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Implementation of Mobile Data Localization using Fuzzy Grid Prediction in Wireless Sensor Networks

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ABSTRACT: In WSN, the position information is crucial. When an abnormal event occurs, the sensor node detecting the event needs the position information to locate the abnormal event and report to the base station. Therefore, the position information is usually embedded in the report message generated by the sensor node. Without position information, WSN cannot work properly. In practice, sensor nodes are often deployed by random bestrewing (airplane bestrewing for example). And for the high-cost, only a few nodes are equipped with Global Positioning System (GPS) which can capture their position after being bestrewed. All the other nodes cannot acquire such information. Therefore how to obtain the position information of unknown nodes, which is called localization problem, Recently, many localization algorithms for sensor networks have been proposed. Most of them suppose that the network includes a small number of anchor nodes, which know their own positions beforehand by either using GPS or being manually configured. The other nodes, called unknown nodes, don't know their own position. The anchors can assist the unknowns to locate themselves. When an unknown node knows more than three anchor nodes' position information, it can use triangulation method to figure out its location. These algorithms can obtain good results in theory. However, the results become poor when they are used in practical applications. This project is developed by using Visual studio Dotnet as front end..

KEYWORDS: Node localization, mobility, fuzzy logic, RSSI, WSN

I. INTRODUCTION

Node Localization problem in mobile sensor networks has received significant attention. Recently, particle filters adapted from robotics have produced good localization accuracies in conventional settings. In spite of these successes, state of the art solutions suffer significantly when used in challenging indoor and mobile environments characterized by a high degree of radio signal irregularity.

New solutions are needed to address these challenges. We propose a fuzzy logic-based approach for mobile node localization in challenging environments. Localization is formulated as a fuzzy multi-lateration problem. For sparse networks with few available anchors, we propose a fuzzy grid-prediction scheme. The fuzzy logic-based localization scheme is implemented in a simulator and compared to state of the art solutions. Extensive simulation results demonstrate improvements in the localization accuracy from 20% to 40% when the radio irregularity is high.

II. MOTIVATION

Most of the proposed localization solutions have low accuracy in obstructed environments. This is due to the existence of obstacles, which obstruct the line-of-sight between nodes (for instance, some nodes may not be able to see

anchor nodes which make localization unfeasible). Obstacles and terrain irregularities can also cause signal reflections, what leads to wrong distance estimations. This problem exists either in indoor or outdoor environments. Hence, localization algorithms must be able to cope with it. Most localization solutions achieve good results in uniformly distributed WSNs. Conversely, only some solutions allow a good performance in irregular networks. For example in applications such as military based rescue such as battle field surveillance and in some cases where the nodes are thrown into a forest territory from helicopters.

III. RELATED STUDY

1) Deploying a wireless sensor network on an active volcano

Authors: Konrad Lorincz , Matt Welsh , Omar Marcillo , Jeff Johnson , Mario Ruiz , Jonathan Lees, March-April 2006.

Augmenting heavy and power-hungry data collection equipment with lighter, smaller wireless sensor network nodes leads to faster, larger deployments. Arrays comprising dozens of wireless sensor nodes are now possible, allowing scientific studies that aren't feasible with traditional instrumentation. Designing sensor networks to support volcanic studies requires addressing the high data rates and high data fidelity these studies demand. The authors' sensor-network application for volcanic data collection relies on triggered event detection and reliable data retrieval to meet bandwidth and data-quality demands. Wireless sensor networks — in which numerous resource-limited nodes are linked via low-bandwidth wireless radios — have been the focus of intense research during the past few years. Since their conception, they've excited a range of scientific communities because of their potential to facilitate data acquisition and scientific studies. Collaborations between computer scientists and other domain scientists have produced networks that can record data at a scale and resolution not previously possible. Taking this progress one step further, wireless sensor networks can potentially advance the pursuit of geophysical studies of volcanic activity. Two years ago, our team of computer scientists at Harvard University began collaborating with volcanologists at the University of North Carolina, the University of New Hampshire, and the Institution..

2) Distressnet: a wireless ad hoc and sensor network architecture for situation management in disaster response

Authors: George, S.M. Texas A&M Univ., College Station, TX, USA Wei Zhou ; Chenji, H. ; Myounggyu Won ; Yong Oh Lee ; Pazarloglou, A. ; Stoleru, R. ; Barooah, P. March 2010.

Situational awareness in a disaster is critical to effective response. Disaster responders require timely delivery of high volumes of accurate data to make correct decisions. To meet these needs, we present DistressNet, an ad hoc wireless architecture that supports disaster response with distributed collaborative sensing, topology-aware routing using a multichannel protocol, and accurate resource localization. Sensing suites use collaborative and distributed mechanisms to optimize data collection and minimize total energy use. Message delivery is aided by novel topology management, while congestion is minimized through the use of mediated multichannel radio protocols. Estimation techniques improve localization accuracy in difficult environments.

3) VigilNet: an integrated sensor network system for energy-efficient surveillance

Authors: ian He , Sudha Krishnamurthy , Liqian Luo , Ting Yan , Lin Gu , Radu Stoleru , Gang Zhou , Qing Cao , Pascal Vicaire , John A. Stankovic , Tarek F. Abdelzaher , Jonathan Hui , Bruce Krogh , Tianhe@cs. Umn. Edu S. Krishnamurthy , Liqian Luo , T. Yan , L. Gu , R. Stoleru , G. Zhou , Qing Cao April 2006.

This article describes one of the major efforts in the sensor network community to build an integrated sensor network system for surveillance missions. The focus of this effort is to acquire and verify information about enemy capabilities and positions of hostile targets. Such missions often involve a high element of risk for human personnel and require a high degree of stealthiness. Hence, the ability to deploy unmanned surveillance missions, by using wireless sensor networks, is of great practical importance for the military. Because of the energy constraints of sensor devices, such systems necessitate an energy-aware design to ensure the longevity of surveillance missions. Solutions proposed recently for this type of system show promising results through simulations. However, the simplified assumptions they make about the system in the simulator often do not hold well in practice, and energy consumption is narrowly

accounted for within a single protocol. In this article, we describe the design and implementation of a complete running system, called VigilNet, for energyefficient surveillance. The VigilNet allows a group of cooperating sensor devices to detect and track the positions of moving vehicles in an energy-efficient and stealthy manner. We evaluate VigilNet middleware components and integrated system extensively on a network of 70 MICA2 motes. Our results show that our surveillance strategy is adaptable and achieves a significant extension of

4) Efficient geo-tracking and adaptive routing of mobile assets

Authors: Balakrishnan, D. SITE, Univ. of Ottawa, Ottawa, ON, Canada Nayak, A. ; Dhar, P. ; Kaul, S. 2009

The recent advancements in technologies such as cellular networks, wireless sensor networks (WSN), radio-frequency identification (RFID), and global positioning system (GPS) have lead us to develop a realistic approach to tracking mobile assets. Tracking and managing the dynamic location of mobile assets is critical for many organizations with mobile resources. Current tracking systems are costly and inefficient over wireless data transmission systems where cost is based on the rate of data being sent. Thus our main research goal is to develop efficient and improved asset tracking solutions and consume valuable mobile resources. In addition, we also adapt their routes by means of a novel and efficient geographical tracking approach that performs route adaptation. We focus on tracking GPS-enabled mobile devices mounted on the asset by understanding the behavior of a mobile device for reporting GPS data in various demographics. This paper is complemented with result evaluations based on a simulation environment with real logs.

5) GPSfree node localization in mobile wireless sensor networks

Authors: Hüseyin Akcan Polytechnic University Vassil Kriakov Polytechnic University Hervé Brönnimann Polytechnic University Alex Delis, June 2010

An important problem in mobile ad-hoc wireless sensor networks is the localization of individual nodes, i.e., each node's awareness of its position relative to the network. In this paper, we introduce a variant of this problem (directional localization) where each node must be aware of both its position and orientation relative to the network. This variant is especially relevant for the applications in which mobile nodes in a sensor network are required to move in a collaborative manner. Using global positioning systems for localization in large scale sensor networks is not cost effective and may be impractical in enclosed spaces. On the other hand, a set of pre-existing anchors with globally known positions may not always be available. To address these issues, in this work we propose an algorithm for directional node localization based on relative motion of neighboring nodes in an ad-hoc sensor network without an infrastructure of global positioning systems (GPS), anchor points, or even mobile seeds with known locations. Through simulation studies, we demonstrate that our algorithm scales well for large numbers of nodes and provides convergent localization over time, even with errors introduced by motion actuators and distance measurements. Furthermore, based on our localization algorithm, we introduce mechanisms to preserve network formation during directed mobility in mobile sensor networks. Our simulations confirm that, in a number of realistic scenarios, our algorithm provides for a mobile sensor network that is stable over time irrespective of speed, while using only constant storage per neighbor.

IV. METHODOLOGY

EXISTING SYSTEM

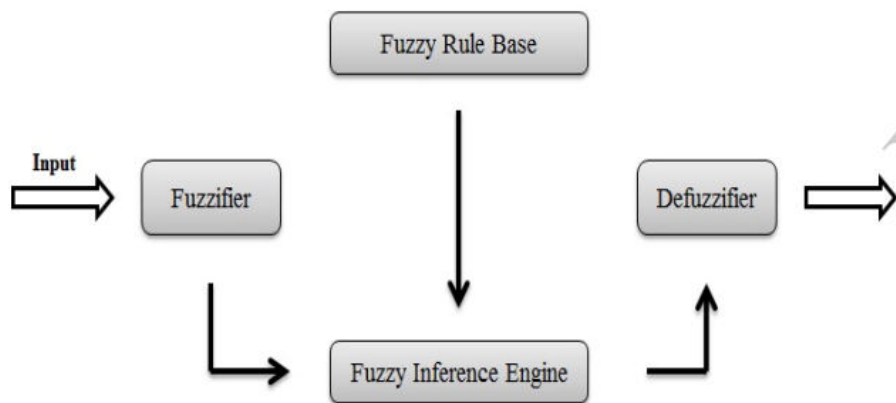
Range-based localization methods require an estimate of the distance or angle between two nodes to localize and may operate in both absolute and relative coordinate systems.

Range-free localization methods are typically used in systems where connectivity is the metric of choice and actual geographic distance is less important. Hop counting is a technique frequently used in these scenarios, where the distance between two nodes is inferred from the number of hops a packet takes and is based on some assumed or measured average hop length.

PROPOSED SYSTEM

Empirical measurements are made between participating anchors in predictable encounters. These measurements are analyzed to produce rules that are used by the fuzzy inference systems, which interpret RSS input from unlocalized nodes and other anchors. The output of this process recovers the actual distance, compensated for variability in the local environment. This basic technique is employed in two constituent subsystems of FUZLOC – the Fuzzy Multilateration System (FMS) and the Fuzzy Grid Prediction System (FGPS).

Fig.2 Proposed Flow Diagram



V. RESULTS AND DISCUSSIONS

MODULE DESCRIPTION

- A fuzzy logic-based node localization framework module
- Fuzzy multilateration module
- Fuzzy inference module
- System implementation validation module

A Fuzzy Logic-Based Node Localization Framework Module

In this module, we develop a scenario with highly irregular radio ranges, typical of harsh indoor or extremely obstructed outdoor environments. The irregularity in the radio range is modeled in these simulators as a degree of irregularity (DoI) parameter. The DoI represents the maximum radio range variation per unit degree change in direction. We define a harsh environment as one in which the distance between sender and receiver cannot be accurately determined from the RSS alone, due to environmental phenomena such as multipath propagation and interference

For more complete problem formulation we mention that the aforementioned localization techniques assume that given a set of mobile sensor nodes, a subset of nodes, called anchors, know their location in a 2-dimensional plane. Also, nodes and anchors move randomly in the deployment area. Maximum velocity of a node is bounded but the actual velocity is unknown to nodes or anchors. Nodes do not have any knowledge of the mobility model. Anchors periodically broadcast their locations. All nodes are deployed in a noisy, harsh environment and they do not have any additional sensors except their radios.

Fuzzy Multilateration Module:

We present fuzzy multilateration, a component of our fuzzy inference process, which obtains a node's location from noisy RSS measurements, using fuzzy rule sets.

Fuzzy Inference Module

We present a fuzzy grid prediction scheme, which optimizes our fuzzy inference process, under conditions of low anchor density. However, in mobile sensor networks with low anchor densities, it might frequently be the case that a node does not have enough anchors for multilateration. To address this problem we extend our fuzzy logic-based localization framework to predict an area, e.g., a cell in a grid, where the node might be. The idea is inspired from cellular systems [21]. We propose to virtualize the anchors, so that a node is within a set of Virtual Anchors at any point in time. A Virtual Anchor is a fictitious anchor which is assumed to be located at a known, fixed location in the field of deployment, the distance to which can be found in an approximate way from the node. In FUZLOC, we place virtual anchors at the center of every square cell that the field is divided into, as described below. The key idea is that the nearer a node is to a virtual anchor, the more likely it is that the node can be found in that cell.

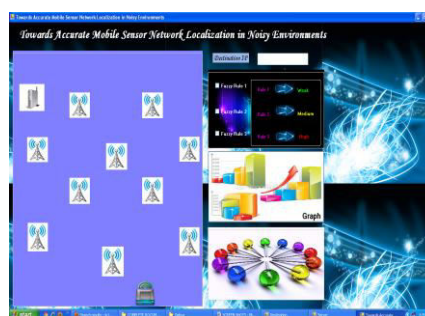
System Implementation Validation Module

We perform extensive simulations and compare our solution with to state of the art algorithms, using both real-world and synthetic data.

SERVER FORM



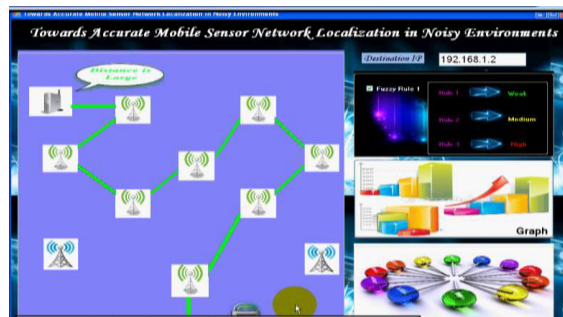
ROUTER FORM



DESTINATION FORM



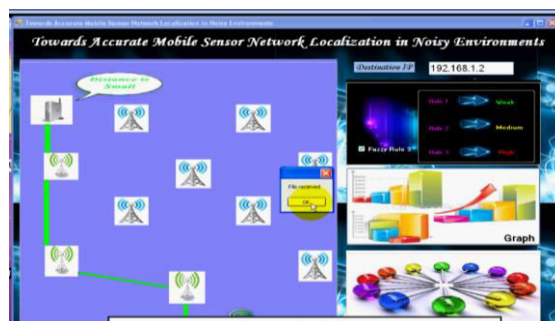
ROUTER IP ADDRESS FORM



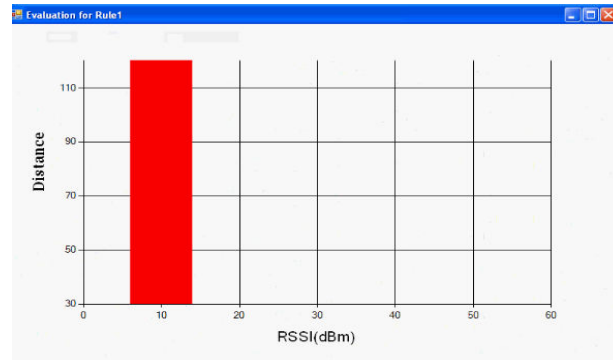
FUZZY RULE1 RUNNING FORM



FUZZY RULE3 RUNNING FORM



Graph



VI. CONCLUSION

We have proposed a fuzzy logic based restriction system suitable for remote sensor hubs that are portable in uproarious, savage situations. The constituent frameworks use fuzzy multilateration and a grid prediction to process the area of a hub as a zone. The Rss is thrown into bins which encode the imprecision. These bins are in this manner utilized within the scientific schema. We comment here that the instance of static stays, acknowledged by MCL, will be examined in future work. Our system has been assessed dependent upon a mixture of measurements. They demonstrate that our strategy is impervious to high DOI situations while giving a low confinement lapse without any additional fittings. Only anchor need to have a somewhat higher space prerequisite. An organization with additional anchor at high DOI diminishes the mistake. The capability to limit utilizing both single-hop and two-hop stays incredibly builds the assortment of topologies where limitation succeeds. The framework usage demonstrates that the calculation capacities well.

VII. FUTURE ENHANCEMENT

- This project can be done better if any other techniques have been proposed in future generations.
- This project done with detailed analysis of existing system and a careful design. So that future modification can be done in efficient manner with minimum disturbance to the system.
- The system is very flexible and user friendly.
- Future enhancement can be made with fewer efforts in the process of development. Since the requirements may increased in future, the system can be easily modified accordingly as the system has been modularized.
- The system is developed in such a way that any future development can be included.

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