MOBILE SINK TRAVERSAL AMONG WIRELESS SENSOR NETWORK USING REINFORCEMENT LEARNING TO REMOVE HOT SPOT PROBLEM

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Abstract

Clustering is playing key role in Wireless sensor network after the evaluation of LEACH protocol. Cluster head formation is depends upon the residual energy of SNs. Cluster heads used to send their data after collection from SNs to sink. Now if the sink placement is nearby any cluster head than hot spot problem occurs. In this problem the nearby SNs are also sending their data to sink and cluster heads, hence overburden occurs. This leads to higher energy consumption and decreases the network lifetime. To address this problem, we are presenting mobile sink traversal using reinforcement learning technique. We have compared this technique with existing TTDD algorithm and found good results on the matrices of energy consumption and network lifetime.

Keywords: *Clustering, Mobile sink, Reinforcement learning, Data collection and latency*

1. Introduction

Wireless sensor network is sensing various environment changes and log the record in servers through sink and gateways. Much research study has already done in this regard which shows that whenever sink is static, the energy consumption is high and hot spot issues appears very frequently. So presently researchers have focused their attention towards sink mobility to save the energy consumption and to remove hot spot problem. In this research study we are presenting mobile sink traversal algorithm based upon reinforcement learning [01]. We have also compared our proposed algorithm with existing TTDD [11] algorithm to better prove our research study.

2. Review of Literature

We have performed literature review study to fully understand issues with mobile sink traversal. In (02), authors proposed two algorithms RkM and DBRkM for path formation of mobile sink. In (03), TTDD [11] protocol is designed where WSN is partitioned into virtual grid based upon the mobile sink node. In (04), here research study focuses on energy efficient routing and clustering algorithm which are based on PSO algorithm [02-04]. In (05), here authors proposed EAPC method which construct a data collection a path and selects the eligible sensors to work as a collection point head.

3. Problem Formulation and our contribution

After the evaluation of LEACH protocol, every research study includes clustering to form cluster head to save the energy consumption [04]. Later on these cluster head collects data from their SNs and send directly to sink. The problem arises when any cluster head is near to sink, in this situation the sink receives the data from cluster head as well as receive the data from other nearby sensor nodes [06-09] also. Hence the sink become overloaded which leads to high energy consumption. This situation in known as hot spot problem in wireless sensor network [05]. In this research study we have proposed below contribution to address this problem:

- Mobile sink traversal using reinforcement learning [01]
- Comparison of proposed algorithm with existing TTDD [11] algorithm

4. Proposed algorithm

The proposed mobile sink traversal algorithm using reinforcement learning is as follows:

Step 01: Mobile sink works as a learning agent of reinforcement learning and used to Store state and action.

Step 02: The learning agent start traversing to cluster heads for collection of data. The Learning agent used to store rewards based upon state and action values and Forms the policy.

Step 03: Now the learning agent used to take experience from newly formed policy from Step 02 to collect the data from mobile sink.

Step 04: After collecting data from cluster head, the mobile sink used to move for next Cluster head through available traversal path.

Step 05: The mobile sink contains Q-table which is frequently updated by new state, Action and reward value. These values update the policy which is later used by Mobile sink to collect the data from cluster heads.

5. Simulation of Proposed algorithm and Result

We have performed the simulation of our proposed algorithm in MATLAB 2012 (a) [12] with following parameters specified in table 01:

Table 01	
Communication Range	50 m
Simulation Area	100 X 100 m
No of SNs	100
Learning Rate (α)	0.6,0.7,0.8
Discount factor (ϒ)	0.2,0.3,0.4
Initial Energy (in jule)	10 mJ
Range of transmission	50 m
Rate of Packet Generation	05 s
Mobile sink traversal speed	01m/s, 02m/s, 03 m/s
Simulation time	100 seconds
No of rounds	20,40,60,80,100

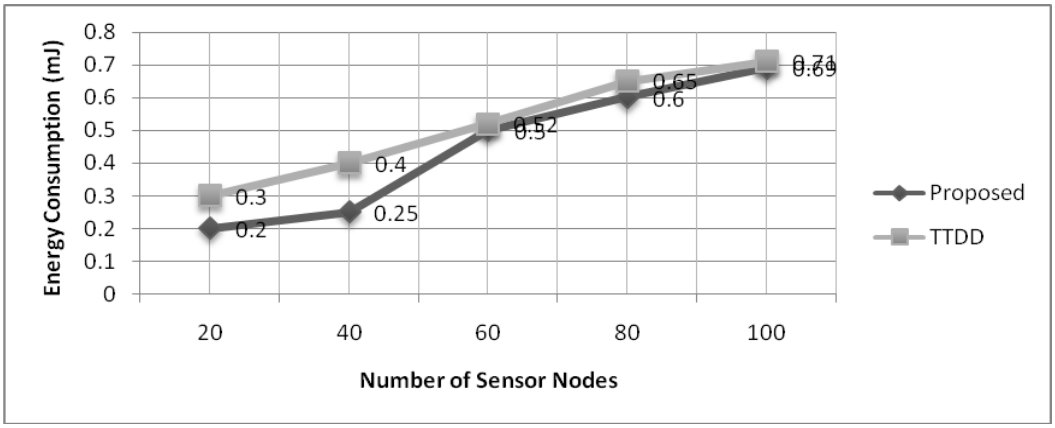

Figure 01: Energy Consumption

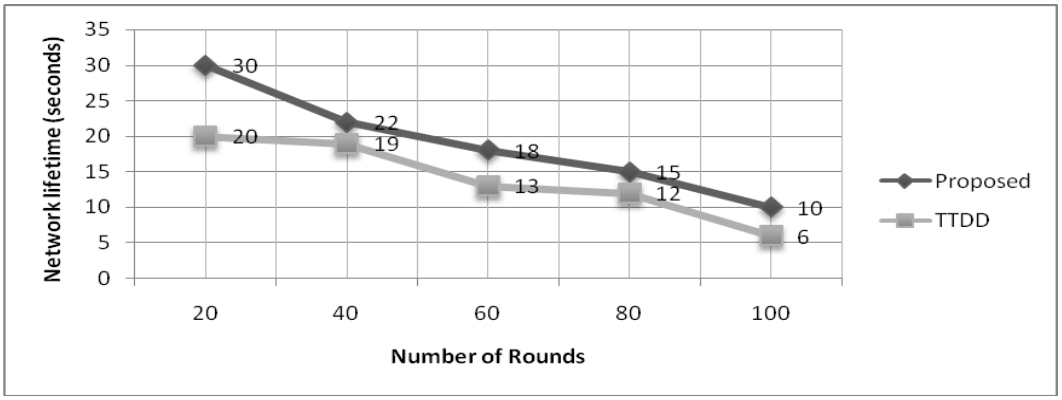

Figure 02: Network Lifetime

5.1 Result

The figure 01 clearly specifies that our proposed algorithm is performing better than existing TTDD [11] algorithm in the terms of energy consumption. Figure 02 represents lifetime of network [10], in this case our proposed algorithm performs well.

6. Conclusion and Future Scope

In this research study, we have mainly focused on mobile sink traversal using reinforcement learning based upon certain performance parameters like energy consumption and network lifetime. We found from simulation results that our proposed algorithm performs well. In future, we will test our proposed algorithm with other performance parameters like PDR, throughput and delay with more than 100 sensor nodes.

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