

# EFFECTIVE RANGE- FREE LOCALIZATION SCHEME FOR WIRELESS SENSOR NETWORK

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## ABSTRACT

*Location aware sensors can be used in many areas such as military and civilian applications. Wireless Sensor Networks help to identify the accurate location of the event. In this paper a cost effective schema for localization has been proposed. It uses two beacon nodes to identify the location of unknown nodes. It also uses flooding and estimating method to accurately identify the location of other nodes. Available area is divided into zones and beacons are provided for each zone. Beacon nodes are placed in appropriate locations normally two in a zone to provide location information. Using the two nodes location of unknown nodes can be calculated accurately.*

## I. INTRODUCTION

Wireless Sensor Networks consist of spatially distributed sensor to monitor physical or environmental conditions such as temperature, sound, pressure, etc. Sensor networks collect data and aggregate them for further processing. There are many methods to implement localization of nodes such as GPS (Global positioning system) and AOA (Angle of arrival), repeated beacon signals are directed in every method. In many of the applications accurate location is necessary. Localization helps in identifying the location accurately. Using GPS on every node makes us to find out location in the cost effective manner. Beacons are introduced to know their location and they use different methods to propagate the location to other nodes. It includes two methods for propagation they are Single hop and Multi hop. In single hop beacon nodes transmit their location to neighboring nodes and in multi hop, it floods the network with location information. Existing system describes an optimized scheme for transmitting location information to other nodes. Location of the deployed sensors is divided into zones and each zone is covered with two beacon nodes. Using the two beacon nodes - their location and distance to the normal node- and using triangulation method location of unknown node can be found out.

## II. LITERATURE SURVEY

A. Boukerche et al. 2009 [1] in this paper shows how Voronoi diagrams can be used efficiently to scale a DV-Hop algorithm while maintaining and/or reducing further DV-Hop's localization error. Nodes can be localized by their Voronoi cells in localization scheme. Voronoi cell limits the region that is flooded when computing its position in order to reduce its localization error for every node. A DV-Hop localization system works by transforming the distance to all beacons (nodes that know their position) from hops to units of length measurement (e.g., meters, feet) using the average size of a hop as a correction factor. To estimate the performance of our scheme, they performed an extensive set of simulation experiments using NS-2. The results clearly indicate that the proposed algorithm performs and scales better than the DV-Hop. DV-Loc algorithm works on sensor networks with a large number of nodes.

NirupamaBulusu, et al. 2000 [2] in this paper, reviews localization techniques and evaluate the effectiveness of a very simple connectivity-metric method for localization in outdoor environments that makes use of the inherent radio-frequency (RF) communication capabilities of these devices. A fixed number for reference points in the network with overlapping regions of coverage transmit periodic beacon signals. Nodes use a simple connectivity metric that is more robust to environmental vagaries. This concludes the proximity in a subset for these reference points. Nodes localize themselves at the centroid for their proximate reference points. The accuracy for localization is then dependent on the separation distance between two adjacent reference points and the transmission range for these reference points. Initial experimental results provide accuracy of 90% for data points within one-third of the separation distance.

NirupamaBulusu, et al. 2001 [3] in this paper analysis and evaluation is performed on three novel adaptive beacons placement algorithms using localization based on RF-proximity. The three simple off-line beacon placement algorithms are Random, Max and Grid. Random methods are localization at different areas can randomly point in the region. Select a random point and add a new beacon. Another method is Max algorithm which is divided in three steps:

Step 1 Divide the terrain into step x step squares.

Step 2 Measure localization errors at each point 'p' in the terrain that corresponding to a square corner.

Step 3 Add new beacons at the point that has the highest measured localization error among all points.

The last method is grid approaches to determine a candidate point to compute the cumulative localization error over each grid, for several overlapping grids in the terrain. This is based on the observation that adding a new beacon affects its nearby area, not just the point where it is placed. In max method step1, step2 are as in the max. A set of computation perform to locate the beacons.

Tian He, et al. 2003 [4] in this paper, they present an approximate point-in-triangulation test (APIT), a novel localization algorithm that is range-free and showed that APIT scheme performs best when an irregular radio pattern and random node placement are considered and low communication overhead are desired. Comparisons are done with extensive simulation with three state-of-the-art range-free localization schemes to identify the preferable system configurations for each. In addition, it determines the effect of location error on routing and tracking performance. Routing performance and tracking accuracy are not significantly affected by localization error. These errors are less than 0.4 times the communication radio radius. This briefly describes the key features of three range-free localization algorithms which are Centroid Scheme, DV-Hop Scheme and Amorphous Scheme. The Amorphous Localization algorithm takes a different approach from the DV-Hop algorithm to estimate the average distance for a single hop. This work assumes that the density for the network,  $n_{local}$ , is known as priori, so that it can calculate HopSize offline in accordance with the Kleinrock and Slivester formula.

$$HopSize = r(1 + e^{-n_{local}} \int_{-1}^1 e^{\frac{-n_{local}}{\pi}(arccost-t\sqrt{1-t^2})} dt)$$

Moreover, they provide insight on how localization error affects a variety for location-dependent applications. These results are accurate which are provided by the range-free schemes and is considered sufficient to support various applications in sensor networks with has only slight performance degradation.

Xiang Ji and HongyuanZha 2004 [5] in this paper a distributed sensor positioning method based on multidimensional scaling technique is proposed. Multidimensional scaling and coordinate

alignment techniques are used to recover positions. The estimated positions of the anchors are compared with their true physical positions and are corrected. The positions of other sensors are corrected accordingly. With iterative adjustment, this model can overcome terrain conditions, adverse networks and generate accurate sensor position. The Proposed model is demand sensor positioning method based on the distributed sensor positioning method. They use multidimensional scaling technique to compute relative positions of sensors in a wireless sensor network. This reduces error cumulation by anisotropic topology. Our distributed method for sensor position estimation is very effective and efficient.

Di Ma et al. 2010 [6] in this paper the basic idea of many hop-count based localization algorithms is to seek a transformation from hop-count information to distance or location information. Traditionally, hop-counts between any pair for nodes can only take integer value regardless of relative positions for nodes in the hop. They partition a node's one-hop neighbor set into three disjoint subsets according at the hop-count values. The transformed real number hop-count is a more accurate representation for a node's relative position than an integer-valued hop-count. They present a novel algorithm termed HCQ (hop-count quantization) by performing transformation. They use transformed real number hop-count to solve WSNs localization problems based on the MDS (multidimensional scaling) method. Simulation results performance's for the MDS algorithm using the real number hop-count outperforms those which use integer hop-count values. An algorithm to transform the integer hop count into a real number based on node neighbor distribution has been proposed. We form the hop-count matrix using the real number hop-count and apply it to the MDS localization algorithm. Simulation results show that the localization performance of the MDS using real number hop-count is better than those algorithms which use integer value hop-counts. The amount of improvement is also proportional to the node density and independent of the number of anchors.

D. Niculescu and B. Nath 2001 [7] in this paper lot of wireless sensor nodes are connected in Ad Hoc network fashion. They used to determine the position of nodes by using the following parameters time of arrival (TOA), time difference of arrival (TDOA), angle of arrival (AOA), and signal strength. Based on the above parameter they have done improvising the quality of the localization. Wireless ad hoc networks are a decentralized type of wireless network. The networks are ad hoc because it does not rely on a preexisting infrastructure has routers in wired networks or access points in managed (infrastructure) wireless networks. They propose a method for all nodes to determine their orientation and position in an ad-hoc network where only a fraction of the nodes have positioning capabilities, that each node has the AOA capability. They proposed two algorithms DV-Bearing and DV-Radial, each providing different signaling accuracy- coverage- capabilities tradeoffs. It provides absolute coordinates and absolute orientation, that it working in disconnected networks, and doesn't require any additional infrastructure.

Andreas Savvides et al. 2001 [8] in this paper Sensor networks consist of numerous tether less devices which should be arranged in an ad-hoc fashion. Sensors perform monitoring task and the physical location of individual nodes. It also assists in group querying or routing traffic to geographic destination and provides information on physical coverage. Setting GPS receiver in every node is not always good because there will be interruption of signal in the path. The nodes start with knowledge of their location and the others dynamically to estimate their positions by distributed algorithm. Algorithm utilizes a new iterative multi-lateration technique, such that all nodes that meet some simple connectivity requirements are finally able to determine their position. Use of ultra sound based TDoA method is ideal candidate for fine-grained localization as it is less sensitive to physical effect.

RongPeng and Mihail L. Sichitiu 2006 [9] in this paper focus on localization techniques based on angle of arrival information between neighbor nodes. A new localization and orientation scheme that considers beacon information which is multiple hops away. The schemes are derived under the assumption of noisy angle measurements. That the proposed method achieves very good accuracy and precision despite inaccurate angle measurements and a small number for beacons. The proposed localization approach is suitable for all AOA distributions mentioned, for analytical convenience, they used the Gaussian distribution to characterize the AOA measurements combining the errors caused by both the channel and the device/method.

AsisNasipuri and Kai Li 2002 [10] in this paper address the problem of location discovery at the sensor nodes, which are one of the central design challenges in sensor networks. They present a new method by which a sensor node can determine its location by listening to wireless transmissions from three or more fixed beacon nodes. The proposed methods are based on an angle-of-arrival estimation technique that does not increase the complexity or cost of construction of the sensor nodes. They present the performance of the proposed method obtained from computer simulations. The distance or angle estimates obtained are Received signal strength (RSSI) measurements, Time-of-arrival and time-difference-of-arrival (ToA, TDoA) measurements and Angle of arrival (AoA) measurements. The proposed localization technique evaluate the errors in location estimates derived assuming "ideal" directional beams from the beacon nodes, i.e. assuming the beam width to be zero. The major cost for implementing the scheme lies with constructing the antennas for transmitting a rotating directional beam from the beacon nodes. Additional advantages for the proposed scheme are that is based on angular estimates, its performance does not depend on the absolute dimensions for the network area. This will make the scheme useful for localization within a small area, whose dimensions might fall below the resolution for a GPS.

Frankie K. W. et al. 2007 [11] in this paper finding the position of the sensor node is a basic problem in wireless sensor network. A novel sub space approach for range based measurement node localization is implemented. The performance of algorithm mentioned in this paper are conventional subspace positioning method namely classical multidimensional scaling and Cramer-Rao Lower Bound (CRLB). In positioning approach suboptimum estimation performance in multidimensional scaling scheme is used. Computer simulation has been conducted to compare the mean square position errors (MSPEs) of the subspace algorithm with the classical MDS method as well as CRLB for WSN localization. In this paper WSN positioning is found by simple subspace algorithm. This algorithm calculates node to node distance from RSS or TOA measurements is devised.

Sukhyun Yun et al. 2007 [12] in this paper, they proposed an enhanced Centroid localization method using edge weights of adjacent nodes. This is based on TSK fuzzy modeling. In this method, first they find adjacent reference nodes which are connected to the node to be localized, and then develop the fuzzy membership function using genetic algorithms (GAs) for edge weights based on received signal strength indicator (RSSI) information. After calculating edge weights, employ weighted centroid method to localize the node. Finally, they simulate to demonstrate the performance. This method is simple and effective.

Raghavendra V. Kulkarni et al. 2009 [13] in this paper wireless sensor networks (WSNs) require location information to deploy Nodes. To localize this problem deploy a few special beacon nodes having location awareness. The non-beacon nodes are used to estimate their locations using noisy distance measurements from three or more non-collinear beacons from which they can receive signals. The ranging-based localization task is formulated as a multidimensional optimization problem, and it is addressed using bio-inspired algorithms, which exploits quick

convergence for quality solutions. It performs investigation on distributed iterative localization is presented so the nodes that get localized in iteration act as references for remaining nodes to localize. This has been addressed using particle swarm optimization (PSO) and bacterial foraging algorithm (BFA). A comparison of the performances of PSO and BFA in terms of the localization accuracy, number of nodes localized and computation time is presented. The bioinspired algorithms PSO and BFA are discussed using Particle Swarm Optimization and Bacterial Foraging Algorithm.

HongyangChen et. al 2008 [14] this paper position the problem of wireless sensor network node's location, DV-Hop positioning algorithm is proposed with basic principle and realization issues. By using this method they can improve location accuracy without increasing hardware cost for sensor node. This Simulation results show that it has good positioning accuracy and coverage. The influence of anchor nodes on the DV-hop algorithm is also explored. They simulated the DV-Hop and our proposed algorithm to evaluate location performance. The experiment region are a square area with the fixed size of 50 x 50 m<sup>2</sup> and the radio range of sensor nodes (R) are set to 10 meter.

### DV-Hop Algorithm

Every anchor node broadcasts a beacon to be flooded throughout the network containing the anchors location with a hop-count value. The hop-count value is initialized to one. The receiving node maintains the minimum hop-count value per anchor of all beacons it receives. Beacons with higher hop-count values to a particular anchor are defined as stale information which is ignored. Those not stale beacons are flooded outward with hop-count values incremented at every intermediate hop. In this mechanism, all nodes in the network get the minimal hop-count to every anchor node. Once an anchor gets hop-count value to other anchors, it will have an average size for one hop, and then it is flooded to the entire network. After receiving the hop-size, the blindfolded nodes multiply the hop-size by the hop-count value to derive the physical distance to the anchor. The average hop-size is estimated by anchor  $i$  using the following formula:

$$HopSize_i = \frac{\sum_{j \neq i} \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2}}{\sum_{j \neq i} h_{ij}}$$

where  $(i x, i y)$ ,  $(j x, j y)$  are coordinates of anchor  $i$  and anchor  $j$ ,  $ij h$  is the hops between beacon  $i$  and beacon  $j$ .

LasseKlingbeil and TimWark 2008 [15] in this paper the development and deployment are a wireless sensor networks for monitoring human motion and position in an indoor environment. Mobile sensor nodes which comprise mote-type devices with inertial sensors are worn by persons moving inside buildings. Motion data are preprocessed onboard mobile nodes and transferred to a static network for seed nodes using a delay tolerant protocol with minimal radio packet overhead. A Monte Carlo based localization algorithm is implemented, which uses a person's pedometer data, indoor map information and seed node positions at provide real-time indoor location information with accuracy. The performance for the network protocols and localization algorithm are evaluated using simulated and real experimental data. Fine-grained localization, a sensor node typically requires specialized hardware and often extensive computational resources. Fine-grained approaches are Radio Signal Strength (RSS), Time Difference on Arrival (TDoA) and Angle of Arrival (AoA). These methods, coarse-grained localization approaches focus on using a minimal amount of information to derive a location estimate. Network Topology and Protocol has to be

Static Network Design and Mobile Network Design. They perform localization through both simulations and experimental validation. The algorithm is robust against radio transmission irregularities and heading estimation errors which occur from sensor noise and magnetic disturbances.

## IV. CONCLUSION

Beacons are introduced to know their location and they use different methods to propagate the location to other nodes. It includes two methods for propagation they are Single hop and Multi hop. In single hop beacon nodes transmit their location to neighboring nodes and in multi hop, it floods the network with location information. Existing system describes an optimized scheme for transmitting location information to other nodes. Location of the deployed sensors is divided into zones and each zone is covered with two beacon nodes. Using the two beacon nodes - their location and distance to the normal node and using triangulation method location of unknown node can be found out.

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