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Research Article

Energy-Efficient Routing Protocol for Next-Generation Application in the Internet of Things and Wireless Sensor Networks

Roopali Dogra,[1] Shalli Rani ,[1] Himanshi Babbar ,[1] and Daniel Krah [2]

[1]Chitkara University Institute of Engineering and Technology, Chitkara University, Rajpura, Punjab, India
[2]Tamale Technical University, Ghana

Correspondence should be addressed to Daniel Krah; dkrah@tatu.edu.gh

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Among the key challenges with wireless sensor networks (WSNs) is that most sensor nodes are fueled by energy-constrained batteries, which has a significant impact on the network's efficiency, reliability, and durability. As a result, many clustering approaches have been developed to enhance the energy efficiency of WSNs. Meanwhile, fifth-generation (5G) transmissions necessitate the usage of multiple-input multiple-output (MIMO) multiple antennas in numerous Internet of Things (IoT) applications to furnish increased capacity in a multipath spectrum environment. Instead of a single senor that can facilitate better load balancing utilization, we believe to balance the energy utilization per unit area. The devices in IoT are submerged with various transmission interfaces known as MIMO in 5G networks. With MIMO being more commonly accessible on IoT devices, an effective clustering approach for rapidly evolving IoT systems is both lacking and urgently needed to support a variety of user scenarios. In this paper, we proposed the intelligent MIMO-based 5G balanced energy-efficient protocol which focuses to achieve Quality of Experience (QoE) for transmitting in clusters for IoT networks. The proposed protocol enhances the utilization of energy and lifetime of the network in which it shows 30% less energy utilized in comparison to the existing protocols.

1. Next-Generation Networks (5G): Clustering for IoT-Based Systems

Many services, programs, sensor-embedded digital equipment, and network protocols have been built, and it is still being constructed as the Internet of Things evolved rapidly. The IoT enables genuinely existing things to see, listen, understand, and execute a crucial task by connecting and engaging with each other and sharing essential knowledge while making a decision and doing critical activities. Wireless sensor networks, that provide a continuous layer for the IoT, are critical for 5G telecommunications. A wireless sensor network is composed of a collection of sensor nodes that detect and transfer data to the sink. Every round's sink (or base station) is the endpoint of transmitting data. The primary problems of IoT-based WSNs are increasing the lifetime of the network and reducing energy consumption.

Therefore, one of the primary aspects of 5G wireless communication is massive machine-type communication. Because the current cellular network has wider coverage, a substantial number of deployed equipment, a robust user service management system, etc., Cisco believes that the 3rd Generation Partner Project (3GPP) produced networks would support 80 percent of a total of IoT device connections. The major approach in the upcoming wireless network to conform to the IoT device service well is to improve the present cellular network for service attributes [1]. As a result, the 3GPP organization has already been focusing on IoT network standardization since Release-8 and is much more likely to adopt optimization strategies that have minimal impact on existing networks to facilitate cellular networks to accommodate huge IoT device communication. The transmission data is little, the transmission is rapid, and the battery is tough to replicate with a high number of IoT devices application services concentrated on the uplink. The key reason for the minimal resource utilization of limited data for IoT devices is collided caused by random access whenever large-scale devices request network connection [2]. The present network has two major flaws that will hinder future widespread IoT access.

(i) Massive IoT device access will occur in a massive number of collisions, particularly with random access congestion, lowering the access success probability and causing a network overload

(ii) IoT devices communicate modest quantities of data, and establishing a data connection with the base station (BS) in Long-Term Evolution (LTE-M) requires more than 25 handshakes, leading to high signaling latency and reduced resource utilization

1.1. IoT-Based WSN's Clustering in 5G. As can be shown, 5G could provide a viable and dependable backhaul infrastructure for a variety of IoT systems. It makes sense to base upcoming protocols for IoT networks on that infrastructure, with QoE monitoring as one of the design principles.

This is becoming the norm because cellular networks with backhaul could provide full connectivity. The communications network usually has three layers, as shown in Figure 1. The devices and sensors in the field make up layer 1 [3]. Telecom companies utilize layer 2 outside of the field, usually in the form of small and medium-sized cells, to assist 3GPP standard communication. Layer 3 is the evolving packet core network (core network), which collects all of the data and information. Layers 2 and 3 are combined to form the backhaul network architecture. In wireless communication, layer 1 is considered as the last hop. All three tiers can benefit from 3GPP communication. Layers 1 and 2 are the only layers where machine-to-machine (M2M) communication is possible. The standard architecture for 3GPP included IoT backhaul is depicted in Figure 1(a). The 3GPP organization, telecom providers, and academia are now working to make 5G a reality by the end of 2021. 5G, as an M2M enabler, offers capabilities like 2–20 Gb/s speed, 0.1-ms latency, and 100 percent coverage and dependability, to support and provide strong QoE for a wide range of applications and utilizations.

In 3GPP for WSN-IoT clustering, the methods used for clustering are essential and can be fruitful for many challenges which can be the managing transmission of data for the numerous sensor nodes, efficiency of energy, decentralized processing, hierarchy in management, etc. [4]. Therefore, to overcome the above challenges or issues, we have applied the clustering methods in WSN-IoT as depicted in Figure 1(b). Clusters are generated at layer 1, and one cluster head (CH) is chosen for each cluster. Each cluster's CH will continue to be responsible for data collection and confusion. First, with clustering in the field, M2M transmission is limited to layer 1. Cross-layer transmission is minimized or avoided, which preserves a huge amount of energy on the devices. Second, the clustering design is advantageous for local data collection and processing. The CH can filter out redundant information, preventing the 3GPP backhaul network from becoming overburdened. Finally, the layer 1 cluster design could be further stratified depending on the network's size, device types, types of application, connectivity, and other factors.

1.2. Main Contributions. To solve the above challenges:

(a) We have proposed the Intelligent Multiple Input Multiple Output-5G based Balanced Energy Efficient (IMIMO-5G based BEE) protocol for intra and interclustering in IoT networking systems

(b) In this protocol, the algorithms are framed for choosing the CH, forming the intra and interclustering for the multihop routing. We have chosen two CH's for the distribution of sensors and energy utilization, and this will increase the lifetime of the network, improve the area of the network by the use of prolonged distance for intercluster transmission

(c) IMIMO-5G-based BEE will firstly allocate the network vertically into intra and interclusters to divide the energy utilization across CHs. The sensors will transmit the data to the CHs and then the data transmitted by the CHs will be sent to the BS (BS)

(d) The clusters that are nearer to the BS have a small radius and by using the clustering and multihop topology, and the nodes interact with one another by transmitting the data from the source to destination to minimize the response time by making the use of Euclidian distance

1.3. Paper Organization. The rest of the paper is organized as Section 2 displays the table showing the literature work of existing authors; Section 3 shows the novelty design of the proposed approach; Section 4 discusses the results and discussion of results which explains the performance evaluation of existing vs. proposed approach; Section 5 concludes the paper.

2. Related Research

Various clustering and nonclustering algorithms are designed to improve the performance of energy consumption, reduce the delay, and increase the lifetime of the network. Below Table 1 displays the existing clustering routing protocol techniques applied by multiple authors.

3. Novel Design

3.1. Clustering Process. The feasible routing for clustering utilizes the k-means algorithm for the formation of clusters, and CHs are chosen based on Euclidean distance and energy of nodes. The attribute value on which the node is authorized to send data to the CH is the rigid threshold communicated by the CH to the appropriate cluster members [13]. When one-third of the nodes have died, and the surviving nodes' leftover energy is inadequate to establish a cluster, the nodes employ the greedy strategy to create a cluster-like multihop routing till the BS is attained. In this phase of networking, n nodes are taken as CHs. In the first round, the leftover node determines the nearest CH using the Euclidean distance, generating n-clusters. The center of each cluster is

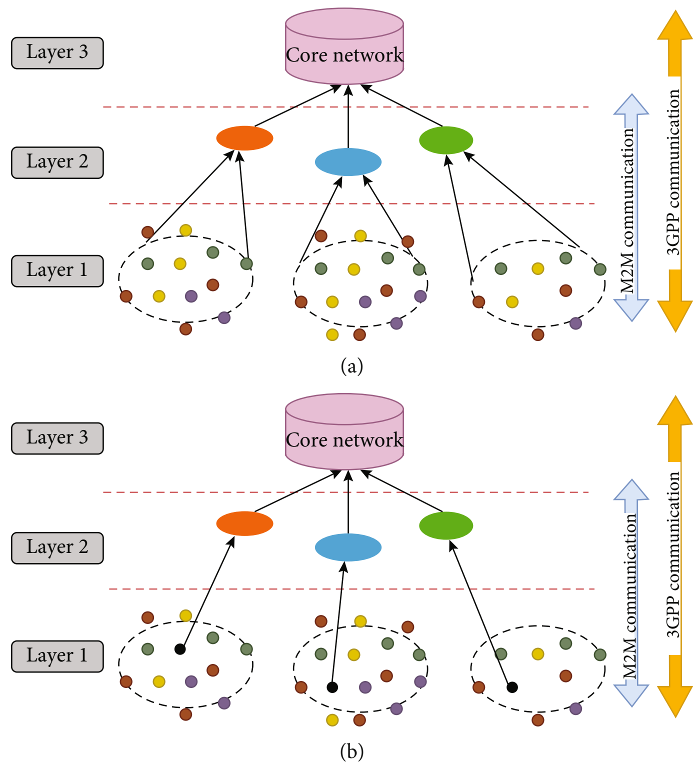

Figure 1: (a) Unclustered WSN-based IoT backhaul. (b) Clustered WSN-based IoT backhaul.

computed in subsequent rounds. The center of m^{th} node, D_j is represented as

$$Dj = \left(\frac{1}{|Q|} \sum_{m \in Q} aj, \frac{1}{|Q|} \sum_{m \in Q} bj \right), \tag{1}$$

where Q denotes the member of the cluster, and a, b denotes the coordinates of the nodes. For the network's gathering of CHs, the algorithm requires not only the distance between the nodes but also their energy. The leftover energy of the nodes is represented by X_j. As a result, the maximal leftover energy and the shortest distance between nodes are used to choose CHs.

$$\text{CH}_{\text{choose}} = \text{maximum}_j \{ \text{minimum}_j \{ g(D_j, X_j) \} \}. \tag{2}$$

A cluster sample is used, with a CH selected at random and a centroid generated to use the centroid formula. At the cluster's core, the centroid is a virtualized node. The preliminary CH is chosen as the node closest to the centroid. Each node is assigned an ID based on its distance from the centroid [14]. The IDs of nodes nearer to the centroid are smaller than those of nodes further away. If the energy of the node containing the next ID number is larger than the threshold, it is selected as the CH. If the value falls below the threshold, the existing CH transfers the cluster member's energy to the BS before terminating the session. BS examines each node to select CH depending on the energy of the nodes. If none of the nodes exceed the threshold's energy, the system creates a data-forwarding loop. The energy of the threshold is computed as

$$X_{ET} = \nu X_{le} \left(\frac{T}{C} - 1 \right) + \nu X_{AD} \left(\frac{T}{C} \right) + \nu X_{le} + \nu \varepsilon_{fs} h^2, \tag{3}$$

where C represents the clusters formed in the area of sensors, as per the time allocated by the CH, the nodes that are nearer to the area will be transmitting the data to the particular CHs.

3.2. Single-Hop and Multihop Topology. WSN might be homogenous or heterogeneous. For most real-time scenarios, a heterogeneous network is preferable to extend the lifespan of the network. Furthermore, there are two kinds of data transmission networks. There are two types of networks: single-hop and multihop.

Single-hop topology: if the cluster-head is one hop distant from the sensor network in clusters, the network is said to be single-hop. It is simple for the cluster head to gather data and transfer it to the base station solely via other cluster heads in single-hop networks. In those other words, the cluster-head performs the time-consuming validation.

Multihop topology: if numerous hops are required to transport data to the cluster-head, the network is said to have been multihop. The operation of obtaining and integrating data for a sensor node in multihop networks is especially costly if next incoming node is not a cluster-head. The gathered information must be authenticated by the sensor node. Signature schemes can be used to offer authenticity.

TABLE 1: Existing literature survey of clustering routing protocols.

Year/ref	Author name	Technique used	Tools	Parameters	Advantages	Limitations
2014/ [5]	S. Zhang, X. Xu, Y. Wu and L. Lu	MAC mechanism for user-centric scheduling	MATLAB	Delay, reliability	Energy-efficient reduced latency and highly reliable networks	Complexity issues in implementation.
2018/ [6]	M. Elappila, S. Chinara, D. Parhi	Survivable path routing	Network Simulator-2.35	Throughput, end-to-end delay, packet delivery ratio, and remaining energy	Minimizes the network congestion, high packet reception rate decreased end-to-end delay	Mac layer designs with transmission power control schemes
2018/[7]	S. Fu, L. Zhao, Z. Su, X. Jian	Unmanned aerial vehicles (UAV) based relay in WSN	MATLAB-2013b	Power consumption	Maximizes the system performance, decrease the transmitting power	Flightpath selection algorithm for UAV to achieve the best path for data collection
2019/[8]	Y. Zhao, K. Liu, X. Xu, L. Huang	Distributed dynamic cluster head selection and k-means	MATLAB	Traffic distribution, throughput, energy consumption	Decreases energy efficiency, uniform density	A large number of devices
2019/[9]	S. Nejakar, P. Benakop	Energy management technique in reactive routing protocol	NSG-2 software	Throughput, packet delivery factor	Improves the network lifetime, increased throughput, reducing energy efficiency	The burden of high power utilization
2019/[10]	T. Behera, S. Mohapatra, M. Khan, A. Gandomi	Efficient cluster head selection scheme	MATLAB	Throughput, average residual energy, number of dead nodes	The optimal number of cluster heads in the network enhances the network lifetime	Realistic scenarios for a WSN-based IoT
2020/[11]	Seyyeddabbasi, F. Kiani	Routing protocol based on ant colony optimization	MATLAB	Energy consumption, network lifetime, remaining energy, buffer size	Finds the optimal path, real-time transfer of data on a large scale of WSN and decentralized IoT	Designed for the generation and analysis of big data
2021/[12]	C. Jothikuamar, V. Deeban, S. Singh	Optimal cluster-based routing and k-means	NSG-2 software	Energy dissipation, packet delivery ratio, end-to-end delay	Energy distribution, maximum transmission, prolonged network lifespan	Security mechanism in the implementation

Furthermore, suggested a technique that, at this time, can be deemed the most effective and reliable. The use of these techniques in sensor networks is still a work in progress.

3.3. Energy Model. To constantly monitor the surroundings, we consider a wireless network of S number of IoT smart sensors that can be deployed evenly throughout $N * N$ square space. The associated set of sensor nodes, let us say that l_a is the a^{th} sensor, then, the sensor nodes are represented by $L = \{l_1, l_2, l_3, \cdots \cdots .., \text{ln}\}^{|L|=S} n = 1$.

The presumptions made on the IMIMO-5G-based BEE protocol are explained as

(a) IMIMO-5G is supported by all the sensor nodes

(b) Less amount of data is sent by the sensor nodes and a large amount of data is sent by the CH's

(c) Limited energy

(d) A GPS-capable gadget is not offered with all sensor nodes (i.e., they are assumed a location-unaware)

(e) To develop a decentralized clustering technique that not only extends network lifetime but also ensures network coverage

(f) Based on the length of the receiver, the nodes can adjust the transmit power level

(g) The nodes are expected to be in a fixed position

(h) Every sensor node has different abilities (communication, processing, and battery)

(i) On the access network functionalities, every sensor has its preferences

The wireless system disperses energy to enable the transmitter and amplifier of the transmitter in the case of network transmission and receiving [15]. Furthermore, the wireless system generates energy to power the receiver circuit. The free space and multipath fading model for the loss of power is p^2 and p^4, respectively. To energize the transmitter, the energy loss is proportional to the distance between both the transmitting and receiving ends. The utilization of power the m-bit message for the distance p is evaluated in equations (4) and (7):

On the transmitting end:

$$A_{TE}(m, p) = A_{TE-elec}(m) + A_{TE-amp}(m, p), \quad (4)$$

$$\text{If } p < p0 \text{ then } mA_{elec} + A\epsilon_{fs}p^2, \quad (5)$$

$$\text{Otherwise, } mA_{elec} + A\epsilon_{bx}p^4. \quad (6)$$

On the receiving end:

$$A_{RE} = A_{RE-elec}(m) = mA_{elec}. \quad (7)$$

3.4. Intelligent MIMO 5G-Based BEE. In the IMIMO-based 5G is required to utilize the latest clustering algorithm through which the IMIMO 5G-based BEE is framed. We presume that almost all IoT devices in the network are MIMO-enabled. When a node is set to CH, MIMO is enabled, allowing it to acquire data from multiple sources via multiple transmission paths [16]. The CHs then will reduce the acquired data and return it directly to the BS. Except for CHs, every sensing node sends a limited amount of data or a video stream (the terminology "Data" defines the limited amount of traffic, including such temperature or humility data, and "Video" defines the massive amount of traffic requiring large bandwidth of the network, such as a video stream). For transmission using the IMIMO-based BEE algorithm, a sensing node will only choose one transmission interface and a CH.

The IMIMO 5G-based BEE comprises of three phases: (a) choosing the CH's, (b) construction of hybrid cluster, (c) collection of data and transmitting, (d) minimizing the consumption of power, (e) improving the Quality of Experience (QoE), and (f) choosing the transmission interfaces. The design of the proposed protocol is shown below. As per the design showcased, the ovals of variable diameter present the unequal architecture of clusters with two different types of transmission topologies, i.e., single-hop and multihop. Besides this, the suboptimal multihop routing paradigm is represented by the routes connecting the CH's. The benefits of the proposed protocol are

(a) It can balance the load

(b) Less overhead for the transmission of data

(c) Fault tolerance is supported

3.4.1. Choosing the CH's. The BS sends a "WELCOME" message to every sensor node in the network domain when the power level reaches a particular threshold. The incoming signal intensity aids each node in calculating its relative distance to the base station (BS), resulting in a combination of clusters of varying sizes [17]. Nodes would quickly calculate their competition radius (CR) after obtaining such a message and submit a report to the BS with anticipated actual remaining energy, revised CR, and the node's ID. In our presented approach MIMO-based 5G, a node's eligibility to be the CH has decided solely if it has more remaining energy than the nodes within its radius. To create unequally sized hybrid clusters, each node must choose its CR. Nodes with more residual energy in MIMO-based 5G will perform larger tasks. As a result, clusters that are farther away from the BS and have more remaining energy employ single-hop topology and have more nodes than clusters closer to the BS that use multihop topology. As the distance between the sensor node and the BS grows, a sensor node with more residual energy must supplement its CR. On the one side, nodes with less residual energy must have a lower CR to avoid dying prematurely. The node CR is evaluated and presented as

$$\text{CR} = \left[\frac{1 - \omega\,(p\max - p(la, \text{BS})}{p\max - p\min} - \gamma\left(1 - \frac{A_{\text{remaining}}}{A_{\max}}\right)\right] {C_R}^0, \quad (8)$$

where $p(l_a, \text{BS})$ indicates the distance between l_a, i.e., sensor nodes and BS; ω and γ are the weight of the factors; ${C_R}^0$ shows the highest value of CR; $A_{\text{remaining}}$ is the node's remaining energy; $A_{\max}$ represents the primary node's energy that is same for every node; $p_{\max}$ and $p_{\min}$ are the maximum and minimum distance between the BS and the sensor nodes.

Therefore, once the push notification is received on the BS from the sensors; then, the CH will be selected from among candidate nodes. Later, the matrix is created by BS and then the notification is transmitted to all the sensors on the network. The matrix is represented as

$$\begin{bmatrix} p_{11}^k \cdots\cdots\cdots\ \cdots \cdots p_{1n}^k \\ p_{ab}^k \\ p_{n1}^k \cdots\cdots\cdots\ \cdots \cdots p_{nn}^k \end{bmatrix}. \quad (9)$$

The list of nodes associated with a specific cluster k, as well as the distance between nodes and the ID of CH. In the above matrix, ${p^k}_{ab}$ indicates the distance between node a and node b; k represents the ID of CH. Acquiring the matrix enables each sensor to simply and correctly determine their specific CH as well as the distance to other sensors; as a result, the transmission power can be adjusted following the obtained distance to improve the energy efficiency.

3.4.2. Construction of Hybrid Cluster. The cluster chain creation or network topology structure is influenced by the BS position. Furthermore, it has an impact on the nodes' entire energy utilization. This will have an impact on the network's effectiveness and productivity. To address the abovementioned issues, a multihop construction technique is presented [18]. This approach enables the multihop topology to accommodate the BS's various locations. To avoid aberrant cluster multihop topology, MIMO-based 5G for hybrid clustering uses a projection method to build the chain. Every node in every cluster project its displacement vector, and all nodes in each cluster are arranged by the vector's primary value.

The value for the principal vector is represented as

If $x_i = 0$, then, $\mathrm{PV} = (x_T, 0)$.

If $y_i = 0$, then, $\mathrm{PV} = (0, y_T)$.

Else

$$\left(-1, \frac{x_T}{y_T}\right). \tag{10}$$

In which x_T, y_T signify the location of the middle point of the network domain, and x_i, y_i are the x and y notations for else vector are indicated as i which is highlighted in equation (11) and is therefore used to make the connection with the middle point (T) and BS; x_j and y_j show the BS location.

$$I = \left(x_j - x_T, y_j - y_T\right). \tag{11}$$

The procedure for the construction of hybrid clustering is as given below in Figure 2.

When the node projection computation is complete, the BS creates a matrix and sends it to each sensor node. Owing to the increasing magnitude of the projection range, the matrix contains ordered sensor nodes on every cluster. The sorted projection value received allows nodes in each cluster to construct a multihop architecture. Below Figure 3 explains the projection and creation for multihop topology. In cluster domain 3, the sensor nodes vector is l_4 which is evaluated by the BS and it follows a multihop topology. The orange marked line in cluster domain 2 shows the projection value of the sensor node l_4 onto a.

3.4.3. Designing the IMIMO 5G-Based BEE Procedure. Presently, IMIMO-based BEE is built with QoE as the top priority task. However, it will make every effort to cut electricity use. If a node wants to send temperature information back to the BS, for illustration, it can presently interact with one CH using Zigbee and then another CH located further away via Direct-WiFi. Because the throughput values for Zigbee and Direct-WiFi are both sufficient for temperature readings, using Zigbee for transmission can save a lot of energy. If, on either hand, the node needs to send a video stream directly to the BS, and both Direct-WiFi and Zigbee are now accessible, Direct-WiFi will be preferred over Zigbee owing to QoE considerations, even though it consumes more energy. The available transmission interfaces will be classified by their desire. The procedure or algorithm for the classification is as below. If there is a need to transmit the simple data then the transmission interfaces are permitted and in the case of the video stream transmission then only the interfaces with ETI $> x^{ar}$ are permitted. In which ETI signifies the data rate transmitted for the y^{th} network access interface (NAI) and x^{ar} signifies the need for data rate from the application running on node x. Later, the desired interfaces can be classified by dividing the square of the energy utilization.

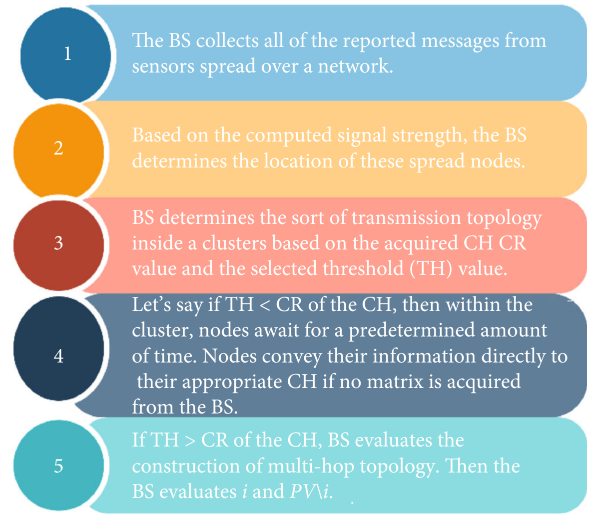

Figure 2: Procedure for the construction of hybrid clustering.

$$\text{Classification}_y = \frac{\left(\text{ETI}_y{}^r\right)}{\left(\text{ETI}_y{}^e\right)2}. \tag{12}$$

In this, $\text{ETI}_y{}^e$ over one unit of the distance transmitted which defines the energy utilized for ETI_y and the classification for interface ETI_y is classification_y.

The following is the QoE for transmission among both node x (Table 2 and link CH via network interface ETI_y:

(i) If $\text{QoE}_{g,h} = 0$, then, by the use of ETI_y the node x cannot connect with CH_h

(ii) If $\text{QoE}_{g,h}! = 0$, then, $\text{classification}_y/\text{distance}_{x,h}$

In which $\text{distance}_{x,h}$ means the distance between node x and CH_h. We must first normalize the properties of the data transmission interfaces in the ability to execute this method. For illustration, the data rate will be categorized as low (value = 1) or high (value = 2). High (value = 3), medium (value = 2), or low (value = 1) energy utilization will be assessed. In 5G communication, any accessible network connecting interface can be included in this data normalization list.

3.4.4. Algorithm for IMIMO 5G-Based BEE. BEE based on IMIMO 5G presents a CH selection for intracluster transmission by responding to MIMO characteristics. Each sensor will also have a choice for network access interfaces based on its transmission specifications and capabilities. To begin, a node must satisfy its network duties and roles. If it is designed to send video, it must use a high-bandwidth interface [19]. If it is meant to transfer data, on either hand, it may offer a wider choice of network interface options. Furthermore, in comparison to BEE, the nodes should lessen energy utilization and hence increase coverage sensitive longevity yet further. As a result, while QoE is ensured, limited transmission interfaces should indeed be preferred. However, three factors should be considered before the nodes make the final decision: (1) application requirements on the network. (2) Transmission range

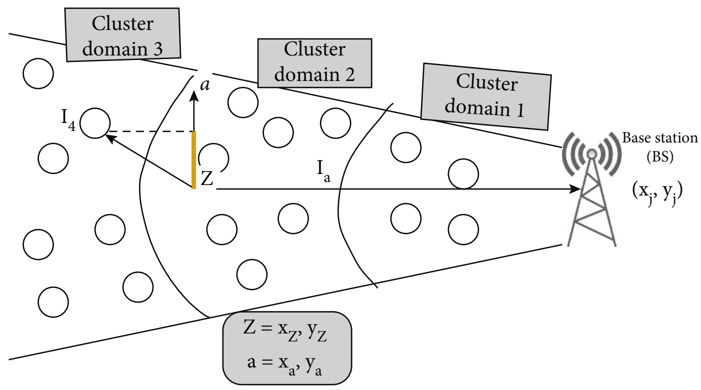

Figure 3: Projection and creation of multihop topology.

Table 2: Transmission interface for node *x*.

Interface for transmission	CH1	CH2	CH3	………	CHq
ETI_1	$QoE_{1,1}$	$QoE_{1,2}$	$QoE_{1,3}$	………	$QoE_{1,q}$
ETI_2	$QoE_{2,1}$	$QoE_{2,2}$	$QoE_{2,3}$	………	$QoE_{2,q}$
ETI_3	$QoE_{3,1}$	$QoE_{3,2}$	$QoE_{3,3}$	………	$QoE_{3,q}$
…….	……..	………	……..	………	……..
ETI_4	QoE_z	$QoEz_{,2}$	$QoE_{z,3}$	………	$QoE_{z,q}$

of the access interface. (3) Distance between the nodes and CHs. The node itself can have its preference on the network interfaces even only concerning its characteristics. In this case, we refer to this scenario as a self-concerned approach. However, to select a suitable CH, the context of the CHs also should be considered. For example, considering its interest, a node prefers to use Zigbee to transmit data. However, in its Zigbee communication range, no CHs are available. Therefore, this node has to select the second choice for interfaces, which has a longer communication range. In another case, this node finds a CH in its Zigbee communication range.

4. Simulation Results

The framed approach and the existing algorithms will perform the computations in NS-3 simulator. In this, CR and energy utilization are the main factors. As compared to the existing algorithms, to optimize energy utilization among cluster heads and eliminate hotspot problems created by overloading cluster heads nearer to the BS, our proposed approach divides the network into hierarchical unequal clusters. It utilizes the multihop topology for intra and interclustering transmission and contributes to increasing the lifetime of the network, improving the robustness in the wireless network topology and efficiently balancing the load. Due to the expansion of the network, the size of the network is enlarged. As a result, the suggested energy-efficient routing protocol would work as well as it does when the network expands. The proposed approach should be capable of supporting the flexibility of the wireless topology of the network for this objective.

According to the factors stated above, it is easier to justify the compute the results. This domain is simulated in which the sensing domain of the sensor nodes is distributed equally, and the BS is located outside the WSNs. The duration taken for each sensor node is taken as 35 bytes to the BS. The parameters used in the simulations are recorded as an average of 50 runs for each input of simulations. The coverage for the network is 0-200 m, location of BS is (200, 350) m, several cluster nodes are 200, preliminary energy utilized is 2 Joule, the size of packet broadcasted is 35 bytes, distance between the nodes and CH is 55 m, and the interface used is Zigbee, WiFi, etc. Power utilization is usually the only statistic used when analyzing a clustering algorithm, to the detriment of other factors such as internet connectivity. Instead of counting nodes, coverage sensitivity lifespan has been suggested as a mechanism to assess the lifetime of the network. The dispersion and detection range of the sensors influence network coverage. In the case of network coverage, various sensors in the network are much more significant than the others. Sensors that do not have a substantial effect on the system coverage are permitted to expire earlier than others.

4.1. Iterations of Clustering and Dispersion of CHs. The algorithm overhead is determined or influenced by the number of iterations in the clustering process. Minimizing the number of iterations in every round can lessen the delay in clustering and the number of packets broadcasted. In this Figure 4, the correlation among CR^0 and the number of CHs when the ω and γ are the two different values. If ω and γ are assigned the value to 1 each. Having the value of ω as 0 and γ as 0 produces the minimum number of CHs to increase the CR. With the increase in CHs, the minimization in CR the values of ω and γ reaches 1. In our proposed approach, the value for ω and γ is 1 for each, and CR is given the value of 60. In Figure 5, the battery life is dependent on the total number of nodes in the network. The simulations are executed until and unless the first CH utilizes its battery.

Let us assume, there are 1000 nodes of the entire population, and the application of the approach proposed utilizes and translates into the average 51 yearly link charges for the

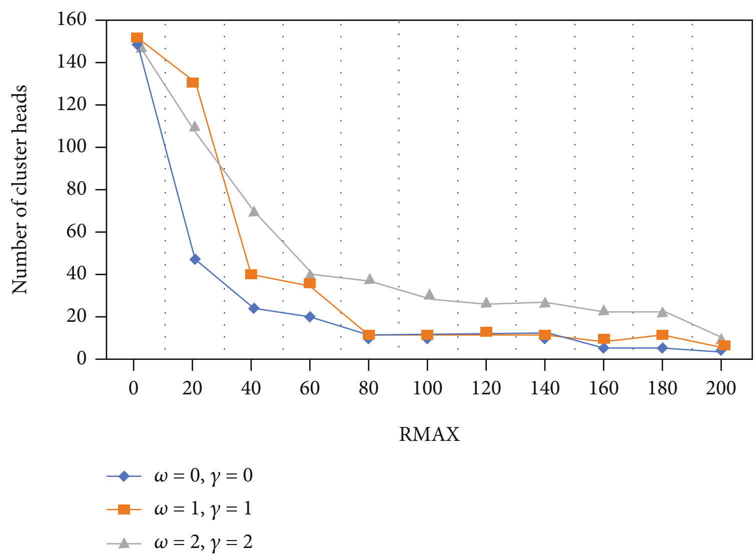

FIGURE 4: Number of CH's network.

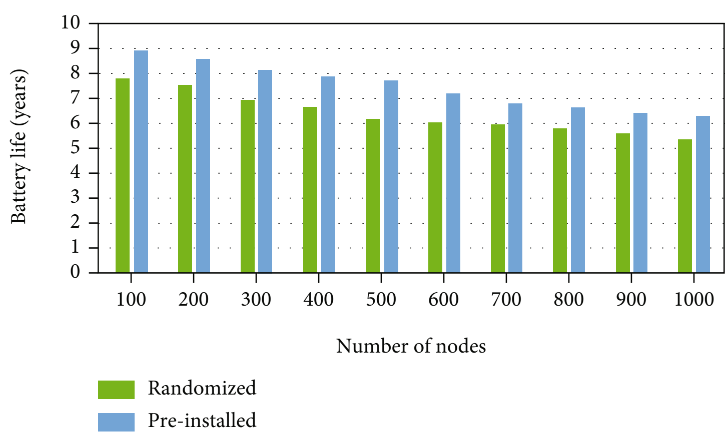

FIGURE 5: Number of nodes vs. battery life.

Link1 CH and preinstalled setup and 110 yearly charges for the initialized randomized setup. It has been observed that the randomized setup configuration generates a wastage of energy which says that in approximately 91% of the cases, the proposed approach adopts the improvement in the life of the battery.

4.2. Network Area. In both BEE and HEED, the cluster radius is fixed to 50 meters. The sensing radius has been set to 15 meters. To make our issue easier to understand, we divide the network region into 25 m 25 m grids rather than circles. The sensing field is divided into 100 cells in this manner. If a sensor is still active in each cell, we believe that this area can be tracked by the system as shown in Figure 6. A clustering method should be able to cover as many cells as possible to ensure network coverage. Because the sensors are distributed in the network at random, the original coverage with 400 sensors is just 94 cells.

4.3. Interdomain Clustering for IMIMO 5G-Based BEE. Interdomain cluster transmission refers to the interaction between the CHs and the BS. Despite multihop routing, data transmission is extremely difficult to ensure when the network grows in size and the sensors do not enable lengthy transmission. As a result, multihop interdomain cluster transmission must be supported. Moreover, by lowering lengthy transmission between the CHs and the BS, multihop interdomain cluster routing can lessen energy utilization even more. Figure 7 depicts the results of the experiment for IMIMO 5G-based BEE. Delivering packets costs 100 pJ/bit/m^2 in terms of energy. As could be shown, IMIMO 5G-based BEE outperforms BEE in terms of network coverage and entire longevity.

The proposed approach emphasizes the selection of CHs whose objective is to provide the nodes based on IoT for choosing the transmission interfaces and CHs. The analysis of delay is done by separating the entire network into unequal clusters where clusters having the smallest radius which thereby single-hop topology comprises of small chains and the clusters with a huge radius that acquires minimum transmission delay. In the below-given Figure 8, it is shown the CH for the IMIMO 5G has shown the low

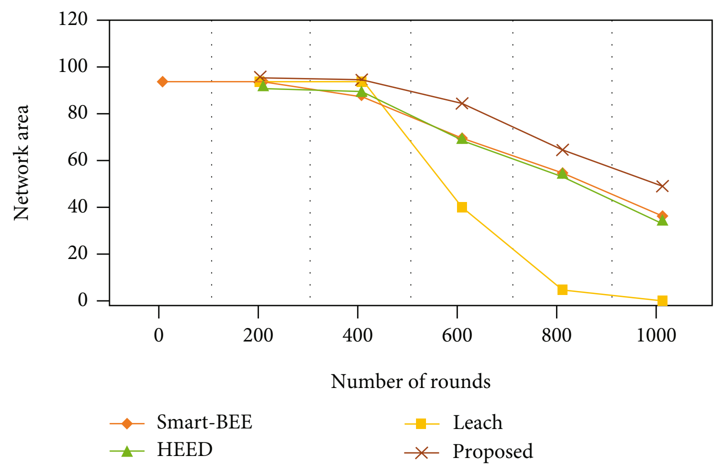

Figure 6: Network coverage area vs. number of rounds.

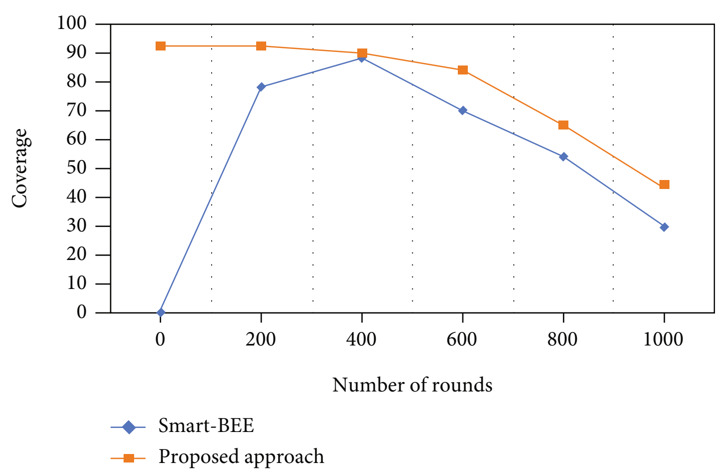

Figure 7: Network sensing coverage between coverage and number of rounds.

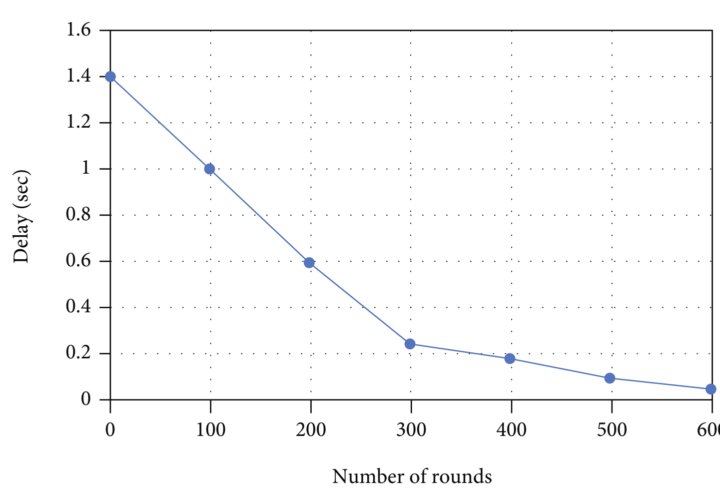

Figure 8: Delay vs. number of rounds.

transmission delay in case of 100 rounds the time took was 1 sec, 400 rounds, it took 0.1 sec, and so on.

5. Conclusion

The purpose of this research is to provide a centralized solution for organizing IoT communication entities into an uneven structure of composite clusters to protect the network from increasing hotspots issues and lengthen the lifespan of the network in the 5G scenario. The proposed protocol, in specific, has distinctive features including multi-hop topology creation, clusters of various communication topologies, balancing energy utilization among cluster heads, conserving energy utilization of nodes in the cluster, and selecting the most appropriate IoT application system transmission interfaces. We have presented the BEE to increase the lifetime of the network which supports the multihop clustering routing protocol. It provides the advanced devices of IoT to choose the transmission interfaces and CHs based on the context of the network. To construct shorter concentric networks, a vector projection approach that determines the BS position was adopted. In contrast, to reduce the strain on the cluster heads and lengthen the network's lifespan, a probabilistic suboptimal and multihop routing method was devised. Lastly, to choose the best transmission interface, a rating system was applied. When compared to state-of-the-art methodologies, quantitative findings demonstrated that an uneven clustering method optimized network survival and balanced energy depletion via cluster heads.

Data Availability

Data is not related to this study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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