A Survey on Energy Efficient Routing in WSN

B. Srimathi[1] and P. Thirumoorthy[2]

[1,2]Department of CSE, Nandha Engineering College (Autonomous), Erode, Tamil Nadu, India.

Email:srimathi.br95@gmail.com[1], thiru4u@gmail.com[2]

Received date: 4th December, 2017, Accepted Date: 24th December, 2017

Abstract - In these paper the computability of distinctive routing protocols for wireless sensor network and routing algorithms are expressed to obtain the efficient network construction and to perform the secure data communication. Wireless Sensor Networks (WSNs) are progressively being implemented in security-basic applications. Recently, there has been dramatic increase in the popularity of the WSN applications. The routing protocols are the hot areas to address quality-of-service (QoS) related issues, energy consumption, network lifetime, network scalability, and packet overhead. The key issue in WSN is that these systems experience the ill effects of the packet overhead, which is the underlying driver of more vitality utilization and debase the QoS in sensor systems. In WSN, there are several routing protocols, which are used to enhance the performance of the network and energy consumption with minimum range. By that we can increase the routing probability. The end to end secure communication is provided from the source to destination for the better communication. Simulation results shows that our design the existing algorithms in terms of energy consumption and network lifetime maximization.

Keywords - Wireless Sensor Network, Routing protocols, Energy efficient, Security trust.

I. INTRODUCTION

Wireless sensor networks (WSN), are spatially dispersed self-ruling sensors to monitor physical or ecological conditions, for example, temperature, sound, weight, and so forth and to helpfully go their information through the system to a principle area. With the fast improvement of system based innovations for example, Internet and pervasive registering, PC organizing turns out to be progressively unavoidable and imperative. As the center gadget, switches are in charge of associating diverse systems and sending information contents. In expansion to committed switch devices, end hubs in systems such as specially appointed systems likewise execute as switches. The more current systems are bi-directional, likewise empowering control of sensor action. The improvement of wireless sensor systems was roused by military applications, for example, war zone observation; today such systems are utilized as a part of numerous mechanical and shopper applications, for example, modern process checking and control, machine well being observing.

Routing is major to how the Internet functions. Routing conventions coordinate the development of parcels between your PC and some other PCs it is communicating with. The Internet's routing convention, Border Gateway Protocol (BGP) is known to be vulnerable to mistakes and assaults. These issues can actually thump whole systems off the Internet or redirect movement to a unintended gathering. Routing is another very challenging design issue for WSNs. A properly designed routing protocol should not only ensure a high message delivery ratio and low energy consumption for message delivery, but also balance the entire sensor network energy consumption, and thereby extend the sensor network lifetime.

In addition to the aforementioned issues, WSNs rely on wireless communications, which is by nature a broadcast medium. It is more vulnerable to security attacks than its wired counterpart due to lack of a physical boundary. In particular, in the wireless sensor domain, anybody with an appropriate wireless receiver can monitor and intercept the sensor network communications. The adversaries may use expensive radio transceivers, powerful workstations and interact with the network from a distance since they are not restricted to using sensor network hardware. It is possible for the adversaries to perform jamming and routing trace back attacks.[2]

Energy saving is an important issue for WSN. Many techniques for energy savings are developed, including sleep scheduling, media access control (MAC) protocols, routing protocols, data aggregation, topological control, etc[2]. Among them, routing protocol is an important issue for designing WSN, and can be classified into two groups: planar routing and hierarchical routing. Hierarchical routing usually manages the network by dividing the network into different clusters which have a cluster head responsible for fusing the data from cluster members and sending it to the base station (BS).[3]

Wireless sensor systems (WSNs) comprise of hundreds or even a huge number of smaller devices each with detecting, preparing, and correspondence abilities to screen this present reality condition. In these systems, an extensive number of sensor hubs are conveyed to screen an immense field, where the operational conditions are regularly brutal or even unfriendly. Nonetheless, the hubs in WSNs have serious asset limitations because of their absence of preparing power, constrained memory and vitality. Since these systems are typically sent in remote places and left unattended, they ought to be outfitted with security components to protect against assaults, for example, hub catch, physical altering, listening

stealthily, dissent of administration, and so on. Lamentably, customary security instruments with high overhead are not practical for asset obliged sensor hubs.

Wireless sensor networks share similarities with ad-hoc wireless networks. The dominant communication method in both is multi-hop networking, but several important distinctions can be drawn between the two. Ad-hoc networks typically support routing between any pair of nodes whereas sensor networks have a more specialized communication pattern.

II. RELATED WORKS

There has been a lot of work done on secure routing and network construction in WSN. New algorithms and implementation techniques and different methods for lifetime maximization in network are being preferred to make sensor network a best experience for providers as well as users. The surveys on secure routing, techniques, methods have been done and a lot of protocol and algorithms are introduced.

A. ActiveTrust: Secure and Trustable Routing In WSN [1]

The most imperative development of ActiveTrust is that it avoids the black holes through the dynamic making of various location courses to rapidly distinguish and acquire nodal trust and in this manner enhance the information course security. All the more vitally, the era and the dissemination of detection routes are given in the ActiveTrust conspire, which can completely utilize the vitality in non-hotspots to make the same number of identification courses as expected to accomplish the desired security and energy efficiency. Both far reaching hypothetical examination and exploratory outcomes demonstrate that the execution of the ActiveTrust conspire is superior to that of the past investigations [1].

B. Cost-Aware SEcure Routing (CASER) Protocol Design for WSN [2]

The CASER protocol to address these two conflicting issues through two adjustable parameters: energy balance control (EBC) and probabilistic based random walking. We at that point find that the energy utilization is seriously disproportional to the uniform energy arrangement for the given system topology, which enormously decreases the lifetime of the sensor systems. To tackle this issue, we propose a productive non-uniform energy development methodology to enhance the lifetime and message conveyance ratio under a similar energy asset and security necessity. The proposed CASER protocol can give an excellent tradeoff between routing effectiveness and energy balance, and can fundamentally broaden the lifetime of the sensor network in all situations.

C. Energy aware hierarchical cluster-based routing protocol for WSNs [3]

Uneven energy utilization is an inalienable issue in WSNs, portrayed by multi-hop routing and a many-to-one activity design. This uneven energy dispersal can fundamentally reduce the network lifetime. In this proposed a Novel Energy Aware Hierarchical Cluster-based (NEAHC) routing protocol with two goals: minimizing the total energy consumption and ensuring fairness of energy consumption between nodes. In NEAHC, energy consumption in multi-hop communication and fairness among sensor nodes has been optimized.[3].

D. Novel Design of Secure End-to-End Routing Protocol in WSN [4]

Gathered information is transmitted in a way comprising of associated links. We propose a novel design of secure end-to-end data communication, adopt a newly published group key pre-distribution scheme in our design, such that there is a unique group key, called path key, to protect data transmitted in the entire routing path[4]. Our proposed conspire utilizes a one of a kind end-to-end path key to ensure information transmitted over the path. The main advantage utilizing our convention is to decrease the time expected to process information by the middle of the road sensors.

E. An energy-efficient QoS routing for wireless sensor networks using self-stabilizing algorithm [5]

Transmission delay of data packets is quantified as the number of hops from a sensor to base station (BS), and a tolerable delay (TD) of each packet denotes the initial value of aging tag (AT) to present their QoS metric [5]. A self-stabilizing hop-constrained energy-efficient (SHE) protocol for constructing minimum hop and energy networks for QoS routing. An adaptive routing protocol is then proposed to convey aggregate data packets from CHs to BSs in different routes depending on their current AT values, thus meeting their TD while prolonging the network lifetime.

F. New Smart nodes distribution using K-means Approach to enhance Routing in WSN [6]

The k-means approach has been implemented to improving the energy consumption in network during the data transmission and these improve the network lifetime. The geographic adaptive routing protocol is used to tackle these above mentioned problems. The communication between the nodes happens by the gravity between the active nodes. By the gravity we have select the nearest node. The energy consumption decreased due to the smart node distribution.

G. Energy Efficient Direction-Based PDORP Routing Protocol for WSN [7]

In dynamic routing protocol the identification of dead nodes and instead of choosing another suitable path for the efficient data transaction and less energy consumption is difficult. To solve these difficulties the Propose Directional transmission-based energy aware Routing Protocol (PDROP) is used which is efficient to gather the sensor information. Here the efficient path is to be identified by the hybridization algorithm. Low end to end transmission delay without obtaining the localization information.

H. Delay-Constrained Energy-Efficient Cluster-based Multi-Hop Routing [8]

Distributed clustering approach is used to find the cluster head for each cluster node. The cost function and end to end delay function is proposed here. The multi-hop routing algorithm is used to spread the sensing data from the cluster head to destination with the minimum energy cost and end to end delay constraint.

I. Optimization Approach for Energy Consumption in Wireless Sensor Networks using Delay Aware Dynamic Routing Protocol [9]

The energy efficient routing protocol forward the packet always through the minimum energy consumption path based on optimal routing. In previous the Energy Balanced Routing Protocol is failed to achieve the throughput and other network problem. To obtain the better throughput, network performance and end to end delay we use the Delay Aware Energy Balanced Dynamic Routing Protocol. The overall network performance is improved by this technique.

J. Optimal and Near-Optimal Cooperative Routing and Power Allocation for Collision Minimization in WSN [10]

The cooperative routing algorithms are used to minimize the packet collision. In this paper we present the optimization framework to minimize the collision probability using cooperative of routing in WSN. The branch and bound algorithm is amplify with reduce the search space. The computation problems reduced by that we can decoupling the power allocation problem and the route allocation problem. The branch and bound technique is used to solve the problem formulated by the non-linear programming.

K. Joint design of hierarchical topology control and routing design for heterogeneous wireless sensor networks [11]

The clustering techniques in these networks use the network resources effectively to the sensor nodes and enhance the network lifetime. The classical clustering and topology controlling techniques are used to improves the network performance. Data routing design which helps to implement the entire network performance. The algorithm of complexity is to be implemented in a centralized control manner. The lightweight fully/semi distributed clustering algorithm is used to implement the distributed clustering algorithm.

L. Joint Design of Energy-Efficient Clustering and Data Recovery for Wireless Sensor Networks [12]

The layer communication is implemented with the cluster head and cluster node. The node clustering algorithm in used to minimize the energy consumption. In this paper we proposed the join design sensor node clustering algorithm to recover the missing data based on the two layered structured in WSN. By these algorithms, we take both the energy-efficiency and data forecasting accuracy into consideration and investigate the tradeoff between them. This is based on the key observation that the high energy-efficiency of the network can be achieved by reducing the distances among the nodes in a cluster, while the accuracy of the forecasting results can be improved by increasing the correlation of the data stream among the nodes in a cluster.

III. RESULT AND ANALYSIS

The following table summarizes efficient techniques to obtain the better network, parameters, and other factors. The different algorithms are working on same parameters at some cases. Each algorithm focuses on improving various kinds of requirements in the network. The differences are shown in Table 1.

TABLE.1 DIFFERENT ROUTING TECHNIQUES/ALGORITHMS

Sl.	Techniques & Algorithms	Parameter Analysis	Conclusion
1	Slicing and assembling, Active Detection Routing Protocol	Threshold distance	To achieve nearly 100% routing probability.
2	Correlation based techniques.	Energy balance control (EBC), Probabilistic based random walking.	Balancing the energy consumption. Increase the sensors lifetime.
3	A novel energy aware hierarchical cluster-based (NEAHC) routing protocol	WSN area/m, Number of nodes, Base station location, Initial energy/J	Energy consumption in multi-hop communication and sensor nodes has been optimized.
4	polynomial based protocol, path key generation,	Authentication has complexity *O(n)*,	Uses path key to protect routing data by removing encryption and decryption
5	Distributed self stabilizing algorithm, multi-hop casting algorithm,	Energy parameters	Most energy efficient way is used to transfer the data, time-sensitive data packets.
6	Geographic Adaptive Fidelity (GAF), Clustering algorithms	Simulation area, Base station location	Allows decreasing energy consumed
7.	Dynamic source routing (DSR) protocol, PDORP protocol	EAD Aggregation Energy of the nodes, ETD Energy consumption transfer packet.	Energy efficiency, scalability, prolonged network lifetime,

8	Inter-cluster routing Algorithm, multi-hop routing algorithm.	Reliability, delay, energy consumption	Clusterheads to sink with a minimum energy cost that is subject to an end-to-end delay constraint.
9	Proposed Delay Aware Energy Balanced Dynamic Routing Protocol	Energy balance, energy efficiency	Achieves in terms of End-to-End Delay, Throughput, Portion of Living Node (PLN)
10	Branch-and-bound algorithm	Energy balance, energy efficiency	Speed up the computational Complexity, minimizing collision in WSN.
11	Geographical routing algorithms,	Power consumption cost, local generated data rate.	Intra-cluster data route, maximize the network lifetime.
12	Node-clustering algorithms, state-of-the-art algorithms.	network structure, generation of the nodes readings,	Decrease data transmission in the network, forecast the missing data.

IV. ADVANTAGES

There are many advantages in these routing protocols while using wireless sensor network. Depending on the protocols and energy level that will get vary.

1) The biggest benefit of routing techniques is that user neither has to install hardware nor software to access the applications, to develop the application and to host the application over the internet facilities with wireless manner
2) The lifetime of the sensor network is enhanced by using the smart node distribution manner and the probability of routing is get improved.
3) During the communication the energy consumption is get reduced by finding the nearest node in the over all network structure.
4) Freshness of authendication response and communication keys. By using the path key we can protect the data by removing the encryption and decryption.
5) While working with the dynamic routing provides the better throughput and less administration maintenance compared to the static.

V. CONCLUSION

Routing is the one of the most important task in data transferring between the various packets. In these paper we have analyzed the various kinds of techniques/algorithms and parameters to obtain the better network implementation. The energy consumption during the data routing get reduced and availability, scalability get increased. The lifetime of the sensor network also get enhanced.

ACKNOWLEDGMENT

I am thankful for the timely and consistent cooperation given by my guide Dr. P. Thirumoorthy, for preparing this survey. I hope this survey will help to understand various kinds of routing protocol and techniques in WSN.

REFERENCES

[1] Yuxin Liu, Mianxiong Dong, Kaoru Ota, and Anfeng Liu, ActiveTrust: Secure and Trustable Routing in Wireless Sensor Networks, IEEE Transactions on Information Forensics and Security, Vol. 11, No. 9, pp. 2013-2027, 2016.
[2] Di Tang, Tongtong Li, Jian Ren, and Jie Wu, Cost-Aware SEcure Routing (CASER) Protocol Design for Wireless Sensor Networks**,** *IEEE Transactions on Parallel and Distributed Systems*, Vol. 26, No. 4, pp. 960-973, 2015
[3] Wang Ke, Ou Yangrui, Ji Hong, Zhang Heli, Li Xi, Energy aware hierarchical cluster-based routing protocol for WSNs, The Journal of China Universities of Posts and Telecommunications, Vol. 23, No. 4, pp. 46-52, 2016.
[4] Lein Harn, Ching-Fang Hsu, Ou Ruan, and Mao-Yuan Zhang, Novel Design of Secure End-to-End Routing Protocol in Wireless Sensor Networks, IEEE Sensors Journal, Vol. 16, No. 6, pp. 1779-1785, 2016.
[5] Da-Ren Chen, An energy-efficient QoS routing for wireless sensor networks using self-stabilizing algorithm, Ad Hoc Networks, Vol 37, Part 2, pp. 240-255, 2015.
[6] Said Raghay, New Smart nodes distribution using Kmeans Approach to enhance Routing in WSN, Indian Journal of Science and Technology, Vol 9, No. 46, pp. 1-8, 2016.
[7] Gurbinder Singh Brar, Shalli Rani, Vinay Chopra, Rahul Malhotra, Houbing Song, Energy Efficient Direction-Based PDORP Routing Protocol for WSN, Special Section on Green Communications and Networking for 5G Wireless, Vol. 4, pp. 3182-3194, 2016.
[8] Trong-Thua Huynh, Anh-Vu Dinh-Duc, and Cong-Hung Tran, Delay-Constrained Energy-Efficient Cluster-based Multi-Hop Routing in Wireless Sensor Networks, Journal of Communications and Networks, Vol. 18, No. 4, pp. 580-588, 2016.
[9] N. Kaleeswari, S. Sangeetha and Jerwin Prabu, Optimization Approach for Energy Consumption in Wireless Sensor Networks using Delay Aware Dynamic Routing Protocol, International Journal of Emerging Trends in Engineering and Development, Vol. 2, No. 7, pp. 54-61, 2017.
[10] Fatemeh Mansourkiaie and Mohamed Hossam Ahmed, Optimal and Near-Optimal Cooperative Routing and Power Allocation for Collision Minimization in Wireless Sensor Networks, IEEE Sensors Journal, Vol. 16, No. 5, pp. 1398-1411, 2016
[11] Jian Ana c, Ling Qib, Xiaolin Guia, Zhenlong Penga, Joint design of hierarchical topology control and routing design for heterogeneous wireless sensor networks, Computer Standards & Interfaces, Vol. 51, pp. 63-70, 2017.
[12] Xuan Liu, Jun Li, Zy Dong, Joint Design of Energy-Efficient Clustering and Data Recovery for Wireless Sensor Networks, IEEE ACCESS, Vol. 5, pp. 3646-3656, 2017.
[13] W. Heinzelman, A. Chandrakasan, and H. Balakrishnan, Energy - Efficient Communication Protocols for Wireless Microsensor Networks, Proc. Hawaiian Intl. Conf. Systems Science, DOI: 10.1109/HICSS.2000.926982, 2000.

[14] Boukerche, X. Cheng, and J. Linus, Energy-Aware Data- Centric Routing in Microsensor Networks, Proc. Sixth ACM Intl. Workshop Modeling Analysis and Simulation of Wireless and Mobile Systems (MSWIM' 03), pp. 42-49, 2003.
[15] O. Younis and S. Fahmy, HEED: A Hybrid, Energy- Efficient Distributed Clustering Approach for Ad Hoc Sensor Networks, IEEE Transactions Mobile Computing, Vol. 3, No. 4, pp. 366-379, 2004.
[16] R.C. Shah and J.M. Rabaey, Energy Aware Routing for Low Energy Ad Hoc Sensor Networks, Proc. IEEE Wireless Communications and Networking Conference (WCNC), pp. 350-355, 2002.
[17] Can Tunca, Sinan Isik, Mehmet Yunus Donmez, and Cem Ersoy, Ring Routing: An Energy-Efficient Routing Ring Routing: An Energy-Efficient Routing Protocol for Wireless Sensor Networks with a Mobile Sink, IEEE Transactions on Mobile Computing, Vol. 14, No. 9, pp. 1947-1960, 2015.
[18] Shuaishuai Tan, Xiaoping Li, and Qingkuan Dong, TrustR: An Integrated Router Security Framework for Protecting Computer Networks, IEEE Communications Letters, Vol. 20, No. 2, pp. 376-379, 2016.
[19] B. Karp and H. T. Kung, GPSR: Greedy perimeter stateless routing for wireless networks in Proc. 6th Annual. Int. Conf. Mobile. Conf. Networks, pp. 243-254, 2000.
[20] J. N. Laneman, D. N. C. Tse, and G. W. Wornell, Cooperative diversity in wireless networks: Efficient protocols and outage behavior IEEE Transactions on Inf. Theory, Vol. 50, No. 12, pp. 3062-3080, 2004.