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A Review of Localization Algorithm in Wireless Sensor Networks

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Abstract: Wireless Sensor Network consist of number of nodes that are spatially distributed and deployed in area where we want control on physical or environmental condition such as in military, disaster management and in automated warehouses. Manually configuration of nodes is difficult in case of crowded environment. In order to get the location of nodes in wireless sensor network we use localization technique. There are mainly two technique used in wireless sensor network, first is range free and second is range based. Range free technique based on relatedness between nodes and topological information of nodes while in case of range based technique we calculates distance between nodes. In this paper we will do a review different localization schemes and make a comparison for different application.

Keywords: Localization, Wireless sensor network, range based methods, range free approach, anchor nodes.

I.INTRODUCTION

Wireless sensor devices is deployed in area where there is necessary to estimate the changes in activity of physical and environmental conditions like movement of living being, temperature measurement, disaster relief management. All sensed data are collected and send to a central server and find location with the help of location references sends by various sensor nodes. The localization can be done by various manners. A simple method is to use GPS devices equipped in each sensor nodes that is in network .By using facility of tracking used in GPS each nodes can find location. But this is not favorable condition for dense network. In dense network large, number of sensor nodes are used due to which it is very costly to use GPS devices in each nodes and high consumption of power and low cost is used. Another solution of GPS problem is to use self configuring nodes. Some nodes are used called beacon nodes, anchor nodes, seeds, references which know its location previously and according to position of these nodes non beacon nodes or blind node can estimate their position by calculating distance or by other localization protocol used. There are three different stages used in localization. They are: (i) distance/angle estimation between the nodes, (ii) position calculation of a single node, (iii)a localization algorithm - used for localization of whole network. Several surveys are done in which localization scheme can be designed on the basis of range measurement. According to dependency of range measurement localization can be divided into two approaches first is range based which uses range estimation and second is range free approach that is based on topological information and connectivity between the nodes to describe who is within range of whom. This paper took a review of all existing paper and make comparison between different algorithms of localization

This paper is organized as follows:
Section I. Introduction, Section II. Related Work, Section III. Classification of Localization Algorithm, Section IV. Performance Calculation.,V. Conclusion

II. RELATED WORK

COMPONENT OF LOCALIZATION
Localization algorithms in Wireless sensor network can be divided into three different components :-

1. **Distance /Angle estimation**: This component is responsible for estimating the distance or angle between the nodes. This estimation is used for both position computation and localization of algorithm. Several methods are used for estimating distance angle between nodes by use of special antennas that is equipped in the nodes that want to know the location. But using special antenna is very costly in terms of hardware, energy, processor resources. Some other methods are used like Received Signal Strength Indication (RSSI), Time of arrival /time distance of arrival, ANGLE of Arrival (AOA) and communication range.

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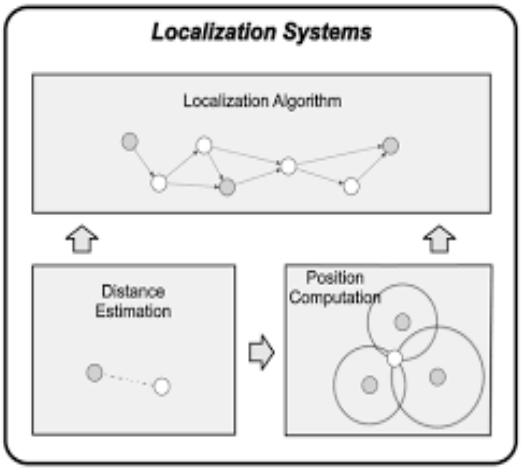
(i)RECEIVED SIGNAL STRENGTH INDICATION (RSSI) This estimates distance on the basis of signal received by the receiver sends by a sender. When sender sends signal to the receiver it fades as it moves from sender to receiver. The signal strength is inversely proportional to square of strength into distance. The advantage and disadvantage both are found in this technique. Advantage is low cost because approximately each receiver can estimate the received signal strength. Disadvantage is various types of noise and hurdles may cause inaccuracy in distance estimation. ANGLE OF ARRIVAL (AOA) Angle can be estimated by using antennas or array of receiver that is separated uniformly. But it is seen that there is inaccuracy found in some degree (about 5 degree). Antennas are very costly so this method has a disadvantage of high cost. TIME (DIFFERENCE) OF ARRIVAL. This is very simple technique in which difference between nodes is directly proportional to the time that signal takes to propagates from one to another. Let t1 is the time when signal is to be sent and it reached at time t2 to another node than the distance can be calculated between two nodes is d= S(t2-t1) where S is propagation speed of radio signal. But this type of technique must require that all nodes must be in synchronized form.

(ii) TDOA is defined on basis of: The difference in the times at which a single signal from a single node arrives at three or more node generally used in cellular network. The difference in the times at which multiple signals form a single node arrives at other node used in wireless sensor network.

2. POSITION COMPUTATION various techniques are given to determine position and angle/distance .Techniques used to estimate a node's location are trilateration, multilateration, and trian-gulation.

3. LOCALIZATION ALGORITHM In this step the information that is collected in above two components should be utilized in order to localize the nodes. Localization algorithm can be categorized into two parts first in centralized algorithm and second is distributed algorithm on the basis of with or without infrastructure relative or absolute positioning, for indoor or outdoor and for one hop or multihop. Centralized localization requires the migration of inter node ranging and connectivity data to a sufficiently powerful central base station and then the migration of resulting locations back to respective nodes. Centralized localization have complex mathematics so we use distributed algorithm where all the relevant computations are done on the sensor nodes themselves and the nodes communicate with each other to get their positions in a network. Some localization algorithm is discussed are Ad Hoc Positioning system (APS), Recursive Position Estimation (RPE) and Localization with a Mobile Beacon (LMB).



III. CLASSIFICATION OF LOCALIZATION ALGORITHM

Localization algorithm is classified on the basis of range estimation in two categories:
1. Range based algorithm uses anchor based approach and anchor free approach.
2. Range free algorithm uses anchor based approach and anchor free approach.

1 .Range based algorithm:

Range based localization algorithms use the range (distance or angle) information from the beacon node to estimate the location. Several ranging techniques exist to estimate an unknown node distance to three or more beacon nodes. Based on the range information, location of a node is deter-mined. Some of the range based localization algorithm includes: Received signal strength indicator (RSSI) [19], Angle of arrival(AoA) [2], Time of arrival (ToA) [1], Time difference of arrival(TDoA) [2]. Range-based algorithms achieve higher localization accuracy, at the expense of hardware cost and power consumption. Range free algorithms have lower hardware cost and are more efficient in localization.

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2. Range free algorithm:

Range-free localization algorithms use connectivity information between unknown nodes and landmarks. A landmark can obtain its location information using GPS or through an artificially deployed information. Some of the range-free localization algorithm includes: Centroid, Appropriate point in triangle (APIT) and DV-HOP. In Centroid the number of beacon signals received from the prepositioned beacon nodes is counted and localization is achieved by obtaining the centroid of received beacon generators. DVHOP uses the location of beacon nodes, hop counts from beacons, and the average distance per hop for localization. A relatively higher ratio of beacons to unknown nodes, and longer range beacons are required in APIT [30]. APIT is an area based range free scheme which assumes that some of nodes those are aware of their positions outfitted with high powered transmitters. APIT [20] is located in area to carry out position estimation by separating the area into triangular zones between anchors. Each nodes presence inside or outside the triangle regions allows declining the viable location until and unless every possible sets have reached to an acceptable accuracy are also more susceptible to erroneous reading of RSSI.

IV. PERFORMANCE CALCULATION

A comparative study is presented in this section between different localization algorithm. Defining limitations and accuracies of different localization algorithms used in wireless sensor network. Various conditions of localization are used to handle such problem.

Localization techniques used	Accuracy (in meters)	Limitations
GPS	2 to 15	Not suitable for dense network.
Proximity based algorithm	1 to 30	Depends on range of signal.
Angle based approach	1 to 8	Require special antenna so have higher cost.
Range based approach	4 to 10	Require special hardware and synchronization between nodes.
DV based approach	10 to 20	Useful for dense network.

IV. CONCLUSION

Localization in wireless sensor networks has received increasing attention over the last one decade. It provides the geographical position of a sensor node and the pre-requisite for geographic routing, spatial querying, and data dissemination. With the continuous research in localization of sensor networks, a number of effective algorithms have been designed, but the stability has not yet reached. This is because of the requirement of resources (storage, battery, processor) hardware and rigid environment. Currently, none of the localization techniques is able to full fill all these requirements. Most existing localization algorithms for static WSNs were designed to work with at least three anchor nodes except in those cases where directional antenna is used. Usage of antenna increases the cost and also the size of node as well as complexity of the algorithm. As the number of anchor nodes required in a network increases, overall cost of the network also increases. In this paper we study about some localization algorithm and make comparative study of it.

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