A Novel Metaheuristic Optimization based Clustering with Routing Scheme for IoT Mobile Edge Computing Platform

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Abstract

Largescale IoT applications with thousands of geo distributed IoT gadgets making huge volumes of data impose immense challenges to designing transmission mechanisms that offer data transfer has less latency and great scalability. In this work, an investigation of a hierarchical Edge-Cloud publishes or subscribe brokers method was performed with the help of an effective two-tier routing structure for alleviating such problems whenever sending event notices in large scale IoT mechanisms. In this technique, IoT gadgets use the benefits of nearby edge brokers deliberately positioned in edge network for data supplying services for minimizing latency. This manuscript introduces a Novel Metaheuristic Optimization based Clustering with Routing Scheme for IoT Mobile Edge Computing Platform, named MOCRS-IoTMEC model. The projected MOCRS-IoTMEC model is mainly concentrated on the identification of optimal routes in the IoT assisted MEC environment by the use of pigeon inspired optimization (PIO) algorithm. Also, the LEACH protocol is applied to initially cluster the IoT devices. The PIO algorithm is applied to determine the fitness function to choose optimal routes. To depict the enhanced performance of the MOCRS-IoTMEC model, a detailed comparison study is made. The experimental outcomes reported the enhanced execution of the MOCRS-IoTMEC method over other approaches.

Keywords: Internet of Things; Mobile edge computing; Clustering; Routing; Meatheursitics

1. Introduction

Moderate improvement of the wireless sensor network (WSN) and Internet of Things (IoT) has demonstrated useful for more extensive arrangement of continuous information collection and tracking applications. Also, WSN acquired significant consideration from designers of different applications, for example, clinical observation, automatic irrigation organization, target monitoring, forest fire prediction, disaster management, and landslide tracking [1]. The significant advantage of WSN is implanted with an enormous amount of viable sensor nodes (SN), that aid to natural disasters arising in remote or unforgiving locales. After which, the SN additionally explores climatic factors, for example, temperature, pressure, dampness, dampness content, and sound that address the disastrous side effects [2]. When the detecting activity is finished by SN, the subtleties are then gathered and shipped off the base station (BS). The sensor units and information correspondence unit in SN use the greatest energy which is an energy use module. At the point when all the energy is drained, then it is thought of as terminated or incapable of processing. A hub is possibly alluded to as dead whenever it isn't reasonable for substitution or it can't be re-energized by some other power sources. Thus, it is fundamental for balancing the power used by SN. To determine such problems, the clustering procedure was implied by numerous designers [3-5]. This is probably the optimal geography for achieving a drawn-out network span and brilliant proficiency. Additionally, it assists with protecting the force of SN below the improvement of a few dependable clusters. The quantity of clusters created may be either impermanent or super durable, contingent upon the clustering instrument utilized. Moreover, clustering likewise isolates the mutually positioned nodes into clusters. This is still up in the air as per the comparability measurements like distance from BS (DBS), transmission range, and cluster thickness. When clusters

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were created, a hub in a cluster can be picked as a head hub named the cluster head (CH) [6]. Fig. 1 shows the structure of IoT enabled MEC platform.

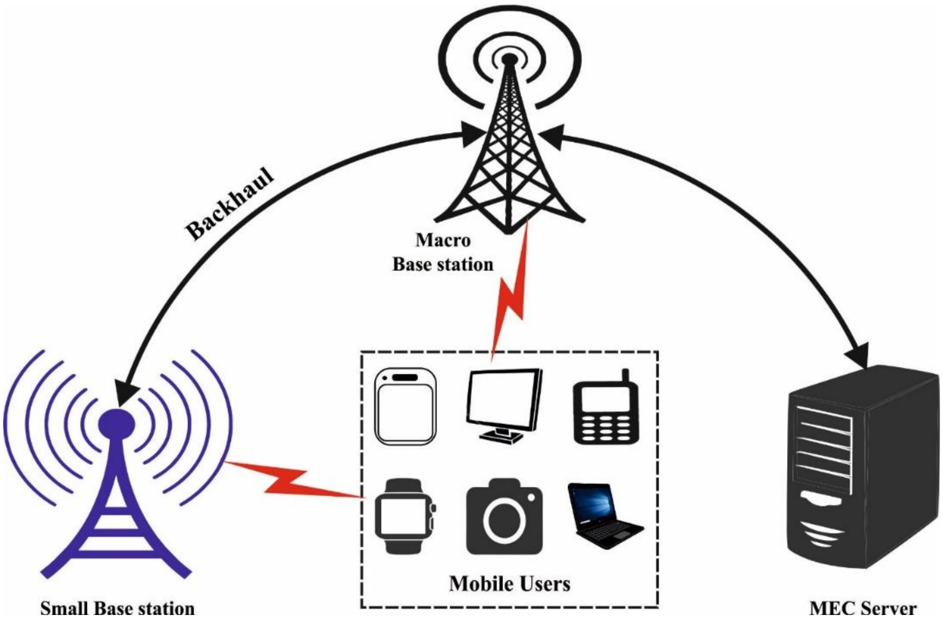

Figure 1: System design of IoT enabled MEC paradigm

Arranging a clustering design to course QoS data is the principal necessity of the WSN-IoT study [7]. Clustering was a fundamental model, and its importance can be recorded in 2 means. Essentially, WSN-IoT management is achieved admirably through clustering structure. A conventional WSN-IoT contains over 100 or 1000 WMNs. In level WSN-IoT setup, unnecessary parcels are moved from source to sink nodes [8]. The adaptability issue may conceivably ascend with level related WSN when there is a need to build the quantity of WMNs and may immerse the organization. Thus, cluster-related directing can be utilized for the successful management of WSN-IoT. Besides, clustering will assist with noting inquiries, for example, geography control, fabricating a virtual organization, and interruption revelation [9]. One such egotistical plan worries of a cluster-related directing calculation are discovering an ideal CH-set that should shield the entire WSN-IoT network region. Every time a WMN is related to a cluster, in any case, it isn't necessary that every cluster contains a CH. As the existence of a CH in a cluster enjoys the benefit of dealing with the WSN-IoT effectively, most of the current work expects the existence of CHs in all clusters. If not, the suggested cluster-based steering plan would consume more energy when contrasted with the level directing convention [10].

This manuscript presents A Novel Metaheuristic Optimization based Clustering with Routing Scheme for IoT Mobile Edge Computing Platform, named MOCRS-IoTMEC model. The projected MOCRS-IoTMEC model is mainly concentrated on the identification of optimal routes in the IoT assisted MEC environment by the use of pigeon inspired optimization (PIO) algorithm. Also, the LEACH protocol is applied to initially cluster the IoT devices. The PIO algorithm is applied to determine the fitness function to choose optimal routes. To depict the enhanced performance of the MOCRS-IoTMEC model, a detailed comparison study is made.

2. Literature Review

Sujanthi and Nithya Kalyani [11] determined this problem by planning a novel Secure DL (SecDL) method for dynamic clustering related WSN-IoT network. To enhance energy efficacy, the network presented a Bi-Concentric Hexagons and Mobile Sink technology. The data aggregation was allowable in each cluster and controlled with 2-way Data Reduction and Elimination systems. Jain [12] present the bi-layered WSN infrastructure to dynamic clustering related to routing and coverage hole recognition and recovery. The presented method comprises formation of cluster, CH selection (CHS), coverage hole recognition, recovery, and routing systems. The cluster is designed by K-means algorithm. The CH was chosen through Determined Weight (DW). This technique was computed by RE, distance in cluster, and center to BS. According to the weighted CH was chosen.

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Alkhliwi [13] establishes an energy-effective clustering-based routing method with secured IDS in HWSN called EECRP-SID. The presented EECRP-SID system contains 3 important stages such as intrusion detection, cluster construction, and optimum path selection. Primarily, the T2FC approach with 3 input parameters was executed to CHS. Preeth et al. [14] established an adaptive fuzzy rule based energy effective clustering and immune-inspired routing (FEEC-IIR) system for WSN supported IoT model. To optimal CHS, adaptive fuzzy multi-criteria decision making (AF-MCDM) technique was utilized that is a group of TOPSIS and fuzzy AHP approaches were established in an energy effective cluster system. The condition of energy, QoS influence, and node place was obtained as the important features which control the selection of CHs but all the criteria comprise any sub-criteria.

Vaiyapuri et al. [15] present the IoT empowered cluster based routing (CBR) system to data centric WSNs (ICWSN) termed CBR-ICWSN. The suggested method endures a black widow optimization (BWO) based clustering system for efficiently selecting the optimal group of CHs. Wang et al. [16] present an energy effective clustering routing system. Assuming the non-uniform traffic distribution, it can be present an uneven cluster development method to load balancing (LB) and energy efficiency. Besides, it can present a distributed CH rotation process for balancing energy utilization in all the clusters. As for long distance broadcast to BS, it is proposed a dynamic multi-hop routing technique amongst CH nodes dependent upon the presented distance-and-energy-aware cost function for avoiding the energy hole problems.

3. The Proposed Model

This manuscript introduced a MOCRS-IoTMEC model for MEC paradigm. The projected MOCRS-IoTMEC model is mainly concentrated on the identification of optimal routes in the IoT assisted MEC environment by the use of PIO algorithm.

PIO is a lately proposed biologically inspired technique, extensively applied to resolve optimization issues. It is depending on the social creature of the swarm through the base of learning. They try to improvise the solution quality arithmetically according to the swarming behavior for adopting with the velocity and position of each individual (Shi et al., 2001). The pigeon is a common type of bird that can fly long distances for finding food. In addition, the pigeon holds a stimulating homing behavior that is more frequently used in the world war for conveying data.

This comes under two key operatives such as landmark, map, and compass. The homing skills termed that the pigeon's abilities to direct the home come from minute magnetic particle situated in peak that convey the signals to brain over the trigeminal nerve. They exploited the magneto response to intellect the magnetic intensity of the earth, in addition, the pigeon perceives the sun's highness as a compass to modify its direction. The PIO algorithm is a kind of metaheuristic approach inspired by the pigeon's hierarchy. It necessitates global and personal optimization and local optimum dataset particles. PIO is proposed by utilizing 2 operators based on the pigeon nature. It encompasses landmark, map, and compass operators, with global and local optimal location and it accomplished optimum performance measures.

(1) Map and compass operator:

Now, the rule is determined by the X_i position and V_i the velocity of i pigeons, velocity, and position in D-dimensional searching space was increased with each iteration. A novel velocity and location of pigeon i at $t\text{-}th$ iterations are defined by the following equation:

$$V_i(t) = V_i(t-1) \cdot e^{-Rt} + rand \cdot \left(X_g - X_i(t-1)\right) \tag{1}$$

$$X_i(t) = X_i(t-1) + V_i(t) \tag{2}$$

From the expression, R determines the map and compass factors, $rand$ signifies an arbitrary integer lies in the interval of [0,1], X_g demonstrates the existing global optimum position, which is accomplished in the comparison of each location.

(2) Landmark operator:

Now, the partial calculation of pigeons is minimized in each generation. For completing the terminus instantly, residual pigeons fly towards the targeted location. Assume the X_c as a middle position of pigeon, the location update rule of i pigeon at $t\text{-}th$ iterations is denoted by:

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$$N_p(t) = \frac{N_p(t-1)}{2} \tag{3}$$

$$X_c(t) = \frac{\sum X_i(t) \cdot fitness\big(X_i(t)\big)}{N_p \cdot \sum fitness\,\big(X_i(t)\big)} \tag{4}$$

$$X_i(t) = X_i(t-1) + rand \cdot (X_c(t) - X_i(t-1)) \tag{5}$$

In the equation, N_p indicates the count of pigeons, whereby fitness is a cost function. For minimized optimization, the terminus function is designated at the least rate.

MOCRS-IoTMEC derived an FF to attain information communication. The goal is to regularize the combined outcome on distance to node mobility, bandwidth, and target to choose relay IoT for broadcast information. As well, FF encompasses 4 components using individual conditions as follows.

$$F = optimize(\emptyset_1 F_1 + \emptyset_2 F_2 + \emptyset_3 F_3 + (1 - \emptyset_1 - \emptyset_2 - \emptyset_3)F_4) \tag{6}$$

Where, $\emptyset_1$, $\emptyset_2$, and $\emptyset_3$ indicates the weighting factor. Then, the key components F_1 defines the Euclidean distance between chemical reaction and the received IoT. It is suitable that a chemical reaction that encompasses less distance towards receiver end, is carefully chosen to succeed in communication IoT. It is accomplished based on the fact that communication IoT might accomplish geographical location of the target IoT (x_D, y_D) by examining its location also determined by the respective location of their neighboring IoT in CAM.

$$F_1 = \|x_n - x_d\| = \sqrt{(x_n - x_d)^2 + (y_n - y_d)^2} \tag{7}$$

Then, F_2 indicates the mobility levels of chemical reactions. A chemical reaction with minimum mobility is specified to eliminate the network segmentation problem. The normal speediness for chemical reaction in existing time T_s is determined by

$$F_2 = \frac{1}{T_s} \sum_{t_s=1}^{T_s} \sqrt{\left(x_{t_s} - x_{t_{s-1}}\right)^2 + \left(y_{t_s} - y_{t_{s-1}}\right)^2} \tag{8}$$

Where $\left(x_{t_s}, y_{t_s}\right)$ & $\left(x_{t_{s-1}}, y_{t_{s-1}}\right)$ indicates the geographical location of chemical reaction at t_s and t_{s-1} time.

For enlightening QoS, bandwidth is a considerable variable i.e., managed as third term F_3. To describe the bandwidth levels, the ABE technique is exploited. ABE generalized channel witnessing to evaluate the tenancy ratio of node with removed emission, probability combination of value to coordinate node, computation of collision probabilities amongst different overheads, and the nodes.

$$F_3 = (1 - A).(1 - p_c).t_s.t_r.B \tag{9}$$

Consider A represents excessive overheads due to dual exponential back-off methodology and p_c denotes the collision possibility of hello packet. t_s and t_r denotes the idle time of receiver and transmitter ends. B specifies the proficiency of connections between receiver and transmitter. The latter constituent F_4 offers a degree based on the chemical reaction. Next, F_4 is defined by the subsequent formula

$$F_4 = \left|N_{deg}\right| \tag{10}$$

In Eq. (10), $\left|N_{deg}\right|$ denotes the amount of neighboring IoT. The IoT positioned nearer to the optimal position is designated as transmission IoT for communication.

4. Results and Discussion

This section inspects the result analysis of the MOCRS-IoTMEC model with other models.

Table 1 and Fig. 2 reports a brief ARE assessment of the MOCRS-IoTMEC model with other models. The results highlighted that the MOCRS-IoTMEC model has demonstrated enhanced performance with maximum values of ARE. For instance, with 3000 rounds, the MOCRS-IoTMEC model has provided increased ARE of 1J whereas the CBR-ICWSN, PSO, GWO, CS, and CCP-IC models have obtained reduced ARE of 0.995J, 0.982J, 0.965J, 0.966J, and 0.906J respectively. Also, with with 6000 rounds,

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the MOCRS-IoTMEC model has provided increased ARE of 0.951J whereas the CBR-ICWSN, PSO, GWO, CS, and CCP-IC models have obtained reduced ARE of 0.807J, 0.666J, 0.255J, 0.227J, and 0.156J respectively. Along with that, with 15000 rounds, the MOCRS-IoTMEC model has provided increased ARE of 0.521J whereas the CBR-ICWSN, PSO, GWO, CS, and CCP-IC models have obtained reduced ARE of 0.308J, 0.192J, 0.025J, 0.005, and 0.000 respectively.

Table 1: ARE Assessment of MOCRS-IoTMEC with other models

Average Residual Energy (J)						
No. of Rounds	**MOCRS-IoTMEC**	**CBR-ICWSN**	**PSO**	**GWO**	**CS**	**CCP-IC**
0	1.000	1.000	0.996	0.989	0.986	0.988
1000	1.000	1.000	0.995	0.982	0.979	0.973
2000	1.000	1.000	0.990	0.977	0.976	0.955
3000	1.000	0.995	0.982	0.965	0.966	0.906
4000	1.000	0.985	0.975	0.857	0.916	0.807
5000	0.998	0.984	0.969	0.782	0.858	0.593
6000	0.993	0.979	0.968	0.554	0.505	0.430
7000	0.989	0.903	0.885	0.456	0.406	0.326
8000	0.987	0.856	0.755	0.324	0.305	0.236
9000	0.951	0.807	0.666	0.255	0.227	0.156
10000	0.924	0.706	0.486	0.200	0.106	0.116
11000	0.885	0.653	0.324	0.158	0.105	0.037
12000	0.835	0.605	0.305	0.129	0.005	0.006
13000	0.795	0.506	0.257	0.106	0.025	0.005
14000	0.661	0.405	0.218	0.057	0.007	0.008
15000	0.521	0.308	0.192	0.025	0.005	0.000
16000	0.432	0.208	0.121	0.008	0.000	0.000
17000	0.221	0.076	0.008	0.006	0.000	0.000
18000	0.152	0.058	0.000	0.000	0.000	0.000
19000	0.082	0.020	0.000	0.000	0.000	0.000
20000	0.000	0.000	0.000	0.000	0.000	0.000

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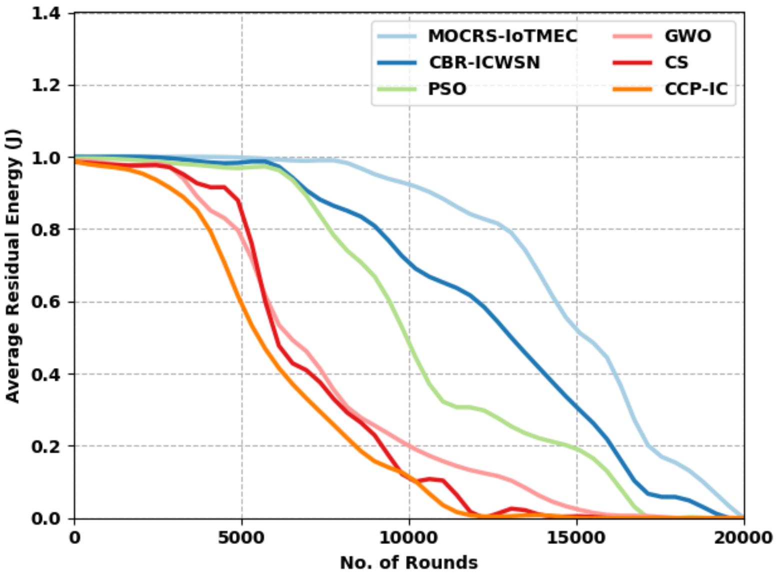

Figure 2: Comparative ARE Assessment of MOCRS-IoTMEC with other models

Table 2 and Fig. 3 reports a NOAN assessment of the MOCRS-IoTMEC model with other models. The results highlighted that the MOCRS-IoTMEC approach has demonstrated enhanced performance with minimal values of NOAN. For example, with 3000 rounds, the MOCRS-IoTMEC model has provided increased NOAN of 985 whereas the CBR-ICWSN, PSO, GWO, CS, and CCP-IC models have obtained reduced NOAN of 976, 970, 922, 916, and 925 correspondingly. Also, with with 6000 rounds, the MOCRS-IoTMEC model has provided increased NOAN of 895 whereas the CBR-ICWSN, PSO, GWO, CS, and CCP-IC models have gained reduced NOAN of 814, 6869, 399, 217, and 85 respectively. Along with that, with 15000 rounds, the MOCRS-IoTMEC technique has provided increased NOAN of 610 whereas the CBR-ICWSN, PSO, GWO, CS, and CCP-IC models have reached reduced NOAN of 270, 160, 19, 8, and 0 correspondingly.

Table 2: NOAN Assessment of MOCRS-IoTMEC with other models

No. of Alive Nodes						
No. of Rounds	**MOCRS-IoTMEC**	**CBR-ICWSN**	**PSO**	**GWO**	**CS**	**CCP-IC**
0	1000	1000	1000	1000	1000	1000
1000	1000	996	985	974	965	954
2000	1000	991	979	948	953	920
3000	985	976	970	922	916	925
4000	976	975	961	899	889	756
5000	971	962	952	754	633	558
6000	949	915	943	646	483	402
7000	912	875	893	563	408	364
8000	903	874	751	394	287	176
9000	895	814	686	399	217	85
10000	880	695	481	250	148	88
11000	816	668	339	183	160	38
12000	765	622	299	164	65	46
13000	727	473	261	154	49	14
14000	651	488	237	46	21	2
15000	610	270	160	19	8	0

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16000	510	252	76	15	0	0
17000	354	124	32	10	0	0
18000	268	45	0	0	0	0
19000	59	24	0	0	0	0
20000	0	0	0	0	0	0

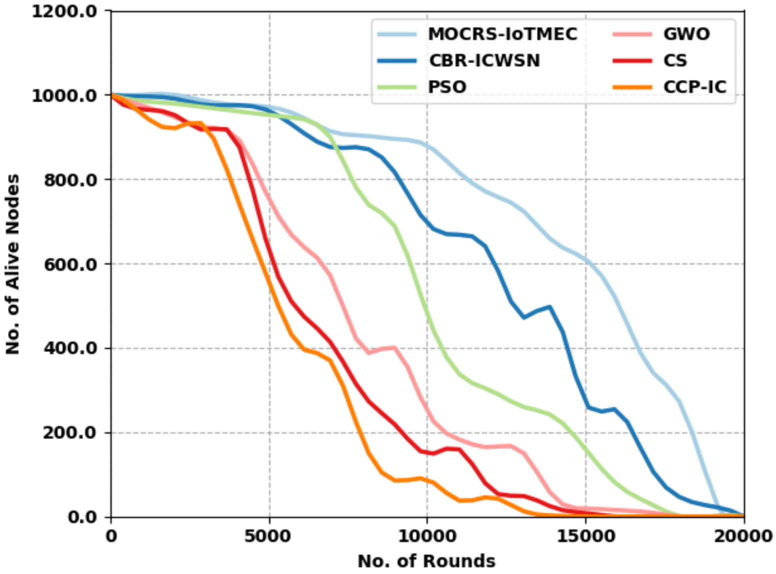

Figure 3: Comparative NOAN Assessment of MOCRS-IoTMEC with other models

A brief network lifetime (NLT) inspection of the MOCRS-IoTMEC model is compared with other models in Table 3 and Fig. 4. Based on FND, the MOCRS-IoTMEC model has offered increased FND of 2950 rounds whereas the CBR-ICWSN, PSO, GWO, CS, and CCP-IC models have obtained reduced FND of 997, 867, 851, 750, and 726 rounds respectively. Besides, based on HND, the MOCRS-IoTMEC model has offered increased HND of 15950 rounds whereas the CBR-ICWSN, PSO, GWO, CS, and CCP-IC models have obtained reduced HND of 12856, 9850, 6462, 5700, and 4389 rounds respectively.

Table 3: NLT Assessment of MOCRS-IoTMEC with other models

Network lifetime (in rounds)						
No. of Dead Nodes	**MOCRS-IoTMEC**	**CBR-ICWSN**	**PSO**	**GWO**	**CS**	**CCP-IC**
FND	2950	997	867	851	750	726
HND	15950	12856	9850	6462	5700	4389
LND	19657	19356	17500	17100	15168	14100

Table 4 and Fig. 5 reports an ADEL assessment of the MOCRS-IoTMEC method with other models. The results highlighted that the MOCRS-IoTMEC model has established enhanced performance with minimal values of ADEL. For instance, with 100 nodes, the MOCRS-IoTMEC technique has provided decreased ADEL of 62ms whereas the CBR-ICWSN, PSO, GWO, CS, and CCP-IC models have obtained increased ADEL of 85ms, 137ms, 119ms, 104ms, and 94ms correspondingly. Moreover, with 600 nodes, the MOCRS-IoTMEC model has provided lower ADEL of 113ms whereas the CBR-ICWSN, PSO, GWO, CS, and CCP-IC models have gained higher ADEL of 136ms, 184ms, 179ms, 167ms, and 138ms correspondingly. Similarly, with 1000 nodes, the MOCRS-IoTMEC model has provided reduced ADEL of 117ms whereas the CBR-ICWSN, PSO, GWO, CS, and CCP-IC models have reached improved ADEL of 150ms, 234ms, 220ms, 187ms, and 160ms correspondingly.

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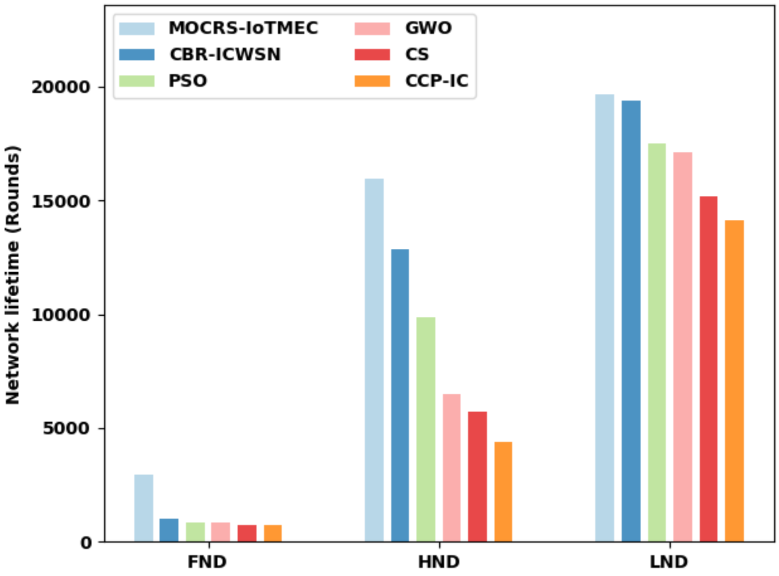

Figure 4: Comparative Lifetime Assessment of MOCRS-IoTMEC with other models

Table 4: ADEL Assessment of MOCRS-IoTMEC with other models

Average delay (ms)						
No. of nodes	**MOCRS-IoTMEC**	**CBR-ICWSN**	**PSO**	**GWO**	**CS**	**CCP-IC**
100	62	85	137	119	104	94
200	88	104	140	131	126	108
300	88	109	143	144	136	124
400	102	119	165	152	148	133
500	107	136	170	164	149	133
600	113	136	184	179	167	138
700	109	126	182	180	173	154
800	125	145	197	199	185	156
900	121	148	231	202	187	158
1000	117	150	234	220	187	160

Table 5 and Fig. 6 reports a PLR assessment of the MOCRS-IoTMEC model with other models. The results highlighted that the MOCRS-IoTMEC model has demonstrated enhanced performance with minimum values of PLR. For example, with 100 nodes, the MOCRS-IoTMEC method has offered decreased PLR of 0.052 whereas the CBR-ICWSN, PSO, GWO, CS, and CCP-IC techniques have obtained increased PLR of 0.078, 0.233, 0.195, 0.179, and 0.156 respectively. Also, with 600 nodes, the MOCRS-IoTMEC method has provided lower PLR of 0.097 whereas the CBR-ICWSN, PSO, GWO, CS, and CCP-IC models have reached higher PLR of 0.136, 0.368, 0.318, 0.263, and 0.202 correspondingly. Also, with 1000 nodes, the MOCRS-IoTMEC method has provided reduced PLR of 0.166 whereas the CBR-ICWSN, PSO, GWO, CS, and CCP-IC models have obtained improved PLR of 0.206, 0.412, 0.392, 0.350, and 0.257 correspondingly.

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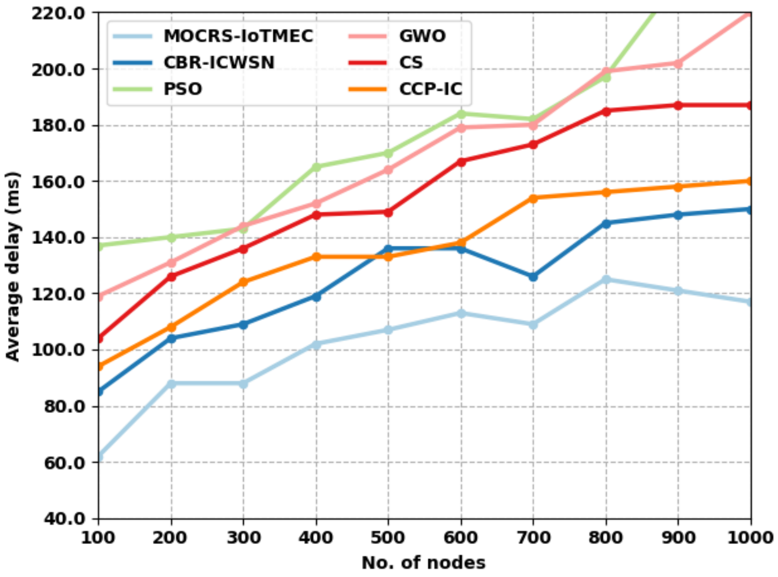

Figure 5: Comparative ADEL Assessment of MOCRS-IoTMEC with other models

Table 5: PLR Assessment of MOCRS-IoTMEC with other models

Packet Loss Rate						
No. of nodes	**MOCRS-IoTMEC**	**CBR-ICWSN**	**PSO**	**GWO**	**CS**	**CCP-IC**
100	0.052	0.078	0.233	0.195	0.179	0.156
200	0.041	0.068	0.270	0.217	0.179	0.173
300	0.062	0.099	0.286	0.213	0.187	0.198
400	0.090	0.116	0.316	0.254	0.249	0.207
500	0.072	0.096	0.320	0.253	0.249	0.213
600	0.097	0.136	0.368	0.318	0.263	0.202
700	0.096	0.124	0.370	0.322	0.284	0.234
800	0.131	0.154	0.383	0.349	0.329	0.228
900	0.144	0.181	0.415	0.352	0.330	0.256
1000	0.166	0.206	0.412	0.392	0.350	0.257

Table 6 and Fig. 7 reports a PDR assessment of the MOCRS-IoTMEC model with other models. The results highlighted that the MOCRS-IoTMEC model has established enhanced performance with maximal values of PDR. For example, with 100 nodes, the MOCRS-IoTMEC system has rendered improved PDR of 0.948 whereas the CBR-ICWSN, PSO, GWO, CS, and CCP-IC models have obtained reduced PDR of 0.922, 0.767, 0.805, 0.821, and 0.844 respectively. Additionally, with 600 nodes, the MOCRS-IoTMEC model has provided increased PDR of 0.904 whereas the CBR-ICWSN, PSO, GWO, CS, and CCP-IC models have obtained reduced PDR of 0.865, 0.632, 0.682, 0.737, and 0.798 correspondingly. Besides, with 1000 nodes, the MOCRS-IoTMEC model has provided increased PDR of 0.834 whereas the CBR-ICWSN, PSO, GWO, CS, and CCP-IC models have obtained reduced PDR of 0.794,0.588, 0.608, 0.650, and 0.743 correspondingly.

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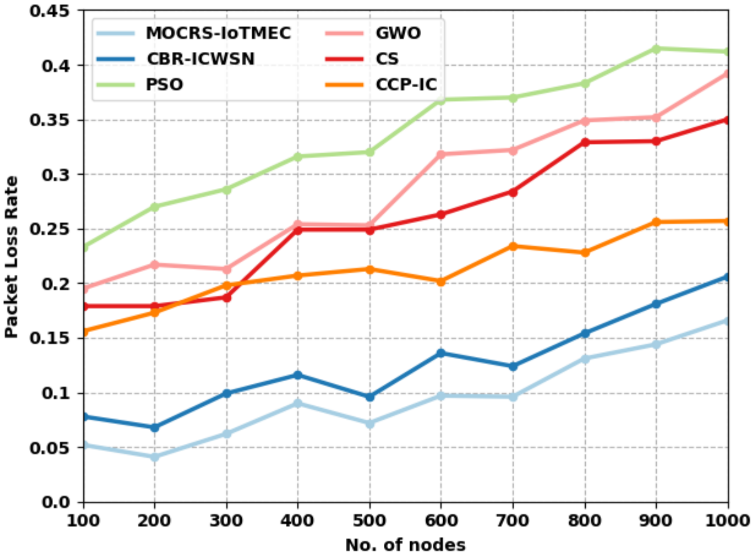

Figure 6: Comparative PLR Assessment of MOCRS-IoTMEC with other models

Table 6:PDR Assessment of MOCRS-IoTMEC with other models

Packet Delivery Ratio						
No. of nodes	**MOCRS-IoTMEC**	**CBR-ICWSN**	**PSO**	**GWO**	**CS**	**CCP-IC**
100	0.948	0.922	0.767	0.805	0.821	0.844
200	0.960	0.933	0.730	0.783	0.821	0.827
300	0.938	0.901	0.714	0.787	0.813	0.802
400	0.911	0.885	0.684	0.746	0.751	0.793
500	0.929	0.905	0.680	0.747	0.751	0.787
600	0.904	0.865	0.632	0.682	0.737	0.798
700	0.905	0.877	0.630	0.678	0.716	0.766
800	0.870	0.847	0.617	0.651	0.671	0.772
900	0.856	0.819	0.585	0.648	0.670	0.744
1000	0.834	0.794	0.588	0.608	0.650	0.743

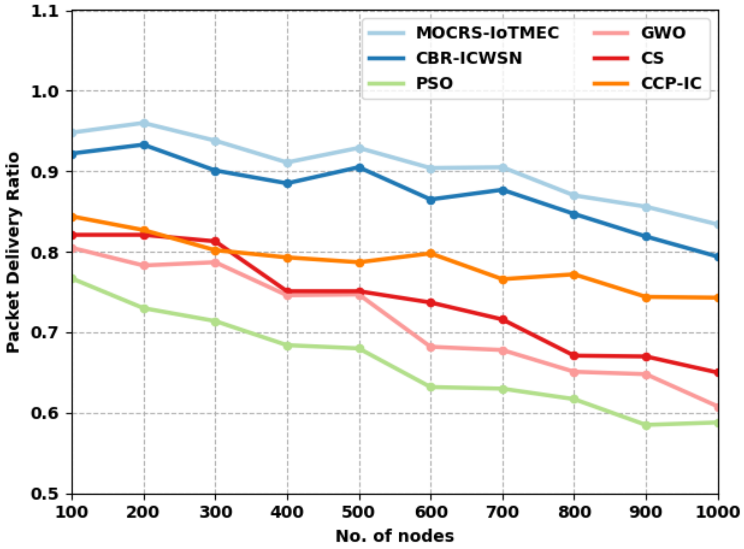

Figure 7: Comparative PDR Assessment of MOCRS-IoTMEC with other models

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5. Conclusion

This manuscript introduced a MOCRS-IoTMEC model for MEC paradigm. The projected MOCRS-IoTMEC model is mainly concentrated on the identification of optimal routes in the IoT assisted MEC environment by the use of pigeon inspired optimization (PIO) algorithm. Also, the LEACH protocol is applied to initially cluster the IoT devices. The PIO algorithm is applied to determine the fitness function to choose optimal routes. To depict the enhanced performance of the MOCRS-IoTMEC model, a detailed comparison study is made. The experimental outcome shows the enhanced performance of the MOCRS-IoTMEC method over other approaches.

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