International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 2346-2354 www.ijaem.net ISSN: 2395-5252

A Distributed Clustering Technique for Energy Efficient Wireless Sensor Network

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Submitted: 15-06-2022 Revised: 25-06-2022 Accepted: 27-06-2022

ABSTRACT: Making a Wireless Sensor Network requires careful consideration of the energy emitted by the sensor nodes. Depending on how long the sensors' batteries endure, the network may not be able to last as long as expected. Once these sensor nodes have been installed, they cannot be changed. As a result, measures must be done to lower the network's energy consumption. Static clustering may cause energy shortages in this situation, despite the fact that clustering is considered a positive thing In this study, a method for balancing the network's energy usage among all nodes is presented. Distributed clustering" is the term for this process. In this example, the network will be divided into clusters and the heads of the clusters will be randomly selected using residual energy. The cluster head will take many paths to the sink in order to provide the consolidated data. The energy consumption of all the nodes in the network is evenly distributed as a consequence of longer-lived nodes, according to simulation data.

Keywords: Cluster; Cluster Head, Distributed clustering, Energy-efficient, Network lifetime, Residual Energy, Wireless Sensor Network

I. INTRODUCTION

Small, low-cost sensors for real-time applications are rapidly being deployed thanks to the rapid evolution of wireless communication networks. Low-power sensing devices are dispersed in an irregular pattern over the distant environment to create a Wireless Sensor Network (WSN). It is possible to use these sensors to monitor any change in a physical quantity over the monitoring area (such as temperature or weight). It collects the data and sends it to the sink node according on the information contained in its programmer memory. The sink node receives the sensed data, which is subsequently processed by the end user.

The sensor nodes remain unreachable to the end users for the duration of their service life. They keep track of the physical world on their own and have the ability to process data and communicate with one another. A sensor node's principal energy resource is its limited battery life [1], which is why it is so limited. The major reason for the node's energy consumption is the collection, processing, and transmission of data [2].

Despite the fact that the sensor nodes are self-coordinating, the data transmission from one node to the next or to the final destination consumes the majority of the system's energy. Sensor nodes might fail if they are constantly drained of energy. A single node's inability to communicate with the rest of the network might have a negative impact on the network's performance [3]. As a result, the development of energy-efficient algorithms to extend the network's lifespan is essential.

The Cluster Head (CH) node in network clustering requires the most energy for data collection and forwarding. CH depletion may cause the whole network to collapse owing to an assignment of a fixed CH [4]. This study suggests a distributed clustering strategy to address this problem. Nodes operating as CHs do not stay the same during a network's lifespan.

Each sensor node is rotated at a set time period using a mechanism that serves as a CH. The sensor node with the greatest amount of remaining energy is considered to be the CH for each cluster, and it is this node that transmits the aggregated data to the sink. Members are just one jump away from the CH, according to this theory. The data is subsequently sent to the sink via multi-hop routing, as seen in the picture. As a result, the energy levels of all nodes in the network are balanced, enabling the greatest number of nodes to remain active during the network's lifespan.

This is how the paper's content is laid out: The project's history is summarised in Section II. Earlier work that is comparable to what we're doing today is discussed in Section III. On the topic of increasing energy, distributed clustering is discussed in Section IV. Simulated findings are discussed in Section V. Conclusions and proposals for further development are provided in Section VI.

1.1 Wireless Sensor Network

Researchers have been paying attention to wireless sensor networks (WSNs) in recent years because of their complicated, multifarious needs that frequently reveal intrinsic trade-offs. Ad hoc and self-configuring connection is used to link sensor nodes in a wireless sensor network.

A wireless sensor network consists of a dispersed group of autonomous sensor nodes that monitor environmental characteristics such as temperature, pressure, and so on, and that collectively transmit their data to a main site known as a sink. Sinks gather data from sensor nodes and transmit it to users across public or private virtual networks, such as the Internet or intranets (PVN). WSNs are inherently ad hoc in nature, hence they inherit their own set of features and specifications. Low-range wireless personal area networks include WSN(LPWPAN).

1.2 Characteristics of WSNs

The energy, capacity, and processing power of wireless sensor networks are all major bottlenecks. In order to improve the network's features, it is thus critical that an effective network be designed.
A few WSN features include the following: -

- MinimalPowerconsumption.
- Ability to cooperate with node failures(flexibility).
- Nonhomogeneityofnodes.
- The abilityofnodestomove.
- Communicationfailure.
- Scalabilitytolargescaleofdeployment.
- AbilitytoholdoutinNonRelevanceenvironmentalconditions.
- Facilityofuse.

1.3 Design issues of WSNs

- **Energy Consumption:** One of the biggest challenges with wireless sensor networks is this. Sensor nodes are powered by a rechargeable battery that is attached to each one. The sensor network may be put in a hazardous environment, making it impossible to recharge or replace the battery. Sensor node processes like as sensing, data processing, and transmission have a significant impact on energy usage. Communication uses a tremendous quantity of energy. To avoid wasting energy, effective routing protocols should be implemented at every tier.

- **Localization**: Network administration and operation are fundamentally hampered without a proper understanding of sensor localisation. Due to the ad-hoc nature of their deployment, the sensor nodes are unable to determine their exact location. The word "localization" refers to the challenge of locating sensors once they have been placed in the field. Beacon nodes, GPS, and proximity-based localisation may all help with this issue.

- **Coverage:** The sensor's trace of an area of interest indicates how successfully it is being regulated. Using a routing method, these Sensor nodes collect data and transfer it to a sink using a coverage technique. Sensor nodes should be chosen in such a way that the whole network is covered in order to get high coverage. The minimum and maximum exposure path algorithms and the coverage configuration protocol are recommended as efficient techniques.

- **Clocks:** WSN relies on clock synchronisation to function properly. The purpose of time synchronisation in sensor networks is to offer a standard timeframe for the local clocks of all nodes. Some applications, such as tracking and monitoring, need that clocks be synchronised.

- **Computation:** Data flow across each node is measured by what we call computation. Computability is all about minimising the amount of time and energy required to complete a task. Processing at each node before delivering data to the base station may be done if the lifespan of base station is more important. We must do all computations at the sink if we have limited resources at each node.

- **Production Cost:** It's safe to anticipate that because sensor networks have a large number of nodes, their total price tag will be significant if even one node is too expensive. Eventually, it will be necessary to keep the cost of each sensor node low. Since each sensor node costs money, this is a difficult problem to solve.

- **Hardware Design:**Any sensor network hardware must be energy-efficient while it is being designed. Power management, microcontrollers, and communication units should all be energy-efficiently designed.

- **Quality of Service:** All data must be supplied within a certain time frame, according to Quality of Service (QoS). Depending on the real-time sensor application, data might be rendered worthless if it is not transmitted to the receiver in a timely manner. Multiple difficulties with sensor network QoS exist, such as network topology changes and legally imperfect status information for routing.

II. LITERATURE REVIEW

Clustering techniques have been suggested for WSN energy conservation. Each of them has its own perks and disadvantages when it comes to selecting a CH. In this part, we provide a short review of previous research that is relevant to our proposed technique.

This technique uses a spanning tree as a multi-hop routing method between CH and the sink, as suggested in [5]. Each node in the network has a certain weight. The link's weight is calculated for each bit sent via the routing tree. For data transmission, the most heavily weighted connection is used. Repeatedly calculating the weight metric and the smallest spanning tree might lead to a greater loss of network energy than is necessary. As a result, this is a poor strategy.

The [6] suggested multi-hop EEBCDA method divides the network into grids. Each grid has a CH, which is a node in the grid. The CH receives data from the smaller grid's member nodes. It will send the data to the next CH in the grid as it moves near the sink. The CH's overhead is increased by using this method of data transfer. Messages are passed up the CH food chain. Network overhead is increased since CH at one level may be exhausted early owing to frequent data transmissions. In addition, a larger quantity of energy is necessary to provide grid location and routing route information to all nodes in the system.

[7] contrasts the MR-LEACH and MH-LEACH strategies of multi-hop routing. The LEACH-1R protocol integrates two multi-hop routing protocols, one of which is LEACH-1R. As part of the LEACH-1R network, the network is divided into smaller parts known as "clusters" by the BS. Data from all nodes is sent to the BS through multi-hop data transmission. This is done to save energy, so the BS picks a single CH and uses it until the CH runs out of power.

[8] shows clusters of CH one- and two-hop neighbours. To transport data from the CH to the sink, a chain topology is utilised. An interconnected network of computers sends and receives data. Only the sink itself has access to the BS node's information. As a result, the nodes closest to the base station may be destroyed. It is thus unable to send data to the sink from the BS-enabled nodes. It increases the pressure on the BS to route traffic. Details concerning the routing method have also been kept under wraps.

Several techniques have been developed to lower the energy consumption of WSNs, but they are unable to handle real-time traffic, necessitating more efficient ways.

Nodes in Wireless Sensor Networks send data using their batteries. In highly populated places, detecting data that is duplicated or correlated might lead to energy waste. Reducing network congestion via data aggregation may save money and resources by extending the life of the network.

With the use of sensors situated in various locations worldwide, the WSN gathers information on physical or environmental factors such as temperature, sound pressure and more....

It may be possible to aggregate data via clustering, in which the cluster head aggregates the data. WSN clustering approaches are compared in this research to discover how much energy they save.

A base station election was used to choose the fuzzy logic cluster's leader. In order to provide a long FND duration and continuous data flow, cluster heads are picked from sensor nodes depending on their energy levels as well as their distances from base stations. Because GPS may not function well in certain cases, the suggested solution does not rely on information about the position of GPS sensor nodes (GPS).

The redundant nodes will be put to sleep in the following cycle in order to safeguard the network's data. Simulations and real-world evidence reveal that we have a more efficient and accurate method for locating clusters and gathering energy.

distributed weights for low-power hierarchical clustering (DWEHC). When determining the weight of a node, which is defined by its residual energy and the distance to its neighbours, each neighbour is first figured out (in its enclosing region). Node cluster heads may be the area's heaviest node by weight. After then, the cluster head will begin adding nodes in the immediate area to its hierarchy of nodes. Regardless of the network's design or size, the clustering method is terminated after only O (1) rounds. DWEHC clusters have been proved to work successfully using simulations.

Energy-harvesting WSNs may be used to track animals, monitor air and water quality, and respond to disasters. We describe the barriers that need to be solved in order to further develop energy harvesting-based Wireless Sensor Networks (WSNs).

III. PROPOSED APPROACH

A distributed clustering approach is presented here to maximise energy usage throughout the network. Sensor nodes are organised into clusters with the primary goal of maintaining near-identical energy levels throughout the network at all times. A larger number of nodes fulfilling the monitoring function for a longer period of time increases the network lifespan.

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Volume 4, Issue 6 June 2022, pp: 2346-2354 www.ijaem.net ISSN: 2395-5252

A. Cluster Formation

The sensor nodes move at a relatively slow pace over the network region. The distance between two nodes is calculated using Euclidean distance. In order to build clusters of varied sizes, each nearby node in a cluster is just one hop away from another node in the cluster.

B. Cluster Head Selection

A node with the most remaining energy in a cluster is chosen as CH at regular intervals. Nodes within a one-hop radius of the designated CH continue to relay the detected information until the whole network has been established. For a node to continue as a CH for long periods of time, it must undergo a process of CH transformation. If the previously selected CH is proven to have the largest residual energy, no adjustment in the CH is made.

C. DataCommunication

An individual node is selected as the "cluster leader" in each group. Multi-hop routing will be used to transport aggregated data from CH to the sink. Non-clustered neighbours of CH will get the RREQ message, which is sent to the next forwarding node based on its distance from the destination, its maximum residual energy, and other parameters. Each subsequent forwarding node calculates the next hop and transmits the data to the sink. The communication inside the cluster is formed in this way.
The network's energy balancing algorithm ensures that each node remains active for the duration of the network's life, resulting in improved network performance.

IV. CLUSTERING IN WSN'S

Each sensor node in a WSN uses energy to relay data directly to the sink node. Clustering is the topological distribution of a network into several tiny sub-networks, each of which has two or more sensor nodes, termed clusters. CH is the primary node in each cluster, and the other nodes are known as member nodes that monitor events. The sink receives data from the CH, which gathers information from all of the member nodes. The data at the sink is either utilised by the end user or transmitted to another network, depending on the situation. Since each node has equal opportunity to send data to the sink, clustering is the most energy-efficient method. It is possible to use the clustering approach in a central or distributed fashion.

Centralized Clustering

All of the network's nodes are managed by a central Base Station in centralised clustering (BS). Members of each cluster are allowed to communicate their data to their pre-selected CH at a pre-determined time period [11]. Clustering in this manner increases the BS's overhead, hence it is only used in WSNs that operate in areas with limited coverage.

Distributed Clustering

This dynamic nature of distributed clustering makes it ideal for a wide range of applications. As the cluster size increases, the number of nodes in the cluster increases as well [12]. Unlike centralised clustering, which may have a single point of failure owing to energy depletion, this rotation of nodes in the CH decreases this risk. It improves network management and is dependable when used in large-scale network systems.

4.1 Design and ImplementationIssues

In order to implement a cluster-based architecture, a substantial amount of work must be completed. While clustering provides many benefits, it also has its own set of downsides, concerns, and challenges. Here we'll go through some of the specific design and implementation challenges that cluster-based network architecture faces.

- **NodeMobility:** The vast majority of network designs are based on the premise that nodes are fixed in place. However, supporting the mobility of base stations or CHs may be necessary in other instances as well. Clustering is made more difficult by node mobility since the node membership is constantly changing, necessitating the evolution of clusters over time.[14]

- **TrafficLoad:** A sensor network may detect events that are either continuous or sporadic. There is a significant difference between intermittent and continuous monitoring, since intermittent monitoring creates traffic only when the event of interest is detected. As intermittent events only need sensing on rare occasions, they do not alter the CH's function, however random selection of a CH from the sensor population may be necessary to account for the unequal load on CHs caused by intermittent events[14].

- **OverlappingClusters:** There are two ways in which network sensors may choose the cluster head CH: either via a predetermined design, or through a democratic process. If the latter option is selected, a member of one cluster may become a member of another. These clusters must be taken into consideration in order for the design process to be successful. Overlapping clusters must be recognised and coordinated with other clusters to avoid injustice, famine, or a stalemate in resource competition[15].

- **LoadBalancing:** Load balancing is a major issue in sensor networks because CHs are chosen from a pool of available sensors. To prevent the failure of the head due to overloading of a single CH, members sensor nodes must be dispersed among the various CHs. In order to level the playing field, massive clusters are required.

- **DynamicClusterControl:** A self-configuring clustering approach must be used to set up a sensor network. We may now create clusters based on geographic location for the first time. Clusters are built using a variety of factors, including data accessibility, node capacity, and network connectivity. An important problem in clustering is that the cluster head must be able to detect changes in node membership as the phenomenon evolves. [15] emphasises that a new CH must be elected when the target is beyond the CH's range of sensing ability.

- **Inter-clusterCoordination:** The CHs needed to talk to each other in order to accomplish their aim. The exchange of information and the attainment of coordination may need communication between them. It is possible to request more data from a cluster that has already collected it. Inter-cluster communication overhead should be handled by the self-configuring clustering method.

- **DataAggregation:** The CH must aggregate and transfer data from the cluster nodes to the CH, using additional energy from the CH. As a result, careful consideration should be given to the CH. The CHs' energy may be conserved by periodically switching duties between various nodes. Additionally, a strong node might serve as the CH in order to deal with any increased energy requirements.

- **FaultTolerance:** Fault tolerance refers to the ability of a sensor network to function even if one or more sensor nodes fail. Due to a lack of power, physical damage, or environmental interference, sensor nodes may malfunction or be prohibited from communicating. A failure of both CHs and cluster nodes is possible. The overall objective and performance of the sensor network should not be harmed by these failures. As a result, a method for responding to mistakes of this kind is required.

- **Scalability:** The CH should be able to adjust to an increase or reduction in the number of cluster members after the initial creation. For many reasons, a cluster's membership might fluctuate. An example of this is a cluster member failing owing to a danger to the environment. Over the next several months, the CH will have to adjust to a drop in its overall membership. A member count may also rise due to the installation of additional sensors, the failure of an existing CH, or any number of other situations. Similarly, the sensor network should be able to respond to changes in the number of clusters by either increasing or decreasing its size.

- **NumberofClusters:** Another design consideration is the total number of clusters or cluster count. If the number of clusters is too high, the network becomes more complicated and the administration burden increases. The energy efficiency of the network may be improved by forming the right number of clusters.

- **ClusterFormationTime:** The network should take the shortest time possible to construct the first cluster. There should be no more than a few days between the selection of a cluster count and the allocation of cluster members to a CH.

- **SinglehopvsMultihopsNetwork:** There are two ways to communicate in clustering: one is single hop and one is multiple hop. A multi-hop network may save energy since the transmission energy varies directly with the square of the distance [16]. Managing topology and media access in a multi-hop network, on the other hand, creates a number of design problems. Another factor to keep in mind is this.

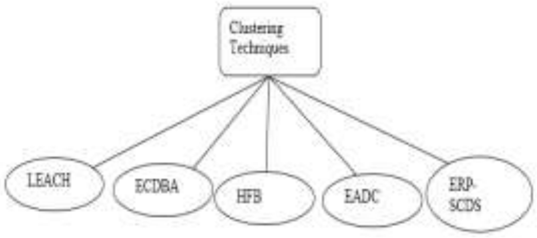
- **NodeHeterogeneity:** A variety of sensor nodes of various sorts and capacities may be necessary

- for certain sensor applications. Sensor data may be produced at varying speeds, and networks can use a variety of data reporting models and quality-of-service limitations to suit their needs. Clustering will be a challenge in such a setup, making the task of CH much more challenging.[16]

- **ClusterFormation:** When constructing clusters, several criteria must be considered, such as whether the clusters are centralised or dispersed and if the number of clusters is predefined or not. Cluster-based routing protocols should overcome these design challenges in sensor networks. A random sensor in a cluster takes up the role of cluster leader to spread the energy burden more equally. The network designer predetermines the network's cluster head percentage.

- **SelfConfigurationandReconfiguration:** The self-organization phase is a critical one in cluster formation. The clusters should be able to configure themselves. It is vital to consider how quickly a wireless sensor network may self-organize into a working entity. The self-organization phase should be as brief and energy-efficient as possible in order to optimise network lifespan. Replenishment or Reconfiguration is another another factor to take into consideration. It is possible to describe replenishment as the process of replacing old and energy exhausted sensors by inserting new fresh sensor nodes with full energy reserves. After the loss or addition of sensor nodes, reconfiguration is the process of self-organization.[17]

4.2 Different Clustering Technique



LEACH- Low Energy Adoptive Clustering Hierarchy
ECDBA - Energy-Efficient Cluster Based Data Aggregation
HFB - Hierarchical Flow Balancing
EADC - Energy Aware Distributed Clustering
ERP-SCDS- Energy-Efficient Routing Protocol with Static Clustering and Dynamic Structure

4.2.1LEACH

LEACH [18] is the most well-known application-specific strategy that utilises clustering to prolong the lifetime of a network. Nodes create local clusters in LEACH, with one node functioning as the cluster head. The cluster head receives and analyses the data for each non-cluster-head node before delivering it to a distant base station. The cluster head receives and processes data for each cluster member before transmitting it to the base station. As a consequence, cluster head nodes spend more energy than nodes that are not cluster heads. When the cluster head loses power, all of the cluster nodes lose the ability to interact with one another. In order to avoid any one sensor in the network from draining its battery, the high-energy cluster head position is randomly cycled among the sensors in LEACH.

The LEACH procedure is comprised of a number of "rounds." Each match has a pre-match setup procedure. The setup step includes both the selection of the cluster head and the creation of the cluster. In LEACH, each node with a role as cluster leader is picked using a probabilistic function.

4.2.2 ECBDA

ECBDA [19], which is an energy-efficient cluster-based data aggregation approach, comprises cluster formation, cluster head election, data aggregation, and maintenance. During the cluster generation step, the network is split into clusters. When the clusters have been formed, elections for Cluster Heads are conducted. Based on the remaining energy and communication cost component, a CH is selected from each cluster.

The third and final phase includes the transfer of real data. Each cluster member transmits its sensed data to the data aggregation node within its allotted time period. The CH waits till its TDMA period concludes. CH initiates the process of aggregation after receiving data from all cluster members. After each CH has eliminated duplicates, the packet is forwarded to BS through the forwarding nodes. During the maintenance phase of each cycle, the CH's unused energy is evaluated. When the remaining energy goes below a predefined level, it is possible to choose a new cluster head from the same cluster.

Typically, CHs communicate data directly to the central node of the station. Direct transmission demands considerable energy. With ECBDA, however, each CH utilises another CH as a forwarding node to the base station, resulting in a reduction in transmission energy. TDMA slots need all cluster members to be active at all times; hence, they are in a sleep state while not in use. With the assistance of ECBDA, network lifetimes are increased.

4.2.3 HFB

HFB [20] is a hierarchical flow balancing technique for collecting and transferring sensor data to the sink. During the route formation phase, a hierarchical backbone network is constructed using cluster heads with the sink at the top of the network, and sensors are clustered according to their overlap degrees. Figure 2 illustrates the overlap of nodes.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 6 June 2022, pp: 2346-2354 www.ijaem.net ISSN: 2395-5252

4.2.4 EADC

The cluster-based routing protocol published by Jiguo Yuan et al. [21] includes an energy-aware clustering algorithm called EADC and a cluster-based routing algorithm for wireless sensor networks with non-uniform node distribution. In order to elect cluster heads with larger energy, competition for cluster heads in EADC is based on the ratio between the average residual energy of neighbouring nodes and the node's own residual energy.

In multi-hop communication clustering systems, inter-cluster and intra-cluster energy consumption are two separate elements of cluster head energy consumption. To establish energy balance among cluster heads, it is required to balance the energy consumption of cluster heads. As a result of energy disparities across clusters, cluster heads in sparse areas take on more forwarding tasks. Cluster heads with larger residual energy are desirable for prolonging the network's lifetime when considering the number of nodes.

4.2.5 ERP-SCDS

As a result of the method's static cluster design, it consumes less energy to cluster. The sink handles the initialization of static clusters, resulting in a clustering process that consumes less energy and provides clusters with equitable distribution. The sink is accountable for the initial distribution of virtual points. Since virtual points are cluster centres, an even distribution of virtual points in ERP-SCDS reduces the amount of energy required to construct a cluster. Cluster formation is the second part of the ERP-SCDS implementation process. Due to the fact that each node may choose the virtual point closest to it, an ever-changing structure is produced.

In the third phase of ERP-SCDS, cluster leaders are chosen. For this phase, ERP-SCDS enables the selection of a new cluster leader in advance to prevent a deadlock. The fourth phase of ERP-SCDS involves route discovery. A straightforward and energy-efficient multi-hop routing approach is utilised to choose relay nodes from the cluster heads to the sink. Two criteria are used by ERP-SCDS to assess whether a node is a relay node. Direct transmission between the cluster head and the sink is feasible in the absence of a relay node.

The approaches listed in this table are based on the selection criteria and function of cluster leaders. Methods of communication between additional sensors and the base station are explained in the next section.

Method	Parameters		
	CH Role	BS Connectivity	CH Selection
LEACH	Aggregator	Direct	Probabilistic
ECBDA	Aggregator	Multihop	Energy
HFB	Aggregator, Relay	Multihop	Overlapping degree
EADC	Aggregator ,Relay	Multihop	Energy + Hop distance
ERP-SCDS	Aggregator, Relay	Multihop	Energy + Cluster centre

Figure4:Summaryofdifferentmethod

4.3 Proposed Clustering Method

4.3.1 Fuzzy Logic Based Cluster Head Election

Small and cost-effective wireless sensor nodes are challenging to construct, but the effort is rewarding. Compute power, power supply, and memory capacity are sacrificed for smaller dimensions. Because the nodes are so small and may be put in dangerous areas, it is difficult and hard to change their batteries. This is the most important issue. The routing algorithm may be enhanced to preserve energy and prolong the network's lifespan. The cluster-based hierarchical routing system is an efficient routing mechanism. Cluster routing combines sensor nodes into many groups, with a cluster head selected for each group. When cluster nodes provide data to the cluster head, the data is aggregated and sent to the base station in a single packet. To save energy and reduce network congestion, this protocol allows only the cluster head to communicate with the base station[22,23,24].

4.3.2 Efficient Sleep Duty Cycle for Sensor Nodes

The incorporation of a cluster-based hierarchical structure into WSN applications provides more efficient data collecting. In this circumstance, it is feasible to partition the sensor nodes into clusters. A cluster head (CH), a member of each cluster, is responsible for data transmission to the base station as well as coordination (BS). By regularly rotating the cluster-heads selection, the node's energy consumption across the network may be balanced. When sensor nodes are distributed densely, the data collected by neighbouring nodes may reveal spatial and temporal correlations between the qualities. Despite the fault-tolerant data aggregation approach, the duplicated data will cause needless data transmission, collisions, and energy depletion, which will limit the lifetime of the network. [26].

4.3.3 Hierarchical Clustering

Clustering strategies have been offered as a means of reducing energy use [3-20]. Some nodes are designated as cluster leaders and gather data from other nodes in their respective groups. In this case, the heads may combine the data and transmit it to the data centre as a single packetwhich will save on the overhead of data packet headers. Several benefits may be reaped through clustering: (i.e., decreasing collisions induced by the channel congestion). 2) lowering unnecessary energy usage by reducing the overhead (i.e., bandwidth utilisation).

4.3.4 Estimated Energy Harvesting

Power-harvesting technologies have evolved substantially in recent years, and systems that can supply continuous power production from a variety of energy sources including sun and vibration have been created (Instruments 2015a). The latest WSN devices are also incredibly energy efficient, allowing them to function for a very long time on the limited gathered energy without shutting down, at least not because of energy depletion.

V. CONCLUSION

Our study focuses on the implementation of homogeneous sensor node distributed clustering. Nodes may communicate with the CH in a single hop or with the BS in a multi-hop fashion. Although CH nodes lose more energy than other nodes, the procedure of offering each node a fair shot to become a CH decreases the risk of fully losing a node in the network. The suggested method guarantees that no nodes in the network will fail owing to total depletion of energy, unlike the many ways used earlier. Consequently, the network's energy usage is reduced.

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Volume 4, Issue 6 June 2022, pp: 2346-2354 www.ijaem.net ISSN: 2395-5252

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