Estimated Necessary Time for Receiving the Information From Cluster Head to BS by Neuro-Fuzzy

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Abstract
In most protocols presented for routing, there is not impressive control and surveillance on the establishing of Cluster Head, and they send the information directly to BS[1]. It is possible that the CH doesn't have enough energy to do its duty, so it is missed and that cluster is practically useless until the next cluster is[1] reproduced.

In the proposed protocol of this article, a coordinator sensor is put to select the sensor with the highest energy as the head cluster. After CHs gather information, they don't send it directly to BS, instead they choose the shortest way to BS. In this stage it is possible that a CH is removed from the rout because of the loss of energy, and as a result the information gotten to BS is incomplete. To solve this problem, the energy of each CH is checked by Neuro-Fuzzy network. The CH having the lowest energy is detected, and how long the CH can continue doing its job with the least amount of energy, is also estimated. It is also considered whether this amount of time is enough to send the message to BS or not, if so, then the transformation is done normally, otherwise, the CH sends its information to an adjacent CH with the lowest energy in the rout to prevent information missing until its power lost.

Keywords-Coordinator Sensor, Neuro-Fuzzy Network, PERME Protocol, Toothily Algorithm, Wireless Sensor Network

1. INTRODUCTION
Due to the limitations of these networks regarding the source of energy and the way of gathering information in them, how their protocols are designed differs from the other networks. In many of these networks, the sensors are powered by non-rechargeable batteries. [2] The number of sensors in these networks is great, but they have low price and quality. So the data of each sensor is not important but this is bond of the data of some close sensors which gives us the peruse estimation of the considered measurement parameter in that place. So, if one or some sensors are lost, the network shouldn't stop working. May be it can be said that the most important parameters to design the protocols of wireless sensor networks are minimizing the energy used and resisting against the probable problems.

In this paper, PERME protocol is proposed for routing in wireless sensor networks. Some of the most brilliant specifications of these protocols are high savings in power consuming, high resistance on possible problems, and short delay on transferring data on networks. The results of simulation show that this protocol is more efficient than other protocols in this field [7].

2. PERME[2] PROTOCOL
This protocol works better than LEACH protocol by using some techniques. In LEACH protocol after cluster forming and starting of stable operation, each sensor in one cluster send its data directly to its own CH and CH sends the useful information to BS after combining all data of sensors of that cluster [3]. But sometimes some of the cluster sensors have a huge distance from CH, so it is not efficient to send data directly. In fact in PREME, other CHs don't send their data directly to BS. In PREME the combination of data is not done just in one sensor, it is done in the whole network locally [5]. This protocol saves the energy by choosing the shortest route to send data. Also clusters are generated just once before the stable operation and remain stable until the end. Each cluster has one CH and one coordinator sensor. Power consuming jobs are divided among high energy sensors. Also CH and the coordinator sensor control each other to keep the network operation working in any conditions.

In PREME, TDMA method is used to prohibiting data interference inside the clusters. Results show that PERME has better and higher efficiency than LEACH.

2.1. Clusters Forming
Because of cluster forming once in PREME, it inhibits using power for gradual clusters forming. It is also possible to choose the clusters in a way that sensors are separate uniformly and ideally. One of the greatest problems in LEACH protocol is that sometimes the number of clusters is fewer the estimated one during a period. For example, in some periods the whole network is one cluster. Perhaps this problem does not seem very important but it will be very important when we consider data combination. Maybe some data whose sensors have a long distance don't have coherence, so data combination loses its meaning and value. But due to choosing appropriate clusters in PERME, this problem is solved. First in PERME, coordinator sensors are chosen and then BS sends a formation cluster message to the whole network that contains some geographic location as the center of clusters. After receiving the start message from BS, each sensor tries to send an invitation message to its

1)Base Station
2)Power Efficient Routing Protocol with Minimum Energ

neighbors with an appropriate delay to its distance to the closest considered place. Actually, the more distance between the sensor and the closest place is more, the delay will be more. Also when a sensor gets the invitation from its neighbor, it doesn't send invitation message by itself. Consequently, the nearest sensors to the ideal places will be chosen as the coordinator sensors. Maybe some sensors receive more than one invitation, so they select the sensor with the most powerful invitation message as their own coordinator sensor. Each sensor after receiving invitation message from its own cluster coordinator sensors, send a join request message to that coordinator. Each joint request has the ID of requesting sensor, the remaining energy and its geographic location. To decrease the interference in sending joint request messages, CSMA technique is used to achieve the channel.

2.2. Stable Operation

When data is received by CHs, CHs routing begins. Clusters header sensor receives the information of cluster sensors places by joint request message. A CH that has the highest energy regarding this data calculated the joint chain by toothily algorithm and sends it to all clusters. The method that is used to determine a CH with lowest power is explained below:
The first and the last CH that the chain starts from them consider their level of energy in their data. The next sensor that receives this data compares to its own energy [4]. If the sensor has lower power, introduces itself as the lower CH and puts the amount of its energy in the sent data. Similarly, each CH after receiving data from the previous sensor, if it is lower, introduce itself as the weaker sensor and finally after the data is received by BS, the strongest sensor in the network will be detected.

In this chain, the weakest sensor receives label number one and other CHs are assigned the next numbers sequentially. Actually, in PERME protocol the number of CHs in the chain specifies their thread of time number.

3. Predicting the Time of Receiving Data to BS

In this step, we predict by Neuro-fuzzy network [1], the minimum time that data is sent to BS by CHs and how long a CH with the lowest energy can live and is this time enough for sending the message to BS? If it is enough, data transferring is done normally, otherwise, first of all CH with the lowest energy sends its data to the closest CH in its route to prohibit loosing data when power is lost.

As you know, we need some data to train, test and the design of the 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.

3.1. 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

t parameter is time in the simulation system, so input parameters sequentially are current cycle HP, previous cycle, two previous cycles and the last input is the amount of losing energy of CH at present time.

The output of system is 〖Damage〗_(t+1), it means predicting the next damage that maybe subtracted from CH. Hence, it will be create the repetitious circle until the energy of CH waste (hp<=0).

4. Designing And Architecture Of ANFIS Neuro-Fuzzy S

In this paper the best Neuro-Fuzzy network to was obtain solving this problem [6]. The kind of Neuro-Fuzzy networks that is used for data training is Sugeno that with different membership function has different Rule Bases for each input data and its subsequently is in the fallowing periods:

〖HP〗_t=2 RulesOr 3 Rules

〖HP〗_(t-1)=2 RulesOr 3 Rules

〖HP〗_(t-2)=2 RulesOr 3 Rules

〖Damage〗_t=2 RulesOr 3 RulesOr 4 Rules

So the number of networks that we designed according to Rule Base is 24 different kinds that were each trained with 8 membership functions such as gaussmf, gauss2mf, dsigmf, trapmf, psogmf, pimf, gbellmf and the networks are trained with two training algorithm like backProb and Hybrid. Then the best network whose test data output had lower error in amount of growth scale process of a growth of the lost energy in 384 different networks as the best network is chosen so that it can solve this kind of problem.

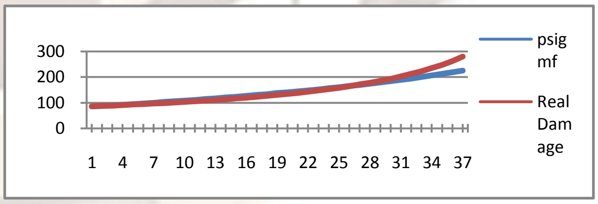

Fig1: compare the growth of the amount lost predict energy with real energy

4.1. Architecture And Structure Of Solving Neuro-Fuzzy Network

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

〖input1 = HP〗_(t-2) =2 Rules

input2 = 〖HP〗_(t-1) =3 Rules

〖input3 = HP〗_t =2 Rules

input4 = 〖Damage〗 _t =4 Rules

output1 = 〖Damage〗 _(t+1)

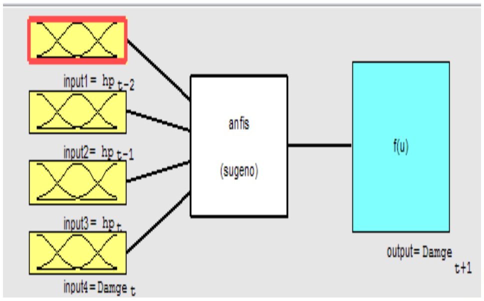

Fig2: Anfis architecture with 4 input and 1 output

And psigmf's membership function for each Rule and for 4 inputs is shown in Fig3:

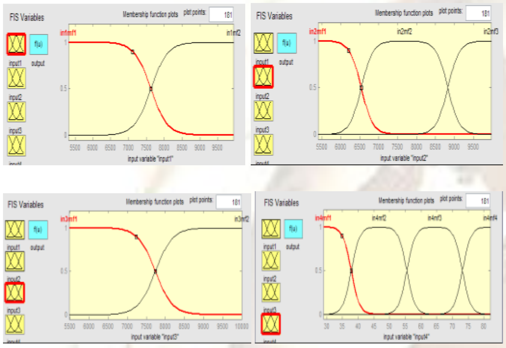

Fig3: figure of Rules of each input[2,3,2,4]

5. Conclusion

PREME protocol exploits from static cluster finding method. The big benefit of this protocol is its high resistance against possible problems. Actually, this protocol is the regenerated version of LEACH protocol that can run in any bad geographical circumstance.

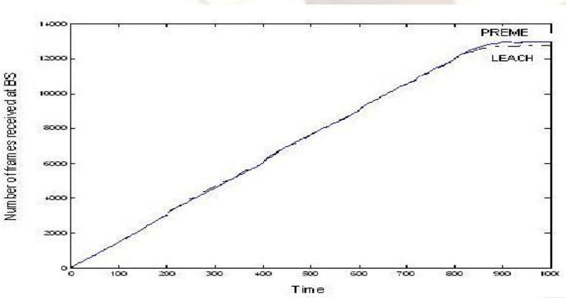

Fig4: Total amount of data received at the BS over time

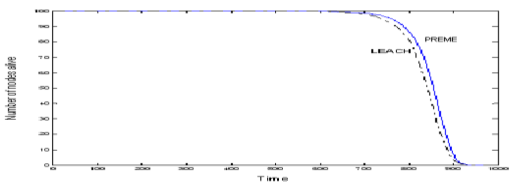

Fig5: Number of nodes alive over time

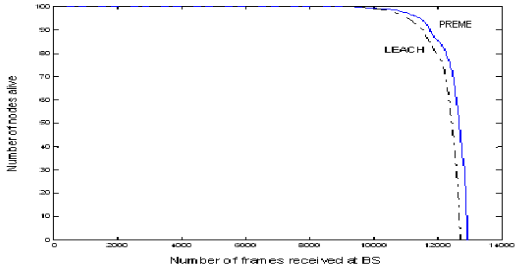

Fig6: Number of nodes alive per amount of data sent to the BS

In PREME each CH send its data that has been produced by the Travelling Salesman Problem, to the neighboring sensor by a chain. That CH combines the received data by its own data, then the energy of CHs is surveyed by a Neuro-Fuzzy network and detects the CH with the lowest energy and estimates how long that CH can work? And is this amount of time enough for sending message to BS If it is, the transferring of the data will be done normally, otherwise, first the CH with the lowest energy puts its data in the next CH on the route to avoid losing data when losing power.
PERSC can increase the age of the network and will be an appropriate, resistant and efficient protocol for wireless sensor networks

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