A Survey of Graph Theory Based Optimized Routing Algorithm for Wireless Sensor Network

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Abstract- A wireless sensor network (WSN) is a wireless network which is a combination of autonomous sensors. Those sensors are deployed to monitor physical or environmental conditions such as temperature, sound, pressure, etc. and are spatially distributed. The sensor nodes cooperatively pass their data through the network to a main location. A wireless sensor network may contain a few to several hundreds or even thousands of sensor nodes. A sensor node has limited number of resources. It is an embedded system of low power processor, limited memory and battery. There are many routing, power management protocols that has been specially designed for WSNs.This is because in WSN energy awareness is an essential design issue. In case of multihop networks like the Internet and the Mobile Ad-hoc Networks, routing is one of the most important issues because it has a significant impact on the network's performance. Several search algorithms like breadth-first search (BFS) algorithm, the Dijkstra's algorithm and the Bellman–Ford algorithm etc. are there for the shortest path (SP) problem. Intelligent analysis and designing of network with optimum routing becomes an important issue amongst the user. This paper contains an overview of graph theory based routing algorithm for wireless sensor network.

Keywords: sensor-nodes, multihop, fonts, optimum path.

I.INTRODUCTION

[1]Wireless sensor networks can be used as the primary mode for monitoring and collecting data in physically challenging environments. A sensor network is composed of a large number of sensor nodes. A wireless sensor network (WSN) is a wireless network of computing devices consisting of spatially distributed autonomous devices. They use sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, motion, intrusion or pollutants, at different locations. In traditional routing, the main goal of the routing algorithm is to find the least-cost path from sender to receiver. [6]One of the most common problems encountered in analysis of networks is the shortest path problem: finding a path between two designated nodes having minimum total length or cost. Sensor nodes in Wireless sensor networks (WSNs) have resource constraints which include limited energy, processing capacity, storage, communication range and bandwidth. These unique features have raised special problems that must be solved while designing routing protocols. For instance, in some applications, routing algorithms must meet QoS requirements such as energy conservation and data delay reduction.[7]Wireless sensor network are usually composed of large number of low power, short-lived and unreliable micro-sensors. The position of sensor nodes not be predetermined. The nodes in the network collect, process and communicate data acquired from the physical environment to an external base station. The some of the main applications of wireless sensor networks are military battle filed, intrusion detection, natural disaster monitoring, inventory control, home application and environmental application. [8]The major challenge in the design of wireless sensor network is the energy conservation and prolongation of network life time. The shortest path problem is defined as finding a minimum – length (minimum – cost) path between the given two nodes such as the source and the destination nodes. The existing traditional routing algorithms for shortest path problem is not most optimized. [2]There are various traditional algorithms are available for the shortest path problems. The BFS, Dijkstra's, Bellman Ford algorithms are

some of the traditional algorithms for solve the shortest path routing problems. With the progress on the semiconductor technology, wireless sensors' capabilities of computation, storage may not be limitations in future. However, how to consume energy efficiently is still one of the most challenging problems in WSNs' researches.

II.PROBLEMS IN WIRELESS SENSOR NETWORK

[2]Wireless sensor network (WSN) is widely considered as one of the most important technologies for the twenty-first century. A WSN typically consists of a large number of low-cost, low-power, and multifunctional wireless sensor nodes, with sensing, wireless communications and computation capabilities. These sensor nodes communicate over short distance via a wireless medium and collaborate to accomplish a common task, for example, environment monitoring, military surveillance, and industrial process control.
[3]Despite the innumerable applications of WSNs, these networks have several restrictions, e.g., limited energy supply, limited computing power, and limited bandwidth of the wireless links connecting sensor nodes. One of the main design goals of WSNs is to carry out data communication while trying to prolong the lifetime of the network and prevent connectivity degradation by employing efficient energy management techniques. The design of routing protocols in WSNs is influenced by many challenging factors. These factors must be overcome before efficient communication can be achieved in WSNs. In the following, we summarize some of the routing challenges and design issues that affect routing process in WSNs.

- **Node deployment:** In WSN node deployment is application dependent and it affects the performance of the routing protocol. Deployment can be of two types, deterministic and randomized.
- **Energy consumption:**: Sensor nodes have limited amount of energy. Without losing accuracy performing computations and transmitting information in a wireless environment is a challenging task.
- **Node/Link Heterogeneity:** In general, all sensor nodes are assumed to be homogeneous, i.e., each node has equal capacity in terms of computation power, communication, and energy. But sensor node can have different role or capability depending on the application.
- **Fault Tolerance:** In WSN at some moment some sensor nodes may fail or be blocked due to power failure, physical damage, or environmental interference. But this failure should not affect the overall task of the sensor network. If many nodes fail, MAC and routing protocols must accommodate formation of new links and routes to the data collection base stations.
- **Scalability:** The number of sensor nodes deployed in the sensing area may be hundreds or thousands, or more. Any routing protocol must be able to work with this huge number of sensor nodes. In addition, sensor network routing protocols should be scalable enough to respond to events in the environment. Until an event occurs, most of the sensors can remain in the sleep state, with data from the few remaining sensors providing a coarse quality.
- **Data Aggregation:** Sensor nodes may generate significant redundant data, similar packets from multiple nodes. It can be aggregated so that the number of transmissions is reduced.
- **Quality of Service:** In some applications, certain data is useful at a certain point of time. So data should be delivered within a certain period of time from the moment it is sensed, otherwise the data will be useless.

These are some problems of WSN routing. From the above given difficulties we are proposing our Graph Theory which will reduce Energy Consumption/Fault Tolerance/Data aggregation.

III.EXISTING WORK

We have gone through many existing algorithms. Graph theory has been a key point of research for the researches .Several types of graphs have been studied such as trees, random graphs, directed and undirected graphs and weighted and unweighted graphs. Most of the optimization problems that associate networks with graph theory are either NP-Complete or NP-Hard.

In one paper [4] the authors present some key graph theory concepts used to represent different types of networks. Then they describe how networks are modeled to investigate problems related to network protocols considering some optimization problems that have been proven to be intractable. Finally, they present some of the tools used to generate graph for representing practical networks.

Graph theory has been studied extensively in association with complex communication networks. The authors described basic concepts of graph theory and their relation to communication networks. Then they presented some optimization problems that are related to routing protocols and network monitoring

We have taken another paper [5], where the author discussed about the energy efficiency of the WSN. Number of protocols has been suggested for energy efficient information gathering for WSN.According to the author current routing protocols are inefficient for Wireless Sensor Network due to undistributed and excessive power consumption and lack of fault tolerance. Much research is being done to develop a more efficient and optimized protocol utilizing routing. But it still can't be determined which protocol is best for minimized power utilization.

Present network systems use single path routing. They use a single line of communication to transmit data over network. This results in an inefficient use of network resources. Also costs power consumtion.Multiple routing on the other hand could help to distribute data across multiple lines. It can also reduce power consumption.

The author suggests two algorithms that finds shortest loop-free paths from a source to a target gateway node, and distributes communication data on different paths based on traffic to minimize power consumption at all nodes. The author simulates some conditions to analyze the proposed algorithm and compare with other algorithms causing the same issue.

The first algorithm will involve the standard Dijkstra's algorithm used in most networking communication algorithm which involve weighted structures (such as ad hoc). This algorithm determines the shortest possible path between 2 points given hops throughout a network. According to the proposed algorithm, the author instead utilize a metric which involves a function of the distance but also incorporates the battery life remaining on the node. This is due to extend the battery life by reducing the likelihood of choosing that node for a given path.

The second algorithm according to the paper is more basic, and involves simply alternating parent nodes in the Dijkstra's algorithm. This is because of greater spreading of routing paths across nodes while still maintaining the simplicity that each node retains little information, As he suggests we would assign each node 2 parents instead of 1, and allow the node to alternate between the 2 as it transmitted data; first sending info to parent1 then transmitting to parent 2 next time it sensed data. Ideally this would produce greater distribution (if only slightly) due to greater spreading out of the path routes.

Besides theses we also looked at some other papers which suggests different solution for routing in WSN based on its application.

IV.CONCLUSION

In our topic we try to visualize the different routing protocols and what are the drawbacks of these. We also try to figure out what are the hardware and software requirement, and are the difficulties of the existing systems. We have gone through different routing protocol for wireless sensor networks and have reviewed some proposed routing protocol to make the network more Power efficient/Fault Tolerance/Data aggregation. We have observed the drawback and benefit of the protocols. Form this section it can be said that there is no complete protocol solution for wireless sensor network because different application of WSN has different requirements. For example, in environment monitoring application such as checking pressure, temperature, humidity etc., where the use of power is more sensitive to make network more energy efficient as well as to extend network lifetime.

REFERENCES

[1] Mis Rigi C.R,Ms. Ancy Antony.C[1], Ms.Shalinu Saju[2], Mr.Sachin Padikkal [3]: Shortest path routing algorithm in wireless sensor network – A Review,Assistant professor ,jyothi engineering college,thrissur, kerala,[1]Jyothi engineering college,thissur,kerala,[2]Jyoythi engineering college,thissur,kerala,[3]Jyothienginneringcollege,thrissur,kerala,Email:college,thrissur,kerala,Email:rigicr@gmail.com,anmariya2193@gmail.com, shalinus@gmail.com, sachin.silent@gmail.com

[2] Shio Kumar Singh[1], M P Singh[2] and D K Singh[3]; Routing Protocols in Wireless Sensor Networks – A Survey,[1]Maintenance Engineering Department (Electrical), Tata Steel Limited, Jamshedpur – 831001, Jharkhand,India, shio.singh@tatasteel.com ,[2]Department Of Computer Science and Engineering National Institute of Technology, Patna, Bihar, India, writetomps@gmail.com,[3]Department Of Electronics and Communication Engineering Department, Birsa Institute of Technology, Sindri, Dhanbad –828123, Jharkhand, India, dkdingh_bit@yahoo.com

[3] B.Baranidharan, B.Shanthi: A New Graph Theory based Routing Protocol for Wireless Sensor Networks, SASTRA University, School of Computing, Thanjavur, India

[4] Kamal A.Ahmat: Graph Theory and Optimization Problems for Very Large Networks,CITY UNIVERSITY OF NEW YORK/Information Technology,New York, USA

[5] R.A.Roseline, Dr.P.Sumathi; Energy Efficient Routing Protocols and Algorithms for Wireless Sensor Networks–A Survey,Chikkanna Government Arts College, Tirupur, India

[6] Kemal Akkaya*,Mohamed Younis; A survey on routing protocols for wireless sensor networks,Department of Computer Science and Electrical Engineering, University of Maryland, Baltimore County, Baltimore, MD 21250, USA
[7] Jamal N. Al-Karaki Ahmed E. Kamal; Routing Techniques in Wireless Sensor Networks: A Survey;Dept. of Electrical and Computer Engineering,Iowa State University , Ames, Iowa 50011,Email: fjk araki, kamalg@iastate.edu
[8] [1]B.Baranidharan, 2B.Shanthi A New Graph Theory based Routing Protocol for Wireless Sensor Networks SASTRA University, School of Computing, Thanjavur, India, [1]baranidharan@it.sastra.edu, [2]shanthi@cse.sastra.edu