Maximizing Network Lifetime of Wireless Sensor Network

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M.Santhosh
M.Phil. Research Scholar, Department of Computer Science
Morappur Kongu College of Arts & Science

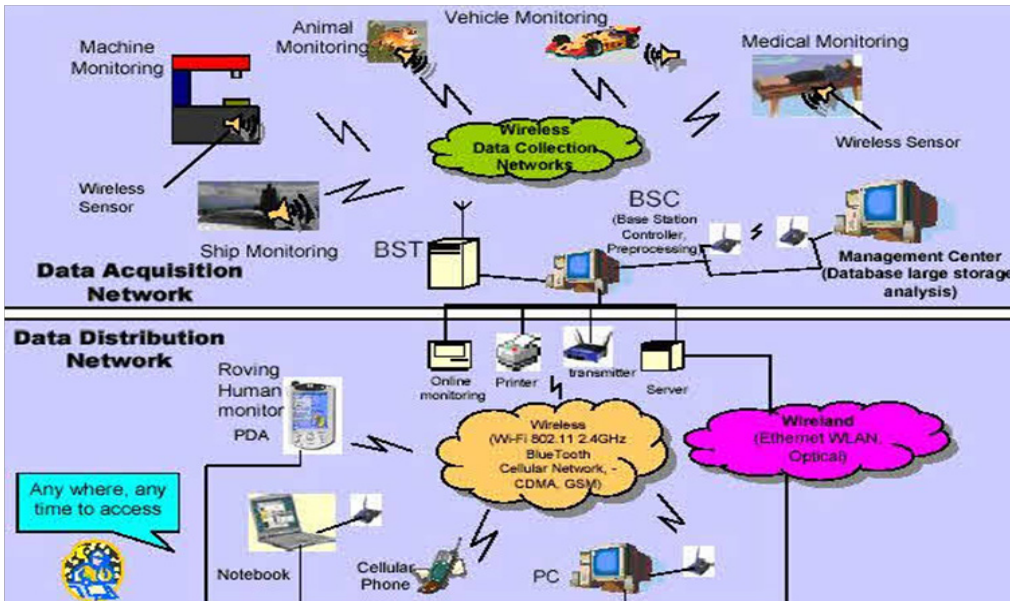
Abstract

Wireless sensor networks are used to extract various information that is used to collect data. It includes a large volume of data so that its performance may get slower and lifetime of the network may get restricted. This paper deals with the maximum usage period of the networks. The modified LEACH protocol is used to which supports the mobility of the node and so extends the lifetime of the network. The network may contain a large number of sensor nodes in which some are the static refers to Cluster Head (CH), and some Mobile Base station (BS). These sensor nodes consequently detect and send the sensed data to the nearest CH, and later this sends to the Mobile Base Station. This leads to efficient extract of information. To display the improvement and reliability this protocol is compared with the fixed node approach.

Introduction

Now a day an efficient design of a Wireless Sensor Network has become a leading area of research. Sensor is a device that responds and detects some type of input from both the physical or environmental conditions, such as pressure, heat, light, etc. The output of the sensor is generally an electrical signal that is transmitted to a controller for further processing.WSN is a wireless network that consists of base stations and numbers of nodes (wireless sensors). These networks are used to monitor physical or environmental conditions like sound, pressure, temperature and co-operatively pass data through the network to the main location.

Wireless Sensor Networks



Clustering communication protocols represent a superior approach and result in more balanced patterns of energy use in WSNs. The first low-energy adaptive clustering hierarchy was leach. It showed how energy loads could be amortized by dynamically creating a small number of clusters.

The technique uses cluster heads (CHs) to mediate data transmission. Simulation results show that the energy dissipation is the same by all nodes because the CH roles are rotated among nodes. Generally, nodes in a WSN are static, i.e., nodes with fixed position. In the literature, the routing protocols do not support sensors mobility. But, few applications, such as the supervision of a complex environment - medical supervision, Natural disaster prevention, etc. To require mobile components in WSN. Some approaches in the literature, treat the mobility in a WSN by the modification of the protocol Low EnergyAdaptive Cluster Hierarchy (LEACH). In general case, Leach and its modified versions supporting mobile nodes are based on a mono-hop communication. Infact, it considers that all nodes can exchange data with the sink node. So, it is useful in indoor where the supply and people limit the wireless components radio range. But the multi-hop routing is a necessity to support the widest area like outdoor applications. In this context, we were interested to develop a multi-hop routing protocol respecting the WSN constraints and then it to support mobile nodes. For this, we studied also the contribution of mobility over the WSN lifetime.

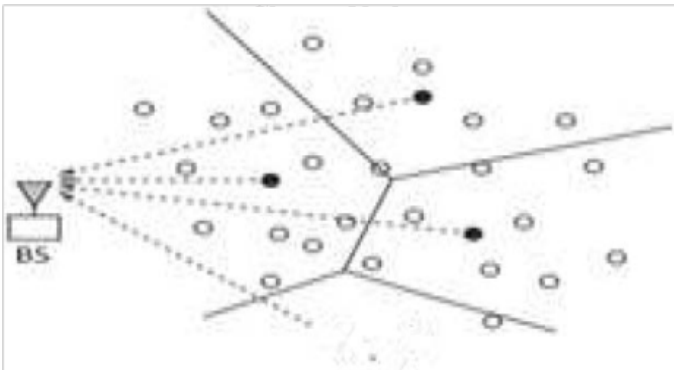
This paper is organized as follows: we describe in section 2 our solution to improve the LEACH protocol to support a multihop network topology and to support the presence of mobile nodes. The Section 3 presents a performance study, that evaluatesour proposed algorithm by comparing it to a fixed algorithm (all nodes are fixed) and to a mono-hop topology network. Finally, we summarize our work in the conclusion section.

Theoretical Analysis

Leach Protocol

This section deals with the mechanism of LEACH protocol. This approach is used to improve this protocol to support multihop architecture. One of the interest techniques is the Hierarchical Routing, which introduces the concept of cluster creation and assigning particular tasks to selected sensor node within the cluster called cluster head (CH). Hierarchical Routing is an efficient

technique to reduce energy consumption by doing data aggregation and fusion to reduce the number of transmissions to the Base Station (BS). The first hierarchical protocol is the Low Energy Adaptive Clustering Hierarchy (LEACH). The idea of LEACH is to form clusters of the sensor nodes based on the received signal strength and use local cluster heads (CHs) as routers to the sink. To enhance the energy consumption since the transmissions will only be done by the cluster heads rather than all sensor nodes. Many hierarchical protocols were emerged based on the idea of LEACH



Multihop Leach Protocol

M-LEACH (Multi-hop LEACH) is one of the descendants of LEACH developed till date rather than directly communicating to BS, CH transfers the data through CHs, deceitful in between source CH and the BSThe working of M-LEACH [12] is performed by two forms of communication.

- Intra-cluster communication
- Inter cluster communication.

Although the M-LEACH became successful up-to, some extent in resolving the issues of LEACH deployed WSN, but still, some loopholes are left in M-LEACH. These are: The CH is elected based on probability function as in simple LEACH. The CH rotation is done after each round of communication. The CH is selected from scratch that introduces delay and increased power consumption.

Fixed Multi Hop Leach Algorithm

Begin
Specify the probability Pi(t), nodes number N
(I) PREPARATION PHASE
Repeat (2times) if there is no response:
ask for cluster I D(); I I sensor broadcasts
Iia request to know which cluster it belongs
if (no answer) then
command the BS to add a new cluster to this node
end if
(II)SET UP PHASE
n = N I K; I In = rounds number,
I I K = required C H number and N = nodes number
repeat for n rounds
r = random (O, 1);

```
if (r < P(i)) then
Actual_CHi = TRUE; I Inode"i" is a CH candidate
Iinode"i" inform the old CH and wait validation
else
Actual_CHi = FALSE; I Inode"i"isnot a CH candidate
End if
(III)STEADYPHASE
if (CHi = TRUE) then
Send_broadcast (IDi, cluster I Di) lithe node
Ilbroadcasts an ADV message to inform other
Iinodes that it has become a CH;
else
Join (IDi); Iinode "i" non - CH join the CH
Capture(2sec); Iinode pick up a measure
 I I every 2seconds to control its environment and
 I I send this measure to the corresponding C H
 while AC K is not received from the C H do
 Send_data (I Di, clusterid, data); I I sending
 Iidata to the CH
 end while
 end if
 if (ActuaCCH(i) = TRUE) and (node <> sink) then
 Receive--:join_Req_fram_member (I Di, cluster J D)
 Send_ACK(CHjD,clusterjD) Ilsend ACK;
 Receive_data(M ember I D, cluster I D, data)
 Send_ACK(ID_CH) Iisend data ACK to a member;
 Send_data_toSink(I Di, cluster j D);
 Receive_ACK_framSink ();
 if (ACK not received) then
 while (delay allow and gateway isn't found) do
 Research--9ateway(I Di);
 Ilresearch a gateway out of the cluster
 if (time is over) then
 the node select a gateway in its cluster;
 join_gateway(IDi, clusterJD); Ilgw to which
 IltheCH transmit its data
 end if
 end while
 Send_data (I Di, cluster _I D, CH, gateway, data);
 I I sending the received data to the gateway
 I land waiting for an ACK
 end if
 end if
 if ((CH(i) = FALSE)and(node <> sink)) then
 while AC K is not received do
 Send_data_ToCH(IDi, clusterID, data);
 / / sending data to the C H;
```

```
if (Receive data from a node member) then
if (received-fJatewayj D = I Di) then
/ /receiving data from the gateway;
SendDataToCH(I D, cluster j D, Data);
I I send the received data and its coordinates
I Ito the C H (with the same source I D)
else I Ireceive data fram a node member which has
I I not taken the C H change
Send_newCHjD(Actual_C H( cluster I D),
clusterID);
this node should join the new CH and transmit
its sensed data
end if
end if
end while
end if
if (IDi = Sink) then
Receive_data (I Di, cluster I D, CH, Data);
Send_ACK(); I I sending data ACK to the CH
end if
```

Several applications such as in telemedicine (If an ambulance is equipped by sensors, doctors in the hospital can reach the nurses to help the patient when this vehicle is moving to the hospital or if a patient equipped by sensors, he can be treated at home) or in military the control of mobile units is strongly requested. But, LEACH doesn't support nodes to be moving. So, we thought to improve this version of LEACH protocols to support mobility.

1) Mobility model: In the topological model, we assume that the BS is mobile and can leave an area to enter in another one. Sensor nodes are fixed. Two cases are considered:

1. If "i" is a non-CH sensor, it should join the corresponding CH.Similarly, it can send its collected data to the CH.
2. If "i" is a CH, it sends its collected data and those received from the other members to the BS. CH nodes must then find the BS in their coverage area to send its data.

2) Mobile mono-hop LEACH: We assume that nodes can directly communicate with BS and nodes radio range is limited to cover a little area like in indoor applications. For example, a person can supervise his habitat using his mobile phone (as a BS) when he practice his activities.

Our approach is based on the following points:

- The network is composing of N homogeneous nodes and some mobile base stations.
- The algorithm operates in n rounds
- Nodes are equal to become CHs and take over to rotate data from other members to the base station.
- Each node, elected to be CH, broadcasts a message to other no desin the same cluster. These nodes have to join this CH and then send their collected data to their closest CH.
- If a node has not taken the new CH ID, the old one should inform this node. The CH for each cluster receives the data from cluster members and then searches the BS in its range to send its data through a single-hop relay.

Conclusion

We considered a heterogeneous WSN which consists of a large number of sensor nodes, a few CHs, and a mobile BS. To rotate sensed event; we are based on the LEACH protocol. This protocol is the famous one used for mono hop WSN. We improved the existing algorithm to support multi-hop architecture and to support mobility. In this topic, we considered the problem of maximizing the network lifetime. We evaluated the performance of the proposed protocols (mobile and fixed LEACH protocol for both mono and multi-hop architecture) in terms of network lifetime, exchanged packet rate and loss the packet rate.

References

Agrawal. D. P., & Zeng, Q. A., (2003) Introduction to Wireless and Mobile Systems, 2nd ed., Books/Cole Pacific Grove, CA., pp: 381-409.

Ali, M., Saif, U. Dunkels, A., Voigt, T., Romer, K., Langendoen, K., Polastre, J., Afzal Uzmi, Z., (2006) Medium access control issues in sensor networks, ACM SIGCOMM Computer Communication Review, vol. 36, No. 2, pp: 33 - 36.

Heinzelman, W. B., Chandrakasan, A. P., & Balakrishnan, H., An application-specific protocol architecture for wireless micro sensor networks, IEEE Transactions on Wireless Communications, vol. 1, No. 4, Oct. 2002, pp: 660-670.

Heinzelman, W. B., Chandrakasan, A. P., & Balakrishnan, H., (2000) Energy efficient communication protocol for wireless micro sensor networks, in Proceedings of the 33rd Annual Hawaii International Conference on System Science, Maui, Hawaii, pp: 1-10. DOl: 10. 1 109/HICSS.2000.926982.

Intanagonwiwat, C., Govindan, R., Estrin, D., Heidemann, J., Silva, F., (2003) Directed diffusion for wireless sensor networking, IEEE/ACM Transactionson Networking, vol. 11, No. 1, pp: 2-16.

Krishnamachari, B., Estrin, D., S. Wicker, Modeling data-centric routingin wireless sensor networks Wireless Communications, vol. 1, No. 4, pp: 660-670.

Lorincz K., Malan D., Fulford-Jones T. R. F., Nawoj A., Clavel A., Shnayder V., Mainland G., Moulton S., Welsh M. (2004) Sensor networks for emergency response: Challenges and opportunities. IEEE Pervasive Computing, Special Issue on Pervasive Computing for First Response 3(4): pp. 16–23 Google Scholar.

Mezghani, M., Gatgout, R., Ellouze, G., Grati, A., Bouabidi, L., Abdellaoui, M., (2011) Multitasks generic platform via WSN, in InternationalJournal of Distributed and Parallel Systems (IJDPS), vol. 2, No. 4, pp: 54-67.

Shepard, A. T., (1996) Channel Access Scheme for Large Dense Packet RadioNetworks ACM SIGCOMM Computer Communication Review, vol. 26, No. 4, pp: 219-230.

Shnayder, V., Chen, B. R., Lorincz, K., Fulford-Jones, T. R. F., & Welsh, M. (2005). In Sensor networks for medical care. Harvard University, Tech. Rep. Technical Report TR-08-05. Google Scholar