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# A STUDY ON NODE RELOCATION ENERGY EFFICIENCY AND POWER MANAGEMENT IN WIRELESS SENSOR NETWORK

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## ABSTRACT

Wireless Sensor Network (WSN) is one among the fastest growing technologies in wireless domain. The sensor nodes are typically light weight and with limited battery power they're failure-prone too. So, efficient power saving schemes must be designed and developed to optimize energy consumption and thereby improve overall network lifetime. Clustering technique is one of the time-tested approaches that effectively reduce energy consumption. The lifetime of WSNs is enhanced by uniform clustering that balances network load among the clusters. The schemes are analyzed thoroughly and a few of them are simulated to assess performance.

In order to extend the availability of the wireless sensor network and to extract maximum possible information from the surveillance area, proper usage of the power capacity of the sensor nodes is important. A deterministic approach is used to deploy sensor nodes into the sensor field where Hexagonal Grid positioning is used to address and locate each sensor node. Sensor nodes those are not planned to be actively used in the close future in a specific cell are preemptively relocated to the cells those will be in need of additional sensor nodes to improve cumulative connected coverage of the network.

## KEYWORDS

wireless sensor network, routing protocol, node relocation, MCU, ADU, power consumption, MaxNetLife, MEMS

## INTRODUCTION:

A SENSOR NETWORK comprises a group of small, powered devices, and a wireless or wired network infrastructure. Sensor network nodes cooperatively sense and control the environment. They enable interaction between persons or computers and the surrounding environment.

A SENSOR NETWORK record conditions in any number of environments including industrial facilities, farms, and hospitals. The sensor network connects to the internet or computer networks to transfer data for analysis and use.

A SENSOR NETWORK connects numerous sensor nodes that can detect information such as heat, pressure, and motion. With the rapid development of sensors, sensor networks are a vital part of the internet of things (IoT) and the modern world.

A SENSOR NETWORK can be wired or wireless. Wired sensor networks use Ethernet cables to connect sensors.

## OPERATION OF SENSOR NETWORK

Sensor networks typically include sensor nodes, actuator nodes, gateways, and clients. Sensor nodes group inside the sensor field and form networks of different topologies.

### The following process describes how sensor networks operate:

A sensor node monitors the data collected by the sensor and transmits this to other sensor nodes.

During the transmission process, data may be handled by multiple nodes as it reaches a gateway node.

The data is then transferred to the management node.

The management node is managed by the user and determines the monitoring required and collects the monitored data.

### Wireless Sensor Network

WIRELESS SENSOR NETWORKS (WSNs) are collections of mini sensor nodes capable of sensing, processing and broadcasting data correlated to some occurrence in the network area.

WIRELESS SENSOR NETWORK (WSNs) is used in most of the real time monitoring applications such as flood monitoring, landslide detection, habitat monitoring, health monitoring, military applications etc. WSN consists of distributed autonomous devices which sense the environmental or physical conditions cooperatively and pass the information through the network to a base station.

Enhancing the lifetime of WIRELESS SENSOR NETWORKs and efficient utilization of bandwidth are essential for the addition of wireless sensor networks in different applications. Recent advancements in micro-electro-mechanical-system (MEMS) and wireless communication technology, opens the way for the growth in applications of wireless sensor networks (WSNs).

Based on the structure of the network, routing protocols in WIRELESS SENSOR NETWORK can be broadly classified into three categories: flat routing, hierarchical or cluster-based routing, and location-based routing.

WIRELESS SENSOR NETWORK (WSNs), as distributed networks of sensors with the ability to sense, process and communicate, have been increasingly used in various fields including engineering, health and environment, to intelligently monitor remote locations at low cost. Sensors in such networks are responsible for four major tasks: data aggregation, sending and receiving data, and in-network data processing.

This implies that they must effectively utilize their resources, including memory usage, CPU power and, more importantly, energy, to increase their lifetime and productivity. Besides harvesting energy, increasing the lifetime of sensors in the network by decreasing their energy consumption has become one of the main challenges of using WSNs in practical applications.

### Sensor Node Energy Efficiency

SENSOR NODES (SN) represent a tiny, inexpensive and main constituent part of Wireless Sensor Networks (WSN). As the main source of power supply of SNs is usually battery, which have a strictly limited capacity, the batter y life extension is the main driver for energy-efficient WSN design.

SENSOR NODES communicate together by many wireless strategies and these communication strategies are administered by routing protocols. Performance of sensor networks largely depends on the routing protocols, which are application based.

SENSOR NODES have various energy and computational constraints because of their inexpensive nature and ad hoc method of deployment. Energy optimization is a critical challenge in WSN since sensor nodes only have a small and finite source of energy. Energy optimization is more complicated in sensor networks because it involves not only reduction of energy consumption but also prolonging the life of the network as much as possible. SENSOR NODES have extreme limitations, such as: bandwidth, short communication range, limited CPU processing facility, memory and energy.

**Impact on Relocation of Sensor Nodes on Coverage of Network**

Wireless sensor networks (WSNs) deployed in harsh and unfavorable environments become inoperable because of the failure of multiple sensor nodes. This results into the division of WSNs into small disjoint networks and causes stoppage of the transmission to the sink node.

Furthermore, the internodal collaboration among sensor nodes also gets disturbed. Internodal connectivity is essential for the usefulness of WSNs. The arrangement of this connectivity could be setup at the time of network startup. If multiple sensor nodes fail, the tasks assigned to those nodes cannot be performed; hence, the objective of such WSNs will be compromised.

Recently, different techniques for relocating of sensor nodes to recover the connectivity have been proposed. Although capable to restore connectivity, these techniques do not focus on the coverage loss. The objective is to provide a solution for both coverage and connectivity via an integrated approach.

A novel technique to relocation neighboring nodes for multi node failure is introduced. In this technique, neighboring nodes of the failed nodes relocate themselves one by one and come back to their original location after some allocated time.

The sensing nodes in Wireless Sensor Network have low power, memory, and computational and radio capabilities. On the contrary, these sensors must perform variety of thermal, mechanical, chemical, biological, magnetic, and optical tasks to measure the environmental properties. Furthermore, these sensors must also communicate from hostile/harsh environment via attached radio to the base station. The major power source of the sensor is the battery.

The secondary power supply may be equipped such as the solar panel to gather the power from the external environment. An actuator can be attached to sensors, depending on the type of sensor and application.

**Power Management in Wireless Sensor Network**

Wireless Sensor Network has greatly evolved the energy efficient utilization. The selection of cooperation nodes must be a long-time usable battery because batteries are not easily rechargeable and available which is not reliable. The selection of such nodes to reduce error estimation and power conserving.

For efficient energy stable power and long-term system adopts a Maximum power point tracking (MPPT) circuitry. In power saving techniques employs power control and power management techniques. Power control includes two factors distance and link factor which affect the power transmission. Power management schema use energy harvesting schemes on different nodes by sleep/awake method. Energy efficient algorithms increase efficiency of power and life time of battery.

There are many Wireless Sensor Network platforms which were proposed to support these applications, the general trend being the focus on low power, small form factor, and very low cost. Advances in sensor technologies, RF communications, low power computing, power generation and power management have resulted in low cost, low power systems which operate battery less, or on small batteries and/or using some smart multi harvester systems.

Developments in low power computing architectures have resulted in a new trend in WSN, namely the migration from communication centric (sending sensed data) to information centric (sending processed data or information) Wireless Sensor Network. Another trend is in the integration of the RF transceiver, the MCU and ADC in a System on Chip (SoC) with the focus being shifted towards more computationally powerful MCU with co-processors (ASIC or FPGAs) being frequently deployed in energy efficient systems.

The dominant constraint in designing Wireless Sensor Network system is by far the power consumption. There are many models for power consumption in Wireless Sensor Network and they are based on the main constituent blocks of a typical node The RF transceiver unit is often identified as one of the major power consumption unit and significant research, development and standardization emphasis was on the design of ultra-low power wireless transceivers. namely: Radio (RF) communications, computing unit (MCU/FPGA and Memory), sensor/actuator unit, and power management unit. For the MCU, the general trend is represented by the migration from 8/16(Atmel/TI) bit towards 32-bit (ARM) architectures.

## RESEARCH AIMS AND OBJECTIVES

The aim of this research is to propose an energy constituent-based model. Not only does modelling of constituents as single energy consumption units present many possible strategies for maximizing the network's lifetime, it also has a few benefits when WSN is seen as a composition of these constituents.

The composition of constituents allows optimization of the energy consumption of a node if desired, permits optimization of a selected constituent for a specific application, and, more importantly, allows an overall optimization of the energy consumption of the entire network by considering the play-off between constituents. Furthermore, the constituents can be adapted to suit the required application.

This research focuses on minimizing and optimizing energy consumption based on the energy consuming constituents as a general model for WSN deployment and development. The model deals with all common aspects of energy consumption in all types of WSNs.

We believe designing wireless sensor networks with their energy constituents in mind will enable designers to balance the energy dissipation and optimize the energy consumption among all network constituents and sustain the network lifetime for the intended application.

Our aim is to propose a single overall formulation of the energy consumption of the entire wireless sensor network. Another possible but more difficult formulation expresses the energy consumption model as a non-linear function of its constituents. This approach requires more extensive exploration, as we do not understand well enough the metrics associated with the energy of each constituent and we are unsure about the mathematical models that can describe such a non-linear relationship.

In this study we comprehensively model the components of each of the five energy constituents of the architecture. The aim is to provide an accurate account of all functional aspects of a constituent and their salient energy-related parameters. These parameters will allow us to evaluate the performance of WSNs, optimize their operation, and design more energy efficient applications.

## CONCLUSION:

We propose a dynamic relocation algorithm called MaxNetLife, which is mainly based on utilizing the remaining power of individual mobile sensor nodes as well as total remaining power of all sensor nodes in clusters within the surveillance area. It also aims to maximize the amount of total collected valuable information from the surveillance area before the death of the sensor network by increasing cumulative connected coverage throughout the sensor network lifetime.

A deterministic approach is used to deploy sensor nodes into the sensor field, where Hexagonal Grid positioning is the selected method to address and locate sensor nodes, since it is the best method to maximize the connected coverage with a given amount of sensor nodes. Excess nodes are preemptively migrated to the cells when number of sensor nodes is decreased below a threshold to prevent a possible hole. When early reaction is impossible, master nodes are relocated to the neighboring cells after the hole occurs. The algorithm also includes details of the relocation activities of the sensor nodes.

MaxNetLife assures highest possible cumulative connected coverage before sensor network dies; thus, this work outperforms all other relocation related algorithms. We also developed an open-source simulation environment, called Mobil-Sim using Java programming language, which we use in simulating our model.

We created various simulation models to measure the effects of relocation cost, mobility capability, deployment type, node density, and time. Results have proven that mobile sensor network using MaxNetLife algorithm outperforms immobile network. MaxNetLife algorithm is also proved to be effective, scalable in cell density in clusters scalable in node density in nodes, and applicable through simulation.

## REFERENCES:

[1] ISSN: 04532198 Volume xx, Issue xx, January, 2020 45 Deep Coverage Strategy for Private Wireless Network Power Using Hybrid (Salp Optimization – Genetic) Algorithms Ibrahim Ahmed Saleh1, Omar Ibrahim Alsaif2, Kifaa H. Thanoon3 Software Engineering Depart., College of Computer and Math, University of Mosul1 Computer System Depart., Mosul Technical Institute, Northern Technical University

[2] Volume 8. No. 8, August 2020 International Journal of Emerging Trends in Engineering Research Available Online at http:// www. warse. org/ IJETER /static/ pdf/ file/ ijeter

38882020.pdf https://doi.org/10.30534/ijeter/2020/38882020 An Efficient Energy Saving Scheme Through Sorting Technique for Wireless Sensor Network Hitesh Mohapatra1,3* , Sourabh Debnath2 , Amiya Kumar Rath3 , Pravinkumar B Landge4 , S. Gayen5 , R. Kumar6 1Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram-522502, Guntur, Andhra Pradesh, India: hiteshmahapatra@gmail.com* 2Department of CS&E, National Institute of Technology, Rourkela, OD, India 3Department of CS&E, Veer Surendra Sai University of Technology, Burla, Sambalpur-768018, OD, India 4Department of Information Technology, SVKM's NMIMS, Shirpur, MH, India 5Department of Mathematics, National Institute of Technology, Jamshedpur, JH, India 6Department of MCA, Jain Deemed to be University, Jayanagar, Bangalore, KA, India

[3] ICSES Transactions on Computer Networks and Communications (ITCNC), Vol. 6, No. 1, March 2020 Manuscript ID = 315 — Copyright © 2018 International Computer Science and Engineering Society (ICSES) — ISSN: 2588-5847 Website: www.i-cses.com — E-mail: info@i-cses.com 1 Energy Efficient Approaches in Wireless Sensor Networks Vinh T. Vu a, Toan V. Quyen b , Linh H. Truong a,c , Anh M. Le a,d , Cuong V. Nguyen a, Minh T. Nguyen b,* a Thai Nguyen University of Information and Communication Technology (ICTU), Viet Nam bThai Nguyen University of Technology, Thai Nguyen (TNUT), Viet Nam c Tsinghua National University (NTHU), Taiwan d National Chiao Tung University (NCTU), Taiwan

[4] e-ISSN: 2582-5208 International Research Journal of Modernization in Engineering Technology and Science Volume:02/Issue:09/September-2020 Impact Factor- 5.354 www.irjmets.com www.irjmets.com @International Research Journal of Modernization in Engineering, Technology and Science [37] STUDY OF COVERAGE AND CONNECTIVITY PROBLEMS IN WIRELESS SENSOR NETWORK R. Christal Jebi*1, Dr. S. Baulkani2 *1Research Scholar, Department of Information and Communication Engineering, Anna University, Chennai, India Email id: jebijewish@gmail.com 2Associate Professor, Department of Electronics and Communication Engineering, Government College of Engineering, Srirangam, India Email id: ramabaulkani@yahoo.co.in

[5] Industrial Wireless Sensor Networks: Protocols and Applications Seong-eun Yoo 1 and Taehong Kim 2, * 1 School of Computer and Communication Engineering, Daegu University, Gyeongsan 38453, Korea; seyoo@daegu.ac.kr 2 School of Information and Communication Engineering, Chungbuk National University, Cheongju 28644, Korea * Correspondence: taehongkim@cbnu.ac.kr; Tel.: +82-43-261-2481 Received: 12 October 2020; Accepted: 13 October 2020; Published: 14 October 2020

[6] Energy-efficient data transmission technique for wireless sensor networks based on DSC and virtual MIMO Manish Kumar Singh1,2 | Syed Intekhab Amin2 This is an Open Access article distributed under the term of Korea Open Government License (KOGL) Type 4: Source Indication + Commercial Use Prohibition + Change Prohibition (http://www.kogl.or.kr/info/licenseTypeEn.do). 1225-6463/$ © 2020 ETRI 1 KIET Group of Institutions, Ghaziabad, India 2 Jamia Millia Islamia, New Delhi, India Correspondence Manish Kumar Singh, KIET Group of Institutions, Ghaziabad, India. Email: mks.manish1983@gmail.com

[7] International Journal of Computer Engineering and Technology (IJCET) Volume 11, Issue 2, March-April 2020, pp. 31-48, Article ID: IJCET_11_02_004 Available online at http://www.iaeme.com/ijcet/issues.asp?JType=IJCET&VType=11&IType=2 Journal Impact Factor (2020): 10.8630 (Calculated by GISI) www.jifactor.com ISSN Print: 0976-6367 and ISSN Online: 0976–6375 © IAEME Publication ENERGY EFFICIENT ROUTING PROTOCOL IN WIRELESS SENSOR NETWORK Anamika Walter, Manoj Singh and Shankar Sharan Tripathi Shri Shankaracharya Technical Campus, Shri Shankaracharya Engineering College, Bhilai (C.G.), India

[8] Hindawi Journal of Sensors Volume 2019, Article ID 3486036, 1-page https:// doi. org/ 10.1155/2019/3486036Enhancing Energy Efficiency of Wireless Sensor Network through the Design of Energy Efficient Routing Protocol Journal of Sensors Received 20 December 2018; Accepted 20 December 2018; Published 12 March 2019 Copyright © 2019 Journal of Sensors. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.