OPTIMIZING CLUSTER-HEAD FORMATION IN WIRELESS SENSOR NETWORKS

Submitted in partial fulfillment of the
requirements for the award of
Bachelor of Engineering degree in Computer Science and Engineering

By

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **TAGINI MYTHREYE M(39111011)** who carried out the Project entitled **"OPTIMIZING CLUSTER-HEAD FORMATION IN WIRELESS SENSOR NETWORKS"** under my supervision from November 2022 to April 2023

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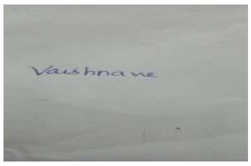
Submitted for Viva voce Examination held on 20.4.2023

Internal Examiner **External Examiner**

DECLARATION

I, **VAISHNAVI R (Reg.No - 39111049),** hereby declare that the Project Phase-2 Report entitled **OPTIMIZING CLUSTER-HEAD FORMATION IN WIRELESS SENSOR NETWORKS”** done by me under the guidance of **GRACELIN SHEENA** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in **Computer Science and Engineering**.



DATE: 20.4.2023
PLACE:Chennai **SIGNATURE OF THECANDIDATE**

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ABSTRACT

Sensor networks consist of a large number of small independent devices. Each device, called a sensor node, is battery powered and equipped with integrated sensors, data processing, and short-range radio communication capabilities. A significant amount of research has been done in the area of connecting large numbers of these sensors to create robust and scalable Wireless Sensor Networks (WSNs). Although individual sensor nodes have limited capabilities, WSNs aim to be energy efficient, self-organizing, scalable, and robust. A substantial amount of research has cantered on meeting these challenges.

The large deployment of WSNs and the need for energy efficient strategy necessitate efficient organization of the network topology for the purpose of balancing the load and prolonging the network lifetime. Clustering has been proven to provide the required scalability and prolong the network lifetime. Due to the bottle neck phenomena in WSNs, a sensor network loses its connectivity with the base station and the remaining energy resources of the functioning nodes are wasted.

This project aims to implement a clustering scenario and analyze the effects of increase in the number of nodes in the cluster on the energy of Cluster Head (CH). The sensor nodes are free to move from one cluster to another. The project further aims to implement an energy efficient dynamic algorithm which re-elects the CH after a specific period of time hence, saving energy. We also compare the efficiency of this algorithm by analyzing the graphs of energy levels of the CH during the lifetime of the network

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 WIRELESS SENSOR NETWORK

The field of Wireless Sensor Networks may be in an infant stage but has a made great progress over the years. WSN is a network of sensor nodes deployed over a wide area. The sensor nodes are micro computers having the ability of sensing data, capturing, processing and transmit it to the sink or main base station of the information. Sensor node is made of five main components namely, sensing unit, processing unit, memory, transceiver and power management unit.

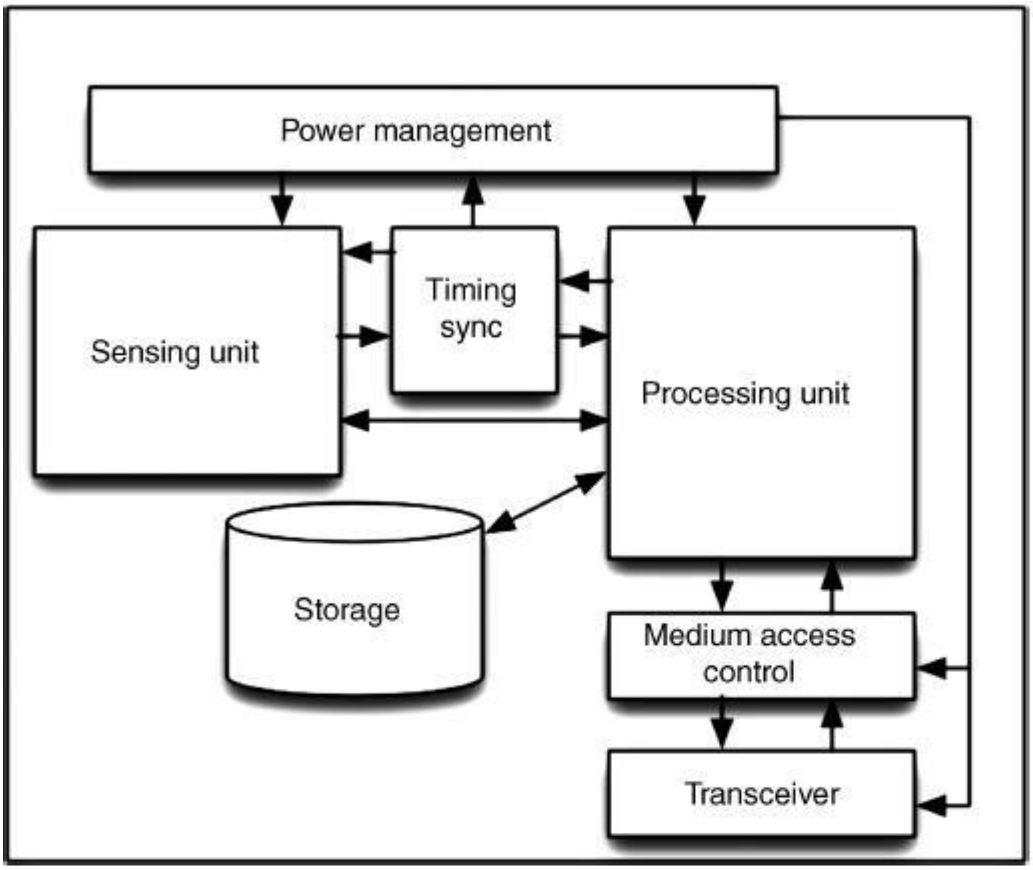


Figure 1.1 Architecture of a Sensor Node

The sensing unit captures the required data, passes it to the processing unit which aggregates together different data and stores it in packets. After timely duration it is transmitted over to the sink from where the user can access the data of various WSN.

A sensor node has many limitations. A sensor node has limited power since it has a small battery as power source. If it dies out, it has to be replaced with new sensor nodes. It has limited computation capability due to which it cannot be loaded with huge computation problems. Although the sensor nodes individually have limited capabilities, their collaboration to perform a specific task produces an enhanced view of the physical world. It is widely used because of its robust nature, easy deployment in remote places and retrieval of variety of information which is helpful in applications.

Most applications fall into one of four classes: environmental data collection, security monitoring, node tracking, and hybrid networks. The different applications are target field imaging, intrusion detection, weather monitoring, security and tactical surveillance; distributed computing; the detection of ambient conditions such as temperature, movement, sound, and light or the presence of specific objects, inventory control, and disaster management.

1.2 APPLICATION

The applications for WSNs are many and varied. They are used in commercial and industrial applications to monitor data that would be difficult or expensive to monitor using wired sensors. They could be deployed in wilderness areas, where they would remain for many years (monitoring some environmental variable) without the need to recharge / replace their power supplies.

Typical applications of WSNs include monitoring, tracking, and controlling. Some of the specific applications are habitat monitoring, object tracking, nuclear reactor controlling, fire detection, traffic monitoring, etc. In a typical application, a WSN is scattered in a region where it is meant to collect data through its sensor nodes.

- Environmental monitoring
- Habitat monitoring
- Acoustic detection
- Seismic Detection
- Military surveillance

1.3 CHALLENGES

In WSN, the limited capabilities (battery power, transmission range, processing hardware and memory used, etc.) of the sensor nodes combined with the special location-based conditions met (not easily accessed in order recharge the batteries or replace the entire sensors) make the energy efficiency and the scalability factors even more crucial. Moreover, the challenge of prolonging network lifetime under the above restrictions is difficult to be met by using only traditional techniques.

- **Dynamic Network Topology:** The variability of network topologies due to node failures, introduction of additional nodes, variations in sensor location and changes to cluster allocations in response to network demands requires the adaptability of underlying network structures and operations.
- **Resource Limitations:** Battery power, memory, processing power and lifetime are physical constraints that impact every aspect of WSNs.
- **Failure Prone:** Individual sensors are unreliable in harsh and unpredictable environments.
- **Network congestion resulting from dense network deployment:** The quantity of data gathered may exceed the requirements of the network and so evaluation of the data and transmission of only relevant and adequate information needs to be performed.

The WSNs with high performance will come into practice if the following requirements are satisfied

- Low power usage
- Efficient memory usage
- Self-organization
- Collaborative processing

CHAPTER 2

LITERATURE SURVEY

2.1 INFERENCES FROM LITREATURE SURVEY

The WSN as a research domain is gaining importance today because of its low cost, mobile nature, small size and its applications in remote area. The literature review is focused over the papers published during the year 2006-2011 in IEEE journal, proceedings and international conferences. The papers are focusing mainly on WSN architecture, clustering and energy efficient protocols. These papers primarily study the above mentioned aspects of WSN and lay down proposed guideline for a better performing WSN. Some of these are elaborated below.

Few Indian authors point out that Energy efficient grid based topology and Cluster Head election based on energy increase the overall life of the network drastically [7]. Mr. Enamul Haque in his thesis compares LEACH, CACH and CAMHP in all aspects. Comparison shows reduced data traffic in CACH compared with LEACH, which ensures more idle time and longevity of the network. Performance evaluation of CAMHP shows significant energy efficiency compared to LEACH and Multi-Hop model. As a whole, techniques applied in CAMHP performs efficiently in energy saving and the network provides a longer full-scale active service. [9].

Mr Muattaz Elaneizi in his thesis conclude that transmission tuning algorithm for cluster- based WSNs balance the load among cluster heads that fall in different regions. This algorithm is applied prior to a cluster algorithm to improve the performance of the clustering algorithm without affecting the performance of individual sensor nodes. As a result, the network lifetime has been prolonged. But they also point out that this algorithm is suited only for static WSN [8]. Another Author shows us the energy consumption for some algorithms in WSN. He proposes a dynamic routing protocol based on probability to reduce the energy consumption of the nodes. Here, the information is routed through the node with the highest energy. But mobility of nodes hampers the routing protocol [11].

CHAPTER 3
REQUIREMENT ANALYSIS

3.1 FEASIBILITY STUDIES/RISK ANALYSIS OF THE PROJECT

3.2 SOFTWARE REQUIREMENTS SPECIFICATION DOCUMENT

H/W Requirements:

1. 1024 MB RAM
2. Processor: Intel family.

S/W Requirements:

1. Network Simulator (NS) 2.34-all-in-one.

Operating System:

1. LINUX Ubuntu 10.04.

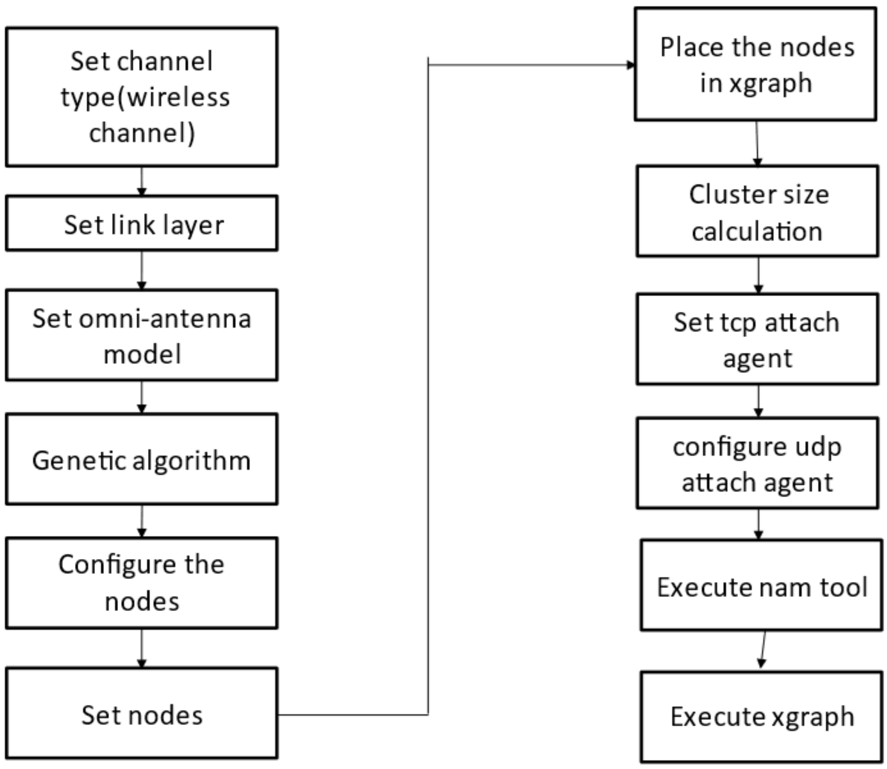
CHAPTER 4

DESCRIPTION OF PROPOSED SYSTEM

Looking at the disadvantages of all the above methodologies used in previous systems, the most common point that pops up is most of these systems implemented this problem statement using only a pre-defined dataset of faces with closed eyes and opened eyes. Also they had only visual types of alerting system to inform the driver of his state, which is not an effective alarm because visual alarms require one to be alert to see the alarm, which defeats the whole purpose at hand. Also, some of these systems' response time between finding the state of the driver and alerting the driver of his state was found to be too long to prevent mishaps in time. Some systems were found to be too sensitive to the eye blinks and yawns and other systems gave alarms continuously for a long time resulting in spamming the system. Our system aims to overcome all these issues with the previously existing systems and address these issues while giving the best accuracy in the results. Our basic idea is to monitor the physical state of the driver while he‘s driving using a live camera. We are making use of facial parameters to track the retina in the eye of the beholder, in case of frequent eye blinks while the driver is tired and also keep track of their mouth movements in case of yawning. When our system detects either of these changes our model will immediately emit an alarm sound as loud as a siren alarm to immediately awaken the driver from his poor state back toalertness.

4,1 SELECTED METHODOLOGY OR PROCESS MODEL

4,2 ARCHITECTURE / OVERALL DESIGN OF PROPOSED SYSTEM



4.3 DESCRIPTION OF SOFTWARE FOR IMPLEMENTATION AND TESTING PLAN OF THE PROPOSED MODEL/SYSTEM

4.4 PROJECT MANAGEMENT PLAN

REFERENCES:-

[1] "NS by Example", Chung, M. Claypool, WPI Worcester Polytechnic Institute, Computer Science,

[2] "An Energy-efficient Grid based Clustering Topology for a Wireless Sensor Network", Ketki Ram Bhakare, Computer Science & Engg RCERT, Chandrapur, India, February 2012.

[3] "Prolonging Network Lifetime of Clustered- Wireless Sensor Networks", Muattaz Elaneizi, Electrical and Computer Engineering Waterloo, Ontario, Canada, May 2008.

[4] "Energy Efficient Protocols for Wireless Sensor Networks", Md. Enamul Haque, Department of Information and Computer Sciences Graduate School of Science and Engineering Saitama University, September 2010.

[5] "Real-time support and energy efficiency in Wireless sensor networks.", Mahmood Ali and Sai Kumar Ravula, School of Information Science, Computer and Electrical Engineering Halmstad University, January 2008.

[6] "An Novel Energy Balanced Dynamic Routing Protocol Based on Probability in Wireless Sensor Networks", Ming Zhang, Department of Electronic Engineering, Huaihai Institute of Technology, March 2011.