ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 5, Issue 3, March 2018

Ecnm: Energy Conscious Native Monitoring In Wireless Sensor Networks – Certain Exploration

[1] M. Satheesh Kumar, [2] P.RaviKumar
[1] Assistant Professor, Department of Information Technology
[2] Associate Professor, Department of Electronics & Instrumentation Engineering
[1][2] K.L.N College of Engineering, Madurai, Tamilnadu, India

Abstract: - **Energy consumption is one of the leading constraints of the wireless sensor node and this limitation combined with the typical positioning of large number of nodes have added many challenges to the design and management of wireless sensor network. Wireless sensor network is at this moment receiving substantial consideration due to their unlimited potential, so in the last few years wireless sensor networks have extended attention from both the research group and actual users. A fundamental challenge in the design of WSN is to enhance the network lifetime, as each sensor node of the network is equipped with a limited power battery. Nodes are placed in a hostile or unpractical environment so very difficult to change or recharging the battery. To overcome this challenge, different methods were developed in the last few years using such techniques as network protocols, data fusion algorithms using low power, energy efficient routing, and locating optimal sink position. In this paper, we do certain exploration of Energy Conscious Native Monitoring in Sensor Networks. This deals with Sleep-Wakeup management, further sectioned into three classes On-demand, Scheduled rendezvous and Asynchronous. The result shows that the performance of the network is increased based on the lifetime of the network and packet delivery ratio.**

Keywords: **Wireless Sensor Networks, sensor nodes, Sleep/Wakeup protocol, on-demand.**

I. INTRODUCTION

A wireless sensor network consists of sensor nodes deployed over a geographical area for monitoring physical phenomena like temperature, humidity, vibrations, seismic events. Small sensing devices are called nodes and consist of CPU (for data processing), memory (for data storage), battery (for energy) and transceiver (for receiving and sending signals or data from one node to another)[7]. The size of each sensor node is different, based on their applications. For example, in some military or surveillance applications, it might be microscopically small. Its cost depends on its parameters like memory size, processing speed and battery. The use of wireless sensor networks is increasing day by day and at the same time it faces the problem of energy constraints in terms of limited battery lifetime. Figure 1 shows the basic component of sensor node: Sensing Subsystem, Processing Subsystem, Wireless Communication Subsystem, Memory Subsystem and Power supply unit.[3][8] Energy consumption of the sensing subsystem depends on the specific sensor type, the energy expenditure of data sensing may be comparable to or even greater than, the energy needed for data transmission. Energy saving focuses on the two subsystems: networking subsystem and sensing subsystem. Networking subsystem energy management is taken into account in the operations of each single node as well as the design of the networking protocol. Sensing subsystem techniques are used to reduce the amount of frequency energy expensive samples. As each node depends on energy for its activities, this has become a major issue in wireless sensor networks. The failure of one node can interrupt the entire system or application. Every sensing node can be active (for receiving and transmission activities), idle and sleep modes. In active mode nodes consume energy when receiving or transmitting data. In idle mode, the nodes consume almost the same amount of energy as in active mode, while in sleep mode, the node shutdown the radio to save the energy.

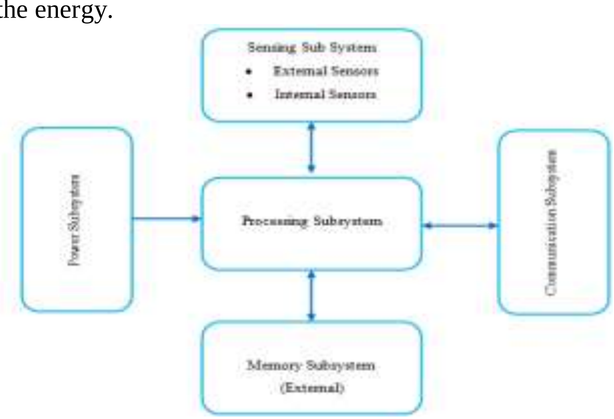

Fig 1. Wireless Sensor Node Architecture

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 5, Issue 3, March 2018

In WSNs the only source of life for the nodes is the battery. Communicating with other nodes or sensing activities consumes a lot of energy in processing the data and transmitting the collected data to the sink. The power required for WSNs may range from a few microwatts to hundreds of milliwatts. In many cases (e.g. Surveillance applications), it is undesirable to replace the batteries and impossible or inconvenient to recharge the battery, because nodes may be deployed in a hostile or unpractical environment. Sensor network should have a lifetime long enough to fulfill the application requirements. In many cases, a lifetime on the order of several months, or even years, may be required. Many researchers are therefore trying to find power-aware protocols for wireless sensor networks in order to overcome such energy efficiency problems. The[6][4] following steps can be taken to save energy caused by communication in wireless sensor networks.

- To schedule the state of the nodes (i.e. Transmitting, receiving, idle or sleep).
- Changing the transmission range between the sensing nodes.
- Using efficient routing and data collection methods.
- Avoiding the handling of unwanted data as in the case of Overhearing.

In this work, Propose the sleep-wake protocols for optimizing the energy overhead of monitoring while maintaining the effectiveness of the monitoring service. We discuss the Energy Conscious Native Monitoring in Sensor Networks (ECNM). This consists of a set of mechanisms that significantly reduce the node wake time required for monitoring. These mechanisms derive from existing native monitoring techniques. Depending on the scenario, The rest of this paper is organized as follows. Section II discusses the different approaches for energy conservation in sensor nodes. Section III Classification of network based energy efficient routing protocols, Section IV general energy consumption by the sensor nodes and Section V Potential scope with the energy management for smart environment.

II. GENERAL APPROACHES: ENERGY CONSERVATION IN SENSOR NODES

A. Duty Cycling

There are three main approaches for energy conservation in a sensor network. Duty Cycle, Data Driven and Mobility based. Duty Cycling is often used to reduce the energy consumption caused by idle listening in Wireless Sensor Networks, . Most studies on WSN protocols define a common duty cycle value throughout the network to achieve synchronization among the nodes. [3][18]Duty Cycling is mainly focused on the networking subsystem, Duty cycle is typically fixed throughout the network, with all nodes utilizing the same duty cycle. However, this may not provide the best overall performance for the network. Duty Cycling can be achieved through two different approaches Topology Control and Power Management. Topology Control which reduces the number of nodes involved in forwarding and routing packets generated by the other nodes without reducing network connectivity and coverage. It ensures that nodes not currently needed for connectivity to go to sleep and save energy, energy conscious attained through two approach named as Location driven and Connection driven approaches. Power Management approach further classified into Sleep/Wakeup Protocols and MAC Protocol with low duty cycle.

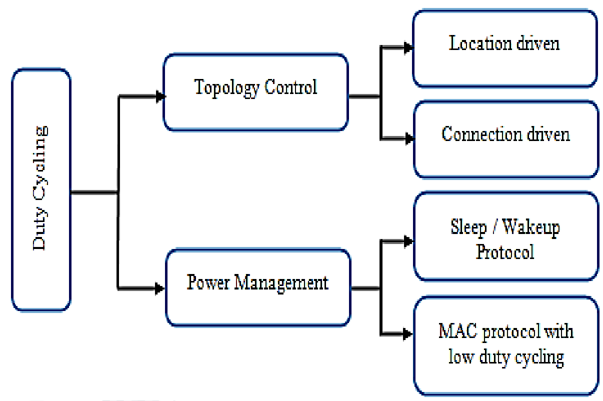

Fig 2. Classification for Duty Cycling Techniques

B. Data Driven Approach

Data driven approaches can be improve the energy efficiency. In data driven approach two ways to consume the energy unneeded samples: Sampled data generally has strong spatial and/or temporal correlation, so there is no need to communicate the redundant information to the sink make happen to decrease the power consumption of the sensing subsystem. Here unneeded samples result in hopeless energy consumption, even if the sampling costs are negligible, they result in unneeded communications. Minimize communication is not enough when the sensor itself is power famished. (Power consumption of the sensing subsystem) Fig. 3. Shows that Data driven approaches are categorized according to the problem they address into data-reduction schemes and energy-efficient data acquisition schemes. In data reduction schemes report the case of unneeded samples and energy efficient data acquisition schemes targeted at minimizing the energy spent by the sensing subsystem. In-network processing the intermediate node processing the gathered data between the source and sink nodes with the objective of reducing energy consumption. It can greatly helpful to reduce the energy consumption by eliminating redundant processing. Energy efficiency also attained through data compression, and data prediction techniques, in data compression scheme source nodes are encode all the information and sink decode that in order to reduce the amount of data transmitted, such a way data prediction techniques form a model telling the sensed singularity, the model can predict the values sensed by sensor nodes within assured error bounds and reside both at the sensors and at the sink. Energy consumption attained through three different approaches such as stochastic approaches, time series forecasting and algorithmic approaches.

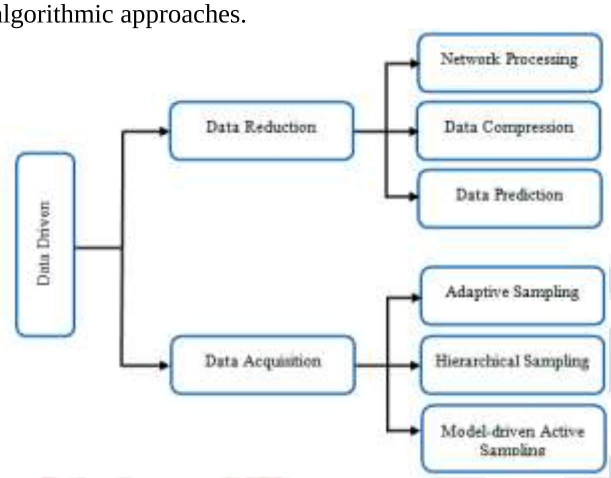

Fig 3., Classification for Data Driven Techniques

The Data acquisition approach is primarily intended at reducing the energy consumed by the sensing subsystem, it consumes suggestively less energy than their transmission. Here energy conservation schemes require to reducing the data models by source nodes, they decrease the number of communications.[11][15] Essentially, many energy efficient data acquisition techniques have been conceived for minimizing the radio energy consumption, under the assumption that the sensor consumption is negligible. In data acquisition schemes different ways to conserve the energy such as adaptive sampling techniques, hierarchical sampling techniques and model based active sampling approach.

C. Mobility Based Approach

In a static sensor network, packets coming from sensor nodes follow a multi-hop path towards the sink. Thus a few paths can be more loaded than others, and nodes closer to the sink have to relay more packets so it conceives more energy. So mobility has been considered as an alternative solution for energy efficient data collection in wireless sensor network. Mobility of sensor nodes can be achieved in different ways; first a mobilizer can be attached at a sensor which helps to change location; however this movement is limited to a few nodes which are not inhibited by energy. Another method is to put sensors on mobile elements such as animals and cars. Mobility based energy conservation schemes can be classified depending on the nature of the mobile element, which is a mobile sink or mobile relay

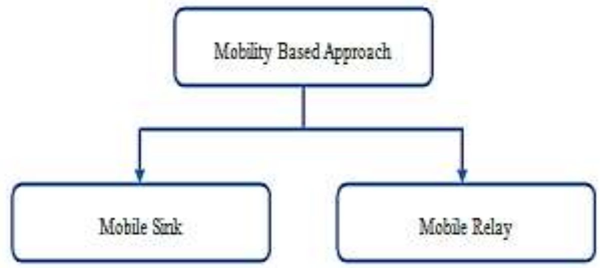

Fig 4. Classification for Mobility Based Techniques

III. CLASSIFICATION OF NETWORK STRUCTURE BASED ROUTING PROTOCOLS

The principle of the routing protocol is how to consume energy efficiently and to lengthen the network lifetime. WSNs routing protocols highlight on data dissemination, some degree of battery power and bandwidth constraints in order to smooth the progress of efficient working of the network, thereby growing the lifetime of the network. [2] It creates the need for routing protocols to be highly adaptive and resource aware. Routing protocols in WSNs are also application specific, which has led to the development of a variety of protocols. Fig 5 shows that overview about routing protocols. Based on the underlying network arrangement, routing techniques can be classified into three categories: data-centric, hierarchical and location based routing.

Data-centric protocols differ from traditional address, data centric protocols in the manner that the information is sent from source sensors to the sink. In address - centric protocols, each source sensor that has the suitable data responds by sending its data to the sink separately of all other sensors. However, in data - centric protocols, when the source sensors send their information to the sink, intermediate sensors can perform some form of aggregation on the data originating from several source sensors and send the aggregated data toward the sink. This process can result in energy savings because of less transmission required to send the data from the sources to the sink and another advantage is data centric protocol to control the redundancy of the data. Some of the data-centric routing protocols are SPIN, ACQUIRE, RUGGED & SAFE.

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 5, Issue 3, March 2018

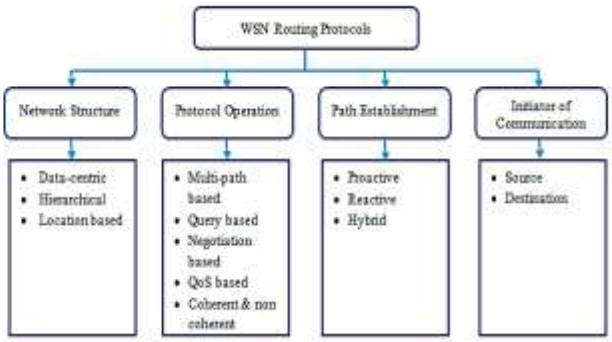

Fig 5. Overview of routing protocols

Hierarchical routing protocols are more energy efficient and scalable compared to data-centric protocols. [4][5]Network size and nodes densities are increased there may be overload in single tire network. This overload causes latency and unnecessary tracking of events. Other thing is that single tire network is not scalable for a large set of sensors in large area and there is a problem of service degradation. To overcome all these problems the hierarchical routing approach is used in some of the protocols of WSN. It maintains the energy consumption of the nodes using multihop communication forming a cluster of nodes. In this approach, head nodes have added responsibilities in order to reduce the load on other nodes in the network. Selection of head node is another challenging task. Some of the hierarchical routing protocols are LEACH, PEGASIS, TEEN, APTEEN, EAP, REAP & BCDCP.

Location based routing protocol is emerging research theme in WSN. The location information is to channel the route finding for the best route; here optimal path can be formed without using flooding techniques, this leads to reducing the energy consumption and maintenance for optimizing the entire network. Generally two techniques are used to find the location, one is to find the coordinate of the neighboring node and another is to use GPS (Global Positioning System). Since, there is no addressing scheme for sensor networks like IP-addresses and they are spatially deployed in a region, location information can be utilized in forwarding packets in an energy efficient way. Example routing protocols are GAF, MECN, GPSR & GEAR.

TABLE I: COMPARISON OF ROUTING TECHNIQUE

Characteristic	Data-centric Technique	Hierarchical Technique	Location-based Technique
Scalability	Limited	Good	No
Lifetime	Long	Long	Long
Data Diffusion	No	Yes	No
Power Required	Limited	High	Limited

IV. ENERGY CONSUMPTION BY THE SENSOR NODE COMPONENTS

Generally [29][30] a data transmission is very expensive in terms of energy consumption than the data processing, Energy consumption of the sensing subsystem is negligible with respect to the energy consumed by the processing, large amount of energy is consumed by node components (CPU, Radio etc.) even if they are idle. Useful Energy Consumption is Transmitting data, Processing query requests and Forwarding queries and data to the neighbors. Wasteful Energy Consumption is Idle listening (waiting for possible traffic), Retransmitting (because of collisions two packets arrived at the same time and sensor), Overhearing (when a sensor received a packet doesn't belong to it) and Over-emitting (when a sensor received a packet while it is not ready). [30]Table I shows that some of the sensor nodes consuming the energy in various states.

TABLE II: POWER CONSUMPTION OF DIFFERENT SENSOR

Sensor Type	Power consumption
Gas sensor	500mW-800mW
Image Sensor	150mW
Pressure Sensor	10mW -15mW
Acceleration	3mW
Temperature	0.5mW- 5mW

TABLE III: POWER CONSUMPTION BY THE SOME SENSOR NODE

Node	Transmit	Receive	Idle	Sleep
Cisco Aironet	1.48W	1.0W	830mW	75mW
ORiNOCO 11b	1.43W	925mW	925mW	45mW
Mica mote	36 mW	13.5mW	13.5mW	< 1μW

TABLE IV : COMPARISON OF DIFFERENT MOTES BASED ON POWER CONSUMPTION

Operation	Mica2	MicaZ	Telosb
Minimum voltage	2.7V	2.7V	1.8V
MCU idle (DCO on)	3.2 mA	3.2mA	54.5μA
Mote standby (RTC on)	19.0μA	27.0μA	5.1μA
MCU + Radio TX (0dBm)	25.4 mA	21.0mA	19.5 mA
MCU + Radio RX	15.1 mA	23.2mA	21.8 mA
MCU Active	8.0 mA	8.0mA	1.8 mA
MCU Wakeup	180μA	180μA	6μA
Radio Wakeup	1800μA	860μA	580μA

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 5, Issue 3, March 2018

MICA2 Mote is a third generation mote module used for enabling low-power in wireless, sensor networks. Features of MICA2 is 868/916MHz, 433 or 315 MHz multi-channel transceiver with extended range, TinyOS (TOS) Distributed Software Operating System v1.0 with improved networking stack and improved debugging features, Support for wireless remote reprogramming, Wide range of sensor boards and data acquisition add-on boards, Compatible with MICA2DOT (MPR500) quarter-sized Mote

MICAz is a 2.4 GHz Mote module used for enabling low-power in wireless sensor networks. The product feature is IEEE 802.15.4 compliant RF transceiver, Direct sequence spread spectrum radio which is resistant to RF interference and provides inherent data security, 250 kbps data rate, Supported by Mote Works™ wireless sensor network platform for reliable, ad-hoc mesh networking, Plug and play with MEMSIC's sensor boards, data acquisition boards, gateways, and software

Telosb mote is an IEEE 802.14.4 compliant, 250 kbps, high data rate radio, TI MSP430 micro controller with 10 KB RAM, integrated onboard antenna, data collection and programming through USB interface and open source operating system. Table III and Table IV show the power consumptions of the most popular radio equipment's used in sensor nodes and some common off-the-shelf sensors, respectively. If we also consider that acquisition time are typically longer than transmission ones, we can conclude that some censors may even consume significantly more energy than the radio.

TABLE V: POWER CONSUMPTION FOR SOME COMMON RADIOS

Radio	Producer	Power Consumption	
		Transmission	Reception
CC2420	Texas Instruments	35 mW (at 0 dBm)	38 mW
CC1000	Texas Instruments	42 mW (at 0 dBm)	29 mW
TR1000	RF Monolithics	36 mW (at 0 dBm)	9 mW
JN-DS-JN513x	Jennic	111mW (at 1 dBm)	111mW

TABLE VI: POWER CONSUMPTION FOR SOME OFF-THE-SHELF SENSORS

Sensor	Producer	Sensing	Power Consumption
STCN75	STM	Temperature	0.4 mW
QST108KT6	STM	Touch	7 mW
SG-LINK (1000N)	Micro Strain	Strain gauge	9 mW
SG-LINK (350N)	Micro Strain	Strain gauge	24 mW
iMEMS	ADI	Accelerometer (3 axis)	30 mW
2200 Series, 2600 Series	GEMS	Pressure	50 mW
T150	GEFRAN	Humidity	90 mW
LUC-M10	PEPPERL+FUCHS	Level Sensor	300 mW
CP18, VL18, GM60, GLV30	VISOLUX	Proximity	350 mW
TDA0161	STM	Proximity	420 mW
FCS-GL1/2A4-AP8X-H1141	TURCK	Flow Control	1250 mW

The table I to VI showed that different sensors and its power consumption properties are listed, apart from this number of sensors and motes are available in the market, every sensor node having separate features.

V. POTENTIAL SCOPE WITH THE ENERGY MANAGEMENT FOR SMART ENVIRONMENT

In future researcher may either modifications of the existing energy efficient routing protocols or developing own energy conscious native monitoring protocol for smart environment. In conclusion, we believe this paper may provide an important contribution to the active researcher community and helping them to develop new solutions to address the energy efficiency protocol designing in the context of wireless sensor networks.

REFERENCES

[1]. Adrian Perrig, Robert Szewczyk, Victor Wen, David Culler, J.D.Tygar "SPINS: Security protocols for sensor networks," ACM –mobile computing and networking 2001.

[2]. Jichuan Zaho, Ahmet T.Erdogan, and Tughrul Arslan "A Novel Application Specific Network Protocol for Wireless Sensor Networks," IEEE, 2005.

[3]. S.Ganesh, R.Amutha "Real Time and Energy Efficient Transport Protocol for Wireless Sensor Networks," Journal Of Advanced Networking and Applications Vol. 01 No. 01 pages: 40-44 (2009).

[4]. P.T.V.Bhuvaneswari and V.Vaidehi "Enhancement techniques incorporated in LEACH- a survey," Indian Journal of Science and Technology, Vol.2 No 5 (May 2009), ISSN: 0974- 6846.

[5]. Ge Ran, Huazhong Zhang, Shulan Gong "Improving on LEACH Protocol of Wireless Sensor Networks Using Fuzzy Logic," Journal of Information & Computational Science 7: 3 (2010) 767–775.

[6]. Shio Kumar Singh, M P Singh and D K Singh "A Survey of Energy-Efficient Hierarchical Cluster-Based Routing in Wireless Sensor Networks," Int. J. of Advanced Networking and Applications Volume: 02, Issue: 02, Pages: 570-580, 2010.

[7]. Zehua Zhou, Xiaojing Xiang, Xin Wang and Jianping Pan"A holistic sensor network design for energy conservation and efficient data dissemination," Comput. Netw, doi:10.1016/j.comnet.2010.

[8]. B.Baranidharan and B.Shanthi "A Survey on Energy Efficient Protocols for Wireless Sensor Networks," International Journal of Computer Applications (0975 – 8887) Volume 11– No.10, December 2010.

[9]. Neda Enami, Reza Askari Moghadam, Kourosh Dadashtabar, Mojtaba Hoseini "Neural Network Based Energy Efficiency in Wireless Sensor Networks: A SURVEY," International Journal of Computer Science & Engineering Survey (IJCSES) Vol.1, No.1, August 2010.

[10]. Chandan Maity, Chaitanya Garg, Sourish Behera "Adaptive Cluster Head characterization in LEACH protocol for power optimization," in Proceedings of ASCNT-2011, CDAC, Noida, India, pp WSN.

[11]. Rajesh Patel, Sunil Pariyani, Vijay Ukani "Energy and Throughput Analysis of Hierarchical Routing Protocol (LEACH) for Wireless Sensor Network," International Journal of Computer Applications (0975 – 8887) Volume 20– No.4, April 2011.

[12]. K. Padmanabhan, P. Kamalakkannan "Energy Efficient Adaptive Protocol for Clustered Wireless Sensor Networks," IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 5, No 1, September 2011, ISSN (Online): 1694-0814.

[13]. L. Nalini Joseph, S.Shanmugavel "Reliable Energy Conservation in Wireless Sensor Networks using Flooding Techniques," IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 5, No 2, September 2011.

[14]. Deepti Garg, Roopali Garg "Angled-Leach in Wireless Sensor Networks," An International online open access peer reviewed journal, Published on April 2012.

[15]. Mohamad Ali Azimi and Mohamadreza Ramezanpor "A Robust Algorithm for Management of Energy Consumption in Wireless Sensor Networks Using SOM Neural Networks," Journal of Academic and Applied Studies, Vol. 2(3) March 2012, pp. 1-14.

[16]. V.Cibi Castro and Dr.R.Rajesh, "A Delay Aware Tree Based Technique in Wireless Sensor Network," International Conference on Computing and Control Engineering (ICCCE 2012), 12 & 13 April, 2012.

[17]. Ikjune Yoon, Dong Kun Noh and Heonshik Shin "Multi-layer topology control for long-term wireless sensor networks," EURASIP Journal on Wireless Communications and Networking 2012, 2012:164.

[18]. M.Shankar, Dr.M.Sridar, Dr.M.Rajani "Performance Evaluation of LEACH Protocol in Wireless Network," International Journal of Scientific & Engineering Research, Volume 3, Issue 1, January-2012 ISSN 2229-5518.

[19]. Jonathan Henderson "A Study of the LEACH Protocol for Wireless Sensor Networks,".

[20]. Dian Tian and Nicolas D.Georganas "A Node Scheduling Scheme for Energy Conservation in Large Wireless Sensor Networks," iSENSE Project, Communications and Information Technology.

[21]. Francesco Corucci, Giuseppe Anastasi and Francesco Marcelloni "A WSN-based Test bed for Energy Efficiency in Buildings,".

[22]. Taran Deep Singh Pawa "Analysis of Low Energy Adaptive Clustering Hierarchy (LEACH) protocol," thesis.

[23]. Nathaniel J. Davis, Dr. F. Midkiff, Y. Thomas Hou, C. Patrick Koelling Timothy Pratt "Energy-efficient Wireless Sensor Network MAC Protocol," thesis.

[24]. Giuseppe Anastasi, Marco Conti, Mario Di Francesco, Andrea Passarella "Energy Conservation in Wireless Sensor Networks: a Survey," thesis.

[25]. Antimo Barbato, Luca Borsani, Antonio Capone "Home Energy Saving through Wireless Sensor Networks," conference.

[26]. Ren Ping Liu, Glynn Rogers, and Sihui (Sue) Zhou "Honeycomb Architecture for Energy Conservation in Wireless Sensor Networks," * CeNTIE is supported by the Australian Government through the Advanced Networks Program (ANP).

[27]. Mihaela Cardei, Ding-Zhu du "Improving Wireless Sensor Network Lifetime through Power Aware Organization," Wireless Networks 11, 333–340, 2005 Springer Science, Business Media.

[28]. Maryam Soltan, Morteza Maleki, and Massoud Pedram"Lifetime-Aware Hierarchical Wireless Sensor Network Architecture with Mobile Overlays,"

[29]. Asfandyar Khan, Azween Abdullah, Nurul Hasan "Maximizing Lifetime of Homogeneous Wireless Sensor Network through Energy Efficient Clustering Method," International Journal of Computer Science and Security, Volume (3), Issue (6).

[30]. Mahmood Ali and Sai Kumar Ravula, "Real-Time Support and Energy Efficiency in Wireless Sensor Networks," Master Thesis in Computer System Engineering.