

Literature Review on Localization in Wireless Sensor Networks

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Abstract - Many Wireless Sensor Network(WSN) application depends on collection service to route data packets towards sink node. When it comes to find location we just can't rely on the location scheme with just connectivity information algorithm only.An efficient algorithm is needed that can measure the location of the sensor nodes near to the living being or being attached to them in 3-D space with a high accuracy.As the sensor networks are highly application specific, no algorithm can be generalized that suits to all the conditions.Further, the algorithms should be efficient and less resource consuming for getting executed on sensor nodes with low processing power.This paper is basically focus on the review of many approaches of 3-D localization with its benefits and disadvantages.

KeyWords: Wireless Sensor Networks ,TDOA , TOA, Localization,Range free approach ,Range base approach

1.INTRODUCTION

A Wireless Sensor Networks(WSN) is an ad-hoc network with a number of sensors deployed across a wide geographical area.Once deployed, sensor nodes can capture data about some physical quantity, like temperature, atmospheric pressure. Sensor readings are then reported to sink node where they are further processed according to the application requirement. A sink can store received packets and forwarded them to external network using reliable and most possibly wired communication link. Node forwarded packets through routing tree up to at least one of sink node within the network. Each node selects one of its neighboring nodes as parent using metric such as link quality, energy of the nodes, hop counts. Parent node is responsible for handling packets coming from children and forwards them to the sink. Node collects information of its neighboring nodes for select the parent using regularly exchange message called beacons that contain information about metric. In Previous years; Localization was being done by two methods: (1) GPS (2) Deployed by Human. But for real scenario human deployment is not always possible for example military field; as in that case calculation is not always right. And for GPS which need satellite to complete

its task,it reduce the battery life as well as cannot be some places like dense forest,mines and any obstacles which stops line-of-sight from satellite. Algorithms which are established for 2-D localization works fine when there is a flat terrains but not accurate at all for harsh terrains.With 3-D,it add extra plane which called as z plane provide more accurate as hight is being added. By using a localization system for 3-D this problem can be eliminated completely. WSN contains few nodes called anchor nodes who know their location either by other anchor nodes or through GPS or self deployed.Determining the location of un-localized sensor nodes with respect to the anchor nodes is called localization [2].The wireless sensor networks can be catagorised into two main strategies:- (1) Range based (2) range free. As name suggest range based strategy relies on distance estimation between nodes using signal strength.Whereas, range free strategy relies on connectivity information only.The range based method uses the sophisticated hardware,radio signal to estimate the distance between the receiver and transmitter.Moreover,the range free method uses wireless communication signals to determine connectivity and no other hardware required.

2. LITERATURE SURVEY

Many research groups have been using different techniques for two dimensional localization.But,very few have been tried to focus on three dimensional localization.The problem is that we cannot use algorithm for three dimensional localization which are being used for two dimensional localization by just adding one parameter.In 2-D space,three anchor nodes or beacon nodes are required to determine a coordinate system.Whereas,In 3-D space, four anchor nodes are required.

2.1 Localization Algorithm

As defination it is clearly suggest that range based approach provide much more accuracy than range free but needs additional hardware,so it will increase cost and size.[3]Time of Arrival(ToA),Time Difference of Arrival(TDoA),Received Signal Strength Indicator(RSSI),Multiscale Radio Transmission Power (MRTP),Angle of Arrival(AoA),etc.. are some methods for range based approach. DV-HOP,Centroid method,etc.. are used for range free approach. bf Time of Arrival(ToA): This

method uses the time synchronization mechanism to calculate the distance between anchor node and unlocalised node. The anchor node send a packet which contain time when it was transmitted.

the hop count value and ignores those anchors with higher hop-count values. All the way propagating through this mechanism, all sensor nodes in the network (including other beacons) get the short- est distance, in hops. Beacons perform this task by obtaining position and hop count information for all other beacons inside the network.

2.2. Localization Algorithm

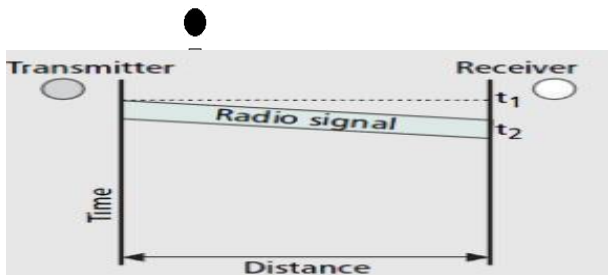
The localization algorithm is the main component of a localization system. This component determines how the information concerning distances and positions is manipulated in order to allow most or all of the nodes of a WSN to estimate their positions. Localization algorithms can be classified into a few categories: distributed or centralized position computation; with or without an infrastructure relative or absolute positioning designed for indoor or outdoor scenarios and one hop or multihop.

AD HOC POSITIONING SYSTEM:

In APS a reduced number of beacon nodes (e.g., three or more) is deployed with the unknown nodes. Then each node estimates its distance to the beacon nodes in a multihop way. Once these distances are estimated, the nodes can compute their positions using trilateration. Three methods of hop-by-hop distance propagation are proposed: Dv-Hop, Dv-Distance, and Euclidean. In Dv-Hop APS the beacon nodes start the propagation of their position information . Working as an extension of the distance vector algorithm, all nodes receive the position information of all beacon nodes as well as the number of hops to these beacons. When a beacon node receives the position information of the other beacon nodes, it has enough information to compute the average size of one hop based on its own position, the position of the other beacon nodes, and the number of hops between them . This last value is then flooded in a controlled way into the network as a correction factor.[10] When an unknown node receives a correction, it is able to convert its distance to the beacon nodes from number of hops to meters . The complexity of message exchange in this algorithm is driven by the total number of beacon and normal nodes, which is $O(n*(m + 1))$, where n is the number of nodes and m is the number of beacon nodes. An advantage of the APS is that its localization algorithm requires a low number of beacon nodes in order to work. However, the way distances are propagated, especially in Dv-Hop and Dv-Distance, as well as the way these distances are converted from hops to meters in Dv-Hop, result in erroneous position computation, which increases the final localization error of the system.

RECURSIVE POSITION ESTIMATION:

In RPE nodes estimate their positions based on a set of initial beacon nodes (e.g., 5 percent of the nodes) using only local information. Localization information increases iteratively as newly settled nodes become reference nodes. The RPE algorithm can be divided into four phases, In the first phase a node determines its reference nodes. In the second phase the node estimates its distance to these reference nodes using, for example, RSSI.[8] In the third phase the node computes its position using trilateration (becoming a settled node). In the final phase the node becomes a reference node by broadcasting its newly estimated position to its neighbors. When a node

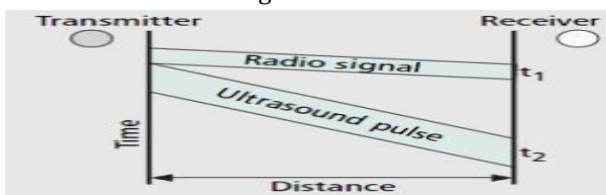


Time Difference of Arrival(TDoA):

TDoA is a special case of ToA. It means it does not require time synchronization as in ToA. It uses the two different signals which have different frequency . Generally one is radio frequency and other is ultrasonic frequency. Therefore even if two signals are being propagated at the same time, it will reach to the destination at different time.[6]

$$\text{Distance}(D) = (S1 - S2) * (T1 - T2) \tag{1}$$

Where, $\Delta T = T1 - T2$ is the time difference between sending and receiving signals and $\Delta S = S1 - S2$ is the speed difference between two signals.



DV-HOP :

DV-HOP assumes that a network consisting of identical sensing nodes and beacon nodes [5]. Instead of going for the single hop broadcast, anchors flood their locations all over the sensor network. As the information propagates over each hop an increment counter each time increments the hop count value. Sensor nodes calculate their position based on the received beacon locations, average distance per hop, the hop count from the corresponding anchor; the working of this strategy is quite similar to existing distance vector routing. One anchor node broadcasts a beacon to all over the network containing the beacon location with a hop count value initially set to one. The receiving sensor nodes maintain a minimum counter value corresponding to each anchor. Every time it receives a beacon it increments

becomes a reference, it can assist other nodes in computing their positions as well. An advantage of this algorithm is that the number of reference nodes increases quickly, in such a way that the majority of the nodes can compute their position. But this technique has the disadvantage of propagating localization errors. This means that the inaccurate position estimation of one node can be used by other nodes to estimate their positions, increasing this inaccuracy. Furthermore, a node must have at least three reference neighbors in order to compute its position.

LOCALIZATION WITH A MOBILE BEACON :

Some recent work has proposed the use of mobile beacons to assist the nodes of a WSN in estimating their positions. A mobile beacon is a node that is aware of its position (e.g., equipped with a GPS receiver) and has the ability to move around the sensor field. This beacon can be a human operator, an unmanned vehicle, an aircraft, or a robot. The system operation in is quite simple. Once the nodes are deployed, the mobile beacon travels through the sensor field broadcasting messages that contain its current coordinates. When a free node receives more than three messages from the mobile beacon it computes its position, using a probabilistic approach, based on the received coordinates and RSSI distance estimations. The communication cost for the WSN is null, since none of the nodes (except the mobile beacon) need to send any packets. An advantage of this algorithm is that position estimations are computed based on the same node (mobile beacon), thus keeping the mean localization error low and preventing the propagation of this error. In addition, this algorithm avoids the use of nodes equipped with GPS, except for the mobile beacon. On the other hand, in this technique a sensor node can estimate.

3. CONCLUSIONS

The literature survey work has shown that an optimal algorithm has not been defined yet, that employ both the strategies (range-free range-based) , and thus the development of a new algorithm has to be founded on the specificities of the situations, taking into account the size of the network, as well as the deployment methods and the expected results. Localization algorithms should be designed to achieve low variance as well as low bias as far as possible; at the same time, they need to be scalable to very large network sizes without dramatically increasing energy consumption or computational requirements. We have proposed and demonstrated an algorithm that successfully localizes nodes in a sensor network with noisy distance measurements. The equations for the proposed algorithm were carried out in MATLAB. Simulations showed the relationship between noise and ability of a network to localize itself, at highly noisy environments. The performance stays above 50% i.e. half of the available nodes can be localized with good approximation. We also have depicted the effect of scalability on the performance of the algorithm. Results show that as the scalability of the network increases with

the number of beacon nodes; the performance of the algorithm goes high above 90%.[11] The granularity of the areas estimated may be easily adjusted by changing the system parameters which makes the proposed algorithm exible. Moreover, with one of the ideas proposed, the Bounding cube. This leads to major developments that have been proposed in this thesis which improves significantly to increase the localization accuracy. They do not require much more computational costs and perfectly match the distributed algorithm's requirements. Continuing further, the proposed algorithm operates in a distributed manner by executing the algorithm in different sensor nodes. The propagating trend of the localization procedure provides wave-spreading like characteristic in this algorithm. The proposed algorithm performed very well on the MATLAB simulating environment.

4.FUTURE WORK

The sensor network field is in the development phase. Many future rescue operations stand out as important area to pursue in order to meet both current and future need. A lot of work remains in order to address the varied localization requirements of applications and sensor network services. A range-free algorithm needs to be developed that doesn't require costly RSS based techniques and can determine the node locations with high accuracy. Future sensor networks will involve mobile sensor nodes. New localization algorithms will need to be developed to accommodate these dynamic topology varying mobile nodes. Some studied algorithms can tolerate a certain amount of movement but much of real-life experiments and algorithm developments are required.

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