



A Novel Cluster Based Routing Protocol for Increasing Lifetime of Node in Heterogeneous WSN

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Abstract: Wireless sensor networks (WSNs) are composed of many low cost, low power devices with sensing, local processing and wireless communication capabilities. Minimizing energy dissipation and maximizing network lifetime are important issues in the design of routing protocols for sensor network. To overcome these issues In this per an attempt has been made to propose a novel cluster based routing protocol for increasing lifetime of node in heterogeneous WSN. In our proposed work mobile sensor nodes are also used that will usually replace the nodes that are dead in the proposed protocol. The simulation of the proposed protocol is carried out using Matlab and the results are compared to the SEP (Stable Election Protocol). Results show that our proposed protocol performs much better as compared to the SEP and the network lifetime is greater in our protocol, also the stability of the proposed protocol is better as compared to SEP.

Keywords: WSN; Cluster Head; Sensor node; SEP; LEACH and lifetime.

I. Introduction

During last few years the use of sensor networks and applications relying on sensor networks has become frequent. This is because of applications of sensor networks in various fields like structural health monitoring, surveillance, habitat monitoring and even in underwater sensing also. A wireless sensor network is basically a network of wireless sensor nodes. A sensor network consists of a large collection of nodes which are low in cost and power. These multifunctional nodes can be placed very close to each other or at some distance depending on the location. The wireless sensor network is a self configuring network in which sensor nodes communicate with each other using radio signals. A wireless sensor network acts as a bridge between the real world and the virtual world this type of networks senses the data through their sensing nodes and this sensed data is then converted into the physical form.

A. Wireless Sensor Network Architecture

In a typical wireless sensor network we usually consider the sensor field which is the space or real world environment in which the sensor nodes are placed or we can say deployed. These sensor nodes can be deployed in large numbers in order of thousands. The figure below shows the schematic of simple sensor network architecture. Here sensor nodes are deployed in sensor field the sensed data from the sensor nodes is passed to a base station. The base station links send data to internet and central manager for further processing.

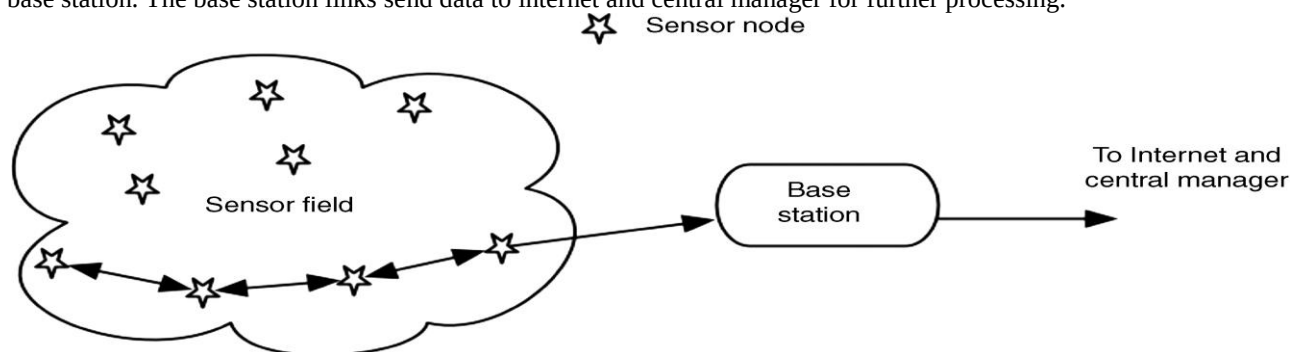


Fig. 1 WSN Architecture

The architecture of the wireless sensor network follows mostly used OSI model as we need the following layers of OSI model:

Application layer
Transport layer
Network layer
Data link layer
Physical layer

Adding on these five layers we also use three different planes namely Task Management Plane, Mobility Management Plane and Power Management Plane

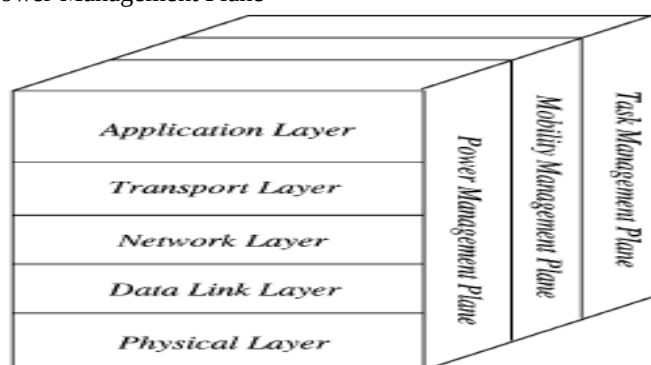


Fig. 2 Layered Architecture

II. Existing Techniques

SEP (Stable Election Protocol): In wireless sensor networks various types of routing protocols are used one such category of routing protocols is hierarchical routing protocols which comprised of protocols like LEACH, SEP etc. LEACH on one hand is used for homogeneous networks whereas SEP used for heterogeneous networks. SEP is Stable Election Protocol it was proposed mainly to address the heterogeneity of nodes as other hierarchical routing protocols were only used for the homogeneous nodes. Sep for choosing a cluster head assigns different probability to each node on the basis of its energy. Node with highest energy is chosen as the cluster head in the cluster. In a situation when a node is either transmitting data or receiving data and is about to dead then in SEP advanced nodes are used to replace the dead node when the energy of the operating node becomes zero. But in proposed work in such a situation instead of advanced nodes super advance nodes are used which are fully charged and as a result has longer lifetime. One more difference is there in these two protocols is that in proposed work operating node is replaced with the super advance node when the energy of node becomes less than 0.5 joule. Due to these differences proposed mechanism gets better output than the SEP.

III. Proposed Work

In this proposed work the concept of mobile wireless sensor nodes is introduced and these mobile sensor nodes will be used to replace the existing sensor nodes which are dead. The mobile nodes will usually take the positions of the nodes that are dead and then start the sensing process in their region thereby sending the data to the base station and thus also prolongs the network lifetime. In this work also additional energy powered sensor nodes are used which are advanced, intermediate and super-advanced nodes, here the energy of intermediate node is less than advanced node, the energy of advanced node is greater than that of intermediate node and energy of super-advanced node is greater than advanced node.

Proposed Algorithm for Cluster Formulation

1. Start
2. for (i=0; i<=n; i++)
3. {
4. Each node formulates cluster head by sending cluster join request.
5. If it receives highest strength of signals then it joins the cluster.
6. Now data routing process is started.
7. Cluster head takes data from node and forwards it to the base station and also helps node to retrieve data from the base station.
8. If $N_{\text{Energy}} < 0.5J$
9. {
10. then
11. Replace node with super advance node.
12. }
13. }
14. End

Description of algorithm

After the selection of a node as a cluster head in previous algorithm the next step is to create clusters by joining other nodes to that cluster head. As we know each node in the cluster formulates cluster head by sending cluster join request. A node joins that cluster from where it receives highest signal strength. After joining of a node to the cluster head the routing process started. In this routing process cluster head takes data from the node and forwards it to the base station and also helps nodes to retrieve data from the base station. If some condition arises where the energy of the node becomes less than the 0.5 Joule that is the time when the node is about to become a dead node then in such situation replace that node with a super advance node in order to continue the processing of data. In

proposed mechanism call a node a super advance node when a node has full energy. Proposed mechanism usually keeps some separate nodes with full energy as backup nodes these nodes are called super advance nodes.

IV. Results

The simulations have been conducted by using the MATLAB simulation environment to compare the performance of our proposed protocol with the Stable Election Protocol (SEP). The results show that the proposed protocol extends the network lifetime.

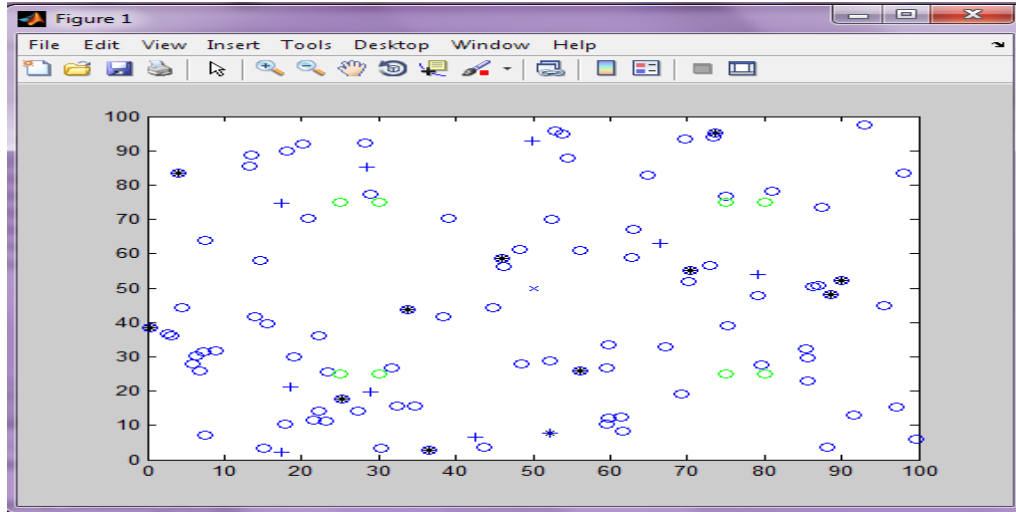


Fig. 3 Deployment of sensor nodes in network

Fig 3 illustrates deployment of nodes in network. Here in proposed work 100 nodes are deployed and base station is situated in middle of the simulation area.

Table 1 Simulation Parameters

Parameters	Values
Network Size	100m*100m
Initial Energy	0.5J
Data Aggregation Energy Cost	50pj/bit
Number of nodes	100
Packet size	4000 bit
Tool used	MATLAB
Operating System	Windows 10
Velocity of mobile node	3.89 m/s

Number of Alive Nodes: The total number of sensor nodes that have not yet depleted all of their energy.

Number of Dead Nodes: The total number of sensor nodes that have consumed all of their energy and are not able to do any kind of functionality.

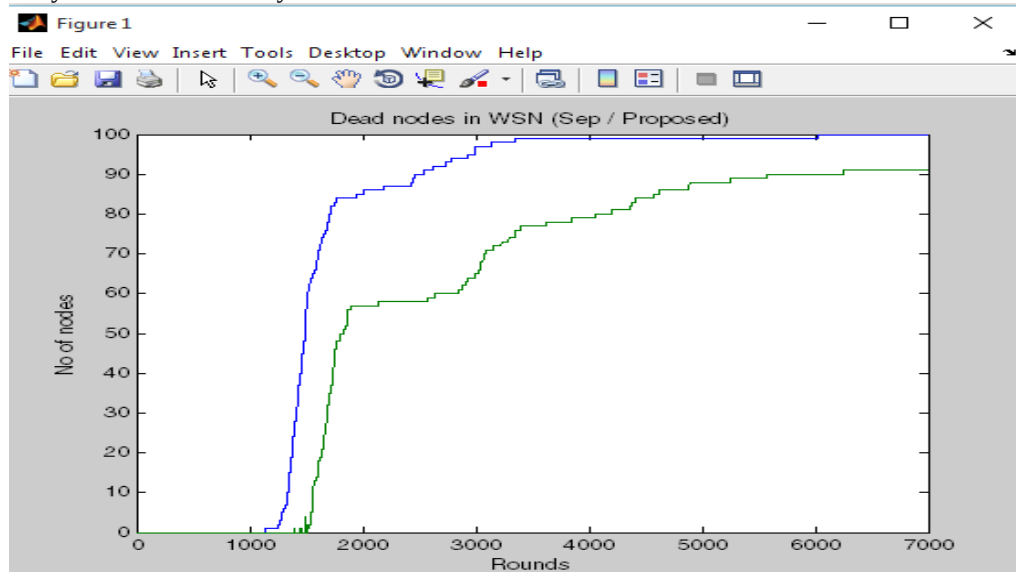


Fig. 4 number of dead nodes in SEP and Proposed mechanism

Fig 4 depicts total number of dead nodes after the simulation in both existing SEP and in proposed mechanism. To perform simulation 100 nodes are used and 1000 to 7000 rounds are used. These rounds are basically iterations. In proposed mechanism dead nodes are less as compare to SEP mechanism.

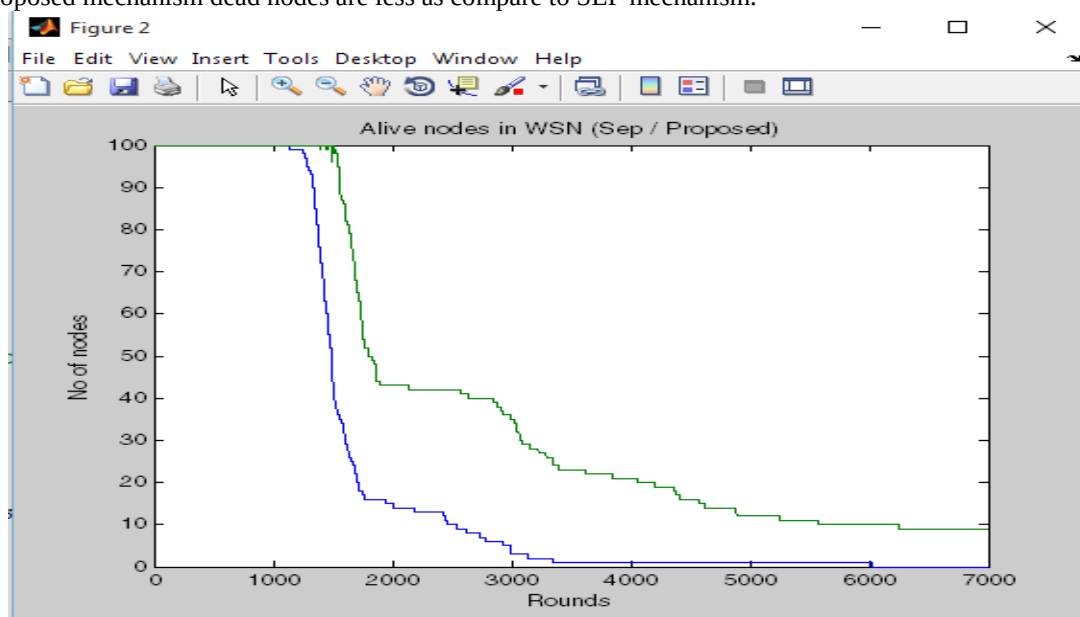


Fig. 5 number of alive nodes in SEP and Proposed mechanism

Figure 5 depicts total number of alive nodes after the simulation in both existing SEP and in proposed mechanism. In proposed mechanism alive nodes are maximum as compare to SEP mechanism.

V. Conclusion

In this paper Novel Cluster Based Routing Protocol for Increasing Lifetime of Node In Heterogeneous WSN has been proposed that is self-organizing in two-level hierarchy using four types of nodes: super advanced nodes, advanced nodes, intermediate nodes and normal nodes in heterogeneous setting is proposed. In the existing protocol the death of nodes start much earlier than the proposed protocol, the results show that the proposed protocol is better than the existing protocol in terms of first node dead. Also the overall lifetime of the network in proposed protocol is better than the existing protocol. The present work can be extended to multi-hierarchy and multi-level system where communication can be by multi-hop instead of a single-hop.

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