Abstract

Data aggregation, information trust, and fault tolerance is considered to enhance the correctness and trustworthiness of collected information. It is based on the multilayer aggregation architecture of WMSNs, existing trust-based framework for data aggregation with fault tolerance with a goal to reduce the impact of erroneous data and provide measurable trustworthiness for aggregated result. DAG method provides fault tolerance for packet loss by forming a Directed Acyclic Graph (DAG), which allows a node to have multiple parent nodes. In particular, this framework can evaluate both discrete data and continuous media streams in WMSNs through a uniform mechanism, which can significantly improve the quality of multimedia information as well as more precisely evaluate the trustworthiness of collected information.

Introduction

Wireless sensor networks (WSN) require pertinent and reliable data collection schemes in order to provide information about their deployment area.

A new in-network aggregation method for sensor network monitoring provides fault tolerance for packet loss by forming a Directed Acyclic Graph (DAG), which allows a node to have multiple parent nodes[1]. It can ensure correct data transmission timing, based on the actual hop count of the edge of the DAG. Furthermore, its evaluated the proposed method in comparison with the previous methods, from the perspective of the error margin of collected data[2].

Related Work

Fault Tolerance for Event Detection wireless sensor network

It proposes a new approach that considers the case where nodes can have different failure probability values. Various types of failures can be handled which can be used as a general distributed fault-tolerance mechanism for any application where nodes may have different accuracy levels[3]. Two new distributed error models that take into account the location and relative position of sensor nodes are developed. The first model takes the fact that nodes that are closer to each other have a higher spatial correlation than far nodes. The second model accounts for the importance of the relative geographical distributions of the two voting quorums (the two subsets of neighbors deciding the presence of an event or its absence, respectively). It comes from the observation that an event detected on all sides of a node (the node is in the middle of the detection region) is more likely to be present at the node itself than an event that was detected by nodes only on one side of the node (the node might be on the edge of the event region).

Several estimation mechanisms that can be used by sensor nodes to learn their error rates continuously are developed[4][5]. The proposed mechanisms utilize the moving average and geometric moving average algorithms. These two schemes can provide accurate and timely estimation of the node error rate when their parameters are set. No longer had Nodes required to know their error rates prior to the deployment. It allow the algorithm to handle the situation where the node error rate changes over time.

Fault Tolerance in Spatial Query Processing

The main contribution of this paper is the proposition of an energy efficient fault-tolerant mechanism for in-network spatial query processing in WSN. Query dissemination avoids failed nodes by requesting candidates to forward the query, thus considering only the nodes that responded to the request. This strategy increases the robustness and energy efficiency of the mechanism, since there is no need of node monitoring for failure detection. The proposed mechanism is composed of three new algorithms. The first is a fault tolerant geographic routing protocol to forward queries to the region of interest.
(RoI). It also propose two failure resilient algorithms to disseminate queries within the RoI, collect environmental data and aggregate them. The proposal is evaluated by simulation against the state of the art of spatial query processing mechanisms.

There are two types of spatial queries in WSN: window and KNN. In window queries, the user defines the RoI inside the area monitored by a WSN and nodes inside this region collect environmental data [6]. Another type of query is called KNN (K Nearest Neighbor). The user defines a point inside the monitored area (called query point) and the value of K. The data is collected by the K nodes closest to the query point [7]. In this work we focus on window query processing.

Spatial query processing can be divided into six stages, as illustrated by Figure 1. The user, represented by the computer, defines the RoI. The Pre-Processing stage is performed in the user’s computer. It prepares queries to be sent to the WSN. The first sensor node to receive the query is named Originator. In the Forwarding stage, the query is forwarded from the Originator to a node within the RoI. This last node in the Forwarding stage is called Coordinator. In the Dissemination stage, the query is disseminated from the Coordinator to all nodes inside the region of interest. These nodes sense environmental data in the Sensing stage and send this information to be aggregated in the Aggregation stage. Finally, in the Return stage, the node with the query result forwards it to the Originator.

Layer Independent Fault Tolerant for wireless sensor network

It presented a layer independent fault tolerance mechanism, which applies to critical monitoring applications. It allows monitoring reports to be stored during failures before its finally retransmitted from fake data sources. It preserved a stateless mechanism, which ensured a complexity of low message and a low energy consumption. A repair-based solution therefore leads to a fast recovery once new paths open toward sink stations[8].

The main objective of LIFT consists in the storage of monitoring reports whenever every next hop relay to the sink becomes unavailable. Considering a mobile environment (e.g. inter-vehicle communication), such situation may occur whenever nodes located on the routing path become out of range resulting in a network partition. Its aim at benefiting from both the in-node resources and the ones located in its vicinity. It then propose to have storing nodes acting as fake data sources once next hops get available again. Upon such recovery, stored packets are delivered to the sink in order to achieve reliable data collection, without emerging from an explicit fault-tolerance mechanism [7]. These messages are indeed considered as standard monitoring reports. All operations defined in LIFT are shown in Figure 2.

DAG Based Fault Tolerance In wireless multimedia sensor network

It propose a new in-network aggregation method for sensor network monitoring. The proposed method forms a Directed Acyclic Graph (DAG), that allows a node to have multiple parents, and collect data using the DAG[9]. Tolerance to packet loss is targeted by using multiple parents as intermediate nodes. It avoids aggregation from the same. When nodes compute a sum of certain data as the in-network aggregation, the avoidance is important, because if multiple parents aggregated the same data, it would be added repeatedly: meaning the computed sum would exceed the actual sum. In addition, the data transmission timing adapts itself to the actual hop count of the edge of the DAG. Through simulation studies, It evaluate the proposed method from the perspective of the error margin of the collected data[10].
It proposes a new in-network aggregation method for sensor network monitoring. Specifically, the proposed method works:

1. The formation of a Directed Acyclic Graph (DAG), which allows a node to have multiple parents, for data collection. The multiple parents provide tolerance to wireless transmission failure as intermediate nodes.

2. Extending data transmission timing control for tuning correctly according to the actual hop count on the edge of the DAG.[11][12]

Conclusion

The proposed method forms a Directed Acyclic Graph (DAG), that allows a node to have multiple parents, and collects data using the DAG. By using multiple parents as intermediate nodes, which provides tolerance for the failure in wireless transmission. Although the method uses multiple parents, the method avoids being aggregated by the same. In addition, the method can tune the data transmission timing control correctly according to the actual hop count of edge of the DAG. It evaluated the proposed method and compared it with existing methods. The results show that there is a trade-off between the accuracy of collected data and the lifetime of the sensor nodes. Although the lifetime of the proposed method may be shorter than existing methods, it still outperforms existing methods from the perspective of the accuracy of the collected data. Our all effort can reduce the impact of erroneous data. The trust based algorithm of data aggregation with fault tolerance can effectively identify failed nodes and filter their data out to keep the aggregated results consistent with the actual value all the time.

References


Biographies

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