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Hierarchical VSCH and Cluster-Tree Routing Algorithms for Energy Efficient WSNs

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Abstract
Energy efficiency of a sensor node is one of the vital and key terms in the operation of Wireless Sensor Networks (WSNs). For developing an efficient network, data aggregation is done taking into consideration different routing algorithms and topologies. This paper develops hierarchical routing algorithms: Money Search Closest Hop (VSCH) and Cluster-Tree which increases the energy efficiency of the network. These algorithms basically consider the node deployment, sink location, grouping of nodes scheduling, and routing. Routing of data is done through various levels by multi-hop technique and data is aggregated at every hierarchical level. Increased network lifetime is achieved with higher energy efficiency and low power consumption.

Document Sections

- 1. Introduction
- 2. Literature Review
- 3. Proposed Methodology
- 4. Results and Observations
- 5. Conclusion

Authors

Figures

References

Citations

Keywords

Metrics

Published in: 2021 International Conference on Intelligent Technologies (CONIT)

Date of Conference: 25-27 June 2021

INSPEC Accession Number: 21174833

Date Added to IEEE Xplore: 04 August 2021

DOI: 10.1109/CONIT51480.2021.9498556

▼ ISBN Information:

Electronic ISBN: 978-1-7281-5583-5

CD: 978-1-7281-5581-1

USB ISBN: 978-1-7281-8582-8

Print on Demand (PoD) ISBN: 978-1-7281-8584-0

Publisher: IEEE

Conference Location: Hubli, India

1 Introduction
Wireless Sensor Networks basically comprise of large number of sensors deployed in an area faraway to human. Sensor nodes sense and process the sensed information which is further transmitted to the sink/gateway. Communication in a WSNs majority occurs over the ISM 2.4GHz unlicensed band. Events may include environmental problems like forest fire, landslides, and earthquakes occurring especially in regions where there is no infrastructure. Hence an accurate and reliable network is required for disaster management.

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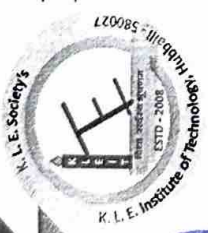
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Hierarchical VSCH and Cluster-Tree Routing Algorithms for Energy Efficient WSNs

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Abstract— Energy efficiency of a sensor node is one of the vital and key terms in the operation of Wireless Sensor Networks (WSNs). For developing an efficient network, data aggregation is done taking into consideration different routing algorithms and topologies. This paper develops hierarchical routing algorithms, Vicinity Search Closest Hop (VSCH) and Cluster-Tree which increases the energy efficiency of the network. These algorithms basically consider the node deployment, sink location, grouping of nodes, scheduling, and routing. Routing of data is done through various levels by multi hop technique and data is aggregated at every hierarchical level. Increased network lifetime is achieved with higher energy efficiency and low power consumption.

Keywords—Wireless Sensor Networks, Energy, Efficiency, hierarchical Routing, Data Aggregation.

I. INTRODUCTION

Wireless Sensor Networks basically comprises of large number of sensors deployed in an area faraway to human. Sensor nodes sense and process the sensed information which is further transmitted to the sink (gateway). Communication in a WSNs majorly occurs over the ISM 2.4GHz unlicensed band. Events may include environmental problems, like forest fire, landslides, and earthquakes occurring especially in regions where immediate action needs to be taken. Hence an accurate and reliable mechanism is thus required for detection and prediction of such events. WSN is a technology which can be realistic to detect or predict such dreadful events instantaneously. However, the key constraint in the development of WSNs is sensor nodes are battery operated. Higher energy consumption may lead to faster depletion of energy in sensor nodes which in turn would reduce the lifetime of network.

Data aggregation in WSNs is an essential technique that plays a vibrant role in energy efficiency. Due to high density of nodes monitoring an event, data generated from the sensors in each other's neighborhood is often redundant and highly correlated. Systematic collection of sensed data from multiple sensors is eventually transmitted to the base station for processing. It is inefficient for all the sensors to transmit the data directly to the base station in a single hop. In such case sensors away from base station would consume more energy as compared to those close to the base station. Hence appropriate routing mechanism needs to be introduced for fusion of data.

Most of the previous research has been focused on hardware design, power saving mechanisms, distributed detection processing, routing, scheduling mechanisms, cross-layer optimization, synchronization and coverage. Therefore, designing an energy efficient Wireless Sensor Network is a major concern.

enhancement of network lifetime. Parameters such as node deployments, routing algorithms, network topologies, sink location needs to be taken into consideration.

Network topology plays a role of paramount significance while dealing with transmission of aggregated data. Nodes can be deployed in various topologies such as star, mesh, tree, cluster, etc. These topologies are considered in accordance with the need of the system in given application. The topology which can give high durability of nodes by consuming less power would be the best topology that can be implemented on the network. This research work takes into consideration different topologies and have developed different routing algorithms.

II. LITERATURE REVIEW

Akyldiz et al.[1] introduces basic characteristics of sensor nodes such as flexibility, high fidelity, low cost. Due to the benefits that arise from the use of WSNs, various applications have been mentioned. To realize a WSN, however, there are a few constraints involved. The applications of WSNs are limited owing to these constraints. Extensive amount of research has been made in this field to make WSN more efficient and to overcome the challenges.

A comprehensive survey of data aggregation algorithms has been presented by P.K. Varshney et al.[2,3] in WSNs. They have focused on optimizing important performance factors including latency, network lifetime, accuracy and energy consumption. Efficient organization, routing and data aggregation tree construction are the prime areas of concern. The main features, advantages and disadvantages of each data aggregation algorithm are described. Algorithm features such as security and source coding are discussed. The trade-offs between energy efficiency, data accuracy and latency have been highlighted.

Amrita Ruperee et al. [4] gives a method to reduce the length of packets compared to other methods. This paper shows a delta modulation method to reduce the size of packet. The reduction in packet size for an even cluster is observed to be 28% and that for an uneven cluster is 34%. J.N. Al-Karaki et al.[5] presents a detailed survey of routing techniques in WSNs. The primary objective of these algorithms is to extend the lifetime of the network while making no compromises with the data delivery. Based on network structure, the classification of routing techniques is done in three categories: flat, hierarchical and location-based routing protocols. The advantages and disadvantages of some of the routing algorithms have been highlighted along with the design arrangements between energy and communication overhead savings in some of the routing pattern.

A topology based routing with Xmesh is proposed by L. Wang et al.[6] using Cayley graph as an underlying topology for Xmesh routing. The best link quality within the

