International Journal of Advance Engineering and Research Development (IJAERD)
Volume 1,Issue 6,June 2014, e-ISSN: 2348 - 4470 , print-ISSN:2348-6406

A Review on Controlling Self Healing Wireless Sensor Networks Using Fuzzy logic

Ramanpreet Singh[1], Gurwinder kaur[2]

[1]*M.tech, Electronics & Communication Engineering, YCoE(Punjabi University Patiala),Talwandi Sabo,Punjab(INDIA), ramanpreet2singh@gmail.com*

[2]*Department of Electronics & Communication Engineering, YCoE(Punjabi University Patiala), Talwandi Sabo,Punjab(INDIA), gurwinder.k.garcha@gmail.com*

Abstract: - Wireless cellular communication networks are undergoing a transition from being a simply optional voice communication to becoming a necessity in our everyday lives. In order to ensure uninterrupted high Quality of Experience for subscribers, network operators must ensure 100% reliability of their networks without any discontinuity either for planned maintenance or breakdown. This paper demonstrates self healing capability to the fault recovery process for each cell. It is proposed to compensate cells in failure by neighboring cells optimizing their coverage with antenna reconfiguration and power compensation resulting in filling the coverage gap and improving the QOS for users. The right choice of these reconfigured parameters is determined through a process involving fuzzy logic control and reinforcement learning. Results show an improvement in the network performance for the area under outage as perceived by each user in the system.

Keywords: - wsn (wireless sensor networks), QOS, Self healing dependency

I. INTRODUCTION

A common sensor network is composed of a large number of sensor nodes (in the majority of cases, these networks are composed of hundreds of thousands of nodes), which are densely deployed either inside the phenomenon or very close to it. The position of sensor nodes need not be engineered or pre-determined. This allows random deployment in inaccessible terrains or disaster relief operations. On the other hand, this also means that sensor network protocols and algorithms must possess self-organizing capabilities because deploying and maintaining the nodes must remain inexpensive – manually configuring large networks of small devices is impractical. The nodes are able to collect, process, disseminate and store data. They perceive the environment, monitor different parameters and collect data according to the application purpose. Another unique feature of sensor networks is the cooperative effort of sensor nodes. Sensor nodes are fitted with an on-board processor. Instead of sending the raw data to the nodes responsible for the fusion, sensor nodes use their processing abilities to locally carry out simple computations and transmit only the required and partially processed data. The reason for this is that computation is much cheaper than communication in regard to the most critical resource, the energy. Each transferred bit costs as much energy as about 1,000 instructions, thus, wireless sensor networks process data within the network wherever possible. A wireless sensor network has applications in environ-mental and habitat monitoring, precision agriculture, indoor climate control, surveillance, treaty verification, intelligent alarms, and medical diagnostics. The most dramatic applications involve monitoring complex interactions, including wildlife habitats, disaster management, emergency response, ubiquitous computing environments, asset tracking, health-care, and manufacturing process flow. The individual micro sensor nodes are not as accurate as their macro sensor counterparts, the networking of a large number of nodes enables high quality sensing networks with the additional advantages of easy deployment and fault tolerance. These characteristics make micro sensors ideal for deployment in otherwise inaccessible environments, where maintenance would be inconvenient or impossible and represent a significant improvement over traditional sensors, which are deployed in the following two ways:

- Sensors can be positioned far from the actual phenomenon, i.e., something known by sense perception. In this approach, large sensors that use some complex techniques to distinguish the targets from environ-mental noise are required.
- Several sensors that perform only sensing can be deployed. The positions of the sensors and communications topology are carefully engineered. They transmit time series of the sensed phenomenon to the central nodes where computations are performed and data are fused.

Some of these applications require a large number of devices making traditional methods of sensor networking impractical due to the high demand on cable installations. To be able to manage wireless sensor networks in an efficient manner proposed the use of the IT Infrastructure Library (ITIL) and the autonomic com-putting paradigm. Some of these applications require a large number of devices making traditional methods of sensor networking impractical due to the high demand on cable installations. To be able to manage wireless sensor networks in an efficient manner proposed the use of the IT Infrastructure Library (ITIL) and the autonomic computing paradigm.

1.1 SELF-HEALING DEPENDENCY CONSTRAINTS

There are often intricate coupling and complex dependency relationships among different parts of a system in modern large scale WSNs. Such dependencies incur constraints that must be understood and accounted for when composing self-healing services. Creating a methodology and run time framework that address these issues provides more effective self-healing both in terms of performance (only protocols that have actual or potential problems need be re-executed) and correctness (when re-running protocols to re-establish consistent distributed state, the proper order and collection of protocols are executed). A key element of this approach is the dependency assessment. We have identified 4 key types of dependencies which we call: invocation, parameter consistency, control and implicit assumption dependencies. The invocation dependencies are often considered easy to identify via the explicit dependency relationships implied by function calls. However, even these dependencies are more complex than implied by the top down call tree (discussed below). Beyond these dependencies, there is a collection of more complex dependencies that exist in many systems. These complex dependencies share similar traits, for example: they are often more implicit and can’t be easily traced from explicit function calls. Rather they exist in the form of race conditions among multiple components, or among competing control loops, or due to the assumptions made by the designer/implementer. In these cases, each dependency must be carefully identified when designing self-healing services. This collection of complex dependencies includes the parameter consistency, control and implicit assumption dependencies.

1.1.1 Invocation Dependency

Imagine that the system performance is being monitored on a continuous basis, and over time more and more nodes were found to be no longer responsive, and certain performance metrics (for example, average end-to-end delay) degrade dramatically. The self-healing framework using the monitoring component decides that certain healing service must be invoked to maintain the performance. However, such healing service can't be trivially defined by the collection of all protocols, because:

1) certain protocols are related to the performance metric, while others are not, so only a portion of the protocols needs to be invoked;
2) due to the dependency constraints among different components of the system, protocols can't be invoked in arbitrary order, but must carefully follow the dependency constraints. We call this type of dependency an "invocation dependency".

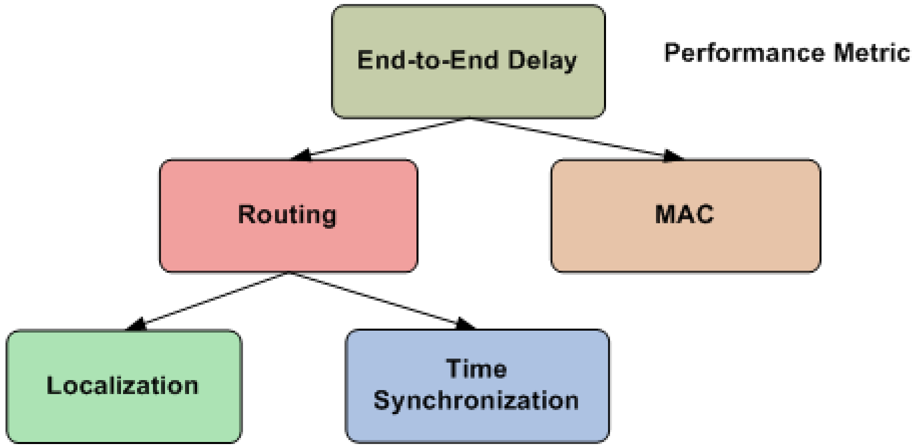


Fig. 1. Invocation dependency.

Invocation dependency primarily refers to the type of dependency that exists due to the vertical integration of a protocol stack or because of a series of function calls. An example of invocation dependency is as follows. Suppose that average "end-to-end communication delay" is an important state variable being monitored and it starts to degrade to a level that affects losing tracks of vehicles or not having enough time to react to alarms. The increased delay may be due to some failed nodes so that current routes are not effective anymore. Thus, a set of protocols must be reinvaded to perform self-healing. End-to-end delay depends on both the routing protocol and the MAC protocol. Further, the delay performance of the routing protocol may also depend on the time synchronization and the localization protocols. The dependency relationships in this example are illustrated in the Fig. 1. This set of protocols must be re-run to re-establish new and effective routes. Individual protocols do not have the global view to solve this problem.

1.1.2 Parameter Consistency Dependency

Parameterized protocols and functions permit flexible systems and adaptive performance by modifying the values of the parameters at runtime. When a problem is detected that needs self-healing, one approach is to adjust some of these parameters. However, this must be performed carefully and consistently. Our framework permits specification of parameter dependencies and the required healing actions. For example, imagine a WSN that is suffering from performance degradation due to node failures and the self-healing service is invoked. The service evaluates the current situation to decide which action to take. Consider the following examples of parameter dependency.

Due to the common practice of node duty cycling in WSNs, there is usually only a portion of total nodes active at given time, and this proportion P is a parameter that is decided by the designer depending on system requirements. Suppose there is another parameter R that determines the number of redundant routes that must be maintained for system communication reliability. Since there are hidden dependencies among these two parameters, we can't set one of the parameters without affecting the other. Thus, in our methodology these parameters are identified and their relationship coded into the self-healing action routines in the framework. The exact settings are application dependent, but with our framework they are set in a consistent manner.

1.1.3 Control Dependency

Many sensor networks employ control loops within and across protocols, nodes and even the entire system. Often such control loops take a localized view and can operate inaccurately from a system perspective. Designers must consider all the control loops in the system and identify potential control loop dependencies and the proper combined actions to avoid control loops from inappropriately positively reinforcing each other resulting in an overshoot situation, or cancelling each other (when these are not the correct actions). Imagine a WSN that implements both a communications power control protocol and a sensor power management protocol. When the RSSI value is found to be low, the power control protocol tries to increase the radio transmission power in order to maintain link quality. Meanwhile power management protocol may prefer the opposite decrease radio transmission power in order to conserve energy (if the energy level is low).

1.2 WSN Routing Scheme

A WSN routing task which consists of stable or limited mobile nodes and a base station is
Considered as the problem. To achieve an efficient and robust routing operation, major features of typical WSNs are taken into consideration. First, failures in communication nodes are more probable in WSNs than classical networks, as nodes are often located in unattended places and they use a limited power supply. Therefore the network should not be affected by a node's failure and should be in an adaptive structure to maintain the routing operation. This is performed by sustaining different paths alive in a routing task. A node transferring data to the base sends it in divided parts (as data packages) using different paths. When a failure occurs in a path, the associated data package cannot arrive at the base. To achieve guaranteed delivery, acknowledgement signals are used. In the case of an absent acknowledgement for a data package, the source node resends that package to a different path.

II. RELATED WORK

[1]Aderemi A. Atayero, Matthew K. Luka, states that third generation (3G) broadband mobile networks such as HSPA+, LTE and LTE-Advanced offer improved spectral efficiency and higher data rates using innovative technologies such as relay nodes and *femto* cells.. In order to address these challenges, self-organizing network operations were envisioned for these next generation networks. For LTE in particular, Self-organizing networks operations were built into the specifications for the radio access network. Load balancing is a key self-organizing operation aimed at ensuring an equitable distribution of users in the network.

[2]Chong Shen, Dirk Pesch described that the dramatic increase in the number of mobile subscribers has put a significant resource and service provisioning strain on current cellular networks in particular in terms of multimedia and high-data rate service provision. Hybrid wireless networks, which is a novel scalable and adaptive wireless network architecture utilizing a mixture of cellular and ad hoc multi-hop routing, facilitates Cellular network design with small cell systems without having to wire a large number of base stations into a core network.

[3]Debanjan Ghosh, Raj Sharman states as modern software-based systems and applications gain in versatility and functionality, the ability to manage inconsistent resources and service disparate user requirements becomes increasingly imperative. Furthermore, as systems increase in complexity, rectification of system faults and recovery from malicious attacks become more difficult, labor-

intensive, expensive, and error-prone. These factors have actuated research dealing with the concept of self-healing systems. Self-healing systems attempt to "heal" themselves in the sense of recovering from faults and regaining normative performance levels independently the concept derives from the manner in which a biological system heals a wound. Such systems employ models, whether external or internal, to monitor system behavior and use inputs obtaining therefore to adapt themselves to the run-time environment. Researchers have approached this concept from several different angles this paper surveys research in this field and proposes a strategy of synthesis and classification.

[4]Hongwei Zhang, Anish Arora described that GS3, a distributed algorithm for scalable self-configuration and self-healing in multi-hop wireless sensor networks. The algorithm enables network nodes in a 2D plane to configure them into a cellular hexagonal structure where cells have tightly bounded geographic radius and the overlap between neighboring cells is low. The structure is self-healing under various perturbations, such as node joins, leaves, deaths, movements, and state corruptions. For instance, the structure slides as a whole if nodes in many cells die at the same rate. Moreover, its configuration and healing are scalable in three respects: first, local knowledge enables each node to maintain only limited information with respect to a constant number of nearby nodes; second, local self-healing guarantees that all perturbations are contained within a tightly bounded region with respect to the perturbed area and dealt with in the time taken to diffuse a message across the region; third, only local coordination is needed in both configuration and self healing.

[5]Mike Holenderski _, Johan Lukkien, investigates the tradeoff between communication and memory usage in different methods of distributing neural networks in a Wireless Sensor Network. A structural approach is presented, categorized in two dimensions: horizontal and vertical decomposition. Horizontal decomposition turns out to be more attractive, due to high reuse of data present at the processor node. General properties of an alternative sematic approach are suggested theoretically allowing to dramatically increasing efficiency.

[6]Natalia Vatic, According to a recent DARPA announcement, self-healing – the ability of a network to effectively combat coverage and routing holes and network disconnection – represents one of the most desired operational properties of wireless sensor networks (WSNs) for military applications. Although previously considered in the WSN literature, the concept of network self-healing, and specifically self-healing by means of mobile nodes, still remains a greatly understudied research area.

[7]Saad A. Munir Yu Wen Bin described that fuzzy logic based congestion estimation within a proposed QoS architecture. The architecture comprises of a QoS Management and Control module which is implemented both at node level and at the sink for a system level QoS administration. The QoS module implemented at sensor node forms a subset of the larger QoS Management and Control module implemented for the system wide information, so as not to encumber the resource constrained wireless sensor network. While much research has been conducted in wireless sensor network, little attention has been given to a holistic QoS approach for WSN. Energy efficiency has been the main QoS metric in research efforts. Congestion estimation model for QoS in wireless sensor network, and implement it using fuzzy logic with fuzzy set variables. Simulations are conducted for our scheme which shows that with increased network dynamics and with increased packets generation rate, our implementation efficiently sorts out the traffic and minimizes the packet loss for prioritized event-driven traffic.

[8]Themistocles Burdens, Faults in WSN are very common and appear in different levels of the system. For pervasive applications to be adopted by end-users there is a need for autonomic self healing. This paper discusses our initial approach to self healing in WSN and describes experiments with two case studies of body sensor deployment. We evaluate the impact of sensor faults on activity and gesture classification accuracy respectively and develop mechanisms that will allow detection of those faults during system's operation.

III. METHODOLOGY

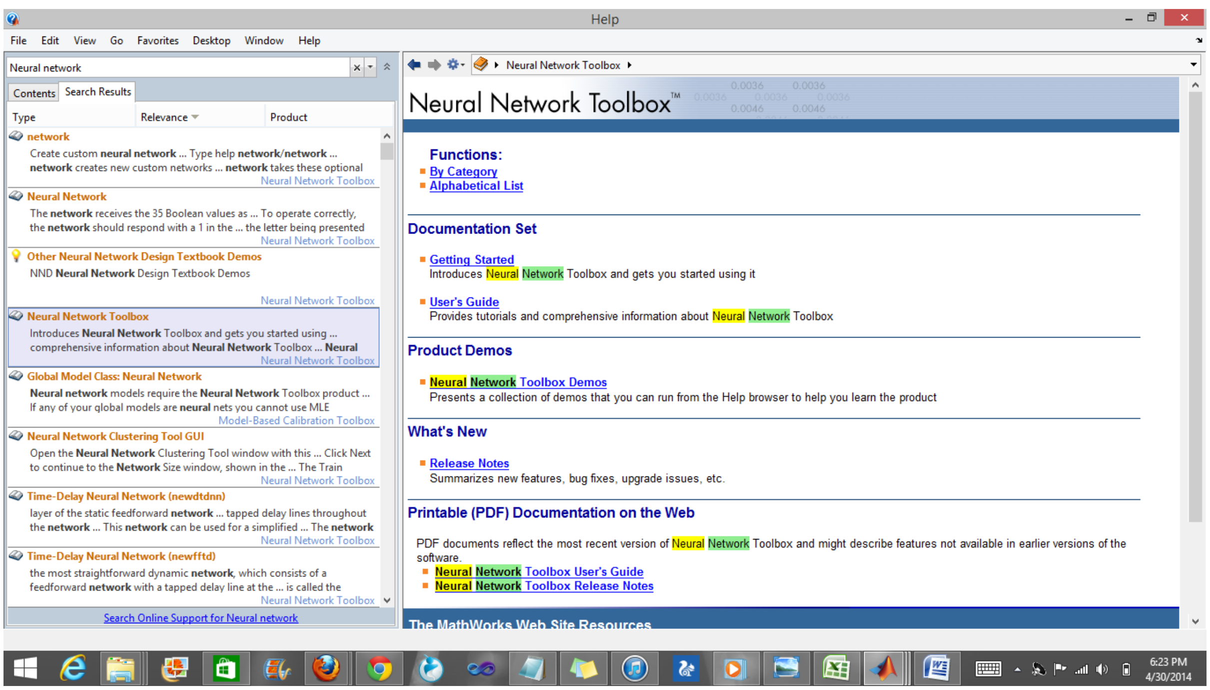
The methodology of optimizing the wsn routing is quite simple. In this contrast we would be defining the training set of feed forward in case of any failure occurrence while the transmission of the data through a wireless sensor network .First of all a training will have to be performed to let the system know what exact are the best possibilities of transmission . This trained system would be attained through newff method of neural network. This method would consists of two parameters, first is the training dataset and another is the target set. The target set identifies the routes selected. At the time of the failure, the trained model would be called along with the features of the failed node to search for an alternative to it. The newff method would return one or more than one probable path and out of them the minimum energy consuming path would be selected as the transmission path.

IV. SOFTWARE TOOLS

Software is used here,That is **MATLAB**(MatrixLaboratory) R2012a.
The MATLAB® high-performance language for technical computing integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation.

V. BETTER RESULTS CAN BE OBTAINED BY NEURAL NETWORK

NEURAL NETWORK TOOL BOX



This represents the input parameters of input. The neural network represent the hidden layers as well. And one output layer.

VI. FUTURE SCOPE

Here we have future for this, during routing in the wireless sensor network if any node failure occurs the protocol due to any sort of miss communication over which the routing is getting done has to be updated simultaneously and enhance the performance of routing using fuzzy logic controller and some other software tools also like neural network etc. After all we can protect the data accuracy using the desired protocols at the time of failure.

VII. CONCLUSION

Energy consumption level is a major challenge in WSNs. The focus of many researches has been to lower the energy consumption level and consequently increase the network life time. The proposed method uses a fuzzy logic approach for clustering using the two parameters of energy level and centrality, supported by a controller in order to avoid unwanted concentration of cluster heads in a particular region. As a result, energy is saved in the process of assigning nodes to cluster-heads, hence, significant increase in network life time.

REFERENCES

[1] Aderemi A. Atayero, Matthew K. Luka," Neural-Encoded Fuzzy Models for Load Balancing in 3GPP LTE" International Journal of Applied Information Systems (IJAIS) – ISSN : 2249-0868 Foundation of Computer Science FCS, New York, USA Volume 3– No.7, September 2012 – www.ijais.org

[2] Chong Shen, Dirk Pesch(2005)" A Framework for Self-Management of Hybrid Wireless Networks Using Autonomic Computing Principles" Proceedings of the 3rd Annual Communication Networks and Services Research Conference (CNSR'05) 0-7695-2333-1/05 $20.00 © 2005 IEEE

[3] Cerpa, N. Busek, D. Estrin, (2003) "Scale: A tool for simple connectivity assessment in lossy environments", Tech. Rep. 21, Center for Embedded Networked Sensing, University of California, Los Angeles, CA, USA.

[4] Debanjan Ghosh , Raj Sharman," Self-healing systems — survey and synthesis" Department of CSE, SUNY, Buffalo, United States ,Department of Management Science and Systems, School of Management, SUNY, Buffalo, NY 14260, United States Received 25 April 2005

[5] D. Niculescu, (2005) "Communication paradigms for sensor networks", IEEECommunications Magazine, 43: 3, 116–122.

[6] F. Mondinelli, Z.M. Kovacs Vajna, *Self Localizing Sensor Network Architectures*, IEEE, 2004

[7] G. Bieber, J. Carpenter, Openwings: A Service-Oriented Component Architecture for Self-Forming, Self-Healing, Network-Centric Systems (Rev 2.0)

[8] Hongwei Zhang *, Anish Arora," GS3: scalable self-configuration and self-healing in wireless sensor networks", Department of Computer and Information Science, The Ohio State University, 2015 Neil Avenue, Dreese Lab 395, Columbus, OH 43210, USA

[9] I. Viering, M. Dottling and A. Lobinger, "A mathematical perspective of self-optimizing wireless networks," in *Communications, 2009. ICC '09. IEEE International Conference on*, 2009, pp. 1-6.

[10] J.H. Chang, L. Tassiulas, (2000) "Energy conserving routing in. wireless adhoc networks", in: Proceedings of IEEE INFOCOM.

[11] M. Amirijoo, L. Jorguseski, T. Kurner, R. Litjens, M. Neuland, L. C. Schmelz and U. Turke, "Cell outage management in LTE networks," in *Wireless Communication Systems, 2009. ISWCS 2009. 6th International Symposium on*, 2009, pp. 600-604.

[12] M. Dirani and Z. Altman, "Self-organizing networks in next generation radio access networks: Application to fractional power control," Computer Networks, vol. 55, pp. 431 438, 2/1, 2011.

[13] Mike Holenderski _, Johan Lukkien: "Trade-offs in the Distribution of Neural Networks in a Wireless Sensor Network" in , Department of Electrical and Computer Engineering, National University of Singapore, Singapore 2004

[14] Neeraj Kumar, 2 Manoj Kumar," Coverage and Connectivity Aware Neural Network Based Energy Efficient Routing in Wireless Sensor Networks" in journal on application of graph in wireless sensor network ,vol.2 no.1 2010

[15]. Natalia Vatic," Self-Healing Wireless Sensor Networks: Results That May Surprise ", Department of Computer Science and Engineering York University Toronto, Canada.

[16] O. Younis, S. Fahmy, (2004) "Heed: A hybrid, energy-efficient, distributed clustering approach for ad hoc sensor networks", IEEE Transactions on Mobile Computing, 3: 4, 366–379.

[17]. ROBERTO DI PIETRO," Self-Healing in Unattended Wireless Sensor Networks", University's did Roma Tree.

[18] Saad A. Munir Yu Wen Bin," Fuzzy Logic based Congestion Estimation for QoS in Wireless Sensor Network" Authorized licensed use limited to: Rajamangala Univ of Tech Phra Nakhon. Downloaded on June 4, 2009 at 12:51 from IEEE Xplore. 1525 3511/07/$25.00 ©2009 IEEE

[19]Themistocles Burdens," Towards Self-healing in Wireless Sensor Networks", Department of Computing Imperial College London, UK {burden, m.sloman}@doc.ic.ac.uk.