Research Paper Engineering

Optimization for Localization in Wireless Sensor Network Using Micro Genetic Algorithm

* Anandakumar. H ** Arunkumar. J
*** Vinothkumar. R **** Yokesh. R

* Assistant Professor, Department of Information Technology, SNS College of Engineering, Coimbatore

** UG Scholar, Department of Information Technology, SNS College of Engineering, Coimbatore.

*** UG Scholar, Department of Information Technology, SNS College of Engineering, Coimbatore.

**** UG Scholar, Department of Information Technology, SNS College of Engineering, Coimbatore.

ABSTRACT

Wireless Sensor Networks (WSN) is used for hunting down targets, environmental supervising, and data collection for factors such as humidity, temperature, and pressure. While these networks are widely used in many applications, their success highly depends on the sensor node positions known as network deployment. Determining the position of sensor nodes is the main objective of deployment network which directly depends on the coverage of the concerned region. To locate sensors, Global Positioning System (GPS) is also used by which sensors know their position. But, this method is not feasible due to economic issues. So, only a small part of the network can affordably be equipped with GPS, and an automatic localization process is required for the rest of the nodes in the network. We estimate random solutions and then apply some technique to find the best feasible solution among all. Classical approach techniques are very efficient in cases where assumptions are fulfilled. In this paper, we are going to use micro genetic algorithm for finding the location of any node which is in the network.

Keywords : Wireless Sensor Networks, Global Positioning System, localization, micro genetic algorithm

1. INTRODUCTION

The primary function of a location estimation method is to calculate the geographic coordinates of network nodes with unknown position in the deployment area. Most applications of wireless sensor networks (WSN) require the correlation of sensor measurements with physical locations, even if the accessible knowledge about positions of nodes is only approximate. Moreover, information about current locations is used in geographical-based routing, data aggregation and various network services. Hence, self-organization and localization capabilities are one of the most important requirements in sensor networks. Both methods have significant defects. Typical WSN usually consists of a large number of sensors that should be densely distributed in a sensing field. The large number of nodes usually precludes manual configuration. Moreover, manually recording and entering positions of each sensor node is impractical and impossible in many applications, in which sensors are distributed randomly in ad hoc fashion, which is cheaper, and in some cases the only possible solutions. Moreover, this method cannot be used in mobile networks where nodes can travel. Another solution is to collect data on the location of sensors by means of GPS devices. This solution can be used in deferent types of networks, including mobile ones. Unfortunately, it is very costly, both due to the price of GPS receivers, and to the increased requirements related to power consumption that may decrease the lifetime of a WSN. Moreover, adding an additional receiver increases the size and weight of the total device (network node).Due to the drawbacks of presented solutions; many automated location systems for assigning geographic coordinates to each node have been developed. All these schemes should work with inexpensive of-the-shelf hardware, minimal energy requirements, scale to large networks, and also achieve good accuracy in the presence of irregularities and give the solution in the short time. Various localization strategies for WSNs have been developed. Position calculation can be conducted using one machine collecting data from the network (base station) or calculations can be distributed. In centralized schemes, data collected in a net-work is transmitted to the central machine that calculates the positions of nodes with unknown location. Distributed algorithms relay only on local measurements – each non-anchor node estimates its position based on data gathered from its neighbors. Our adapted MGA for localization consists of two major genetic operators, namely the descend-based mutation and crossover operators, trying to improve on the objective values of individual chromosomes, with each denoting a position estimation of the current node of interest until the best k chromosomes converged to the same solution or the maximum number of iterations exceeded. To demonstrate the feasibility of our proposal, we implemented a prototype of our adapted MGA, and evaluated the performance of the improved APS integrated with our adapted MGA against that of the improved APS using simulations on the challenging anisotropic networks. When compared to the nonlinear optimizer provided in the Mat lab Optimization Toolbox, our adapted MGA-based optimizer achieved remarkable improvements on both isotropic and anisotropic topologies of our simulation tests, prompting for more detailed analysis in our future investigation. In addition, our proposal of MGA-based post-optimizer is so generic that it can readily be integrated into other heuristic-based on mathematical localization methods.

2. EXISTING SYSTEM

Typical WSN consists of a large number of sensors that should densely exist in a sensing field. The large number of nodes precludes manual configuration.The primary function of a location estimation method is to calculate the geographic coordinates of network nodes with unknown position in the deployment area. Self-organization and localization capabilities are one of the most important requirements in sensor networks. Information on the location of nodes can be obtained in two ways:

– Recording data on the location of nodes during their distribution,
– Fitting nodes with a GPS system.

Position calculation can be conducted using one machine collecting data from the network (base station).Data collected in a network is transmitted to the machine that calculates the positions of nodes within known location. Recently proposed localization techniques consist in identification of approximate location of nodes based on merely partial information on the location of the set of nodes in a sensor network. A network formed by $L = M+N$ sensors; *M*anchornodes and N non-anchor nodes where **anchor node** is a node that is aware of its own location, either through GPS or manual recording and entering position during deployment. N**on-anchor node** is a node that is not aware of its own location in the deployment area the goal of a location system is to estimate coordinate vectors of all N non-anchor nodes.

***Stage 1*:** Inter-node distances estimation based on hop connection information (hop counting) or true physical distance calculation based on inter-node transmissions and measurements.

***Stage 2*:** Transformation of calculated distances into geographic coordinates of nodes forming the network.

- The drawbacks of the existing system are it is very costly, both due to the price of receivers, to the increased requirements related top owner consumption adding an additional receiver increases the size and weight of the total device (network node).
- This method cannot be used in mobile networks where nodes can travel.
- Manually recording and entering positions of each sensor node is impossible and impractical in many applications.

3. LOCATION SYSTEMS USING HEURISTIC TECHNIQUES

Many applications of wireless sensor networks (WSN) require information about the geographic location of each sensor node. Devices that form WSN are expected to be remotely deployed in large numbers in a sensing field, and to self-organize to perform sensing and acting task. The goal of micro genetic localization is to assign geographic coordinates to each device with unknown position in the deployment area. Recently, the popular strategy into apply optimization algorithms to solve the localization problem. In the existing approach they address issues associated with the application of heuristic techniques to accurate localization of nodes in a WSN system. That describes and evaluates the methods that combine trilateration and heuristic optimization In our approach to make the localization very easier we are going to use the micro genetic algorithms. One of the best optimization algorithms is micro genetic algorithm. This algorithm will give estimated optimized locations for the deployment of wireless sensor nodes. In order to develop robust, accurate and scalable location this algorithm has been used.

Module 1: Distance calculation of nodes in the network.

The range-free algorithm uses only connectivity information to locate the entire sensor network. The calculated values are broadcasted into the network, and the inter-node distances expressed in hops are estimated. The range-based algorithm uses absolute point-to-point distance estimates (range) or angle estimates in location calculation. Hence, distance-based methods require the additional equipment but through that we can reach much better resolution than in case of range-free ones. The advantage of this method is low cost (no additional hardware), easy configuration, calibration and deployment. The standard approach is to formulate a localization problem as the optimization task with the nonlinear performance function

$$\min_{\hat{x}} \{ J_N = \sum_{k=1}^{M} \sum_{j \in S_k} (d_{kj} - \hat{d}_{kj})^2 + \sum_{i=1}^{N} \sum_{j \in S_i} (d_{ij} - \hat{d}_{ij})^2 \}, \quad (1)$$

where

$\hat{d}_{kj} = ||a_k - \hat{x}_j||$, $\hat{d}_{ij} = ||\hat{x}_i - \hat{x}_j||$, a_k denotes the real position of the anchor-node k, $\hat{x}_i$ and $\hat{x}_j$ denote, respectively, the estimated positions of nodes i and j, $\tilde{d}_{kj}$ and $\tilde{d}_{ij}$ the estimated distances between pairs of nodes calculated based on measurements, and S_i, S_k sets of neighboring nodes defined as follows:

$S_k = \{(k, j) : ||a_k - x_j|| \le r_k\}$, $j = 1, \ldots, N$

$S_i = \{(i, j) : ||x_i - x_j|| \le r_i\}$, $j = 1, \ldots, N$, (2)

Where x_i and x_j denote real positions of nodes with unknown locations and r_i and r_k their transmission ranges.

Module2: co-ordinates calculation for localization process

The co-ordinates can be calculated using hybrid schemes that use two different schemes TSA and TGA. TSA and TGA methods operate in two phases. In the beginning of the *first phase* all nodes in the network are divided into two sets: $A = \{a1 \ldots aM\}$ containing anchor nodes, and $B = \{x1, \ldots, xN\}$ of nodes with unknown location. Next, iterative multi trilateration is used to determine the relative positions of nodes from the set B based on the known locations of nodes from A, and the estimated distances between pairs of nodes. To determine the relative positions of each non-anchor on a 2D plane using trilateration at least three neighbors with known locations are needed. In every iteration each node from B with estimated position is moved to the auxiliary set C and finally, in next iteration of the algorithm changes its role to anchor and move to A. This phase stops when there are no more nodes from B that can be localized based on the available information about their neighbors. In the *second phase* the optimization problem is formulated, and the SA or GA algorithm is used to solve it. The goal of this phase is to increase the accuracy of the location estimation calculated in the first phase, and estimate the position of nodes that cannot be calculated using iterative multitrilateration.

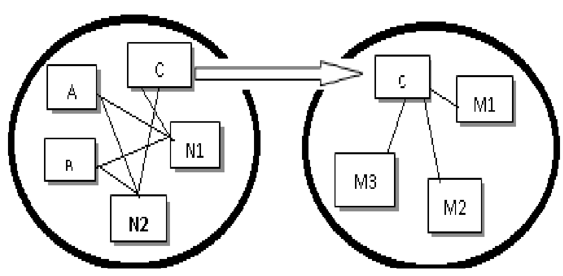

Figure 1: Multilateration System

Nodes A, B and C Have Knowledge of their Positioning Coordinates. Node N1, N2 can then Calculates its Position by Measuring the Distance to Nodes A, B and C.

Module3: Heuristic optimization process

The original MGA is targeted to solve hard CSPs or constrained OPTs involving variables of finite domains. Though with sufficient domain knowledge and carefully designed domain revision techniques, the original MGA should be easily adapted to solve continuous CSPs or constrained OPTs.

4. ALGORITHM BEHIND

The original MGA is targeted to solve hard CSPs or constrained OPTs involving variables of finite domains. Though with sufficient domain knowledge and carefully designed domain revision techniques, the original MGA should be easily adapted to solve continuous CSPs or constrained OPTs. Obviously, it can be difficult to directly use our adapted MGA to independently solve this *generalized* localization problem in wireless sensor networks.

Therefore, we propose in this paper to adapt the original MGA as a "post-optimizer" to be *flexibly* integrated into various localization methods so as to further reduce the overall estimation error of the best estimates returned by the underlying methods. As the first attempt to apply an evolutionary approach toTackle localization in wireless sensor networks, this new proposal has a unique property of being adaptive to any existing localization method. Since we never make any restrictive assumption, like the existence of sufficiently close neighbors in the convex programming approach, about the physical environment of the underlying sensor networks in the generalized formulation of localization problem, on which our adapted MGA are based, this simply implies that our adapted MGA can be integrative to any existing localization method. In a nutshell, the specific assumptions about the background or physical environment of the underlying sensor networks are being made in the relevant localization method but not in our adapted MGA, thus giving much flexibility to our adapted evolutionary approach.

MGA*LOC(Best-Values, PZ, fitness())
construct an initial Population of PZ chromosomes by flipping some values in Best-Values;
repeat
foreach*chromosome cs□ Population*
produceoffspring1 by the descend-based mutation
if*(fitness(cs) >fitness(offspring1))*
replacecswith offspring1
produceoffspring2 by the descend-based crossover
if*(fitness(cs) >fitness(offspring2))*
replacecswith offspring2

endforeach
until*(Population is converged or the resource limit isexceeded)*

5. CONCLUSION
This paper has presented an optimization method for localization in wireless sensor network using heuristic techniques. The proposed method uses micro genetic algorithm and multitrilateration method. We are going to find location of non-anchor nodes (a node that is not aware of its own location) with the help of anchor nodes (a node that is aware of its own location).We are going do it in a distributed network. The location of non-anchor nodes can be found by using information from its neighbor nodes. The micro-genetic algorithm (MGA) is adopted to improve the accuracy of calculated estimates.

REFERENCES

[1] I. F. Akyildiz and M. C. Vuran, Wireless Sensor Networks. WestSussex, UK: Wiley, 2010. | [2] B. D. O. Anderson, G. Mao, and B. Fida, "Wireless sensor network localization techniques", Comput. Netw., vol. 51, no. 10,pp. 2529–2553, 2007. | [3] G. Mao and B. Fidan, Localization Algorithms and Strategies for Wireless Sensor Networks. Information Science Reference, Hershey,USA, 2009. | [4] G. Sarigiannidis, Localization For Ad Hoc Wireless Sensor Networks.Paperback, LL, 2007. | [5] P. Barsocchi, S. Lenzi, S. Chessa, and G. Giuntaa, "Virtual calibration for rssi-based indoor localization with IEEE 802.15.4", in Proc. IEEE Int. Conf. Commun. ICC, Dresden, Germany, 2009,pp. 1–5. | [6] K. Benkic, M. Malajner, P. Planinsic, and Z. Cucej, "Using rssivalue for distance estimation in wireless sensor networks based onzigbee", in Proc. 15th In. Conf. Sys. Sig. Image Proces. IWSSIP2008, Bratislava, Slovakia, 2008, pp. 303–306. |