Shortest Hop Multi-Path Algorithm for WSN

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Abstract- **Wireless Sensor Networks (WSNs) are a research theme alluring over the recent years because of its ample applications. WSNs are a set of wireless embedded devices which have the ability of processing and communicating video and audio streams collected from the environment in a distributed fashion. This work presents a Dijkstra's algorithm to figure out the shortest path between the source node and destination node with lower cost. Emanating on the multidimensional scaling (MDS) technique the node locations can be procured to fit the approximate distances between pairs of nodes. It uses the Shortest Path Position Estimation between Source and Destination nodes in Wireless Sensor Networks with Lower Cost.**

Index Terms- **WSN, WTE, STL, SWSN.**

1. INTRODUCTION

Wireless sensor network (WSN) consists of a large number of spatially distributed autonomous sensor nodes operating collaboratively to monitor the surrounding physical or environmental conditions (monitored target) and then communicate the gathered sensory data to the main central location through wireless links. A sensor node (mote) is a small, low-powered, wireless device, with limited computation and communication capabilities, capable of gathering sensory information, perform limited data processing and transmit the gathered information to other nodes in the network via optical communication (laser), radio frequencies (RF) or infrared transmission media. (Hussain, et al., April, 2013).

A sensor node comprises of a sensor, memory, processor, mobilizer, communication system, power units and position finding system. Each sensor node is made up of three subsystems namely:

- Sensor subsystem that senses the physical phenomena or environmental conditions.
- Processing subsystem that performs local computations operations on the sensed data.
- Communication subsystem that is responsible for message transmission and exchanges among neighboring sensors.

Sensors can monitor several phenomena such as humidity, temperature, lighting conditions, pressure, vehicular movement, noise level, chemical concentrations, soil makeup, and other properties. There are several types of sensors which include infrared, seismic, thermal, magnetic, acoustic, visual and radar based on the sensing mechanism employed by them (Ali , 2012).

Once the phenomena is sensed, the data collected (measurement) is converted into signals for further processing to reveal some characteristics pertaining the phenomenon from the target area (Hussain, et al., April, 2013)
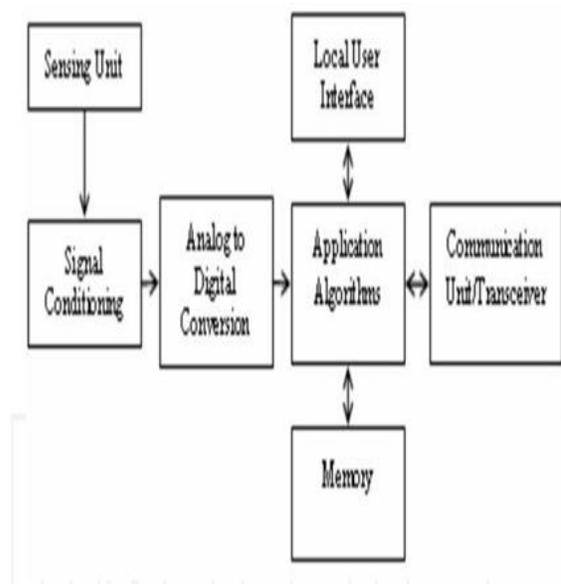
Figure 1: Sensor node basic architectural components (Ali , 2012)

WSN have great potential for deployment in mission-critical applications like battlefield surveillance applications, healthcare (elderly people, home-patient monitoring), disaster relief as well as fire detection applications among others. Since WSNs are employed in mission-critical tasks, security is an essential requirement. However, sensor networks pose unique challenges and as such existing traditional security schemes used in traditional networks are inadequate (PERRIG, et al., June 2004). Limited sensor node energy, computation and communication capabilities and the hostile deployment environments bring a challenge of employing efficient security solutions in WSN.

2. OBJECTIVES

- Improve the performance of distance vector algorithm.
- Making distance vector algorithm dynamic and randomly it reduced the increased complexity of the algorithm.
- Avoid loop formulation and malicious attacks.
- Improve the space and time complexity of dijkstra's and bellman-ford algorithm.
- Improve the space complexity for random generated graph in dijkstra's algorithm.
- Improve the run time complexity of dijkstra's, bellman-ford and distance vector algorithm.
- It give accuracy to the wireless sensor network.

3. PROBLEM FORMULATION

In performance measurement of dijkstra's using wireless sensor network the problem formulation is based on the time complexity of the different algorithms that's are used in estimating the shortest path in various routing algorithm. The dijkstra's algorithm found shortest path with positive edge weight cycles. In bellman ford algorithm and there are negative edge weight cycles that are not able to give the least time complexity in wireless sensor network. Both algorithms have the worst time complexity in nature. And bellman-ford is slower than dijkstra's for some problem, but more versatile, as it is capable of handling graph in which some of

the edge weight are negative number. In such a case, the bellman ford can detect negative cycle and report there existence. A distributed variant of bellman-ford is distance vector routing. Distance vector algorithm is iterative and asynchronous and each local iteration is caused by, local link cost change and distance vector update message from neighbour. A distance vector routing protocol require that a router inform its neighbour of topology changes periodically as compared to link state protocols, which require a router to inform all the nodes in a network of topology changes. The distance vector have less computational complexity. In link state routing this contrast with distance-vector routing protocol, which works by having each node share its routing table with its neighbours. In link state protocol the only information passed between node is connectivity require. The distance vector avoid loop formation but suffer from increased complexity. To avoid the increased complexity in distance vector, make distance vector algorithm dynamic. By making algorithm dynamic graphs are dynamically created and avoid loop formation, malicious nodes can not be occurred and there is no intrusion attack. That reduced the time complexity and improve the performance of the algorithm. This gives least time complexity to the wireless sensor network. With the help of dijkstra's it is easy to find the malicious nodes and choose the best one. The random selection of nodes can take more time and increased the time complexity. The random selection of nodes are developed with dijkstra algorithm.

4. PROPOSED METHOD

The Shortest path method is used to estimate all sensors' relative locations by applying Dijkstra's algorithm to compute the relative positions of sensors with low cost and high error tolerance. The routing algorithm is stored in the router's memory. The routing algorithm is a major factor in the performance of position estimation and distance measurement in the senor field. The purpose of the routing algorithm is to make decisions for the router concerning the best paths for estimating the positions of anchors. The router uses the routing algorithm to compute the path that would best serve to find out the shortest path between the source and destination.
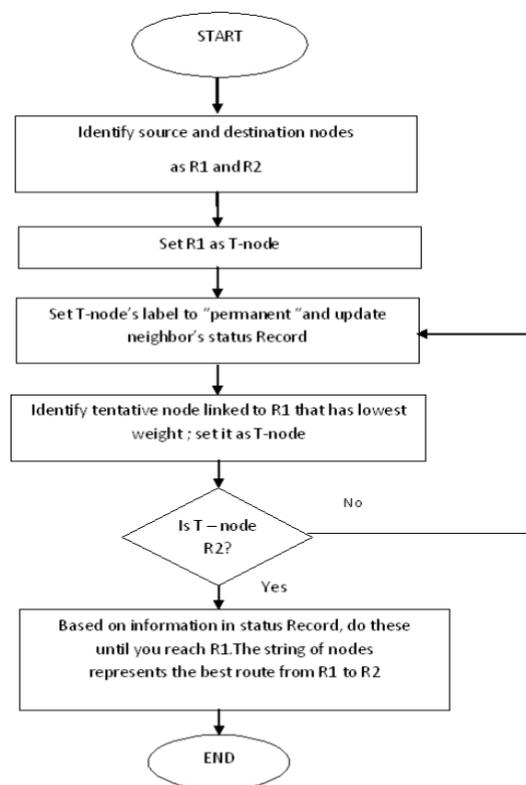
4.1 Dijkstra's algorithm

The router builds a graph of the network. Then it identifies source and destination nodes, for example R1 and R2. The router builds then a matrix, called the "adjacency matrix." In the adjacent matrix, a coordinate indicates weight. [i, j], for example, is the weight of a link between nodes Ri and Rj. If there is no direct link between Ri and Rj, this weight is identified as "infinity."

Procedure for finding the shortest path using Dijkstra's algorithm is as follows:

1. The router then builds a status record for each node on the network. The record contains the following fields:
   - Predecessor field - shows the previous node.
   - Length field - shows the sum of the weights from the source to that node.
   - Label field - shows the status of node; each node have one status mode: "permanent" or "tentative."
2. In the next step, the router initializes the parameters of the status record (for all nodes) and sets their label to "tentative" and their length to "infinity".
3. During this step, the router sets a T-node. If R1 is to be the source T-node, for example, the router changes R1's label to "permanent." Once a label is changed to "permanent," it never changes again.
4. The router updates the status record for all tentative nodes that are directly linked to the source T-node.
5. The router goes over all of the tentative nodes and chooses the one whose weight to R1 is lowest. That node is then the destination T-node.
6. If the new T-node is not R2 (the intended destination), the router goes back to step 5.
7. If this node is R2, the router extracts its previous node from the status record and does this until it arrives at R1. This list of nodes shows the best route from R1 to R2 as shown in Fig.3

Fig.4.1 Flow Chart to find shortest path using Dijkstra's algorithm

5. RESULTS

In the MATLAB simulation, a random network of 50 nodes was created and Dijkstra's algorithm was used to find the routes between Source node and destination node. In Figure 4 the blue dots represent the true position of unknowns; anchors are indicted explicitly. A line between two nodes indicates a radio link. In the figure the Red dotted line represent the shortest path between the anchors that means from source node to destination node.

Fig.18. Shortest path between Source node and destination node

6. CONCLUSION & FUTURE DIRECTION

It is shown that the proposed algorithm works well for near uniform radio propagation. However, in the real world, radio propagation indoors and in cluttered circumstances is far from uniform. Local distance estimation may also be poor. Further simulations will be needed to determine reducing the range errors by using MDS algorithms can be to such errors. As Dijkstra's algorithm builds the local positions and routings of the estimated sensors for applications that require absolute coordinates of nodes, waiting until large number sensor nodes has formed before transforming to absolute coordinates may be a poor choice. Using the method described here, Position estimation using the shortest path method between source node and destination node with low cost in wireless sensor networks that compute absolute coordinates of individual nodes or sub networks independently can be developed.

Long distance shortest-path information is used only for rough layout decisions while two-hop information is used to determine precise node positions. It would be interesting to develop a framework that precisely characterizes the contribution of each datum to the position estimation. The main question is whether an approach based on unified statistical inference could be as efficient as the special purpose algorithms explored here. Shortest path method can be extended by applying more advanced MDS techniques. Instead of Dijkstra's algorithm, Interior routing algorithm, Exterior routing algorithm and Hierarchical routing algorithms can be applied. We have done some limited experiments with shortest path method using Dijkstra's algorithm. Our results show that Dijkstra's algorithm is better than the MDS-Square method using the connectivity level of the network is low, and is comparable with Dijkstra's algorithm when the connectivity level is high and ranging error is low

REFERENCES

[1] N. Pushpalatha and Dr.B.Anuradha, "Distribution of Nodes on Square Method for Wireless Sensor Networks", in International Journal of Computer Science and Telecommunications [Volume 3, Issue 1, January 2012].

[2] N.Pushpalatha and Dr.B.Anuradha, " Study of Various Methods of Wireless Ad-hoc Sensor Networks using Multidimensional Scaling for Position Estimation" Global Journal Engineering and AppliedSciences-ISSN2249-2631(online): 2249-2623(Print) GJEAS Vol.1(3) , 2011

[3] Rohit Kadam, Sijian Zhang, Qizhi wang, Weihua Sheng, ltidimensional Scaling Based Location Calibration for Wireless Multimedia Sensor Networks" The 2010 IEEE/RSJ International Conference on Intelligent Robots and Systems October 18-22, 2010, Taipei, Taiwan

[4] X. Nguyen, M.I. Jordan, and B. Sinopli. "A kernel-based learning approach to ad- hoc Sensor network localization". ACM Transactions on Sensor Networks, 1(1):134–152, 2005.

[5] XiangiJi, and HongyuanZha, "Sensor positioning in wireless Ad-hoc sensor Networks using multidimensional Scaling", in 23rd annual joint conference of the IEEE computer and communication society, pp: 2652-2661, 2004

[6] F.Zhao and L.Guibas."Wireless Sensor Networks: An Information Processing Approach". Elsevier and Morgan Kaufmann Publishers, 2004.

[7] R. L. Moses, D. Krishnamurthy, and R. Patterson. "A self-localization method for wireless sensor networks". Paper on Applied Signal Processing, 2003(4):148-158, March 2003.

[8] Shang.Y.; Ruml.W; Zhang,Y.; Fromherz, M.P.J." Localization from mere connectivity". Fourth International ACM Symposium on Mobile Ad Hoc Networking and Computing ; 2003 June 1-3; Annapolis; MD. NY: ACM; 2003; 201-212.

[9] K. Akkaya, M. Younis, A survey on routing protocols for wireless sensor networks, Ad Hoc Networks,Vol. 3(3), 2005, 325-349

[10] F. Zabin, S. Misra, I.Woungang, REEP: Data-centric, energy-efficient and reliable routing protocol for wireless sensor networks, Communications, IET, Vol. 2-8, 2008, 995-1008

[11] Y. Xu, J. Heidemann, D. Estrin, Adaptive Energy-conserving Routing for Multihop AH hoc Network Research Report 527, USC/Information Sciences Institute, 2000

[12] B. Yahya, J. Ben-Othman, An energy efficient and QoS aware multipath routing protocol for

wireless sensor networks, IEEE 34th Conference on Local Computer Networks, 2009, 93-100

[13] T. H. Cormen, C. E. Leiserson, R. L. Rivest, Introduction to Algorithms (Second Edition), MIT Press and McGraw-Hill, 2001, 595-601

[14] T. Van Dam, K. Langendoen, An adaptive energy-efficient MAC protocol for wireless sensor networks, Proceedings of the 1st International Conference on Embedded Networked Sensor Systems, 2003, 171-180

[15] D. J. Nelson, K. Sayood, H. Chang, An extended least-hop distributed routing algorithm, IEEE Transactions on Communications, Vol. 38-4, 1990, 520-528

[16] E. R. Sanchez, L. M. Murillo, B. Montrucchio, An adaptive power-aware multi-hop routing algorithm for wireless sensor networks, 2011 8th International Conference on Information Technology, 2011, 112-116

[17] S. S. Chiang, C. H. Huang, K. C Chang, A minimum hop routing protocol for home security systems using wireless sensor networks, IEEE Transactions on Consumer Electronics, Vol. 53-40, 2010, 1483-1489

[18] E. W. Dijkstra, A note on two problems inconnexion with graphs, Numerische Mathematik, 1959, 269-271

[19] P. Murali, K. Rakesh, C. Hota, A. Yla-Jaaski, Energy-aware routing in mobile ad-hoc networks, Wireless Days, 1st IFIP, 2008, 1-5

[20] D. Cheng, Y. Xun, T. Zhou, W. Li, An energy aware ant colony algorithm for the routing of wireless sensor networks, Intelligent Computing and Information Science, 2011, 395-401

[21] Pankaj Verma , J.S Bhatia , "Design And Development Of GPS-GSM Based Tracking System With Google Map Based Monitoring", International Journal of Computer Science, Engineering and Applications (IJCSEA) Vol.3, No.3, June 2013.

[22] Vishal Bharte, Kaustubh Patil, Lalit Jadhav, Dhaval Joshi, "Bus Monitoring System Using Polyline Algorithm", International Journal of Scientific and Research Publications, Volume 4, Issue 4, April 2014.

[23] Sacha Varone, "On a many-to-one shortest paths for a taxi Service", Haute ecole de gestion de Gen eve CRAG - Centre de Recherché Appliqué ee en Gestion Cahier de Recherché

[24] Carlos Martín García and Gonzalo Martín Ortega, "Route planning algorithms: Planific@ Project", International Journal of Artificial Intelligence and Interactive Multimedia, Vol. 1, No 2.

[25] Abboud, Marwan, LM Abou Jaoude, and Ziad Kerbage. "Real Time GPS Navigation System." disponible sur http://webfea-lb. fea. aub. edu. lb/proceedings/2004/SRCECE- 27. pdf (2004).