THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

Sink Mobility based Clustering Technique for Synchronization in Sensor Networks

Dr. R. Manjula
Associate Professor, SCOPE, VIT University, Tamil Nadu, India
V. Dinesh Kumar
M. Tech. Student, Department of CSE, SCOPE, VIT University, Tamil Nadu, India

Abstract:
Recent rapid advancements in technology and wide usage of smart devices prompting wireless sensor networks to be an important area for researchers. Wireless sensor networks has wide range of applications say domestic, industrial, military etc. where number of small sensors are deployed to sense the data, making the synchronization an issue as data is to be fused at the destination .In this paper we discuss an time synchronization method along with sink mobility which is based on sender- receiver communication for data fusion purpose. Sink node is provided with endless energy travels along a trajectory and stays at sojourn locations for a while to collect the local-synchronized data among cluster heads. Global synchronization is done with respect to base station thereby increasing the lifetime of the network.

Keywords: *clustering, synchronization, sink mobility*

1. Introduction

Wireless sensor networks, the objective of WSN's are to sense the data from the remote areas. As much number of sensors can be involved in each system data fusion plays an important role to draw meaningful information from the data collected. Sensor networks works in a distributed systems manner hence synchronization plays a prominent phase to get the concluded data at the base station.

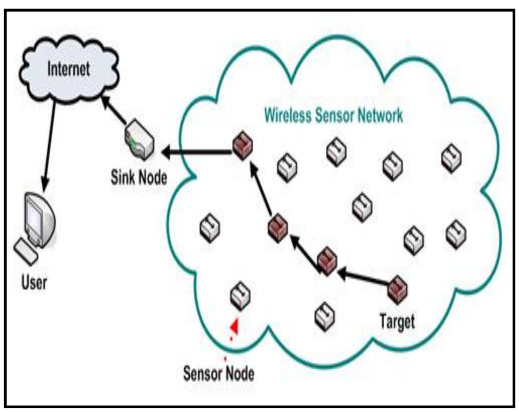

Figure 1: Wireless Sensor Networks [1]

WSN is a disturbed network that consists of several nodes located at different positions and each node is provided with a computational, communicational and sensing capabilities, as each node maintains its own physical clock for time stamping the order of events the Time Synchronization problem still exists in wireless sensor networks from past two decades in spite of good amount of research. Geo Positioning Satellite system (GPS) and Network Time Protocol (NTP) are commonly used methodologies for clock synchronization. as WSN's can't afford structure and more expenses these methods cannot be used in Wireless Sensor Networks. Time Synchronization Protocols comes in to picture with the failures of GPS and NTP in WSN's, various synchronization protocols such as Lightweight Fault-tolerant Time synchronization [6], TPSN [5], Reference Broadcast Synchronization [3] (RBS), Post facto synchronization [3] and Romer synchronization [4] are analysed from years and according to the scenarios suitable protocol is applied for betterment of results. The Time Synchronization block diagram structure with respect to TPSN Protocol is given in the following figure

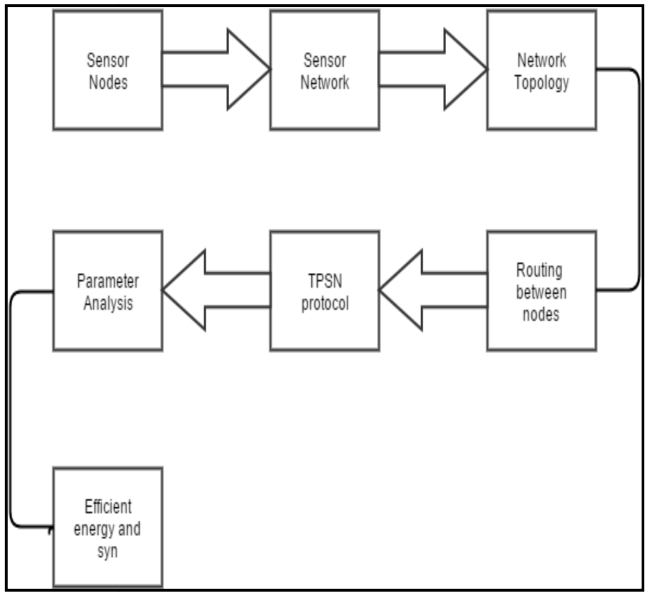

Figure 2: Block diagram of Time Synchronization

First step is to design networks with a certain number of nodes and then creating network topology and then setting sensor network. Next step is to establish routing between the nodes using routing protocol. The routing protocol used here is Destination sequenced distance vector routing protocol (DSDV) routing protocol, it is a table driven routing protocol. Each entry in the routing table contains a sequence number, the sequence numbers are generally even number if a link is present; else, an odd number is used.
After providing routing between the nodes, implementing the Timing-sync protocol for sensor network (TPSN).TPSN is a clock-sync protocol and it is based on the spanning tree structure, where the leader node is selected. Final step is that simulating the timing-sync protocol under three different parameter overhead, data rate and synchronization accuracy
WSN are used to sense diverse attributes of environment by using wireless sensors. Wireless Routing Protocols strive to ensure efficient data transmission in WSN. As the proficient energy utilization is very important acquisition in WSN, it is possible by using sink mobility in WSNs. Routing protocols, that attempt to ensure proficient energy consumption in WSN mostly spotlight on the sensors, while a current development specifies a focus shift to the activities of base station which can be utilized to advance the network lifetime As far as, the routing protocols LEACH, IEEPB [7], DEEC [8] and SEP [9] are not sufficient to overcome the energy dissipation of sensors competently so there is a need to utilize sink mobility in WSN to maximize network lifetime. Fixed path mobility is really efficient for its application in enhancing the network throughput. On one hand, a mobile sink can minimize the energy utilization of sensor nodes by collecting information at their place, whereas on the other end it lessens the delay in data delivery for all the nodes in chain.

2. Literature Review

Time Synchronization protocol operates in three nodes, first one in unidirectional mode, with a basic technique a reference node essentially shows a reference clock sign to different nodes. Which revise their time with the reference clock. This technique is the most seasoned and least difficult system for synchronization with the system time. The most old and common approach used in unidirectional mode is The Flooding Time Synchronization Protocol (FTSP) [2] where local clocks of the nodes are synchronized. It utilizes single radio message time stamp to synchronize the different receivers. This protocol offers multi-hop synchronization. Here, the root node keeps up the global time and all other nodes synchronize with the root node
Second, receiver-receiver synchronization, Elson and al [3] have proposed the RBS approach which utilizes the idea of receiver-receiver synchronization. The later has been, saw as reference to a few works in the same line of consideration (Synchronization Solution). The RBS synchronization component depends on the abuse of the way of dispersion of remote medium. With this property, the hubs in the transmission scope of the same area in the crossing point of two neighbourhoods would be synchronized. Regardless of the points of interest of end of real sources of indeterminism, transmitter gets the same message with a low offset.
Third, sender-beneficiary utilizes the round outing time of the message to revise the balance and proliferation delay. In figure 2 we detail a sample of the essential operation, which incorporates three successive stages. To begin with, node A send it's neighbourhood time at t1, furthermore, node B gets the message at time t2 and records it's clock, then, time t2 is ascertained as $t2=T1+d+\delta$, where d is the propagation delay and δ is the clock offset.

$$D=(T2-T1)+(T4T3)/2$$
$$\delta=(T2-T1)-(T4-T3)/2$$

TPSN is a hierarchical algorithm which deals with two distinct stages: The discovery and synchronization stage. In the initial stage, we give a system node level. The node that starts the synchronization is known as the root node with the estimation of level zero neighbours with n jumps (n=1, 2, 3, K) have the estimation of level n. This procedure proceeds until all neighbours adjust their levels. In second stage, a pair wise synchronization is performed along the edges of the hierarchical structure up to all out synchronization of the tree built with the message altercation system.

The issue of information accumulation and versatile sink is broadly studied in the literature [10]. A prominent method for sink versatility is Clustering and Set Packing Technique [10]. It manages the unique plan, got from the set packing technique and travelling salesman problem. By plan, the sink partitions the region into clusters on the premise of Set Packing Algorithm and decides the course between group heads by means of travelling salesman problem. EART [11] prescribes multi-way directing thought, which guarantees enhanced Quality of Service (QoS) by inspecting parameters, for example, steady quality, convenience and energy in WSNs. DAMLR [12] is a helpful system that uses very much concentrated on direct programming and Lagrangian strategy to design greatest lifetime calculation. It can accomplish appropriated calculation in light of the sub-slope strategy to decide sink visit times and directing stream vectors to sink stay areas. The real confinement in the above methodologies is that, they don't indicate the configuration of sink portability for directing conventions, for example, LEACH, SEP and PEGASIS.

3. Proposed Method

3.1. Balanced Clustering

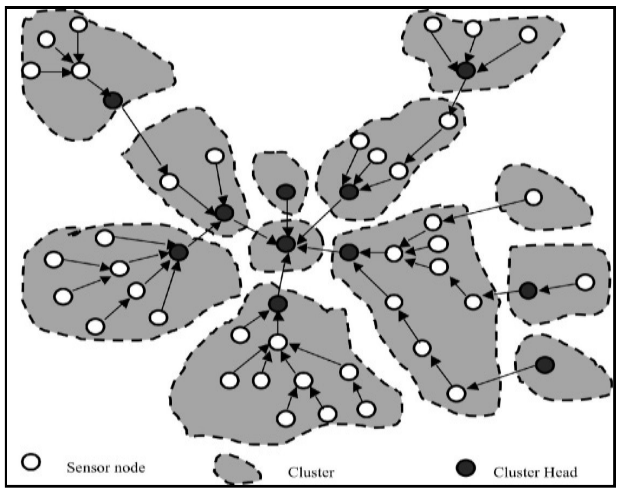

Figure 3: Balanced clusters formation.

The proposed method is based on the thought that local clock offset difference increases as number of levels increases. Considering this condition our method is based on balanced clustering technique along with sink mobility to increase the lifespan of the network and to decrease the complexity among the nodes. Network compromises of sink node, cluster heads, normal nodes and gateway nodes for communication between the clusters .The following figure demonstrates the setup of the balanced clustering model.

Assumptions made in clustering time synchronization and sink mobility are as follows

- N sensor nodes are deployed randomly in the network.
- Initially root node is located at the level-0.
- Nodes are unaware of their locations.
- The cluster heads are elected randomly and knows the locations of sensor nodes.
- Local synchronization phase.
- Nodes are synchronised with respect to the Cluster heads.
- Sojourn locations are identified by the sink node.
- Trajectory is drawn joining all the sojourn locations.
- Sink node moves accordingly and waits at each sojourn location to collect the data.
- Global synchronisation phase.
- Cluster heads are synchronised with respect to Sink node.

Synchronization plays an important role in making Wireless Sensor Networks energy efficient, TPSN [5] (Time Synchronization Protocol for Sensor Networks) is used for synchronizing data and this approach is categorised into two phases:

1. Level Discovery phase
   a. Create a TPSN hierarchy
   b. Define the number of children for each parent.
   c. Define the depth for each cluster
2. Synchronization phase
   a. Synchronization inter cluster
   b. Global synchronization

3.2. Sink Mobility

The utilization of sink mobility in Wireless sensor systems (WSN) is normally perceived as a standout amongst the best method for load balancing, at last prompting less dead nodes and longer system lifetime. The point of this part is to give a far reaching outline and assessment of different WSN organization techniques including sink mobility as examined in the literature to date. The assessment of the reviewed methods is construct not just in light of the conventional execution measurements (energy utilization, system lifetime, packet delay), at the same time, all the more significantly, on their functional feasibility in real-time WSN applications.

The traditional Wireless Sensor Network (WSN) system, as depicted in various researches accept the presence of an expansive number of smaller than expected battery-controlled sensor nodes scattered over anarea of interest and sorted out in a specially appointed correspondence way. The objective of the wireless sensors is to assemble important information from environment and usually forwarded to the sink. The sink is by and large accepted to have far predominant abilities than the "standard" sensors, i.e. hubs, and it serves as a passage point to the end client of the framework.

From the routing point of view, the routine many to-one WSNs depend on multi-hop communication, i.e. directing, to convey information to the sink.A basic issue for data gathering in wireless sensor systems is the arrangement of energy gaps close to the sinks. Sensors close to the sinks need to take an interest in handing-off information for the benefit of different sensors and therefore will drain their energy rapidly, resulting in system dividing and limitation of the system lifetime. The arrangement that we propose in this paper is to utilize mobile sinks that change their location when the close-by sensors energy turns out to be low. This way the sensors situated close to sinks change after some time. In choosing another area, a sink looks for zones with more sensor energy. To start with, we think about the change in system lifetime when sinks proceed onward a predetermined way, along the margin of a hexagonal overlaying. Two cases are considered for information gathering when sinks stop in the hexagonal corners and when the sinks stop on different areas on the hexagon border. This study demonstrates that there is increase in the system lifetime. Second, we plot a conveyed and localized algorithm utilized by the sinks to choose their next development location such that the virtual backbone formation by the sinks stays interconnected at all times. Simulation results are exhibited to check the approach.

3.2.1. Sink Mobility in Wireless Sensor Networks

The concept of using mobile sinks is used to balance the energy consumption. A lot of researches have been done in this area. There are 3 major phases involved in applying Sink Mobility to Wireless Sensor Networks to maximize the performance of network: Sink node movement, data packets routing and data gathering.

Step 1: Sink Node Movement:

The base station location computation method using Integer Liner Programming to prolong network lifetime and data throughput considering the base stations located at the boundary of the network area. The optimal positions of relay nodes are computed using an ILP to extend lifetime.

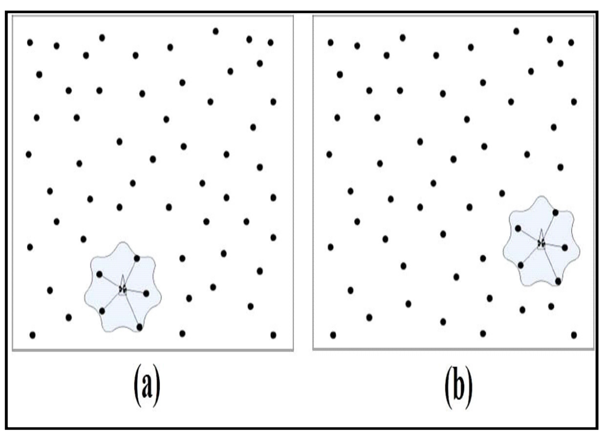

Figure 4: sink node at (a) Initial position (b) Final position

Step 2: Data Packets Routing:

Energy efficiency is a crucial topic in designing WSNs. The energy utilization is to a great extent because of data transmissions - both sensor-to-sensor and sensor-to-sink. In this manner a proficient transmission way will enhance the energy usage in the framework and spare more energy. Unique Routing approach called Mobile Sink Routing Protocol is utilized to accomplish energy efficient routing for Data transmission hat makes routing decisions locally and when selecting a neighbouring node, it depends on two major factors: average energy and distance in transmission. Pre-estimation scheduling scheme and Routing scheme are two phases in the sink routing protocol. In the scheduling scheme the schedule queue set up is built on the average lasting energy of the sensors and the distance from the current cluster head to another head. All data is stored in the sink's routing table.

Step 3: Data Gathering:

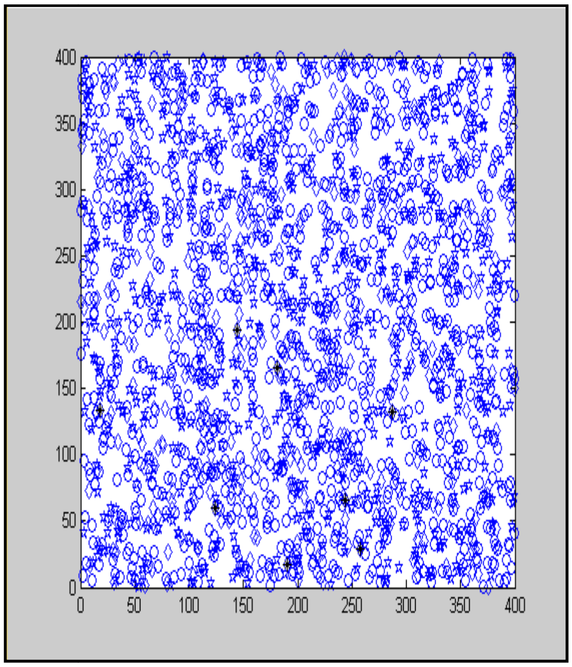

Figure 5: Nodes plotted in a network.

The issue of information accumulation in scanty sensor systems is experienced in numerous situations, for example, checking physical situations, creature movements in remote-ranges, climate conditions in national parks, territory observing on remote islands, city activity checking and so on. The goal is to gather information from sensors and convey it to an access point in the infrastructure. One imperative issue in executing mobile sink nodes in Wireless Sensor Networks is the means by which the sink assembles information from static sensor nodes while sink node is moving. As the location of the sink is dynamic, sensor nodes are empowered to send the information bundles to the sink.

4. Simulation analysis and Inferences

This section contrasts the execution of balanced cluster model with static sink node and with sink node mobility. The sensors are recreated to send over the square estimated range. Simulation is performed using MATLAB, Figure 5 describes how the nodes are plotted in a network, Figure 6 shows how the nodes are divides into clusters and number of clusters formed, Figure 7 shows the simulated analysis of balanced clusters with static sink node and Figure 8 depicts the simulated graph with sink mobility node. We have compared the performances of both models discussed and draw a conclusion that mobility sink node offers a better network lifetime than the static sink node method. Through analysis drawn from the respective simulated diagrams we state that a sink mobility applied network lifetime increases and it can be handy only for larger networks.

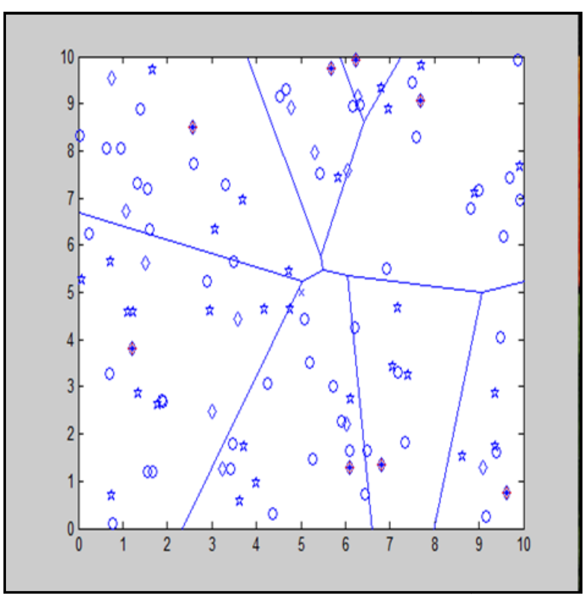

Figure 6: Clusters formed

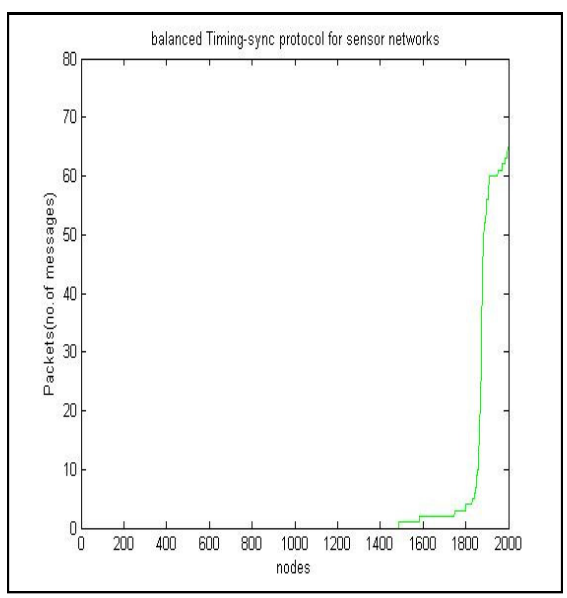

Figure 7: balanced clusters with static sink node.

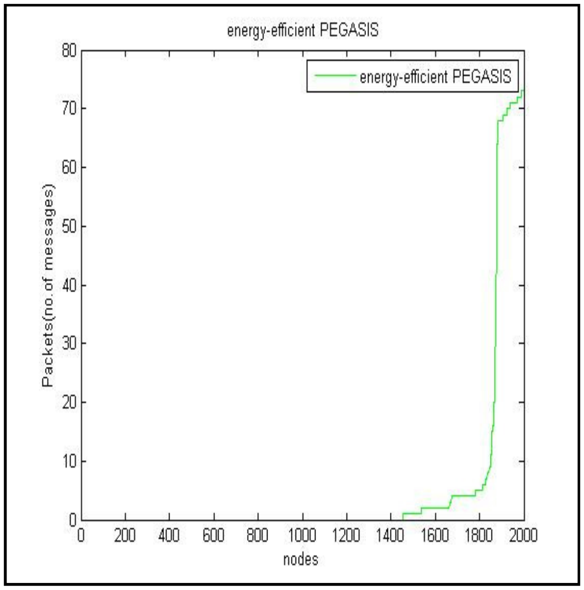

Figure 8: balanced clusters with sink mobility node.

5. Conclusion

In proposed method sink node is given with unlimited energy and made mobile. Sojourn locations are identified and sink node moves in a path through the sojourn locations and collects data. In existing approach Sink node is made static and message packets collected by cluster heads are forwarded to sink node. As sink is static the energy of the nodes in the clusters dry soon and die eventually at some point of time making the communication break and decreasing the network lifetime. By simulated graphs in Fig.7 and Fig.8 we conclude that in sink mobility method more number of packets transmitted and lifetime of the network is maximized.

6. References

i. http://monet.postech.ac.kr/images/intro duction/image007.jpg
ii. EL. Salim, N. NASRI and A. KACHOURI, "Diverse Synchronization Issues in Wireless Sensor Networks," The 23rd international conference onmicroelectronics (ICM 2011). Tunisia, December 2011.
iii. J .E.Elson, L.Girod and D.Estrin, "Fine-Grained Network Time Synchronization using Reference Broadcasts." The Fifth Symposium on Operating Systems Design and Implementation (OSDI), p.147-163, December 2002.
iv. K. Romer, "Time synchronization in ad hoc networks," Proceedings of ACM Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc'01), pp. 173–182, 2001.
v. S. Ganeriwal, R. Kumar, and M. Srivastava, "Timing-Sync protocol for sensor networks," Proceedings of First International Conference on Embedded Networked Sensor Systems, Los Angeles, California, November 2003.
vi. S. Seareesavetrat, C. Pornavalai, R. Varakulsiripunth, "A light-weight fault-tolerant time synchronization for wireless sensor networks," 8th International Conference on ITS Telecommunications, 2008. ITST 2008, pp. 182-186, 2008.
vii. Sen, F., Q. Bing and T. Liangrui, 2011. "An improved energy-efficient pegasis based protocol in wireless sensor networks," in Fuzzy Systems and Knowledge Discovery (FSKD), 2011 Eighth International Conference On, 4: 2230-2233.
viii. Meelu, R. and R. Anand, 2011. "Performance evaluation of cluster-based routing protocols used in heterogeneous wireless sensor networks," International Journal of In-formation Technology and Decision Making, 4(1): 227-231.
ix. Haibo, Z., W. Yuanming and X. Guangzhong, 2009. "Edfm: a stable election protocol based on energy dissipation forecast method for clustered heterogeneous wireless sensor networks," in Wireless Communications, Networking and Mobile Computing, 2009. WiCom'09. 5th International Conference On, pp: 1-4.
x. Nakayama, H., Z. Fadlullah, N. Ansari and N. Kato, 2011. "A novel scheme for wsan sink mobility based on clustering and set packing techniques," Automatic Control, IEEE Transactions On, 56(10): 2381-2389.
xi. Ghaffari, A., S. Taghipour and M. Attari, 2012. "Eart: Energy aware routing algorithm for realizing the reliability and timeliness in wireless sensor networks," World Applied Sciences Journal, 17(9): 1205-1210.
xii. Gatzianas, M. and L. Georgiadis, 2008. "A distributed algorithm for maximum lifetime routing in sensor networks with mobile sink," Wireless Communications, IEEE Transactions On, 7(3): 984-994.