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***Journal of Scientific and Engineering Research*, 2017, 4(4):67-73**

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

Enhancement of Network Lifetime using Mobile Sink Based Routing Protocol

V. HariPriya, R. Senthil Kumaran*

Department of ECE, IFET College of Engineering, Villupuram, India

Abstract Mobile Sink based Routing Protocol (MSBPR) is used to send the packets from source to destination directly without visiting all the regions in the scenario. Packets are not sent from source to destination directly in a previous proposed protocol. The performance of MSBRP is compared with the previously proposed protocol that is Mobile Sink-based adaptive Immune Energy Efficient clustering Protocol (MSIEEP). In that protocol Adaptive Immune Algorithm (AIA) is used to find the Cluster Heads (CHs), after finding the CH the packets are sent from source to destination not in a straight form, it sends the information region by region. Simulation result show that MSBRP is more reliable and energy efficient as compared with other protocols. Furthermore, it improves the lifetime and stability period over the previous protocol, because it always selects CHs from high-energy nodes.

Keywords Wireless sensor networks, MSBRP algorithm, cluster head, clustering protocols, mobile sink.

Introduction

Wireless sensor network is a wireless network consisting of spatially distributed autonomous device using sensor to monitor physical or environmental condition. Wireless Sensor Network (WSN) typically consists of a large number of low-cost and low-power wireless sensors. Sensors measure and monitor ambient conditions in the surrounding environment such as heat, pressure, vibration, presence of objects, etc. The measurements and monitored events are then forwarded towards a static sink. Direct transmission to sink does not guarantee well balanced distribution of the energy load among sensors of the network. Thus, many clustering protocols have been specifically designed for WSNs to improve data aggregation mechanisms, balance distribution of the energy load among sensors in WSN and thus increase the network lifetime. These protocols widely vary depending on the nodes deployment, the network and radio models, and the network architecture.

The advancements in wireless communication technologies enabled large scale wireless sensor networks (WSNs) deployment. Due to feature of ease of deployment of sensor nodes, wireless sensor networks (WSNs) have a vast range of applications such as monitoring of environment and rescue mission. Wireless sensor network is composed of large number of sensor nodes. The event is sensed by the low power sensor node deployed in neighborhood and the sensed information is transmitted to a remote processing unit or base station. The main reason in the advancement of wireless sensor network was military applications in battle fields. In the beginning but now the application area is extended to other fields including industrial monitoring, controlling of traffic and health monitoring. Different constrains such as size and cost results in constrains of energy, bandwidth, memory and computational speed of sensor nodes.

To deliver crucial information from the environment in real time it is impossible with wired sensor network whereas wireless sensor network are used for data collection and processing in real time from environment. The ambient condition in the environment are measured by sensors and then measurements are processed in order to accesses the situation accurately in area around the sensor. Over a large geographical area large numbers of sensor nodes are deployed for accurate monitoring. Due to the limited radio range of the sensor node the increase in network size increases coverage of area but data transmission i.e communication to the base station (BS) is made possible with the help of intermediate nodes.

In general the two types of wireless sensor networks are: instructed and structured. The structured wireless sensor networks are those in which the sensor nodes deployment is in a planned manner whereas unstructured wireless sensor networks are the one in which sensor nodes deployment is in an ad-hoc manner.

Related Work

Mobile sink based adaptive immune energy efficient clustering protocol is used to find the cluster head. Thus the cluster head is selected based upon the energy level, the cluster which is having higher energy is selected as a cluster head. The cluster head send the data to the mobile sink but not in a straight form. If we want to send the packet from region1 to region4 it does not send the packet straightly, first it send the packets to region2 then region3 after crossing these regions only the data is sent to region4 [1]. Energy hole problem is a critical issue for data gathering in WSN, sensor near the static sink act as a relay for far sensor and thus will deplete their energy very quickly, at last the energy hole is created in the sensor field. In this paper MSIEEP protocol used Adaptive Immune Algorithm to find the cluster head based on the higher energy level. In previously paper LEACH protocol is first clustering protocol to collect and aggregate data from the sensor. The problem of LEACH protocol is the randomly selections of cluster heads [2]. During movement of nodes network lifetime, mobility model place a vital role on the accuracy of emulation in wireless body area network. In this paper we proposed a mobility model for the movement of nodes placed on the human body, in this the forward based routing technique is used to increase the network lifetime and stability period [3]. Moving the sink to high density region ensure maximum collection of data. No of nodes send data directly to the mobile sink so the energy is saved, although it have certain limitation node which are far away from sink have to wait much for their turn so there are chances of buffer overflow is not desirable, to overcome that our scheme include NbC. It is used to communicate those region which are away from mobile sink. DYN- NbCper form other two protocol they are D-Leach, Leach in terms of stability period, lifetime [4]. Coverage problem have received increased attention recently. Different coverage problem has been proposed among that target coverage is measure the quality of services which is proved to be an N- phased problem. In target problem no of target is monitored by some sensor. Target coverage is based on Immune Clonal Selection Algorithm (IMCSA), this method is used to extend the sensor network operational time [5]. In this paper we addressed hot spot problem and proposed Mobile Sink based Routing Protocol for prolonging network lifetime. Performance of proposed strategy is compared to the static and multiple sink strategies, using metric and energy per packet and throughput. The result shows that mobile sink strategy outperformance both static and multiple sink strategy in terms of energy per packet and throughput. The performance improvement can be made by using mobile sink in cluster WSN. So MSRP is effective in prolonging the network lifetime as well as throughput than static and multiple sink strategies [6]. When the sink moves, frequent location updated from the sink can generate excessive power consumption of sensor. In this paper we proposed Intelligent Agent Based Routing protocols that provide efficient data delivery to the mobile sink. Thus the sink periodically examine its distance from the current immediate relay and initiate a new relay path, immediate relay node can receive the missed data while the sink moves out of range of the agent, the sink can receive almost every packet.IAR protocol provide efficient data delivery to the mobile sink and reduce the signal overhead and improve degraded route called triangular routing problem. Result shows that our scheme effectively support sink mobility with low overhead and the improvement of triangular routing problem [7].WLAN progressed quickly and found its wider application recently because of mobility, flexibility and low cost .WLAN has become important for future communication. QOS is a hot point of research about wireless network. Two losses are seen they are distributed loss and burst loss. Random uniform model and Gilbert Elliott model are used to abstract and stimulate the case [8]. Important issue for wireless sensor network is finding way to decrease the consumption. LEACH is an efficient clustering algorithm where nodes within a cluster send their data to a local cluster head, thus the mobile sink is used to reduce the consumption and rendezvous node to act as a store point for MS, thus the mobile sink and rendezvous is combined with LEACH algorithm. This combination is an efficient method when compared to LEACH algorithm incase of energy consumption [9]. Many data dissemination protocols have been proposed to allow the dissemination of collected data toward a sink. Mobile sink were shown to be more energy effective than static once. In static method direct diffusion method is done even though it send the information to the mobile sink, it does not scale with the network size and increase the network blockage. In a proposed system the blockage is reduced and the network life time is increase [10]. Control sink mobility is used to increase the network life time. In this mixed integer linear programming is used to maximize the life time, another method is Greedy maximum residual energy is drawn towards the area where nodes have the highest residual energy. The different mobility scheme are compared to ns2 based simulation in networks with different data routing protocol and constrained on the sink movement. In all consider scenario, we observe that moving the sink is an efficient way to increase the network life time. In this paper controlling the mobility of the sink leads to remarkable improvement and increase the network lifetime [11]. The sink is not able to move thus the propagation of data is not efficient. In this paper the sink is able to move data propagation is done efficiently, but the network life time is not increased [12].

Proposed System

Mobile Sink based Routing Protocol (MSBPR) is used to send the packets from source to destination directly without visiting all the regions in the scenario. It improves the lifetime and stability period over the previous protocol, because it always selects CHs from high-energy nodes. In MSRP, the sink moves to CHs having higher energy in the clustered network to collect sensed data from them. There are two phases, they are

- Set up phase
- Steady state phase.

A. Set up Phase

In a set up phase Sink node finds the selection of cluster heads based on the energy level. It also finds the location of CHs. After selecting CH and its member, sink node broadcasts two short messages. First message is sent to the CHs to inform each one by IDs of its members. Second message that contains CHs ID sent to member nodes to inform each node to join.

B. Steady state phase

In a steady state phase each CHs creates TDMA schedule by assigning time slots to its member nodes. TDMA schedule is used to avoid intra-cluster collisions. Every CH selects a unique CDMA code and informs all member nodes within the cluster transmit their data to the mobile sink node.

C. Network model and assumption

System model has the following properties:

- Sensor nodes are mobile and each one knows its location.
- Sink node is mobile.
- Communication channel is symmetric (i.e., the same energy required to transmit a message between any two sensor nodes.
- Energy consumed for transmitting and receiving ‘l’ bits of data to a distance ‘d’ is,

$$E_{Tx}(l,d) = \begin{cases} l * E_{elec}^{Tx} + l * \varepsilon_{fs} * d^2, d > d_0 \\ l * E_{elec}^{Tx} + l * \varepsilon_{mp} * d^4, d \geq d_0 \end{cases}$$

$$E_{Rx}(l) = l * E_{elec}^{Rx}$$

Threshold value,

$$d_o = \sqrt{\frac{\varepsilon_{fs}}{\varepsilon_{mp}}}$$

ε_{fs}- Energy consumption factor for free space.

ε_{mp} - Energy consumption factor for multipath radio models.

D. Algorithm for MSBRP

1. Initialize the network with mobile sink node.
2. Send request for node ID, position and the energy level.
3. Find the location of CHs in the region.

4. Calculate the distance between the sink and the cluster heads is given by,
   $d_0 = \sqrt{(x_i - x_o)^2 + (y_i - y_o)^2}$.
5. When sink moves near to the cluster head after reaches within the range of the cluster, sink node gathers information.
6. After gathering the information from the CH, sink nodecalculates the distance from the sink to the next CH.

The same procedure is repeated until the sink node gathers information from all sensors through cluster heads.

Simulation Results

NAM SCENARIO FOR MSBRP

Simulation tool used: Network simulator2

Table 1: Simulation Parameters

Parameters	Values
Number of nodes	100
Initial energy	100 joules
Simulation area	1000 m * 1000 m
Energy consumed for transmitting / receiving per bit	50 nJ/ bit
Free space energy consumption factor	10 pJ/bit/ m^2
Energy consumption factor for multipath radio models	0.0013 bit pJ/bit/ m^4

A. Network Animator Window

Figure 1: NAM window

Packet Delivery Ratio (PDR)

Packet delivery ratio (PDR) is the ratio of packets that were received successfully by the destination, to the packets originated by the source.

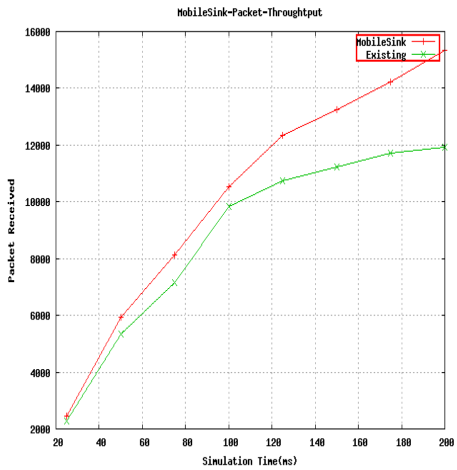

Figure 2: Packet Delivery Ratio

Packet delivery ratio in the existing protocol (MSIEEP) is very low. In MSBRP the packet delivery ratio is high.

D. Number of Alive Nodes

The number of nodes that have not yet expended all of their energies.

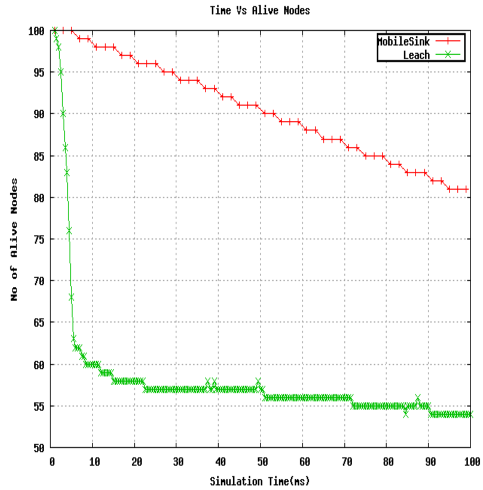

Figure 3: Number of alive nodes

E. End to End Delay

This measures the average time it takes to route a data packet from the source node to the sink.

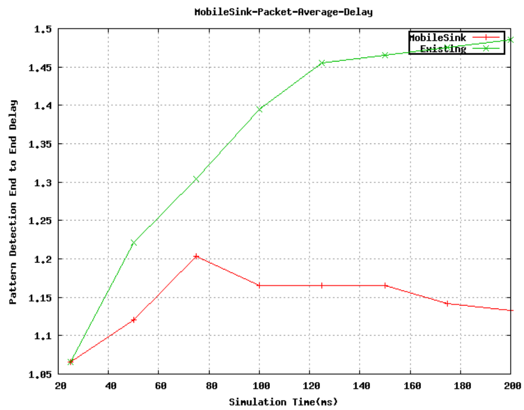

Figure 4: End to end delay

Delay is reduced in the proposed system when compare to existing protocol.

F. Average Remaining Energy

Average remaining energy of nodes for each round is main important factor in wireless sensor networks.

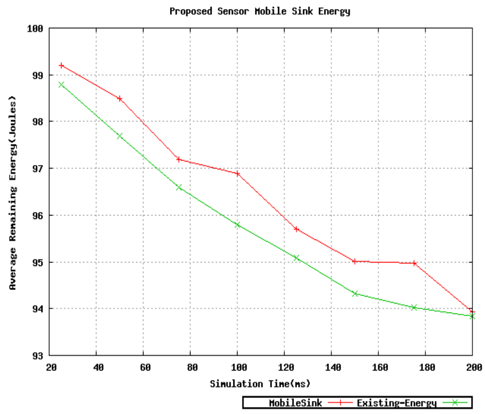

Figure 5: Average Remaining Energy

Average remaining energy of existing protocol is low compare to our proposed protocol. Therefore energy efficiency of MSBRP protocol is better than the existing protocol.

Conclusion

In this work energy efficient distributed clustering approach is presented called Mobile Sink Based Routing protocol (MSBR) for wireless sensor network. This approach can be applied to the design of several type of sensor network protocol that requires energy efficiency, scalability, prolonged network lifetime. Simulation results show that MSBR prolong network lifetime than MSIEEP and LEACH protocol. From the graph analysis, it is obtained that this protocol is able to deliver more data packets than the original MSIEEP and LEACH protocol.

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