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LOCALIZATION IN WIRELESS SENSOR NETWORKS USING ARTIFICIAL INTELLIGENCE

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Abstract: *In wireless Sensor Networks, to estimate the accurate physical location of the sensor nodes is known as localization. Localization plays a critical role in various applications like tracking, battlefield, intrusion detection, medical surveillance etc. TDOA helps in finding out the distance between anchor nodes and sensor nodes and compares result on the basis of Root Mean Square Error (RMSE). In this report main focus is to find the position of sensor nodes in NLOS environment and with precise accuracy. This report propose the technique to find the path of anchor nodes and sensor nodes by using Time Difference of Arrival (TDOA) technique in NLOS environment with the help of Artificial Intelligence and also determines the location estimation in 3 Dimensional comprising various factors like accuracy, communication cost and feasibility in 3 Dimensional.*

Keywords: *TDOA, NLOS, RMSE, WSN, AI*

1. INTRODUCTION

Wireless sensor networks (WSNs) consist of small, low cost, smart sensor nodes which are interconnected wirelessly by a transceiver in a network [2]**.** Wireless sensor networks are consisted of hundreds and thousands of nodes, and have been emerged from computing and communication technology. The main advancements in WSNs are basically shown by micro electro mechanical systems (MEMS). Each node communicates with other sensor nodes, to sense the environment which performs simple computations and communication occurs with its sensors or with central unit [7]. One way of deploying the nodes is to scatter the nodes throughout the region of interest. We make topology random by deploying the nodes randomly in the area. Our network is ad hoc because we don't use any priori communication protocol to define our network. These networks perform a number of tasks like medical applications, battlefields, target tracking etc. These networks range from vary to vary like environmental and natural habitat monitoring to home networking, medical applications. Sensor network can warn smoke if there is forest fire about to start and signals machine malfunction to control centre in a factory [5]. Wireless sensor nodes also detect ground vibrations generated by burglar footsteps and alarm triggered.

Most applications need efficient localization algorithms to compute their positions in fixed coordinate system. These algorithms need successful localization i.e. exact position of locating the node in region. Routing can also be done in large scale and ad hoc networks for node localizations. Node localization also tracks or monitors the progress of children interacts with each other and also with their toys. It can also be used in hospitals to monitor the patients, doctors, nurses and also keep track of their equipments used in hospitals [6]. Due to all these advantages detailed, accurate and specific knowledge of node localization in ad hoc sensor networks is an active field of research in wireless networking.

Unfortunately, GPS is not feasible solution for large number of sensor nodes to sense the network because

a) GPS cannot be implemented in the areas where they block line-of-sight for e.g. the presence of dense forests, mountains or other obstacles that block from GPS satellites.
b) GPS reduce the lifetime of the entire network and power consumption also reduces the battery life of the sensor nodes i.e. power consumption is also reduced.
c) Cost factor is also an important issue in GPS with large number of nodes in a network.
d) Sensor node form factor also increases due to size of GPS and its antennas. So, Sensor nodes are required to be small.

For these reasons GPS cannot be used to track the region and we need an alternate solution of GPS

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which is cost effective, rapidly deployable and can operate in diverse environments. Therefore, in all applications it is necessary to know detailed, accurate and exact origin of an event i.e. precise location of sensor nodes. This process is called localization [8].

2. LITERATURE SURVEY

Prince Singh *et. al.* (2013) [1] said that the exact positions of the sensor nodes are necessary for location-aware services in wireless sensor network. To calculate accurate node localization we use Time Difference of Arrival (TDOA) information with neural network. In their work, they use two artificial neural network models- Back Propagation Network (BPN) and Radial Basis Function (RBF) Network model for Wireless Sensor Network's node localization problem. TDOA (Time Difference of Arrival) data is used to calculate the distance information between the anchor nodes and sensor nodes. This distance information was used to train the neural networks' models. All the simulation results show that Radial Basis Function Network is more superior to Back Propagation Network. They calculate superiority in terms of root mean square error (RMSE) when training data density is high.

Urvashi Singh *et. al.* (2013) [2] implemented accurate localization or tracking of devices by using CMDS technique and NN. This work attempts to deal with Classical Multidimensional Scaling (CMDS) technique to estimate the geometric configuration and mapping of nodes. To determine the accuracy in localization, stress is estimated in wireless sensor networks. In CMDS technique we give inputs in CMDS which gives insignificant stress and in result gives good localization with NN technique as compared to CMDS technique. In this seize of sensor nodes is the primarily issue of concern so that production cost do not increases. As ANN technique increases the size and cost of sensor and it requires additional hardware and higher memory. So, accuracy obtained with ANN technique is very high.

Long Cheng *et. al.* (2012) [3] presented a comprehensive survey of these challenges: localization in non-line-of-sight, node selection criteria for localization in energy-constrained network, scheduling the sensor node to optimize the trade-off between localization performance and energy expenditure, cooperative node localization, and localization algorithm in heterogeneous network. All these challenges need different techniques to solve their particular challenge. All of them have some limitations and benefits in their issues. They solve their particular challenge in two dimensional coordinate.

3. PROPOSED WORK

To know the exact location of unknown nodes, we need accuracy in the localization process. Therefore, it is not feasible to place large no of nodes manually. So, the main difficulty arises when we determine the position of nodes in non line of sight points in which accuracy is very less. In NLOS environment accuracy is the main issue. Therefore, main emphasis is to find the position of nodes in NLOS environment and with precise accuracy. This also determines the location estimation in 3D by using TDOA technique with the help of artificial neural networks. Fig 1 shows localization in 3D.

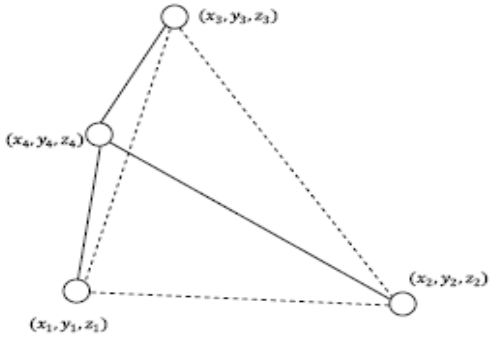

Figure 1: Localization in 3D [4]

M=K+N, where K= anchor nodes i.e. no. of nodes known their location in advance. N=beacon nodes i.e. nodes unaware of their location. The location of k nodes is:

$[(x_1, y1, z1), (x_2, y_2, z_2)..... (x_k, y_k, z_k)]$

The problem is to determine the location of all nodes as:

$[(x_{k+1}, y_{k+1}, z_{k+1}), (x_{k+2}, y_{k+2}, z_{k+2})\ldots\ldots\ldots(x_m, y_m, z_m)]$

without human interference with accuracy and low cost in communication [4]. Therefore some techniques are to be used to measure the location estimation in 3D.

To achieve localization various steps are:

a) Study and comparison of various node localization techniques in WSN.
b) Propose a technique for node localization in non line of sight (NLOS) using TDOA (time difference of arrival).
c) Implement the proposed technique using MATLAB and analyze the results.
d) Calculate RMSE and compare proposed technique with existing technique.
e) Implement location estimation in 3D by using TDOA.

Figure 2 shows the process of localization.

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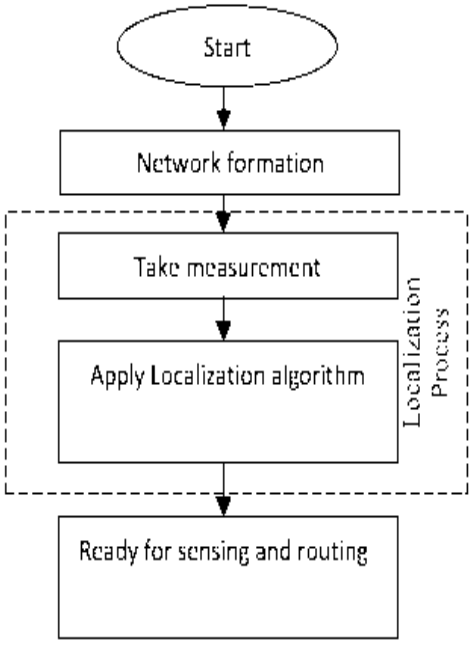

Figure 2: Localization process

4. CONCLUSION

Depending on the results of initial study, this concludes that there are different methodologies and techniques that are used to solve the problem of localization. RBN is more superior to BPN in terms of RMSE error. This method is applied to LOS environment and do this localization in 2-Dimensional only. If this method is applied to small density area only then it works best but if this is applied to large density area it do not works best. After detailed observations, three localization problems found:

a) TDOA based node localization in NLOS environment
b) Addressing noisy environments
c) Location estimation in 3-Dimensions

Keeping in mind all these issues our focus is on TDOA localization in NLOS environment and in 3D. However, since the direct path between nodes can be blocked by buildings and other obstacles, the transmitted signal could only reach the receiver through reflected, diffracted, or scattered paths called non line-of-sight (NLOS) propagation paths. This will increase the accuracy in localization identification and estimation. By using TDOA technique it will help to find the shortest path to connect nodes in accurate position. The main scope is to find the accuracy in the position determination in the non line of sight points and to determine the location estimation in 3D which will enhance the work from 2D to 3D.

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