Localization Techniques for Wireless Sensor Networks

Jyothi N S, Monica R Mundada

Abstract— **The important function of a sensor network is to collect and forward data to destination. It is very important to know about the location of collected data. This kind of information can be obtained using localization technique in wireless sensor networks (WSNs). Localization is a way to determine the location of sensor nodes. Localization of sensor nodes is an interesting research area, and many works have been done so far. It is highly desirable to design low-cost, scalable, and efficient localization mechanisms for WSNs. In this paper, we discuss sensor node architecture and its applications, different localization techniques.**

Index Terms— **wireless sensor networks, localization algorithm, learning, range, anchor.**

I. Introduction

Wireless Sensor Network is a collection of many tiny sensing and wireless communication device called sensor nodes. Each node consists of a processor, a battery and a transceiver for communication [8]. Nodes are connected to each other via transceiver. Wireless Sensor Network consists of one node, called base station which collects sensory information from other nodes in the network and transfers the information to the Computer. They perform specific tasks of sensing some physical phenomena. They are smart, cheaper and deployed in large numbers help in controlling and monitoring the surroundings [1].

Sensor nodes collect and forward data about particular application. Sensor nodes usually produce output when some kind of physical change occurs, such as change in temperature, sound, and pressure. WSNs have many applications such as military, civil, and environmental applications. Some important applications are discussed below.

A. Area Monitoring:

Sensor nodes are deployed in the area where some actions have to be monitored; for instance, the position of the enemy is monitored by sensor nodes, and the information is sent to base station for further processing. Sensor nodes are also used to monitor vehicle movement.

B. Environmental Monitoring:

WSNs have many applications in forests and oceans, and so forth. In forests, such networks are deployed for detecting fire. WSNs can detect when fire is started and how it is spreading. Senor nodes also detect the movements of animals to observe their habits. WSNs are also used to observe plants and soil movements.

C. Industrial Monitoring:

In industries, sensors monitor the process of making goods. For instance, in manufacturing a vehicle, sensors detect whether the process is going right. A response is generated if there is any manufacturing fault [12]. Sensor nodes also monitor the grasping of objects by robots [12].

D. Medical and Healthcare Monitoring:

Medical sensors are used to monitor the conditions of patients. Doctors can monitor patients' conditions, blood pressure, sugar level, and so forth, review ECG, and change drugs according to their conditions [12]. Personal health monitoring sensors have special applications. Smart phones are used to monitor health, and response is generated if any health risk is detected. Medical sensors store health information and analyze the data obtained from many other sensors such as ECG, blood pressure, and blood sugar [14].

E. Traffic Control System.

Sensor nodes monitor traffic flow and number plates of travelling vehicles and can locate their positions if needed. WSNs are used to monitor activities of drivers as well such as seat-belt monitoring [12].

F. Underwater Acoustic Sensor Networks:

Underwater special sensors can monitor different applications of numerous oceanic phenomena; for instance, water pollution, underwater chemical reactions, and bioactivity. For such purposes, different types of 2D and 3D static sensors are used. 3D dynamic sensors are used to monitor autonomous underwater vehicles (AUVs) [12].

The performance of WSNs is quite dependent on how the sensor nodes are located within the network [2]. There are different kinds of sensors which can monitor different ambient condition like lightening, pressure, vehicular movement, sound levels, humidity, and availability of certain object [7][8].

II. Related work

WSN localization is an active area of research with several surveys [3], [4], [5], [6], [7] on this topic. But there are some important techniques which are not discussed in them. In other hand, this paper categorizes localization techniques in a new proposed taxonomy. This taxonomy helps to distinguish different schemes based on key features and also helps to

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understand the operation of varies localization algorithms. In another view, it is usable for who wants to implement a new localization algorithm. Then, the paper also introduces key factors to evaluate localization algorithms. It is usable to validate a new algorithm or compare existence algorithms in order to find the best for an especial application.

III. LOCALIZATION

Localization is estimated through communication between localized node and unlocalized node for determining their geometrical placement or position. Location is determined by means of distance and angle between nodes. There are many concepts used in localization such as the following.

(a)Lateration occurs when distance between nodes is measured to estimate location.

(b)Angulation occurs when angle between nodes is measured to estimate location.

(c)Trilateration. Location of node is estimated through distance measurement from three nodes. In this concept, intersection of three circles is calculated, which gives a single point which is a position of unlocalized node.

(d)Multilateration. In this concept, more than three nodes are used in location estimation.(v)Triangulation. In this mechanism, at least two angles of an unlocalized node from two localized nodes are measured to estimate its position. Trigonometric laws, law of sines and cosines are used to estimate node position [16].

IV. LOCALIZATION PROCEDURE

First, we recapitulate the scheme proposed in [11] by using a simple network shown in Figure 1. This network consists of five sensor nodes, and the sink node is omitted in this figure for simplicity of explanation. Figure1(a) depicts the configuration of the network in which the identifications of nodes are attached. The solid lines between nodes represent their connectivities, that is, the sensor nodes connected along this line can communicate among themselves. For example, nodes A, B, and C can communicate and share information such as LQI values among themselves, but nodes A and D cannot communicate directly. Furthermore, node E can communicate only with node B.

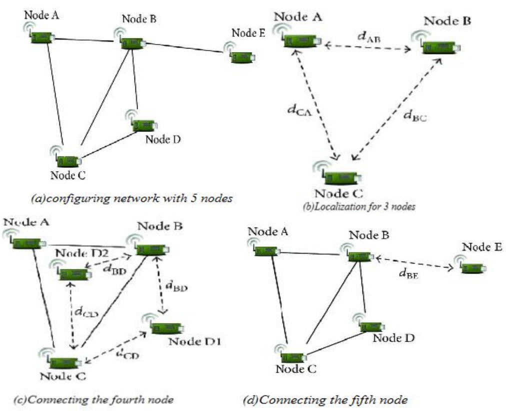

Figure 1: An example of localization procedure with five sensors

The first step of localization is to choose three nodes that can communicate among themselves and to from a triangle-shaped network of these nodes. In this example, a group of nodes A, B, and C is chosen for the network (Figure 1(b)). The LQI values for these nodes can be measured through their communication, and thus the distances among these nodes can also be estimated by determining the relation between the distances and the resultant LQI values. The distances among these nodes are denoted by d_{AB}, d_{BC}, d_{CA}, which correspond to the distance between nodes A and B, B and C, and C and A, respectively. When one of the nodes is virtually located at a particular position (e.g.(0,0),), the locations for the other two nodes can be calculated on the basis of their distances to that node. Subsequently, each node in the remaining group of nodes is chosen and connected to the base triangle network. The chosen node is a node that can communicate with the two nodes in the base triangle. In the example in Figure 1(a), node D is the target node because it can communicate with nodes B and C. Two candidates can arise on connecting the node to the triangle, as shown in Figure 1(c) (nodes D1 and D2), but according to the connectivities of nodes, only one of these candidates can be selected. The location of node D can be determined if the locations of nodes in the triangle are already set. Finally, the nodes that can communicate to only one node are connected to the network, for example, node E in Figure 1(d). The locations of such nodes are set appropriately such that the connectivity of the network remains unchanged. As in the example in Figure 1(d), node E should be set at an arbitrary location such that this node is not directly connected to nodes A, C, and D.

V. TYPES OF LOCALIZATION

Localization schemes are classified as anchor based or anchor free, centralized or distributed, GPS based or GPS free, fine grained or coarse grained, stationary or mobile sensor nodes, and range based or range free. We will briefly discuss all of these methods.

a. Anchor Based and Anchor Free: In anchor-based mechanisms, the positions of few nodes are known. Unlocalized nodes are localized by these known nodes positions. Accuracy is highly depending on the number of anchor nodes. Anchor-free algorithms estimate relative positions of nodes instead of computing absolute node positions [16].

b. Centralized and Distributed: In centralized schemes, all information is passed to one central point or node which is usually called "sink node or base station". Sink node computes position of nodes and forwards information to respected nodes. Computation cost of centralized based algorithm is decreased, and it takes less energy as compared with computation at individual node. In distributed schemes, sensors calculate and estimate their positions individually and directly communicate with anchor nodes. There is no clustering in distributed schemes, and every node estimates its own position [21–26]

c. GPS Based and GPS Free: GPS-based schemes are very costly because GPS receiver has to be put on every node. Localization accuracy is very high as well. GPS-free algorithms do not use GPS, and they calculate the distance between the nodes relative to local network and are less costly as compared with GPS-based schemes [27, 28]. Some nodes need to be localized through GPS which are called anchor or beacon nodes that initiate the localization process [16].

d. Coarse Grained and Fine Grained: Fine-grained localization schemes result when localization methods use features of received signal strength, while coarse-grained localization schemes result without using received signal strength.

e. Stationary and Mobile Sensor Nodes: Localization algorithms are also designed according to field of sensor nodes in which they are deployed. Some nodes are static in nature and are fixed at one place, and the majority applications use static nodes. That is why many localization algorithms are designed for static nodes. Few applications use mobile sensor nodes, for which few mechanisms are designed [29].

VI. RANGE-FREE AND RANGE-BASED LOCALIZATION

Range-based and range-free techniques are discussed deeply in this section.

A. Range-Free Methods: Range-free methods are distance vector (DV) hop, hop terrain, centroid system, APIT, and gradient algorithm. Range-free methods use radio connectivity to communicate between nodes to infer their location. In range-free schemes, distance measurement, angle of arrival, and special hardware are not used [24, 25].

a. DV Hop: DV hop estimates range between nodes using hop count. At least three anchor nodes broadcast coordinates with hop count across the network. The information propagates across the network from neighbor to neighbor node. When neighbor node receives such information, hop count is incremented by one [24]. In this way, unlocalized node can find number of hops away from anchor node [13]. All anchor nodes calculate shortest path from other nodes, and unlocalized nodes also calculate shortest path from all anchor nodes [26]. Average hop distance formula is calculated as follows: distance between two nodes/number of hops [13]. Unknown nodes use triangulation method to estimate their positions from three or more anchor nodes using hop count to measure shortest distance [26].

b. Hop Terrain: Hop terrain is similar to DV hop method in finding the distance between anchor node and unlocalized node. There are two parts in the method. In the first part, unlocalized node estimates its position from anchor node by using average hop distance formula which is distance between two nodes/total number of hops. This is initial position estimation. After initial position estimation, the second part executes, in which initial estimated position is broadcast to neighbor nodes. Neighbor nodes receive this information with distance information. A node refines its position until final position is met by using least square method [13].

c. Centroid System: Centroid system uses proximitybased grained localization algorithm that uses multiple anchor nodes, which broadcast their locations with (Xi, Yi) coordinates. After receiving information, unlocalized nodes estimate their positions [24]. Anchor nodes are randomly deployed in the network area, and they localize themselves through GPS receiver [13]. Node localizes itself after receiving anchor node beacon signals using the following formula [24]:

$$(X\text{est}, Y\text{est})=\left(\frac{Xi, + \cdots +, Xn}{N}, \frac{Yi, + \cdots +, Yn}{N}\right) \quad ,(1)$$

where Xest and Yest are the estimated locations of unlocalized node.

d. APIT: In APIT (approximate point in triangulation) scheme, anchor nodes get location information from GPS or transmitters. Unlocalized node gets location information from overlapping triangles. The area is divided into overlapping triangles [13]. In APIT, the following four steps are included.
(i) Unlocalized nodes maintain table after receiving beacon messages from anchor nodes. The table contains information of anchor ID, location, and signal strength [13].
(ii) Unlocalized nodes select any three anchor nodes from area and check whether they are in triangle form.This test is called PIT (point in triangulation) test.
(iii) PIT test continue until accuracy of unlocalized node location is found by combination of any three anchor nodes.
(iv) At the end, center of gravity (COG) is calculated, which is intersection of all triangles where an unlocalized node is placed to find its estimated position [24].

e. Gradient Algorithm: In gradient algorithm, multilateration is used by unlocalized node to get its location. Gradient starts by anchor nodes and helps unlocalized nodes to estimate their positions from three anchor nodes by using multilateration [13]. It also uses hop count value which is initially set to 0 and incremented when it propagates to other neighboring nodes [13]. Every sensor node takes information of the shortest path from anchor nodes. Gradient algorithm follows fes steps such as the following
(i) In the first step, anchor node broadcasts beacon message containing its coordinate and hop count value.
(ii) In the second step, unlocalized node calculates shortest path between itself and the anchor node from which it receives beacon signals [27]. To calculate estimated distance between anchor node and unlocalized node, the following mathematical equation is used [27]:

$$Dji = h_{j,Ai} d_{\text{hop}}, \quad (2)$$

where $d$hop is the estimated distance covered by one hop.
(iii) In the third step, error equation is used to get minimum error in which node calculates its coordinate by using multilateration [13] as follows:

$$Ej = \sum_{i=1}^{n} (d_{ji} - d^{ji}), \quad (3)$$

where dji is the estimated distance computed through gradient propagation.

B. Range-Based Localization: Range-based schemes are distance-estimation- and angle-estimation-based techniques. Important techniques used in range-based localization are received signal strength indication (RSSI), angle of arrival (AOA), time difference of arrival (TDOA), and time of arrival (TOA) [28–34].

a. Received Signal Strength Indication (RSSI): In RSSI, distance between transmitter and receiver is estimated by measuring signal strength at the receiver [16]. Propagation loss is also calculated, and it is converted into distance estimation. As the distance between transmitter and receiver is increased, power of signal strength is decreased. This is measured by RSSI using the following equation [13]:

$$Pr(d) = \frac{ptGtGr\lambda 2}{(4\lambda)^2 d^2}, \quad (4)$$

where Pt = transmitted power, Gt = transmitter antenna gain, Gr = receiver antenna gain, and λ = wavelength of the transmitter signal in meters.

b. Angle of Arrival (AOA): Unlocalized node location can be estimated using angle of two anchors signals. These are the angles at which the anchors signals are received by the unlocalized nodes [16]. Unlocalized nodes use triangulation method to estimate their locations [13].

c. Time Difference of Arrival (TDOA): In this technique, the time difference of arrival radio and ultrasound signal is used. Each node is equipped with microphone and speaker [35]. Anchor node sends signals and waits for some fixed amount of time which is $t$delay, then it generates "chirps" with the help of speaker.

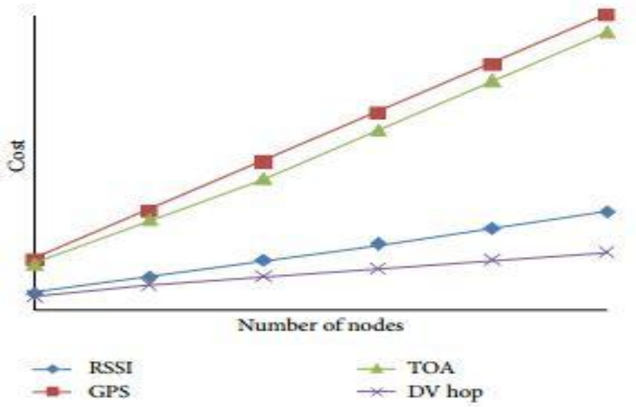

Figure 3: Cost analysis of localization techniques.

These signals are received by unlocalized node at $t$radio time. When unlocalized node receives anchor's radio signals, it turns on microphone. When microphone detects chirps sent by anchor node, unlocalized node saves the time $t$sound [35]. Unlocalized node uses this time information for calculating the distance between anchor and itself using the following equation [12]:

$$d = (s\text{radio} - s\text{sound}) * (t\text{sound} - t\text{radio} - t\text{delay}) \quad (5)$$

d. Time of Arrival (TOA): In TOA, speed of wavelength and time of radio signals travelling between anchor node and unlocalized node is measured to estimate the location of unlocalized node [13]. GPS uses TOA, and it is a highly accurate technique; however, it requires high processing capability. We generated some interesting results by comparing few localization techniques. The results are based on our observations and analysis. Figure 3 shows cost of four localization techniques, and it is observed that GPS- and TOA-based systems are more expensive as compared with DV hop and RSSI. Figure 4 represents accuracy comparison of different localization techniques. It is observed that localization mechanisms equipped with GPS systems are highly accurate. Such mechanisms are needed for WSNs, which are energy efficient. Figure 5 shows comparison of energy efficiency of different localization mechanisms. GPS-based localization mechanisms are less energy efficient while RSSI-based mechanisms are highly energy efficient.

VII. LOCALIZATION ALGORITHMS

Based on the inputs data, a localization algorithm estimates the location of nodes in the network area. Inputs can be range estimation with or without the location of beacons or access points. In the continuous, available algorithms are classified in taxonomy (Fig. 2).

They are categorized into two main groups based on learning criteria: Learning based and Non- Learning based approaches, which are described below.

A. non-learning based localization algorithms

Most of the localization algorithms are non-learning based. These groups classified into anchor based and anchor free classes. They will be expanded in continuous.

a. non-learning anchor based localization algorithms

Anchor refers to the nodes which are aware of their positions because of adding GPS or manual configuration (aka beacon, landmark and merit). Anchor nodes are used in some algorithms to estimate the location of other nodes which don't know their positions. Using anchors help to have better accuracy. In anchor based schemes the accuracy of location depends on the number of anchors and their distribution in the network. Several of these algorithms suffer from scalability and wide flooding. Anchor based algorithms can be deployed in the fixed, mobile or hybrid networks.

Fixed networks contain of static sensor nodes and they are used to localize non-aware nodes. Hybrid Networks consist of static nodes and mobile beacon acts as a static one (broadcasting its accurate position) and represents many virtual static beacons. The goal of these schemes is to localize static nodes. Mobility makes WSNs more flexible and enables more possible applications. However, makes additional challenges. Latency is the first issue in mobile wireless sensor networks (MWSN)s. Another problem is Doppler shift. This problem happens when transmitter moves relative to the receiver. It causes frequency shift and makes error in measurement. The shift in frequency is related to the speed and position of both transmitter and receiver nodes. In addition to above, there is another challenge available in localization techniques with line of sight (LOS) requirement. It is possible that a sensor moves from a position with good LOS to a position with bad LOS. So, it's required to ensure LOS availability for mobile nodes. Localization algorithms in a wireless sensor network can be implemented in centralized, locally centralized and distributed manner.

Centralized implementation: In these approaches, all the information (for example, connectivity and pair wise distance measurement) about the entire network is sent to a central unit to analysis, and then computed positions are transported back into the network. Sending all information to the unit sink causes single point of view and bottle neck problem.so it is more accessible for small scale area networks. It is simple and easy to implement. Because of existence of global information, it is more accurate than other implementations.

Locally centralized implementation: In these techniques two or three central units are available. It is proposed as a solution to solve high communication overhead and scalability problem of centralized approaches.

Distributed implementation: In these algorithms, all the relevant computation is done on the sensor nodes themselves. So It is harder to implement but computational efficient and more flexible for large scale networks. All algorithms in the non-learning category use Euclidean properties to localize the sensor nodes. The most important are Triangulation, Trilateration, Multilateration and Proximity based. The methods which are proposed in [15-22] are in the group of anchor based and non-learning localization algorithms. Convex position algorithm [17] is a centralized localization algorithm for fixed networks. This method is based on semi-definite programming with high computation cost. This algorithm is executed by a single centralized node. So, it is not feasible for many ad hoc applications. CBLALS method [20] is a locally centralized localization algorithm for fixed networks. It uses ultrasound and RF signals with TDOA measurement technique to localize indoor sensors. In more details, CBLALS establishes cluster on the whole network by improving tri-color method. Three-dimensional localization performs on each cluster. Then, one head beacon is chosen for each cluster, based on some rules. Finally, the local coordinate of each cluster will be transformed to global coordinate by head beacons.

In DV-hop algorithm [18], at the first step all anchors flood their location to the network via a message. The massage is propagated hop by hop and counts the hop count from anchor to node heard. Each node has a counting table and maintains the minimum number of hops that is away anchors. Anchor nodes calculate average hopdistance and send it back to the network as correction factor. When a non-anchor node gets correction factor from nearest anchor, uses it to estimate its distance to anchors. Then, node performs trilateration to estimate its location.

The proposed algorithm given in [19] is called distributed grid-based transmitting power (DGL). In this technique, anchor nodes can change their communication range by increasing their transmitting power. Each node establishes a rectangular coordinate system and divides it into square grids. Distributed Range-free Localization (3D-DRL) [21] is a technique for three dimensional wireless sensor networks under irregular radio propagation environment. The interested area is divided into cubic cells. Each anchor votes for each cell. Each non anchor node estimates its location by using the average of the center of gravity of cubic cells with highest votes.

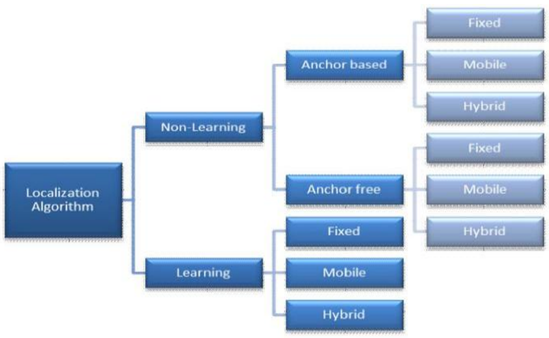

Fig.1. The proposed taxonomy for localization algorithms

b. non-learning anchor free localization algorithms

In contrast to anchor based, this category has not even one anchor node. In these schemes instead of finding the nodes' position, the algorithm finds relative positions of the nodes in the coordinate system by a reference group of nodes (anchors).

These approaches can be deployed in fixed, hybrid and mobile networks with the same properties as mentioned in the last section. There is also many localization techniques implemented based on Centralized, Locally Centralized and Distributed.

The methods which are given in [30-33] are in the group of anchor free and non-learning localization algorithms. Basically, the multi-dimensional scaling (MDS-MAP) technique uses data analysis and information visualization to display distance-like data in geometrical visualization. This algorithm computes the shortest distance between all pairs of nodes and then makes a distance matrix and applies MDS to construct relative location of nodes. If there was sufficient anchor numbers available, it can estimate absolute nodes' location by transforming relative locations. MDS requires global information and it has high communication and computation cost. IMDS-MAP approach [31] is based on MDS-Map method. It is locally centralized algorithm for large scale networks and accuracy required.

B. learning based localization algorithms

In previous sub-section, we mentioned non-learning based approaches but in this section we will classify a number of localization techniques that employ the concepts from machine learning. Localization techniques based on learning approaches are interested because of having simple implementation and modest requirements. The input of learning approaches can be signal strengths or hop-count information which can obtain at no cost. Generally, machine learning based localization algorithms function in two phases: offline training phase and online localization phase.

In the first phase, the training information gathers from the network. Learning approach runs on the information and the result is a predicted model. After that, in the online localization phase, any sensor can use this model to localize itself without knowledge about other sensors. This property makes the learning based localization algorithms cost efficient, fast and low computation. However, it has its own limitation; the accuracy of algorithm depends on the number of training data which is produced by beacons. Therefore, more beacons make more accuracy and more cost for algorithm.

According to our knowledge there are only anchor based techniques in this group. And anchors are used to make training information for learning localization algorithms. In addition of using learning concepts in fixed networks, it is also sufficient for dynamic sensors. As mentioned before each node can determine its position individually in distributed manner. In additional, past information is useful in the learning procedures. So, such algorithms are suitable for target tracking especially where the information about target is sparse. In this case, Euclidean approaches are not useful. Generally in hybrid case, there are several access points and some mobile nodes available. The goal is to localize mobile nodes. The localization algorithms in this field can implement in Centralized, Locally Centralized and Distributed schemes. Most of them are based on kernel functions to solve the localization problem.

LSVM technique is [34] is a distributed algorithm based on SVM algorithm for fixed networks. Connectivity measurement is used as training data for learning machine. Connectivity information makes the algorithms to be applied for large network area.
The proposed method given in [35][36] are mobile network localization algorithms for indoors. These two algorithms are based on RSS information. They assume that direct signal from all beacons are possible for nodes. So these algorithms are not applicable for large scale networks.

VIII. EVALUATION OF LOCALIZATION ALGORITHMS

In the last sections, we categorize different algorithms in the proposed taxonomy in order to help researchers for designing a new localization algorithm or distinguishing the existence approaches and identifying the key efficient factors. After new algorithm implementation, or for choosing a proper existing localization approach for specific application, it is very important to validate it.
There exist a large number of factors which affect the performance of localization algorithms. But, there are not standard criteria as evaluation for localization schemes. This part tried to introduce the more important criteria to compare and validate the localization algorithms.

Accuracy: It is the most important key for location evaluation. Most of the application needs high accuracy.

Scalability: Scalability is an important factor to validate the localization algorithm. As mentioned in the last section, Centralized approaches suffer from scalability. In contrast distributed algorithms are suitable for large scale networks.

Robustness to Failure and Error: Localization algorithm should be robust against node failure and Error and noise in the input data.

Coverage: One other significant factor key is coverage. It means how much of the network can be localize with the algorithm. There is also attention on the simplicity of adding another node to the network after completing the initial localization algorithm.

Cost: The cost of localization technique refers to several items, including, computation and communication cost, number of beacon nodes or access point, processing time, energy consumption, hardware or software required by each node, etc.

There are many other factors like distribution of anchors and non-anchors, irregular node densities, border problem, geometric shape of the network, etc. It's not able to have all factors together. The best result is trade off among criteria based on the application requirement. When a localization algorithm has excellent performance on the simulation environment, maybe it has not satisfaction performance in the real.

Table 1: Comparison of different localization techniques.

Technique	Cost	Accuracy	Energy efficient	Hardware size
GPS	High	High	Less	Large
GPS free	Low	Medium	Medium	Small
Centralized based	Depends	High	Less	Depends
Decentralized based	Depends	Low	High	Depends
RSSI	Low	Medium	High	Small
TOA (using ultrasonic pulse)	High	Medium	Less	Large
TDOA	Low	High	High	Less complex, may be large
AOA	High	Low	Medium	Large
DV hop	Low	Medium	High	Small
APIT	Medium	Medium	High	Medium

IX. OPEN ISSUES

With several proposed localization algorithms but there are some issues that need more attention yet.
Security in the Network: Accuracy of the output of localization algorithm is really important. Some localization algorithms have high accuracy. But, after implementation they are subject to attacks. Therefore, it is important to consider the security and privacy of nodes locations. There is some work in this field like [29] but the problem is not solved adequately.
3D area: More of the proposed localization algorithms are applicable for 2D area. However, many of applications need 3D localization algorithms.
Low cost, anchor based location approach: Since many applications especially in industry fields are anchor based and it is avoidable to decrease number of anchors, it is required to decrease another cost of localization methods.
Large scale mobile learning approach: Learning concepts have been considered because of their good efficiency on the performance of localization especially for mobile networks. But more works are developed for mobile indoors. And most of the large scale localization algorithms just can work on the fixed networks.

X. CONCLUSION

In this paper, we proposed a new classification for localization techniques. In this classification, localization algorithms were classified based on different key features like learning, anchor existence, movement in network, etc. This classification is usable to understand the operation of varies localization methods and it is also usable for who wants to implement a new localization algorithm. In additional, some evaluation factors were introduced to validate new proposed methods or to compare different existence techniques in order to find the best one for a specific application.

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