A review on different mechanism for Node Localization in Wireless Sensor Network

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Abstract: Wireless Sensor Networks is used for finding particular targets, information collection about whether etc. Localization of sensor node plays major role in the research areas of wireless network. Localization is the method of finding the position of the sensor node in the network. It uses wireless devices known as sensor nodes which are present in wireless sensor network for transmitting the data from source to the target. Localization is the method for obtaining the data regarding the position of the sensor nodes present in the network. Various techniques have been implemented for localization of sensor. Most of them are cost effective, efficient as well as scalable. The goal of our survey is to present different localization techniques of node in wireless sensor network. In this paper, we also compared centralized and distributed localization techniques with respect to various parameters such as accuracy, cost, delay and scalability.

IndexTerms **– WSN, Difference of Arrival, Time of Arrival.**

I. INTRODUCTION

One of the most important applications of Wireless sensor network is location discovery. Localization involves determining the position of the sensor node based on the distance of other sensor nodes with known locations. The node can calculate its distance and/or angle between itself and the reference points. Global positioning system can be given to each node and then the position of object can be estimated by using sensor. But unfortunately, it may not be suitable due to its economic issues.

Many localization techniques are used to measure the distance between sensor nodes. The initial step is to find the position of nodes using measurements such as, Time of Arrival (ToA), Time Difference of Arrival (TDoA), Angle of Arrival (AoA), direction of arrival which is illustrated in Fig.I. Then, computation techniques are used to compute location of a node. Finally, localization algorithm is used to locate WSN nodes.

To reduce the cost factor in location discovery, some self-localization techniques such as centralized or distributed approach, are also used. In centralized, the localization is done by single central node. Whereas in distributed, localization is done for each single node. GPS is not used to determine the position of sensor node in both centralized and distributed system. However there are some sensor nodes which already have the information about their position also called Anchor nodes and other sensor nodes called Normal nodes. The anchor nodes use GPS to find its location and other nodes can estimate its location with the help of anchors.

Some of the constraints of WSN are that they must operate in remote areas and harsh environments, without infrastructure support or possibility for maintenance and repair therefore, sensor nodes must be self-managing in that they configure themselves, operate and collaborate with other nodes. Also its large scale and energy constraints make it unsuitable for centralized algorithms to implement network management solutions. Other problems are design issue and security. WSN can detect fire fighting, whether information or transportation tracking.

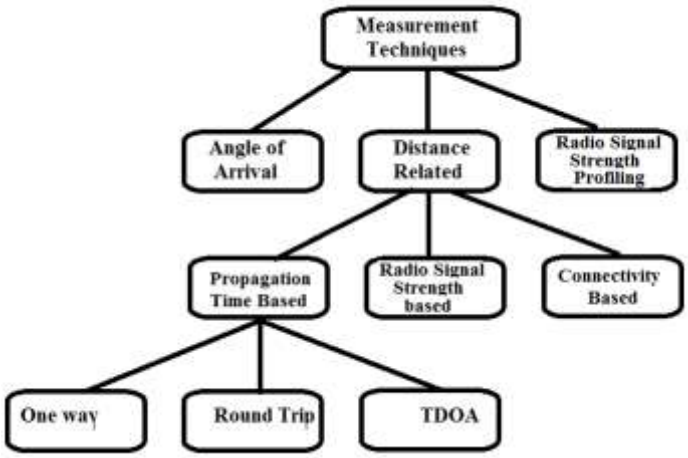

Fig –I Classification of measurement techniques for localization algorithm.

The parameters that can affect the performance of localization algorithms are Accuracy, Scalability, Robustness to Failure and Error, Coverage and Cost. Localization algorithm should be robust against node failure and Error and noise in the input data. Scalability is used for testing the efficiency of localization algorithm. Coverage means how much of the network can be localize with the algorithm. Most applications need high accuracy so localization algorithm should offer accuracy and cost effective in terms of computation cost, communication cost, number of beacon nodes or access point, processing time, energy consumption, hardware or software required by each node, etc.

II. COMPARISION OF CENTRALIZED AND DISTRIBUTED LOCALIZATION

Different localization techniques can be compared with each other in terms of various parameters such localization error or accuracy, cost required, etc. In centralized localization, all information is transferred to centralized node hence centralized approach offers greater accuracy as compared to distributed approach. As centralized localization delay occurs during the process of transferring all information to centralized node and then receiving the results back, whereas no delay occurs in distributed localization. Lastly, in centralized localization; the operations are performed on a central node while in distributed localization the operations are performed on each single node. Hence in centralized technique, scalability depends on processing power of the central node. Thus, Distributed localization is assumed to be more scalable than Centralized localization. Also cost of finding sensor node in centralized localization is comparatively less as compared to that of distributed localization..

III. RELATED WORK

Ramesh, Maneesha.[1], implemented bio inspired algorithms, due to their quick convergence to quality solutions. Distributive localization is done using Particle Swarm Optimization (PSO) and Comprehensive Learning Particle Swarm Optimization (CLPSO). After simulation, the accuracy of both algorithms is determined using features such as number of nodes localized, computational time and localization error. The simulation results show that the PSO based localization is faster and CLPSO is more accurate..

Raghavendra V. kulkarni, et.al. [2] proposed real-time autonomous deployment of sensor nodes from an unmanned aerial vehicle. Bioinspired algorithms such as particle swarm optimization and bacterial foraging algorithm were used as optimization tools to filter image and to perform distributed localization of the deployed nodes. Image segmentation for autonomous deployment and distributed localization are formulated as multidimensional optimization problems. After simulation, results show that both the algorithms perform multilevel image segmentation faster than the exhaustive search for optimal thresholds. Also, PSO-based localization is shown to be faster, and BFA-based localization is shown as more accurate approach.

Bhavana Adiga H. P [3], proposed a novel clustering protocol that uses bacterial foraging algorithm [BFOA]. The goal of this paper is improving the existing basic LEACH protocol for reduction in energy consumption with respect to communication, to enhance the network lifetime. After Simulation, results show that implementing this computational intelligence in the pre-existing protocol improves overall performance.

Chen, et.al. [4] improved traditional DV-HOP algorithm for three-dimensional localization precision and designed a novel three-dimensional localization DV-Hop algorithm (NTLDV-HOP) which revises per jump distance to enhance the accuracy of distance calculation between unknown nodes and anchor nodes, and uses the Total Least Squares (TLS) method to modify the positioning deviation of the anchor node itself. After simulation results prove that the NTLDV-HOP improves the location accuracy.

Mihail L. Sichitiu [5], proposed a localization technique based on a single mobile beacon aware of its position. Sensor nodes receiving beacon packets infer proximity constraints to the mobile beacon and use them to construct and maintain position estimates. This technique is radio-frequency based, and thus no extra hardware was necessary. The accuracy was sufficient for most applications.

Koen Langendoen [6], discussed the problem of localization in ad-hoc networks. by comparing three localization algorithms. i.e. N-hop multilateration, Adhoc Positioning and Robust Positioning. It is shown each algorithm produces different result corresponding to various features such as anchor fraction, range errors etc. All the three algorithm are having multiple benefits.

Gayan, et.al. [7] designed a novel algorithm to enhance the accuracy of localization. It uses DV-Hop algorithm to estimate positions of the anchors which are already known. The estimation errors so obtained are then minimized through an optimization algorithm which finds the optimum correction to the hop size. The positions of the unknown nodes are then determined with the modified hop size using least squares estimation. After simulation, results prove that the algorithm has better performances in localization precision and better stability as compared to traditional DV-Hop algorithm.

Xue et al. [8] reviewed tracking systems that is based on the auto regressive moving average (ARMA) model while distribution in peer-to-peer signal processing framework. In this technique, wireless sensor nodes is acting as peer that is performing target detections, feature extractions, classifications and tracking, in case of target localization required the collaboration between wireless sensors nodes for improving the accuracy and robustness of networks. Then, a progressive multi-view localization algorithm is designed in distributed P2P signals processing method.

Li,Mo, et.al.[9] proposed Rendered Path Protocol., a range-free localization scheme in anisotropic sensor networks. It captures the geometric features of the network and disseminates such data by rendering the shortest paths among nodes. Using the concept of virtual hole, it constructs virtual shortest paths in order to find the distances between pair of node. After simulations, results show the effectiveness and scalability of REP.

Amitangshuet al. [10] proposed some new approaches for localization of node discovery in WSN using different scholars for improving the localization and also discussed future scope for improving node localization in WSNs..

Satviret al. [11] proposes the application of different migration variants of Biogeography-Based Optimization (BBO) algorithms and Particle Swarm Optimization (PSO) for distributed optimal localization of randomly deployed sensors. Biogeography is collective learning of geographical allotment of biological organisms. It has a new inclusive vigor based on the science of biogeography and employs migration operator to share information between different habitats, i.e., problem solution. PSO models had only fast convergence but less mature. An investigation on distributed iterative localization is presented in this paper. Here the nodes that get localized in iteration act as anchor node.

Safa Hamdoun et al [12], proposed a comparative study of RSSI-based localization algorithms using spatial diversity in WSNs. It consider different kinds of single / multiple antenna systems: Single Input Single Output (SISO) system, Single Input Multiple Output (SIMO) system, Multiple Input Single Output (MISO) system and Multiple Input Multiple Output (MIMO) system. It focused on the well known trilateration and multilateration localization algorithms to determine and compare different antenna systems. Exploiting spatial diversity by using multiple antenna systems improved the accuracy of the location estimation. They used three diversity combining techniques at the receiver: Maximal Ratio Combiner (MRC), Equal Gain Combining (EGC) and Selection Combining (SC). The localization performance in terms of location accuracy is improved when using multiple antennas. Using multiple antennas at the both sides yields to better performance than using multiple antennas at the transmitter as well as the receiver side.

Shagun Nasrani et al [13] proposed the concept of Membrane Computing has been introduced for the localization of nodes in an efficient manner and deals with the handing of multisets of pictogram items in a localized approach. The optimized location a target node has been determined by the use of membrane computing. The nodes which are not aware of their locations or positions are determined.. Thus, evolution rules allow the evolving objects to be attached into compartments expressed by membranes.

Avinash[14] (2012) et al. proposed Classical Approach to find the location of sensor node in WSN. They designed three stage optimization techniques to reduce the estimated fault and then used it to find the position of a sensor node in a WSN. They took random solutions and applied the above mechanism for finding the best optimal solution.

Shi et al. [15] proposed an applied localizations models by using linear intersections and do some concerned experiments for estimating the location computation algorithms. They also discussed that each node in a WSN has the ability to measure distance and also presented allocation of computation techniques also known as linear intersections for node localization.

ShikhaBhardwaj et al [16] proposed the Artificial Neural Networks (ANNs) technique to localize sensor node. This technique used Backpropagation algorithm (BPN) based on multilayer perceptron (MLP) neural networks to carry out the localization process. The network consisting of sensor nodes which are already trained by using training algorithms such as Levenberg-Marquardt and Resilient Backpropagation, to predict the location of the sensor nodes in the network grid. The computations are made by varying parameters suchas the transfer function, training algorithm, number of anchor nodes and number of hidden neurons.

Loukas Lazos et al [17], address the problem of enabling nodes of Wireless Sensor Networks to determine their location in an untrusted environment, known as the secure localization problem. He proposed a novel range-independent localization algorithm called SeRLoc that is well suited to a resource constrained environment such as a WSN. SeRLoc is a distributed algorithm based on a two-tier network architecture that allows sensors to passively determine their position without interacting with other sensors

Mary [18] et al. proposed an improved localization algorithm by means of Least square and Minimum mean square error along with the basic DV-Hop algorithm. The localization errors were reduced by proposed algorithm which improved the localization accuracy of the basic DV-Hop algorithm with minimum number of beacon nodes. Then it is simulated and compared with other algorithms such as DV-Hop, ROCRSSI and APIT. The simulation is considered both with obstacle as well as without obstacles for triangle and C shaped obstacles.

IV. CONCLUSION

Location discovery plays an important role in areas where Wireless Sensor Networks are used. Localization is the method of finding the position of the sensor node in the network. There are various Localization mechanisms in wireless sensor network, reviewed in this paper. Some of the techniques are efficient and beneficiary while others have few drawbacks. Some of the recent methods studied in this paper are modification of in traditional methods. The issues in various techniques in localization are Localization Errors. These errors occur when nodes cannot find optimal path which further causes inaccurate positioning. While these networks are widely used in many applications, their success highly depends on the sensor node positions known as network deployment. The goal of deployment network is determining the position of sensor nodes, which directly proportional to the coverage of the concerned region. Various localization techniques have been proposed for determining the position of sensor which is low cost designing, scalable and efficient. This paper presents a review of various localization techniques to determine the position of sensor node in wireless network. In this paper, we also compared centralized and distributed localization techniques with respect to various parameters such as accuracy, cost, delay and scalability.

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