

# Point in Triangle Localization Algorithm for Non Uniform Sensor with Anchors in WSN

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## Abstract:

Wireless Sensor network are tiny nodes which are distributed in nature. Programming of the sensor nodes use to done in such a way that it can cover as larger area as possible. The position of the sensor nodes varies according to the application on which they are implemented. Localization of the sensor nodes are difficult and challenging area to work on. Especially in case of military applications, it is very important to position the wireless sensor node as it is based on sensitive and strict constraints. Lots of other applications are related to location information. The cost of the hardware on WSN nodes hinder the application of distance based localization technologies that depend on absolute point-to-point distance measurement. When sensor nodes have directionality, the network localization problem must be extended to consider each sensor's orientation as an unknown parameter, to be estimated along with position as it is very important to perform the localization for better utilization of the network.

Point in triangle method is efficient way to judge the accurate positioning of the sensor node. Anchor nodes help the localization process so in this research, focus is on anchor nodes and point in triangle technique for localization process of sensor nodes. As point of triangle scheme is accurate by have some issues such uncertainty in finding target nodes so in this research, anchor nodes have been used to increase the probability of localization process. The simple vision is to use the anchor nodes for finding estimated location and then use of cluster head's RSSI value for exact position locking of the target nodes.

Finally performance analysis has been done based on point in triangle and proposed scheme.

**Keywords:** *Wireless Sensor Nodes, Anchor Nodes, Cluster Head, Point in Triangle, Approximate Point in Triangle*

## 1. Localization of Wireless Sensor Network

The ultimate goal of sensor networks is to remove the need for extensive network topology planning and thus the need for knowledge of node location when deploying. [1] Localization is the process by which sensor nodes determine their location. In simple terms, localization is a mechanism for discovering special relationships between objects. In node mobility four different scenarios arise. First, both sensor and beacon nodes are static. Second, sensor nodes are static while beacon nodes move. [2] Third, sensor nodes move while beacon nodes are static. Fourth, both sensor and beacon nodes move. In localization models that use GPS as the source, the localization process is straightforward. However, in a localization model that uses beacon nodes to help sensor nodes with location discovery, the beacon nodes are either manually configured with their location or equipped with a GPS receiver which they can use to determine their location.

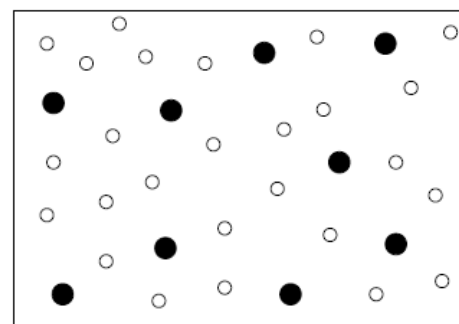
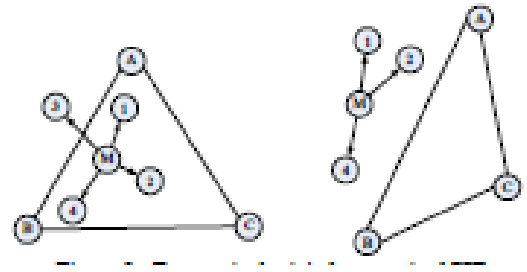


Figure 1: Beacon nodes for wireless nodes

Beacon nodes then provide their location information to sensor nodes and help them in computing their location. The idea of beacon-based localization is presented in Figure 1. Sensor nodes are represented by hollow circles and beacon nodes are represented by shaded circles.



**2. Point in Triangle Concept**

The theoretical method used to determine whether a point is inside a triangle or not is called the Point-In-Triangle (PIT) test. The PIT test can be carried out only under ideal physical layer conditions, when every node in the network is mobile can move around its own position. [9]

The basic idea of APIT (Approximate Point in Triangle) algorithm is to simulate the mobility of node M in PIT algorithm through the information exchange between node M and its' neighbor nodes, which can be shown in Figure 2. [2] APIT algorithm requires anchors in a single hop, high nodes' density and anchors' uniform distribution. Yet nodes' density is seldom high and nodes' distribution is uneven in actual WSN networks, in which the accuracy of APIT only reaches to about 35% [3].

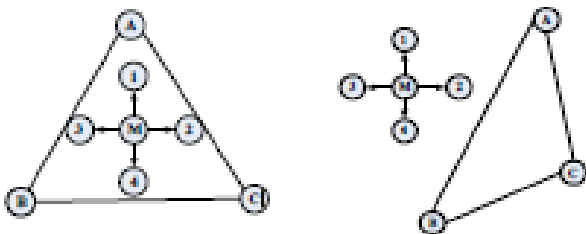


Figure 2: APIT Algorithm [2]

Due to the limited number of nodes in WSN, APIT can only judge in finite directions and make wrong judgment in some cases [4]. Two typical misjudgments in APIT can be shown in Figure 3.

Figure 3: Two typical misjudgments in APIT [2]

Further research has been proposed for enhancement of APIT algorithm with area based localization for wireless nodes as shown in figure 4. First, SS (Signal Strength) information must be exchanged among the nodes within a single hop, that is, the participated anchor nodes and ordinary nodes must be within one hop from the test node and APIT demands there exists at least three anchor nodes within one hop distance. [2]

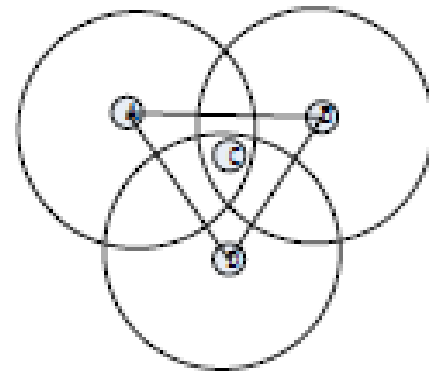


Figure 4: Central based localization with enhanced APIT

**3. Proposed Work**

In our research we have focused on the finding the localization of the non located nodes by implementing point in triangle algorithm. We have considered the high density of anchor nodes by converting ordinary nodes to anchor nodes which are lies in between point in triangle area. Main focus is to solve the issue when anchor nodes are unevenly distributed. To solve this issue, we have used cluster head approach to find the cluster heads which can be anchor nodes and neighbor nodes will become the part of cluster head automatically. After finding cluster heads

and child to the cluster head, point in triangle has been used to find the exact location of the non located node as non located node will be the part of one of the cluster heads. This solved the problem of non uniform distribution of anchor nodes for finding the non located nodes accurately.

Routing Protocol	Optimized Point in Triangle
Traffic Model	CBR
Pause Time	100 sec
Speed	11 mps

Table 1: Basic parameters used for Experimentation

#### 4. Research Methodology

We have started experimentation of localization of wireless sensor nodes by implement sensor grid area of  $100 \times 100$  meters and 100 sensor nodes have been used for experimentation. Starting has been done by locking the anchor nodes for finding the hidden nodes. After finding anchor nodes, various information have been checked like RSSI value for anchor nodes. More anchor nodes have been required for finding target node so we have matched the range of the anchor nodes and if target node is inside the range then we has converted ordinary node to anchor node. Accuracy in finding the targeted node has been the parameter to compare.

#### 5. Experimentation and Results

Basic parameters used for experimentation. Some of the experimentation done for checking the behavior of AODV protocol under wormhole attacks are given below:

Parameters	Value
Simulator	MATLAB
Simulation Time	1200 seconds
No of nodes	100

#### Number of Dead Nodes

In case of Point in triangle method, the numbers of dead nodes are more as compared to the proposed work because in proposed work, we have save a lot of resources by using RSSI value for distance calculation.

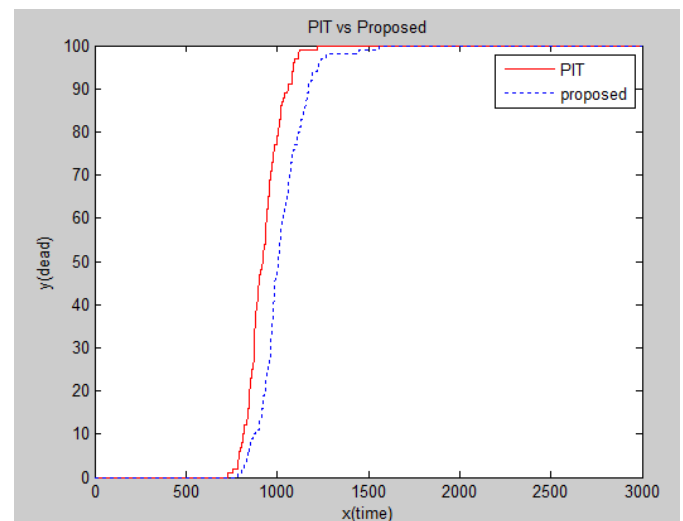


Figure 5: Shows the Number of dead nodes with accordance to time

The communication of sensor nodes is done with routing process and according to the parameters defined in the network y various cluster heads. Normally the wireless sensor nodes are limited with energy and during communication by sensing area, energy consumption by the nodes occurred. This energy consumption is directly proportional the task performed by the sensor nodes. In normal communication while finding hidden node in

network, all the sensor nodes have activities for finding hidden node which could lead to the rise in energy consumption by the nodes. In our research as discussed earlier, anchor nodes has performed good task to save energy and energy consumption by remaining sensor nodes is lower as compared to normal techniques. Number of dead nodes is directly proportional to the energy consumption by the nodes. The number of dead nodes is less in proposed scheme because the energy is saved due to selection of distance calculation by RSSI values but the dead nodes are more in traditional point in triangle due to calculation of the distance by anchor nodes only.

**Judgment Accuracy**

Judgment accuracy is shown in the figure, which is much better in case of proposed work to the increase of anchor nodes.

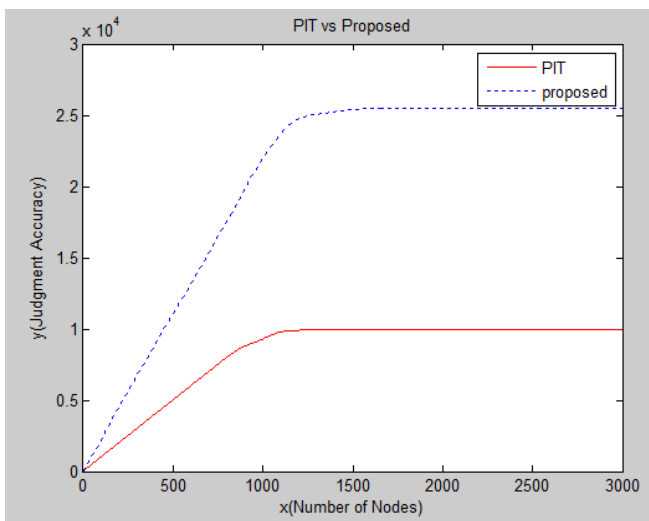


Figure 6: Shows the Judgment Accuracy of PIT and proposed work

Above figure shows the accuracy of the hidden nodes. In particularly clustering, RSSI value for distance calculation and increased number of anchor nodes. As discussed earlier, accuracy of the finding of hidden node is play important role in successful finding of node. Accuracy in judgment means less number of resources wasted on

particular process. Judgment accuracy is totally dependent the exact location finding of the hidden node in localization process. In our research, we have used clustering approach with RSSI values along with anchor nodes which produce better results in term of accuracy in localization process.

**Degree of Accuracy**

Degree of accuracy is more in case if Point in Triangle method. Degree of accuracy for both schemes and it shows the improvement of degree of accuracy in case of proposed scheme as compared to Point in triangle scheme.

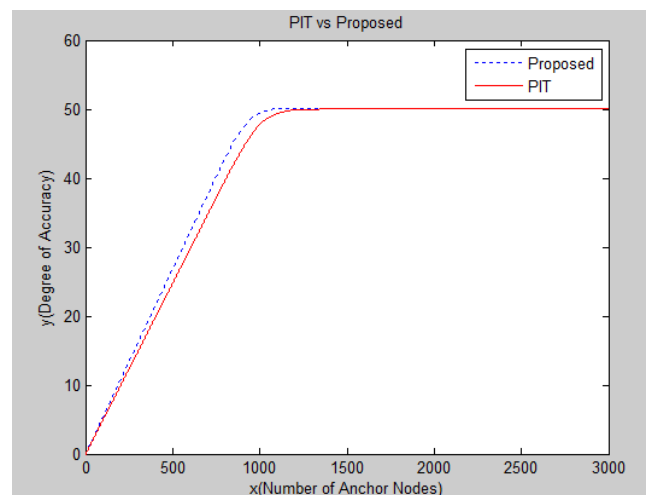


Figure 7: Shows the Degree of Accuracy of PIT and proposed work

Normally the degree of the accuracy is measured by the value difference in the accuracy of a scheme. In our research, we have improved scheme of localization process sensor network over the point in triangle scheme which is already used for localization process. Proposed scheme has better results as compared to traditional point in triangle scheme.

**Distribution of the Information**

Figure show the behavior of Point in Triangle concept and proposed concept based on the distribution of information shared in the sensor network.

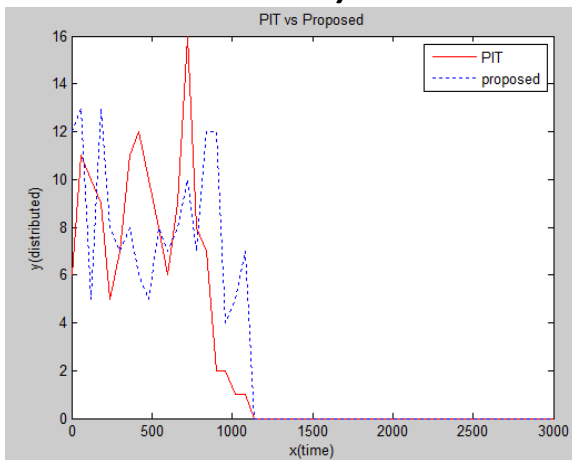


Figure 8: Shows the Distribution of PIT and proposed work with accordance to time

Normally wireless sensor network nodes exchange information from cluster heads and to cluster heads only. Dependent on the protocol selected, information flow occurred. Distribution of data is depending on the nature of protocol. More distribution of data means more information sharing which could lead to the congestion avoidance conditions and quick updates in network. In our research, distribution of information is improved as compared to other techniques available.

### Balance of node communication

Figure below shows the balance of the current approach compared to normal Point in Triangle method. Balance equation is better in PIT as compared to proposed work, this is because of more fluctuation in case of proposed work. Fluctuations are due to the distance measure by using this information transfer by RSSI value.

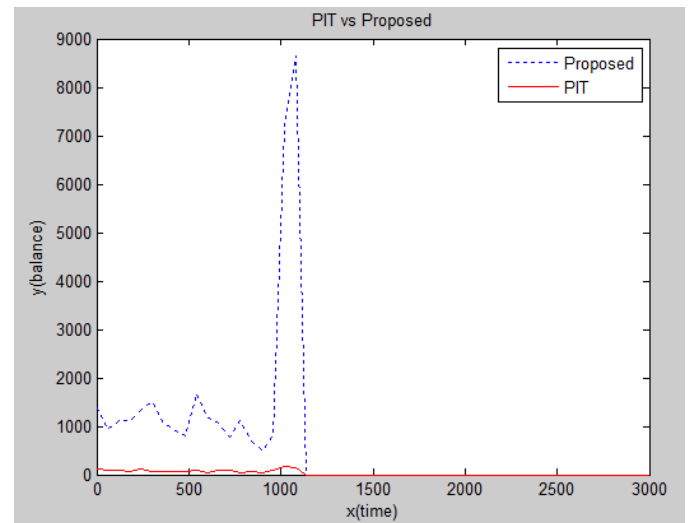


Figure 9: Shows the Balance equation of PIT and proposed work with respect to time

The balance of the network is always played an important role in finding better solution for various functions of the network. The balance of the proposed scheme is similar to the point in triangle and proposed scheme is having other benefits which make it overall better performer than point in triangle.

### 6. Conclusion and Future Scope

Our research is based on the localization of the hidden nodes in wireless sensor network. This research is very useful in localization process of the target nodes which can be used as real time application such as target locking of military targets in war zone. This particular research has considered clustering and RSSI value of the sensors for finding the hidden nodes. Particularly, we have used anchor nodes concept for finding nodes and anchor nodes are helpful in term of number of anchor nodes which are used in finding nodes in wireless sensor network.

Moreover point in triangle concept is used along with appropriate point in triangle concept for locking and finding of the nodes. Propagation models are useful in finding motion of the sensor nodes and can be locked using anchor nodes along with RSSI value and point in triangle

approach. Comparison has shown the improvement in accuracy of finding node in wireless sensor network. Our proposed work has shown better values in accuracy while finding nodes.

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