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A Survey on Network Lifetime Maximization in Wireless Sensor Networks

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Abstract—Wireless Sensor Networks (WSNs) are being deployed in various environmental surroundings to monitor the events according to the need of the application. In WSN, network interference and energy consumption are the major factors to be considered to maximize the lifetime of the network. The prime aim of the survey is to analyze the techniques in order to mitigate the problems by reducing the interference, and high energy consumption by classify the taxonomy of techniques depending on the i) Self-Organizing and fault tolerance, (ii) QoS requirements, (iii) coverage & connectivity, (iv) mobility and deployment, and (v) Routing in WSN for maximization of network lifetime. Further, a brief outlook of recent techniques used in improving the lifetime of WSN is carried** out**.

Keywords— wireless sensor networks, energy efficiency, interference, network lifetime

I. INTRODUCTION

Wireless sensor networks (WSNs) have attracted significant attention in the recent years for a numerous number of application and it has become a hot research area [1]. A WSN is capable of sensing, aggregating data, and transmits the events generated through wireless communication [2]. Each of these devices is capable of concurrently sense and process the data [3, 4]. Having these capabilities on a sensor device, it offers a vast number of compelling applications. On examining the market for WSN in the current period, the rapid development of Internet of Things (IoT) and wireless communication has attracted many researchers and engineers for implementing new ideas in industrial revolution and academic studies. Furthermore the IoT enables to communication between human and machine by the use of intelligent technologies [5]. In a recent study conducted be Cisco IBGC, it has been predicted that a whopping amount of 50 billion users demand internet access by the year 2020. This includes a major part of users from the industry field of about 20%. Hence there is a need in integrating IoT and WSN to provide more efficient, automatic, and maintenance free structure.

In our manuscript, an overview of State-of-the-Art approaches in improving the lifetime of the network are surveyed based on the some of the important design constraints such as, (i) Data Transmission, (ii) Resource Limits, (iii) Coverage and Connectivity, (iv) Self-Organization and Fault tolerance, (v) QoS Requirements, (vi) Mobility and Deployment. The major classification we highlighted here is based on (i) Self-Organizing and Topology, (ii) Selection of relay and mobile sink, (iii) Coverage & Connectivity, (iv) Sleep Wake-Up transmission, and (v) Routing.

II. TAXONOMY NETWORK LIFETIME MAXIMIZATION BASED ON STATE-OF-THE-ART TECHNIQUES

Self-organizing and topology, selection of relay and mobile sink, coverage & connectivity, Sleep Wake-up transmission, and routing are the generalization of network lifetime maximization of WSNs.

WSNs require self-organization abilities that allow each node to find a path towards the sink without any human intervention. The two main issues faced in WSNs are connectivity and coverage area. Sensing coverage and network connectivity are two of the most fundamental problems in wireless sensor networks. These two challenges play a vital role in providing the Quality of Service (QoS). Another method used to conserve the energy in WSN is by sleep scheduling. By doing this, each sensors goes to sleep mode when it is not used and only becomes active during the transmission or reception of data. However, due to the varying topology and nature of WSN, an efficient routing protocol has to be designed to improve the system performance.

TABLE 1

RELEVANT LITERATURES ON VARIOUS STATE-OF-THE-ART TECHNIQUES FOR NETWORK LIFETIME MAXIMIZATION

Name of author & year	Classification	Methods	Advantages	Disadvantages
Hu and Lu [6] 2018	Clustering topology	RHCS and SFTEM	Improved fault tolerance and saves energy	No backup scheduling when failure occurs in the network
Hao et al. [7] 2018	Topology	MLPM and TCAMLPM	To improve network robustness, network connectivity and the network lifetime	Prolong the coverage for minimum number of nodes
Ma and Zhao [8] 2018	relay	C1NP	Achieves the connectivity requirement associated with HCRNP problem.	More deployment cost
Kumar et al. [9] 2018	Mobile sink	ACO-MSPD	Increased network lifetime and reduced delay	Not suitable for extra-large network
Elhoseny et al. [10] 2018	coverage	GA	Coverage requirements are optimized in WSNs and lifetime is increased.	Not suitable for homogeneous model of WSN.
Xu et al. [11] 2018	coverage	Hybrid-MOEA/D-I and Hybrid-MOEA/D-II	Reduce energy consumption retaining with more coverage rate.	Further need improvement in coverage problem.
Ye [12] 2018	sleep/wake-up approach	TR-MAC	Provides a new way in sleep/wake-up scheduling in WSNs.	Extremely complex.
Lalwani et al. [13] 2018	Routing/ swarm	HSA	It provides the complete routing solution for each CH.	Fault-tolerance and delay is not considered.
Gupta and Jha [14] 2018	Routing/ swarm	Cuckoo–Harmony Search based algorithm	It provides the complete routing and clustering solution for each CH selection.	It has an issues of communication void, network with obstacles, and delay sensitivity.

III. CONCLUSION

Energy is the most essential resource in sensors that ultimately defines the network lifetime. Hence, energy usage is a significant problem for these systems due to restricted battery capabilities of SNs. This article makes effort in this direction, as it provides a comprehensive review for improving the network lifetime by reducing interference and energy consumption. The future direction of this work can be taken as follows. Firstly, further research needs to be conducted in addressing the lifetime, interference, QoS problem, authentication, efficiency, that are existing in real-time applications. There are a lot of node-mobility applications, thus handling the overhead of node mobility and topology changes, routing, coverage and connectivity etc, must be further taken into account. Therefore, a compromise between reducing interference is still an open question.

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