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Data Routing for in-Network Aggregation in WSN

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ABSTRACT: Wireless communications have become very pervasive. The number of mobile phones and wireless internet users has increased significantly in recent years. Traditionally, first-generation wireless networks were targeted primarily at voice and data communications occurring at low data rates. The evolution of second- and third-generation wireless systems incorporates the features provided by broadband. In addition to supporting mobility, broadband also aims to support multimedia traffic, with quality of service (QoS) assurance, presence of different air interface technologies, and the need for interoperability has increasingly been recognized by the research community. Wireless networks include local, metropolitan, wide, and global areas.

I.INTRODUCTION

A Wireless Sensor Network (WSN) consists of spatially distributed autonomous devices that cooperatively sense physical or environmental conditions, such as temperature, sound, vibration, pressure, motion, or pollutants at different locations. WSNs have been used in applications such as environmental monitoring, homeland security, critical infrastructure systems, communications, manufacturing, and many other applications that can be critical to save lives and assets. Sensor nodes are energy-constrained devices and the energy consumption is generally associated with the amount of gathered data, since communication is often the most expensive activity in terms of energy. Wireless allows for devices to be shared without networking cable which increases mobility but decreases range. There are two main characteristics named performance and space.

Wireless networks satisfy a variety of applications such as voice and video. The use of the technology also gives room for expansion, such as from 2G to 3G. As wireless networking has become common place, sophistication increases through configuration of network hardware and software, and greater capacity to send and receive larger amount of data, faster, is achieved. Wireless networks offer many advantages when it comes too difficult in wired networking where it s separated by area like across river, street, building, premises. But wireless networks allow users to define the space of access and communicating with other devices eliminating the bridges of wire.

Sensor nodes are energy-constrained devices and the energy consumption is generally associated with the amount of gathered data, since communication is often the most expensive activity in terms of energy. WSNs are data-driven networks that usually produce a large amount of information that needs to be routed, often in a multi hop fashion, toward a sink node. For more efficient and effective data gathering with a minimum use of the limited resources, sensor nodes should be configured to smartly report data by making local decisions. The objective of this paper is to design a Data Routing for In-Network Aggregation, (DRINA) to decrease Energy conception.

In paper [1], the energy consumption and the extension of the network's lifetime is focussed. Here the routing protocols are classified as Location-based or Mobile Agent-based, Network Structure, Communication Model, Topology Based. In paper [2], In-network data aggregation which is essential for wireless sensor networks is proposed for data dissemination to increase the amount of path sharing, reducing energy consumption. In paper [3], Dynamic Data Aggregation Aware

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Routing Protocol is proposed. In paper [4], The methodologies in Wireless technology enables the sensors to gather data to the base station through a so-called multi-hop communication. the data transportation from one node to another in an efficient way. Here the data aggregation means that the data is merged while it is transported among the sensors. In paper [5], an overview of different approach of node localization discovery in wireless sensor network is given. And this paper also proposed different schemes in localization which helps many scholars for improvement of the localization of node. The performance of any localization algorithm depends on a number of factors, such as anchor density, node density, computation and communication costs, accuracy of the scheme and so on. The disadvantage of this paper is some algorithms require beacons and some do not. Beaconless algorithms produce relative coordinate system which can optionally be registered to a global coordinate system. Sometimes sensor networks do not require a global coordinate system.

Section 2 deals with the literature study, description about the existing system, problem definition and proposed system. **Section 3** gives the detail description of the proposed system, specifies the software and hardware requirements specification and software implementation. **Section 4** deals with the system design which includes architecture, data flow model and UML diagrams, specifies modules and algorithm used. **Section 5** explains the testing which includes test plan and test case report. Also system implementation which includes sample code and screen shots as explained. **Section 6** gives comparisons of our project in terms of key management schemes. Finally **section 7** gives the conclusion and future enhancements.

II. SYSTEM ANALYSIS

This section describes the overall analysis of the existing system and the limitations in the existing systems are encountered. Based on this system analysis, the objective for the new system and required features to overcome the limitations in the existing systems are identified.

2.1 Existing System

Algorithms and protocols designed for WSNs should consider the energy consumption in their conception. Moreover, WSNs are data-driven networks that usually produce a large amount of information that needs to be routed, often in a multi-hop fashion, toward a sink node, which works as a gateway to a monitoring center. Given this scenario, routing plays an important role in the data gathering process. A possible strategy to optimize the routing task is to use the available processing capacity provided by the intermediate sensor nodes along the routing paths. This is known as data-centric routing or in-network data aggregation. For more efficient and effective data gathering with a minimum use of the limited resources, sensor nodes should be configured to smartly report data by making local decisions. From the analysis of the existing papers following problems are identified: a. routing technique need improvement, b. need efficient obstacle resistance, c. Routing overlapping and d. Need energy efficient operation.[1]

2.2 PROPOSED SYSTEM

The main goal of the proposed in DRINA algorithm is to build a routing tree with the shortest paths that connect all source nodes to the sink while maximizing data aggregation. The proposed algorithm considers the following roles in the routing infrastructure creation:

- **Collaborator:** A node that detects an event and reports the gathered data to a coordinator node.
- **Coordinator:** A node that also detects an event and is responsible for gathering all the gathered data sent by collaborator nodes, aggregating them and sending the result toward the sink node.
- **Sink:** A node interested in receiving data from a set of coordinator and collaborator nodes.
- **Relay:** A node that forwards data toward the sink.

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2.3 SYSTEM DESIGN

System architecture represents the basic behavior and overall description of the system. The environmental activities has been monitored through the sensor nodes. Coordinator nodes makes a cluster head as a single node. The Collaborator (cluster head) is selected through the sink by HCM. Relay nodes passes the data's and sent to the Sink.

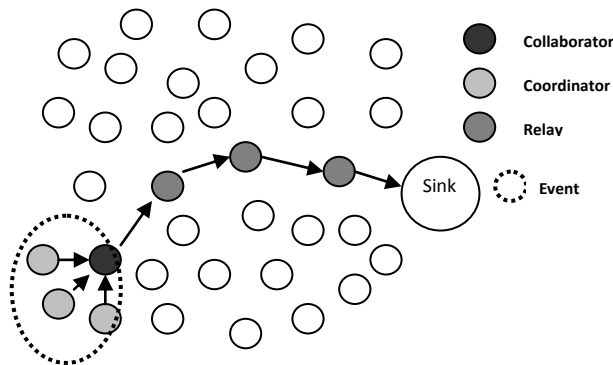


Figure 1 Overview of the system

Functional architecture of the proposed protocol is shown in Figure 2. The multiple nodes in a particular area senses the environmental changes eg:(temperature, humidity etc). It forms a cluster head by the process of HOP3 values from sink to the nearest node. Then data are sent through the nodes from the cluster head to the sink by calculating the nearest relay nodes. [2]

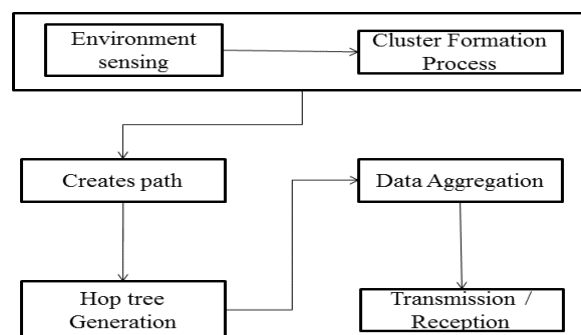


Figure 2 Processing from environmental changes to data aggregation.

In the proposed system three main functions are identified 1. Building Hop Tree 2.Cluster Formation and Head Selection 3.Routing Formation and Route Repair Mechanism[3].

2.4 Building Hop Tree

In this Module, the distance from the sink to each node is computed in hops. This phase is started by the sink node sending, by means of a flooding, the Hop Configuration Message (HCM) to all network nodes. The HCM message contains two fields: ID and HopToTree, where ID is node identifier that started or retransmitted the HCM message and HopToTree is the distance, in hops, by which an HCM message has passed.[4]

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2.5 Cluster Formation and Head Selection

When an event is detected by one or more nodes, the leader election algorithm starts and sensing nodes will be running for leadership (group coordinator). For this election, all sensing nodes are eligible. If this is the first event, the leader node will be the one that is closest to the sink node. Otherwise, the leader will be the node that is closest to an already established route.[5] In the case of a tie, i.e., two or more concurrent nodes have the same distance in hops to the sink (or to an established route), the node with the smallest ID maintains eligibility. Another possibility is to use the energy level as a tiebreak criterion.[6] At the end of the election algorithm only one node in the group will be declared as the leader (Coordinator). The remaining nodes that detected the same event will be the Collaborators. The Coordinator gathers the information collected by the Collaborators and sends them to the sink. A key advantage of this algorithm is that all of the information gathered by the nodes sensing the same event will be aggregated at a single node (the Coordinator), which is more efficient than other aggregation mechanisms (e.g., opportunistic aggregation).

2.6 Routing Formation and Route Repair Mechanism

The elected group leader, starts establishing the new route for the event dissemination. For that, the Coordinator sends a route establishment message to its Next Hop node.[7] When the Next Hop node receives a route establishment message, it retransmits the message to its Next Hop and starts the hop tree updating process. These steps are repeated until either the sink is reached or a node that is part of an already established route is found. The routes are created by choosing the best neighbor at each hop. The choices for the best neighbor are twofold:

- 1) when the first event occurs, the node that leads to the shortest path to the sink is chosen.
- 2) After the occurrence of subsequent events, the best neighbor is the one that leads to the closest node that is already part of an established route.[8]

The route created to send the data toward the sink node is unique and efficient since it maximizes the points of aggregation and, consequently, the information fusion. However, because this route is unique, any failure in one of its nodes will cause disruption, preventing the delivery of several gathered event data. Our DRINA algorithm offers ACK-based, route repair mechanism, which consists of two parts: failure detection at the Next Hop node, and selection of a new Next Hop[9]. When a relay node needs to forward data to its Next Hop node, it simply sends the data packet, sets a timeout, and waits for the retransmission of the data packet by its Next Hop.

This re-transmission is also considered an ACK message. If the sender receives its ACK from the Next Hop node, it can infer that the Next Hop node is alive and, for now, everything is ok. However, if the sender node does not receive the ACK from the Next Hop node within the predetermined timeout, it considers this node as offline and another one should be selected as the new Next Hop node.[10] For this, the sender chooses the neighbor with the lowest hop-to-tree level to be its new Next Hop; in case of a tie, it chooses the neighbor with the highest energy level. After that, the sender updates its routing table to facilitate the forwarding of subsequent packets. After the repairing mechanism is applied, a newly partial reconstructed path is created.[11]

III. IMPLEMENTATION AND RESULTS

To detect the event from a particular area it need sensor nodes. So to place random number of wireless sensor nodes for a particular area. These nodes detect the environmental changes which happens as an event. Environmental changes may be temperature, humidity etc.

Cluster head from the sensed nodes is selected by the sink through the HCM. The HCM has 1.ID value 2.Hop to tree. It selects the cluster head which is nearest to the sink as a shortest path.[13]

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Data's are aggregated and sent through each and every relay nodes. The datas are sent through the nodes which has only HOP tree values. The result can be retrieved from the Sink. All the process can be viewed in Graph.[14]

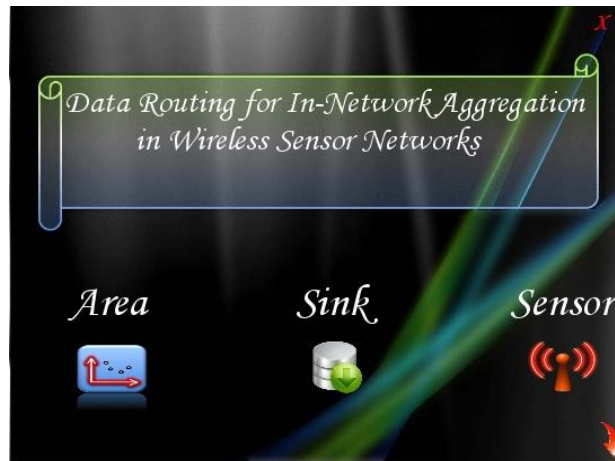


Fig 3 Main frame

In figure 4 shows the main frame is created to show the selection of area, sink, sensor.[15]



Figure.5 Sink Creation

In figure 5 show the Sink creation which has a the contents of area (latitude, longitude, coverage). It also has the generation of HOP tree, Event locator, Configuration of event and to trigger event.[16] The result of the environmental changes has been displayed in sink.[12]

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Figure 6 Sensor Creation

In figure 6 shows the creating of sensor nodes. It has random number of ID values. If the sink has sent Hop values to all the sensor nodes and it is displayed in connected sensors.



Figure 7: Sink Update

In figure 7 shows the result of the event as temperature, humidity and wind. Environmental changes are updated regularly at 10-30 sec. Neighboring sensors are also displayed.

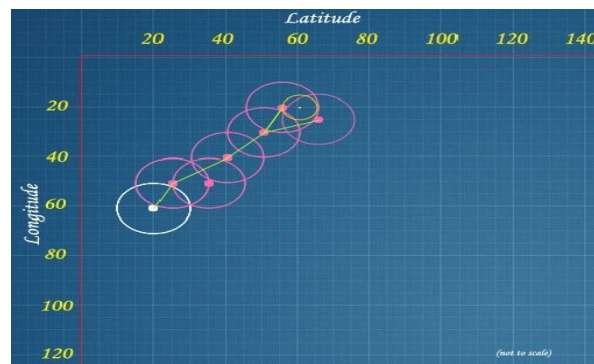


Figure 8 Output Graph

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In figure 8 shows the graph of the area which has latitude and longitude. Each and every sensor nodes, sink and event has its area coverage independently. Final result of the event and process is shown in graph.

IV. CONCLUSION AND FUTURE ENHANCEMENT

4.1 CONCLUSION

Aggregation aware routing algorithms play an important role in event based WSNs. In this work, the DRINA algorithm is a novel and reliable Data Aggregation Aware Routing Protocol for WSNs. The proposed DRINA, algorithm was extensively compared to two other known routing algorithms, the InFRA and SPT, regarding scalability, communication, costs, delivery efficiency, aggregation rate and aggregated data delivery rate. By maximizing the aggregation points and offering a fault tolerant mechanism to improve delivery rate, the obtained results clearly show that DRINA outperformed the InFRA and SPT algorithms for all evaluated scenarios.

Also, it show that the proposed algorithm has some key aspects required by WSNs aggregation aware routing algorithms such as a reduced number of messages for setting up a routing tree, maximized number of overlapping routes, high aggregation rate, and reliable data aggregation and transmission.

4.2 FUTURE ENHANCEMENT

In future works, Speed and efficient nodes with long lasting batteries can be used. Relay nodes can be stochastically selected to improve shortest path to sink. The average distance of the event coordinators and spatial semantics event correlation based on waiting time of aggregated nodes can be improved.

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