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# A Review on Modified Residual Energy Aware for Electing Optimal Cluster Head Selection in Wireless Sensor Network

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Ankita S, Shwetambari C, Vijayshri Khedkar, Sonali Kothari

*Address* Symbiosis Institute of Technology, Symbiosis International (Deemed University),

Lavale, Pune, Maharashtra, India

*Email* [Ankita.sharma.mtech2020@sitpune.edu.in](mailto:Ankita.sharma.mtech2020@sitpune.edu.in),

## Abstract

WSNs are a collection of specialized transducers that provide sensing services to IOT objects that have limited power and storage. Because it is practically impossible to replicate or recharge batteries in sensor nodes, energy consumption is one of the most significant design concerns in WSN. The clustering technique is crucial for power conservation inside an energy-constrained network. Picking the right cluster head can assist in network load balancing, saving energy usage and boosting longevity. The study is focused on a cluster head election mechanism that can be used in IoT fields such as environmental surveillance, smart cities, and systems. WSN apps have dramatically advanced in recent years. Clustering is a technique used in WSNs to extend the network's lifecycle and improve operational processes. Every cluster elects a leader, referred to as the Cluster Head. Optimized grouping has the potential to save a lot of energy in the system. The authors of this paper discussed a variety of clustering protocols for WSN.

**Key Words**— Wireless Sensor Networks, Internet of Things, Cluster Head selection, Residual energy, Network Lifetime, Energy efficiency.

## I. INTRODUCTION

Internet of Things (IoT) is a collection of networked devices and objects that can send and receive data over the internet. It's an impenetrable but smart network that detects, manages, and can be configured to connect with one another via embedded system. IoT offers great efficiency and productivity by providing immediate access to data about any object. Approximately 5 billion smart gadgets have been connected to date. The number of persons who are actively communicating may outnumber the number of devices/machines with whom they are virtually connected. This will result in massive traffic, with humans becoming the minority of traffic creators and recipients. Because of the challenges and potential that IoT presents, it is being investigated for numerous study topics [1].

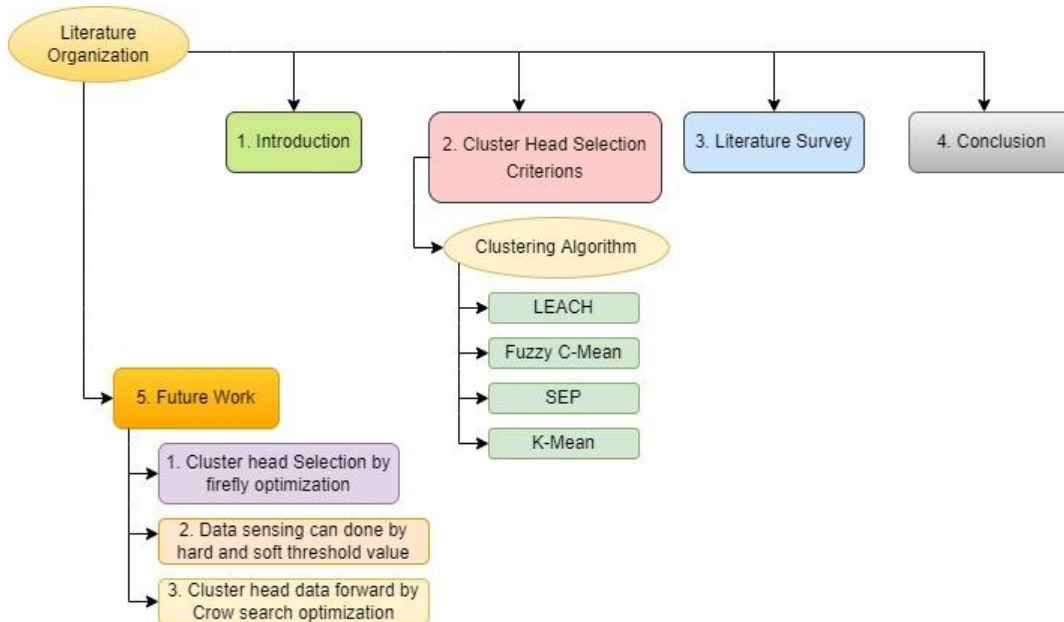


Figure. 1. Workflow of Paper

Wireless sensor networks (WSNs) have developed as a rapidly expanding topic in wireless transmission. Narrow, limited, and smart sensors are placed in immediate environments and interconnected through wireless channels, providing new potentials for detecting physical traits such as motion, stress, temperature, and attacks, among others, thanks to new advancements in Micro-Electronic-Mechanical Structures and interaction devices. It can be used in a wide range of applications, including army, commercial, farming, traffic enforcement, atmospheric or ecosystem monitoring, and other essential domains. WSN design concerns differ depending on the applications since WSNs are application-specific. A wireless sensor network is a self-organizing ad hoc system composed of multiple sensor networks. A device's ability to self-organize allows it to join new nodes without the need for user intervention [1]. These networks are composed of a variety of small, low-cost sensors called nodes, and also one or even more base stations called sinks. The BS receives data from these nodes.

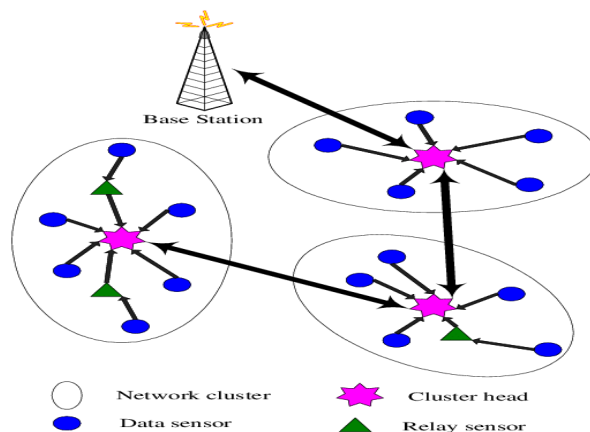
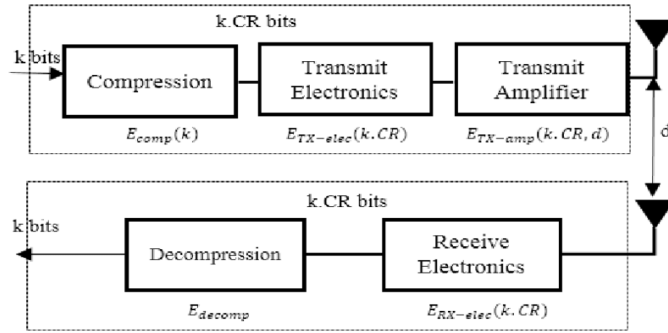


Figure. 2. Architecture of WSN

These sensor nodes are used in a wide range of settings, including commercial, civil, climate, and intelligence data collection [2]. A Sensor Node is an implementation for a pair of different low-power self-sufficient machines that can sense, calculate, and broadcast signals in order to acquire local knowledge and make global judgments about their physical environment.



**Figure 3. Radio Energy model**

### Characteristics of Wireless Sensor Networks

1. All wireless sensor network use data transfer or multi-hop transfer to communicate with the BS.
2. SN detects conditions at predetermined intervals in different locations and always has data to send to the BS.
3. Sensor Nodes are grouped together in what is known as a cluster. The Cluster Head gathers information, and the BS retrieves information that has been stored.
4. The WSN lifespan is the amount of time it takes for the initial SN to lose energy.

The practice of grouping several sensor nodes is known as clustering. The CH is the administrator for each cluster. Cluster members decide who gets a CH. This CH collects and sends data from cluster nodes to the destination (BS) [3]. To boost longevity and extensibility aims, clustering algorithms are commonly used. A hierarchy that reduces the load of communicating with the BS could be built using a variety of clustering algorithms [4].

In IoT-based Wsn applications, significant source content, redundant data, changing network size, less trustworthy medium, heterogeneous network, and multiple BS or sink units often provide significant challenges to Qos parameters [6]. Security challenges in WSN [7] include data authenticity and encryption, integrity of data, and information crispness. When designing WSNs, lowering power consumption always has been a top priority. Recent research has yielded a variety of approaches for reducing energy use and extending network longevity in order to maximize resource utilization.

Selecting a CH is tough since numerous variables must be considered while determining the best node inside the cluster [9]. There are several factors to consider, including the range among nodes, remaining energy, agility, and capacity of each node. Clustering is the process of forming a hierarchical system of set of groups of sensing devices which receive and process data to CH. After that, the CH aggregates the data and sends it to a mobile sink, also called as a base station (BS), which serves as a link between both the end user and the network. As a result, this work is organized so that Clustering Algorithms & Protocols for WSN are included in part II. The literature review is explained in Section III, and paper is concluded in Section IV.

## II. CLUSTER HEAD SELECTION CRITERIONS

Clustering in sensor nodes is widely proposed by research community to address sensory network scalability, energy, and life challenges [11]. A community of cluster nodes is made up of the cluster's head (selected leader) and local interactions between members. Cluster members frequently interact with the cluster's leader, who collects data and mixes it with energy efficiency [13].

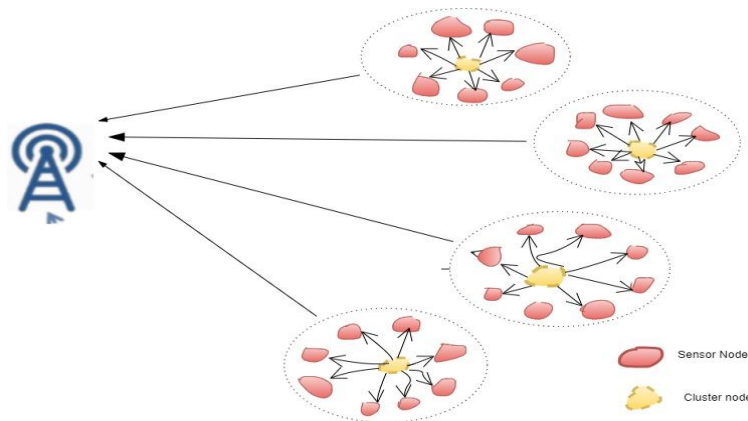


Fig. 4. Cluster head Selection

Clustering is most often used energy consumption methods. groups are formed by sensor's nodes [6]. Each group has cluster leader as well as some node members. Member nodes forward their detected information to the heads of their clusters. Cluster head gathers all of the data, aggregates it, and then sends it to the BS [7]. When compared to regular sensor nodes, each CH [8] depreciates at a rapid rate. This condition is made possible by making Cluster Heads (CHs) dynamic. Clustering is the grouping of entities that are linked [9], and clustering procedures include searching for similarity and pattern grading using unsupervised learning techniques [10].

## CLUSTERING ALGORITHMS

- a) **Fuzzy c-Means:** The FCM [14] methodology divides a sample into  $n$ -clusters, with each data point in its own cluster. The FCM clustering technique is implemented in FORTRAN IV [15]. The FCM program covers a broad spectrum of geostatistical research issues. This method generates varying parts and prototypes for each numbered data set. These divisions are used to confirm or imply a previously unknown data structure. The clustering criterion for aggregating subsets is a generalized function. Based on these findings [3] implemented a fuzzy value index based on furious compactness, segregation, and a penalty feature to ensure that the value of the clustering index never monotonously decreased and that the number of groups was nearly zero when items bordered, resulting in the loss of robustness and decision-making functionality.
- b) **LEACH:** It's a TDMA-based MAC technology that combines grouping with a network routing algorithm. Sensors are installed in LEACH, and the CH is performed by a single node. A hierarchy protocol is used to extend a wireless network sensor. The lead cluster collects and compresses data from each node to the BS. Authors [18] provided a clustering strategy for constructing a routing tree that is both efficient and energy efficient.
- c) **Stable Election Protocol (SEP):** The SEP protocol is an enhancement to LEACH protocol. It is a heterogeneous protocol that extends the period before the first node dies, which is useful in a variety of situations. To make the most of the system's energy, several clustering strategies are described. These two hierarchical clustering-based routing protocols [3] are clustering techniques that primarily broaden system lifetime. SEP is one of the suggested energy efficiency algorithms.
- d) **K-means Clustering:** K-means clustering [14] finds groups in data, with group numbers shown as variable  $K$ . depending on supplied variables, procedure allocates every point of data to a group of  $K$  repeatedly. The data instances are clustered together on basis of how competitive their qualities are. K-means algorithm calculates  $k$  centroids and assigns each instance to the closest group, keeping the centroids as small as possible [10]. The 'means' in K-means relate to the data's mean; that is, to determine the centroid. The suggested algorithm's efficiency is calculated using a variety of performance metrics. For optimal cluster evaluation, a cluster strategy based on K-means and ant lion optimization (ALO) was invented.

### III. LITERATURE SURVEY

Table 1: List of Literature Survey Table in WSN [1-15]

Literature Table			
Sr.no.	Author	Methodology	Limitation
1.	<b>Trupti Mayee Behera et al.,[10]</b>	Modified LEACH protocol.	Choosing an energy-efficient routing algorithm, restricted to limited CH parameters network lifetime ,throughput , energy utilized and dispatched
2.	<b>Ali Abdul et al.,[12]</b>	CH selection with rotation mechanism (CHSRA), modified FCM algorithm(M-FCM)	To improve protocol by upgrading FCM algorithm and CH selection goal function by using a weighted energy-based distance.
3.	<b>S. M. Mahdi et al.,[13]</b>	Grey wolf optimizer (GWO), fitness function.	There is no energy waste prevention, no fault tolerance mechanism, and no other quality of service (QoS) metric than lifetime.
4.	<b>Mishra et al.,[15]</b>	Optimal Cluster Size Selection-based Clustering Protocol, FIS (fuzzy inference system)	Limited computation complexity, network performance suffers the consequences of the death of lesser amount of nodes, and network performance suffers consequences.
5.	<b>Rajnish Kansal.,[4]</b>	ACS algorithm, K-means clustering, Fuzzy-leach	It withstands failures, has no route computation overhead, and provides steady and optimal clustered structure performance.
6.	<b>T. Sharma.,[7]</b>	LEACH-Fuzzy Clustering (LEACH-FC) protocol	When compared to LEACH, EEDCF the energy efficiency has improved, resulting in lower energy usage
7.	<b>V. Loscrì.,[9]</b>	ECHSSDA protocol	On basis of energy consumed, it was better than the LEACH and LEACH-C protocols.
8.	<b>G. Smaragdakis.,[8]</b>	Particle Swarm Optimization (PSO) technique for energy-aware clusters generation	Due to the limited ability to deploy sensor mobility in larger dimensional regions, the distributed PSO-application will be the focus.
9.	<b>K. Pawar., [7]</b>	Energy-LEACH and multihop-LEACH protocols	The Energy-LEACH protocol takes into account residual energy heads and employs multi-hop communication among the cluster and sink.

10.	<b>W. Heinzelman.,[2]</b>	ANP (Analytical Network Process) assessment tool used for CH choice	The approach can be employed for various scenarios in IoT based processes, such as ZH selection for further variables for which nodes are portable and change their stance.
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#### IV. CONCLUSION

The choice of cluster head has major effect on network performance, service, and dependability. This necessitates large no. of clustering protocols in wireless sensor networks. Clustering methods are critical for maintaining uninterrupted connectivity between network nodes. Clustering protocols for WSNs are classified in a variety of ways. Several clustering algorithms for WSNs are presented in this research. As a result, in order to extend the network's lifespan, building a residual-based energy-conscious technique is critical. This study presents a comparison of several well-known WSN protocols. Its ongoing evolution has resulted in a large body of knowledge in this field. The cluster-dependent protocol is a low-power method of selecting and transmitting information to the CH. This study looks at a number of energy-efficient clustering algorithms used in the wireless sensor industry. The paper also looks at LEACH, K-means, and SEP, which are all energy-saving cluster algorithms. These algorithms' main purpose is to reduce energy usage while increasing network longevity.

#### V. FUTURE WORK

In this paper future work can be expanded by First modification will be done based on way cluster head is elected. While current protocol uses no. of optimum cluster heads as well as energy of nodes as parameters for CH selection, proposed protocol would use Firefly optimization to do so. The residual energy of node and its closeness to cluster members would be taken into account in this. Second modification will come in the form of data sensing where we will be used the concept of hard and soft threshold values of the data sensed by the nodes.

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## Author Profile



**Ankita Sharma** is a Research Scholar, completed her MTech in the area of Wireless Sensor Network. She is currently working as Associate Software Engineer in Holtecasia Pvt. Ltd. She has received best paper award in Banarsidas Chandwala Institute of Professional Studies. Her recent research interests include wireless sensor network, algorithms, cyber security, IoT and machine learning and NLP.



**Shwetambari Chihwane** is an Assistant Professor skilled in Artificial Intelligence and Machine Learning. She has been awarded Ph.D. in Deep Learning from Bharath Institute of Higher Education and Research, Chennai, India. She is currently associated with Symbiosis International University, Pune, India as an Assistant Professor in Department of Computer Science and Engineering. She has also worked with Pune University, Delhi University, Mumbai University. She has published more than 30 research papers in International and National Journals.



**Vijayshri Khedkar** is an Assistant Professor working at Symbiosis Institute of Technology and skilled in NLP, Applied Machine Learning, Data Analytics, Information Retrieval & Deep Learning. A life-long learner with a strong educational background holding two Master’s Degrees (M.B.A. & M.E.) and pursuing Ph.D. in Computer Engineering (NLP) from Symbiosis International University, India. She is a life member of IAENG and Senior IEEE member. She has published around 30 papers at various reputed conferences and journals. She is active reviewer for IJECE journal indexed in Scopus and reviewed papers for various conferences and journals.



**Dr. Sonali Kothari** has obtained PhD in computer engineering from Sant Gadge Baba Amravati University, Amravati, India. Currently she is working as Associate Professor in Department of Computer Science and Engineering at Symbiosis Institute of Technology, Symbiosis International (Deemed University), Pune, India. She has more than 20 years of teaching and research experience, senior member of IEEE and Life member ISTE. She has worked as reviewer for various International conferences and guest reviewer for Elsevier and IGI-Global journals. She has received best paper award in international conference for her research work in field of malware analysis. She has published 35+ research articles in various International/National

conferences and journals. She is a recognized PhD guide in Symbiosis International (Deemed University) and guiding students in the area of Network Security, Machine learning and IoT. Her recent research interests include cyber security, precision agricultural using IoT and machine learning. She has delivered many talks in various educational institutes at national level.