

Chapter 9

Node Localization: Issues, Challenges and Future Perspectives in Wireless Sensor Networks (WSNs)

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ABSTRACT

Wireless sensor networks (WSNs) are taking a major share with almost all types of different applications and especially, it is most suited in very harsh and tough environments, where it is too hard to deploy conventional network applications, for example in the forest fire area, battlefields during the war, chemical and thermal sites, and also for few underwater applications. WSNs are now becoming part of almost all applications because of their ease in deployment and cheaper cost. These networks are resource constraints, very small in size, computation, and with much less communication capabilities. Nodes are normally deployed in random fashion, and it's too hard to find their location because there is no any predefined way like conventional networks to discern location. Location is highly important to know the data correlation: for example its target tracking, and to know actual vicinity of the any event occurrence. This chapter describes the current available approaches, issues, and challenges with current approaches and future directions for node localization, one by one. Node localization is highly important for large sensor networks where users desire to know about the exact location of the nodes to know the data location.

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INTRODUCTION

Wireless Sensor Networks, are rapidly growing with a high scale with a good number of good applications. Its adoptability is very high because of its cost, working and feasibility of deployment with a range of applications. This network is highly different than the conventional networks with all aspects. Conventional networks have high power capabilities with very high computation, storage and communication strengths along with their global ID to be locate the conventional node and easily can find its location. While with sensor networks are almost different almost with all aspects, because these type of networks are small in small in size with holding small nodes without and centralized administrative control, there distribution is random in nature and nodes are normally not aware about their location when they are collecting the data and passing it to their neighboring nodes. researchers are trying to find out different ways to find out its location by using different approaches like GPS (Zaman & Abdullah, 2011), but it is still little hard to reach up to a bench mark. As these networks are resource constraints to most of the approaches are valid up to assumption base only.

The aim of the localization in the sensor network is to define the exact identification of the sensor node or about its exact position. The correct information is highly required in case of localization, currently researchers defined different approaches which can be classified further into classes on the range base, such as.

1. Range Based Technique

Under this mechanisms, extra hardware and extra computation is required to know about the location of the sensor nodes exact location. The various range based techniques are Radio Interferometric Measurement (RIM) (Merico & Bisiani, 2006),

Multidimensional Scaling (MDS), 3D - Landscape (Zhou, Zhang, & Cheng, 2006), DV-distance, DV-hop, Euclidean distance (Chraibi, 2005). These techniques works with the help of the distance or angle metrics, and those are normally linked with the operational timings, such as Time of Arrival (ToA), Time difference of arrival (TDoA) and also Angle of arrival (AoA), and that can be measured through (RSSI) Received Signal Strength Indicator. This mechanism become costly for the WSN, as the WSN type network is very low in cost, but when the additional hardware is required it needs more cost.

2. Range Free Technique

With range free technique, the location of the node can be identified by its neighboring nodes, based on hop count. The popular range free technique are such as APIT (Blum, Stankovic, Abdelzaher, He & Huang, 2005), chord selection approach (Ou & Ssu, 2008), three dimensional multilateration approach (Jin, Wang, Tian, Liu, & Mo, 2007), SerLOC (Lazos & Poovendran, 2005), centroid scheme (Martins, So, Chen, Huang, & Sezaki, 2008) etc. Many more techniques are discussed in (Mao, Fidan & Anderson, 2007)(Yu, Shun, & Mei, 2006)(He, Stoleru, Stankovic, 2006)(Chraibi, 2005)(Tseng & Wang, 2008a)(Tseng & Wang, 2008b). the range free techniques are normally providing good solution but they contain almost around 10-12% error rate too. These techniques are normally very cheaper if we compare it with range based techniques where extra hardware and computation is required, but less in accuracy comparable with range based techniques.

Furthermore more, node localization in wireless sensor network can be grouped in Centralized and Distributed locations. While distributed localization will be further sub divided into nine different groups such as following, and as shown in Figure 1.

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