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Estimated Necessary Time for Receiving the Information with Coordinator by Neuro-Fuzzy

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Abstract—In most presented protocol with static clustering, when the CH can't work, other sensors in that cluster miss their performance. To solve this problem the PERME protocol has presented that put one coordinator sensor for survey the CH energy then routing done in CHs and the CH with lowest energy is identified then by Neuro-Fuzzy network estimate Energy that is required to send information to BS. This protocol is better than the leach protocol, but the selection of coordinator has some weakness and also using the Neuro-Fuzzy network, it may be imposed overload on CHs and raises energy consumption in CHs. To solve this problem we present EECME protocol that obviate the selection of coordinator and with running the Neuro-fuzzy network on coordinator, it can be save more energy of CHs.

Keywords—Coordinator Sensor, Neuro-Fuzzy Network, EECME Protocol, Toothily Algorithm, Wireless Sensor Network.

I. INTRODUCTION

A wireless sensor network (WSN) is an event driven system that relies on the collective effort of numerous micro sensor nodes. This approach has many advantages over conventional sensing networks including more accuracy, larger coverage area, and extraction of localized features. In order to realize these goals, it is necessary for the desired event features to be reliably transmitted to the BS.

The protocol that is presented in order to improve Protocol PERME1is called EECME. Although this protocol has prominent characteristics, it also increases the life of the network. The main problem in static clusters is that with destroying CH, other sensors of that cluster loses their efficiency and became useless. For solving this problem in EECME, CH sensor changes according to the saved energy in sensors and the coordinator sensor supervises its function. So we can be sure that there is at least a CH in cluster and the function of that cluster continues until there is energy in sensors even in one of them. As stated earlier, after the creation of clusters a sensor is chosen as a sensor coordinator and its job is to allocate time slot to the sensors of that cluster. So same as PERME, the sensor communicate with CH like TDMA and sends its information without interference. It is possible to management mobile sensors in EECME at network. A mobile sensor sends its information to the CH of the new cluster when it enters from a cluster to another cluster. In the following EECME protocol is explained in detail. It consists of two parts. At first the way clusters created is explained, then the function phase in stable network is studied and finally the results of simulation are discussed.

This paper organized as follows: The protocol description Section 2. The simulation results present in Section 3, finally, the paper will be ended by conclusion and future work.

II. PROTOCOL ARCHITECTURE

Data of individual nodes are usually not very important. Since the data of sensor nodes are correlated with their neighbor nodes, data aggregation can increase reliability of the measured parameter and decrease the amount of traffic to the base station. EECME uses this observation to increase the efficiency of the network.

2.1Setup phase

The coordinator sensors in PERME are chosen randomly. So there is no guarantee that the distance between sensors will be appropriate. Therefore it was possible that some close sensors were chosen as coordinators sensors and that causes final clusters with unsuitable shape. So in some clusters the numbers of sensors are few and in other clusters there are a lot of sensors and this makes the importance of data composition a challenge. But in EECME there is not such a problem because the clusters are formed once and they remain stable until the end life of the network. Also the size and the position of clusters depend on network user and he/she can define parameters. So we can form clusters suitable and desirable. Therefore we can control the number of sensors in each cluster to be suitable and acceptable or even sensors can be divided equally. The formation of clusters is explained in the following:

[1] Estimate Energy of CH with Minimum Energy

At first coordinator sensors are selected. Then BS sends a start message to the entire network. This message introduces suitable locations for coordinator sensors. Indeed the location of each coordinator sensor is almost at the center gravity of each cluster. This cause the load of network distributes on sensors almost equally and also the life of network increases. And because sensors dies almost at the same time, until the end life of network the target area is covered. Each sensor sends a connect request the coordinator sensor of its cluster after it receives an invitation message from it. The level of remaining energy is mentioned in connection request. After all connection requests are received by coordinator sensor, it allocates a time slot to every sensor even itself. So that sensors can send their data in usual network function phase and sleep in other times. Also multiple time slots are reserved, so that a time slot is allocated to a mobile sensor if it enters cluster in usual network function phase. Then coordinator sensor selects a sensor with maximum energy as CH. It is important that a mobile sensor never is selected as CH or coordinator sensor. The same as LEACH and PERME for decreasing the interference in sending data, sensors use CSMA function in order to access a canal and sending connection request message.

2.2 Steady state phase

Stable operation phase is same as PERME in many aspects. In this phase information is sent as frames. At the first of each frame a start frame message is sent to all clusters by coordinator sensor, which firstly it shows the beginning of a frame and secondly the sensor that is operating in recent frame as CH is introduced to other sensors. Coordinator sensor selects CH according to sensors energy. Indeed highest energy sensor is selected as CH. Of course the interesting thing is that the change in CH does not change time slots because there is a separate time slot for each sensor. After the start frame message, sensors send their data in their corresponding time slot and then go to sleep mode. Also sensors send their energy level along with their data once every few frames in order to coordinator sensor and CH identifies the highest energy sensors in network for next selection of CHs.

This information does not interference with the information in clusters because they are encrypted. Routing in cluster head is such that a cluster head is selected randomly that it starts routing and number 1 is given to it. Same as PRME for routing in this method the technique is used. So cluster heads that they are selected for routing is numbered from 1 to N respectively.

2.3 Predicting the time of receiving data to BS

In this step, at first, CHs select the shortest path with toothily algorithm, then the coordinator of selected CH, predict the time of receiving data to BS by Neuro-Fuzzy network and how long a CH with lowest energy can live and is this time enough for sending the message to BS? if it is enough, data transfer is done normally, otherwise, first of all the CH with the lowest energy, send own number and data to the closes CH in its route to the prohibit loosing data when power lost. As you know, we need some data to train, test and design of network for time estimation of given operation. So we should test different kinds of networks to obtain the best network input, output and designing parameters to find the best network that has minimum fault to solve this kind of problem.

Required input and out-put data and Designing and Architecture of ANFIS Neuro-Fuzzy are like PERME protocol.

2.4 Required input and output data

1. HP: The amount of energy of CH that has until now.
2. Damage: The amount of loss energy in each timeline form CH.
3. Distance to BS

So the input data for training and testing are:

〖HP〗_t، 〖〖HP〗_(t-1)،HP〗_(t-2)، 〖Damage〗_t

The network that provided best solution for this problem has these specifications:

$$input1 \quad = HP_{t-2} \qquad 2\ Rules$$

$$input2 \quad = HP_{t-1} \qquad 3\ Rules$$

$$input3 \quad = HP_{t} \qquad 2\ Rules$$

$$input4 \quad = Damage_{t}\ 4\ Rules$$

$$output1 \; = Damage_{t+1}$$

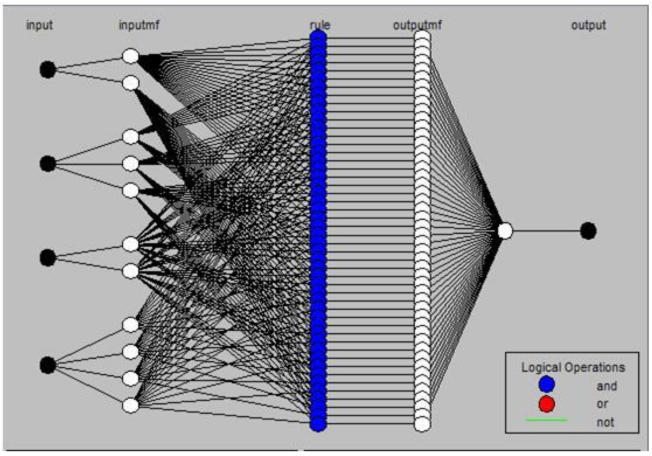

Figure1: ANFIS architecture with 4 inputs and 1 output

The coordinator always supervises to CH operation, and if the CH doesn't work for any reason, the coordinator sensor, replace another sensor. On the other hand CH supervised coordinator sensor too.

III. SIMULATION RESULTS

In this section the performance of EECME is compared to PERME. A network with 100 nodes is used in which nodes are randomly distributed between (x=0, y=0) and (x=100, y=100) with the BS at location (x=50, y= -75). The bandwidth of the channel is set to 1 Mb/s, and each data message is 500 bytes long.

We assume a simple model for the radio hardware energy dissipation where the transmitter dissipates energy to run the radio electronics and the power amplifier, and the receiver dissipates energy to run the radio electronics [5]. Both the free space (d2 power loss) and the multipath fading (d 4 power loss) channel models are used depending on the distance between the transmitter and the receiver [5]. Power control can be used to invert this loss by appropriately setting the power amplifier—if the distance is less than a threshold, the free space (fs) model is used; otherwise, the multipath (mp) model is used. Thus, to transmit an l-bit message to a distance d, the radio expends

$$E_{Tx}(l,d) = E_{Tx-elec}(l) + E_{Tx-amp}(l,d) = \begin{cases} lE_{elec} + l\varepsilon_{fs}d^2, & d < d_0 \\ lE_{elec} + l\varepsilon_{mp}d^4, & d > d_0 \end{cases} \quad (1)$$

and to receive this message, the radio expends

$$E_{Rx}(l) = E_{Rx-elec}(l) = E_{elec}. \quad (2)$$

The electronics energy, elec E, depends on factors such asthe digital coding, modulation, filtering, and spreading of the signal whereas the amplifier energy, d 2 fsε or d 4 mpε depends on the distance to the receiver and the acceptable bit-error rate.

We set the communication energy parameters as in [6] to = 50 elec E nJ/bit, = 10 fsε pJ/bitm2 , and = 0.0013 mpε pJ/bit/m4 .The energy for data aggregation is set as = 5 DA E nJ/bit/signal.

As shown in [6] the optimal number of cluster-heads forthis problem is 5. The initial power of all nodes is considered tobe 2J.

.In Figure 2 the number of data received by all CHs in the network level, the time is shown. As shown in Fig 2, performance of ECME is better than PERME.

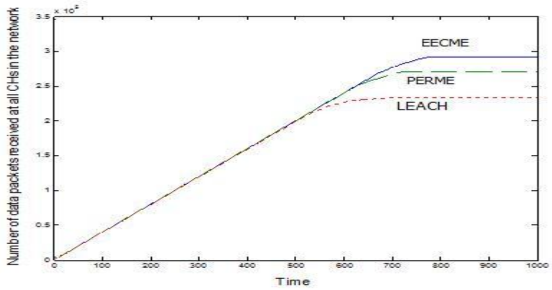

Figure2: Total amount of data received at the BS over time

In Figure 3 the number of data received by all CHs in the network level, in terms of total energy consumption in the network is plotted indicating that the ability of Protocol EECME to PERME ratio is higher in energy savings.

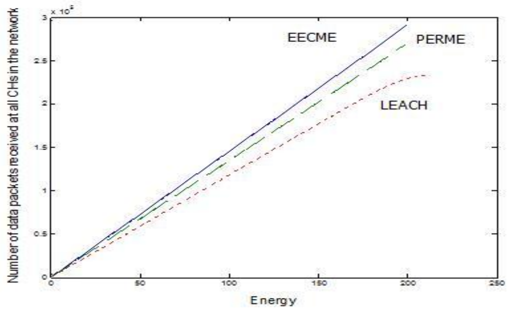

Figure 3: Total amount of data received at the BS over energy

Figure 4 shows the network as a way of life. As it can be seen in both protocols EECME and PERME sensors almost at a time to die.

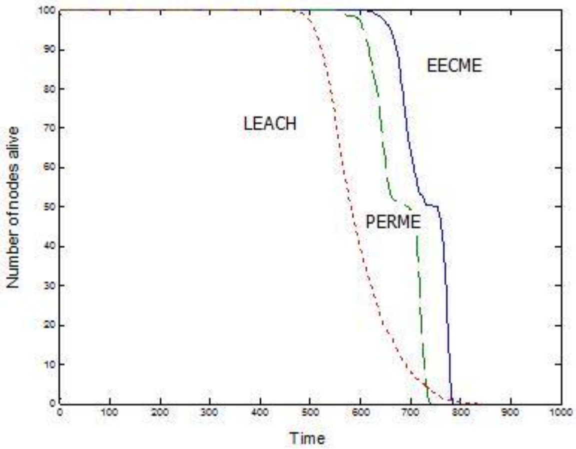

Figure4: Number of nodes alive over time

Figure 5 Number of active sensors, the number of data received by all CHs is drawn.

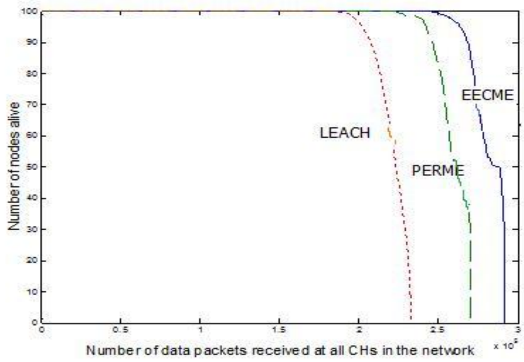

Figure5: Number of nodes alive per amount of data sent to the BS

Simulation results can be realized with an overview of the EECME to PERME in an important improvement in network performance is created. Since sensor performance is always under control and not rely on network performance to specific sensors, the problem for most sensors, other sensors are divested of their duties. Therefore, the EECME protocol called strong and resistant to failure and problems.

VI. CONCLUSION

Results of comparing performance of EECME and PERME protocols are achieved , shows that EECME's performance are more better than PERME. EECME has been able to maintain all the advantages of PERME, like, management of mobile sensors, high resistance against high duties assigned to the possible problems and high energy consumption among sensors, Better performance of the show. In this simulation as before is assumed that the sensors with same energy and equal to the 2j value began to work. On the other side network speed consider more than comparing of LEACH and PERME, although this pattern hasn't any effect.

In future work for less energy consumption in clusters, sensors do not send their data to head cluster directly instead, they send their data to head cluster with finding shortest route and combining their data in each cluster.

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