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A survey on Unequal Clustering Protocol based on Fuzzy approach for Heterogeneous Wireless Sensor Networks

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ABSTRACT

Wireless Sensor Networks (WSNs) have increased due significance for applications requiring remote detecting. Wireless Sensor Networks have gained due importance for applications which require remote sensing such as Intrusion Detection, Weather Forecasting. The major challenges faced are related to energy and routing. The sensor nodes being battery operated devices of limited resources, techniques like data aggregation, selective node activation and energy efficient routing are adopted with main focus of saving energy. The objective is to prolong life of the network but also distributing the load evenly among the nodes. Several approaches have been suggested in literature most of the methods applicable to homogeneous WSNs only This paper proposes a fuzzy logic based unequal clustering protocols for WSNs in heterogeneous settings. Four choice criteria for choosing bunch heads are contribution to the fuzzy logic which gives two yields rather than one. This novel element makes the proposed technique viable.

Keywords

Wireless Sensor Networks, Cluster Heads, Network Lifetime, Energy Consumption, Heterogeneous Networks

I. INTRODUCTION

Wireless Sensor Networks can be called a gateway for the purpose of providing wireless connectivity to the wired world and distributed nodes. There is no boundary to the applicability of the field in today's world. From healthcare to utilities to monitoring (remote/manual) to security tracking, the networks are being appreciated everywhere.

Wireless Sensor Networks (WSNs) [1] have recently been a center of researches for many, due to their applicability and efficiency in various sensing and monitoring tasks. To define,

these networks consist of autonomous sensor nodes deployed in the Region-of-Interest (RoI) for sensing the area's physical and environmental conditions like pressure, temperature, sound and more. Over the years, WSNs have been useful to fields like healthcare, military and defense services, environment sensing, infrastructure monitoring, event security and more. The reasons for the same are the capacity of the networks to work in harsh environments, with easy repair and troubleshooting and return as output satisfactory performances. The sensed data can be translated into services, embedded, networked and distributed to clients. The sensing activity takes place from the source to sink (base station) in three phases – sensing,

processing and transfer. All the sensor nodes individually perform sensing of the interested RoI, process the sensed data using local processing tools and transfer the processed data to the desired location. The deployment of nodes takes place either manually (placing the nodes at desired locations by hand) or randomly. Nodes also can be categorized into homogeneous (similar natured) or heterogeneous (differently natured) nodes. The environment for sensing can be static (nodes are immobile) or dynamic (nodes are continuously moving). Communication from the source to the sink can take place in single hop or multi hops. As efficient as they seem, there are still a few issues the networks are continuously trying to cope up with.

II. CLUSTERING IN WIRELESS SENSOR NETWORK

Using all nodes individually can cause much energy consumption in the network. A promising alternative is to select some nodes of all as Cluster Heads (CHs) responsible for the aggregation and compression of the data which is sensed from its member nodes and transferring of the same to the BS. The task left upon the left behind nodes is of data sensing thereby leading to reduced energy consumption/ increased lifetime of the nodes and thereby of the entire network. Overloading of CHs does not hamper the network's performance, because nodes which have high energy are elected as CHs and their positions are randomly rotated so as to not drain their entire energy. CH election and Cluster building around the selected CHs might depend on different criteria, varying from protocol to protocol. However, the clustering in WSNs cannot be associated to conventional data clustering. The focus of data clustering algorithms is to find similar points together while clustering protocols for WSNs is more related to leader election in distributed algorithms. The concept of considering numeric distance for selection of cluster representatives/heads is similar but any data clustering algorithm cannot be applied to WSNs. Over the years, many clustering protocols are proposed, varying in the manner of CH election, cluster building and transfer phases. The concept of randomized clustering protocols was first introduced by Heinzelman et al [3] and was so widely praised that most or all the clustering protocols since then have basic methodology similar to LEACH.

III. CLUSTER ELECTION AND FUZZY LOGIC

Criterion for CH election varies across protocols. According to the research works read about in this direction, probability/threshold value, residual energy, distance of node to the BS and combination of the above are some of the criteria for CH election. The elected CHs advertise their status to the nodes within their communication range and these nodes then decide which cluster they would like to be a part of depending on closeness of nodes to the BS.

A recently adopted approach for CH election is Fuzzy logic. Fuzzy logic uses Fuzzy if-then rules to convert fuzzy input linguistic variables into fuzzy output linguistic variables. The obtained fuzzy output variables are transformed into a crisp value using a defuzzification operator. The output variables deduce the chances of a node to be selected as a CH.

IV. CLUSTERING IN HOMOGENEOUS WIRELESS SENSOR NETWORK

Clustering algorithms for WSNs is the LEACH protocol by Heinzelman et al [3]. The concept of randomly rotating the CH positions to prevent quick death of the initially selected CHs helped in energy efficiency of the networks.

The next most popular clustering protocol and an immediate improvement to the LEACH protocol in terms of the criterion for CH election is the HEED (Hybrid Energy-Efficient Distributed) [4] Clustering Protocol. The selection criterion in the proposal is parameter-based, the parameters being a node's residual energy and intra-cluster communication cost between the candidate nodes. The protocol is a multi-hop clustering protocol with emphasis on even distribution of CHs throughout the network. It also reduces to a big extent the probability of selecting as CHs the nodes lying between each other's

communication range. The performance is better in case of HEED protocol due to energy level consideration at the time of election of CHs.

V. UNEQUAL CLUSTERING IN WIRELESS SENSOR NETWORK

One of the earliest unequal clustering protocols is EECS (Energy Efficient Clustering Scheme) [5]. At the time of CH election, a control message is broadcasted by each node to the neighboring nodes lying within its radio range. A node on finding any node with increased energy level lying within its radio range will withdraw itself from competition. In the else case, the node will declare itself as a CH broadcasting the information across the network. Another unequal clustering protocol with methodology similar to EECS is the EEUC (Energy Efficient Unequal Clustering) [6] Protocol. The nodes that are probable candidates for being CHs broadcast control messages to neighboring nodes lying within their competition radius.

Another unequal clustering protocol is COCA (Constructing Optimal Clustering Architecture)[7]. The entire region of interest is divided into units. CH election is dependent on energy of nodes. The nodes with higher energy than their neighboring nodes are elected as CHs with the probability of more than one CH in a unit. The protocol forms unequal sized clusters. The clusters away from the BS are larger in size compared to the clusters near to the BS. The resultant cluster formation is claimed to perform better in non-uniform node distributions.

DSBCA (Distributed Self Organization for Wireless Sensor Networks) [8] protocol is an unequal clustering protocol working in phases of CH election, cluster building and cycle. CH selection is done on the basis of weights of nodes that in return are determined using a node's residual energy and connectivity. After the CH selection phase, cluster formation takes place in the cluster building phase. The remaining nodes get assigned to the CH with high residual energy. The cluster size is limited based on a threshold value. On number of nodes less than this threshold value, the associated cluster accepts more points, otherwise reject.

VI. FUZZY LOGIC BASED CLUSTERING

The first of the fuzzy-logic based clustering protocols is proposal by Gupta et al. A fuzzy logic approach to cluster-head election is proposed based on three descriptors-energy, concentration and centrality The research works that followed are the CHEF by J. Kim, S. Park, Y. Han and T. Chung

cluster head election mechanism using fuzzy logic. By using fuzzy logic, collecting and calculating overheads can be reduced and finally the lifetime of the sensor networks can be prolonged and DUCF by B. Baranidharan, B. Santhi

An unequal clustering in homogeneous wireless sensor network using fuzzy logic protocols. Each of the protocols takes some fuzzy input variables evaluated on the basis of fuzzy if-then rules. The fuzzified output variables are then deffuzified using some defuzzification operator. CH selection is based on these output variables.

VII. CONCLUSION AND FUTURE SCOPE

In this paper we analyze different clustering method for homogeneous wireless sensor network to save energy of the nodes in a network for better overall network life time. Though homogeneous WSNs have received much attention by researchers, there are many real life applications where heterogeneous deployment is present. Since the primary objective of any energy

efficient protocol for WSNs should be to uniformly distribute load throughout the network, the problem in heterogeneous networks is much harder than that in homogeneous network where the node begins with the same energy level.

We have to proposed a protocol for heterogeneous WSNs. The method is for cluster head selection which is a complimentary problem to data aggregation technique. The proposed method uses fuzzy logic to incorporate as many factors that affect the decision of electing a CH, residual energy, indegree, outdegree and distance to BS. We have used a simple Mamdani method of inference for fuzzification of crisp values to linguistic variables. Centroid of Area method is used for defuzzification of linguistic variables into crisp output variables. Unlike other fuzzy logic based protocols for WSNs, the proposal uses two output variables – chance and size for evaluating the eligibility of a node to be selected as a CH. Size denotes the number of members a cluster can have. The proposed protocol can be further improved by including other input parameters like coverage, node centrality and other related. This can be further refined by checking actual connectivity of the nodes in the network and preparing clusters accordingly. The proposal can be tested with dynamic deployment settings also.

REFERENCES

[1] W. Dargie and C. Poellabauer, "Fundamentals of wireless sensor networks: theory and practice", John Wiley and Sons. pp. 168–183, 2010.

[2] S. Tarannum, "Energy Conservation Challenges in Wireless Sensor Networks: A Comprehensive Study", Wireless Sensor Network, Vol. 2, pp. 483-491, 2010.

[3] W. R. Heinzelman, A. Chandrakasan, H. Balakrishnan, "Energy-Efficient Communication Protocol for Wireless Microsensor Networks", Proceedings of the 33rd Annual Hawaii

[4] International Conference on System Sciences, pp. 10–19, 2000.

[5] O. Younis and S. Fahmy, "HEED: A hybrid, energy-efficient, distributed clustering approach for ad-hoc sensor networks", IEEE Transactions on Mobile Computing., Vol. 3, pp. 366–379, 2004.

[6] M. Ye, C .F. Li, G. H. Chen and J. Wu, "EECS: an energy efficient clustering scheme in wireless sensor networks", Proceedings of the 24th IEEE International Performance, Computing, and Communication Conference (IPCCC 2005), pp. 535–540, 2005.

[7] C. F. Li, M. Ye, G. H. Chen and J. Wu, "An energy-efficient unequal clustering mechanism for wireless sensor network", Proceedings of the IEEE International Conference on Mobile Adhoc and Sensor Systems Conference, pp. 596–640, 2005.

[8] H. Li, Y. Liu, W. Chen, W. Jia, B. Li, J. Xiong, "COCA: Constructing Optimal clustering architecture to maximize sensor network lifetime", Computers Communications, Vol. 36, pp. 256-268, 2013.

[9] Y. Liao, H. Qi, W. Li, Load-balanced clustering algorithm with distributed self organization for wireless sensor networks, IEEE Sensors Journal, vol. 13, no. 5, pp. 1498-1506, 2013.

[10] Z. Xu, Y. Yin and J. Wang, "An Density-based Energy-efficient Routing Algorithm in Wireless Sensor Networks Using Game Theory," International Journal of Future Generation Communication and Networking, vol. 5, pp. 99-112, 2012.

[11] W. A. Ellatief, O. Younes, H. Ahmed and M. Hadhoud, "Energy Efficient Density-based Clustering Technique for Wireless Sensor Network", Proceedings of the 8th International Conference on Knowledge and Smart Technology (KST), 2016.

[12] I. Gupta, D. Riordan and S. Sampalli, "Cluster-head election using fuzzy logic for wireless sensor networks", Proceedings of the Communication Networks and Services Research Conference, pp. 255–260, 2005.

[13] J. Kim, S. Park, Y. Han and T. Chung, "CHEF: cluster head election mechanism using fuzzy logic in wireless sensor networks", Proceedings of the 10th International Conference on Advanced Communication Technology, pp. 654–659, 2008.

[14] H. Bagci and A.Yazici "An Energy Aware Fuzzy Unequal Clustering Algorithm for Wireless Sensor Networks," Proceedings of IEEE Conference on Fuzzy Systems, pp. 1-8, 2010.

[15] B. Baranidharan and B. Santhi, "DUCF: Distributed load balancing Unequal Clustering in wireless sensor networks using Fuzzy approach", Applied Soft Computing, Vol. 40, pp. 495–506, 2016.

[16] E. H. Mamdani, "Application of fuzzy logic to approximate reasoning using linguistic synthesis", IEEE Transactions on Computers, vol. 26, no. 12, pp. 1182–1191, 1977.

[17] Xuxun Liu, " A survey on clustering routing protocol in wireless sensor networks", MDPI Journal 2012, 1424-8220.

[18] R. Sarvana kumar, N. Mohan kumar and J. Raja, " Proficient node scheduling protocol for homogeneous and heterogeneous wireless sensor networks", Volume 2013, International journal of distributed sensor network, Article id 826482.