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Improving the Location of Nodes in Wireless Ad Hoc and Sensor Networks Using Improvised LAL Approach

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Abstract*: This Paper aims to present a localization of many nodes in wireless networks. Localization is an enabling technique for many sensor network applications. In the deployment of network includes many nodes, due to hardware or deployment constrains, the networks almost not entirely localizable, there is possible for any of the nodes placed as a non-localizable nodes in the wide range of network area. From that, the server doesn't know where the destination nodes have been deployed. It is difficult to transfer the data from source to sink whether the deployed nodes is not in the range of particular network. So, I proposed a Improvised LAL approach that triggers a single round adjustment and that carries and beware of node localizability, that makes easy for us to make the non-localizable nodes in the network into localizable nodes.

***Index terms*: Localization, localizability, Improvised LAL approach, wireless and sensor networks.**

I. INTRODUCTION

Beyond the established technologies such as mobile phones and WLAN, new approaches to wireless communication are emerging; one of them are so called ad hoc and sensor networks. Ad hoc and sensor networks are formed by autonomous nodes communicating via radio without any additional backbone infrastructure.

Localization is the main problem in wireless ad-hoc and sensors networks in which each and every node determines its own location in network region.*"If you board the wrong train, it is no use running along the corridor in the other direction"- Dietrich Bonhoeffer* . As he says, wireless technology has the capability to reach any location on the earth. Defining the ad-hoc network in terms of network as an autonomous system of mobile hosts(MH's),connected by wireless links, using that, the mobile hosts that connect with the base station.

To locate non-localizable nodes, the traditional approach mainly focuses on how to tune network settings according to these nodes. At first they attempt to deploy additional nodes or beacons in application fields. Beacons are act as a backbone for our network. Due to this increment in the deployment of node density and creates abundant internodes distance constraints thus, enhancing the localizability. But this attempt lacks to provide feasibility, since the additional nodes and beacons should be placed in the region of non-localizable nodes, in the network. The controlled motion of beacons provides thorough information for the localization of nodes, but it has a limitation on adjustment delay and controlling overheads. One approach is to augment that is to make the greater in transmitting power of nodes stage-by-stage until all nodes become localizable, which causes multiple rounds of configuration dissemination and data collection in a network. A straight-forward single-round configuration solution is maximizing the ranging capability of the network regions. The drawback of power maximization is that it introduces many unnecessary distance measurements, which are obtained with costs. In this paper, I propose an Improvised localizability-aided localization (LAL) that arrogates sufficient condition of node localizability to identify localizable and non-localizable nodes.

II. RELATED WORK

The localization methods can be categorised as a range-free and range-based methods. Range-free localization methods, merely use neighbourhood information (such as node connectivity and hop count) to determine node locations. Range-based approaches assume nodes are able to measure internodes distances, from that we can derive the accurate locations of the nodes. There are number of range-based algorithms are used to find out the accurate location of the nodes, these algorithm adopt distance ranging techniques, such as radio signal strength (RSS) and time difference of arrival (TDoA).The RSS maps received signal strength from the distance between two nodes like a signal extinction model, while TDoA measures the signal propagation time for distance calculation. One can see that naive approaches for localization are not adequate for all scenarios. While it may be possible to manually configure each node with its position in small and static networks, this approach is impracticable in envisioned large-scale networks of thousands of geographically distributed nodes.

From the past, a few works and techniques are done on localization in non-localizable networks. In previous technique such as range-free localization the cop count between two nodes are proportional to their distance. In range-based localization technique that measure the accurate distance between two nodes using specific ranging hardware. A technique is a GPS-equipped mobile node to localize fixed nodes by measuring the distance between the mobile node and fixed ones, which use a mobile node with known location information. *Wu- proposes a similar approach with the assumption that each node can move around and measure the distances to its neighbors and the relative distances between successive positions along its route.* However, the availability of mobile nodes is much more costly and not scalable for this approach. In contrast to this mobility based approaches, *Anderson-propose a graph manipulation method to assure the network localizability*. A distributed range free localization scheme is used in recent years for localization in non-localizable networks. In DRLS a node called anchors, get their own location information via GPS or some other mechanism. The other nodes called normal nodes that do not have its own location information a few algorithm has been used to estimate the nodes location information effectively.

III. FINE-GRAINED APPROACH

A. Formation of Network Topology

Here a network has been formed with the help of dynamic topology due to a mobility of the nodes in the network. Setting up and organizing such a virtual infrastructure is an important challenge. The inherent trade-off between energy-efficiency and rapidity of event dissemination is characteristic for wireless sensor networks consisting of battery driven devices.

Localization in wireless ad hoc and sensor networks is the main problem for every node to determines its own location, a wireless ad hoc or sensor network cannot be ridiculously dense because the mechanism of topology control is usually used to reduce the collision and interference, ignoring the localizability of thenetwork.Thetopology of these networks often plays a crucial in the speed with which certain tasks can be accomplished using these networks.

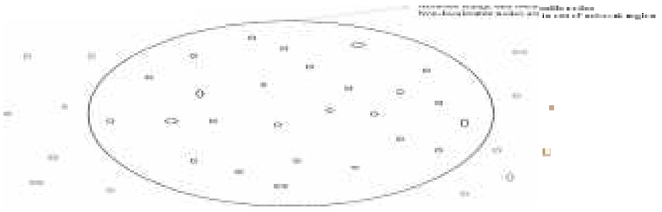

Figure 1 Formation of network

B. Localization Method

In localization method, first attempt to deploy a network with corresponding topology that described in previous section how to deploy a network with multiple nodes. Then we are going to measure the deployed nodes location whether it is, within the range of network or not, there is a main problem to find out the locations of each and every node in the network. From the fig 1, the localizable nodes are shown within the network region and non-localizable nodes are indicated as red dots, are out of region of our network. If there is an additional nodes, which is going to be deployed in the network that increases in node density and creates abundant internodes distances constraints, this enhancing the node localizability.

C. Measurements on Network Using Distance Graph

The network is said to be a unique and localizable, then it must have a unique set of rigidity and distance graph and also the set of anchors such of beacon nodes. Whether a formed network cannot be localizable given its distance graph, then it is called as a localizability problem.

Some of the method used to deploy a distance graph using mathematical formation. The distance graph is formed from a collection of points in the Euclidean space. The set of measurements for the network can be modelled by a distance graph G, let G = (V,E),where V denotes the set of vertices and E denotes the set of edges. For (i,j) € V ;and (i,j) € E if the distance between i and j can be measured or both of them are in known locations, are exploited by a graph theory

D. Construction of Localizable Graph

It is important to construct a localizable graph through an incremental construction. A common mathematical formation can also be used to construct the localizable graph. From the graph theory, Define G^2 as $(V,E \cup E^2)$, where (i;j)€E^2 if i≠j and ∃k€2 V such that (i,k) and (j,k)€E. Similarly, define G^3 as (V,EUE^2UE^3), where (i,j)€E^3 if i≠j and ∃k€V such that (i,k)€E and (j,k)€E^2.

IV. DESIGNING OF PROPOSED SYSTEM

A. Improvised Lal Design And Implementation

Design phase of Improvised LAL has been begun with being aware of node localizability, Improvised LAL can effectively conduct the adjustment of network ranges, but in traditional approach that is only an indistinctive network adjustment can be made out and could only make indistinctive augmentations. Basically, Improvised LAL consists of three major modules and is workflows are shown in Fig. 1.

In improvised LAL approach, first the network has been deployed by using the network topology is described in previous sections. After the network formation, the proposed techniques are explored in the network and the nodes in the network are act depend upon the described techniques. After the explosive of all techniques has been finished the nodes are try to send the packet and location information. There is a large number of nodes has been deployed in the network, so the density of the network much more increased and each node doesn't know the location information of other nodes. An Improvised LAL approach used here to know the location information of all other nodes. Processing and work flows of Improvised LAL approach are explained below,

Module 1: *Localizability test*ing. In Localizability testing, after the network is deployed in an application field, due to some hardware or environmental factors that is for unpredictable issues in the design phase, it may not ready for localization. So, node localizability testing is conducted in an Improvised LAL, which identifies localizable and non-localizable node in a network for further adjustment.

Module 2: A*nalysis of Network structure.* In an analysis of the structure of the network must support fine-grained approach, to measure the accurate location information about the entire node. So, we have to decompose a constructed distance graph into two-connected components. These components are managed as a tree structure and the one of these components containing beacons in the root of the distance graph. Adjustments are made out along with the tree edges from the root to the leaves. Beacons are mainly used to find out the Localization and improve the accuracy of the nodes in the network.

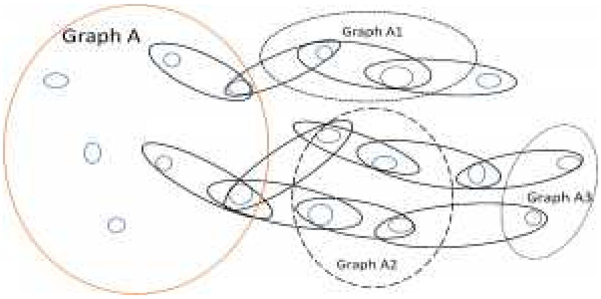

Figure 2 Decomposition of a Graph

Module 3: *Distinctive adjustment.* In Improvised LAL treats nodes differently regarding to their localization and places in the component tree. Through vertex augmentation, Improvised LAL converts all non-localizable in a single round. The network adjustments made out by Improvised LAL are localizable and can be localized by the existing localization and localizability techniques.

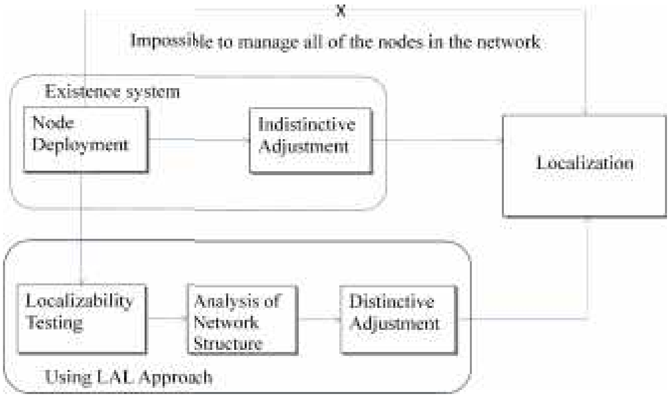

Figure 3 Workflows between traditional and Improvised LAL approach,

Module 1 can be done by applying Theorem 2(shown in below). For a given specific node, its localizability that depends upon the property of disjoint paths and redundant rigidity, which is being tested in polynomial time by network flow algorithms and the pebble game algorithm, respectively. That is, a node localizability testing can be conducted. In Module 2, a created distance graph is decomposed into two-connected components using depth-first search. And these components are managed as a tree structure and the adjustments can be made in these tree edges. In module 3, node adjustments are made out along the paths of the component tree starting at the root. I present an Algorithm (Basic _Localization _Algorithm) to explain the module 3.

From that, the node will know the location information of all other nodes in the network. In the network topology, the nodes are formed as a cluster and a cluster has a cluster head, a cluster head have location information about all of the other nodes in the cluster. If a node placed in cluster A want to send a packet to a other node that placed in cluster B, then it will send a request to cluster A, a cluster head A have the location information about all of these node and where it is deployed then redirect the request to cluster head B, the B send the packet to the corresponding node that formed under that particular cluster

B. Add_Heuristic Approach

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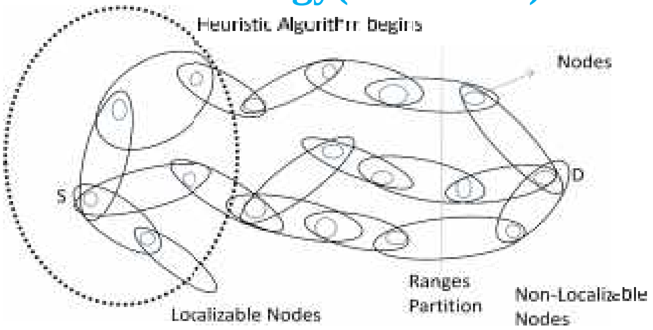

Figure 4 to find out all non-localizable neighbors of localizable

In Add_heuristic approach, find out all non-localizable neighbors of localizable vertices. From the above figure 4, the edges have been added for each non-localizable node to convert these nodes as a localizable node. The edges have been added by heuristic algorithm to connect these non-localizable nodes for the purpose of delivering the data from localizable nodes from non-localized nodes in the deployed network. Algorithm for Add_heuristic is described in a later section.

C. Geographical Routing Approach

Geographical routing is an emerging technique to find out the direction of any nodes in the certain region of any network. A 2D graph has been deployed and it has x-axis and y-axis using that a nodes direction has been found out. Basically a network has been deployed and measured by a distance graph. If a sender node try to deliver a packet to a receiver node but it does not know the location information of the receiver nodes, so using this approach the location that is the direction of the node has been found out. Here a beacon signals are act as a backbone of our network The fig 5 shows that, a sender collects the nodes location information based on the direction of the nodes, and finally they select a shortest path from the all selected paths, from that shortest path they sent the data packet to the corresponding receiver.

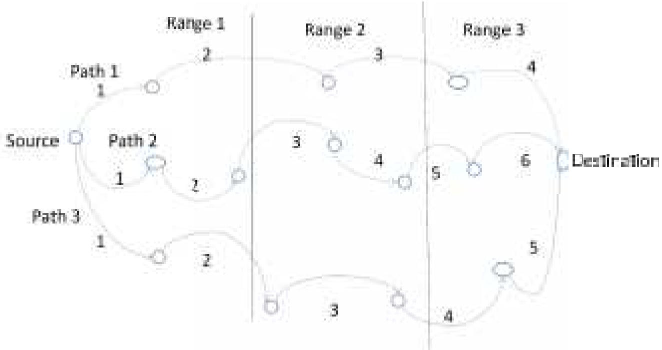

Figure 5 Geographical Routing

D. Ease of Use

Description of an Algorithm

A Basic _Localization _Algorithm, applied here for the purpose of localize all the nodes in the network without any incompatibility. In that algorithm, edges are added by vertex augmentation of all non-localizable node vertices in G_A, that is Graph A and G_A is localizable from the Theorem 3(shown in below). This Algorithm repeats all of the steps, until all components get handled. After applying of an Algorithm, the entire network is localizable; all of node in the network gets localized. Popular localization algorithms can then be used seamlessly to localize all nodes in the network.

The repeated edges has been reduced by analyze the graph properties of these components.

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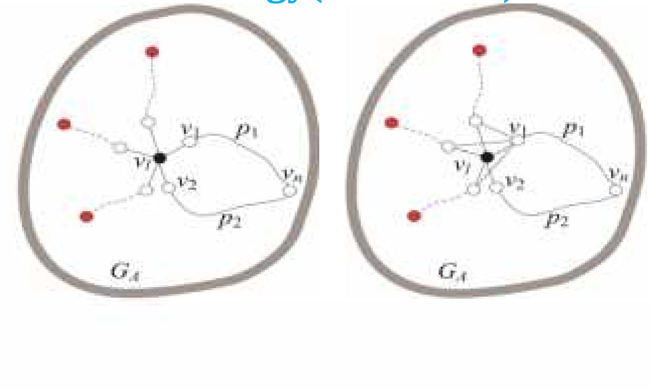

Figure 6 proofs of theorem 3, red dots and black holes

Algorithm 2.Add_Heurictic _Algorithm.

If G_A is used as an input of Add_Heuristic, the algorithm first finds all non-localizable neighbors of localizable vertices, and adds edges for each non-localizable one according to the following analysis made out from the distance graph. Then add edges to all non-localizable vertices from the localizable vertices. After that, the adjustments are made out continuously to localize these non-localizable nodes by adding edges from non-localizable vertices to localizable vertices.

E. Analysis from the Graph

From the above graph GA some non-localizable vertices have at least one localizable neighbour vertex. Adding two edges between the vertices, which connect two neighbour vertices on different vertex-disjoint paths to the non-localizable vertex, is enough to make the vertex localizable according to Theorem 2. From the analysis from the above graph, If a non-localizable vertex has more localizable neighbours within two-hop distance, that is, the distance between these neighbours are connected with only two edges, then, these localizable vertices makes it non-localizable as a localizable. Some of the decomposed components in a distance graph are not localizable due to the lack of beacons. If these nodes are adjusted to be localizable in a decomposed component, the component is instantly localizable without extra manipulation.

V. THEOREMS

Theorem 1. A graph with $n \geq$vertices is globally rigid in two dimensions if and only if it is three-connected and redundantly rigid. A graph G=(V,E) is called k-connected (for k€IN) if $|V| > k$ and G-X is connected for every set X $\subseteq$ V with $|X| < k$.

Theorem 2. In a distance graph G=(V,E) with a set B⊆V of k≥3 vertices at known locations, a vertex is localizable if it is included in the redundantly rigid component inside which there are three vertex-disjoint paths to three distinct vertices in B.

Theorem 3. Suppose G=(V,E) is a two-connected graph with a set B of k≥3 beacons and B∋V . Let V_N denote the set of non-localizable vertices, and E_N denote the set of edges (i,j),i€V_N and (i,j)€E^2. Then, G=(V ,E U E_N) is localizable.

VI. DISCUSSION

The network topology is a by product of some basic services in ad hoc and wireless sensor networks,

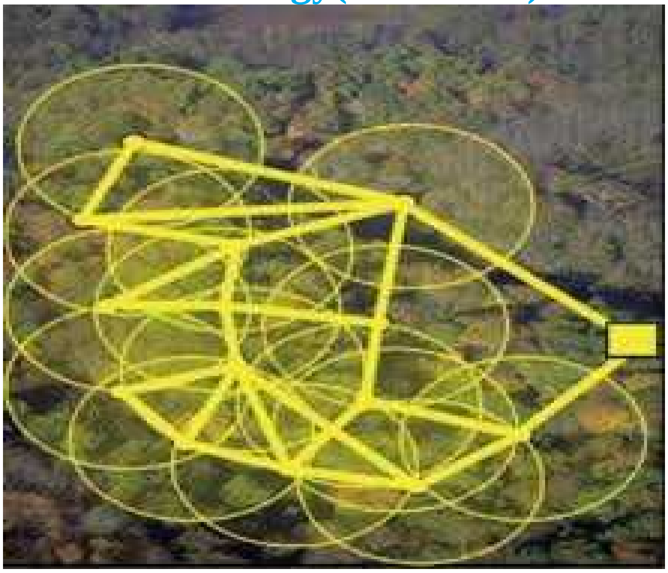

Figure 7 GreenOrbs system in a campus

Its collection induces none or little additional overhead. Inspired by this fact, this paper naturally adopts the centralized scheme, which mainly comes from the localizability testing part. The fig 7 shows the wireless sensor nodes that scattered the signals to get the location information of other nodes, which is intended to send the data packets from source to sink and vice versa.

The rigidity and beacons are used as backbone of our network to transform the data's from source to destination. A rigidity, they find the co-ordinates and transforms these relative co-ordinates to a global co-ordinates,

Table 1 Experimental results on Greenorbs

	LAL_Basic	Add_heuristic	Indistinctive adjustment
No of edges	340	309	736
No of added edges	55	24	451
No of power 1 nodes	61	73	0
No of power 2 nodes	39	27	100
No of power 3 nodes	0	0	0

Assume that noisy results (the outliers with large errors) are sifted by these approaches, and only used accurate ranging results in Improvised LAL design.

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VII. EVALUATION

A. Experiment

To examine the correctness and effectiveness of Improvised LAL approach, I implement it on the ongoing wireless sensor network system, that is Green Orbs system and the data trace collected from the system Green Orbs. From the data collection the important factor is to reduce the energy consumption of the deployed nodes. Using, cycling theorem, the transmission power is also well controlled under the highest level to provide the enough connectivity for data collection or other services.

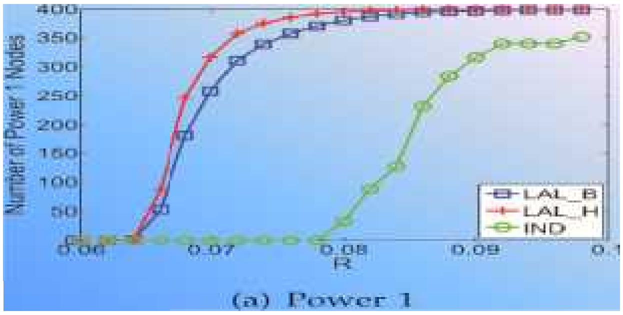

Figure 8a Number of nodes plotted at different power levels

From the fig.9, there are 285 edges are needed to connect the edges between the nodes. A comparison can be made out between the edges and nodes with different transmitting power output from the resultant topology, I just denote the nodes that have original communication range as power1 nodes, the ones with doubled and tripled ranges are denoted as power2 and power3 nodes from doubled and tripled like wise

From those following figures, the comparison made between the improvised LAL and traditional approach, to find out the location of the nodes.

B. Simulation

Simulation is the process or operation that has a limitation among the real time implementation of original process. In this paper, I have to stimulate and further examined the scalability and efficiency of Improvised LAL under different network instances and varied network parameters.The transmission power requirements of LAL_Basic and Add-Heuristic algorithms in deployed nodes are shown in fig.8. Plots the number of nodes at different power levels. As shown in fig.8a and 8b, results of Add_Heuristic and LAL_Basic, have much more power 1 nodes than the traditional approach except R denotes original communication range less than 0.66 and much less than power

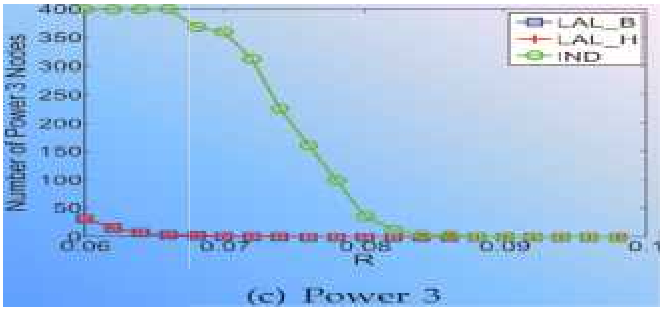

Figure 8c High power levels at Improvised LAL intend to add more edges in the graph

3 nodes than traditional approach except when R greater than 0.99 that shows in fig.8b.

The results in fig.8c also explain about the Improvised LAL that can have a ability to serve much extra edges than traditional approach because higher power levels tend to induce more edges than a lower one.

Abbreviations used

Traditional approach→IND (Indistinctive Adjustment Approach)

Improvised Traditional approach→Improvised IND(Improved Indistinctive Adjustment Approach)

Because Traditional approach treats the entire network indistinctly and obviously needs more adjustments than LAL, an improved approach (Improved IND) is implemented instead. From the above all description it suggests that LAL_Basic and Add_Heuristic are more fine grained than improved IND.

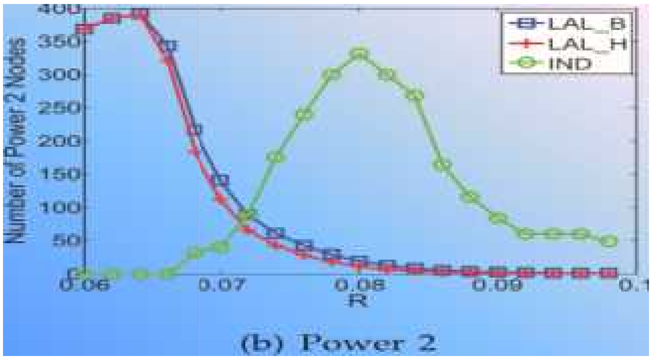

Figure 8b Number of nodes at different power levels in traditional approach

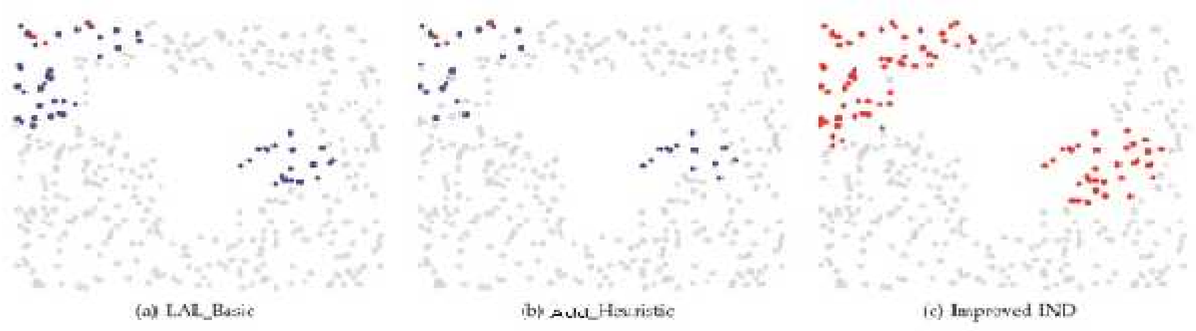

Figure 9 Testing Improvised LAL and Improvised traditional approach on network instances consists of 400 nodes

VIII. CONCLUSION

The analysis of the limitation and power requirements of existing approach on localization in non-localizable networks, and propose a Improvised Localizability-aided Localization approach named Improvised LAL. Improvised LAL treats the network as whole and localize all the nodes in the network, while if it is in non-localizable state. That makes the adjustment corresponding to node localizability results in the first module, other than traditional approach, that includes the nodes in localizability testing and made a indistinctive adjustment. From that Improvised LAL approach, a nodes need to be augment with their ranging capability to connect and added new edges are needed to be measured. It also has some good characteristics for the purpose of implementation aspects in the real world application and I, implement the Improvised LAL and demonstrate its effectiveness through working system experiment and extensive simulations.

IX. FUTURE SCOPE

I, proposed the Adaptive Position Update strategy to address these problems. The APU scheme employs two mutually exclusive rules. The MP rule uses mobility prediction to estimate the accuracy of the location estimate and adapts the beacon update interval accordingly, instead of using periodic beaconing. The ODL rule allows nodes along the data forwarding path to maintain an accurate view of the local topology by exchanging beacons in response to data packets that are overheard from new neighbors, Then, We mathematically analyzed the beacon overhead and local topology accuracy of APU and validated the analytical model with the simulation results.

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