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Adaptive Reliable Cluster Head Selection Strategy for Multi-Hop Multimedia Wireless Sensor Networks

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Abstract: The multimedia wireless sensor networks (MWSN) need high bit-error rates and high transmission rates in order to send high-quality images through smart devices. The multiple-input multiple-output (MIMO) technology, on which MWSN is based, significantly depends on cooperative communication to properly exploit its benefits. By simultaneously broadcasting multiple symmetrical channels to prevent interference, large-scale wireless networks use multi-radio, multi-channel technology to increase performance. Significant interference can prevent cooperative communication from progressing in large networks. Additionally, since each node in the network is mobile, cooperative multimedia wireless sensor networks have serious issues with routing and transmission latency. The MWSNs become more dynamic as a result of mobility, which is reflected in the overhead control traffic. An adaptive clustering algorithm (ACA) was proposed by concurrently considering (i) relay selection by using channel capacity, mobility and distance metrics and (ii) channel assignment (CA) utilising a dynamic global table (GT). Further to improve the stability of a cluster an adaptive reliable clustering algorithm (ARCA) is present based on a priority neighbour-following technique to choose the ideal neighbour nodes to join the same cluster during the cluster head selection phase to increase cluster stability and reliability passively. Our approach selects a relay-node based on mobility and the maximum available channel capacity in order to reduce end-to-end transmission latency while maintaining aggregate throughput. Simulation results shows that the proposed approach improves the aggregate throughput of the network by 150%, 225%, and 240% when compared to that of the Cluster-based cooperative multi-hop optimal relay selection (CCORS), energy aware cooperative image transmission (EACIT), and efficient cooperative image transmission (ECIT) respectively.

Keywords: Wireless multimedia sensor networks, Decode and forward, Cooperative image transmission, Energy efficiency, Relay selection.

1. Introduction

Cooperative communication (CC) has been widely used in wireless networks to reap the advantages of multiple-input, multiple-output (MIMO) with a single radio node. The need for high data rates and the drop in the price of electronic equipment that satisfies the IEEE 802.11 network standard has ushered in a new age of cooperative communications based on utilising multiple channels

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with several antennas. Channel assignment (CA), relay selection, and routing should be optimised to maximise multi-radio advantages in large-scale cooperative networks. In reality, routing and CA rely on one another and are often considered simultaneously. Since routing specifies the traffic rate at each connection and CA sets the capacity of each link in a network, the two are inseparable.

As the monitoring landscape evolves and adapts, primary data from wireless sensor networks no longer suffices to meet environmental monitoring needs. The use of wireless sensor networks for environmental monitoring requires the collection of visual, auditory, and multimodal data. This has led to an increase in the number of MWSNs (multimedia wireless sensor networks). The wireless mobile sensor network (WMSN) is a novel sensor network consisting of sensors such as cameras and microphones to collect data about the surrounding environment. Based on the MWSN architecture, multimedia wireless sensor networks (MWSN) use mobile modules to link multimedia sensor nodes to movable objects like animals, drones, and robots. MWMSN has been used in many monitoring applications, such as those for intelligent transportation [2], in healthcare [3], environmental monitoring [4], and home automation [5].

A large amount of data flow across networked sensors reduces the network's lifespan since it uses more nodes' batteries than other WSN applications for wireless visual broadcasts. To combat these issues, picture compression technology advances led to network lifetime creation. Compression sensing, in the context of sensor networks, is synonymous with image compression (CS). Only a few techniques exist for compressing images and providing CS for picture transfer via WSNs. The wavelet transform is a widely used method for solving problems in both competitive and cooperative multimedia broadcasts. Non-cooperative network-based image compression approaches do not affect communication factors like picture-reconstruction quality and energy efficiency [5]. The DWT approach automatically identifies transmission and coding in the literature, which uses numerous quality layers and methods. These days, cooperative image transmission is widely used to conserve power; it is predicated on the assumption that, owing to the size and cost considerations, wireless nodes often only have access to a single antenna. While it is true that two parties may benefit from each other's pictures being sent, this is only the case if certain performance conditions are satisfied.

Physical layer characteristics have led to a novel security research and development approach: constructive collaboration [6-7]. Relay nodes are often used between the source and destination nodes to provide capability beyond wiretaps to the main link [8]. Therefore, the need to increase the number of relays to improve the success of keeping secrets is emphasised [9]. Relay selection is a method for enhancing the efficiency of cooperative systems that may be used with or without the addition of security needs being met [10]. Recent studies have used various relay selection strategies that consider the listener's state of activity. Channel state information (CSI) connection from the main channel and the unaware listener are used in the standard method of selecting the relay [11]. In addition, when the known eavesdropper is considered, the optimal relay is chosen based on how readily available the CSI of the wiretap is [12].

Multiple-hop communications and cooperative relaying are the two main subsets of cooperative communication. In order to increase "Quality of Service (QoS)" and/or coverage, it has been used in cellular networks. Networks that combine cellular and multi-hop communication technologies are referred to as "hybrid Ad hoc networks" (HANETs) [13]. With the "3rd generation partnership project (3GPP) for time-division duplexing (TDD) and universal mobile telecommunications system (UMTS)" [14], the "Opportunity driven multiple access (ODMA) protocol" is introduced to implement MCN. It is suggested for maximising high data rate coverage and network capacity [15] and for delivering spot coverage and traffic hotspots.

Cooperative communication is generally a successful method in many civilisations [16]. Therefore, enhancing the efficacy of cross-layer or physical-layer viewpoints in wireless relay transmission systems is essential. To counteract this, MWMSNs increasingly turn to cooperative communication technologies, which offer a broad range of protocols and more comprehensive designs [17].

In order to reduce transmission time in large-scale cooperative communication, it is more important to establish the shortest route routing with candidate channel assignment along with minimum sessions. To solve this issue, a dynamic routing technique was developed to use channel capacity, mobility, and distance characteristics. The major contribution of proposed work:

- To minimize the end-to-end transmission latency without compromising aggregate throughput, an adaptive clustering algorithm (ACA) was proposed employing channel capacity, mobility and distance metrics.

- To guarantee route stability, reliability, and durability in MWSN, the adaptive reliable clustering algorithm (ARCA) adds an adaptive mechanism for selecting cluster heads to the original algorithm, obtaining the tradeoff between quality of service (QoS) and mobility constraints over link parameters.
- To illustrate the excellence of this study effort, the effectiveness of the created multi-hop MWSN communication model with varied performance metrics was validated using standard methods.

The rest of the paper is organized as follows. In section 2, we presented the related work. Our model, relay selection strategy is presented in section 3. Adaptive reliable relay selection is presented in section 4. Section 5 gives the simulation results of proposed approach and finally we concluded our paper in section 6.

2. Related work

As real-time multimedia transmission requires a lot of network capacity and a single wireless access technique cannot provide those needs, constrained communications competencies and varied working methodologies. Services for real-time HD video demand stringent end-to-end delays and delay jitter due to the limited communication capabilities unlike a single wireless access technology, which is unable to provide users with a superior user experience. [18–19]. There are numerous heterogeneous wireless networks in the wireless heterogeneous network environment, such choose from, for example, WLAN, LTE, and 5G, is a key component of next-generation wireless networks. Systems for multiple-path parallel transmission can effectively increase network resource utilization, by combining the transmission performance of multiple sources, a service transmission rate and load balancing capabilities many links [20].

An important factor in WSN's widespread acceptance is the challenging problem of multimodal data transfer. A cooperative numerous-path routing method presented for photo transmission in WMSN in the literature [21]. This strategy employs a polynomial heuristic approach to tackle the problem of cooperative multi-path routing with bandwidth awareness (BP-CMPR). By utilizing multi-node collaboration and resource distribution, this technique may effectively cut energy consumption. Routing in clusters solutions there have put out in the written word to reduce energy consumption [22–24]. The low energy adaptive clustering hierarchy (LEACH) method created in the literature [22] to spread the energy burden among the network's sensors equally. For scalability and endurance, this method for dynamic networks leverages localized coordination. In order to send less data to the base station, it incorporates data fusion into the routing protocol. Based on the outcomes of the simulation, it has been found that the LEACH method evenly spreads out the energy loss among the sensors.

An improved LEACH method for mobile sensor networks is described in [23]. The system uses fuzzy inference techniques to reduce packet loss while simultaneously lengthening the network lifetime. The literature [24] offers hierarchical strategies based on a clustering hierarchy for energy conservation in WSNs. In this scenario, data collection and data relay to a base station may be carried out by the nodes with the most energy left over. The outcomes of the simulation show that this strategy works.

In order to guarantee real-time QoS performance, an updated Speed-RR, or real-time routing protocol, developed according to the SPEED procedure in the literature [25]. With this protocol, the remainder of two-energy hop's neighbor complete nodes taken into account. It separates congestion control for various services using a control method based on node sending, receiving, and cache queue length. It has been established that the suggested SPEED-RR protocol reduces transmission latency and energy usage. A QoS multimedia applications assurance protocol is recommended in the literature for wireless multimedia sensor networks [26] to effectively realize multimedia data transport, processing, and storage on the cloud. On the basis an opportunistic dynamic multimedia cloud platform is presented for the first time, taking advantage of changes in the decodable frame ratio, PSNR of channel quality, and packet error rate. Considering the collaborative multimedia stream, the most effective multi-relay hierarchical transmission method is developed and put into action. The results suggest that the suggested protocol might be able to satisfy the requirements for QoS for WSN multimedia apps.

The authors of [27-28] presented a successful image transmission strategy that depends on relayed picture transmission via wireless channels in order to achieve the greatest image quality and bit error rate performance. Secondly, a lightweight picture quality enhancement system was built at both the transmitter and receiver ends while pictures were taken under various lighting conditions. Second, the approximation coefficient of the 2D discrete wavelet transform was used to execute the recommended compressive sensing. Using the wavelet de-noising

Table 1. Features and challenges of relay selection approaches

Paper	Methodology	Features	Challenges
[5]	CCORS	• The relay nodes are chosen based on the highest possible QoS value. • QoS evaluated by using route stability, reliability, and durability	• Cluster Adaptability was not considered
[27]	ECIT	• Improved Energy efficiency by transmitting compressed image. • 2D-DWT was used for image compression	• Effect of mobility was not considered
[28]	EECIT	• Energy efficiency and quality-aware multi-hop one-way cooperative image transmission framework proposed based on image pre-processing technique, wavelet-based two-dimensional discrete wavelet transform (2D-DWT) methodology, and decode-and-forward (DF) algorithm at relay nodes	• Effect of mobility was not considered
[29]	ECAIT	• Minimize energy Consumption by calculating the maximum transmitting power to meet the target bit error rate in a hop • Improve the performance of EACIT by implementing spatial multiplexing	• Effect of mobility was not considered. • Cluster Adaptability was not considered

Table 2. Summary of notations

Symbol	Description
N	Number of nodes
P_t	Transmit power
$R_c(s)$	transmission coverage area of source node
B	Bandwidth
$ACC_{s,l}$	available capacity between s and l
WF_{M_s,M_l}	Weight factor
MF	Mobility factor
A	Amplification factor
$h_{l,j}$	Rayleigh fading channel coefficient
α	transmission efficiency
d_{ij}	distance between the node i and j
η_i	AWGN noise with zero mean
G_{Tx} and G_{Rx}	Transmitter and receiver gains respectively
N_f	Noise figure
M_l	Link margin

benefit by creating a hybrid thresholding function. Lastly, relay nodes use the decode-forward mechanism to decode and send incoming image data blocks. The inverse fast Fourier transform is applied with the compressed a part of the 2D discrete wavelet transform that approximates in accordance with the standard orthogonal frequency division multiplexing model, and then transmit over an AWGN channel to relay nodes using quadrature phase shift keying. By using spatial multiplexing with many radio terminals, a cooperative energy-aware transmission method was created in [29] to improve energy efficiency and visual quality. Numerous relay selection approaches have been reviewed in Table 1.

While there is much outstanding research on MWMSNs and cooperative communications, there are several fundamental problems that are not fully utilized. In order to obtain the least amount of network overhead highest PDR, our approach aims to maximize cluster heads while minimizing cluster heads in order to further achieve the lowest network overhead. On each hop, an optimization procedure is carried out in order to reduce the end-to-end energy consumption, and the ideal number of cooperating nodes is attained. The notations used in this paper are listed in Table 2.

3. System model

We take into account the Fig. 1 cooperative multi-hop wireless network. There are N nodes that are scattered over an area of $L \times L\ m^2$ and each of which is outfitted with several radio terminals (multi radio). The Amplify and Forward (AF) relaying technique is used by each node. Every node in the network is regarded as having the identical transmit having power P_t, concurrent symmetrical channels OCH and K. Every node uses GPS to determine its location, and other nodes can be located by periodically emitting beacon signals [30].

Each node in a MWSN keeps track of its own information and the maximum hop range of its neighbours in a database called T_{info}. After receiving a HELLO packet from a neighbour node or when the node's state changes, the T_{info} table is updated. The HELLO packet is sent to the nearby nodes. Some of the most important bits of data it contains are: node ID, heading, speed, hop count to CH node, and parent node ID. If a node hasn't heard from a neighbour node for a certain amount of time, the route record is deleted.

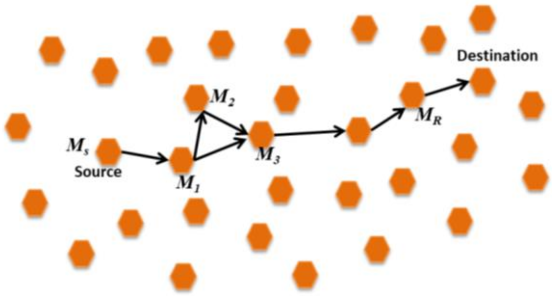


Figure. 1 Cooperative wireless multimodal sensor network

We presume that each network node has access to the access point's global table of the network. Each node's operational channels are listed in this table so that every node in the network is aware of the operational channels of every other node. Using the setup channel, every node changes its working channels. Using this table will help with channel assignment. We presummated that each cell site has a global table at the base station that holds the link SNRs and mobility of each node and is reached by every node in the network. Every node updates the measured SNR in the global database after calculating the link SNR, which is helpful in the relay selection process outlined in algorithm 1.

As shown in the equation below, let $R_c(s)$ be the set of nodes inside node s's coverage area where the symbol error rate (SER) is below a predetermined threshold τ_1 [31]

$$R_c(s) = \{r|SER_{s,n_i} < \tau_1\} \tag{1}$$

Based on maximum available channel capacity, mobility and distance characteristics, the source node chooses one of the nodes n_j to serve as relay node. For the subsequent hop, the chosen relay node serves as the source node. The relay node gets data from the source node in each hop, amplifies it, and then retransmits it to the relay node in the following hop. The node i node j received signal is reported as [30].

$$y_{ij} = \sqrt{P_t} h_{ij} x + \eta_{ij} \tag{2}$$

At node j, this data is amplified and sent again to relay l, the following hop. The information sent is as follows:

$$y_{jl} = A\sqrt{P_t} h_{jl} y_{ij} + \eta_{jl} \tag{3}$$

3.1 Adaptive cluster head selection algorithm

This section explains an adaptive cluster selection algorithm (ACA) that establishes the maximum capacity path with minimal transmission time between the source and destination based on the maximum available channel capacity, distance and mobility. The capacity of a channel that is open. It is assessed as,

$$ACC_{i,j}^{ch_l} = B.\log\left(1 + SNR_{i,j}^{ch_l}\right) - \sum_{p,q\epsilon I_i} T_{m,n}^{ch_l} \tag{4}$$

Where I_i is the collection of nodes in node i's interference region,

The average mobility factor value, which is influenced by the node's speed, is shown in equation (5).

$$MF_{M_s,M_k} = \frac{V_r - V_{max}}{V_{max} - V_{min}} \tag{5}$$

Where V_r shows the recipient vehicle's speed. V_{min} and V_{max} represent the node's minimum and maximum speeds, respectively.

The selection of the relay and the assignment of the channel are described in depth in Algorithm 1. Selecting the adaptive cooperative relay technique is used to find the channels, relay nodes, and routing route whenever newly requested flow enters the system. Each flow's source node executes the route is updated using Algorithm 1 on a regular basis.

4. Adaptive reliable clustering algorithm (ARCA)

The node and cluster head nodes with the lowest relative mobility are recruited as cluster members in the conventional multi-hop clustering technique. Getting exact motion data from a vehicle node's multi-hop neighbours might be challenging in a cluster design. Because there are so many possible cluster head nodes within a multi-hop range, it is difficult for a vehicle to choose one. There will be significantly more effort for the network to process all the broadcast packets. However, it is possible to determine the most stable node within the node's one-hop range. If the two nodes are combined into one cluster, the clustering cost is reduced, and the cluster's stability is much improved. We propose the adaptive reliable clustering algorithm (ARCA) in this subsection. A node is not required to actively seek over long distances for the cluster head nodes during the cluster-building phase. Rapid changes in node velocity have a significant bearing on the stability of

Algorithm 1: Adaptive cluster selection algorithm

Input: A new flow request
Output: shortest routing path between node s and node d with relay nodes, and channel assignment.
1: **while** source node ≠ destination node do
2: Obtain $R_c(s)$
3: Using Global table node s obtains the working channels ς in its co-channel interference region (I_s).

$$\varsigma = \bigcup_{m \epsilon I_s} W_{ch}(m)$$

4: From $R_c(s)$, a subset is formed based on node location. i.e., nodes which lies between source and destination.

$$DD(s) = \{l | D(l,d) < D(s,d), l \epsilon R_c(s)\}$$

5: **if** $d \epsilon R_c(s)$ **then**
6: candidate channel between s and d will be evaluated as
7: $ch_{s,d}^{ca} = \max\left\{ACC_{i,j}^{ch_i} | ch_i \epsilon OCH\right\}$
8: **else**
9: candidate channel between s and j will be evaluated as
10: $ch_{s,j}^{ca} = \max\left\{ACC_{i,j}^{ch_i} | ch_i \epsilon OCH, j \epsilon DD(s)\right\}$
11: **end if**
12: Form a set $MC_{s,j}^{ch_i} = \left\{ACC_{i,j}^{ch^{ca}} | j \epsilon DD(s)\right\}$
13: Form a set of nodes ψ which satisfy the condition,
14: $\psi = \left\{z | \max\left(MC_{s,j}^{ch^{ca}}\right) - MC_{s,z}^{ch^{ca}} < \alpha; z, j \epsilon DD(s)\right\}$
Where α is a predefined capacity threshold
15: Form a set which contains nodes $j(j \epsilon \psi)$ perpendicular distances to LOS
16: $\chi_{z,LOS} = \{D(z, LOS) | z \epsilon \psi\}$
17: Forms a subset, that satisfy
18: $\xi = \left\{y | \chi_{y,LOS} - \min\left(\chi_{y,LOS}\right) < \beta; y \epsilon \psi\right\}$
Where β is predefined distance threshold
19: $relay\ node = \{r | \min MF_r; r \epsilon\ \xi\}$
20: Candidate channel for the pair s and r will be assigned for transmission.
21: relay node will be act as source node for next hop
22: **end while**

the cluster and the reliability of inter-vehicle communications in a MWSN. With the proposed ARCA, cluster stability and reliability are massively improved. In contrast, cluster expenses are reduced by selecting a member and head node based on their node mobility, link quality and dependable link lifespan.

4.1 Link quality

The connection element is taken into account to ensure a wide coverage area, the bandwidth parameter is taken into consideration to give dependability, speed and distance are taken into consideration to provide route stability. Assume that M_s is a source node in the network and M_k is a two-hop vehicle. The capacity available between M_s and M_k is denoted by C_{M_s,M_k}. The link quality for M_s is LQ_{M_s,M_k}, and the representation to the source vehicle neighbors is $R_c(s)$ [5].

$$LQ_{M_s,M_k} = C_{M_s,M_k} \times MF_{M_s,M_k} \quad (6)$$

4.2 Dependable link lifespan (DLL)

A greater DLL indicates that the connection between the automobiles will hold for a longer period of time. Let's assume that at time t, a node M_k is travelling at speed $v_k(t)$, represented by the coordinates $v_k(t) = \left(v_{kx}(t), v_{ky}(t)\right)$, and that its current position is $p_k(t)$, where $p_k(t) = \left(p_{kx}(t), p_{ky}(t)\right)$. At τ_0 second intervals, it broadcasts a HELLO packet to its nearest neighbour node. The HELLO packet contains information on the location, velocity, and direction of the node. When it receives this HELLO packet, a neighbour node M_l of the car M_k will calculate when it needs to do connection maintenance. At time t, the position is $p_l(t)$ if and only if M_l is travelling at a speed of $v_l(t)$. Assuming that the broadcast distance between two nodes is B_d. When the distance between the two automobiles exceeds the maximum broadcasting range, which is B_d, the connection will be lost. Therefore, it's pleasing that the connection may last through the ages.

$$|p_k(t + RLL) - p_l(t + RLL)| = B_d \quad (7)$$

$$|p_k(t) + v_k(t)RLL - p_l(t) - v_l(t)RLL| = B_d \quad (8)$$

$$RLL = \frac{B_d - \left(p_k(t) - p_l(t)\right)}{v_k(t) - v_l(t)} \quad (9)$$

Priority is a crucial metric considering the degree, reliable link life duration, and predicted transmission counts. To indicate the priority, we utilise the priority of a node M_k $\left(Pr_{M_k}\right)$ formula, which is as follows:

$$Pr_{M_k} = a. LQ_{M_s,M_k} + b. RLL \quad (10)$$

Algorithm 2: Adaptive reliable clustering algorithm (arca)

Input: A new flow request
Output: shortest multi hop routing path.
1: **while** source node ≠ destination node do
2: **if** no CH in a cluster **then**
2: Obtain $R_c(s)$
3: **% Obtain parameters**
4: Link quality using equation (6)
5: Dependable Link Lifespan using equation (9)
6: calculate the priority
7: $Pr_{M_k} = a.LQ_{M_s,M_k} + b.RLL \ \ \forall M_k \epsilon R_c(s)$
8: $M_i = \arg \max_{M_k \epsilon R_c(s)} Pr_{M_k}$
9: select the node M_i as cluster head.
10: **end if**
11: relay node will be act as source node for next hop
12: **end while**

Table. 3 Proposed approach result for various images

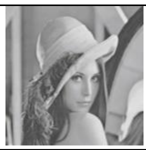
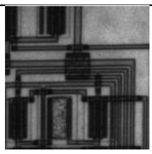
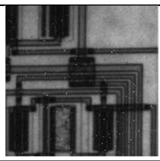
Image Name	Input image	Image at destination
Lena		
Cameraman		
Barbara		
Circuit		

Table 4. Comparative values of PSNR

Image Name	ECIT [28]	ECAIT [29]	CCORS [5]	ARCA Proposed
Lena	35.45	38.51	68.12	70.85
Cameraman	35.50	38.45	67.55	69.21
Barbara	35.10	38.45	66.85	69.95
Circuit	34.55	35.55	66.14	68.82

Where a and b are the arbitrary constants which represents the weights such that a+b=1. The larger the Pr_{M_k} is, the greater the priority is, as shown by the formula (10). As the target node to follow, the node node M_k will choose the node M_k with the greatest priority. Adaptive reliable clustering algorithm (ARCA) is presented in Algorithm 2.

5. Simulation results

We give the simulation results of the suggested strategy in this part and compare them with state-of-art algorithms. MATLAB software was used to run the simulation and the simulation parameters like $1000 \times 1000\,\mathrm{m}^2$ area, with 30 nodes placed randomly with a meer distance of 200m apart. The performance of proposed approach is verified for fifty-five images from digital image processing (DIP) images, and twenty MATLAB images. Some of the images from these datasets are presented in Table 3. To assess the effectiveness of the suggested clustering method, we look at the Peak signal to noise ratio, structural similarity index, end-to-end energy consumption and impact of node density on aggregate throughput.

The mean squared error, structural similarity index, and peak sigal to noise ratio are used to assess the output pictures to the input. The MSE is the mean square error between the destination node-D and the source node-S, determined by Eq. (11):

$$MSE = \frac{\sum_{MN}\left(I_1(m,n)-I_2(m,n)\right)^2}{M*N} \quad (11)$$

The Structural similarity (SSIM) index compares the transmitted picture to the destination image. SSIM values typically range from 0 to 1. Similar to the above parametric analysis, this determines signal power to noise power by comparing both pictures. The PSNR of a picture with intensity L is computed using Eq. (12):

$$\mathrm{PSNR} = 10\log_{10}\left(\frac{\mathrm{L}^2}{\mathrm{MSE}}\right) \quad (12)$$

Table 4 compares the comparing the PSNR (peak signal to noise ratio) of the suggested methodology to numerous cutting-edge methods. For a cameraman's image, with approach proposed in [28] has a value of 35.50 dB, while previous approaches ECAIT and CCORS both gained 38.45 dB and 67.55 dB, respectively. This proposed work obtained a PSNR value of 69.21 dB, meaning shows the quality of the reconstructed image improves with increasing PSNR.

In Table 5, the proposed approach is compared to various cutting-edge techniques based on the structural similarity index (SSI). The cooperative

Table 5. SSI comparative values

Image Name	ECIT [28]	ECAIT [29]	CCORS [5]	ARCA Proposed
Lena	0.816	0.855	0.853	0.891
Cameraman	0.789	0.831	0.848	0.872
Barbara	0.813	0.821	0.849	0.879
Circuit	0.794	0.814	0.831	0.855

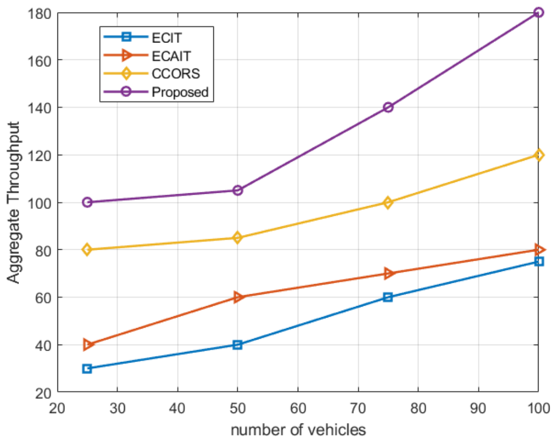


Figure. 2 Impact of traffic density on network throughput performance

Table 6. Impact of traffic density on network throughput performance

Node Density	Aggregate Throughput			
	ECIT [28]	ECAIT [29]	CCORS [5]	ARCA Proposed
30	30	40	80	100
60	40	60	85	105
90	60	70	100	140
120	75	80	120	180

transmission for a cameraman's image through ECIT [28] is 0.789, while ECAIT and CCORS earlier approaches produced 0.831 and 0.848, respectively, and this proposed work produced a SSIM value of 0.872, which raised the SSIM good quality reconstruction.

5.1 Impact of Traffic density

In order to explore the influence that the traffic density has on the functioning of the network, we varied the number of cars in the network from 30 to 120. When there are more nodes in a network, there is a greater potential for more cars to participate in cooperative relay races. As a direct consequence of this, the total throughput of all routing systems improves, as seen in Fig. 2.

Under the technique that we have described, the aggregate throughput of all of the routing algorithms rises as the number of cars in the system grows. Our strategy is able to more efficiently leverage the resources of cooperative vehicles and, as a result, achieve a significant cooperative benefit even when the number of vehicles is rather high thanks to a well-designed algorithm for both the route selection and the relay selection. When compared with the ECIT [28], ECAIT [29], and CCORS [5] techniques, our method enhances the aggregate throughput of the network by 240%, 225%, and 150%, respectively, when the traffic density is at 120. The influence that the number of nodes has on the aggregate throughput is summarized in Table 6, which may be found here.

6. Conclusion

An adaptive clustering algorithm (ACA) was proposed for wireless multimedia sensor networks research in order to take advantage of the advantages of cooperative relays in the large-scale wireless network with several radios and channels. To choose the best candidate relay node from a list of potential relay nodes have low improved channel efficiency, nodes with poor mobility, close between the source and the destination LOS, and far from the source node are taken into consideration. Using the access point's global database, a dynamic channel assignment with large channel capacity is created. Further an adaptive reliable clustering algorithm was developed to improve the reliability of the cluster by considering the link quality and dependable link lifespan. From the demonstration, we conclude that the proposed algorithm gives the better performance interms of aggregate throughput and network life time compared to the ECIT, ECAIT, CCORS approaches.

Conflicts of interest

The authors declare no conflict of interest.

Author contributions

The paper conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing-original draft preparation, writing-review editing and visualization, have been done by 1st and 5th authors. writing—review and editing have been done by author 6. The supervision and project administration have been done by 2nd, 3rd and 4th authors.

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