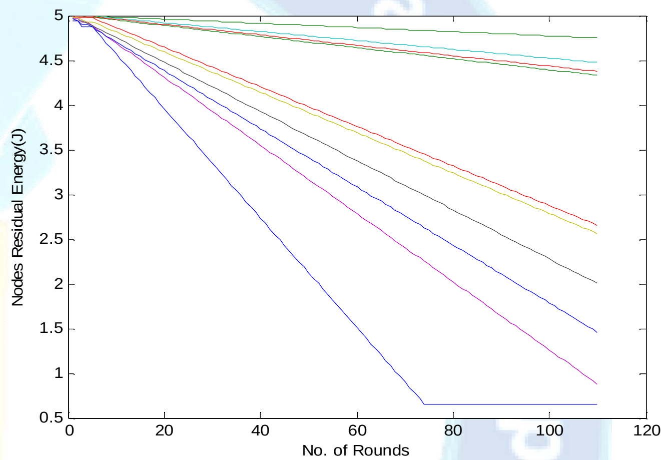

Figure 3. Nr/Nt ratio for every node at any arbitrary round when sink is at centre.

Figure 3 shows the Nr/Nt ratio of the nodes at any round for every node ids. The no. of packet received and no. of packets transmitted is measured by keeping account of lossed packet at sink on sending through the source.

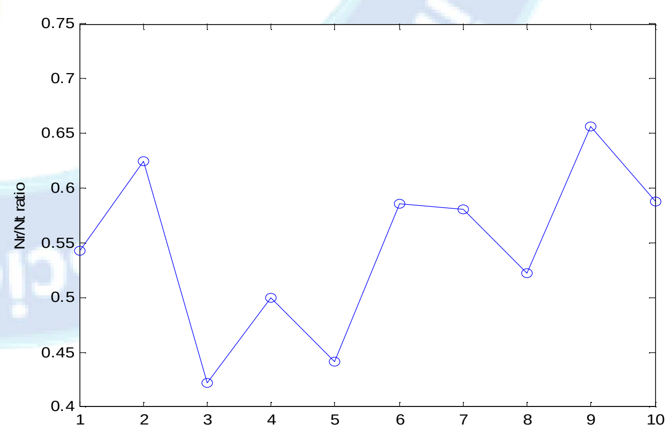

Figure 4: Residual Energy of every node at different rounds when sink is at centre.

The optimal path can be discovered with regard to the maximum residual energy of the next hop sensor node, high link quality, buffet occupancy and minimum hop counts. Simulation result indicate that the proposed scheme improves network lifetime.

5. Conclusion and Future Scope:

In this work sensor nodes network in the large scale packet data transmission networks is considered and implemented on MATLAB programming environment. The nodes are considered with initially powered by limited and inexpensive energy source batteries with considerations of existence for a suitable time period. A schematic algorithm of components of a sensor node is simulated that consist of sensing, processing, transmission using limited power units. It also shows the communication architecture of a WSN, Each sensor node makes its decisions based on its mission, the information it currently has, knowledge of its computing, communication, and energy resources. The node in this algorithm are simulated with assumption that they have capability to collect and forward propagate data by systematic routing approach to other neighbouring nodes and consequently to an externally placed far away base station or stations which are fixed or a mobile node with quality of connecting to the sensor network for accomplishing the on-going communication infrastructure or to the internet. The nodes have limited communication range and the nodes under the communication range are the neighbour nodes our algorithm decides the best neighbour on the basis of surrounding nodes parameters. Sensor nodes forward its sensed data to those node which fulfils the node status criteria related to nodes residual energy factor, nodes packet reception rate standards and the nodes buffer state for deciding the next node for data propagation during establishment of multiple hop routing from source to sink node.

The sensor nodes status in respect of three inputs is evaluated by simple fuzzy rules and the sensor node acts as a next routing element for other nodes which have highest value of node status for transmitting data. Energy is therefore of utmost importance in the power constrained based fuzzy evaluation rules but decision also involves date gathering and forwarding capability in terms of packet reception and buffering state of sensor nodes of the networks. The performance of algorithm, are validated in terms of nodes residual energy and it has been observed that the fuzzy based nodes status evaluation and propagation to most suitable node is work better than A&F and A* algorithm. In future more input parameters can be considered which can help in energy consumption better managed to maximize the network lifetime. We can also give considerations to the unbalanced energy consumption situation due to node position and distance from base station to solve the inherent problem in WSNs faced by the multi-hop routing and also apply this algorithm on many-to-one traffic pattern. This heterogeneous energy dissipation effects significantly reduce network lifetime hence they are also required to be considered in future. We can improve this routing algorithm for the best path selection for transmission of data from source to destination by minimizi.ng the condition of the same path selection for all communications in order to achieve battery performance in terms of quick transmission time, those nodes on this path will get drained fast.

Reference:

[1] Eugene Shih, Seong Hwan Cho,Nathan Ickes RexMin AmitSinha, Alice Wang Ananthe Chandrakasan "Physical Layer Protocol and Algorithm design for Energy Efficient Wireless Sensor Networks", MOBICOM(2001).

[2] GianlucaDini, Marco Pelagatti, and Ida Maria Savino, "An Algorithm for Reconnecting Wireless Sensor Network Partitions", *Springer*-Verlag Berlin Heidelberg 2008.

[3] Stefanos A. Nikolodakis, DionisisKandris, Dimitrios,D. Vergados and Christor Douligeris, "Energy Efficient Routing in Wireless Sensor Networks Through Balanced Clustering Algothrims". (2003)

[4] Ali Ghaffari, "An Energy Efficient Routing Protocol for Wireless Sensor Networking using A-star Algorithm", (2015)

[5] Pesovic, Goze J.Mohorko, Karl Benkic, Zarko F.Cucej, "Single-hop vs. Multi-hop-Energy efficiency analysis in wireless sensor networks', (2010)

[6] MohdFauzi Othman, KhairunnisaShazali," Wireless Sensor Network Applications: A Study in Environment Monitoring System", Procedia Engineering.

[7] Chandra Prakash Yadav, Reena kumara Jain, Sunil Kumar Yadav,"An Efficient Routing Method for Lifetime Enhancement in wireless Sensor Network using Fuzzy Approach and A- Star Algorithm", (2014).

[8] TareqAlhmiedat, Anas Abu Taleb, Mohammad Bsoul," A Study on Threats Detection and Tracking Systems for Military Applications using WSNs",*International Journal of Computer Applications* (0975 – 8887) Volume 40– No.15, February 2012.

[9] Dilip Kumar, Trilok Chand Aseri, and Ram Bahadur Patel, "Prolonging Network Lifetime and Data Accumulation in Heterogeneous Sensor Networks", *The International Arab Journal of Information Technology*, Vol. 7, No. 3, July 2010.

[10] Deepak S. GAikwas, SampadaPimpale, "Routing Alternating for Network Lifetime Maximization of WSNs Using Heuristic and Fuzzy Logic Approach", (2013)

[11] Vema, Suneetha Devi, Sk. RahilHussain,"Energy Efficient WSN using HEED protocol", (2016).