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IDENTIFICATION OF SUPERIOR NODE SELECTION IN WSN USING SNL ALGORITHM

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ABSTRACT

In wireless sensor network, detecting the node/link failure is a great challenge .Failed nodes must be identified and renovated as earlier by system controller to reduce the damage. Various fault detection mechanisms have been suggested, these work cooperatively within a particular region. Extending this concept to multiple regions will decrease the efficiency in terms of time. In our proposed method in Section 1 Superior Node Selection Mechanism (SNSM), we suggest an approach for selection of superior nodes within a region. This superior node is cooperatively connected to other nodes within the region and in turn with other superior nodes belonging to other region in Section 2. Given that, Superior nodes are scattered across multiple regions, each superior node is connected via the SNL (Superior Node Linking) Algorithm.

Keywords: cluster, cluster haad, fault detection, coverage.

INTRODUCTION

Wireless sensor networks (WSN) are a network of distributed sensors. Each of the sensors in the network is used to detect and monitor physical conditions such as temperature, pressure or sound, of any particular environment. Data from each of these sensors in the network are routed to a central location. Each sensor in the network is part of the node architecture. A node is capable of gathering the 'sensed' information, processing it and communicating this processed information to the other nodes. The functions above are performed using - a controller that is generally a processor optimized for embedded applications, a Communicating device, Sensors and actuators, inbuilt memory and some form of power supply .WSNs are today being used in highly critical environments. Hence, is important that they be highly reliable, provide a greater degree of availability and are easily maintainable.

Availability is largely a factor of the system's immunity to network failures. Setting up large-scale WSN is not a small task. Data delivery is inherently unreliable in Sensor networks for a variety of reasons. The battery might drain or the node might have been destroyed by an external event. Environmental conditions might lead to faulty readings being read and communicated. The links between the nodes are also failure prone resulting in network partitions. There is also a possibility that links may get damaged and packets may be corrupted due to environmental conditions. Nodes may have crossed the range of communication. Congestion might also lead to power loss. Additionally, congestion may start in one local area network propagate to the sink and thus affect the delivery of data. The multihop communication nature of wireless sensor networks implies that nodes are not self reliant and are dependent on other nodes.

The above mentioned faults may be majorly categorized into - Connectivity faults, link faults, Node faults and malfunction faults. Connection issues between two nodes in a WSN can be dealt with by placing relay nodes so as to ensure connectivity between the sensor nodes. Node faults are usually due to drain in battery power and may also occur due to external condition. Dealing with node faults is entirely application dependent. Link faults occur due to link damage that occurs between two nodes of a network. A strategy to prevail over link faults would be to update the existing routing tables and further searching the network for ways to replace the failure link. Malfunctioning nodes are nodes that do not perform the desired function or nodes that send incorrect data to the base station. Dealing with malfunctioning nodes involves identifying the faulty node and isolating it from the network.

The main aspect is illustrated as follows. Section 2 explains the related work. Section 3 contains two parts. Section 3.1 describes fault detection problem statement is used to identify the faulty node and select the superior node based upon the characteristics of the set of nodes in the particular region. Section 3.2 describes the superior node connection in various region which uses Superior Node Linking Algorithm. The conclusion regarding this paper is explained in Section 4.

RELATED WORK

The study of the venture networks have been done by the network. The commercial tools suggested in [10, 11, 12] are the network identifies used to monitor servers and routers with various control messages for large-scale venture networks. In addition, the method suggested in [13] analyses the enterprise network problem via shared risk modeling. Also, the method proposed in [14] initiates a probabilistic inference scheme and investigates the bipartite graph inference model to estimate the dependencies in venture networks. But, the network identifies for venture networks are not appropriate for WSN since the in- network formations and node performances are difficult to view in the ad hoc manner of WSNs.

Many diagnosis methods for Wireless Sensor Networks have been suggested and work in a integrated manner [15-17]. These techniques frequently allow all

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sensor nodes in a network periodically report messages including node/link information to the sink, where the sink is a powerful node which acts as an important gateway between the outside network and the WSN. The sink node will find out the basic reason of the node/ link failures when it collects the all the necessary informations. In [15], the sink inspects the enduring energy of each sensor node to supervise all of the wireless sensor networks. In [16], the sink gathers the neighbour list and data flow for each and every sensor node and uses an experiential conclusion tree to analyze the network status and identifies the failures in WSN. Liu *et al*. [17] used a probabilistic inference model to deduce the root of the failure by proposing passive diagnosis method (PAD). The centralized methods shorten the network lifetime [15-17] but mostly suffer a great amount of message overhead, which thus gradually increases the probability of packet collision/loss.

Various research conclusions have been detailed for the future, stating the problems of observing exposure and system connectivity in WSN. In many of the works, authors thought the exposures are the only issues in WSN. In [1, 2], authors introduced efficient distributed algorithms to most favourably solve the exposure problem in WSN. In [3], authors provide an systematical frame-work for the exposure problem and lifetime maximization of a WSN. In [4] a localized and decentralised node density control algorithm is stated for net- work exposure. The work in [5] for the set-k Cover problem, where each point of the query region will be covered by at least k nodes is proposed in three approximation algorithms. The work in [6] covers the query region considering the problem of maximizing the number of disjoint sets of sensor nodes. The data which is got by the nodes in the region can not be gathered at the sink node in multi hop Wireless Sensor Node's can be done except in the exposure and the connectedness problem. Authors of [7], [8] focused mainly on the objective of finding a single connected set that covers both connectivity and exposure problems. Another NP-hard problem is authorising a connected set cover of minimum size. [7].

In this paper we focus to detect the faulty node in the set of n sensor nodes and identify the superior node based upon the characteristics. In second part to connect all the superior nodes using the SNL Algorithm in various regions.

PROPOSED MODEL AND PROBLEM FORMULATION

In this section, we briefly illustrate our problem formulation in the proposed domain work. These days, fault detection and proficient routing in the defect environment is a foremost challenge in WSN. In the proposed system.

Problem statement of fault detection

Given a set of sensor nodes consisting of the factors (sensor, receiver, transmitter, battery, microcontroller), the plan of our proposed method is to discover the failure in sensor node due to failure of any of the above factors. Each sensor in the networks is supposed to cyclically send a HI message to connect with other sensors. Sensor P is said to be sensor Q's neighbour if P (or, Q) can send a message to Q (or, P). Hence P and Q is said to be a neighbouring pair in the network. Every node in WSN is assumed to have at least one neighbouring pair. The relation state can be evaluated by using an ACK message. Once a sensor node Q receives a hi message from sensor node P, Q returns an ACK message to P. If P can obtain the ACK message, the link state between P and Q is bidirectional; else the relation state is unidirectional. Hence, P->Q denotes an unidirectional link between sensors P and Q. Every sensor node P, in the networks has to verify if each of its relation states between itself and its neighbouring sensors Q is abnormal or not. A link Q ->P is abnormal if P has not received a message from the neighbouring sensor Q for a time t. When Q->P is abnormal, P initializes the analysis process. In future, the initiative process is done by the sensor node P, if it detects an abnormal link; and the sensor Q is said to be a faulty node of P.

CHARACTERISTICS

The main characteristic of a Superior node in WSN has two parts, data forwarding and control switch. Forwarding packets represents the data forwarding plane; controller attains the control function in the network view. In wireless sensor network, the control function of the traditional distributed network equipment will be drifted to the controlled sensor devices. According to the control unit, the superior node is the controller that will decide how to achieve synergy and interaction between nodes for themselves.

In wireless sensor network (WSN), we give the superior node as a controller; superior node is the core of the network and maintains all the data in the entire network. There are some constraints to be verified to conclude that a sensor node to be a faulty node, certain conditions to be checked to find the superior node in the Wireless Sensor Network and ensure few of its characteristics.

Condition C1

If P.ID= Q.ID, it means that P= Q. As Q can receive the request message from other sensors, that is, Q is normal. The sink node will be given the information about the routine of Q for reference.

Condition C2

If P.ID≠Q.ID it means that P≠Q, P can receive a message sent from Q before and the time interval between the correct time and the time at which P receives the latest message and node Q is normal. The sink node will be given the information about the routine of Q for reference.

Condition C3

If P.ID≠Q.ID it means that P≠Q, P can receive a message from Q before, but the time interval for receiving the message is greater than Q when compared to the time

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interval between the current time and the actual time. Hence, P can decide that Q is abnormal.

Condition C4:

If P.ID≠Q.ID and P cannot receive a message from Q. And thus, x cannot make a decision about Q. As a result in this case, Q is the faulty node.

Let there be n number of sensor nodes 1, 2…n and m conditions C1, C2… Cm. Let C_i^{jk} be the condition C_i between the nodes i and k. Then between the node j and k we have the condition C_i^{jk}, C_2^{jk} ,..,C_m^{jk} .Let A_{jk} be the condition more suitable among them between the nodes j and k.

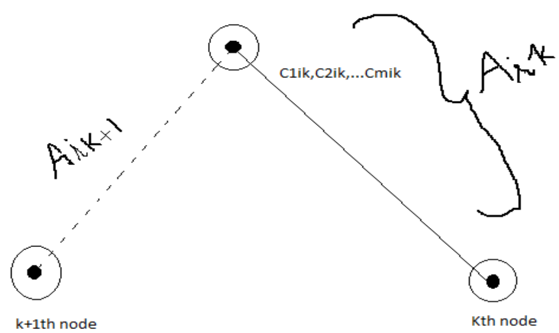


Figure-1. Select the superior node based upon the characteristics and conditions.

Then there will be $^nc_2$ number of such A_{ik}s. Among these A_{ik}s, let A_{lm} be the most suitable, which is between two nodes say B and C. If B has more number of suitable conditions, than C, choose B, otherwise choose C.

FUNCTIONALITY OF THE SUPERIOR NODE

The master node can establish a transmission path for the information according to the QoS of the information

a) After receiving the node failure information, the superior node maintains the information of QoS and the network topology maintained by the superior node.

b) When the superior node has chosen a path to another superior node in the adjacent region using SNLA, the data can be forwarded according to the sensor node linking approach that has been built. The optimal path selection is done by SNLA with respect to the QoS, node status regarding to the failure and the network topology, the message forwarding efficiency will be very high.

c) When the information about the failure of any other superior node is sent to the Superior node of the adjacent region, it uses the SNLA to switch over the control to itself. If the data can be matched with the last, it means the QoS, node status, and the network topologies are consistent with the previous one.

Problem formulation of superior node linking

Consider a wireless network having a set S with n sensors and a single region R.A set of sensor nodes N ⊆ S is a attached single coverage for R. For each point {p∈ R} is connected by atleast one superior node N and the statement graph made by N is attached.

Attached multiple region coverage problem

If given n sensor nodes scattered for a distinct region, the attached set coverage problem is to find a interconnected multiple coverage of least size. This issue is said to be an NP-hard problem [18].

Attached multiple region coverage dividing problem

The Connected multiple region coverage dividing problem is to division of the sensors into a attached multiple region covers such that the number of connections is maximised.

Algorithm for superior node linking

In WSN environment, the superior node detects the failure node information from the scattered nodes through poorly connected region. For collecting data of the entire region at a Superior node is not viable in terms of communication overheard and energy prerequisite where many number of sensor nodes are organised over an environmental region. Thus the concentration of our work is on connected superior nodes of multiple regions.

In this part, Superior Node Linking Algorithm is used to connect the superior nodes of multiple regions. As mentioned earlier, to detect the fault node of a maximum number of nodes in a single region and to select a superior node based upon the head node characteristics. It is concluded that a set of n nodes S={s1,s2… sn} is divided into say, m regions R={r_1,r_2,.. r_m}in the 2D plane R as has been described in above problem definition. Each region has unique id. Each sensor node knows the region.

We suggest the following categories of messages to be exchanged between nodes.

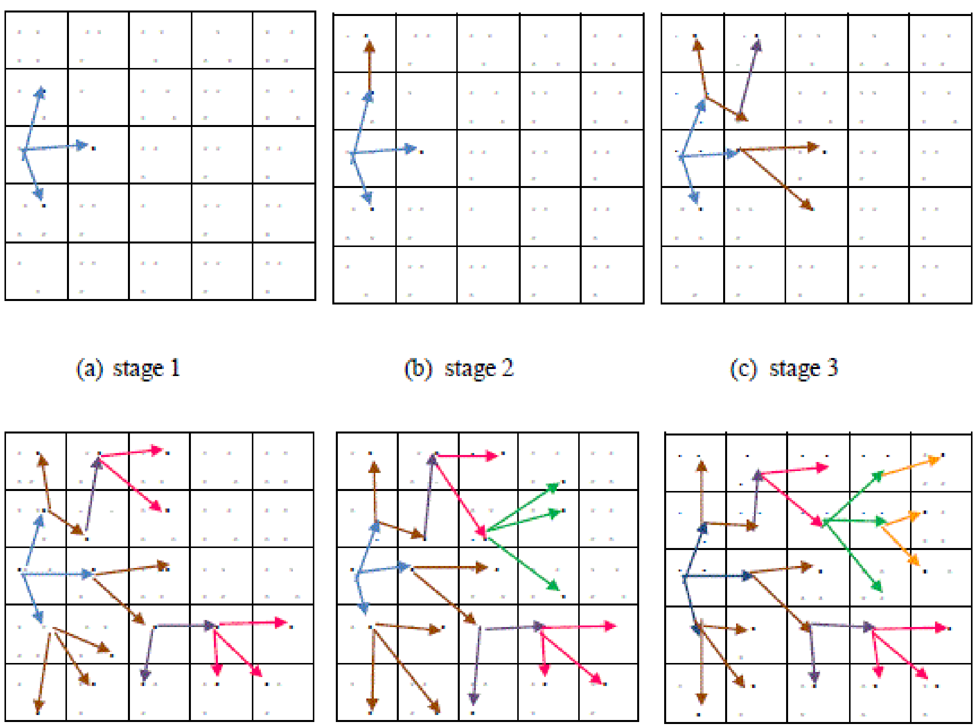
- Chooselist (C_i,i,{j}): This information is transmitted by a sensor node-i which chooses a table of neighbour {j} for enclosure in its division with Superior $\mathbf{C_i}$.
- Selected (C_i, {j}): This data is commenced by the superior node C_i and is transmitted to neighbour node {j} for enclosure in its division.
- Substantiate (C_i, {j}): Sensor node j transmits this information to the superior node behind attaching the division C_i
- Include (C_i,j) :This data within C is transmitted by the Superior node to include node-j in C_i

According to the superior node mechanisms, we select the superior node. In step 1, each superior node L_i ∈ L commence a partition Ci = {l_i}. In each step, every sensor node i∈C_i prepares “choose list” consisting maximum number of neighbours, each node from an uncovered region. If a node is attached to more than one superior node in the similar region, it selects the neighbour with least degree D. Head node-i transmits “choose list” data to its higher node ,if it is a child node in Ci. Or else sensor node $j \in C_i$. Choose a list of sensor nodes where each go to uncovered region from its own list and from the received "choose list" message from its children in the same partition and then the send the "choose list " message to the superior node if not a head node.

At last "choose list" message select the superior nodes to be added and transmits the "choosed" data to the other nodes. If a neighbour sensor node gets "choosed" informations, it select superior node with minimum D and substantiate the demand by transmitting a "substantiate" call to the related header. The header adds the nodes in C_i, and also transmits the "Include" message to all the sensors in C_i .On getting " Include (C_i; j)" , all the superior nodes are connected to C_i contain sensor node-j in its division and build updates. Each and every round of this process is executed frequently with moreover all regions are covered up by a division C_i, or no neighbours are there remaining for enclosure.

Superior node Linking Algorithm

Input: 1-step neighbour tables of every sensor NL (i) of degree D, Region -Id, Region level, Level, Superior Probability: Sprob
Output: division Ci of Superior Si
while each sensor node i do
if node i is superior then
$C_i \leftarrow \{i\}$, Superior =ϕ ; Level = 1;
end
if Level = 1 and not all regions covered up then
Select neighbours from uncovered region and received 'Choose list' messages, selecting sensor nodes with minimum D;
if Superior ≠ ϕ then
Transmit 'Choose list' to the Superior node;
else
if 'Choose list' =ϕ then
transmit result=0 and exit;
else
transmit 'Selected' data to the selected neighbours;
end
end
end
if Level= 0 receives 'Selected' data then
Select that division where the sender have least D and send 'Substantiate' data to superior;
Update NL(i), Region level, Level and add in Ci;
end
if superior node gets 'Substantiate' data then
Transmit 'Include' information to every sensor nodes in Ci and update NL(i) , Region level, Level;
if all regions are covered up then
Transmit result=1 and exit;
end
else
update NL(i);
end
end



(a) stage 1 (b) stage 2 (c) stage 3

(d) stage 4 (e) stage 5 (f) stage 6

Figure-2. Stages for making connection for various regions.

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In Figure-2, it is described that in stage 1, superior node Blue picks the neighbours (the Brown) of exposed region. In the second stage, the Blue and Brown nodes choose all the black nodes. This method proceeded again to add Green and Pink nodes till all regions are covered. The final stage, all orange nodes are picked and the procedure is finished as no uncovered regions exist. In each stage of the method the sensor nodes already in divison include several neighbours in the divison so that the divison stay connected with new sensor nodes covering additional regions. Thus, the method finishes faster, each superior node whichever results either a failure in the division stating it to be an incomplete one and letting them as free nodes or a successful divison of convincing the circumstance of coverage.

CONCLUSIONS

According to this paper, we have focused to provide a reference for a system supervisor in the repair network. In the first part of the paper, according to the characteristics, the failed nodes must be identified and renovated as earlier by system controller to reduce the damage and identify the superior node. In the second part, we have proposed SNLA that is used to connect the superior nodes belonging to the various regions. A self organised SNLA is proposed for finding the superior node in maximum number of connected cover regions. In future research works, Node/Link failures are caused by many problems such as low battery power; environment interference will include analysing the detailed problems of Node/Link failure.

REFERENCES

[1] Li M., Wan P.J., Frieder O. Coverage in Wireless Ad-hoc Sensor Networks. IEEE Transactions on Computers. 52(6): 753-763.

[2] Meguerdichian S., Koushanfar F., Potkonjak M., Srivastava M. 2001. Coverage Prob- lems in Wireless Ad-hoc Sensor Networks. In: Proceedings Twentieth Annual Joint Conference of the IEEE Computer and Communications Societies. IEEE INFO-COM 2001. 3: 1380-1387.

[3] Wang, D., Xie, B., Agrawal, D. 2008. Coverage and Lifetime Optimization of Wire-less Sensor Networks with Gaussian distribution. IEEE Transactions on Mobile Computing. 7(12): 1444-1458.

[4] Jiang J., Dou W. 2004. A Coverage-Preserving Density Control Algorithm for Wireless Sensor Networks. In Nikolaidis, I., Barbeau, M., Kranakis, E., eds.: Ad-Hoc, Mo-bile, and Wireless Networks. Volume 3158 of Lecture Notes in Computer Science. Springer Berlin Heidelberg. 42-55.

[5] Huang Chi-Fu and Tseng, Yu-Chee. 2003. The Coverage Problem in a Wireless Sensor Network. In: Proceedings of the 2nd ACM international conference on Wireless Sensor Networks and Applications. WSNA '03, New York, NY, USA, ACM. pp. 115-121.

[6] Slijepcevic S., Potkonjak M. 2001. Power E_cient Organization of Wireless Sensor Networks. In: IEEE International Conference on Communications, ICC 2001. 2: 472-476.

[7] Gupta H., Zhou Z., Das S., Gu Q. 2006. Connected sensor cover: self-organization of sensor networks for e_cient query execution. Networking, IEEE/ACM Transactions on. 14(1): 55-67.

[8] Bing-Hong Liu, Chih-Hsiang Hsun, Ming Jer Tsai. 2014. Cooperative diagnosis for realistic large scale wireless sensor network. Computer communications.

[9] T. He, S. Krishnamurthy, J.A. Stankovic, T. Abdelzaher, L. Luo, R. Stoleru, T. Yan, L. Gu, J. Hui, B. Krogh. 2004. Energy-efficient surveillance system using wireless sensor networks. In: Proceedings of the 2nd International Conference on Mobile Systems, Applications, and Services. pp. 270-283.

[10] HP Openview. <http://www.openview.hp.com>.

[11] IBM Tivoli. <http://www.ibm.com/software/tivoli>.

[12] Microsoft Operations Manager. <http://www.microsoft.com/mom>.

[13] R.R. Kompella, J. Yates, A. Greenberg, A.C. Snoeren. 2005. IP fault localization via risk modeling, in: Proceedings of the 2nd Conference on Symposium on Networked Systems Design and Implementation. pp. 57-70.

[14] S. Kandula, D. Katabi, J.P. Vasseur. 2005. Shrink: a tool for failure diagnosis in ip networks. In: Proceedings of the ACM SIGCOMM Workshop on Mining Network Data. pp. 173-178.

[15] Y. Zhao, R. Govindan, D. Estrin. 2002. Residual energy scans for monitoring sensor networks. In: Proceedings of IEEE Wireless Communications and Networking Conference. pp. 356-362.

[16] N. Ramanathan, K. Chang, R. Kapur, L. Girod, E. Kohler, D. Estrin. 2005. Sympathy for the sensor network debugger. In: Proceedings of the 3rd

International Conference on Embedded Networked Sensor Systems. pp. 255-267.

[17] Y. Liu, K. Liu, M. Li. 2010. Passive diagnosis for wireless sensor networks. IEEE/ACM Trans. Network. 18(4): 1132-1144.

[18] Gupta H., Zhou Z., Das S., Gu Q. 2006. Connected sensor cover: self-organization of sensor networks for efficient query execution. Networking. IEEE/ACM Transactions on. 14(1): 55-67.