Modified DV-Hop Algorithm in Wireless Sensor Network

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Abstract: - Finding Location is one of the important techniques in wireless sensor network. The location can be finding out in two ways, one is target/source localization and second is node self-localization. In target localization, we essentially introduce the energy-based method. Then we inspect the node self-localization methods. Since the widespread implementation of the wireless sensor network, the localization technique is defferent in numerous applications. And there are many challenges in some special scenarios. In this paper, we present a comprehensive survey of different localization method: localization in non-line-of-sight, node selection criteria for localization in energy-constrained network, scheduling the sensor node to optimize the tradeoff between localization performance and energy consumption. Finally, we introduce the evaluation criteria for localization in WSN.

Keywords— *Target/source localization, self-localization, non-line-of-sight, trade off.*

I. INTRODUCTION

Availability of low energy cost sensors, microprocessor, and radio frequency circuitry for Data transmission; there is a extensive and fast diffusion of wireless sensor network (WSN). Wireless sensor networks which consist of thousands of cheaper sensor nodes have been used in many promising applications such as battle field surveillance, environmental monitoring and health surveillance,. Location estimation is one of the key important subjects because of the location information is usually useful for deployment, routing, coverage, target tracking, location service, and rescue. Hence, location estimation is a significant technical challenge for the many research scholar. The sensor nodes are randomly deployed in the sensor filed (the vehicle robots or aircrafts). While the Global Positioning System (GPS) is one of the most popular positioning technologies which is widely accessible, but it has high cost and consume more energy which make it different to install in every node. In order to reduce the energy consumption and cost, only a few of nodes which are called anchor nodes contain the GPS modules. The remaining method of nodes could obtain their locations through localization technique. The process of estimating the unknown node position within the network is referred to as node self-localization. And WSN is composed of a large number of low-cost nodes that are heavily deployed

in a region of interests to measure certain incident. The primary objective of this technique is to determine the location of the target node. As shown in Figure 1, we have classify the location estimation method into node self-localization and target/source localization. And the source localization can be further classified into four types: multiple-target localization in WSN, single-target localization in WSN, multiple-target localization in WBSN and single-target localization in wireless binary sensor network (WBSN). And node self-localization can be classified into two types: range- free localization and range-based localization. The earlier method uses the measured the distance/angle to estimate the location. And the second method uses the connectivity or pattern matching method to estimate the location. We will present the localization method in some special scenarios and finally introduce the evaluation criteria for localization in WSN.

II. NODE SELF-LOCALIZATION

A. Range-Based Location Estimation:

The typical methods to find out the indoor location are angle of arrival (AOA), time of arrival (TOA), time deference of arrival (TDOA), and received signal strength (RSS). Time of arrival (TOA) technique used to measures travel times of signals between the nodes. Time difference of arrival (TDOA) technique estimates location by measuring the signals' arrival time difference between unknown node and anchor nodes. It has a capability to achieve high ranging accuracy, but it requires extra hardware which consumes more energy. As a low-cost approach, RSS has recognized the mathematical representation on the basis of path loss attenuation with distance, and it needs relatively less configuration and energy. We can obtain the distance between the anchor node and unknown node by the above mentioned three measurement methods.

Consider the position of anchor node as {(x 1, y 1)..... (x N, y N)}And then unknown node position is calculated as P= [X, Y]T*di.

Where di. is the calculated distance between ith anchor node and unknown node. We can find out the coordinate of the unknown node as follows:

$$P = \begin{bmatrix} X \\ Y \end{bmatrix} = (A^T A)^{-1} * (A^T B)$$

Where,

$$A = 2 * \begin{bmatrix} (x_1 - x_3) & (y_1 - y_3) \\ (x_2 - x_3) & (y_2 - y_3) \end{bmatrix}$$

$$B = \begin{bmatrix} d_1^2 - d_3^2 - x_1^2 + x_3^2 - y_1^2 + y_3^2 \\ d_2^2 - d_3^2 - x_2^2 + x_3^2 - y_2^2 + y_3^2 \end{bmatrix}$$

B. Range-Free Localization

AS RANGE-FREE POSITIONING SYSTEM, DV-HOP IS THE TYPICAL REPRESENTATION. IT DOES NOT REQUIRE TO MEASURE THE TOTAL DISTANCE BETWEEN THE ANCHOR NODE AND UNKNOWN NODE. IT USES THE AVERAGE HOP DISTANCE TO ESTIMATE THE ACTUAL DISTANCES AND MINIMIZES THE HARDWARE REQUIREMENTS. IT IS SIMPLE TO IMPLEMENT AND APPLICABLE TO LARGE NETWORK. BUT THE POSITIONING ERROR IS ALSO LIKEWISE INCREASED. THE POSITIONING PROCESS OF DV-HOP IS SEPARATED INTO THREE STAGES: INFORMATION BROADCAST, DISTANCE CALCULATION, AN POSITION CALCULATION. IN INFORMATION BROADCAST STAGE, THE ANCHOR NODES TRANSMIT THEIR LOCATION INFORMATION PACKAGE WHICH INCLUDES HOP COUNT AND IS INITIALIZED TO ZERO FOR THEIR NEIGHBORS. THE RECEIVERRECORDS THE MINIMAL HOP OF EACH ANCHOR NODES AND IGNORES THE LARGER HOP FOR THE SAME ANCHOR NODES. THEN THE RECEIVER INCREASES THE HOP COUNT BY 1 AND TRANSMITS IT TO NEIGHBOR NODES. ALL THE NODES IN A NETWORK CAN RECORD THE MINIMAL HOP COUNTS OF EACH ANCHOR NODES. IN DISTANCE ESTIMATION STAGE, ACCORDING TO THE POSITION OF THE ANCHOR NODE AND HOP COUNT, EACH BEACON NODE USES THE FOLLOWING EQUATION TO ESTIMATE THE ACTUAL DISTANCE OF EVERY HOP:

$$\text{Hopsize} = \frac{\sum_{j \neq i} \sqrt{(x_i - x_j)2 + (y_i - y_j)2}}{\sum_{j \neq i} Hops_i}$$

where (xi, yi) and (xj, yj) are the coordinates of anchor nodes i and j, respectively. hj is the hop count between the anchor nodes. Then, an anchor node will estimates the average distance and transmits the information to network. The unknown nodes only record the first average distance and then broadcast it to neighbor nodes. Finally, the unknown nodes estimate its location. In order to get better the localization accuracy, the improved algorithms mainly concentrate on the following several aspects: average hop distance between anchor nodes, deployment of the anchor nodes, and node information.

C. EVALUATION CRITERIA FOR LOCALIZATION IN WIRELESS SENSOR NETWORK

Simulation with MATLAB software localization algorithm for sensor nodes in wireless sensor networks:

1. Nodes are randomly distributed throughout the network, in accordance with a uniformly distributed random number generator, the coordinates of each node (x, y) .
2. Estimate the hop count between anchor and unknown nodes, then find out the shortest distance between node sensor with respect to the hops.
3. Then used least square method for solving nonlinear equations and to get the unknown node location.
4. Change the network parameters such as the total communication radius, number of nodes, and anchor node density observation and analysis of the accuracy of DV-Hop algorithm.
5. Once we get the coordinates of unknown node, then we can estimate the error value. That is nothing but the difference between calculated locations to the original location. The localization errors are inevitable in the estimations. The average error is defined as:

$$\text{Error} = \frac{\sum_{i=1}^{n} ((x_{cal} - x_{real})^2 + (y_{cal} - y_{real})^2)}{n}$$

III. MODIFICATION IN DV-HOP ALGORITHM

A. Increased Number of Nodes

The performance and accuracy of DV-Hop deteriorates if the node distribution is sparse or non-uniform. Therefore we increased the total number of nodes and for each total number of nodes we observed the error, which is going to decreased as the number of nodes increased. So Dv-Hop algorithm gives better accuracy for dense network.

Case-1

Length of Boarder = 100 ;

Total No. of nodes = 30 ; (Every time increased the number of nodes by 10 till it reach to 100)

Total Anchor Nodes = 10 ; (keep the anchor nodes fixed)

Unknown Nodes =Total No. of nodes –Total Anchor Nodes

Radius=60;

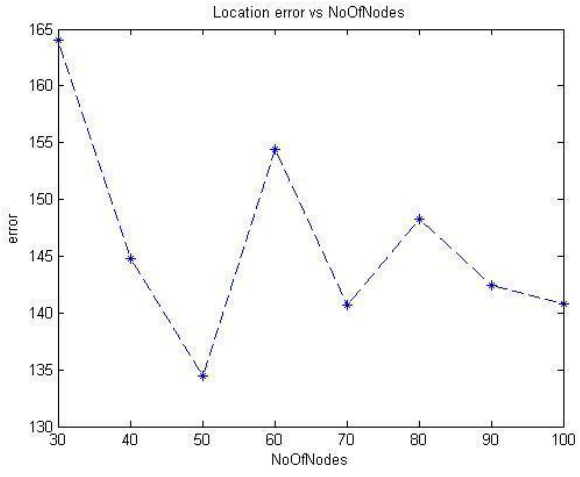

Fig 2: MATLAB result of number of nodes Vs Position error

B. Increased the Anchor Nodes:

Increased the anchor node by keeping total number of nodes constant. Therefore, Accuracy is improved as the number of anchor nodes increased. Then calculate the Anchor ratio as fallows.

$$\text{Anchor Ratio}=\frac{Total\ No.of\ Anchor\ Node}{Total\ No.of\ Node}$$

Case-2

Length of Boarder = 100 ;

Total No. of nodes = 100 ; (keep the No. of nodes fixed)

Total Anchor Nodes = 5 ; (Every time increased the number of anchor nodes by 5and calculate anchor ratio)

Unknown Nodes = Total No. of nodes –Total Anchor Nodes

Radius=60;

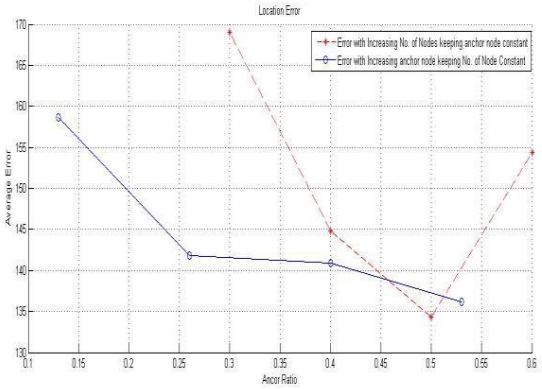

Fig. 3: Location Error with increasing anchor node.

IV. CONCLUSION

Here we present range free modified DV-Hope method that reduces localization error to a great extent by increasing no. of anchor node rather than increasing total No. of node. In Future again accuracy can be increased by combining RSSI with DV-Hop algorithm giving new RDV algorithm.

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