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Algorithm for 3D Localization in Wireless Sensor Networks

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ABSTRACT
Localization means finding or estimating the accurate position of nodes. Through localization, node sends the accurate location position with the information to the interested users. Localization algorithm is applied to every sensor nodes with respect to their coordinates. The earlier two dimensional localization algorithm works on flat network topology, it hard for 2D network to work with irregular network topology. The 2D may failed many time for finding position in complex hilly and harsh terrain and large altitude differences, for this we need for three dimension localization of nodes. The algorithm proposed in this paper for 3D localization i.e. Ring-Overlapping based on Comparison of Received Signal Strength Indicator (ROCRSSI) it is already implemented in 2D localization, this paper proposed this algorithm in 3D localization of node in sensor networks. Here we use finger-print approach to implement this algorithm. Finger-print techniques divide into two phase's online and off-line method. It takes the signature of node location in offline phase and store it on database and online phase new measurement is taken for finding the node position with respect to data. ROCRSSI is based on range-free method; its property is to work with the small number of anchor in the network, it is isotropy in nature so it provides equal radiation power to the distance node so that it can be used for long region area.

Keywords
Anchor nodes, fingerprint techniques, ROCRSSI algorithm, and unknown node.

1. INTRODUCTION
Sensor networks application used in many field such as Military Applications as a Targeting, Battlefield surveillance etc., now a days it can be used in Habitat Monitoring as a medical care, Environment Monitoring as a measurement of environment temperature, earth quakes and volcanoes, home automation application, disaster relief etc, and its usability is increasing day by day. Wireless sensor networks is adhoc based network where the node in the networks are organize by own self and monitor the physical condition by them self and gathered the data through it and send data to the interested node or base station. Sensor node need to localize own self correctly, if any error occur node localization the hole process become disturbed. In their earlier method, node localization is done by manual configuration and GPS (Global positioning system), but they are not complete solution because through manual configuration localization is done through human, and sensor networks deployment is basically done through without human interaction, second by GPS they consume power, increase size of node and reduce the lifetime of node, and GPS is also affected by line of sight. The other solution is by using localization algorithm where algorithm runs on every node. Earlier algorithms are based on two dimension localization where the node localizes him by coordinates in the network. Where in two dimensions localization working with x, and y axis, the third dimension is constant and find the node position with two coordinates. Error comes during localization because the real world consists of 3D view. 3D localization concept works for providing better accuracy for finding node position. The 2D provide good result in flat surface but result provide difficulty to calculate node position in harsh terrain, therefore we need for extra more dimensions i.e. 3D dimensions coordinates in every node. Through 3D coordinates sensor node can be deploy on harsh and hilly terrains it can be used in Mountain battlefield, Pollution monitoring using sensor network floating in air, under water etc. There are some localization algorithm implement based on 3D node localization that should be improved in accurate localization, small computational amount, and suppression over complex noise, energy saving, faster executing, etc.

Localization method work on two basis range based and range free based scheme. The range based calculation work on inter-node distances between nodes and this calculation is done through special ranging hardware that is present on every node for range based method. It is anisotropy in nature and it is affected by irregular radio propagation, low sensor density, anisotropic terrain condition, obstacle, signal fading but it provide good accuracy in shortest path between two nodes. Whereas the range free method works on hop counts between the nodes and the hop count is directly proportional to the distance between them. It is isotropy in nature where it is not depend on the directions means uniformly in all directions. Range based schemes are Time of Arrival, Time Difference of Arrival, Angle of arrival, Receive Signal Strength Indicator, lateration and Range-free scheme is Hop Count, Proximity etc. Range free schemes does not disturbed with fading, propagation, or with low sensor density and it does not needed extra hardware for distance estimation. So range free scheme overcome from the disadvantage of range based method.

2. LITERATURE REVIEW
There is a lot of work has been done on 2D node localization basis. Algorithm proposed in 2D localization range free schemes are Centroid algorithm, DV-HOP, APIT etc. In 3D localization algorithm propose are:

2.1 New 3-dimensional DV-Hop Localization Algorithm:

Algorithm calculating the minimum hop distance between the unknown nodes and the beacon nodes, where it taken only the smallest hop distances between the beacon node (who known their position earlier using GPS system) and them self. Beacon nodes sent the mobile agent to the unknown nodes; agent recorded the coordinates of the beacon nodes and the number of hops distance between the unknown node and beacon node. After it calculating the average per-hop distance and measurement error and broadcast the value to whole network.

2.2 Novel Centroid Algorithm for 3D:

This scheme works in a distributed way. It extended earlier Centroid algorithm. It provides linear relationship between the rectangular and the volume coordinates, where all anchors send their beacon signals to all unknown nodes within their transmission range. Each unknown node selects randomly four anchor nodes from various reference points in range to form a series of tetrahedrons. It proposed Centroid theorem of coordinate- tetrahedron in the volume-coordinate system to calculate the barycenter, where nodes present at the center of four bodies. After it calculate the average coordinates from this centroid theorem using barycenter and estimate the final position.

2.3 Three-dimensional azimuthally defined area localization algorithm (3D-ADAL):

This algorithm works in every node. In their mobile node who known their position earlier called beacon node. Beacon node contain rotary and tilting directional antenna and it have property to flight over the whole network and broadcast messages with the antenna to the unknown node, where unknown node have Omni directional antenna who receive the messages from mobile beacon node. The 3D Co-ordinates will be taken for position calculation of unknown nodes, as the node present horizontal plane (*xy*-plane) and the *z*-coordinates is calculated with mobile beacon, it will be used to determining its altitude. Calculations are performed with the previous phase with present through it estimate the altitude and continue the process.

2.4 Three Dimension Distributed Range Free Localization Algorithm (3D-DRL):

It is based on grid-based representation in the space; where the location area of unknown node (UN) is divided into cubic grid where each unknown node establishes its own grid. In their anchor node broadcast the information including their ID, coordinates(x, y, and z), power level and additional propagation. UN take the beacon and decide with the help of BJT (beacon judgment threshold) if anchor beacon is above the BJT then it initialize in the table otherwise discard. Unknown node maintain table for representation of grid cells. In their anchor node is voted for cell if anchor node communication range come in the cell, where value is given by in each grid of unknown node cell for anchor presence. Those which have high value have more anchors in the unknown node cell. High value UN may estimate their position otherwise UN sends re-requirement for re-localization from starting.

3. PROBLEM STATEMENT

The existing system works with the 3 dimension fingerprint technique uses RSSI method for localization of node. Fingerprint technique consists of two phases:

The first phase is offline phase; the fingerprints information are collected and stored in a database. Finger print collects the information such as the Received Signal Strength Indicator (RSSI), position from other fixed nodes, with the help of known node.

In the online phase, the normal network operation is happen; in normal network operation contains the temperature measurements, humidity measurements, light measurements and sends this measurements to the base station. The new measurements are taken from nodes, and calculate the new node position with the help of WCL (Weighted Centroid localization) algorithm and KNN (K-nearest neighborhood) algorithm and estimate the final position with the comparison based on stored fingerprint. In their two stages can be run separately, the first stage a mobile node (MN), which broadcast messages for knowing their position, in there they does not known their position earlier. When the anchors receive they send packet with the calculated averaged RSSI of the MN and its known position to the MN. The MN measures the averaged RSSI from each Anchor (AN). The MN is executes the Weighted Centroid Localization (WCL) algorithm for position estimation in online phase. For getting higher accuracy the second stage is used. The MN sends the calculated averaged RSSI values to the anchor node from which it received the strongest RSSI value. The selected AN calculate the position of MN using the received RSSI value from MN and from stored value in database. During this execution through anchor node the MN become into sleep mode. In their MN wake up if needed for asking for its position. Then the selected anchor node sends the result calculated by the fingerprint technique.

It is based on the assumption that the information collected in online phase is similar to the offline phase. This assumption is not always correct through it degraded performance and accuracy.

The RSSI (received signal strength indicator) algorithm is using in fingerprint technique for calculation of 3D node position; it is a range based method for calculation of node position. The drawback with this is multipath and shadowing, it also affected from attenuation, it cannot used for long distance node position calculation.

4. PROPOSED WORK

Propose work is also working with the fingerprint techniques with the two phases online and offline. Main objective is to implement a 3D localization of node with the help of existing 2D algorithm. Ring-Overlapping based on Comparison of Received Signal Strength Indicator (ROCRSSI) algorithm will propose for implementing 3D localization of node in the network instead of RSSI. The main advantage is providing constant signal to the range of node. It is used for long distance without fading. In their anchor node generate ring for finding node position with the help of known nodes. The rings are generated by the signal strength value of nodes. It computes the unknown node region with the intersection of the overlapping rings of known node. Each sensor unknown

node collect the enough information from the overlapping ring. Find the position of nodes with the help of nearer anchor node and center of gravity based method calculation. Figure 1 is based on ROCRSSI algorithm ring generation and finding the grid area of UN.

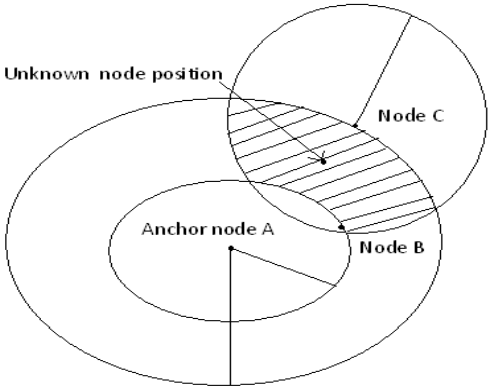

Figure 1: ROCRSSI algorithm for finding unknown node area

The ROCRSSI algorithm operates in three phases:

4.1. RSSI measurement:

Each anchor node calculates the RSSI value from each anchor and other node in there range after calculation broadcasting their own beacon to each anchor node, the algorithm is Range-free method so no additional hardware is required.

4.2. Anchor node data distribution:

Each anchor node transmits its location information including its xy coordinates and calculated average RSSI data from other anchor node to the unknown node. UN stores the information for position estimation.

4.3. Sensor node location estimation:

With the ring generation through anchor node that containing the unknown sensor between the two known or anchor node, it calculating the grid area where the unknown sensor is presents for this grid scan algorithm is needed. Through it final estimation is grid region using grid scan method. In their area is divided into a square grid. The grids provide better accuracy. Grid algorithm used to calculate the center of gravity of the intersection area for finding position of unknown node. Each sensor node takes the grid data from the previous phases and determines its position through it.

5. CONCLUSION

The ROCRSSI algorithm implemented in 2D localization provide better result for long distance localization and it also help to get accurate node position with small number of anchor node. ROCRSSI Algorithm using for 3D node localization, to increase the further efficiency and accuracy and the usability in real world. 3D localization provide correct estimation in real world view, we need to develop another algorithm for increasing usability of node for wireless sensor networks.

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