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Localization Based Distributed Selective Cluster Scheduling for Sustainable Energy Consumption and Efficient Data Transmission

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Abstract: Wireless Sensor Network (WSN) is a transitional layer in Internet of Things (IoT) framework, and its success is determined by the distribution strategy deprived of compromising throughput or energy efficacy. The network is split in sets of sensors in order to utilize resources and minimize energy utilization. Clustering is effective method to lessen the energy utilization in WSN. As WSNs have substantial nodes dispersed at different locations, and they may or might not remain static at their own location, localization is a key challenge. Numerous distance and location estimate algorithms are applied in localization. Throughout transmission, the received signal strength (RSS) plays an essential part in minimising node energy usage. To harvest the energy of network for optimal data transmission, appropriate use of RSS values with clustering is essential. In this paper, we concentrate on Localization Based Distributed Selective Cluster Scheduling in WSN that will demonstrate how to lessen placement mistakes, enhance accuracy, and balance energy consumption by varying cluster size. The method achieves appropriate cluster head dispersion amid nodes and prevents recurrent cluster head selection associated with the input nodes' Signal Intensity and remaining energy. SECCP assurances an advanced packet distribution proportion of 95.25 %, energy performance of 0.8226J with added data transmissions and throughput of SECCP as 6.059 x104 Kbps to I-SEP, EBCT, ECSS, and EDCHSA as 2.698×10^4 Kbps, $6.085\ \times10^4$ Kbps, $1.128\ \times10^4$ Kbps and $0.5434\ \times10^4$ Kbps respectively.

Keywords: Cluster head selection, Energy efficiency, Received signal strength (RSS), Energy consumption, Wireless sensor networks (WSNs).

1. Introduction

WSNs have established excessive attention due to their numerous widespread usages in all fields although their output is usually restricted by energy limitations. WSN deployment is suitable for wide variety of utilization as monitoring environmental parameters, intruder surveillance, smart homes, maintenance, smart price tags, real world traffic management monitoring habitat and in disaster management [1]. WSN is collection of sensor node deployment over an area for a specific application. Its self- organizing capability helps to create a network model associated to a required task. Sensor transmits data to BS directly or through other nodes in case of multi-hopping. Sensor nodes are operated on constrained battery so the lifetime of the network varies which affects energy efficiency of WSN. Energy efficiency of WSN is most challenging as it is hard to recharge or replace the node battery in hazardous areas. So, the energy proficient protocol should be designed for transmission in sensor nodes and Base Station (BS) [2]. To assurance balanced energy consumption, the clustering protocols have been implemented. Clustering improves the efficiency and scalability of WSN [3]. This procedure monitors the topology and group sensors into small divisions as clusters, each having a node leader as Cluster Head (CH). All nodes transmit though their CH. CH removes duplicate information, aggregate it then forward to BS. The nodes near BS have higher utilization of energy due to forwarding task of all the sensed data. To balance the energy utilization node rotation dormancy mechanism is implemented to minimize the load of nodes near BS.

Sustainable Energy Consumption Clustering Protocol (SECCP) is proposed. For optimal data transmission, appropriate use of RSS values for localization. Localization [4, 5] is a crucial function and a serious difficulty with WSNs because they are unaware of the placement of their sensor nodes. It is among the most essential network facilities in the WSN so it reports data that is geologically relevant and boosts the lifespan and energy efficiency. It is a very rigorous strategy for surveillance applications, localization-based routing, and other things in recent times. In fact, many of these networks are installed outside, where they are subjected to a variety of meteorological changes, which can lead to serious performance deterioration. As a result, elements such as the radio signal intensity index must be considered in order to limit the impact and adapt to changing climate factors.

In this paper, we extend the Energy Balanced Cluster Technique (EBCT) [6] to distributed selective CH scheme for sustainable energy usage and data transmission for variable cluster sizes, dependent on the remaining energy of nodes and signal strength between the node and BS of that cluster. The method describes the CH's mobility and takes into account elements such as radio signal intensity for the CH's segment. It is evident that the ambient and multi-path fadings have a substantial impact on RSS level. Variations in ambient circumstances, as well as the effects of time - frequency, affect its readings. The RSS indicator disparity and its magnitude are unrelated to one another, although they are both affected by the complication of the surroundings [7, 8].

The following is the outline of the paper: Section 2, the relevant investigations on the various routing protocols for WSN. Section 3 examines the system model and recommended methodologies, as well as appropriate CH selection (CHS) and hybrid routing algorithm deployment. In Section 4, simulation settings, and result analysis are presented. In Section V gives conclusion and future work.

2. Literature review

Clustering is a topology control approach, is critical for energy conservation in sensor networks. By lowering energy depletion and boosting sensor network lifetime, choosing a CH can efficiently balance load and control data transmission. This segment, discuss previous research in clustering protocols that are primarily focused on energy competence and, as a result, prolong global network lifespan.

Low Energy Adaptive Clustering Hierarchical (LEACH) protocol is Time Division Multiple Access (TDMA) based Media Access Control (MAC) convention. The motive behind this protocol is to prolong lifespan of WSN by minimizing the energy utilization required to in process of selection of CH by implementing election algorithm [9]. The essential thought of clustering convention is to divide all nodes into numerous clusters each having CH capable of transmitting the information within cluster and sending it to BS. The CH is selected after each round of communication so as to equally disperse the data transmission. The CH is selected randomly and sends data to BS. The probability of selection of CH is same for all the cluster members as CH on the basis of different distances from BS, which affects the energy consumption and more distant clusters drains energy prior.

Vice Cluster Head-LEACH (V–LEACH) [10] employs vice-CH (VCH) through the retained energy of nodes and Numerous CHs in Clusters, thus enhancing the reliability of identifying CH. VCH functions as CH in the event of a significant CH failure and ensures data recovery based on two CHs. Due to the deployment of VCH rather than a re-clustering process, network lifespan is substantially extended in V-LEACH, thus conserving energy throughout network. In addition, the reliability of transmitting data to BS is improved including the failure of CH. Therefore, this scheme ensured forwarding data to BS but Communication cost is not included in this process. Improved-LEACH (I-LEACH) [11] mechanism focuses on long-lasting energy of cluster sink node. The threshold formula in conventional algorithm is modified by integrating leftover energy component. If a significant amount of energy is contained in a node, likelihood of being CH will boost. If a node's probability of being a CH increases and this node's long-lasting power is high, it is likely that network existence will improve. I-LEACH is stronger than conventional process in enlarge network lifespan and reducing power dissipation. Even then, transmission cost issue is not considered by this method. Another efficient solution was suggested to maximize stability period in multi-hop network as LEACH One Round (LEACH-1R) [12]. Rather than shifting in each phase this convention switches a CH to next node when it drains out of energy. Once the current CH energy is less than threshold, it identifies a node having more potential and broadcast explanatory request to be new CH. On getting the notification request, new CH conveys a signal to certain nodes in the cluster containing its ID, position and vitality level. In residual vitality efficiency terms, it has successful outcomes. The important challenge, indeed, is the shift of a CH; after many cycles, this can trigger an energy void. In addition, this method doesn’t provide an answer to issue of communication cost. The protocol's fundamental flaw is that altering the CH after it runs out of energy can result in an energy hole after a few rounds.

Energy Efficient Multi-hop Leach (EEM-LEACH) [13] has been formulated to boost CH choice and enable rapid transmission. A threshold is determined to pick CH by determining remaining energy. In this mechanism, if CH advertising is obtained from BS, transmission cost is estimated for every CH. A successful strategy for energy reduction and rising data distribution is given by this advancement. Besides that, estimations in the computation of the communication overhead by each node to pick CH and measurement of leftover energy for determining node's path, packet delay goes up exponentially. In addition, the distance from BS to CH is not taken into account. Energy Efficient - LEACH (EE-LEACH) [14] consider residual energy parameter for research in Energy efficiency domain Contributing Gaussian distribution further choosing relay node for improvement in network lifespan and power utilization but it shortfalls data integrity and scalability extent. Fault Tolerance-LEACH (FT-LEACH) [15], suggested decreasing fault tolerance in WSNs to increase outcomes. The flaw is observed based on energy values. The creation of clusters is considered by FT-LEACH in major folds: global and localized re-clustering. To rebuild cluster, if flaw is in CH localized re-clustering is implemented by dropping CH. Due to energy use and fault tolerance, this methodology is superior to conventional. It has some flaws, including as how the energy level identifies malfunctioning nodes, how local re-clustering works, and how redundant data is handled using a criterion. Partition-LEACH [16], evenly divide energy amongst nodes in large networks to improve the efficiency of communication link. In this approach, creation of cluster is carried out in circular structures of same radius for enhancing the effectiveness of transmission. First cluster is created and the centre node of it becomes node that has highest vitality level. Clusters are created across the first and node placed in middle of each cluster being centre node. Entire system configuration consists of splitting clusters, the contact area and four division clusters along with mobile sink position observer. If one of the gate nodes senses the mobile sink, it transfers notification to change the state to sleep. But due to sink movement, its complication and communication cost has risen.

Cell-LEACH (C–LEACH) [17], formulated to improve network coverage in WSNs which splits network into groups of cells with several sensors in each cell, unlike P-LEACH. Each of the seven neighbouring cells is clustered jointly and forms one cluster. There is indeed a separate node in each cell that is called cell head. Any such node's task is to assign slot via TDMA, to accumulate sensed data, and to send that data to its CH. In order to pass data to BS via optimal path, similar task is achieved. There are several perks to this protocol. Because of the technique of splitting networks into cells, it has strong network coverage. In addition, it increases the production of electricity. The drawbacks of this convention are additional workload of entire network and the ambiguity because of various head nodes. Orphan-LEACH (O–LEACH) [18] offers more communication range in each cluster, sensors are linked to CHs, but some nodes still aren't associated. Such nodes are known as orphan nodes. Nodes exchange notifications to nodes in gateway. Afterwards, by collecting and forwarding information to BS, gateway functions as CH. A further way suggested in this method is to design a separate orphan node cluster and to pick a specific CH corresponds to that particular cluster. The key issue with this protocol is locating the knowledge of orphan nodes. There are also other difficulties that have to be addressed, such as data supply delays and control overhead.

In energy-harvesting (EH) WSNs, an efficacious CH option strategy termed Energy-Efficient Cluster Head Selection Scheme (EECHS) is presented [19]. This is in response to the huge energy utilized during the CH selection phase and the unequal gathered energy across stations. The approach identifies all nodes as three categories: CH, Cluster Members (CM), and scheduler node. Sensors have struggled from energy concerns and complicated routing operations as a result of their restricted competences, which has resulted in transmission malfunction and slowdown in sensing agriculture. Because of these constraints, sensors surrounding the BS are constantly depending on it, causing the BS to be overburdened or becoming ineffective. To overcome these challenges, this research presents a Gateway Clustering Energy-Efficient Centroid-(GCEEC-) proposed scheme, in which the CH is chosen from centroid region and gateways nodes from each cluster [20]. Furthermore, LEACH has some flaws, particularly during the setup phase, when CH is chosen at random and is improved by determining a CH that consumes the least amount of energy [21, 22]. The High-Quality Clustering Algorithm (HQCA) is a process for making elevated clusters [23]. It employs a criterion for assessing cluster strength, which can enhance inter-cluster and intra-cluster ranges while also lowering clustering failure rates. The infrastructure was partitioned into many zones and clusters were developed within each zone to eliminate hazards and give more significant coverage. The quantity of remaining energy and the range from the centre of each node were estimated by the BS (containing the placement and residual energy of each node) for all surviving nodes in each zone while picking the CH in each phase [24]. Energy Efficient Cluster Head Selection Scheme (ECSS) [25] framework intended for a heterogeneous network and focuses on identifying an energy-efficacious CH that enables in boosting lifespan and throughput by using the energy levels of nodes for the CH selection. The Enhanced Dynamic Cluster Head Selection Approach (EDCHSA) [26] is able to control timer activities with distinct best effort operations while meeting all disturbance and energy restrictions.

The Energy-Coverage Ratio Clustering Protocol (ECRCP) [27] uses the coverage ratio to reduce energy usage by applying the concept of' minimum energy depletion' to calculate the ideal clusters and the criterion of 'coverage maximisation' to pick the CH. Investigations with the suggested model revealed that in the setting of heterogeneous sensor networks, it is possible to achieve extended network lifetime, load balancing, and reduced energy utilization. BS builds a vector collection with SN ids and RSSI from this announcement in EBCT [6]. The BS then chooses CH based on the RSSI level with the maximum priority. Because SNs have variable initial energies, the energy factor for identifying first CHs is frequently addressed throughout the setup. The BS also sends an alert to all SNs regarding inaugural CHs, and SNs will send participate responses to CHs in direct range, which increases the expected lifespan by almost 8% to 53%. The CH in the network is determined by a target value in an upgraded model of stable Election Routing Protocol [28]. This helps CHs make the best judgement possible. In comparison to current versions, efficiency has increased by up to 56%.

Many significant criteria are taken into account by the clustering methods discussed above, including the position of the BS, the surroundings of the sensor nodes (SNs), the category of SNs, and the remaining energy of the SNs. The majority of centralised LEACH variations rely on GPS for position data, which is both expensive and energy-intensive. The finest localization strategies must be devised and implemented. We designed a decentralized selective CH strategy in this paper that decreases connectivity overheads while avoiding superfluous CH decision after each round. The approach is simulated to validate advances in energy consumption and Throughput for variable cluster extent.

3. Proposed approach: sustainable energy consumption clustering protocol (SECCP)

3.1 Network model

Considering a collection of sensors organized in arena having properties as:

- Nodes are scattered arbitrarily across the region.
- The nodes and BS are presumed to be immobile and on implementation, are left unsupervised.
- The BS has no energy constraints and is acquainted of the node's geographical whereabouts.
- Each node has identical sensing, processing, and communication capabilities as well as the capacity to automatically change transmitter power levels according on RSSI values.
- Node's connectivity is multi-hop.

The infrastructure is separated into two parts using this method. The two-tier technology's key benefit is that it significantly minimises the transmission range amongst the nodes CH and CMs. As a result of this strategy, the transmission power of CH nodes can be reduced, increasing the lifespan of network entities. Fig. 1 depicts the functional structures.

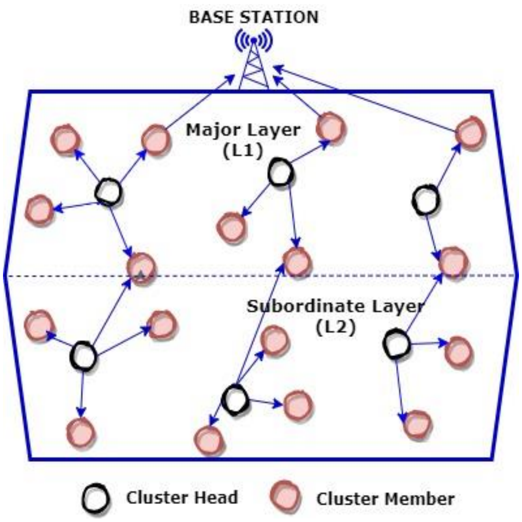

Figure. 1 Functional structure of SECCP

3.1.1. BS-cluster transmission segment

Nodes interconnect with the BS during this stage to establish layers, nominate CHs. Every node transmits a hello packet to the BS at the start of this phase. Then it constructs a lookup table with each node's identifier and Received Signal Strength Indicator (RSSI) level grounded on this message. By adding the RSSI values of all nodes and dividing by the total number of nodes, the BS derives the mean RSSI values of nodes from the look up database. The BS now divides the network into major layer (L1) and subordinate layer (L2).

The nodes with RSSI values more than the mean RSSI value are divided into two sets: N1 represents the nodes with RSSI values higher than the current RSSI value, and N2 represents the remaining of the nodes. N1 refers to the major layer, while N2 corresponds to L2, according to the BS. In L1, the base station chooses three types of sensors: CHs that interact with CMs, nodes that forward data between the L1 and L2. The foremost CH is identified in the provided monitoring area so that the CH is not too distant from the BS. To accomplish so, L1 CHs can be chosen from nodes that are near to the mean RSSI value. Because all of the nodes' energy levels will be the same at the start, the energy level statistic will not be used to find the first CHs. In the L2, the BS evaluates the mean RSSI power level of all nodes and determines the CH. As a result, the recommended procedure seeks to keep the communication range between the BS, L1, and L2 as short as possible.

3.1.2. Information announcement segment

This is the stage of clustering. The BS gives a message to all sensors informing them of the recently elected cluster leader. The nodes in the vicinity broadcast a Joining Request packet to CH, who accepts the contribution and establishes a cluster. Each CH elects one node in L1 to guarantee that is nearer to the BS. In the L2, one node was chosen in a similar way. For data transmission, CH now assigns a TDMA schedule to each node in the cluster. The message will be sent during the allocated time period by the cluster node. The data obtained from cluster nodes is now aggregated and compressed by the cluster head.

3.1.3. CMs transmission and re-election segment

This segment focuses on communication amid nodes in two layers and re-election of the CH. If the existing CH's remaining energy falls beneath half its original, the CH will send the CH forecast signal to CMs. This notification indicates that the current CH has inadequate leftover energy to operate as CH, and that cluster head changeover is required immediately to extend the network's lifespan. The cluster nodes communicate the parameter T(i) [29] to the CH in response to the scheduling message, and is the combination of their remaining energy (E_{Ri}) and RSSI power level (dBm_i). The cluster head now evaluates$T_{CH}(i)$, the threshold value for determining the next cluster head. The value of the threshold for of being the next CH can be stated as Eq. (1).

$$T_{CH}(i) = \sum_{i=1}^{n} \left(\frac{E_{Ri} + dBm_i}{n} \right) \tag{1}$$

Here n is nodes Count. Existing CH compares the $T_{CH}(i)$ with T(i) value for each node. The node which has T(i) value closer to $T_{CH}(i)$ will be nominated as the subsequent CH. The preliminary CH is chosen based on its near to the RSSI value of all the sensor nodes' final mean. The base station now divides the nodes into major layer (L1) and subordinate layer (L2) by determining if the RSSI value of each sensor node is larger than the mean RSSI of all sensor nodes.

The methodology operates by establishing a cluster in the initial stage, when CH advertises the JOIN notification at the start of the round. By recognizing, all adjacent SNs are prompted to JOIN. The BS then broadcasts a message to all SNs informing them of the earliest CHs, and any SN in close vicinity will send a join-request response to the CH. For implementation of the algorithm Assign random position of SN applying random function as Fun_Random(x,y), where x as X coordinate of SN ; y as Y coordinate of SN; set the location of BS as (Fun_Max(x/2), -10) and Dominant node as (Fun_Max(x/2), Max(y/2)). At the start of each round, the approach employs RSSI measurements to calculate a criterion for broadcasting to everyone. If SN lies within the threshold of communication range then the SN is allocated to L1 for direct communication it Initiate sensed node data collection and communicate otherwise it lies in L2 for indirect communication and identify the CH previous round. Dependent on the residual energy threshold function T(i) is estimated for the next cycle of connectivity to modify the corresponding cluster head entrance. To send network configuration statistics to every SN, appropriate announcements are saved and delivered. The Pseudocode of the SECCP for CH selection dependent on Localization is given in Algorithm 1.

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Algorithm 1: SECCP

Input: Sensor Nodes: $SN = \{SN_1, SN_2, SN_3 ...., SN_n\}$.
WSN Measurement: *m*m*
RSS values of sensor node: *rss= {rss1, rss2, rss3………, rssn}*

Output: Optimal selection of cluster heads:
$CHs = \{CH_1, CH_2, CH_3 ...., CH_m\}$.

```
Step 1: Set Nodes Location
        SN(x,y)→Fun_Random(x,y)
        Base Station → {Fun_Max(x/2), -10}
        Dominant SN → {Fun_Max(x/2), Max(y/2)}
Step 2: Accumulate RSSI value of all nodes.
Step 3: For i: =1 till n
        {
         Estimate distance from BS and leading node as Dist(SNi)
        }
Step 4: For i: =1 till n
        {
          if (Dist (SNi)<Dist (Comm_Range)
          allocate node as direct communication → CMs from L1
          Else
          allocate node as indirect communication → CMs from L2
        }
Step 5: For Round: =1 till Max_R
           For i: =1 till n
           {
            If (node in direct transmission_list = =1)
               Initiate senser node data collection
               and communicate
            Else If (SNi CH previous round pi = =0)
                 {
                 Estimate remaining energy (E_Ri)
                 Evaluates T(i)  and
                 T_CH(i) = Σ_{i=1}^{n} ((E_Ri + dBm_i)/n)
                 }
              if (node which has T(i) value closer
                 to T_CH(i) nominated as the
                 subsequent CH)
                 Set SNi as CH
              endif
            endif
          endfor
       endfor
Step 6: Exit
```

4. Performance analysis

This part contains a list of the simulation parameters as well as the comparison methods. Experiments with cluster sizes of 25, 50, 75, and 100 are used to test the proposed technique. The suggested method SECCP is contrasted to I-SEP[28], EBCT[6], ECSS[25] and EDCHSA[26] to see how different RSSI values affect threshold selection. RSSI values and distance are utilised to plan and monitor transmission data values, as well as to determine CH in each iteration. Performance is measured using energy consumption and Throughput.

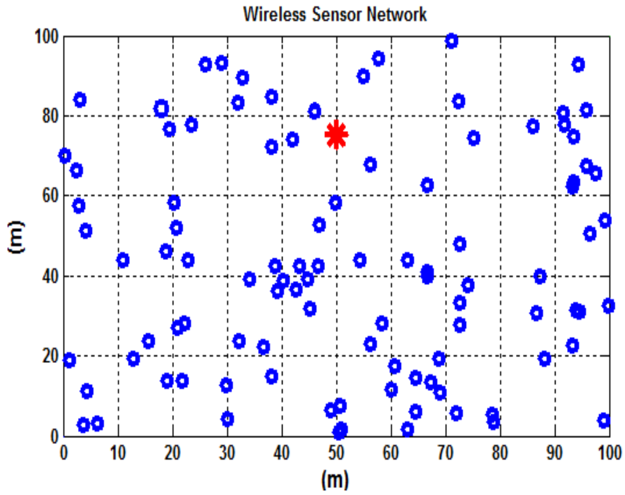

Figure. 2 Sensor network

Table 1. Simulation parameters table

Parameter	Value
Numbers of sensor nodes	100
Initial energy of node, Eo	1 J
Eelec	5 nJ/bit
Efs	10 pJ/bit/m4
Eamp	0.013 pJ/bit/m4
Eda	5 pJ/bit
Data packet size	500 bytes
Round time	10 * initial energy
Control packet size	25 bytes

4.1 Simulation environment

Analysis is carried on MATLAB in network region of 100 m x 100 m dimensional nodes where WSN is randomly deployed shown in figure 2. The suggested algorithm is contrasted to the pre-existing procedure focused on probabilistic approach. We conducted analysis with distinct node count of 25, 50, 75 and 100 to examine the effectiveness of our methodology. The simulation parameters used to investigate the performance of our algorithm during our experimentation for all approaches are described in Table 1.

4.2 Results and discussion

In packet forwarding, the received signal strength plays an important role in minimising node energy usage. To extend the network's life span,

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proper RSS value clustering is essential to harvest

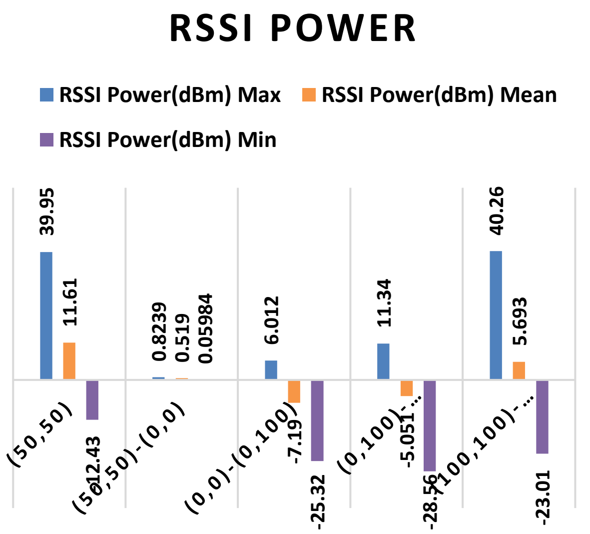

Figure. 3 RSSI values received by sensor node at different locations

balanced energy usage with varying cluster size. We

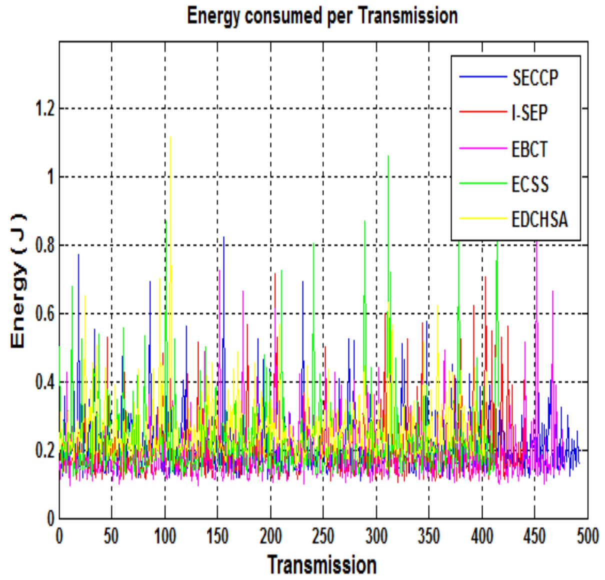

Figure. 4 Performance analysis of energy consumption

Table 2. Energy consumed per transmission

Protocols	Transmissions	Energy Consumed(J)
SECCP	492	0.8226
I-SEP	441	0.7172
EBCT	478	1.024
ECSS	416	1.06
EDCHSA	405	1.119

Table 3. Energy consumed varying node count

Protocol	Transmissions	No of Nodes	Energy Consumed (J)
SECCP	500	25	0.00003022
SECCP	500	50	0.0002414
SECCP	500	75	0.0001284
SECCP	500	100	0.0001794

the vitality of each node. Modified RSSI-based Node Selection technique for WSNs that takes RSSI of SNs from BS. Fig. 3 shows the RSSI values received by nodes at various locations. The suggested protocol SECCP is compared to I-SEP, EBCT, ECSS, and EDCHSA to see how different RSSI values affect threshold selection.

4.2.1. Energy consumed per transmission

Investigating with cluster sizes of 5, 10, 20, and 25 affects the projected protocol. Figure 4 shows the effectiveness of the suggested SECCP's energy consumption assessment compared to existing methodologies.

In comparison to other simulation findings, the SECCP energy usage is the lowest. Energy consumption, as demonstrated by the investigative results for I-SEP, EBCT, ECSS, and EDCHSA and SECCP is 0.7172 J, 1.024J, 1.06J, 1.119J and 0.8226 J in Table 2, which specifies Lowest Energy Consumption per Transmission for SECCP.

To examine the effectiveness of our approach, cluster size of 25, 50, 75 and 100 is taken to analyse the impact of varying load on CH with distinct node counts shown in Fig. 5 and Table 3 presents analyzed the energy use in great depth and for various rounds. The energy usage variance between the node with the most energy and the node with the least energy is shown in this section. It is self-evident that SECCP uses the least amount of energy, implying that the network will last longer. Furthermore, the lower energy deviation per Transmission shows that SECCP may successfully minimize deviation.

There is no such thing as a node that dies due to high energy usage. As a result, in both cases, the energy consumption between the nodes employing SECCP is more balanced, and the network lifetime is extended in contrast to the other two algorithms due to the further energy reserves.

4.2.2. Throughput

The dominant node merely used communication data of all CH and direct transmission nodes aggregate data; it did not sense and transmit their data. The over-all packets communicated by the SECCP are more than the conventions. The nodes adjacent to dominant node and BS send their data straight deprived of participating in the clustering method. The SECCP approach reduced the amount of energy required for overhead. As a result, these

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nodes can transfer data for longer periods of time

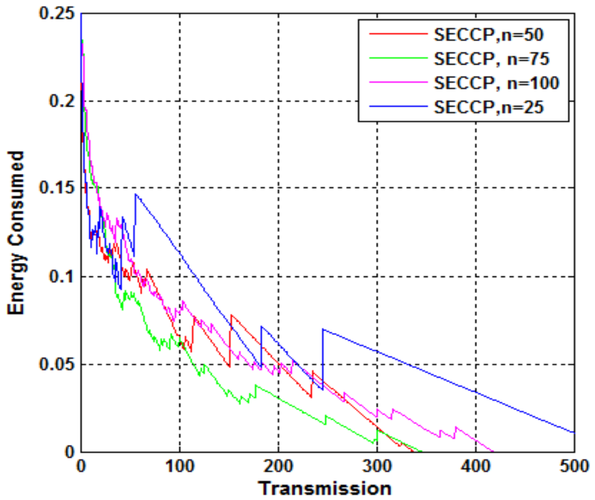

Figure. 5 Performance analysis of energy consumption varying the SNs considering r=500

Table 4. Packets sent to BS

Protocols	Throughput (Kbps)
EDCHSA	5434
I-SEP	26980
ECSS	11280
EBCT	60850
SECCP	60590

before vanishing. Another important indicator for our evaluation is the quantity of data packets received by BS.

Fig. 6 illustrates the packets sent to the BS utilising the SECCP to I-SEP, EBCT, ECSS, and EDCHSA techniques over the network's lifetime as 60590, 26980, 60850, 11280 and 5434. The SECCP algorithm clearly outperforms the I-SEP, EBCT, ECSS, and EDCHSA algorithms in terms of throughput as shown in Table 4. This is because some nodes send sensed data to the BS without first sending it to their CH. This lowers the BS's energy usage while boosting the total quantity of data it receives.

4.2.3. Packet delivery ratio calculation

The packet delivery ratio is calculated by dividing the number of packets accepted by the target by the packets sent to sender node. Table 5 shows how the nodes' packet delivery ratios compare for several protocols, including I-SEP, EBCT, ECSS, EDCHSA, and SECCP. The simulations experiment is conducted out with 100 nodes in this environment. SECCP protocol packets have a 95.25 % success rate. Earlier protocols, such as I-SEP, EBCT, ECSS, and EDCHSA, have energy efficiency of 84.37 %,90.99 %, 78.36 % and63.45%.

Thus, according studies, the efficacy of the SECCP protocol is superior to that of the others.

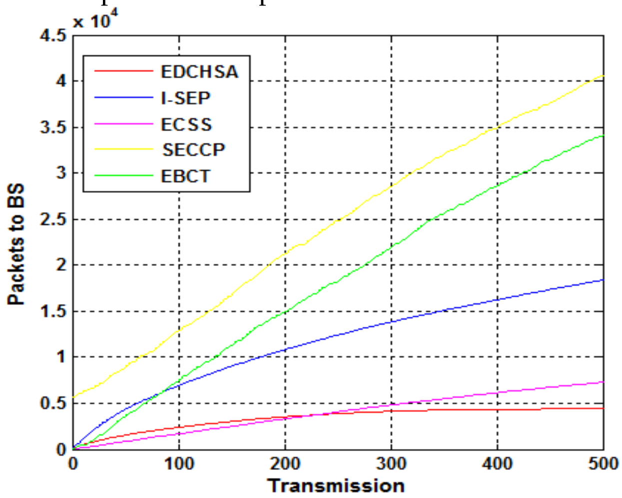

Figure. 6 Throughput comparison of SECCP with existing methods

Table 5. Packet delivery ratio calculation

Protocols	No of Nodes	Throughput (Kbps)	PDR %
EDCHSA	100	0.5434 x10^4	63.45%
I-SEP	100	2.698x10^4	84.37 %
EBCT	100	1.128 x10^4	78.36 %
ECSS	100	6.085 x10^4	90.99 %
SECCP	100	6.059 x10^4	95.25 %

Through evaluation, our suggested approach lowers communications overheads and prevents excessive CH selection in each round, outperforming other established protocols. SECCP uses energy consistently; it has more leftover energy available for a larger number of rounds.

5. Conclusion and future work

The WSN supported IoT devices are have batteries as a result, the energy consumption plays significant influence in the network's performance. Clustering has proved out to be most proficient method for saving energy in WSNs. However, WSN based on hierarchical clustering CH utilize more energy because of extra overhead for received data and aggregating the data to BS. Therefore, the appropriate election process of CHs is utmost important to conserve vitality of nodes. We proposed a Localization Based Distributed Selective Cluster Scheduling for efficient communication. It has been evidently verified through the simulations and results that SECCP guarantees a higher packet delivery ratio of 95.25 %, energy performance of 0.8226J with additional data transmissions and throughput of SECCP as 6.059 x10^4 Kbps to I-SEP, EBCT, ECSS, and EDCHSA as 2.698×10^4 Kbps, 6.085×10^4 Kbps, 1.128×10^4 Kbps and 0.5434×10^4 Kbps separately. Furthermore, incorporation of deep reinforcement learning strategies and adaptable meta-heuristic optimal routing strategies can improve the performance of the suggested method in future.

Conflicts of Interest

The authors declare no conflict of interest.

Author Contributions

"The paper methodology, conceptualization, analysis, investigation, original draft preparation has been done by 1st author. The supervision and project administration have been done by 2nd author and 3rd author".

References

[1] O. O. Ogundile and A. S. Alfa, "A survey on an energy-efficient and energy-balanced routing protocol for wireless sensor networks", *Sensors*, Vol. 17, No. 5, pp. 1084-1091, 2017.

[2] W. R. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "Energy-efficient communication protocol for wireless microsensor networks", In: *Proc. of the 33rd Annual Hawaii International Conference on System Sciences, IEEE Computer Society*, p. 10, 2000.

[3] K. Kalaivanan and V. Bhanumathi, "Reliable location aware and cluster-tap root-based data collection protocol for large scale wireless sensor networks", *Journal of Network and Computer Applications*, Vol. 118, pp. 83-101, 2018.

[4] N. Chuku, A. Pal, and A. Nasipuri, "An RSSI Based Localization Scheme for Wireless Sensor Networks to Mitigate Shadowing Effects", In: *Proc. of IEEE Southeast Con*, 2013.

[5] T. Stoyanova, F. Kerasiotis, C. Antonopoulos, and G. Papadopoulos, "RSS-based Localization for Wireless Sensor Networks in Practice", In: *Proc. of 9th International Symposium on Communication Systems, Networks & Digital Sign, IEEE*, pp. 134-139, 2014.

[6] V. Bahl and A. Bhola, "Prolonging Network Survivability and Optimizing Energy Consumption in Heterogeneous Wireless Sensor Networks", *International Journal of Intelligent Engineering and Systems*, Vol. 14, No. 4, pp. 166-176, 2021.

[7] R. H. Wu, Y. H. Lee, H. W. Tseng, Y. G. Jan, and M. H. Chuang, "Study of characteristics of RSSI signal", In: *Proc. of 2008 IEEE International Conference on Industrial Technology*, pp. 1-3, 2008.

[8] M. Kaddi, A. Banana, and M. Omari, "RSS-Based Selective Clustering Technique Using Master Node for WSN", *Computers, Materials & Continua*, Vol. 69, No. 3, pp. 3917-3930, 2021.

[9] L. Xuesong and W. Jie, "A Method for Energy Balance and Data Transmission Optimal Routing", *Wireless Sensor Networks*, *Sensors*, Vol. 19, No.13, p. 3017, 2019.

[10] S. D. Sasikala, N. Sangameswaran, and P. Aravindh, "Improving the energy efficiency of leach protocol using VCH in wireless sensor network", *IJERS*, Vol. 3, pp. 918-924, 2015.

[11] Z. Beiranvand, A. Patooghy, and M. Fazeli, "I-leach: An efficient routing algorithm to improve performance amp to reduce energy consumption in wireless sensor networks", In: *Proc. of 5th Conference on Information and Knowledge Technology*, pp. 13-18, 2013.

[12] M. Omari and W. Fateh, "Enhancing multihop routing protocols in wireless sensor networks using leach-1r", In: *Proc. of 2nd World Symposium on Web Applications and Networking*, pp. 1-6,2015.

[13] A. Antoo and A. Mohammed, "EEM-LEACH: Energy efficient multi-hop leach routing protocol for clustered WSNs", In: *Proc. of the International Conference on Control, Instrumentation, Communication and Computational Technologies*, pp. 812-818, 2014.

[14] G. Arumugam and T. Ponnuchamy, "EE-LEACH: Development of energy efficient leach protocol for data gathering in WSN", *EURASIP Journal Wireless Communication Network*, Vol. 2015, pp. 1-9, 2015.

[15] S. Chouikhi, I. Korbi, Y. G. Doudane, and L. Saidane, "A survey on fault tolerance in small- and large-scale wireless sensor networks", *Computing Communication*, Vol. 69, pp. 22-37, 2015.

[16] R. Abdul, A. Musbah, J. Chaitrali, A. Fathi, and C. Mrunal, "P-LEACH: Energy efficient routing protocol for Wireless Sensor Networks", In: *Proc. of IEEE Long Island Systems, Applications and Technology Conference*, 2016.

[17] A. Yektaparast, F. Nabavi, and A. Sarmast, "An improvement on leach protocol -Cell-LEACH", In: *Proc. of 14th International Conference on Advanced Communication Technology*, pp. 992-996, 2012.

[18] W. Jerbi, A. Guermazi, and H. Trabelsi, "O-LEACH of routing protocol for wireless sensor networks", In: *Proc. of 13th International Conference on Computer Graphics, Imaging and Visualization*, pp. 399-404, 2016.

[19] Q. Ren and G. Yao, "An Energy-Efficient Cluster Head Selection Scheme for Energy-Harvesting", *Wireless Sensor Networks, Sensors*, Vol. 20, p. 187, 2020.

[20] K. N. Qureshi, M. U. Bashir, J. Lloret, and A. Leon, "Optimized Cluster-Based Dynamic Energy-Aware Routing Protocol for Wireless Sensor Networks in Agriculture Precision", *Hindawi Journal of Sensors*, Vol. 2020, p. 19, 2020.

[21] S. S. Saleh, T. F. Mabrouk, and R. A. Tarabishi, "An improved energy-efficient head election protocol for clustering techniques of wireless sensor network", *Egyptian Informatics Journal*, Vol. 22, No. 5, 2021.

[22] D. W. Sambo, B. O. Yenke, and A. F. P. Dayang, "Optimized Clustering Algorithms for Large Wireless Sensor Networks: A Review", *Sensors*, Vol. 19, No. 2, p. 322, 2019.

[23] A. A. Baradaran and K. Navi, "HQCA-WSN: High-quality clustering algorithm and optimal cluster head selection using fuzzy logic in wireless sensor networks", *Fuzzy Sets and Systems*, Vol. 389, pp. 114-144, 2020.

[24] H. R. Farahzadi, M. Langarizadeh, M. Mirhosseini, and S. A. F. Aghda, "An improved cluster formation process in wireless sensor network to decrease energy consumption", *Wireless Network*, Vol. 27, pp. 1077-1087, 2021.

[25] P. Rawat, S. Chauhan, and R. Priyadarshi, "Energy-Efficient Cluster head Selection Scheme in Heterogeneous Wireless Sensor Network", *Journal of Circuits, Systems and Computers*, Vol. 29, No. 13, 2050204, 2020.

[26] C. Sudha, D. Suresh, and A. Nagesh, "An Enhanced Dynamic Cluster Head Selection Approach to Reduce Energy Consumption in WSN", *In: Saini H.S., Singh R.K., Tariq Beg M., Sahambi J.S. (eds) Innovations in Electronics and Communication Engineering. Lecture Notes in Networks and Systems*, Vol. 107, 2020.

[27] M. Zeng, X. Huang, B. Zheng, and X. Fan, "A heterogeneous energy wireless sensor network clustering protocol", *Wireless Communications and Mobile Computing*, Vol. 2019, p. 11, 2019.

[28] T. M. Behera, S. K. Mohapatra, U. C. Samal, M. S. Khan, M. Daneshmand, and A. H. Gandomi, "I-SEP: An Improved Routing Protocol for Heterogeneous WSN for IoT-Based Environmental Monitoring", *IEEE Internet of Things Journal*, Vol. 7 No. 1, pp. 710-717, 2020.

[29] Vasudha and A. Kumar, "Probabilistic Based Optimized Adaptive Clustering Scheme for Energy-Efficiency in Sensor Networks", *International Journal of Computer Networks and Applications*, Vol. 8 No. 3, pp. 188-202, 2021.