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Range-Based Iterative Distributed Localization Algorithm for Mobile Anchor Node-Based Localization in Wireless Sensor Network

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Abstract:
The localization of sensor nodes is a significant issue in wireless sensor networks (WSN's) because many applications cannot provide services without geolocation data. In this study, consumes different amounts of energy during phases of start-up, turning, and uniform motion considering the aftermath of disasters. Initially, sensor nodes are localized using anchors in the neighbourhood, then these localized nodes progressively localized remaining nodes using multilateration. It localized nodes with sparse connectivity. Simulation results show that proposed approach localize all sensor nodes with good accuracy.

1. INTRODUCTION

Wireless Sensor Networks(WSNs) are a novel process of embedded integration, wireless communication, and micro sensor technology that is currently on the rise. The basic hardware units for building WSNs are low-cost, low-power tiny sensor nodes. After deployment in an area of interest, the nodes collaborate with each other to efficiently perform sensing and transmission functions. According to the differences of the processing function, nodes in WSNs can be divided into two categories: ordinary nodes and sink nodes. The former gather the information bit by bit. The later aggregate and fuse uploaded data for further processing. Recently, numerous localization methods have been proposed for WSNs. These methods can be classified into two generic groups: range-based and range-free. Range-based localization determines the position of unknown nodes using the distance or angle to establish geometric constraint equations. Range-free localization uses the connectivity or pattern matching method to estimate the location of unknown nodes. Both range-based and range-free localization methods require anchor nodes, which are equipped with GPS units to provide reference positions. However, since the cost of an anchor node is hundreds of times that of an ordinary one, it is unrealistic to increase the ratio of anchor nodes, especially for large-scale WSNs and affordable disaster management. Thus, a feasible method is to enable a mobile anchor node to walk along a planned trajectory and timely spreads its location information to locate unknown nodes. However, in a realistic rescue scenario, a mobile vehicle consumes more energy in the phases of start-up and turning than when travelling at constant speed. Thus, the number of corners needs to be minimized for efficient path planning

2. RELATED WORK

Mobility of sensor nodes brings the new challenges in wireless sensor networks. The mobility of sensor nodes in conjunction with harsh environmental conditions has influence on link reliability and energy efficiency. The energy losses are associated with the movements of the nodes and frequent updating of their coordinates which ultimately results in setting up of the final path. Here, we propose an algorithm MSDC (Mobile Sinks Data Centric), which with the help of direction agent (DA) makes the network more efficient. Direction agent (DA) and Data Dissemination Node (DDN) persistently senses the event in local grid and guides the DDNs where to disseminate the data packet. Then DDN will decide the shortest path by which the query and data is to be processed. Simulation results show how our approach can reduce the energy consumption, overhead delays, and to obtain the optimum data route [1].In the reported metrics of the existing literature, the realistic wireless channel situation is generally ignored in selecting the appropriate next-hop relay node during packet forwarding in wireless sensor networks (WSNs). In this paper, we propose a new energy-efficient local metric, which is called the efficient advancement metric (EAM), for sensor networks. EAM considers both the maximum forwarding distance and the packet's successful transmission probability by taking into account the wireless channel condition. This will enable the forwarding node to choose the most energy-efficient relay node in the geographic-informed routing protocol. Theoretically, we show the existence of the unique optimal relay node to maximize EAM over a typical Nakagami-m channel of a code-division multiple-access (CDMA)-based WSN. Furthermore, based on the proposed metric EAM, we present a cross-layer packet-forwarding protocol channel-aware geographic-informed forwarding (CAGIF) by optimally selecting the relay nodes. CAGIF only requires that nodes have the knowledge of their own location information and the location information of the source and destination nodes. Numerical examples are presented to show the characteristics of EAM and the optimal distance. Compared with the previous geographic packet-forwarding schemes in WSNs, CAGIF consumes much lower energy and generates a significantly decreased signal overhead [2].In this paper, we study the reliable packet forwarding in Wireless Sensor Networks (WSNs) with the multiple-input multiple-output (MIMO) and orthogonal space time block codes (OSTBC) techniques. The objective is to propose a cross-layer optimized forwarding scheme to maximize the Successful Transmission Rate (STR) while satisfying the given end-to-end power consumption constraint. The channel coding, power allocation, and route planning are jointly considered to significantly improve the transmission quality in terms of STR. The joint optimization design is formulated as a global deterministic optimization and also a local stochastic optimization issues. It is found that the stochastic optimization approach can effectively model, analyse, and solve the routing problem. In order to substantially reduce the implementation complication of the global optimization, we propose a low-complexity distributed scheme. The determination of relaying nodes and power budgets are decoupled, i.e. performing route planning and power allocation separately. We have shown that the result in the distributed scheme is able to provide sufficiently accurate predication of the global optimization. In addition, the proposed scheme can clearly reduce the Symbol Error Rate (SER) and achieve higher STR compared with two existing energy-efficient routing protocols, in which no joint design is considered [3]. In this existing work, range based localization algorithms is used to design the path planning scheme of the mobile anchor node. The communication range of the mobile anchor node is not adjustable. The mobile anchor node travels among unknown nodes according to a predefined trajectory and periodically broadcasts beacon messages. The speed of the mobile anchor node is uniform during motion. To enable a trade-off between location accuracy and energy consumption, a path-planning algorithm combining a Localization algorithm with a Mobile Anchor node based on Trilateration (LMAT) and SCAN algorithm (SLMAT) is presented. SLMAT ensures that each unknown node is covered by a regular triangle formed by beacons. Furthermore, the number of corners along the planned path is reduced to save the energy of the mobile anchor node. In addition, a series of experiments have been conducted to evaluate the performance of the SLMAT algorithm.

A. Deployment of beacon points

After determination of the communication range r of the mobile anchor node, beacon points need to be deployed. Because the localization error of regular triangle is optimal. Thus, if each unknown node can be covered by a regular triangle, its localization accuracy will be improved. Based on the above-mentioned analysis, the side length of a regular triangle needs to satisfy so that all unknown nodes in the triangle can be successfully localized. In addition, to ensure each unknown node can be covered by a regular triangle composed of beacon points, beacon points are required to be located outside the sensing area.

B. Energy consumption

The energy of a mobile anchor node is not infinite when it is applied to assist disaster relief; both turning and start up result in substantial energy consumption. Thus, during the period of localization, the cost of mobility is the sum of energy consumed during the phase of start-up, turning, and uniform motion. Compared to the cost of mobility, the energy used for information transfer can be ignored. Considering the flexibility of the mobile anchor node, it is suggested that the mobile anchor node can turn off only after stopping at each corner.

C. Obstacle free path planning

To minimize the number of turns in motion, the mobile anchor node is inclined to move in a straight line. Upon detection of an obstacle, the mobile anchor node will detour around the obstacle and broadcast beacon messages at detour flags for location.

D. Obstacle avoidance path planning

When the mobile anchor node is applied in disaster management, it is required to avoid obstacles in the path. It is used to bypass an obstacle. It can be see that when the dark part on the left is bigger than the light-coloured part on the right, the mobile anchor node will turn right and detour along the edge of the obstacle. In case when the dark part on the right is bigger than the light-coloured part on the left. Then, the mobile anchor node will turn left to detour the obstacle. If the obstacle is too big so that the mobile anchor node cannot detect any open space, the mobile anchor node will turn right to detour the obstacle.

3. LOCALIZATION METHOD

Range-based Iterative Distributed Localization method has been proposed. Nodes with less connectivity (less than three neighbours) are localized using a mobile beacon**.** In this work, we categories all the sensor nodes into two types viz, anchor and non-anchor node. Initially, non-anchor nodes are localized using multilateration technique. After that, an iterative mechanism is used to localized remaining non-anchor nodes progressively. Nodes with less connectivity (less than three neighbours) are localized using a mobile beacon. The proposed method consists three phases: Initial, progressive and mobile. In the first phase, nodes with more than two anchor neighbours are localized using multilateration. In the second phase, localized non-anchor nodes are used as a pseudo-anchor for nodes localization. In the last phase, a mobile anchor node moves randomly and broadcast its position for node localization.

3.1 Initial phase

At the very beginning, all the anchor nodes broadcast their position beacon packets within communication range. This beacon packet consists of the anchor node location and the node id. Once a non-anchor node receives the beacon packet, it stores the beacon location along with the RSSI value. After receiving beacon packet from theminimum three anchor nodes, each non-anchor sensor node calculates positional coordinates using the multilateration method by taking into considering the distance calculated through the RSSI value of the corresponding anchor node and its coordinates. After that, broadcast computed coordinates within communication range.These coordinates information is useful for non-anchors that do not have neighbour anchor nodes.

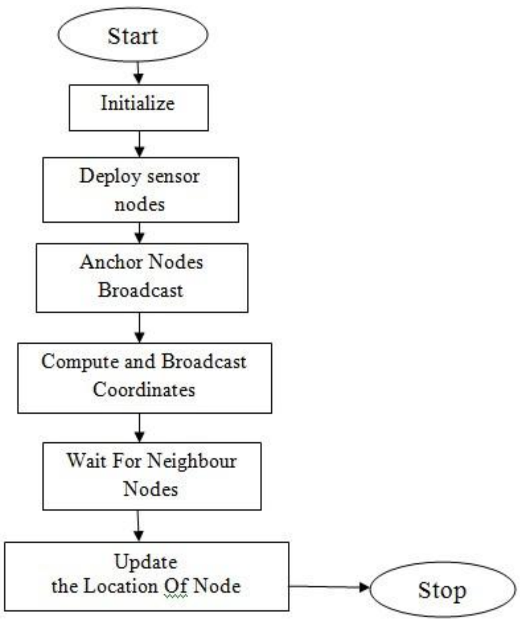

Figure.1. Flow diagram of our proposed scheme

3.2 Progressive localization

In this phase, non-anchor nodes are localized using their neighbour which is already localized. This is an iterative phase in which each non-anchor node waits for three beacon packet, as soon as it gets required number of the packet, computes their coordinate using multilateration. After that, broadcast coordinates which help to other neighbour nodes to compute their location coordinates. In this phase, all nodes get their location which is well connected to the network; it means has more than three neighbours. The remaining nodes are localized in next phase.

3.3 Localization using mobile anchor

A non-anchor with less connectivity is not able to compute their location. To solve this problem, we used a mobile node as an anchor, which moves randomly in field and periodical broadcast location coordinates. As soon as non-anchor node gets three beacon packet from the static or moving anchor, it computes location coordinate. The selection of beacon coordinates depend on the RSSI value degrades localization accuracy. The topological arrangement of the node is not a constraint. Hence, the all beacon packet considers for location computation. Localized non-anchor nodes may also use new position coordinates to update their estimated location.

4. RESULT AND DISCUSSION

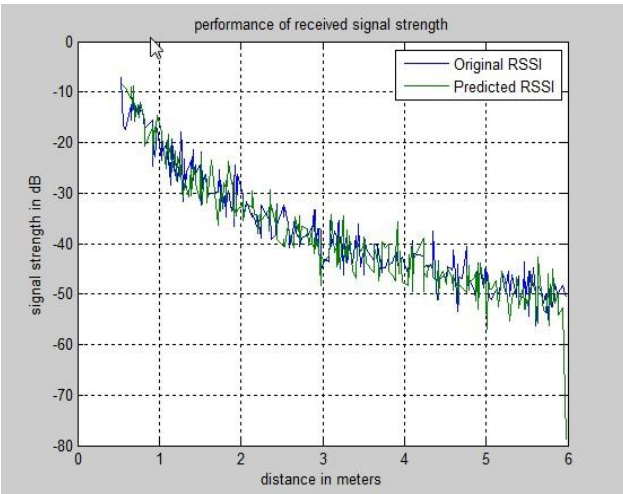

Figure.2.Performance of received signal strength (predicted RSSI)

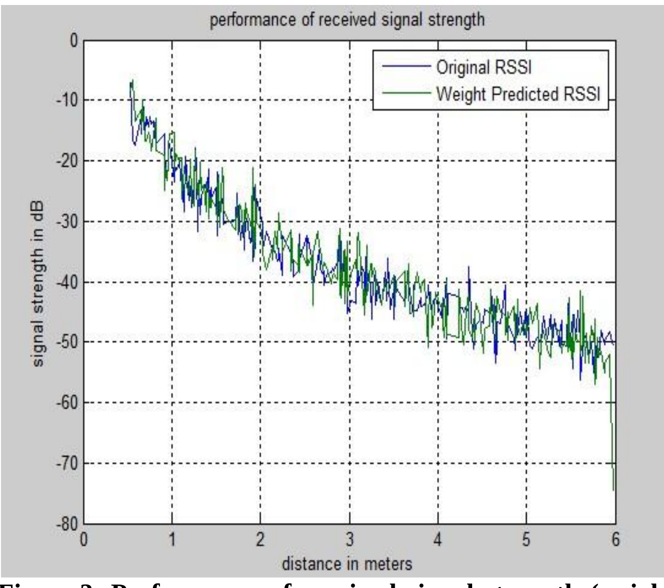

Figure.3. Performance of received signal strength (weight predicted RSSI)

5. CONCLUSION

In this paper, we proposed a Range-based Iterative Distributed Localization method that uses the mobile anchor nodes that move randomly and send location information to their neighbours to compute their approximate location. A progressive technique also helps to localize sensor nodes with low anchor density. The proposed algorithm is based on the multilateration which used the distance between nodes for location computation. It is found that the localization error is further reduced by receiving multiple beacons from the mobile anchor nodes from the different position during their mobility.

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