

Design & Implementation Of An Algorithm For Proximity Estimation In Sensor Network

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Abstract

Sensor networks are often used to perform monitoring tasks, such as in animal or vehicle tracking and in surveillance of enemy forces in military applications. In this project we will introduce the concept of proximity queries that allow us to report interesting events that are observed by nodes in the network that are within certain distance of each other. An event is triggered when a user programmable predicate is satisfied on a sensor node. To study the problem of computing proximity queries in sensor networks using existing communication protocols and then propose an efficient Algorithm that can process multiple proximity queries, involving several different event types. This project gives solution utilizes a distributed routing index, maintained by the nodes in the network that is dynamically updated as new observations are obtained by the nodes. This project presents an extensive experimental study to show the benefits of this techniques under different scenarios.

Keywords:—position estimation, wireless sensors network, decentralized algorithm, position-based routing, location identification

I. INTRODUCTION

Sensor networks are used in a variety of monitoring tasks. This survey will be study of new decentralized algorithms for the detection of events that are observed by nodes within certain distance of each other, i.e. events that are reported by sensor nodes in spatial proximity. An event is triggered when a user-programmable predicate is satisfied on a sensor node. The definition allows different types of events, depending on the sensing capabilities of the nodes in the network and on the application. For instance, in an application where nodes are used for collecting meteorological data, an event may be defined for when the temperature readings on a sensor exceed a certain threshold. Another type of event, in the same application may be defined when temperature readings fall below another, lower value. When both events are detected, each by a different node and these two nodes are in proximity, this may

indicate an abrupt, abnormal shift in temperature in the terrain. In a military Surveillance application, events may be used to detect the movement of friendly and enemy forces. Proximity alerts then may be used for the early warning of approaching enemy forces. In another application of wild animal tracking, we may want to raise an alert when a predator is spotted in an area occupied by a flock that observe, assuming that the presence of each animal can be detected by the use of RFID technology. Sensor networks consist of wireless, battery-powered sensing devices, have introduce new challenges in data management and have spawn several recent proposals for embedded database systems, such as COUGAR and TinyDB. Most of the proposed techniques explore in network processing to carefully synchronize the operation of the nodes and utilize the, Multi-hop communication links to leverage the computation of expensive queries, such as those involving aggregation. Continuous monitoring queries and distributed join algorithms have also been considered. Alternative methods try to reduce the cost of data processing in sensor networks through probabilistic techniques, data modelling or through the use of decentralized algorithm. In this project algorithms will fall in the latter category. Application of existing methods for computing set-expressions in data streams in the evaluation of proximity queries is an open research question due to the different settings and cost considerations. Most of these fundamental techniques have been devised to support event-based monitoring applications. For example, in animal tracking, an event such as the presence of an animal can be determined by matching the sensor readings to stored patterns. This project proposes an event detection mechanism based on matching the contour maps of in-network sensory data distributions. In kernel-based techniques are used to detect abnormal behaviour in sensor readings. Since most applications depend on a successful localization, i.e. to compute their positions in some fixed coordinate system, it is of great importance to design efficient localization algorithms. It can also be used in hospital environments to keep track of equipments, patients, doctors and nurses. For these advantages precise knowledge of node localization in ad hoc sensor networks is an active field of research in

wireless networking. Recent advances in wireless sensor network (WSN) technology have enabled deployment of sensor networks in numerous applications, ranging from medical and environmental monitoring to detection and tracking of intruders. Localisation of sensor nodes of a wireless sensor network is an essential prerequisite for its successful operation. However, localisation in WSNs is often constrained by the low cost, low energy and conjugation requirements. Thus, it is unreasonable to expect that every sensor node can be equipped with a GPS receiver (a GPS receiver is large, heavy and expensive, as opposed to a sensor node which is supposed to be small, light and cheap). While there are many algorithms for node localisation reported in the literature this project focus on range-free, a cost-effective alternative to the more expensive range based methods. In range-based systems, every sensor node requires hardware that can deduce the distance between the sensors. While this information improves localisation accuracy. Range-free systems, on the other hand, use only the connectivity or proximity information to localise themselves. The assumption is that (small) subsets of sensor nodes, called anchors, know their exact position within some global coordinate system. The anchors broadcast their position and this information is received by sensor nodes that are within their respective communication range.

II. LITERATURE REVIEW

Miloš Jevtic, Nikola Zogovic, (2009) done wireless sensor network (WSN) simulator surveys. They examine four WSN simulators: ns-2, Castalia (OMNeT++ based), TOSSIM, and COOJA/MSPSim, and define a set of criteria to evaluate and compare the simulators. They provide short descriptions of simulators and tabular comparison based on the criteria. Since none of the simulators under survey is a universal solution, rough guidelines on which simulator to use in particular situation's Sanjiv Rao and V Vallikumari, (2012) published, the recent advances in electronics and wireless communication technologies have enabled the development of large-scale wireless sensor networks that consist of many low-powers, low-cost and small size sensor nodes. Sensor networks hold the promise of facilitating large-scale and real time data processing in complex environments. Some of the application areas are health, military, and home. In military, for example, the rapid deployment, self-organization, and fault tolerance characteristics of sensor networks make them a very promising technique, for military command, control, communications, computing, and the targeting systems. Deployment of nodes in Wireless Sensor Networks (WSNs) is a basic issue to be addressed as it can influence the performance metrics of WSNs connectivity, resilience and storage

requirements. Many deployment schemes have been proposed for wireless sensor networks. In this paper we consider the implications of various deployment schemes for the connectivity and resilience of the WSNs. Our approach to deal with the affective trade-offs between resilience, connectivity and storage requirements for each deployment schemes in the literature, we survey four deployment models random, grid, group and grid-group to show which deployment scheme can be used to increase network connectivity, without increasing storage requirements or sacrificing resilience with respect to some factor. Their contribution is to be implemented of WSNs using random, grid and grid-group deployment Knowledge. WSNs have been simulated with Network Simulator 2.34 for node configuration, sink node configuration, topology creation, with sensing capabilities, temperature and energy by using Mannasim.Khalid K. Almuzaini (2010) presented Node localization is an essential component of many wireless networks. It can be used to improve routing and enhance the security of a network. Localization can be divided into range free and range-based algorithms. Range-based algorithms use measurements such as ToA, TDoA, RSS, and AoA to estimate the distance between two nodes. Range-free algorithms are based on proximity sensing between nodes. Although this is typically less accurate than range-based, it is cheaper and easier to implement. A new range-free scheme is proposed. Every target forms two sets of anchors. The first set contains one-hop anchors from the target. The second set contains two-hop and three-hop anchors away from the target. Each target uses the intersections between these anchors to estimate its position. This new approach is simple, but is more accurate than DRLS when the anchor ratio is low. Cuong Pham Duc A. Tran (2011) Designed data-centric sensor networks, sensor data is not necessarily forwarded to a central sink for storage; instead, the nodes themselves serve as distributed in-network storage, collectively storing sensor data and waiting to answer user queries. A key problem in designing such a network is how to map data and queries to their corresponding rendezvous nodes so that a query can find its matching data quickly and efficiently. Existing techniques are mostly aimed to address a certain type of queries. The capability to support queries of any type is desirable, yet remains a challenge. We propose search efficient architecture for data-centric sensor networks that can simultaneously address range queries and top-k, the two most popular query types. Importantly, the proposed technique does not require location information, hence applicable to a wide range of sensor networks. Our theoretical findings are complemented by a simulation-based evaluation. Razia Haider, Dr. Muhammad Younus Javed, Naveed S. Khattak (2008) they had invented

routing in sensor networks is a challenging issue due to inherent constraints such as energy, memory and CPU processing capabilities. The energy efficiency is one of the key concerns in sensor networks for their better performance, as sensor nodes are limited in their battery power. In this research work, different routing algorithms have been studied and the main focus was on geographic routing in sensor networks. A location based protocol EAGR (Energy Aware Greedy Routing) has been presented for sensor networks to extend the lifetime of the network and to get higher data delivery rate and to balance the energy consumption of nodes. In EAGR, each node makes the local decision to choose its next hop. This algorithm works on forwarding rule based on location and energy levels of nodes. Each node knows its own geographic location and its energy levels and the location and energy level of its Neighbours. The transmitting node writes the geographic position of destination into the packet header and forwards it to the destination by establishing the sub-destinations. The sub-destination nodes must be alive and geographically near to the destination node to route the packet by choosing the shortest and reliable path. Simulation has been made by using OMNET++. Simulation results show that the proposed algorithm gives better performance in terms of higher data delivery rate and less number of dead nodes. It has been noted that the ratio of successful packet delivery will increase in EAGR as number of nodes increased in the network. Consequently, the proposed algorithm can scale to thousands of nodes in future sensor networks and can effectively increase the lifetime of the sensor networks. Jaehun Lee, Wooing Chung, and Euntai Kim (2009) proposed an efficient range-free localization algorithm based on shortest path information. The proposed method is a kind of range-free localization algorithm which only uses the proximity information between sensor nodes. In the proposed method, an efficient distance vector based on shortest path information is proposed. The proposed method is applied to various kinds of network topologies. The simulation results demonstrate that the proposed method shows excellent and robust location estimation results. Miloš Jevtic, Nikola Zogovic, (2009) they examined four WSN simulators: ns-2, Castalia (OMNeT++ based), TOSSIM, and COOJA/MSPSim, and define a set of criteria to evaluate and compare the simulators. They provided short descriptions of simulators and tabular comparison based on the criteria. Since none of the simulators under survey is a universal solution, rough guidelines on which simulator to use in particular situation. Amitangshu Pal (2010) Publishesh that recent advances in radio and embedded systems have enabled the proliferation of wireless sensor networks. Wireless sensor networks

are tremendously being used in different environments to perform various monitoring tasks such as search, rescue, disaster relief, target tracking and a number of tasks in smart environments. In many such tasks, node localization is inherently one of the system parameters. Node localization is required to report the origin of events, assist group querying of sensors, routing and to answer questions on the network coverage. So, one of the fundamental challenges in wireless sensor network is node localization. This paper reviews different approaches of node localization discovery in wireless sensor networks. The overview of the schemes proposed by different scholars for the improvement of localization in wireless sensor networks is also presented. Future research directions and challenges for improving node localization in wireless sensor networks. Vaidyanathan Ramadurai, Mihail L. Sichitiu (2009) considered a probabilistic approach to the problem of localization in wireless sensor networks and propose a distributed algorithm that helps unknown nodes to determine confident position estimates. The proposed algorithm is RF based, robust to range measurement inaccuracies and can be tailored to varying environmental conditions. The proposed position estimation algorithm considers the errors and inaccuracies usually found in RF signal strength measurements. They also evaluate and validate the algorithm with an experimental testbed. The test bed results indicate that the actual position of nodes are well bounded by the position estimates obtained despite ranging inaccuracies.

Jin Zhu and Symeon Papavassiliou, (2006) published that due to hardware, energy, cost and other physical constraints, sensor-based networks present various design, implementation and deployment challenges. In this letter an analytical model to estimate and evaluate the node and network lifetime in a randomly deployed multi-hop sensor network is presented. Based on this, we provide a procedure for the creation of an energy efficient sensor network organization, that attempts to extend the lifetime of the communication critical nodes, and as a result the overall network's operation lifetime. Umair Sadiq, Mohan Kumar (2011) published a series of opportunistic contacts in space and time among devices carried by mobile users, can be utilized to forward messages from one user to another in the absence of an end-to end connected path. Existing routing metrics exhibit efficient performance in either homogeneous (users have similar mobility characteristics) or specific heterogeneous (users exhibit varied mobility characteristics) scenarios. However, in practice, behaviour of users changes at different locations and times, making it hard to generalize any one routing algorithm. The adaptive forwarding scheme,

ProxiMol, proposed leverages two simple facts - some users have better likelihood of message delivery due to higher mobility, while others do due to their location's proximity to destination. Key contributions of ProxiMol include: i) a model to infer user's location over time from its diffusion (a measure of mobility); ii) an analytical result to estimate distance between users; and iii) an empirical method to estimate diffusion of a user. These are used to compute the likelihood of delivery taking into account both the mobility of a user and her proximity to destination. In addition to this robust forwarding scheme, a novel concept of disconnected distance that captures partial paths in networks with moderate levels of connectivity is introduced. ProxiMol improves delivery ratios (10-20%) and reduces delays by up to 50%, when compared against previously proposed algorithms, in user environments that range from relatively homogeneous to highly heterogeneous settings. Jaehun Lee, Wooyong Chung, Euntai Kim and In Wha Hong , (2010) proposed a novel localization algorithm in Wireless Sensor Network. The proposed method is a kind of range-free localization algorithm which only uses the proximity information between sensor nodes. In the proposed method, a robust weighted algorithm is presented to calculate the average hop distances between sensor nodes and anchor nodes. The proposed method is applied to an isotropic network and three anisotropic networks. The simulation results demonstrate that the proposed method shows excellent and robust location estimation results Satoshi Kurihara , (2010) described a method for accurately estimating the topology of sensor networks from time-series data collected from infrared proximity sensors. Our method is a hybrid combining two different methodologies: ant colony optimization (ACO), which is an evolutionary computation algorithm; and an adjacency score, which is a novel statistical measure based on heuristic knowledge. We show that, using actual data gathered from a real-world environment, our method can estimate a sensor network topology whose accuracy is approximately 95% in our environment. This is an acceptable result for real-world sensor network applications. Qiang Le (2009) presented the maximum likelihood localization (ML) algorithm for multi-target localization using proximity-based sensor networks. Proximity sensors simply report a single binary value indicating whether or not a target is near. The ML approach requires a hill climbing algorithm to find the peak, and its ability to find the global peak is determined by the initial estimates for the target locations. This paper investigates three methods to initialize the ML algorithm:

1) centroid of k-means clustering, 2) centroid of clique clustering, and 3) peak in the 1-target likelihood surface.

To provide a performance bound for the initialization methods, the paper also considers the ground truth target positions as initial estimates. Simulations compare the ability of these methods to resolve and localize two targets. The simulations demonstrate that the clique clustering technique outperforms k-means clustering and is nearly as effective as the 1-target likelihood peak methods at a fraction of the computational cost.

III. CURRENT STUDY

- This project will be introducing the concept of proximity queries in sensor networks. It captures a large number of interesting queries that may be used in a variety of monitoring applications in sensor networks.
- This project will propose the use of a distributed routing index for capturing the spatial distribution of interesting types of events in the sensor network. This routing index requires minimal resources at each node and is being updated dynamically, when the nodes collaborate to provide answers to proximity queries.
- This project will provide a detailed experimental evaluation where study the effect of various parameters in the accuracy of the algorithms. This will results demonstrate that techniques are very robust and can accurately process a variety of proximity queries, while substantially reducing the number of messages exchanged in the network.

IV. PLATFORM USE

Mannasim is a Wireless Sensor Networks simulation environment comprised of two solutions:

- the Mannasim Framework;
- the Script Generator Tool.

The Mannasim Framework is a module for WSN simulation based on the Network Simulator (NS-2). Mannasim extends NS-2 introducing new modules for design, development and analysis of different WSN applications. The Script Generator Tool (SGT) is a front-end for TCL simulation scripts easy creation. SGT comes blunded with Mannasim Framework and it's written in pure Java making it plataform independent.

V. MANNASIM OBJECTIVES

Mannasim goal is to develop a detailed simulation framework, which can accurately model different sensor nodes and applications while providing a versatile testbed for algorithms and protocols.

Numerous challenges make the study of real deployed sensor networks very difficult and financially infeasible. At the current stage of the technology, a practical way to study WSNs is

through simulations that can provide a meaningful perspective of the behavior and performance of various algorithms

Configuring Access Points

To create an access point (AP) the first thing it to set node-config structure. This is a ns-2 structure used to define a bunch of mobile node parameters. In Mannasim context the only difference from the traditional settings is the inclusion of -sensorNode ON command. With this command whenever an instance of a mobile node is instantiated a wireless sensor node is automatically created. The box bellow shows a sample configuration (note the use of val() vector).

```
$ns_ node-config -sensorNode ON
      -adhocRouting $val(rp)
        -adhocRouting $val(rp)
        -llType $val(ll)
        -macType $val(mac)
        -ifqType $val(ifq)
        -ifqLen $val(ifqlen)
        -antType $val(ant)
        -propType $val(prop)
        -energyModel $val(en)
```

On demand networks require that the AP or other outsider send requests messages to the WSN. These messages specify the situation when the network should provide data to the requester.

To create a request message to be send by the AP the following parameters should be set:

- When requested data should be sent back to AP (for example, send data when temperature exceeds 25 celcius degrees).
- request type - two values are possible: REAL (0) when sensor node drops all data all data from its buffer, gather new one, process and deliver it to the disseminating module. BUFFER (1) when sensor node process data from its buffer and give the results to the disseminating module. The sample code provided bellow defines the request time, schedules when data structure that encapsulates request data is created and when request message will be sent.

VI. CONFIGURING CLUSTER HEADS

The Cluster Head (CH) configuration is similar to what was made for the Access Point. The CH however, can execute data sensing and processing so its configuration is a bit more complex (as the sensor nodes executes more different tasks more configuration adjustments should be made). To create a sensor node just put in the tradicional node-config structure the -sensorNode ON command. Just like it was made in the AP configuration. Continuing CH configuration, the user should set a node field to represent the sensor node just defined, create a tansport protocol (again an UDP transport protocol is used in the example presented in the box bellow), a sensor node application (as expected a

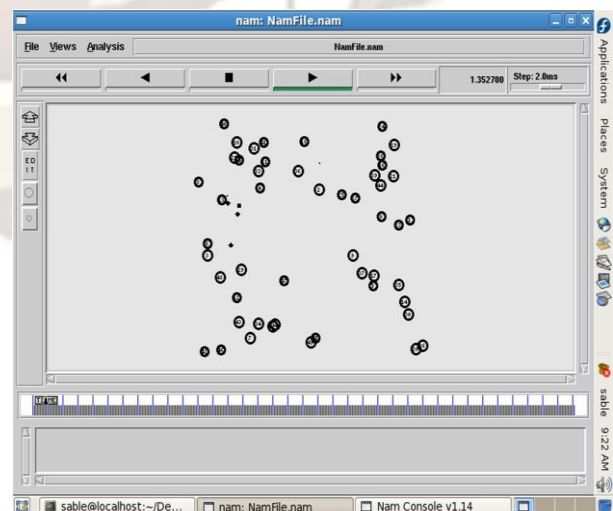
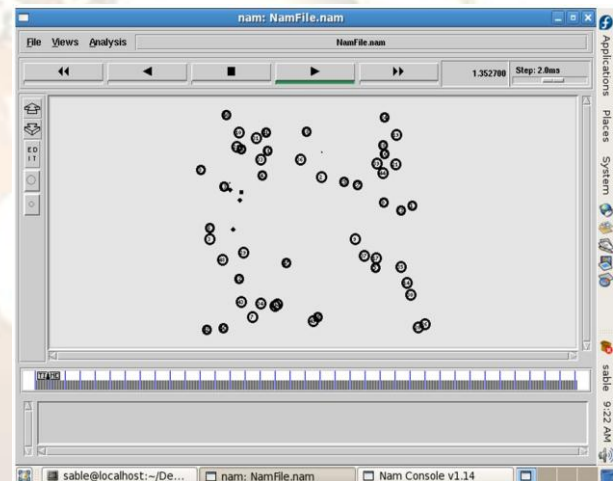
ClusterHeadApp) and an instance of a processing module.

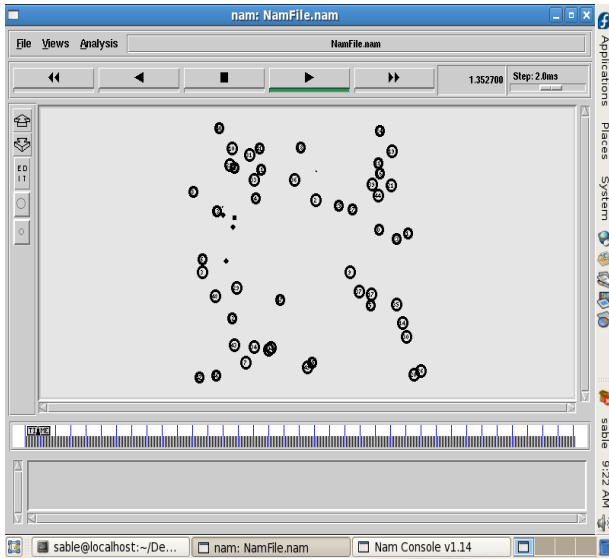
VII. CONFIGURING COMMON NODE

The Common Node (CN) configuration presents the greater number of parameter to be set. Since a CN has an application, a processing module and a data generation module used to simulate sensing tasks.

Sensor node creation is equal to Access Point node creation. Just put in the tradicional node-config structure the -sensorNode ON command.

Next step is to create common node functionality modules including a transport protocol, an sensor application, a processing and a data generator. The data generator module is the difference between a Cluster Head and a Common Node configuration. In the example box presented bellow an UDP transport protocol, an Aggregate Processing processing module, a TemperatureDataGenerator data generator module and a CommonNodeApplication application module were used.





VIII. RESULTS

Nodes in the proximity of 0

10

Nodes in the proximity of 1

9

28

29

32

48

Nodes in the proximity of 2

7

18

38

49

Nodes in the proximity of 3

29

42

Nodes in the proximity of 4

Nodes in the proximity of 5

24

38

40

Nodes in the proximity of 6

17

23

Nodes in the proximity of 7

2

14

46

Nodes in the proximity of 8

23

26

Nodes in the proximity of 9

1

22

Nodes in the proximity of 10

0

36

42

Nodes in the proximity of 11

18

Nodes in the proximity of 12

15

23

Nodes in the proximity of 13

18

29

43

Nodes in the proximity of 14

7

36

Nodes in the proximity of 15

12

21

45

Nodes in the proximity of 16

49

Nodes in the proximity of 17

6

40

Nodes in the proximity of 18

2

11

13

43

Nodes in the proximity of 19

34

46

Nodes in the proximity of 20

40

Nodes in the proximity of 21

15

44

46

48

Nodes in the proximity of 22

9

27

Nodes in the proximity of 23

6

8

12

Nodes in the proximity of 24

5

33

Nodes in the proximity of 25

34

Nodes in the proximity of 26

8

33Nodes in the proximity of 27

22

Nodes in the proximity of 28

1

Nodes in the proximity of 29

1

3

13

34

Nodes in the proximity of 30
45

Nodes in the proximity of 31
Nodes in the proximity of 32

1

Nodes in the proximity of 33
24

26

Nodes in the proximity of 34
19

25

29

Nodes in the proximity of 35

Nodes in the proximity of 36
10

14

Nodes in the proximity of 37

Nodes in the proximity of 38

2

5

Nodes in the proximity of 39

Nodes in the proximity of 40

5

17

20

Nodes in the proximity of 41

Nodes in the proximity of 42

3

10

Nodes in the proximity of 43

13

18

Nodes in the proximity of 44

21

Nodes in the proximity of 45

15

30

Nodes in the proximity of 46

7

19

21

Nodes in the proximity of 47

Nodes in the proximity of 48

1

21

Nodes in the proximity of 49

2

16

Proximity TCP ACK Event estimated

minimal resources at each node and is being updated dynamically,

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IX. CONCLUSION & FUTURE WORK

This survey will introduce the concept of proximity queries in sensor networks. The definition captures a large number of interesting queries that may be used in a variety of monitoring applications in sensor network. This survey will propose the use of a distributed routing index for capturing the spatial distribution of interesting types of events in the sensor network. This routing index requires