ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

REALIABILITY EVALUATION OF WIRELESS SENSOR NETWORKS- A Review

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DOI: 10.5281/zenodo.205836

ABSTRACT

Reliability Evaluation of WSN is an currently the booming topic in the communication networking environment which has a drastic advantage over the traditional method and has to be adopted in the industrial environment for the mile connections in networking .The WSN is also an alarming need in the communication network to transport, chunks of data that are forwarded in node to node form in most of the application in the day to day life that has an outrageous development in the present world in the field of networking, which has adaptive link control and enhanced hop-by-hop reliability. The WSN has thousands of sensor points which enable the evaluation of permanent faults, optimize the fault occurrences (by improving the WSN QoS), sensor fusion,collaborative target tracking, along with this the Zigbee based networking solution is rapidly rising as one of the best choices in order to provide the reliable WSN environment among the variety of sensor network applications. . On this aspect, this paper aims to discuss the technology to evaluate the reliability of sensor network

KEYWORDS: WSN, QoS, hop-by-hop, Zigbee, sensor fusion.

INTRODUCTION

Wireless sensor network has been used in variety of areas such as visual, thermal, seismic, acoustic, and magnetic, that can monitor temperature, noise , radioactivity, pressure , speed and object movement. It is to analyze the reliability issues and importance of heterogeneous fault tolerance, where a single type of sensor backs up different types of sensors. WSN devices are capable to compute and communicate to provide a way for efficient low cost, provide low complexity, less power consumption, and low data rate wireless connectivity among inexpensive devices for all sensing applications. The WSN standard can be applied for not only home network, but also very small device network which makes use of sensor methodology. The WSN consists of thousands to hundreds of sensor nodes that collect data from different environment and send them to the sink node,which in forward it to remote user. Specifically, when we try to apply the reliability of point to point transmission to WSN, variety of reliability related parameters are considered for the WSN. WSN is a multi-service path for transforming the data for the communication purpose of voice or video format. Individual voice or video type of service has a particular constraint to satisfy the communication in an effective manner. For example a voice or video data has a time delay to transmit data within a certain delay sensitive time. So the constraints are satisfied for each type of data needs. Hence it is also considered to be the multiple fashioned sensors for fusion.

WSNs are densely deployed for a wide range of applications in the military, health, environment, agriculture and smart office domain. Wireless sensor networks are a distributed, self-organization solution to provide sensing and computing in various environments where conventional networks are impractical. However, reliability in wireless sensor networks is an intractable issue due to the limited power and computing capability of little sensors [1][2]. The cost for processing power and wireless communication started to decrease which eventually made WSNs more reasonable and more attractive[3]. Some studies on QoS have focused on protocols and mechanisms for MAC and the network layer, and almost all these have been developed and tested through simulations. All these approaches for supporting QoS in WSN can constitute a base for future work in this direction, and they obviously represent the starting point in our proposal. We have already conducted work on state-of-the-art QoS in WSNs. This work has focused mainly on QoS-based protocols and mechanisms both in MAC and network layers. The results of this work can be consulted in [4]. It's necessary to study how reliability can be guaranteed in such an error prone environment. There are two well-known ways to achieve reliability on multi-hop paths: multipath and retransmission [5-6]. The structure of wireless sensor network have two categories, that is, flat structure and hierarchy structure[7].The wsn applications may require reliable network for collecting all data without loss from nodes. But on the other hand the inexpensive sensor nodes may not be highly reliable since they are limited in energy, memory space and processing capabilities, and the onboard sensors have direct contact with the environment. This results in error introduced in some of the sensor measurements while sensing, processing or reporting the data to the sink.So in order to improve data integrity and detection reliability [8].

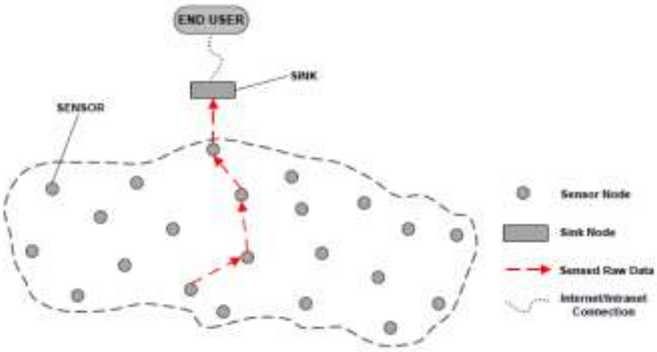

Fig1. Wireless sensor network

THE TYPICAL BASIC STRUCTURE OF WSN

The structure of wireless sensor network has two categories, that is, flat structure and hierarchy structure [9-11], Fig 2. It is a relatively simple model of hierarchical wireless sensor network, and the model consists of three layers. The bottom layer consists of sensor nodes which complete the perceived acquisition task; the middle layer is the gateway layer, it is composed of sink nodes which are relatively abundant in terms of the resources in wireless sensor network, and completes all data transmission task. It is divided into two steps, sink nodes in sub network collect all perceptual information of sensor nodes firstly, then each sink node in subnets transmits all the information to the monitoring center in multi-hop way; the highest level is the monitoring center, and it is the control decision center to end user[9-10].

CLASSIFICATION OF RELIABILITY MODELING AND EVALUATION

Reliability of WSN, depends on combination of hard- ware, software and wireless link is modeled in many ways the to reliability modeling of hardware system. Fig 1.Two of the most commonly used are: Deterministic reliability modeling Probabilistic models, but probabilistic not suitable for modeling the reliability of real time applications of WSN [11].

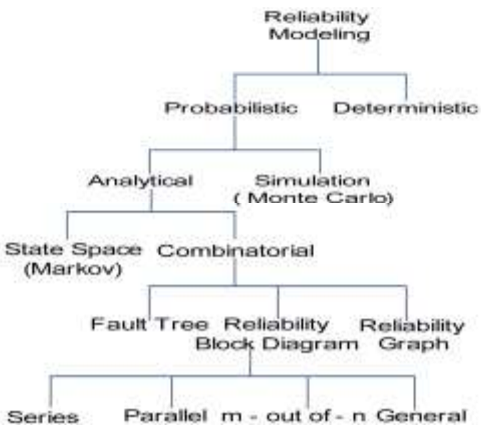

Fig 2. Classification of reliability models.

CLASSIFICATION OF RELIABILITY OF WSN

In WSNs critical event data collected by the sensor nodes need to be reliably delivered to the sink for successful monitoring of an environment. Therefore, given the nature of error prone wireless links, ensuring reliable transfer of data from resource constrained sensor nodes to the sink is one of the major challenges in WSNs. Reliable transfer of data is the surety that the packet carrying event's information arrives at the destination[19]. In WSNs, reliability can be classified into bellow levels i.e.

- Packet or Event reliability level
- Hop-by-Hop or End-to-End reliability level

Packet or event reliability is concerned with how much of information is required to notify the sink of an occurrence of something happening in the environment. Packet reliability requires all the packets carrying sensed data from all the sensor nodes to be reliably transported to the sink. Whereas, event reliability ensures that the sink only gets enough information about a certain event happening in the network instead of sending all the sensed Packets[19].

LITERATURE REVIEW
Antônio Dâmaso *et al*.,[29] represent presented a WSN reliability model that is generated automatically from the WSN topology and information about adopted routing algorithms and the mote battery level. This model considers that WSN can fail in two points: links and sensor nodes. The proposed models were evaluated in three scenarios. Using these scenarios, it was possible to observe that the reliability of a particular region is affected by the routing protocol adopted, by the number of nodes belonging to the region and by the distance of these regions to the sink node. This paper has three main contributions related to the evaluation of WSN: it considers the mote energy level as the main factor of failures of WSN nodes; it uses the routing algorithm to define the paths between different WSN regions and the sink node; and it automatically generates reliability models considering the aforementioned elements. As future work, two main steps are now starting to be developed: to consider the reliability of additional communication protocols (e.g., B-MAC and RSMT); and to extend the current tooling in such way that it becomes able to suggest improvements in the WSN in order to increase the WSN reliability.

Yueh-Min Huang *et al.*,[16] Wireless sensor networks are well suited to remote sensing applications due to their flexibility, scalability, fault tolerance, high sensing fidelity, low-cost and rapid deployment and reconfiguration. Wireless sensor networks technology was surveyed with particular emphasis on their low-rate wireless communication, routing protocols, network architecture and applications. Taeshik Shon and Hyohyun Choi [30], have proposed a hybrid hop-by-hop reliable transport approach based on IEEE 802.15.4 standard for wireless sensor network. A hybrid hop-by-hop reliability approach is an efficient and simple transmission mechanism in order to guarantee high link reliability between sensor nodes and short delay time between end-to-end communications. The distinguishing features of hybrid hop-by-hop reliable approach are an adaptive link control scheme and enhanced hop-by-hop scheme. A key design idea we made an adaptive link control scheme is that an application type of a packet and link status are first considered when a packet has to be sent. And then appropriate MAC transmission parameters are chosen according to the first considered two features. Another important advantage of our approach is to improve highly end-to-end reliability using node-cache and hop acknowledgement with an alternative path finding in comparison with the existing upper layer support schemes. To the best of our knowledge, the enhanced hop-by-hop reliability is very stable and efficient solution without end-to-end long round-trip delay. Md. Mamun-Or-Rashid *et al.,* [31]Reliable event perception is essential for collaborative actions in many envisioned applications of sensor networks. Congestion in WSNs causes huge packet loss and thereby hinders reliable event detection. We found that two major reasons of congestion are (i) congestion due to collision and (ii) congestion due to buffer overflow. To reduce packet loss and achieve a fair delivery ratio we propose a *source count* based hierarchical medium access control (HMAC) and weighted round robin forwarding (WRRF). HMAC ensures a hierarchical access of the medium according to the *source count* value. While WRRF assigns a weighted-share of packet delivery to the downstream node. These two schemes together greatly reduce media contention and thereby congestion due to collision. Congestion due to buffer overflow is completely avoided. we proposed a secure and Suat Ozdemir,[31] reliable data aggregation protocol using trust relations among sensor nodes.

The proposed protocol establishes a web of trust based on node misbehaviors. Data aggregators weight collected data using the web of trust to improve the reliability of the aggregated data. Simulation results show that the proposed protocol ensures the reliability of the aggregated data in the presence of compromised nodes. Moreover, the overhead imposed the proposed protocol is shown to be tolerable [32].

APPLICATIONS OF WSN
A wide range of WSN applications and systems have been developed in recent years. WSN applications can be classified according to their design dimension [12] or areas of deployment [13]. There are several WSN

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

applications that utilize multiple hop radio connectivity between wireless sensor nodes in a mesh network, such as military applications,environment applications, habitat monitoring applications, various self-organization or reconfigurable wireless sensing applications and other applications like Zigbee. These applications may be fixed or may evolve. Applications are designed to detect events or monitor the environment through a large number of unattended wireless sensor nodes [16]. Two examples [17, 18] of such networks can be found in military and environmental monitoring applications (see Figs. 4 and 5). WSN design dimensions include deployment, mobility, resources, cost, energy, heterogeneity, modality, infrastructure, topology, coverage, connectivity, size, lifetime and QoS. Example applications include Great Duck (bird observation on Great Duck island), ZebraNet, Glacier Monitoring, Cattle Herding, Bathymetry,\ Ocean Water Monitoring, Grape monitoring, Cold Chain Management, Rescue of Avalanche Victims, Vital Sign Monitoring, Power monitoring, Parts Assembly, Tracking Military Vehicles, and Self-healing Mine Field and Sniper Localization [12,14,15].

Fig. 4 WSN military applications (Reproduced with permission from USC information sciences institute [17]

Military Applications

Military sensing networks are designed to detect and gain as much information as possible about enemy movements, explosions, and other phenomena. Therefore, wireless sensor nodes are integrated with military command, control, communications, computing, intelligence, surveillance, reconnaissance and targeting systems.

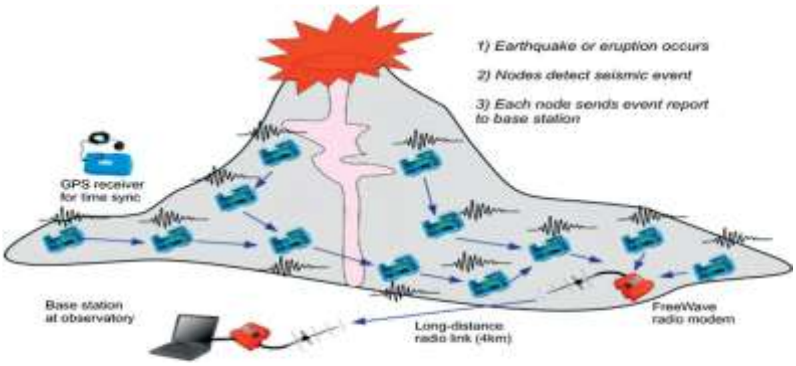

Fig. 4 A WSN environmental monitoring application (Figure taken from [18])

Environment Applications

Examples of environmental WSN applications include tracking the movements of animals, and insects, forest fire detection, habitat monitoring, flood detection, precision agriculture and civil and environmental engineering monitoring. Forest fires are uncontrolled fires that occur in wild areas which cause significant damage to natural and human resources. A forest fire wireless sensor network detection system can relay the exact origin of the fire and minimize the scale of the disaster.

There are several WSN applications that utilize multiple hop radio connectivity between wireless sensor nodes in a mesh network, such as military applications, habitat monitoring applications, and various self-organization or reconfigurable wireless sensing applications. These applications may be fixed or may evolve. Applications are designed to detect events or monitor the environment through a large number of unattended wireless sensor nodes.
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Other Applications

The Zigbee and 802.15.4 standards have triggered a wide range of application that are becoming increasingly commonplace and this development is expected to continue as the sensing technology and wireless communication technologies evolve. Wireless sensor network design issues related to various application types has been discussed including securityand synchronization. Which are suited to remote sensing applications due to their flexibility, scalability, fault tolerance, high sensing fidelity, low-cost and rapid deployment and reconfiguration.

RESEARCH OPPORTUNITIES AND CHALLENGES

1. The Zigbee and 802.15.4 standards have triggered a wide range of application that are becoming increasingly commonplace and this development is expected to continue as the sensing technology and wireless communication technologies evolve. WSN design issues related to various application types can be discussed including synchronization, connectivity, security, and real-time communication.
2. We believe that an intelligent combination of retransmissions and redundancy schemes to achieve high level reliability will be the challenge of the search research.
3. The diverts to the attention towards achieving data transport reliability in wireless multimedia sensor networks and WSNs powered by energy harvesting , which is mostly unexplored in terms of reliability.
4. Multimedia-based sensing in WSNs is also important . Multimedia data, in forms of snapshots, audio, and video require strict QoS support from the network. New QoS-compatible media formats multimedia sensing may become one of the major research topics in WSNs.
5. Two main steps are now starting to be developed: to consider the reliability of additional communication protocols (e.g., B-MAC and RSMT); and to extend the current tooling in such way that it becomes able to suggest improvements in the WSN in order to increase the WSN reliability.
6. To extend the research of path selection and focus on how to effectively deal with congestion and interactional routing of multiple sources from the whole network perspective
7. There are opportunity to an intelligent combination of retransmissions and redundancy schemes to achieve high level reliability which will be the center of research.

METHODOLOGY

WSN Power Consumption Evaluation is as important to assess as its reliability. WSN power Consumption may be evaluated as proposed in [25, 26]. In this approach, Coloured Petri Net (CPN) [27–28] evaluate the WSN power consumption through a set of steps as shown in Fig 5. In the first step, the user implements an application (in a programming language) and configures the WSN by defining its topology and adopted communication protocols. Next, the application code and network configurations are converted into Application and Network CPN Models, respectively.

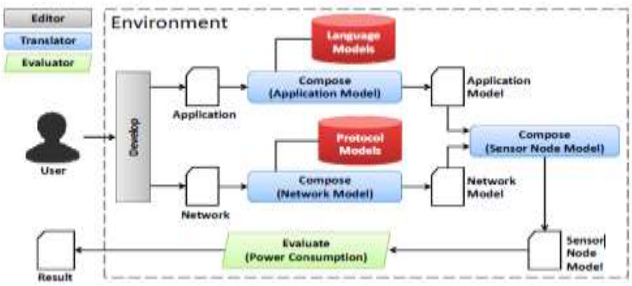

Fig 5. Step-by-step to evaluate the power consumption of WSNs.

CONCLUSION

There are various methods to handle the reliability of the wsn in the sensor network field , whereas here in this we have tried to define a way to produce a reliable free data transfer throughtout sensor environment with a suitable challenges that can be taken up as an opportunity to improve the reliable wsn evaluation with certain methodologies and algorithms that can be implemented to produce a proper outcome.,Which enhance the wsn and also help in the design,deployment and overall handling of the wsn.

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