ENHANCED ROUTING PROTOCOL FOR HETEROGENEOUS WSN

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Abstract: Applications for WSNs have significantly advanced in recent years. Clustering is a technique used in WSNs to increase operational efficiency and lengthen network lifecycle. The method of clustering involves splitting the sensing field of a sensor platform into a number of clusters. A leader, often referred to as the Cluster Head, is chosen for each cluster. Cluster heads may be chosen by the sensor node of the cluster or by the network administrator. The cluster- dependent routing protocol is a method of selecting and transmitting data to the CH that uses extremely little energy. This study looks at various energy-efficient clustering techniques used in the wireless sensor industry. Numerous energy-saving cluster algorithms, including LEACH, K- means, SEP, and Z-SEP, are also examined in the paper. These algorithms' main objectives are toreduce energy usage and increase network longevity. The system may save a large amount of energy with optimised grouping. The authors of this study conducted extensive research on WSN clustering procedures.

Keywords: Internet of Things, Wireless Sensor Networks, Energy Efficiency, Clustering,
Cluster Head

1. Introduction

The Internet of Things (IoT) faces various technological challenges, but the end outcome is a massive network of trillions or thousands of interconnected "things." The Internet of Things (IoT)is the term used to describe the expanding network between physical items and other internet- connected systems and devices. The goal of the Internet of Things is to connect everything to everyone and everything, ideally using all pathways, networks, and services [1]. IoT is seen as a technology and an economic stream in the global information business, following the Internet. IoT stands for an intelligent Internet-enabled network that enables communication and information exchange through information sensing devices that adhere to the same standards. The goal is to intelligently define, locate, map, control, and manage issues. The Internet-based network is the network that improves connectivity from humans to people, things, or things and things [2].

WSNs are sensor nodes that can be used in a range of IoT-related applications, such as healthcare, defence, and agriculture, by connecting to the internet. Using sensors, controllers, and the web, the IoT enables the

analysis and sharing of data in physical items. The main characteristics of a WSN system are its energy usage, scalability, dependability, resilience, and other factors. WSN is a collection of several sensor networks that self-organizes in an ad hoc manner. A system's capacity for self-organization enables it to quickly attach new nodes without the need for operatorassistance. These systems consist of one or more base stations known as sinks and a wide varietyof small, inexpensive devices known as nodes. These nodes send information to the BS. [3].

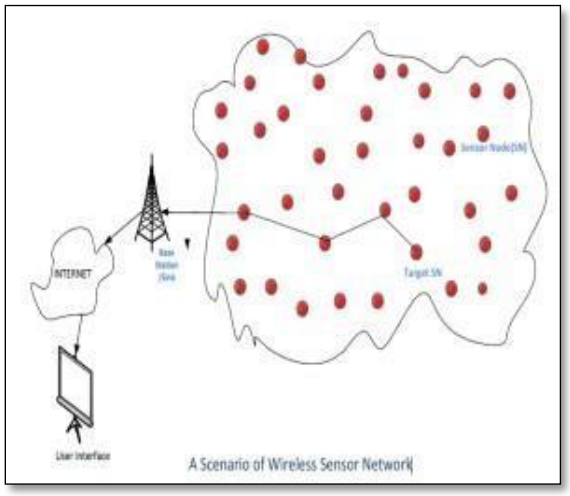

Fig. 1. Architecture of WSN [1]

These sensor nodes are used in a range of settings, including the gathering of intelligence data and commercial, civil, and climatic settings. A Sensor Node is an implementation for a few different minimally self-sufficient machines that can sense, compute, and transmit signals in order to gatherlocal information and make overall judgments about the physical environment.

The paper is divided into four parts of equal length. Section 1 provides an outline regarding the role of IoT in Wireless sensor networks. Section 2 goes into detail about clustering in WSN. The third section focuses on the clustering algorithms. Section 4 provide related works and finally, section 5 summarizes the entire document.

2. Clustering

Due to the restricted amount of energy stored in the battery, the use of WSNs has increased in recent years, as have the challenges posed by energy limitations. It is challenging to charge and replace the battery unit because the amount of energy available determines how well nodes function. The network as a whole fails if any network device malfunctions [4]. In clustering concepts, SN clusters are created (or each cluster is given

a CH). In this arrangement, each SN sends information to the CH that they have chosen for their cluster before the CH sends the information to the BS server. The nodes could send and receive data for a constrained region and hence utilise a constrained quantity of energy because all of the SN in the cluster could receive and transmit data inside their own clusters. However, a significant amount of energy is needed when transmission takes place between the CH and the BS.

There are many ways to classify the clusters of which the two popular classification are:

(a) Heterogeneous and Homogenous clusters (b) static and dynamic clusters.

In heterogeneous SN, there are sensors with complex hardware and advanced processing capabilities. In most instances, these SN act as the CH. They are in charge of processing data gathered from other nodes. Some other type of sensor finds the necessary environmental variables. All nodes in homogeneous networks have the same hardware and computations. During the implementation of the network, static clusters are constructed. Each cluster has fixed characteristics, such as size, CH, and number of network participants. When the sensor field is preplanned and the targets of the sensors are not moving, this sort of clustering is beneficial sinceit makes it easy to remove the sensors from the system.

Large systems make greater use of sensors [5]. They can be employed in heterogeneous systems but are commonly used with homogeneous sensors. As opposed to the static network, there is nopre-allocation of the CH. A cluster may form in response to a special message, and the clusters' characteristics can vary. As a result, the clusters' dimensions might be altered, and it offers networkruntime skills for job distribution, cluster size variation, etc. However, it is necessary to establish a CH election technique, a cluster construction strategy, or a cluster maintenance approach.

3. Clustering Algorithms

One of the processes with the highest energy use is clustering. Clusters have been created from the sensor's nodes [6]. Every cluster consists of a cluster head and a few node members. The heads ofeach cluster receive the sensed data from member nodes. The data is collected, compiled, and thensent to the BS by CH. Each CH uses up energy at a higher pace than typical sensor nodes. This condition is enabled by the dynamic nature of Cluster Heads (CHs). Grouping related items into clusters is called clustering, and clustering procedures include looking for similarity and patterns [7].

The scientific community has strongly supported clustering in sensor nodes as a solution to the scalability, energy, and life issues associated with sensory networks. Cluster algorithms control local domain communications, which are only disseminated to the rest of the internet via transmission nodes. A cluster's head (designated leader) and neighbour hood interactions amongst members make up the cluster node community. The cluster head gathers data and integrates it with energy efficiency, and cluster members frequently interact with the cluster head.

A. Fuzzy c-Means

Each data point is grouped into a different cluster according to the FCM [8] approach. Dunn developed this strategy in 1973, and Bezdek improved it in 1981. The utilisation of patterns is veryprevalent.

It transmits a FORTRAN IV programme for the FCM clustering technique. An extensive range of geostatistical research subjects are covered by the FCM programme. This system generates varyingparts and prototypes for each numbered data set. These partitions are employed to support or hint at a previously unrecognised data substructure. The clustering criterion for aggregating subsets isa generalised function. The software allows users to choose between three standards (Euclidean, diagonal, or Mahalanobis), a weighting factor that may be adjusted and essentially controls noise resistance, the acceptance of changing cluster numbers, and the outputs of numerous evaluations of cluster validity.

B. LEACH

It is a MAC protocol built on TDMA that combines network routing protocol with grouping. In LEACH, sensors are installed, and one node handles the CH. A hierarchy of protocols is used to expand a wireless network sensor. The lead cluster then gathers and compresses data from each node and sends it to BS [9].

C. Stable Election Protocol (SEP)and Z-SEP

A modification to the LEACH technique is SEP. This heterogeneous protocol extends the period before the first node dies, which is necessary for a number of applications. The SEP offers a greateraverage output and a longer period of stability. The EP grouping and the LEACH grouping are thesame.

We develop Zonal-Stable Election Protocol, a two-level heterogeneous network protocol. They have two types of nodes: conventional energy-based nodes and advanced nodes. There are three different fields: Zone 0, Zone 1 header, and Zone 2 header. To save energy and limit direct data transfer to the BS, standard nodes are only utilised in zone 0. The stability period increased by around 50% by changing how the various components were used [10].

E. K-means Clustering

Data are grouped via K-means clustering, which displays the group numbers as a variable K. Eachdata point is iteratively assigned to a group of K using the supplied qualities. Based on how closelythe data points share certain characteristics, they are grouped. In order to keep the centroids as minimal as possible, the K-means algorithm determines k centroids and authorises each instance to the nearest group. The term "means" in K-means refers to the data's mean, which is used to locate the centroid [11].

F. HEED

A distributive clustering technique in the Hybrid Energy Efficient Distributed (HEED) algorithm takes energy and communication costs into account. The HEED is an iterative algorithm for clustering that chooses the best cluster node for energy and communication based on remaining node costs [12]. The essential variable of the probabilistic CH option of the HEED protocol is theremaining power of each sensor node. If there is a tie, the average distance from the neighbours orthe node ranking is used as the CH. The HEED, U-HEED, RUHEED, and the newest R-HEED variant ER-HEED clustering methods have been relatively investigated.

4. Literature Review

Kitaw et al. [13] Topology control balances sensor network demand while also enhancing networkscalability and longevity. A good technique to control the topology is to group the sensor nodes. Our proposed approach uses a variety of power levels in a sensor network but makes no assumptions about the existence of infrastructure or node capabilities. The HEED protocol choosescluster heads on a regular basis by combining secondary criteria, such as node distance from its neighbours, with node remaining energy. HEED produces a remarkably uniform distribution of cluster formation across the network and completes in O(1) iterations. Given appropriate limitations on node density and intra cluster and intercluster transmission ranges, authors

demonstrate that HEED may nearly certainly ensure clustered network connection asymptotically. Results from simulations demonstrate that our proposed technique is effective in extending network lifetime and enabling scalable data aggregation.

R. Kaur et al. [14] Power-effective K-means clustering for WSN is recommended. The objective function takes both the membership weight and the distance between the CH and the node into account. The authors present a technique for producing multiple node clusters using Optimal K- means (OK-means). While inter-cluster communication employs a multi-hop communication technique, intra-cluster communication uses a single hop mode. The performance is evaluated using Ns-2. In the CH geographical domain, the suggested technique achieves uniform distribution. The energy usage is successfully balanced as a result. To further illustrate OK-means'full potential, extensive simulations with various node densities have been run.

Alagirisamy et al.,[15] The possibility of the mobile sink to be employed in inaccessible areas is examined by the authors, along with the delay constraints that dynamically affect constant monitoring systems. An Energy Aware Unequal Clustering approach with a stationary and mobilesink is presented by the authors. The study suggests smaller clusters that encircle static sinks, withall network data being sent to the nearest static or mobility sink. In terms of network longevity andenergy usage, simulation findings show that EAUC-DUAL beats LEACH with static sink and LEACH with dual sink.

Ali et al.,[16] Present an IEECP to increase the lifespan of WSN-based IoT. Three sections of thesuggested IEECP must be finished in that sequence. First, a commitment is made to the ideal number of clusters for the overlapping equitable clusters. The consistent clusters are then created using a modified fuzzy C-means algorithm and a framework designed to reduce or maintain the SN's energy usage. In the end, many cluster members rotate the CH feature to employ a novel CH selection-rotation approach by combining a back-off timing technique for CH selection as well as a rotation technique for CH orientation. This results in CHs being picked in optimal roles. The suggested method balances and reduces node power consumption by improving functional architecture; IEECP is suitable for systems with long lifespans. The results demonstrate that the IEECP performs better than earlier algorithms.

Sakshi Vasan et al [17] To secure a certain area, the WSN disperses a lot of wireless nodes. Small batteries that run out quickly power these nodes. These networks act as the foundation of the

internet. Clustering is being used to lengthen the life of the network. This study provides a clustering technique strategy for data collection based on the usage of mobile agent data from the heads of clusters and optimal cluster head selection. The suggested protocol is known as the Mobile Agent-based Protocol. For mobile marketing companies, the protocol that has been used has been upgraded. Compared to the current I-LEACH method, this approach is an improvement. The protocol's effectiveness was evaluated in relation to the system's remaining energy, the live node set, the dead node set, the throughput, and the latency.

Jiguo Yua et al., [18] Clustered networks show higher uneven energy demand among nodes, according to non-uniform node deployment. Based on this problem, this work proposes an energy- aware clustering algorithm and a non-homogeneous node distribution routing approach. EADC uses the competition range to group clusters of equal size. In addition, the routing algorithm causes cluster heads to choose higher-energy nodes with fewer member nodes as their next hops, establishing load balance among cluster heads in the process. This increases node forwarding jobs in sparsely covered locations. Theoretical research and simulation results show that our protocol can balance energy consumption between nodes and improve network performance.

Behera et al.,[19] development of the current SEP that integrates a threshold-based CH selection for a heterogeneous environment. The threshold makes sure that both CH nodes and member nodesreceive an equal amount of energy. Based on their initial energy supply, SN are divided into threetypes: normal, intermediate, and developed, in order to distribute the network load fairly. The results of the simulation show that the proposed method beats SEP and DEEC processes by 30% in cluster formation and by 56% in throughput.

Lata et al.,[20] The LEACH-FC method was recommended to high rise decade, and a FL-based CH selection & cluster development was carried out. For cluster head selection as well as cluster formation, we choose a centralised strategy as opposed to a distributed one. We also employed FL,a centralised algorithm, to choose the vice CH. The power load at each node may reportedly be calculated using the suggested method, improving WSN dependability. It outperforms other suggested algorithms in ways to lengthen system life and reduce power consumption.

5. Conclusion

The most challenging part of creating a wireless sensor-based system is designing an energy- efficient solution. It was found in this paper that the many writers used an energy-efficient routing- based clustering technique to build a wireless network. The authors emphasised the benefits of clustering in a WSN as well as the many variables to take into account while creating a clustering approach. The benefits of clustering and some of the current clustering techniques are summarised by the authors. Finally, based on a few key considerations, the authors have presented a comparisonof the various algorithms.

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