# Energy Efficient, Protocols for Wireless Sensor Network: A Survey and Review

**Varun Sen[1] Dr. Shilpi Sharma[2]**
[1,2]Department of Digital Communication Engineering
[1,2]Bhopal Institute of Technology Bhopal, India

*Abstract*— Wireless sensor network (WSN) is emerging as most promising technology. WSN has numerous applications such as scientific exploration, disaster prevention and monitoring, healthcare, military surveillance, etc. WSN has limited resources with traditional data collection technique. One of the biggest limitation of Wireless Sensor Network is its nodes have limited energy resources. Maximize the energy efficiency in WSN is the biggest challenge. In this paper, we discuss about different studies in this area. By summarizing we found some pros and cons and trying to eliminate those drawback that belongs regarding our work, we also draw attention to possible research for future work.
***Key words:*** WSN, Flooding, Protocol

## I. INTRODUCTION

A Wireless Sensor Network is a network of sensors which distributed in a region, to communicate the sensed information to a sink node through wireless links. The sink may further be connected to other networks, like the internet, through a gateway. To solve the problem, they co-operate and co-ordinate with each other. Fig. 1.1 shows a typical WSN in which information from the sensor field is transmitted to the remote user. A single node is not sufficient to achieve much on its own, but when hundreds of them are distributed over a region, radical new technological possibilities emerge. Many applications such as military surveillance, scientific exploration, disaster prevention and monitoring, healthcare have been envisaged for them. Fig. 1.2 shows taxonomy of wireless sensor network applications. WSN can be used for two types of applications: monitoring and tracking. The network can be scaled very easily by adding more nodes to the network [1]. They can adapt to changing environmental conditions very easily by changing the network topology, which is not possible in the wired networks. There is strength in number for wireless sensor networks. By increasing the number of deployed nodes, WSN can cover an as large area as desired and can perform a wide range of applications [2].

The wireless sensor network devices equipped with sensors, a processor, memory, a radio interface, an A2D converter and a power supply. The sensors attached to the device can sense humidity, light, temperature, pressure, etc. The processor performs data processing and other functions. Due to power and bandwidth constraints, sensors have lower sensing rates and limited computational power. Sensors use a short-range radio to communicate with each other. Since communication is the most energy-intensive operation, efficient communication protocols must be used. Sensors may utilize power harvesting methods so that they can work unattended for many years. The requirements set by the new applications enabled by WSNs put several design constraints on them.

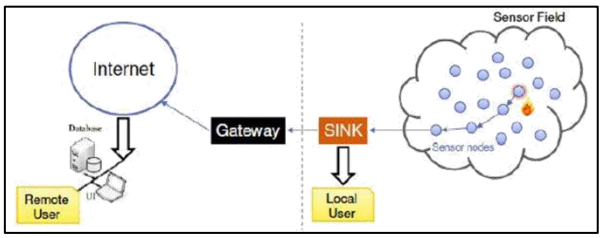


Fig. 1: Wireless sensor network (WSN) [1]

For instance, if it is difficult or infeasible to access the environment then ad-hoc deployment of sensors is preferred over pre-planned deployment. The number of nodes to be deployed also depends on the environment. An outdoor environment requires a large number of nodes to cover the entire region whereas few nodes may suffice in an indoor environment. Since sensors are very tiny devices; they have several resource constraints. They have a limited amount of energy supply, low bandwidth, very short communication range and limited storage and processing capability in each node. The unique features of wireless sensor network give rise to new challenges in the communication protocol, hardware, and application design. These challenges must be addressed to realize the envisioned applications. This requires modifying traditional protocols used by ad-hoc networks or designing new eff ective protocols tailor-made for WSNs.

## II. EXISTING RESEARCH SURVEY

Some survey of existing research in WSN, protocols for energy efficiency are described in this section.

Rahman et al. [3] have presented the energy efficient zigzag routing protocol for WSN. In this research author faces the issues of sensor nodes i.e. limited power and developed a routing protocol which optimizes the energy consumption.

A research study was carried out by Li et al. [4] on security mechanisms for WSN. The author has broadly explained the various routing protocols and mainly focused on the SPIN routing protocol. Author has compared each routing protocol by performing the simulation over NS2 Simulator and through analysis concluded that the SPIN algorithm is secure and maintains more confidentiality.

The combined study of Taranto's and Zagursky [5] prepared the efficient communication purpose medium access protocol for clustered WSN. The energy efficiency is the challenging issue in WSN as the sensor nodes of it have low power battery. Hence author has prepared the cluster based MAC protocol for WSN.

The low power adaptive RP for WSN is presented in Ji et al. [6]. To add the energy efficiency and disolve the data aggregation problem author has prepared the adaptive routing algorithm for clustering. In this clustering, For measuring the area head was selected based on node density. The results of algorithm are compared with LEECH algorithm and

 

concluded that the algorithm brings energy optimization as well as improved communication quality.

The work of Hu and Li [7] presented the geography region based clustering algorithm in WSN. In this, every region chooses its respective cluster head. To reduce the energy usage and proper resource allocation, multi-hop and single hop combination is used. The simulation result of the geographic region algorithm satisfies the above requirement.

A mechanism of load balance in WSN using compressive sensing is described in Cao and Yu [8]. In this work, the energy consumption of SNs is considered. The load is balanced by using compressive sensing, and the performance is evaluated by Tiny OS and simulation results represent the significant results.

The multipath routing for cluster tree WSN (ZigBee) in Bidai et al. [9]. The study is also concerned with efficiency, throughput and data transmission at low and high data rates.

Thaskani et al. [10] have developed a cross-layer design protocol using token passing mechanism in WSN to bring the energy efficiency. Optimization layer of WSN is presented to eradicate the issues of traditional energy efficient WSN method. Efficient results are found in this mechanism compare to some other routing mechanisms.

Author Othman et al. [11] have implemented the selfstabilizing algorithm to mitigate the energy usage in WSN. To build the backbone for a sensor that brings the efficient routing, the approximation algorithm is presented. The author has acomplished the efficiency in their method by simulation results.

To balance the load in WSN, a multipath routing protocol is presented in Ming-hao et al. [12]. A load balance algorithm is designed to balance the network over the established paths. The data packets are distributed over more number of SNs and help in energy optimization. The simulation is performed and compared the results with a various routing protocol. The mechanism brings the energy optimization in WSN.

For the uneven node deployment of WSN, a clustering routing algorithm is presented in Gu et al. [13]. In this, the sensing area was divided into various nodes and concentric annuli which are distributed over an uneven area. The method outcomes with better load balancing mechanism and energy optimization.

The work of Chabalala et al. [14] also described the cross-layer adaptive RP for WSN. The method is intended to minimize the usage of routing packets on WSN by which energy optimization will take place.

The work carried by Zhang and Li [15] have introduced the routing protocol for WSN. In this multi-level protocol between cluster heads and more sink nodes is presented. By simulation of this protocol, the author concluded that scalability increased and WSNs lifetime enhanced.

Authors Liu and Zhang [16] given the hybrid (Adaptive dynamic) routing algorithm for WSN. Authors have considered issues like redundant low rate data, low reliability, and energy balance in the communication channel. From the simulation results of the algorithm obtains better network transmission rate, communication channel reliability, energy balance.

A routing protocol with trust and link state is presented in Raha et al. [17], which eliminates the un-trusted nodes. Later it finds the most trustworthy link by calculating the trustworthiness of each route. The study gives the comparison of both direct and indirect trust.

A public transportation system monitoring mechanism is presented by using the WSN in Tianjin and Yao-yao [18]. The presented monitoring mechanism is completely implemented, and its structure of hardware and software is finally explained. The presented mechanism offers the better data transmission function.

## III. RESEARCH AND FUTURE SCOPE

The unique features of wireless sensor network give rise to new challenges in the communication protocol, hardware, and application design. Since nodes have limited energy supply, they are operated on low-duty-cycle. Nodes stay awake for a very small time between two long dormant periods. Low-duty-cycle flooding is a challenging problem for wireless sensor networks as every node has a random working schedule. Existing traditional flooding methods for always-awake networks cannot be used directly for wireless sensor networks.

Opportunistic Flooding is state-of-the-art flooding protocol for low-duty-cycle flooding in wireless sensor networks with the asynchronous working schedule. In this work, three diff erent protocols namely protocol X, protocol Y and protocol Z have been proposed for flooding in low-duty-cycle wireless sensor networks. Their performance is compared with opportunistic flooding protocol and the optimal bounds. It is observed that protocol Z outperforms all other protocols. Eff ects of link-quality variations and node failures on the performance of the protocol Z are investigated. It is shown that link-quality variations as high as 20% have insignificant impact on flooding performance. To ensure high flooding coverage in the presence of node failures, modified protocol Z is proposed. Modified protocol Z ensures high flooding coverage while incurring a little more energy cost than protocol Z.

## IV. CONCLUSION

In this survey paper, we described different research of routing protocols to save the energy and maximise the life cycle of sensor network. Here we have summarised different protocols, designs and algorithms. It gives me hint to consider the specific field that is energy efficiency, which will always demand improvisation to achieve optimised result.

## REFERENCES

[1] Y. Liu, Y. He, M. Li, J. Wang, K. Liu, and X. Li, “Does wireless sensor network scale? a measurement study on greenorbs,” IEEE Transactions on Parallel and Distributed Systems, vol. 24, no. 10, pp. 1983–1993, 2013.

[2] J. Chen, X. Cao, P. Cheng, Y. Xiao, and Y. Sun, “Distributed collaborative con-trol for industrial automation with wireless sensor and actuator networks,” IEEE Transactions on Industrial Electronics, vol. 57, no. 12, pp. 4219–4230, 2010.

[3] Z. Rahman, A. Rahim and M. Aslam, "ZRIC (Zigzag routing inside cluster) energy efficient routing protocol

 

for wireless sensor networks," Open Systems (ICOS), IEEE Conference on, Langkawi, pp. 381-383, 2011
[4] Y. Li, F. Liu and L. Ding, "Research about security mechanism in wireless sensor network," International Conference on Image Analysis and Signal Processing, Hubei, pp. 447-451, 2011
[5] R. Taranovs and V. Zagursky, "Medium access protocol for efficient communication in clustered wireless sensor networks," Telecommunications Forum (TELFOR), 19th, Belgrade, pp. 582-585, 2011.
[6] P. Ji, C. Wu, Y. Zhang and F. Chen, "A Low-Energy Adaptive Clustering Routing Protocol of Wireless Sensor Networks," Wireless Communications, Networking and Mobile Computing (WiCOM), 7th International Conference on, Wuhan, pp. 1-4, 2011,
[7] C. Hu and X. Li, "A clustering algorithm based on geography region for WSN," Electrical and Control Engineering (ICECE), International Conference on Yichang, pp. 480-483, 2011.
[8] G. Cao and F. Yu, "The Analysis of Load Balance for Wireless Sensor Network Using Compressive Sensing," Computational Science and Engineering (CSE), IEEE 14th International Conference on, Dalian, Liaoning, pp. 100-105, 2011
[9] Z. Bidai, H. Haffaf and M. Maimour, "Node disjoint multi-path routing for ZigBee cluster-tree wireless sensor networks," Multimedia Computing and Systems (ICMCS), International Conference on, Ouarzazate, pp. 1-6, 2011.
[10] S. Thaskani, K. V. Kumar and G. R. Murthy, "Energy efficient crosslayer design protocol by using token passing mechanism for WSN," Computers & Informatics (ISCI), IEEE Symposium on Kuala Lumpur, , pp. 572-575, 2011
[11] J. Ben-Othman, K. Bessaoud, A. Bui and L. Pilard, "Self-stabilizing algorithm for energy saving in Wireless Sensor Networks," Computers and Communications (ISCC), IEEE Symposium on Kerkyra, pp. 68-73, 2011
[12] T. Ming-hao, Y. Ren-lai, L. Shu-jiang and W. Xiang-dong, "Multipath routing protocol with load balancing in WSN considering interference," 2011 6th IEEE Conference on Industrial Electronics and Applications, Beijing, pp. 1062-1067, 2011
[13] Y. Gu, Y. Shao, H. Han and T. Yi, "A clustering routing algorithm of WSN based on uneven nodes deployment," Wireless Communications and Signal Processing (WCSP), International Conference on, Nanjing, pp. 1-6, 2011
[14] S. C. Chabalala, T. N. Muddenahalli and F. Takawira, "Cross-layer adaptive routing protocol for wireless sensor networks," AFRICON, Livingstone, pp. 1-6, 2011.
[15] Zhang and Y. z. Li, "Based on more sink nodes of routing protocolfor wireless sensor networks," Computer Sciences and Convergence Information Technology (ICCIT), 6th International Conference on, Seogwipo, pp. 25-30, 2011
[16] G. Liu and H. Zhang, "Adaptive dynamic hybrid routing algorithm in WSNs," IT in Medicine and Education (ITME), 2011 International Symposium, Cuangzhou, pp. 1-6, 2011
[17] A. Raha, S. S. Babu, M. K. Naskar, O. Alfandi and D. Hogrefe, "Trust integrated link state routing protocol for Wireless Sensor Networks (TILSRP)," 2011 Fifth IEEE International Conference on Advanced Telecommunication Systems and Networks (ANTS), Bangalore, pp. 1- 6, 2011
[18] D. Tianmin and S. Yao-yao, "Design of the intelligent public transportation monitoring system based on WSN," Consumer Electronics, Communications and Networks (CECNet), 2011 International Conference on, XianNing, pp. 4024-4027, 2011

 