Fuzzy Logic Scheme for Energy Efficient Routing in AOMDV for Wireless Sensor Networks

Dr.V.Ramesh
Associate Professor, Dept. of IT, MGIT, Hyderabad, India.

Abstract – Recent advances in wireless network and mobile technologies have resulted in more improvements in sensor networks. But there are various challenges and security threats that disturb the Wireless communication. In this paper we implement the cluster head selection scheme for selecting the cluster head and the usefulness of multi-path routing to achieve lifetime improvements by load balancing and exploiting cross-layer information in wireless sensor network. The cluster-based wireless sensor network (WSN) can enhance the whole network lifetime. In each cluster, the cluster head (CH) plays an important role in aggregating and forwarding data sensed by other common nodes. We are using fuzzy logic scheme for selecting cluster head. Using AOMDV protocol for route discovery in sensor network.

Index Terms – Wireless sensor network, Adhoc on demand multipath distance vector protocol, Adhoc on demand vector.

1. INTRODUCTION

Wireless sensor networks (WSN) have become increasingly one of the most promising and interesting areas over the past few years.WSNs network consist of inexpensive wireless nodes with limited capacity and memory. The sensor nodes are scattered in various places. sensors are used in various applications like environmental and disaster monitoring ,habitat monitoring ,military and healthcare applications . These networks may be very large systems comprised of small sized, low power, low-cost sensor devices that collect detailed information. Each device has one or more sensors, embedded processor(s), and low-power radio(s), and is normally battery operated.

The security and energy consumption are important factors in wireless sensor network. The energy consumption can be reduced by only allowing the some nodes only sending the data to the base station. These nodes are called as cluster head nodes which are responsible for collecting the aggregated data from the sensor nodes and forward the data to the base station. The cluster head selection mechanism reduce the power consumption and increase the sensor node lifetime .The location of the cluster head is also very important .The cluster head is always nearer to all nodes. The sensor nodes have one or more base stations. The base station also act as gate way to another network. The base station exist in the form of laptop or mobile or server. It serve as the interface between sensor network and external world. The base station acts as a central trusted authority .The sensor nodes are constrained in energy consumption and communication bandwidth. Routing in wireless sensor network has inherent characteristics that differentiate wireless sensor network from other networks. In the following ,we summarize the routing challenges and problems in wireless sensor network[1].

Node deployment : The node deployment in wireless sensor network can be deterministic or randomized depending on the applications. The position of cluster head and sink also important factor in wireless sensor network.

Energy consideration: The transmission of wireless channel is also based on how the data can be routed .multi hop routing will consume less energy than the direct routing.

This paper investigate the power management and also routing challenges in sensor networks. In section 2 it describes the related work ,we propose fuzzy logic scheme for cluster head selection, AOMDV protocol for route discovery operation. The AOMDV protocol is evaluated by simulations as discussed in section 4. Section 5 concludes the paper.

2. MULTIPATH ROUTING

Sensor are constrained to use lower power, lower bandwidth, short range radio communication. So the sensor nodes form a multi hop based routing technique for data communication. Standard protocols are used to find the single route between the source and destination. These protocols are used to find the best path based on cost. But multi hop routing protocols can be used to find multiple paths. Multiple routes can be useful for energy and resource constrained sensor networks. Discovering the multipath routes can yield lot of advantages like load balancing, fault tolerance ,bandwidth aggregation, reducing the delay. The sensor nodes send the steady stream of data to base station at every second. This stream of data is called data flow. The Benefits from multipath Routing are listed below:

Reliability: It mean that probability of that message can be generated at one place routed to the destination. The multipath routing is applied at the source to distribute the traffic on to multiple disjoint paths between the source and destination.

Load balancing : when the certain nodes and link can be overloaded, multipath routing can spread the data over alternative routes to balance the traffic. Load balancing will improve the network .The on demand routing scheme always utilize the data traffic at some links only. In multi hop routing

load is balanced over multiple routes, network lifetime can be improved.

Bandwidth aggregation: By splitting data to the same destination into multiple streams, each stream is routed through a different path. The effective bandwidth can be aggregated.

Reduced Delay : When we are using single path routing protocol, it produces delay for route discovery. But multipath routing protocols uses backup routes for route failures. It reduce the delay for route discovery.

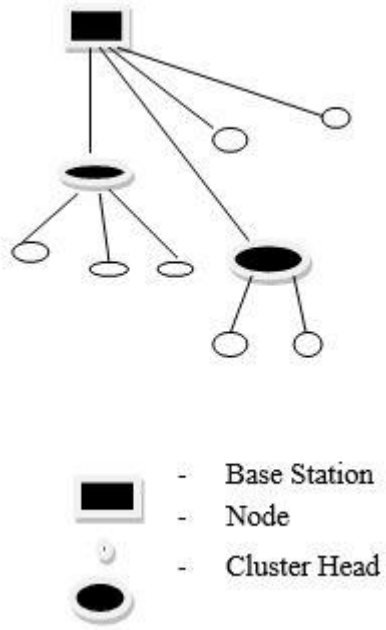

Fig 1 Sensor Node Architecture

In order to reduce the total no of messages sent using base station, we need some aggregation scheme for data collection. An aggregation node collects all sensor readings from the sensors and forward a single message representing an aggregated values. The aggregated node also a sensor node. The aggregated node selection is not static.

A. Route Discovery

Route recovery scheme in sensor networks to reduce the time delay and control overhead in the route recovery process. The idea of this distributed heuristic is based on maintaining the route information at each node to the sink and then utilizing such information for the relocation of the sensors. Route recovery scheme to solve the link failure problem caused by node movement, packet collision or bad channel condition. Routes need not be included in packet headers Nodes maintain routing tables containing entries only for routes that are in active use . Sequence numbers are used to avoid old/broken routes Sequence numbers prevent formation of routing loops.

B. Multipath routing protocols

The protocols described in this paper influenced by adhoc on demand multipath distance vector protocol ,which is the extension of Adhoc on demand protocol for discovering node disjoint or link disjoint path. If the paths are to be node-disjoint, then each path must avoid the sources and sinks in the second and third parts as it passes from the first part to the fourth part. To avoid these sources and sinks, we declare them to be blocked. We then apply the technique for tolerating faults in multi butterfly networks to the second and third parts, treating blocked nodes as if they were faulty.

The figure 1 and 2 explain the mechanism of AOMDV mechanism to find routing. Each RREQ arriving via a different neighbor of the source has a different first-hop in the RREQ header, and therefore defines a node-disjoint path. Nodes do never rebroadcast duplicate RREQs, so any two RREQs arriving at an intermediate node via a different neighbor of the source could not have traversed the same node[5].

C. AOMDV Route Discovery

Several changes are necessary in the basic AODV route discovery mechanism to enable computation of multiple link disjoint routes between source destination pairs. Note that any intermediate node on the route between a source and a destination can also form such multiple routes to , thus making available a large number of routes between and Recall that in the route discovery procedure a reverse path is set up backwards to the source via the same path the route request (RREQ) has traversed. If duplicates of the RREQ coming via different paths are ignored as before, only one reverse path can be formed. To form multiple routes, all duplicates of the RREQ arriving at a node are examined (but not propagated), as each duplicate defines an alternate route. Three copies of RREQ reach destination _, two of which are not via disjoint paths. How do we differentiate between duplicate RREQs that come via disjoint routes and that do not? Reverse routes should be formed only using the former type. The copies of a RREQ reaching via node disjoint paths must take different first hops from Thus, all trajectories of a RREQ between any pair of nodes with unique first hops are guaranteed to be disjoint.

To determine this, however, the first hop information needs to be included in the RREQ packet as an additional field. Each node remembers the first hop of each RREQ (in a first hop list) it has seen with the same source id and broadcast id. A reverse path is always formed when the first hop is unique. However, as in regular AODV, only the first copy of the RREQ is forwarded. Thus there is no additional routing overhead. All these reverse paths can be used to propagate multiple RREPs towards the source so that multiple forward paths can be formed. Note that all such paths are node disjoint. In the hope of getting link disjoint paths (which would be more numerous

than node disjoint paths) the destination node adopts a “looser” reply policy.

It replies up to copies of RREQ arriving via *unique* neighbors, disregarding the first hops of these RREQs. Unique neighbors guarantee link disjointness in the first hop of the RREP. Beyond the first hop, the RREP follows the reverse route that have been set up already which are node disjoint (and hence link disjoint). Each RREP arriving at an intermediate node takes a different reverse route when multiple routes are already available. Note that because of the “looser” reply policy it is possible for the trajectories of RREPs to cross at an intermediate node. The parameter _ is used to prevent a RREP explosion. Also, our earlier observation indicated that additional routes beyond a few provide only marginal benefit, if any. We have used in our experiments. Suppose, the second copy of RREQ is transmitted over the dotted link. AODV ignores it. But AOMDV forms a reverse path through the previous hop. Either protocol does not forward the second copy.

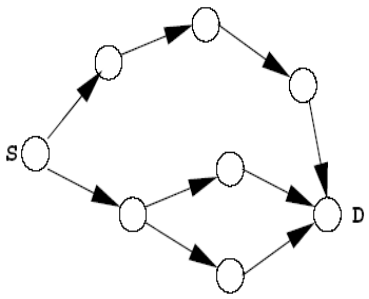

Fig 2 Three copie of RREQ will reach D; but only two are via disjoint routes.

3. CLUSTER HEAD SELECTION

In sensor networks ,the cluster node always overloaded by collecting and forwarding the data to the base station. This problem can be avoided by changing the cluster head node frequently based on energy level. The cluster head spend more time than the other nodes. The cluster head plays an important role in wireless sensor network[3].Our cluster head selection is based on fuzzy logic control. The fuzzy logic control consist of fuzzifier, defuzzifier ,inference engine, fuzzy rules .Three factors which directly influence the network life time. They are energy, mobility ,distance to the central cluster. The cluster head election is based on fuzzy logic scheme[5].

- Node energy : energy level available in each node.
- Node concentration : No of nodes present in the cluster.
- Node centrality : Nodes can be classified based on the how the node is central to the cluster .To find node centrality the base station select each node and calculates the sum of squared distance of other nodes from the selected node.

The process is performed in four steps.

Fuzzification : The input variables in a fuzzy control system are in general mapped into by sets of membership functions similar to this, known as "fuzzy sets". The process of converting a crisp input value to a fuzzy value is called " fuzzification ". The input variables are energy ,concentration, centrality.

Rule evaluation : All the rules that apply are invoked, using the membership functions and truth values obtained from the inputs, to determine the result of the rule. This result in turn will be mapped into a membership function and truth value controlling the output variable.

Defuzzification: The input for the defuzzification process is the aggregate ouput fuzzy chance.

4. FUZZY CONTROL

Fuzzy controllers are very simple conceptually. They consist of an input stage, a processing stage, and an output stage. The input stage maps sensor or other inputs, such as switches, thumbwheels, and so on, to the appropriate membership functions and truth values. The processing stage invokes each appropriate rule and generates a result for each, then combines the results of the rules. Finally, the output stage converts the combined result back into a specific control output value. The most common shape of membership functions is triangular, although trapezoidal and bell curves are also used, but the shape is generally less important than the number of curves and their placement. There are several ways to define the result of a rule, but one of the most common and simplest is the "max-min" inference method, in which the output membership function is given the truth value generated by the premise. Rules can be solved in parallel in hardware, or sequentially in software. The results of all the rules that have fired are "defuzzified" to a crisp value by one of several methods.

The variable used to represent the node energy and concentration by low, medium, high. The node centrality is represented by using adeq ,med, very small, small, large, very large, rather large levels. If the energy is high and concentration is high and centrality also close ,then the chance value is very large . All the nodes are compared on the basis of chance level. The node with maximum chance will be elected as a cluster head.

5. RESULTS AND DISCUSSION

We use the NS2 simulator to study the performance of our proposed system. The network model consider for simulation is shown in Table 1.In this paper, sensor in healthcare environment is proposed. The performance metrics is used to evaluate the efficiency of the proposed system under the

normal case are, packets send, packets received, delivery rate, delay. The packet delivery ratio is the total no of packets received all nodes by total no of packets they sent.

Table 1 Simulation parameters

S.NO	Parameters	Details
1	Node Placement	Random
2	No Of nodes	50
3	No of sink	5
6	Packets sent interval	0.5 s
7	Pause time	0,100,200,300
8	Size of packet	160 bits

The following fig 4 shows the cluster head selection scheme. The cluster node is selected by using three descriptors. The values are then fuzzified and passed to the fuzzy rule base for rule evaluation .After this, defuzzification gives the cluster-head election chance. The best node 108 on the other hand has all the three descriptors suitable for being elected as the cluster-head with a maximum chance of 75 for the current scenario.

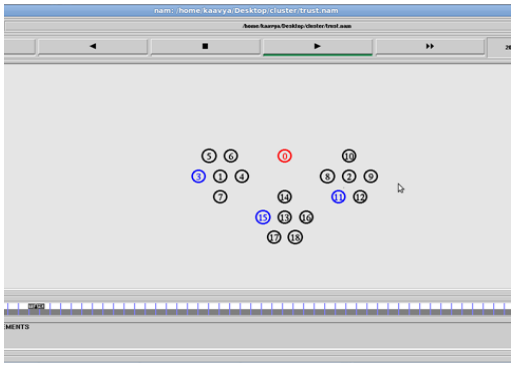

Fig 4 Cluster head selection

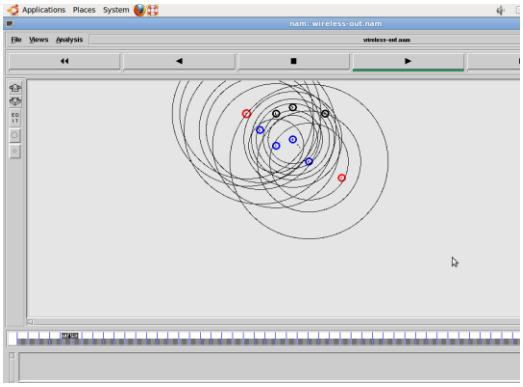

Fig 5 Route Discovery

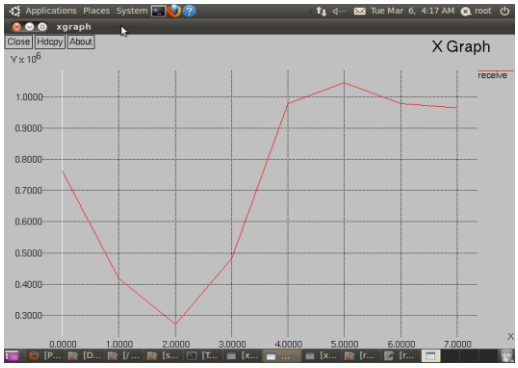

Fig 5 No Of packets send

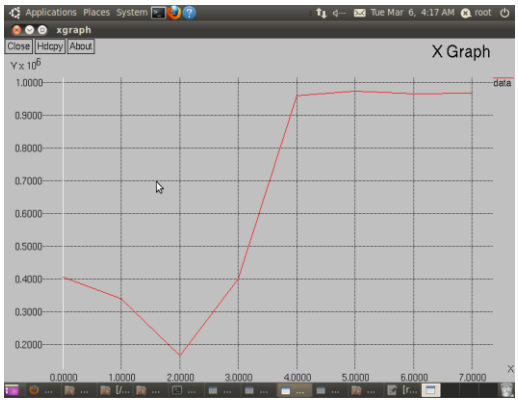

Fig 6 No of Packets received

6. CONCLUSION

We have implemented the route discovery using AOMDV protocol . Route recovery scheme to solve the link failure problem caused by node movement, packet collision or bad channel condition. AOMDV establishes multiple loop-free and link-disjoint paths. AOMDV provides a factor of two improvement in delay and also reduce the routing overhead, while having similar packet delivery fraction. The cluster head selection is implemented using fuzzy logic scheme.

REFERENCES

[1] C. Hartung, R. Han, C. Seielstad, and S. Holbrook, “FireWxNet: a multitiered portable wireless system for monitoring weather conditions in wildland fire environments,” Proc. International conference on Mobile systems, applications and services, pp. 28–41, 2012.

[2] M. Bertocco; G. Gamba; A. Sona; S. Vitturi., "Experimental Characterization of Wireless Sensor Networks for Industrial Applications," IEEE Trans. on Instrumentation and Measurement, vol.57, no.8, pp.1537-1546, Aug. 2012.

[3] Philipp Hurni and Torsten Braun “Energy-Efficient Multi-path Routing in Wireless Sensor Networks “Springer-Verlag Berlin Heidelberg 2008.

[4] Yaoyao Yin1, Juwei Shi, Yinong Li, Ping Zhang” Cluster Head Selection Using Analytical Hierarchy Process For Wireless Sensor Networks “The 17th Annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC'06) 2006 IEEE.

[5] Philipp Hurni and Torsten Braun " Energy-Efficient Multi-path Routing in Wireless Sensor Networks "Springer-Verlag Berlin Heidelberg 2008.
[6] Indranil Gupta Denis Riordan Srinivas Sampalli"Cluster-head Election using Fuzzy Logic for Wireless Sensor Networks"Indranil Gupta Denis Riordan Srinivas Sampalli.
[7] Bo-Chao Cheng, Hsi-Hsun Yeh, and Ping-Hai Hsu"Schedulability Analysis for Hard Network Lifetime Wireless Sensor Networks With High Energy First Clustering" 2011 IEEE.

Author

Dr. V. Ramesh, Professor in the Department of Information Technology, obtained B.Tech in CSE from S.V. University , M.Tech and PhD in Computer Science and Engineering from Sathyabama University, Chennai. He has 12 years of teaching experience. He has authored two books "Principles of Operating Systems" by University Science Press, New Delhi. & " Preemptive DSR for Mobile Ad Hoc Networks" by Lambert Lap Publishers, Germany. He has published 48 research papers in various refereed International Journals and Conference Proceedings. He is the Editorial Board member for International Journal of Computer Engineering and Applications, Honorary Reviewer for Global Journal of Computer Science and Information Technology, Reviewer for IET Journal of Networks, IEEE Transactions of Mobile Computing and many more. He served for many conferences as session chair, advisory board member and technical committee member. He is the member of CSI, ISTE, IAENG, IACSIT, ASDF, GARD, etc.