

A Survey on Data Aggregation cluster based technique in wireless sensor network for modern railway track monitoring

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ABSTRACT: Accidents occurring in railway transportation systems cost a large number of lives. Many people die and several others get physical and mentally injured. There is certain need of advanced and robust techniques that can prevent these accidents. Track maintenance is the primary concern for railways to prevent accidents. Human inspections of the track are subjective and consume a lot of time. Wireless Sensor Network can provide the integrated view of the entire railway asset and thus can reduce human inspection requirements through automated monitoring. The survey on cluster based routing techniques that can be used to reduce communication cost, Data aggregation techniques to reduce data redundancy and help to transmit useful information and fault detection techniques to identify the faulty nodes in the network.

autonomous sensors which are equipped with wireless communication devices to monitor or collect the information from various environments [4]. Data aggregation aim to combine the data coming from different sources. It also reduces the redundancy; minimize the number of transmissions so save the energy [5]. Many routing protocols are proposed to make the network energy efficient [6].

This paper presents an overview of what WSN is and why data aggregation is required and it also focuses on reducing the power consumption of WSN by using clustered based approached protocols namely LEACH by taking certain Clustering Parameters into consideration like number of nodes, overlapping, algorithm complexity.

KEYWORDS: railway track; security; WSN; Data Aggregation technique.

II. RELATED WORK:

I. INTRODUCTION:

Railways are very large infrastructure for transportation in many countries [1]. Railway transportation system involved high risk like human lives and also infrastructure cost. The common causes of train accidents are mechanical failure, problems with the track, and crashes with other trains and vehicles etc. This shows that proper maintenance is required to govern such issues. The major reported accidents are occurring due to improper maintenance in train tracks. So, track Monitoring system is required to maintaining the safety of the railways [2]. In recent years, track monitoring is done by human inspection but it consume lot of time because they use the rail cycle for inspection so this approach is create a more delay to other scheduled train [3].

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Wireless sensor network technology is widely used for system monitoring such as railway security, transportation system etc. WSN consist of number of distributed

The use of sensors in Rail Track inspection has been studied for a long time. Types of the sensors and configuration to be used are given in the paper [7]. An automatic inspection system is proposed in the paper [8] but it is limited to the track bed and the rails. A new system for detecting the railway tracks and avoidance of collision in the tracks which is based on IR Rays & Sensors has been presented in paper. The trains coming from opposite direction also have the same option. The algorithm [9] is based on the simultaneous use of movable and fixed sensor network design and has the ability to send information as online-offline. Movable algorithm, displays how to collect information of fixed sensor network by installed networks on the locomotive or monitoring cars, it also check the balance point line and register in a data position. In this system, GPS will detect coordinates of points that their data is registered. The authors [9] have proposed a model in which wireless sensor network are deployed along a railway track. The network consists numerous control centers (sink nodes) that are connected through a wire lined connection, and the sensor nodes are deployed along the railway lines. The Proposed algorithm is motivated by this work and is an attempt to make this method energy efficient. The main disadvantage of the work is that sensor nodes will sense the normal vibration for most of the time, so it is not

optimal to send the normal vibration difference which is zero always to the next levels. This is wasting much battery power of the sensor nodes and poles.

III. SIGNIFICANT of WIRELESS SENSOR NETWORK CHARACTERISTICS

Wireless Sensor Network considered as real time embedded system deployed in a particular region to sense various types of environmental parameters [12]. Wireless Sensor Networks are widely distributed sensors (nodes) to measure change in physical and environmental conditions by sensing variations in temperature sound pressure etc.to achieve this purpose sensor nodes work together in predetermined to transfer the data to a main location.

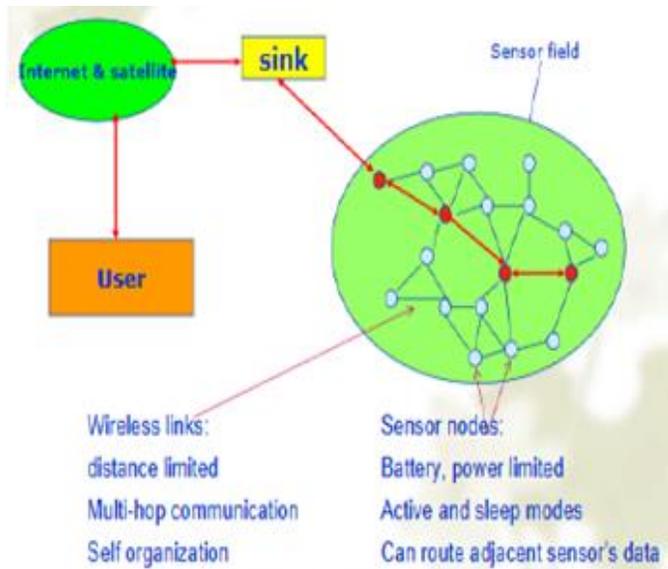


Figure 1: Architecture of WSN

A typical design of WSN is shown in the figure1 where the sink node is collecting data from the sensor nodes and giving it to the server (internet in this case) which providing the data to the user[13].

Basic Characteristics of the WSN

- a) Limited power consumption of sensor nodes when nodes works on batteries.
- b) Nodes are mobile opposed to conventional wires.
- c) Use in harsh environment.
- d) Nodes can be placed in any fashion over an area.
- e) Easy to use and multi-layer design operation.

IV. DATA AGGREGATION TECHNIQUES

To avoid duplication and save resources (energy and bandwidth) data aggregation is used [10]. In a Wireless Sensor Network number of nodes collect information and this information is transferred to base station where it is processed in doing so high amount of battery consumption take place, at the same more bandwidth is being consumed to avoid this data is processed at various nodes before giving it to the sink node such processing is called Data Aggregation [11].

Data Aggregation is the process of aggregating the sensor data using aggregation algorithms like, LEACH(Low Energy Adaptive Clustering Hierarchy), TAG(Tiny Aggregation),HEED(Hybrid Energy Efficient Distributed).This aggregated data is transfer to the sink node by selecting the efficient path.

The objective of data aggregation is to reduce the required communication at various levels, and so as to reduce the total energy consumption [10]. When energy consumption for aggregation is less than energy consumption for raw data transmission to the upper level, data aggregation saves energy.

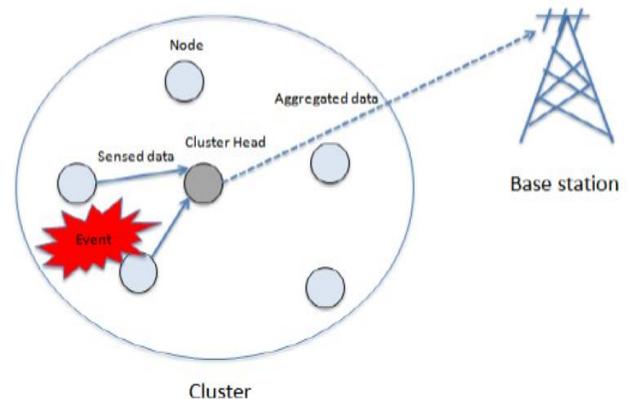


Figure2: Data Aggregation

A. Features of Data Aggregation

- Increasing network lifetime by using resources in an exciting manner using many algorithms
- Using Shortest Path algorithms nearest node is reached.
- There are four Data Aggregation techniques :
 - a) Centralized Approach

- b) In-Network Approach
- c) Tree Based Approach
- d) Cluster based Approach

a) Centralized Approach:-

In this method, each sensory node selects the most powerful node among its neighbors and sends it the data packets via the shortest possible route. This node is known as header node which perform the data aggregation and combining the data packets in single packet.

b) In-Network Approach:

In this approach there are two types:
 With Size Reduction: - All the data are collected from different nodes and by using many methods to reduces the power.

Without Size Reduction: - it is only used for aggregating the data and convert into single packet for additional transmission.

c) Tree Based Approach:

A tree is generated is known as data aggregation tree. For all the transmission minimum spanning tree is created. Each node acts as leaf send its data to parent node, which acts as branch node, and data in this way flows from leaf node to sink and the final parent node does the processing.

d) Cluster based Approach:

Most efficient approach in which network is divided into clusters containing various nodes in each. In each cluster, one node is selected as Cluster Head this done using algorithm and after one process cluster head changes so that optimization can be achieved[10]. These cluster heads perform the aggregation reducing the packet size as well as redundancy and then transmit the packet to required location.

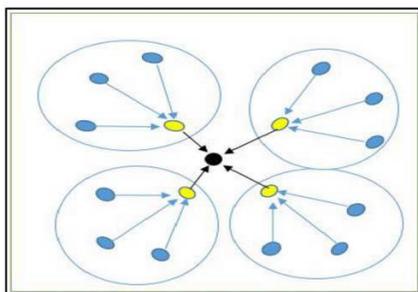


Figure3. Cluster Based Data Aggregation[10]

Comparison between Various Data Aggregation Approaches:

Approach	Delay	Redundancy	Accuracy	Traffic	Energy Consumption
Centralized	Moderate	Moderate	Moderate	High	High
In-Network	Moderate	Moderate	Less	High	Moderate
Tree	Less	Less	Moderate	Moderate	Less
Cluster	Less	Less	High	Less	Less

Table1. Comparison between various approaches [11]

Based on the Comparison between various approaches, cluster approach is a best technique because, by using this approach energy consumption is less also accuracy is high. Clustering - based aggregation protocol is approach in WSN for minimum communication and maximize overall network lifetime. Clustering reduces direct transmission to the base station by in network data aggregation as well as decreases energy consumption by reducing the transmitting distance. Better aggregation for large number of nodes is provided by Hierarchical clustering. Hierarchical Clustering protocols are extremely useful rather than single-tier communication considering the area where sensors needed to be deployed and the battery energy of the sensors. Grouping Sensor nodes to form cluster is widely accepted in order to fuse data and make aggregation possible leading to saving energy of many intermediate nodes.

V. CLUSTERING BASED PROTOCOL LOW ENERGY ADAPTIVE CLUSTERING HIERARCHY (LEACH)

The main aim of this protocol is to improve the lifespan of wireless sensor networks by lowering the energy. It protects from battery reduction and stability in nodes energy consumption.

Leach protocol consists of two phases:

- 1) Set-up phase
- 2) Steady phase

Operation of leach protocol consists of several rounds with two phases in each round. Leach protocol is a typically representation of hierarchical routing protocol. It is self-adaptive and self-organized [14]. Leach protocol uses round as unit, each round is made up of cluster set-up stage and steady state storage for the purpose of reducing unnecessary energy costs.

The Cluster Heads aggregates the whole data which lead to reduce the traffic in the entire network [8]. As there is a single hop routing from nodes to cluster head it results in saving energy [5]. It increases the lifetime of the sensor network. In this, location information of the nodes to create the cluster is not required. LEACH is completely distributed as it does not need any control information from the base station as well as no global knowledge of the network is required [5].

VI. SUMMARY

This paper has addresses to use of WSNs in the railway industry. By using Wireless Sensor Network Approach it reduces the power consumption, with effective & accurate way it detect the dead nodes at exact location with minimum time. Based on the related work, in existing system rail network does not use the fast mechanism for rail track maintenance and found the exact location of the fault on the track.so by using the data aggregation, all sensors data are aggregated and send to sink node without duplication. By using the cluster based data aggregation technique, very accurately find the location of fault and also saving the energy of intermediate nodes.so this approach is very much suitable for finding the fault in railway track.

VII. PROPOSAL AND FUTURE WORK

In this survey paper, we surveyed on different data aggregation techniques helps to eliminate duplicate data transmission. Higher efficiency, network scalability and lower transmission of Hierarchical cluster based routing protocols make it most efficient routing protocols in WSN. According to my opinion, by read this technique all the limitation of track monitoring are solvable and also time is reduces. In future, the more improvements are done on LEACH protocol so they also be used for the track monitoring.

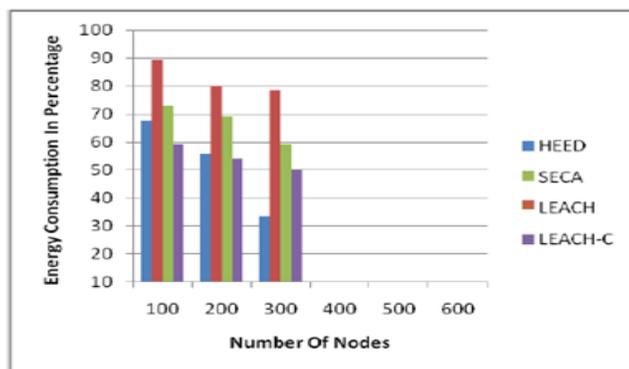


Figure 4: Comparative Graph

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