Performance Evaluation of Non-Dominated Sorting Genetic Algorithm III in Wireless Sensor Network

Kantveer[1], Dr. Navdeep Singh[2], Dr. Harminder Singh Bindra[3], Ajay Vasishth[4]

[1]*Research Scholar, I.K Gujral, Punjab Technical University, Jalandhar, kantveer1@gmail.com*
[2]*AssociateProfessor, Amritar Group of Colleges, Amritsar, arora_navdeep@rediffmail.com*
[3]*Professor and Head of Department (IT), Malout Institute of Management and Information Technology, Malout. bindra.harminder@gmail.com*
[4]*Department of Physics, Chandigarh University, Mohali, Punjab, India*

Abstract.

Wireless Sensor network plays an vital role in developing robust, affordable and convenient network. The Wireless Sensor Network methods are effectively used to implement Time division Multiplexing (TDM). In WSN sensor nodes are connecting to one another wirelessly and one of the main characteristics of the WSN is that they are cost effective and efficient. Due to the vibrant nature of Wireless Sensor network the links in the network changes consequently. The proposed method uses NSGA-iii for data aggregation. The proposed algorithm is power efficient. It has been visualized that the proposed protocol considerably improves the life span of the network over the other traditional techniques. The proposed work is done in two phases in the first phase Tree based clustering is done for WSN. Clustering schemes in the WSN has certain drawbacks as it leads to data redundancy. Hence, to reduce the limitations of the clustering scheme inter cluster data aggregation is used. It will improve the lifeline of the network and power efficient.

Keywords. Wireless Sensor Network (WSN), Time Division Multiplexing (TDM), Non-dominated sorting genetic algorithm (NSGA-III).

1. INTRODUCTION

WSN is a collection of nodes in which all node is connected to other Senor. Every node as different parts. A Radio transceiver, microcontroller, source of energy. Multiple sensor nodes are included in the Wireless Sensor Network and each node is power-efficient, Multi-function, and equipped with wireless communication. The architecture of wireless Sensor network contains 3 units.

- Sensing Unit
- Processing Unit
- Transmitter
- Power unit

- Position Finding System
- Mobilizer

1.1. Sensing Unit

The sensor nodes in the WSN have power limitations and can be able to handle low-data rate.

1.2. Processing unit

Processing unit comprised of 2 Sub-units. Processor and the storage processor which is used to compute both the local information as well as the information from another computing node and the storage unit are used to store data. This can be in the form of RAM and ROM.

1.3. Transmission Unit

The communication between the nodes in WSN is radio waves. The topology which is used for the WSN can be Star Network, Mesh Network, and Hybrid Network etc.

WSNis the kind of ad-hoc network which is very effective in nature. The topology in the Wireless Sensor Network changes when the new node enters the network or left the network

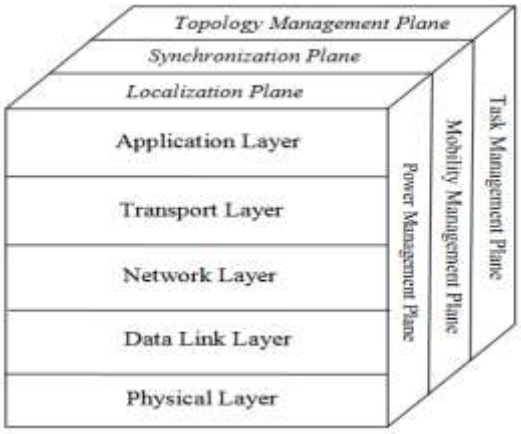

Figure 1.1. Layered Architecture of WSN [2, 3]

2. LAYERS OF WIRELESS SENSOR NETWORK

- ***Physical Layer:*** The Physical Layer Transfer the data in the form of stream of bits.

- ***Data Link Layer:*** The Data Link Layer accept the data in the form of bits and convert it into the form of frames and the layer is also accountable for flow control and error control.

- ***Network Layer:*** The main function of the layer is to perform Routing. There are many routing algorithms available to perform routing. These routing protocols adjust themselves according to the path available.

- ***Transport Layer:*** The transport layer is accountable for the host to host delivery. The main function of transport layer is to avoid congestion. It uses two protocols:
  - Transmission control protocol.
  - User Datagram protocol.

- ***Application Layer:*** The layer provides services to the user. The Application layer can be used to provide services such as Military, Environment, Health Monitoring and Agriculture.

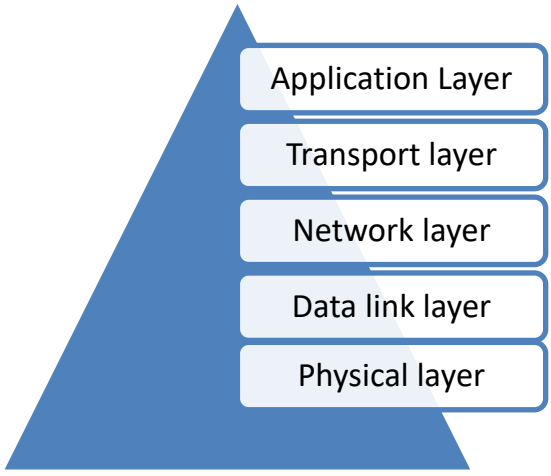

Figure 2.1. Layers of Wireless sensor Network [5, 6]

3. APPLICATIONS OF WIRELESS SENSOR NETWORK

3.1. Environment Monitoring

WSN is used to collect the data sample from the various geographical locations, such as oceanography, land, forest etc.

3.2. Security

Security is one of the major challenges in this dynamic work. WSN is used to provide security for Public Infrastructure as well as for home network. Public infrastructures include Nuclear power plant, Data centers, warehouses etc.

3.3. Military

In Military sector Wireless Sensor Network is widely used to track the location of enemy's vehicle, or to provide communication between tanks and the fighter plans.

3.4. Medical Sector

Wireless Sensor Network is used to diagnostic investigation, drug administration, Patients Psychological information.

3.5. Industries

One of the major advantages of Wireless Sensor Network is it hiding the complexity and provides services to the user. As the Wired network is highly complex as it comprised of complex set of wires.

4. RELATED WORK

Reham et al. states that the Wireless Sensor Network has diverse applications in the field of military, automations, health, and transportation. Residual energy, topology and data routing protocol are very significant. The author proposed a dynamic routing protocol. The simulation results states the network life span of the network has increased by 13 percent.

Parshant et al. States that the Wireless Sensor Network communicate through a single channel. The channel has a behavior of broadcasting a message at one time. WSNitself organizing network. The nodes in the wireless sensor network adjust them according to the incoming traffic. Routing protocols are used to provide communication within the network. Numerous routing protocol are used to provide communication. However, security is the major concern of the network. The purpose of this work is to enhance the security of the network.

Kemal Akkaya et al. states that every routing protocol should be examined on the basis of the network flow and Quality of service.

A.P. Chandrakasanet et al. States to improve the lifespan, minimize delay and improve overall quality LEACH protocol is used. The finding has suggested that the LEACH protocol has significantly improve the life span of the network.

Ming Liu et al. States that one of the major concern in the wireless sensor network is to conserve energy. The energy is conserved by optimizing the load across all the nodes EAP adds a new clusters in the network that can handle energy levels better.

Meghna et al. uses a tree which is self replicating tree to minimize the utilization of energy. The simulation results are performed using NS-2 simulator. The nodes in the network has different densities such as 20ms, 40ms, 60ms. The proposed method conserves energy and the life span of the network also improved.

Syed Umar et al. Wireless sensor network has diverse applications in the field of military, medical, and communication. The Proposed work use tree based energy protocol which conserves the energy and hence improves the life span of the network.

Shiksha Chabra et al. States that the wireless sensor network has limited battery capacity and it is very difficult to conserve the energy in the wireless sensor network. The author used GSTEB technique for improving the efficiency of the network.

Alain Bertrand Bomgni et al. states that the wireless sensor network is comprised of small devices which are known as stations. These stations are having less energy which significantly reduces network life time. The objective of each node is to deliver each item to its intended recipient. The proposed technique conserves sensor energy and thus the life span of the network improved significantly.

5. ROUTING PROTOCOL IN THE WIRELESS SENSOR NETWORK.

Routing protocol in the sensor network is categorized in the following parts:

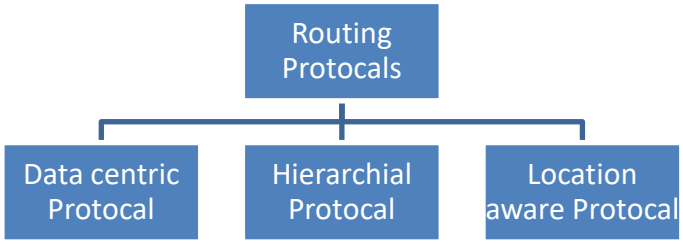

Figure: 5.1. Types of Routing Protocal [1]

5.1. Data Centric Protocal

WSNis collection of Multiple nodes and it is not possible that each node in the network is provided with an identifier. The Data-centric protocal do not use identifier and instead of this naming of these nodes are based on the attributes.

5.2. Hieraricahal Protocal

WSNis a set of complex nodes and hence scalability is one of the major issue. In case of single node design the problem of conjection arises and this result in overloading of the network. The hierarichal protocal are highly scalable network and one such example of hierarchial network is LEACH.

5.3. Location Aware Protocal

These protocals are used to find the distance between the noses. Most important location aware protocal are CBGR, TTDD, and MECN.

5.4. Quality Based Protocal

When the broadcast of the data is done from the source to destination it must satisfy parameters like Bandwidth, Latency, energy consumption and data quality.

6. PROPOSED WORK

6.1. Inter clustring techniques

In the clustering techniques nodes are organised in the hierarchial fashion and effectively used to the resources such as electricity, frequency and Bandwidith. In order to decrease the data redundancy in the network certain kind of the inter clustring is done. This not only focus on the data redundacy by also manages the traffcing in the network.

6.2. Objectives of the Interclustring

- *Load Balancing:* Inter clustering algo is use certain kind of aggeration which balance the load in the network and hence congestion can be controlled.

- *Fault tolerance:* Fault tolerence is the ability of the network to work in the even when any of the sensor node failuare occurs.

- *Network lifetime:* The life time of the network can be imporved by distributing the load over the CHS, selecting particular path for the data delivery.

7. PARAMETERS TO EVALUATE THE PERFORMANCE OF THE SYSTEM

7.1. Network Life time

The network life span is calculated on the basis of different charging schemes, effect of different areas, effect of different moving speeds of Wireless sensor network.
The network life time is shown in the figure 6.1. The number of nodes selected from 40 to 70. And the area size is taken in the dimenssions of 50*50, 100*100, 150*150, 200*200.

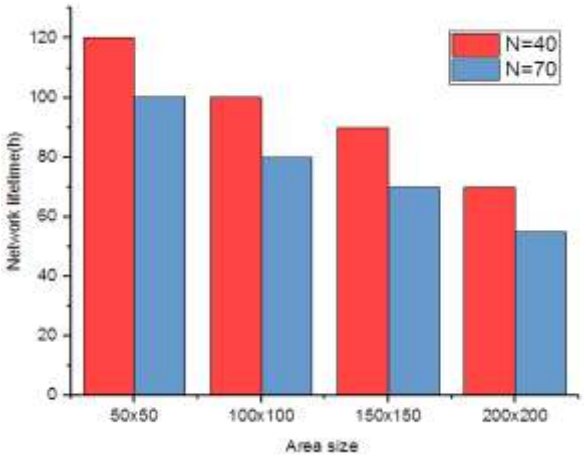

Figure:6.1. Network lifetime

7.2. Energy consumption

Energy utilization is the total energy used by the sensor nodes while transmitting the data from the source station to destination station. When the propesed method is compared with the traditional method it result in 20% energy consumption.

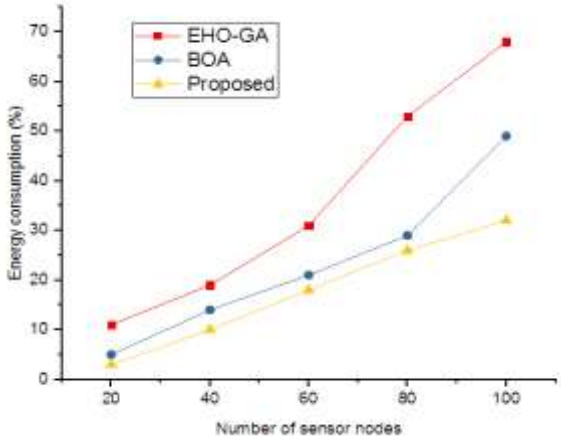

Figure:6.2 Energy consumption

7.3. Throughput

The following draft shows that the troughput of the propsed method is highly efficient when compared with the traditional system.

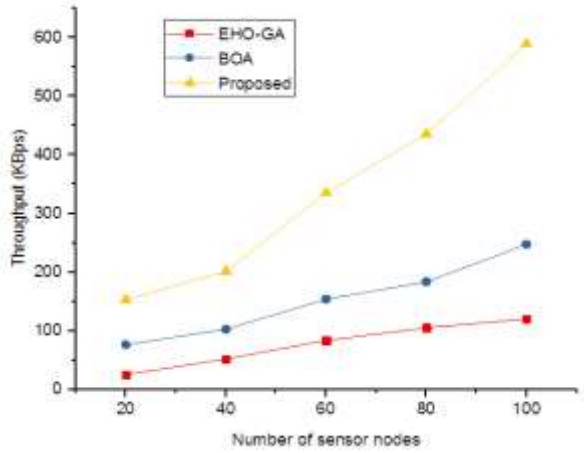

Figure:6.3 Throughput

7.4. End to End delay

End to End delay may be define as the total time required to send the packet to the reciver to the number of packets recived by the reciver.

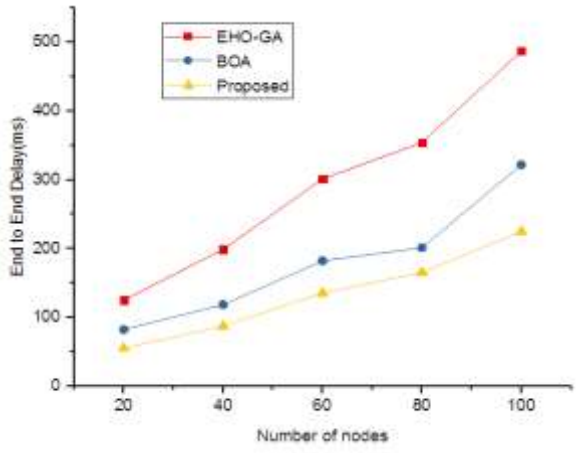

Figure6.4 End to End delay

8. CONCLUSION

The energy conservation is one othe maindare in WSNand it effects the lifetime of the network. The porposed work designed an energy efficiancy routing protocal. It may be possible that the number of phases in the porposed system increases and the network life time significantly impove the proposed work. The proposed algorithm used in the study will enhance the network life time and also use better optimized path. The performance of the parameters such as energy consumption, end to end delay, throughput imporved significantly when compared with traditional methods. For performing the whole work MATLAB is used. The proposed work is performed using clustring approach. While considering the performance of the whole network the physical factors such as temprature, pressure and sound are all real time.

9. FUTURE WORK

The proposed research work is performed using static nodes. In near future we wil further work on dynamic nodes and evaluate the performance of the system. We will futher investigates various routing protocal which improved the life span of the network. In the proposed work to evaluate the performance of the network simulator is used in near future we will use real network test bed to evaluate network performance. When we use wireless sensor network in the typical environemtn the security threats may occur. Therefore, we will also focus on improving the security of the network.

10. REFERENCES:

[1] Garcia-Sanchez, A.-J., Garcia-Sanchez, F., Losilla, F., and Palomares, F., (2010), "Wireless Sensor Network Deployment for Monitoring Wildlife Passages," Sensors, 10(8), pp. 7236–7262.

[2] Heinzelman, WB, Chandrakasan, AP, and Balakrishnan, H, (2002), "An application-specific protocol architecture for wireless micro sensor networks," IEEE Transactions on Wireless Communications, 1(4), pp. 660-670.

[3] Olariu, S., and Xu, Q., (2005), "Information Assurance in Wireless Sensor Networks," In 19th IEEE International Parallel and Distributed Processing Symposium, pp.1-5.

[4] Matin, M. A., and Islam, M. M.,(2012), "Overview of Wireless Sensor Network', In Wireless Sensor Networks-Technology and Protocols. In Tech open Book," pp. 3-24.

[5] Akkaya, K., and Younis, M.,(2005), "A survey on routing protocols for wireless sensor networks," Ad Hoc Networks, 3(3),pp. 325–349.

[6] Akyildiz, I.F., and Kasimoglu, I.H., (2004), "Wireless Sensor and Actor Networks: Research Challenges," Ad hoc Networks Journal-Elsevier, 2(4), pp.351-367.

[7] Al-Karaki, J.N., and Kamal, A.E., (2004), "Routing Techniques in Wireless Sensor Networks: A Survey," IEEE wireless communications Journal, 11(6), pp.6-28.

[8] Krishnamachari, B., Estrin, D., and Wicker, S.,(2002), "Modeling Data Centric Routing in Wireless Sensor Networks," USC Computer Engineering Technical Report CENG 02-14.

[9] Bakr, B.A., and Lilien, L.T., (2014), "Extending Lifetime of Wireless Sensor Networks by Management of Spare Nodes," Procedia Computer Science- Elsevier, 34, pp. 493-498.

[10] Bandyopadhyay, S., and Coyle, E.J., (2003), 'An Energy Efficient Hierarchical Clustering Algorithm for Wireless Sensor Networks," Proceedings of IEEE INFOCOM, 3 , pp. 1713-1723.

[11] Attea, B. A., and Khalil, E. A., (2012), "A New Evolutionary Based Routing Protocol for Clustered Heterogeneous Wireless Sensor Networks," Applied Soft Computing Journal-Elsevier, 12(7), pp.1950-1957.

[12] Li, G., andZnati, T., (2007), "RECA: A ring-structured energy-efficient clustering architecture for robust communication in wireless sensor networks," International Journal Sensor Networks, 2(1/2), pp.34–43.

[13] Martirosyan, A., Boukerche, A., andPazzi, R., (2008),"A Taxonomy of Cluster-Based Routing Protocols for Wireless Sensor Networks," 2008 International Symposium on Parallel Architectures, Algorithms, and Networks (i-Span 2008), pp. 247-253.

[14] Yi, C., Wang, L., and Li, Y., (2015),"Energy Efficient Transmission Approach for WBAN Based on Threshold Distance," IEEE Sensors, 15(9), pp. 5133–5141.

[15] Liaw, J.-J., Dai, C.-Y., and Wang, Y.-J., (2009),"The Steady Clustering Scheme for Heterogeneous Wireless Sensor Networks," 2009 Symposia and Workshops on Ubiquitous, Autonomic and Trusted Computing, pp. 336-341.

[16] Rezvani, M., Ignjatovic, A., Bertino, E., &Jha, S., (2015),"Secure Data Aggregation Technique for Wireless Sensor Networks in the Presence of Collusion Attacks," IEEE Transactions on Dependable and Secure Computing, 12(1), pp. 98–110.

[17] Tiwari, T., and Roy, N.R., (2015), "Modified DEEC: A Varying Power Level Based Clustering Technique for WSNs," International Conference on Computer and Computational Sciences (ICCCS-2015)-IEEE, pp. 170-176.

[18] Bsoul, M., Al-Khasawneh, A., Abdallah, A. E., and Abdallah, E. E., (2012),"An Energy-Efficient Threshold-Based Clustering Protocol for Wireless Sensor Networks," Wireless Personal Communications, 70(1), pp, 99–112.

[19] Ramachandran, C., Misra, S., and Obaidat, M.S., (2008), "A Probabilistic Zonal Approach for Swarm-Inspired Wildfire Detection Using Sensor Networks," International Journal of Communication Systems, 21(10), pp.1047-1073.

[20] Ramesh and Somasundaram,(2011), "A Comparative Study of Cluster Head Selection Algorithms in Wireless Sensor Networks," International Journal of Computer Science &Engineering Survey(IJCSES), 2(4), pp. 153-164.