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RESEARCH ARTICLE

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CLUSTER HEAD SELECTION ALGORITHM ENHANCEMENT IN MOBILE WIRELESS SENSOR NETWORK

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ABSTRACT

Wireless Sensor Networks are the raising technology for monitoring the physical world. In Wireless Sensor Networks some of the application consist only stationary nodes. But some application has both stationary and mobile nodes. Sensor nodes are usually equipped with restricted battery power, small amount of memory, small computation capability and small communication range. Because of these feature there may be performance degradation, when mobility is functioned. Therefore an energy efficient routing protocol to forward the packet is needed. In this paper, we propose an improved Cluster Head Selection Algorithm and Enhanced Data Transmission method in Mobile Wireless Sensor Network i.e, CHSAE-MWSN protocol. The cluster-head nodes are selected from the Residual Energy, Lowest Mobility Factor, Density of the Node and Received Signal Strength(RSS). Also Gateway nodes are used which are act as an intermediate node to transfer the data to the Base station. Simulation results represents that the proposed protocol has better Energy consumption and network lifetime than LEACH-Mobile protocol which is existing one.

Keywords— Mobile Sensor Network, Mobility, Energy efficient, density, RSS.

I.INTRODUCTION

Sensor networks may contain hundreds or thousands of nodes, and they may need to be deployed in remote or dangerous environments, allowing users to extract information in ways that would not have been possible otherwise. This requires that nodes be able to communicate with each other even in the absence of an established network infrastructure and predefined node locations. Wireless sensor networking that includes data sensing, computation, and communication functions. In most of the scenarios assumption is that the sensor network is stationary. But in certain scenarios, sensor nodes must be mobile or combination of both. Also such network is called as heterogeneous network. For instance, in wild life applications, sensors are cast in the field as well as mounted on animals to be monitored. By proper communication arrangement of static and mobile

nodes, one can transfer data more efficiently and autonomously.

In mobile wireless sensor network, one of the main constraints is limited battery power. The researchers have considered many parameters for energy efficient cluster head (CH) selection protocols of Mobile WSN[1]. For example LEACH[9], LEACH-M[10] and LEACH-ME[11] etc are called energy efficient protocols. In these protocols, the data transmission phases are divided into rounds and in each round

a random CH selection is performed. Our proposed protocol CHSAE-MWSN gets better than LEACH-M[9] protocol by improving the selection of the cluster-head nodes, considering Residual Energy, lowest mobility node, Density of the Node and Received Signal Strength. And also here in data transmission special the gateway nodes are used to transmit the data from cluster head to Base station. Simulation result shows that the proposed protocol has better performance than LEACH-M.

RELATED WORK

In LEACH [9], the nodes organize themselves into local clusters, with one node acting as the cluster head. All non-cluster head nodes transmit their data to the cluster head, while the cluster head node receives data from all the cluster members, performs signal processing functions on the data (e.g., data aggregation), and transmits data to the remote BS. The operation of LEACH is divided into rounds. Each round begins with a set-up phase when the clusters are organized, followed by a steady-state phase when data are transfered from the nodes to the cluster head and on to the BS. But the cluster formation is initiated in each round is not energy efficient and also it does not support mobility.

As a result, the work done by Do-Seong Kim and Yeong-Jee Chung propose LEACH-Mobile (LEACH-M) [10] routing protocol which applicable to Wireless mobile networks. LEACH-M has been designed to support mobility (for applications where fixed and mobile sensor nodes are mixed together). It declares the membership of a cluster as they move and confirms whether sensor nodes are able to communicate with a specific cluster head. It transmits a message back to mobile sensor node from cluster head for data transmission within a timeslot allocated in TDMA schedule of a wireless sensor cluster. If the mobile sensor node does not receive the data transmission from cluster head within an allocated timeslot according to TDMA schedule, it sending join-request message at next TDMA time slot allocated. Then it decides the cluster to which it will belong for this moment by receiving cluster join-ack messages back from specific cluster heads. But in this protocol, transmission overhead is increased to send a message because of membership declaration.

To move forward this problem, Santhosh Kumar G et al. propose LEACH-Mobile-Enhanced [11] (LEACH-ME), the

node with a Lowest Mobility Factor is selected as a CH. Mobility factor is calculated based on the number of time that a node changes from one cluster to another. In steady state phase, if the non-CH node may not receive any request packet from CH node due to mobility then the CH node does not receive any acknowledgement form the non-CH nodes. If it is happened two consecutive timeslots, then CH assume that the node has moved and it deletes the timeslot of the node. However, LEACH-ME consumes much energy for determining mobility factor of the each node.

The effort taken by Samer A.B Awwad et al proposes cluster based Routing protocol for mobile Nodes in WSN [12] (CBR Mobile-WSN) to avoid the packet loss. The idea of this method is that, one of the cluster heads must be free to receive the packet from lost node that cannot receive data request message. The sensor node does not wait for two consecutive failure frames from cluster head to make decision but directly decided that the node has moved out of the cluster after one frame. Thus the data loss is reduced by sending its data to the new free cluster head and sends join acknowledgement message to the cluster heads.

The work done by Lutful Karim and Nidal Nasser propose Fault Tolerant Clustering Protocol for Mobile WSN [13] (FTCP-MWSN) that is not only energy efficient but also reliable. It does not require any extra timeslot for calculating the mobility of sensor node. So that it provide faster data delivery to BS. In the steady phase, CH assigns timeslots to the member nodes using TDMA scheme. If a node moves into a new cluster then it sends a Join-Request message to CH. Then the CH does not

allocate the node a timeslot until any timeslot becomes free for moving a node out of this cluster.

SYSTEM MODEL

Assumptions of Network Model

For our proposed model, we adopt a few reasonable assumptions of the network model based on [4][5] as follows:

- Sensor nodes are deployed randomly and densely in sensor field.
- At the beginning all the nodes of the sensor network are equipped with same amount of energy level.
- There is mobility in sensor nodes.
- Each sensor node has a potential to transmit data to any other sensor node or directly to the base station using power control.
- Gateway node is used to transmit data into Base station from Cluster Head node.
- The radio channel is symmetric such that energy required for transmitting a message from node A to node B is the same as the energy required for transmitting a message from node B to node A.

Proposed Model

In proposed system, Base Station and gateway nodes are stationary. Rest all the nodes has mobility. Because both base station and neighbor nodes are in mobile state then both nodes will consume large amount of energy that may leads small network life time[7]. Gateway node may be a Common gateway or Distributed gateway. Our proposed work consists of two main phases in each round. They are Cluster phase and Data Transmission phase.

I.*Cluster setup Phase*:

During this phase, all the sensor nodes in the Mobile Wireless Sensor Networks are divided into smaller zones known as clusters. These zones are then involved in cluster head selection.

•*Cluster Formation Phase*

Based on geographical location of the sensors, Clusters are formed. By base station cluster formation will be taken place. During the first round, the base station first splits the network into smaller clusters. The base station repeats the cluster splitting process until the desired number of clusters is reached. When the splitting algorithm is completed, the base station will select a cluster head for each cluster. But nodes in each cluster are not in same number.

•*Cluster Head Selection phase*

In this phase, Base station broadcasts a request message to all the nodes in the clusters using a non-persistent carrier-sense multiple access (CSMA) MAC protocol. After received the request message each node responds with its basic information like node's ID, node category and also about the Residual Energy, Mobility factor, Density of the Node and Received Signal Strength.

By subtracting the total energy dissipated during the transmission from initial energy of the mobile node The Residual Energy is calculated. Mobility is calculated based on the number of times a node changes from one cluster to another or on the basis of remoteness. From ratio of Average distance from other nodes in same cluster and inter-node distance Density of the Node is calculated. Received Signal Strength is calculated from communication range of the individual node. These factors assures that whether the node, to be selected as CH or not.

After the selection of the CH node, it should inform their role to the other nodes in the networks. To do this, each Cluster head node broadcasts an advertisement message (ADV) using a non persistent CSMA MAC protocol to other nodes. This message is a small message containing the node's ID and a header that differentiate this message as an announcement message. After received the message from CH, each node transmits a join-request message (Join-REQ) back to the cluster head. This message is again a short message, consisting of the node's ID and the cluster head's ID.

II.*Data transmission Phase:*

During the data transmission phase, cluster performs data gathering and routing. This phase can be further divided into intra-cluster transmission and inter-cluster Transmission.

•*Intra-cluster Transmission*

In intra cluster communication, the sensors of each zone are sense the information and send that to the cluster head. There are two types in intra cluster communication. The end user does not requires all the data. Instead, the end user needs a high level function which explains the event occurring in the network. Therefore Cluster Head receives all the data from sensor nodes and then aggregates the

data and sends it through nearby gateway node to the Base Station.

•*Inter-cluster Transmission*

In inter-cluster communication the aggregated data at the cluster head node is forwarded to the Base station via special gateways. The Gateway nodes are acts as intermediate node. So by sending the data though intermediate gateways reduce the energy consumption.

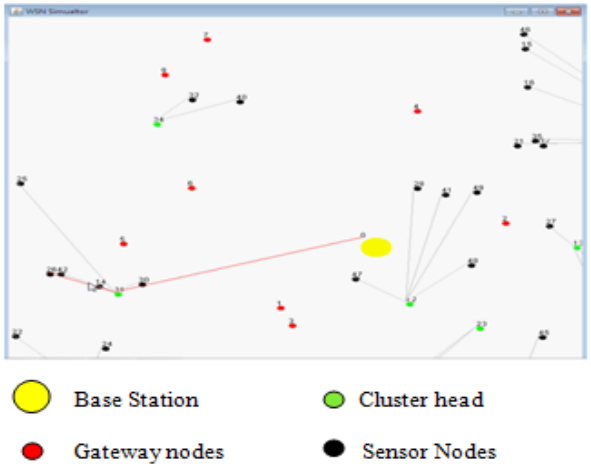

Fig1. Data transmission from CH to BS through Gateway nodes

IV . SIMULATION AND RESULTS

In this paper, an Energy efficient cluster head selection method is presented for mobile wireless sensor nodes. A protocol for cluster formation, cluster head selection, intra-cluster transmission and inter-cluster transmission was proposed. This work is validated by using simulation and compared it with existing energy efficient protocol LEACH –M[10]. The following subsections present mathematical analysis, simulation setup and simulation results.

A.Performance Analysis

In order to check the performance of the protocol in terms of its efficiency there are different metrics to be used. In this paper, we use Average energy consumption and Network lifetime.

1) Average Energy Consumption: The metrics that we selected for performances evaluation are as follow:

The Average Energy Consumption is calculated as follows.

Average Energy Consumption [j] = Total Energy consumption

/ Total Number of received packets

2) Network lifetime:

This is the time interval from the start of operation of the sensor network until the death of the last alive node.

B. Simulation setup

We use a 900m×900m region and 200 sensor nodes are scattered randomly in the sensor region. The tool Netbeans IDE is used to implement the simulation. The Netbean SDK includes the Netbean java development tools (JDT), offering an IDE with a built-in incremental Java compiler and a full model of the Java source files. This allows for advanced refactoring techniques and code analysis. Java language is used for coding. For front end java swings is used.

TABLE I. SIMULATION PARAMETERS AND THEIR VALUES

Parameter	Value
Network size	100 X 100 meter
Number of sensor nodes	100
Percentage of clusters Head	5 %
Percentage of Mobile sensor nodes	5 – 100 %
Base station position	90 X 170
Data Packet size	512 Bytes
Mobility model	Random way Point Model
Energy consumption for sending data packets	50 pJoule
Energy consumption in free space/air	0.01 pJoule
Initial node energy	2 Joule

C. Simulation Results

The performance of the proposed protocol is evaluated and compared with existing LEACH-M protocols in terms of Average Energy Consumption and Network life time. Some significant results are as follows:

1) Average energy consumption per packet

Average energy consumption per packet is the measure of energy spent in forwarding a packet to the BS. It indicates the

lifetime achieved by the protocols.

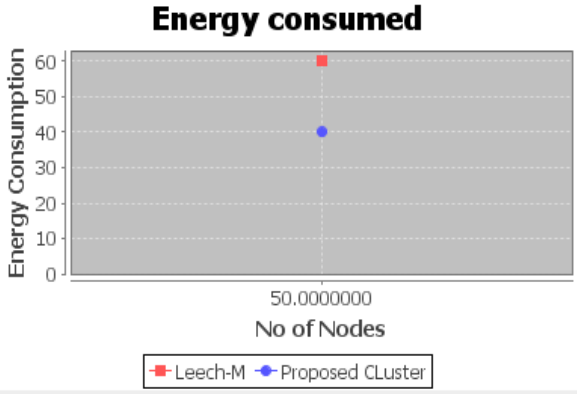

Fig 2: Number of Nodes Vs Energy Consumption of the network.

In Figure 2, the number of nodes as x-axis and average energy per packet as y-axis is plotted. From the graph, it can be observed that the average

energy consumption per packet using CHSAE-MWSN is less than LEACH-M.

2) Network life time

Figure 3 shows that the proposed protocol CHSAE-MWSN gives the better Network lifetime when compared to LEACH-M and other clustering algorithms. This may due the following reasons. First, an alternating the role of Gateway node can balance energy consumption among cluster members. Second, CHSAE-MWSN protocol considered residual energies of nodes, Mobility and density to elect the optimum cluster heads that can save more energy in nodes.

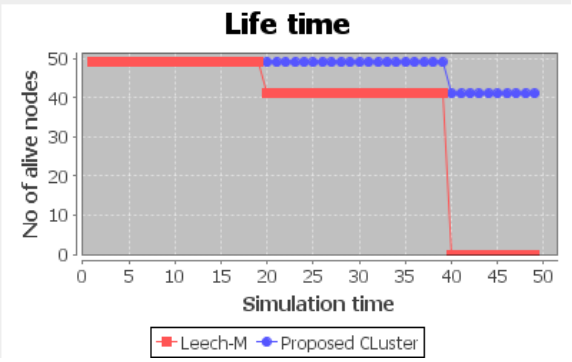

Fig. 3: Number of Nodes Vs Lifetime of the network.

V. CONCLUSIONS AND FUTURE WORK

This paper presents a protocol CHSAE-MWSN, whose aim is to increase the lifetime of the network and reduce the energy consumption in heterogeneous wireless sensor network. here the selection of the cluster-head nodes is based on the parameters - Residual Energy, Lowest Mobility Factor, Density of the Node and Received Signal Strength. Here Gateway nodes are used which are act as intermediate node data transmission to the Base station. Simulation result shows that the proposed protocol gives better performance than LEACH-M in terms of Energy consumption and Network life time. The new proposed scheme obviously has future scope for betterment of increasing network lifetime. In future, the plan is to extend the simulation by considering more challenging scenarios.

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