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A Grid-Based Localization Algorithm for Wireless Sensor Networks Using Connectivity and RSS Rank

S. Bhuvaneswari[1], E.K. Girisan[2]
MPhil Scholar, Department of Computer Science, Sree Narayana Guru College, Coimbatore, Tamil Nadu, India[1]
Associate Professor, Department of Computer Science, Sree Narayana Guru College, Coimbatore, Tamil Nadu, India[2]
Corresponding Author: S. Bhuvaneswari

Abstract: A new grid-based localization algorithm is improves the paper concept, which means it is to improve the localization accuracy and to reduce the system cost by using wireless sensor networks. This paper concept is used RSS ranking. The grid-based localization algorithm is also known as a "new range-free localization algorithm". The wireless sensor networks using the connectivity and RSS (Received Signal Strength) ranks. In this concept is first to take the unknown node and this node is fixing in to the initial node of residence area that is center node of the network area and then, apply the connectivity constraints, it based on residence area choosing node. The residence area is refined or filtered by using the RSS rank vector. The RSS rank vector is calculated from the unknown node. The RSS rank vector, how to form the unknown node which means, get the values from ranks of RSS values, this values get from the neighboring anchors. Then, to find out the estimated location of unknown node and this node is select the centroid or center node of the filtered or refined residence area. The grid-based localization algorithm can use the grid scan approach for reduce the complex geometric computations. This new range-free localization is improved by using an adaptive strategy, it determines the grid size. These methods working performance is analyzed by using analysis and simulation techniques. Finally, this survey paper concept is provides the result is, better localization accuracy, greater than the previous algorithm.

Keywords: Wireless sensor networks, localization, received signal strength, connectivity, grid-scan approach.

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I. INTRODUCTION

The localization is a basic term of Wireless Sensor Networks (WSNs), but it includes the critical issue and this issue increasing in the every year. So, this is considering the problem of wireless sensor network, the concept is solving this problem. The problem definition expose the reason is, most of the WSN applications requires the location of the sensor nodes that is, which place used in sensor nodes. The example of the sensor nodes is, (i) battlefield monitoring, (ii) environment surveillance, (iii) object tracking. The problem is additionally mention the term dependency, which means many WSN applications included routing protocols and network management techniques or a methods is based on the location of each sensor node is available or not, that is one assumption based to take this node. This WSN additionally includes only small percentage of sensor nodes. This type of sensor nodes is called, "Anchors" (Links). This anchor is getting the location information from GPS (Global Positioning System) or another sophisticated and networking oriented technologies. Then, the remaining nodes is called the "unknown nodes", it is estimates the location information from the anchors.

Many localization algorithms are available for Wireless Sensor Networks (WSNs), these all algorithms is based on two different categories like, (i) Range-based, (ii) Range-free. The first category, previously measures the distance between two nodes. The measured distance is based on range –information that is, (1) TOA (Time Of Arrival), (2) TDOA (Time Difference Of Arrival), (3) AOA (Angle Of Arrival), or RSS (Received Signal Strength). This range-information is used for location estimate. The multipath fading and measurement noise is affects the estimation accuracy. The drawback of this category is complexity. The Second category is to localize the nodes. These localization nodes are based on the simple sensing information are (i) Wireless connectivity, (ii) Anchor proximity, (iii) Event detection. But this category is requires small range of system requirements, so this category is choose for WSNs with limited hardware of node.

Key terms

Received Signal Strength (RSS)

The RSS is popular technique and it known as, "Neighborhood sensing Technique", so it is widely used. this is available in many sensor platforms like, Mica2, MicaZ, and TelosB. The range-based techniques are using the RSS for to estimate the radio propagation model. This model is to find the distance between nodes. This term not good selection for precise ranging measurement, but RSS shows effective metric for outdoor environment, it included in range-free localization. Mostly, the RSS is indicates the distance relationships among nodes. These distance relationships are getting from rank order of RSS values.

Connectivity RSS Rank Vector (CRRV)

The term, CRRV are used for a new range-free localization algorithm. This CRRV is descending orderly sorting the RSS values. An improved CRRV algorithm is called "Adaptive-CRRV", it is to determines the large grid size.

II. LITERATURE REVIEW

In this paper [1] author has presented the concept of "Sequence-based localization in wireless sensor networks". This concept is divides the localization space. The localization space is divided in to the number of distinct regions. The regions are uniquely identified by sequential order, which means ranking the distances from the reference nodes to regions. This concept is includes symbolic notations such as, (i) n means reference nodes in the localization space, (ii) so, that nodes combinatorially called, $O(n^n)$, but these sequences are possible one. It is used in to the geometric constraints, so the number of feasible that is, optimal location sequences is very low, so only $O(n^4)$. The location sequences are used in to develop localization techniques. The localization methods are robust, which means to reduce the errors, the bugs are come from the multipath and shadowing effects of wireless channels or signal.

The lightweight localization technique is provides better accuracy, and easy to compare the other. This accuracy is getting from through extensive systematic simulations and more time tested experimental results. The better accuracy is less than other state-of-art radio signal strength-based localization techniques. It use the RSS rank factor, so to forms the unknown nodes. It predetermines the list of all feasible location sequences from the localization space, so it is called, "Location sequence table". The Location sequence table finds the region, it represents the nearest node. The location sequence table expresses the maximum number of location sequences. But, this concept is depends on the weak assumption. When, the signal strength is decrease with distance, this technique cannot be true.

In this estimation approach paper [2] has presented by author, to deliver the Wireless Sensor oriented experimental message are, "Direction of estimation approach for collaborative location in wireless sensor networks". The collaborative location technique chooses the base term, "Direction of Estimation" (DoE). These directions are divided in to two types, (i) Border-to-Centre (B-C), (ii) Centre-to-Border (C-B). These two types of directions investigate and evaluate the location accuracy. These two directions based experimental results shows that the first direction outperforms the second direction, this results based on the term namely, "Root-Mean Square Error (RMSE)" and "Cramer-Rao Bound (CRB)". The Border-to-Centre method is to use the different terms and node densities. This method is to decrease the errors of location estimation and it performs clearly, this performance greater than other methods. It accumulates the error, but increase the number of iterations.

In this paper [3], "Distributed RSS-Based localization in WSN based on the second-order cone programming", has presented by author. The paperconcept is to propose in this approach to optimize RSS based localization problem related to WSN. The network uses the iterative procedures and measurements between two adjacent nodes. The target node represents the position. To solve the localization problem by using the Maximum Likelihood (ML), it provides the ML-based efficient solutions. In another hand, to overcome the ML problem use the Second-Order Cone Programming (SOCP). In this term, additionally introduce the approach for improving the convergence of the paper concept. This approach is provides the computational complexity and energy consumption details. The concept is to provide the result estimation accuracy more than 1.5 m it compared in previous system, it provides better accuracy. This approach requires the number of iterations or levels to converge. This approach cannot guarantee for all conditions. But the simulation results show the good result.

In this paper [4] author has presented the experimental approach, "RSS localization algorithm based on virtual sample nodes in WSN". The RSS technique is apply in Virtual sample nodes. To collect the RSS vector of sample nodes based on off-line acquisition. Using the RSS vector samples nodes and to-be-located node, then directly calculates the likelihood probability, then find out the closet node, and calculates the coordinates by using weighted centroid method. Finally, the this survey paper concept provides, (i) High localization accuracy,

(ii) Simple algorithm, (iii) low computation complexity. In this system use the IFA algorithm for reduce the increased anchor proportion. When change the node number, it is not sensitive.

In This paper [5] author has presented the ecolocation based concept, "Ecolocation: A sequence based technique for RF localization in wireless sensor networks". The sequence-based RF localization algorithm is called "Ecolocation". The concept of RSS it takes and applies the multiple reference nodes. The constraint-based approach is provides the robust location, then the random RSS use the multipath fading and shadowing. This approach provides the better accuracy. The ecolocation analyze the ordered sequence of nearby nodes that is reference nodes. The reference nodes are includes the locations. The unknown node includes the unknown locations. It already obtains the reference nodes that are with ranking, and then, RSS measurements between the unknown nodes. So, the measurement result show that the how many order-constraints are satisfied, but this result is get form comparison of ideal distance-based sequence for each location. The numbers of satisfied constraints are maximized from the location. The single localization technique is not provides the best accuracy for all unknown node locations, so this technique includes hybrid localization technique. This technique is switches between the different localization techniques, it depends on (i) RF channel characteristics and (ii) node deployment parameters. So, it provides the better accuracy for any single localization technique.

In this paper [6] author has presented the concept, "Wireless Sensor Network Deployment". This concept solves the problem namely, "Optimal deployment of WSNs", but mainly focus, this term the coverage and energy consumption. In this paper introduce five deployment algorithm for developing the maximal sensing range and minimal energy consumption. These all algorithms are included the capability, it is order to restore the operation in WSN, and then, number of nodes is calculated. In this concept, introduce the centralized optimization algorithm, it is divided in to two types are, (i) Generic Algorithms (GA), (ii) Particle Swarm Optimization (PSO). These two algorithms are used in powerful central nodes that are centroid nodes, then, calculate and include the globally optimized outcomes. The first algorithm is used then it determines the optimal tradeoff between network coverage. And then after find out the overall distance, that is travelled distance by fixed range of sensors.The second approach is to ensure the network coverage and to minimize the mobile energy consumption and the range-adjustable sensors. The remaining three distributed optimization algorithm is to relocate the sensors and network coverage is optimized with better design and cost constraints that is best logical constraints. Finally, it provides the better accuracy for indoor environments. The drawback of this approach is if sometimes using the distributed optimization algorithms to provide the less energy.

In this paper [7] author has presented the topology concept namely, "Sensor Networks-Localization and Topology." This paper exposes the localization but doesn't take the account parameter of distance between SRs (Sensor Networks). Then, the type describes the localization in telemetry. So, the issues of network coverage and network topology are too analyzed. It, firstly give the high importance to network problems. It easily understands the problems, but the network performance is affected. The network is affected by reason of combination of attributes.

In this paper [8] author has presented the concept, "A Fuzzy Set-Based Approach to Range-Free Localization in Wireless Sensor Networks". The WSN using the localization refer to the positions of sensor nodes that is determined, with added the acceptable accuracy, it based on positions of several anchor nodes, that is linked nodes. Use the RSS of plethora of possible localization schemes is based on the range-free localization methods and it is simplicity and low cost. But this approach is including low accuracy. So, this problem is overcome to use the fuzzy set-based localization method. The fuzzy set-based localization method step by step performs the functionality.

First, it uses the fuzzy membership function then it based on RSS measurements. This first step is to generate fuzzy sets of rings. This rings forms the nodes, that is constrains sensor nodes position with anchor. The second step is to generate the fuzzy set of regions. This regions intersects the rings, this rings takes from different ring sets. Then, finally the method apply the functionality then, analyze the weighted centroid methods on this second step generated fuzzy set of regions, it is to localize the node. It is improve the localization accuracy only the presence of radio irregularity. The accuracy is only for the large number of anchors.

In this paper [9] author has presented the concept namely, "The Ins and outs of Distance-Based WSN Localization schemes". Localization is basic problem of WSN and sensor location information is very complex for the data processing and understanding many applications. The GPS (Global Positioning System) is finding out the more locations, but it requires the high cost, so to location estimates is apply the GPS. The GPS cost is estimated is very interesting researched concept of researchers, so it based on to develop the localization protocols and it determines the locations. The cost of location estimate is planned and it focuses the hardware side estimation, that is cheap hardware and wireless intra-network measurements are used in this work to get the better performance.

To select the localization algorithm and it use the WSN, but it critically understands the performance of any algorithm based on take the different network topologies. It uses the different basic algorithm in this paper concept. These algorithms are compared each and every steps and give the final result. Two algorithms are take,

that is DV-Distance and Robust Quadrilateral, then it is compared, it is well-known and generally uses the localization algorithm.

The useful concept of this paper finally uses the five algorithms but these algorithms cannot exist, then it produces the realistic performance. This paper concept use the MDS-MAP algorithms, but it performs only best on the small networks, then, DV-Distance, TSL, and dwMDS performs very poorly on the large networks. The five algorithms are categorized by, (i) centralized, (ii) distributed, (iii) distributed-centralized, (iv) anchor-based, (v) cooperative.

In this paper [10] author has presented the algorithm namely, "wireless sensor network localization based on BAT algorithm". The WSN based more application requires only the each sensor node information about geographical location area. WSN requires the form of devices is expected, then it works on remotely, it is apply in the large number of sensing field, and then to organize self, and sensing and acting task are performed. The aim of the paper concept is to assigns the geographical coordinates for each device, but it included with the unknown position area. In the concept of this paper includes the new approach "optimization algorithm" and apply the approach to solve the localization problem. The BAT algorithm is used in to implements the estimated sensor's positions. It gives the more accuracy. But this algorithm increases the iteration that is number of localized nodes.

In this paper [11] author has presented the localization concept, but it express the "localization of active nodes within distributed ultra-wideband sensor networks in multipath environments". The applications of WSN are used in localization technology, it which refers the term, "positioning or geolocation". The GPS is the traditional geolocation system, but it cannot design for indoor applications, so cannot provide the accurate location estimation of indoor scenarios. So, these two problems are solved by this concept. It use the location and Tracking (LT) system that is, UWB (Ultra-WideBand). It combining the concerning size and the power consumption, and it provides the high precision based on distance estimation, and it allows the simultaneous localization and the data transmission.

The main purpose of this system is investigates and develop practically and then, use the feasible localization algorithm included in distributed UWB sensor networks of the multipath environments. This working methodologies is applied in each step in novel localization and tracking framework. It use the number of procedures are, (i) ranging, (ii) Non Line-Of-Sight (NLOS) identification and mitigation, (iii) location estimation, (iv) range modification, (v) range tracking, (vi) location estimation, (vii) location tracking. The MPCs (MultiPath Components) is main error source of the ranging step, it is based on range-based localization algorithm.

In the paper have three algorithms are used namely, (i) Time Of Arrival (TOA), it estimation algorithm, (ii) Constant False Alarm Rate (CFAR), it based on this alarm rate based method, (iii) Maximum Probability of Detection (MPD), it is based on maximum probability. So, the method is to improve the robustness of range estimators. This range estimator is included in multipath environments and the NLOS situations.

The application of TOA is estimated the location in step by step, and it continued in large position errors it based on NLOS constraints. The approach is differentiates between the nodes in Line-Of-Sight (LOS) and in NLOS positions. But the NLOS identification and mitigation is included by hypothesis testing method. This approach is determines the NLOS channel conditions and it comparing the mean square error of estimated ranges. Finally, produce the result gives the better accuracy. In this technique use the different tracking technique, that is Kalman Filter (KF), it is applied in both location tracking and range tracking. So, this localization framework is evaluates step by step and verified by using the ray-tracing area. This system finally, provides the design for indoor scenario that is recorded by the Multiple Input and Multiple-Output channel sounder system.

In this paper [12] author has presented RSS concept namely, "Modeling and Mitigating Noise and Nuisance Parameters in Received Signal Strength Positioning". This concept solves the problem is RSS based localization problem. Sometimes, RSS holds the weak signal, so this problem is solved by the concept, and is used in to distance and convert operation and to avoid the interference. So, to avoid the background noise and transmitter parameters and environment are known, but it assumes implicitly.

The background noise is measured by RSS models in both types. It also derives and evaluates the Maximum Likelihood Estimators (MLEs). The MLEs is extends and it is to estimate the transmit power and/or loss the path, it is known. The new model is justify the measured data based RSS. It provides more accuracy based on the new model. But, this approach is loss the path and the DRSS is to removes the parameters.

Table 1.0 Comparison table

Paper Number	Techniques	Advantages	Disadvantages
1	lightweight localization techniques	better accuracy	The signal strength is decrease with distance
2	Collaborative location technique	decrease the errors of estimation	increase number of iterations
3	Maximum Likelyhood (ML)	accuracy more than 1.5	cannot guarantee for all conditions
4	RSS localization	high localization accuracy,simple algorithm,low computation complexity	not sensitive
5	single localization, hybrid localization	better accuracy for any single localization method	depends on RF channel characteristics, node deployment parameters
6	Generic,particle swarm optimization, distributed optimization algorithm	better design, better accuracy	less energy
7	localization	easily understands the networks problem	network performance affected
8	plethora of possible localization scheme	simplicity ,low cost	low accuracy
9	centralized, (ii) distributed, (iii) distributed-centralized, (iv) anchor-based, (v) cooperative	produce realistic performance, better accuracy	Sometime performs poorly in large networks
1	BAT technique	more accuracy, implements estimated sensor positions	increase the iterations
1	(i) Time Of Arrival (TOA) (ii) Constant False Alarm Rate (CFAR)	accurate location estimation of indoor scenario	include main error source
1	DRSS	More accuracy	loss the path, remove parameters

The above table 1.0 depicts the working methodologies of various techniques which can be used to solve the localization problem in Wireless Sensor Networks.

III. CONCLUSION

In this paper is uses the new distributed range-free localization algorithm for WSNs. Then, connectivity uses the CRRV algorithm and the RSS rank factor is to localize the unknown node that is form the unknown node use the RSS values. This RSS values are get from neighboring anchors. Many refined techniques are used and filtered the centroid node. This system is to reduce the computational complexity and employed in to the grid-scan approach, obviously. This system improves the CRRV so it makes an improved version of CRRV and it is denoted the adaptive CRRV, it included in to adaptive strategy, then if determines the grid size. It gives the advantages are, (i) good localization, (ii) low computational complexity.

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