High Density Stable Election Protocol for Energy Conservation in WSN

Rohit Koge[1], Prof. Achint Chugh[2]
[1]M-Tech Research Scholar, [2]Research Guide
Department of Electronics and Communication Engineering, MIT, Bhopal

***Abstract** In the real world physical environment consists of large and diverse information sources, such as light, temperature, motion, seismic waves, and many others. For a better understanding of the environment, it is important to fetch the data from multiple disparate sources, and the wireless sensor network is a simple to deploy infrastructure permitting fetching of such rich data. The energy aware wireless sensor networks are the need of today's wireless generation of information communication. The sensor networks are the specific type of wireless networks. The essential thing to decrease the energy consumption of the specific sensor network is to improve the collection pattern of data from the nodes to base station or server. The protection of energy is likewise imperative because of all the WSN nodes are battery operated. The battery has the limited source of energy and this limitation is also motivation to develop efficient routing technique. In this work we have proposed modified routing algorithm stable election protocol(SEP) and optimize the pattern of cluster head election probability. The simulation has been done for 600 rounds and the network live longer more than 600 rounds and throughput is around 7.03x10*^{5}**.**

***Keywords** - WSN, SEP, Cluster Head, Energy Efficient Routing, Wireless Networks, MANET.*

I. INTRODUCTION

The present-day advances in micro-sensor technology provides with great opportunities for a wide range of applications. These extend across the fields of monitoring health, traffic, weather and toxins, surveillance of fields, observance of global resources and geological activities, industrial applications etc. Prominent research work has been done to address data aggregation schemes, routing techniques and efficient energy usage in WSNs.

A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor the physical environment, and to co-operatively pass their data through the network to a main node or central location (base station). Modern wireless sensor networks are bi-directional, allowing transmission of information being monitored from nodes to central node or base station, as well as enabling control of sensor activity from base station to sensors. The development of wireless sensor networks was motivated primarily by military applications such as battlefield surveillance; but today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, environmental detection, and habitat monitoring. The WSN is built of "nodes" from a few to several hundreds or even thousands of nodes (sometimes called as motes), where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network.

Routing in WSNs is far more challenging than wired due to absence of global addressing scheme, presence of numerous nodes and corresponding data traffic which is highly redundant. Also, transmission, processing, data storage and battery power is constrained limiting the schemes to be more coherent. Figure 1.1 shows a diagrammatic representation of the wireless sensor network.

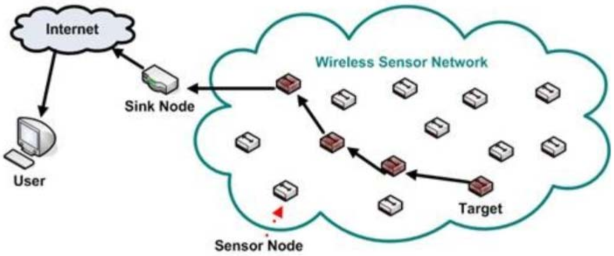

Figure 1.1 Representation of WSN.

Due to such limitations many algorithms and routing schemes have been proposed. On the basis of network structure routing protocols for WSN can be classified as flat network routing, hierarchical network routing and location-based network routing.

Stability is said to be attained for an interval by the network when there is no dead node present in the network. After this period network nodes tend to die in a frequent manner. The work done in this investigation tries to attain more stability and network lifetime by introducing transmission distance and residual energy as the main factors for the Stable Election Protocol is used.

a. Energy Dissipation in WSN Node

Energy is a precious resource in WSNs and therefore the routing protocol must be energy efficient. The term "efficiency" creates many different aspects of a system, which should be carefully distinguished to form actual, measurable figures of merit.

A sensor node typically consists of four basic components: a sensing unit, a processing unit, a communication unit, and a power unit, which is shown in Figure 1.2.

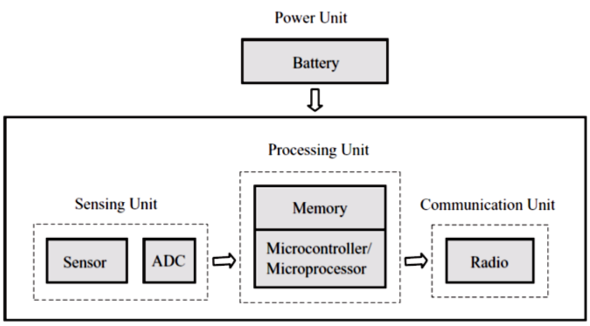

Figure 1.2 Sensor Node Structure.

This figure is taken from (Karl and Willig). The energy dissipation in a sensor node is due to the following components of the sensor node:

- Sensing Unit (Sensors+ADC)
- Processing Unit (Microprocessor/Microcontroller + Memory)
- Communication Unit (Radio)

However, energy dissipated by the communication unit, i.e. radio, is very high com- pared to energy dissipated by Sensing Unit or Processing Unit (Abbasi and Younis Akkaya and Younis). Hence, to enhance the network lifetime of WSNs, radio should be kept in low power mode, i.e. sleep state as and when possible. Also, energy expenditure is directly proportional to the square or quad of the distance. Thus, to achieve maximum network longevity, long distance communication should be avoided as far as possible. In addition to that, energy expenditure is proportional to the number of packets transmitted or received by radio. Hence, data aggregation techniques (such as Min, Max or Avg) should be used to reduce energy consumption of radio.

b. Energy Efficient Route Selection Policies

Energy efficiency is a critical issue in WSNs. The existing energy-efficient routing protocols often use residual energy, transmission power, or link distance as metrics to select an optimal path., the focus is on energy efficiency in WSNs and the route selection policies with novel metrics in order to increase path survivability of WSNs. The novel metrics result in stable network connectivity and less additional route discovery operations. The devices used in a WSN are resource constrained, they have a low processing speed, a low storage capacity and a limited communication bandwidth. Moreover, the network has to operate for long periods of time, but the nodes are battery powered, so the available energy resources limit their overall operation. To minimize energy consumption, most of the device components, including the radio, should be switched off most of the time. Another important characteristic is that sensor nodes have significant processing capabilities in the ensemble, but not individually. Nodes have to organize themselves, administering and managing the network all together, and this is much harder than controlling individual devices.

Furthermore, changes in the physical environment, where a network is deployed, make also nodes experience wide variations in connectivity and thus influencing the networking protocols. The main design goal of WSNs is not only to transmit data from a source to a destination, but also to increase the lifetime of the network. This can be achieved by employing energy efficient routing protocols. Depending on the applications used, different architectures and designs have been applied in WSNs. The performance of a routing protocol depends on the architecture and design of the network, and this is a very important feature of WSNs. However, the operation of the protocol can affect the energy spent for the transmission of the data. The main objective of current research in WSNs is to design energy-efficient nodes and protocols that could support various aspects of network operations.

The simplest idea is to greedily switch to lower mode whenever possible. The problem is that the time and power consumption required to reach higher modes is not negligible. So, techniques and protocols that would consider energy efficiency and transmit packets through energy-efficient routing protocols and thus prolonging the lifetime of the network are required for the packets. This could result the death of the nodes along the shortest path. Since in a WSN every node has to act as a relay in order to forward the message, if some nodes die sooner, due to the lack of energy, it is possible that other nodes will not be able to communicate any more. Hence, the network will get disconnected, the energy consumption is not balanced and the lifetime of the whole network is seriously affected. Therefore, a combination between the shortest path and the extension of the network lifetime is the most suitable routing metrics to be used in WSNs. Moreover, the lifetime of a node is effectively determined by its battery life.

II. PROPOSED METHODOLOGY

To enhance energy efficiency and network lifetime of wireless sensor network a high density stable election protocol for energy conservation in WSN has been proposed in this work. The implementation and simulation of proposed algorithm has been completed in MATLAB SIMULINK. The proposed protocol algorithm is shown in figure 2.1.

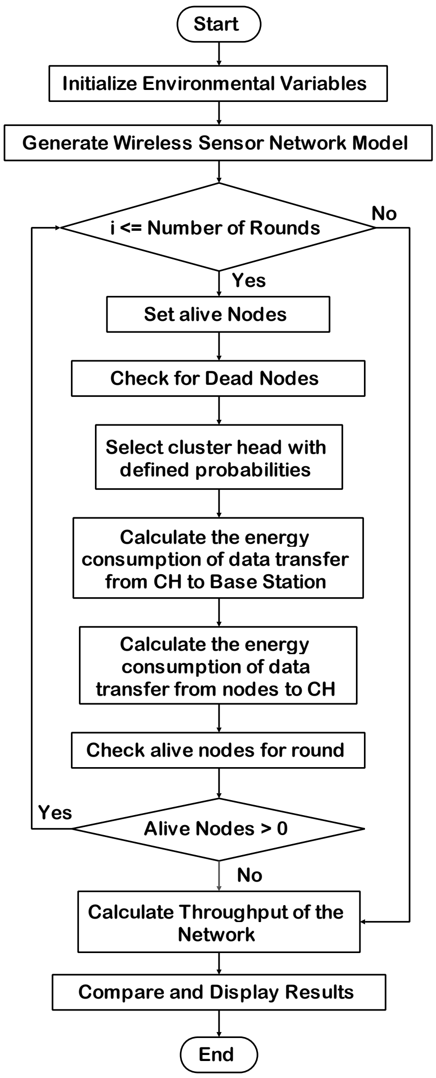

Figure 2.1 Flow Chart of the Proposed Methodology.

The proposed protocol high density stable election protocol is based on the probabilities of weighted election of each node to become cluster head as per the remaining of energy in each node.

In SEP, a node accept a random number between 0 and 1 and a node is elected as CH, if the chosen random number is not as much as the threshold. As SEP utilizes the heterogeneous network, threshold esteems are different for typical nodes and propelled nodes. The threshold value for normal nodes is given by Equation.

$$T(S_{nrm}) = \begin{cases} \dfrac{p_{nrm}}{1 - p_{nrm} * \left(r \bmod \frac{1}{p_{nrm}}\right)} & if\ n \in G, \\ 0 & Otherwise \end{cases}$$

where the threshold applied to a population of N nodes is $T(S_{nrm})$, r is the current round, G is the set of nodes that have not become Cluster Heads within the last 1 rounds, To become Cluster Heads p_{nrm} is the probability of the normal nodes .

The protocol mainly aims at increasing the stability time of the network or rather to delay the time for the first dead node in the network. SEP was a breakthrough protocol, as it proved to be better than others in terms of stability. However the instability period which is the time between the death of first sensor node in the network and the time of the last dead node in the network was found to be very low. This protocol aims at bridging the gap between the stability and energy efficient protocols in a WSN. This can be achieved by increasing both the stability and instability period of the network.

Initially nodes are deployed in the field. During the node deployment, each node is assigned with different energy levels. After the node deployment, base station broadcasts packets to nodes. The node with energy above the threshold energy is classified as the advanced node which reports back to the sink thus forming a first concentric cluster. The entire working is divided into three phases.

1) Creation of a concentric cluster.
2) Election of cluster head.
3) Data transmission.

The proposed algorithm has following steps

1. Start MATLAB Simulation environment.

2. Initialize environment variable.

3. Create wireless sensor network model.

4. Check condition if i<=Number of rounds if the condition is found to be true follow the next step.

5. Set alive nodes

6. Check for dead nodes.

7. Select cluster head with defined probabilities.

8. Calculate the energy consumption of data transfer from CH to Base station.

9. Calculate the energy consumption of data transfer from CH to base station.

10. Calculate the energy consumption of data transfer from node to CH.

11. Check alive nodes for round.

12. If found jump to step 4 else follow next step

13. Calculate throughput of the network.

14. Compare and display result.

15. End process.

III. SIMULATION OUTCOMES

To evaluate the performance of given method, implementation is done using MATLAB. The following results are obtained when the protocols - SEP is used simulated in MATLAB shown in figure 3.1 to figure 3.3. The network size is increased justifiable results are obtained for a fixed number of rounds. The nodes are considered to be stationary once they are deployed in an environment. The number of rounds is fixed to 600 to observe the difference in the values more accurately in terms of the number of alive nodes using high-density SEP routing protocol in WSN.

The Performance evaluation of proposed work is done with parameters like number of rounds, number of packet sent to base station and number of nodes alive number of packet sent to cluster head.

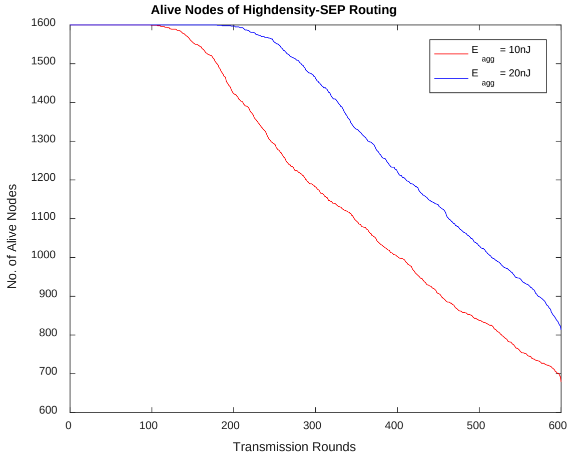

Figure 3.1 Network Life Time (Alive Nodes vs Rounds) of Proposed Methodology.

Figure 3.1 sows the network life time of (Alive Nodes vs Rounds) of proposed high-density-SEP Routing protocol with fixed number of 600 transmission rounds aggregate numbers of alive nodes are between 800-900.

Figure 3.2 shows the number of packet Packets Sent to Base Station using Proposed Methodology. In figure a plot between numbers of rounds fixed to 600 vs number of packet sent to base station has given.

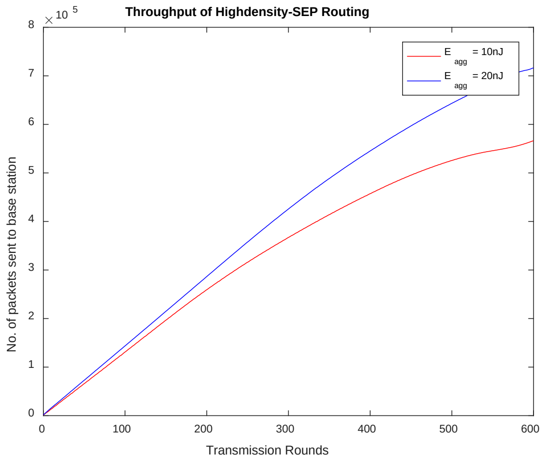

Figure 3.2 Packets Sent to Base Station of Proposed Methodology.

Fig. 3.3 shows the plot of Packets Sent to Cluster Head of Proposed Methodology. in this figure a graph between transmission rounds fixed to 600rounds vs number of packets send to cluster head has given.

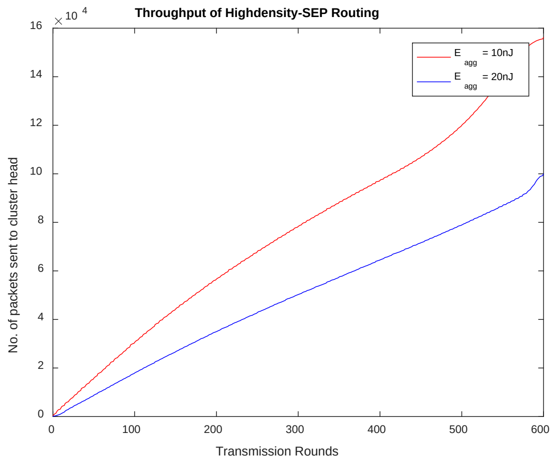

Figure 3.3 Packets Sent to Cluster Head of Proposed Methodology

IV. CONCLUSION AND FUTURE SCOPE

This work proposed new protocol for wireless sensor network. The proposed Energy Efficient Protocol using Stable Election Protocol is based on the residual energy of sensor nodes and location information of the sensor nodes. The proposed algorithm based on SEP protocol is a bridges the gap between stability and energy efficiency in wireless sensor networks. Proposed protocol can delay the death of the first node in the network thus increasing the stability period in the network lifetime. The division into cluster, based on the position of the advanced nodes and selection of cluster head based on the combined rating will make sure that the network will exist for longer time.

A number of WSN applications benefit from having data from a diversity of sources for as long as possible. To determine the overall life time of the network the various proposed routing protocols simulation experiments are performed in which sources regularly generate data and route it towards a sink.

Even though the requirements for energy aware and efficient protocol design are accomplished, still many more issues are to be addressed. The solutions proposed are for wireless sensor network. As future work these networks can be integrated with cloud computing.

REFERENCES

[1]. K. Cengiz and T. Dag, "Energy Aware Multi-Hop Routing Protocol for WSNs," in IEEE Access, vol. 6, pp. 2622-2633, 2018.

[2]. R. Kalyana and S. N. Aruna, "A hybrid energy efficient FF algorithm for wireless sensor network," 2017 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET), Chennai, India, 2017, pp. 1635-1639.

[3]. S. Vançin and E. Erdem, "Performance analysis of the energy efficient clustering models in wireless sensor networks," 2017 24th IEEE International Conference on Electronics, Circuits and Systems (ICECS), Batumi, Georgia, 2017, pp. 247-251.

[4]. W. Abushiba, P. Johnson, S. Alharthi and C. Wright, "An energy efficient and adaptive clustering for wireless sensor network (CH-leach) using leach protocol," 2017 13th International Computer Engineering Conference (ICENCO), Cairo, Egypt, 2017, pp. 50-54.

[5]. V. W. Mahyastuty, Iskandar and Hendrawan, "Evaluation of low energy adaptive clustering hierarchy routing protocol for wireless sensor network over high altitude plaftform," 2017 3rd International Conference on Wireless and Telematics (ICWT), Palembang, Indonesia, 2017, pp. 60-64.

[6]. G. Alvarado, C. Bosquez, F. Palacios and L. Córdoba, "Low-energy Adaptive Clustering Hierarchy protocol and optimal number of cluster head algorithm in a randomized wireless sensor network deployment," 2017 International Conference on Electrical, Electronics, Communication, Computer, and Optimization Techniques (ICEECCOT), Mysuru, India, 2017, pp. 1-4.

[7]. J. Wang and L. Zhang, "Work on TEEN with network coding," 2017 IEEE 2nd Information Technology, Networking, Electronic and Automation Control Conference (ITNEC), Chengdu, China, 2017, pp. 990-993.

[8]. Majid et al., "An Energy Efficient and Balanced Energy Consumption Cluster Based Routing Protocol for Underwater Wireless Sensor Networks," 2016 IEEE 30th International Conference on Advanced Information Networking and Applications (AINA), Crans-Montana, 2016, pp. 324-333.

[9]. Y. Liao, H. Qi and W. Li. Load-balanced clustering algorithm with distributed self-organization for wireless sensor networks[J]. IEEE Sensors JOURANAL, 2013, 13(5):1498-1506.

[10]. Zheng L Z, Gao L, Yu T G. An Energy-Balanced Clustering Algorithm for Wireless Sensor Networks Basedon Distance and Distribution[J]. Proceedings of the 6th International Asia Conference on Industrial Engineering and Management Innovation,2015(10): 229-240.0.

[11]. BILAL A,LESZEK T.Comparison by simulation of energy consumption and WSN lifetime and LEACH-SM[J]. Procedia computer science,2014(34):180-187.

[12]. S Rani, J Malhotra, R Talwar. Energy efficient chain based cooperative routing protocol for WSN[J]. Applied Soft Computing, 2015(35):386-397.