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Review on Localization Techniques In Wireless Sensor Networks

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Abstract - *Localization is the most important emerging field of research in Wireless Sensor Networks (WSNs). Localization is an essential and important issue in WSN because most of the applications require the position data of the sensor nodes, hence the data received from the sensor nodes remain meaningless unless it is correlated with the information of the position. Although there are many technologies emerging for localization of nodes in wireless sensor networks, these may not work properly in indoor environment. GPS is widely used technology for localization but it rarely works indoors. So location estimation in such environments is still a big challenge. The solution to this problem is addressed in this paper. To localize the mobile nodes in such indoor environment, co-operative localization is used. In co-operative localization, the estimated position of surrounding nodes is utilized to estimate the position of the target node. The nodes with known position information which may be static or dynamic in nature called pseudo anchors are used to estimate the position of the target node. In order to increase the accuracy in co-operative localization, the neighbouring nodes called pseudo anchors broadcasts their position updates frequently. This paper describes various localization techniques.*

Key Words: **Localization, Wireless sensor network, Sensor nodes, Localization techniques**

1.INTRODUCTION

More and more advances in wireless communication technology has enabled to the growth of sensor nodes. These sensor nodes are comparatively of low cost and consume less power. Hence using sensor nodes in various applications has increased on large scale. The goal behind this is just to build wireless sensor networks which sense something from environment and try to perform some analysis on received data. Collection of such sensors along with capability to communicate with each other is known as Wireless sensor network. A general diagram showing wireless sensor network is shown in figure below.

Localization in Wireless Sensor Networks (WSNs) is the most important issue and a very emerging field of research in WSNs. Many of the application such as underwater surveillance [6], military surveillance, traffic monitoring [7], habitat monitoring [8], forest fire detection [9], and flood detection [10] require location information. The WSNs consists of hundreds, thousands of low-cost and low-power

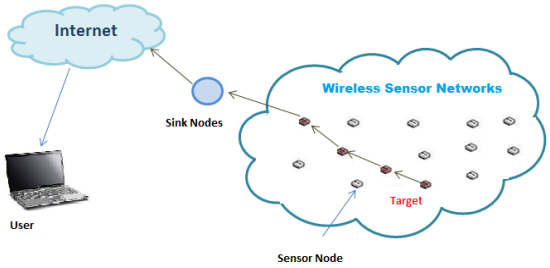

Fig -1: Wireless Sensor Networks

sensor nodes which are deployed in certain range of field. Deploying each sensor node with highly equipped positioning devices such as Global Positioning System (GPS) [11], [12] is not a practical approach to find the location of the sensor nodes.

To reduce the localization cost of sensor nodes in WSN, instead of using GPS, the self-localization technique can be adopted. This can be done in centralized or distributed manner. In centralized, the sensor nodes localization is done by single central node. In distributed, localization is done at each single node. In both of these methods GPS is not used to estimate the location of sensor instead the sensor does this in co-operative manner. In WSN there are some sensor nodes which know their location information in advance also called Anchor nodes and other sensor nodes which try to find its location also called Normal nodes. The anchor nodes can use GPS to find the location or these sensors can be installed at known coordinate points and other nodes can estimate its location with the help of anchors. Due to many constraints such cost, power consumption, the area in which the sensors are planted such as places where GPS doesn't work or the scattering of sensors, most of the sensors does not know their location information and hence makes use of anchor or beacon nodes.

The localization algorithms can be classified into two categories called Range-Based and Range-Free. Range-Based algorithms makes use of Time of Arrival (TOA) [13], Time Difference of Arrival (TDOA) [14], Angle of Arrival (AOA) [15], and Received Signal Strength Indicator (RSSI) [16] to find the distance between two nodes. In Range-free scheme,

the normal nodes (not having the location information) estimates its location by gathering the location information of neighboring anchor nodes and then processing it. Both the schemes has its advantages and drawbacks. Range-free location has certain drawbacks such as localization accuracy, cost for computations and high power consumptions. Various algorithms are proposed to overcome these drawbacks of Range-free schemes. This paper describes various techniques of localization and how the help overcoming these drawbacks.

2. Localization

Localization in Wireless Sensor Networks simply means finding out the physical location of the sensor nodes with unknown location information. A sensor can find its location with help of GPS. If GPS is not present in the sensor node it makes use of other anchor nodes location information to find its location. The anchor nodes broadcast the location information periodically and the remaining nodes with unknown location use this as input to find its location. The overall process can be well understood with figure 2.

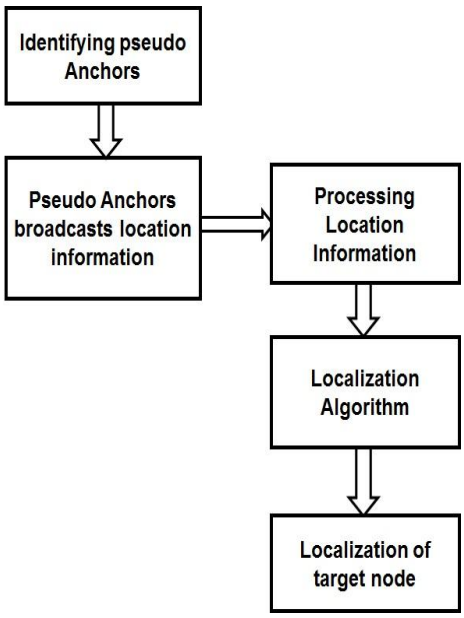

Fig -2: Process of Localization

3. Localization Techniques

Based on the nodes at which processing of location information can be done, the localization technique is broadly classified into two categories: Centralized and Distributed localization Technique.

3.1 Centralized Localization

In centralized localization [17], [18], [19], the computations are done at one central node. The sensor nodes send information to the central node. The central nodes process this information and estimate the location of non-anchor nodes and send back the result to the sensor nodes. There is a great advantage of centralized method that every node in wireless sensor network need not have the processing capability to estimate the location. Hence the overall cost of sensor network is reduced.

3.2 Distributed Localization

In distributed localization [19], [20], [21], [22], the computations are done at every node instead of central node, unlike centralized localization technique. The sensor node estimates its location by using location information of neighbouring nodes. In this type of localization technique, every node in WSN should have the processing capability to find location. Hence the overall cost of sensor network is increased. The distributed localization technique can be broadly classified as Range Based and Range free method.

3.3 Range Based

In range based localization [24], the location of the sensor node is calculated by using distance between two sensor nodes which is calculated by using the distance estimation techniques. The distance is calculated with the different techniques such time difference of arrival (TDOA), time of arrival (TOA), received signal strength (RSS). In range- based method the sensor can be equipped with GPS which will help in estimating the distance between nodes and estimating the location. Range- based methods are suitable for outdoor areas where GPS is useful, but it hardly works in indoor environment.

3.4 Range Free

In range free localization [24], the distance between two sensor nodes is not used to calculate the location of the nodes. Hence no extra functionality is required to convert distance into co-ordinates of the node.

4. COMPARATIVE STUDY OF ALL TECHNIQUE

We have seen above various localization techniques and those can be compared considering various parameters such cost required, localization error, localization accuracy, etc. Centralized localization and Distributed localization comparative study is given as under.

Cost: In centralized localization, the processing is done on a central node while in distributed localization the processing can be done on every single node hence cost in centralized localization is comparatively less than distributed localization.

Delay introduced: As centralized localization require sending information to centralized node and then receiving back the results hence delay is introduced in finding the

location, whereas in case of distributed no such delay is introduced because of transmitting the result.

Localization accuracy: In centralized localization all information is send to centralized node hence localization accuracy is better than distributed localization.

Scalability: Centralized localization is not much scalable compared to the distributed as all processing in centralized technique is done at central node hence scalability can be decided on the capacity of processing power of the central node.

5. CONCLUSIONS

Localization is finding the position of static or dynamic sensor nodes in wireless sensor networks. There are various application such human tracking, finding out the temperature of coal mines, detecting fire in forest etc which needs position of sensors to locate the affected area. To locate the position of sensor nodes there are various techniques which are implemented by different researchers and each technique has its advantages as well as some disadvantages. There are various parameters such as localization accuracy, localization cost etc on which we can decide the advantages and disadvantages of the localization technique.

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