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## Maximizing Solar Energy Efficiency Through Grasshopper Algorithm- Based Site Selection



**Abstract:** - This paper gives optimal placement of solar power plant in IEEE 57-bus\_e system\_e for voltage stability. The recitation learning of PV\_E is carried out in IEEE 57-bus\_e test system\_e for the development of voltage\_e stability through MATPOWER. When a power device is going through unexpected loading, its balance is affected. It needs reimbursement to improve the steadiness from the disorders. Here, the machine is analyzed by using CPF to enhance the steadiness. Various operating situations like without PV\_E, with PV system using PSO and with placement of PV\_E (by using Grasshopper algorithm) are used to evaluate the overall recital of the suggested system\_e. The results show that the device with PV\_E (tuned with the aid of Grasshopper) displays top result than the device without PV\_E and with PV system placement by PSO.

**Keywords:** PV cell, MATPOWER, voltage stability, CPF, Grasshopper algorithm, PSO

### I. INTRODUCTION

Rejuvenation fashions a fresh trend in the world. Fresh skills ease the rate of the system\_e and bounce more features in systems. It is being all grounds. In Power system\_e, fresh skills spread an uprising updating it. Photo volt photovoltaic are the up-to-devices which are rethatd in many aspects like power quality, stability. In this paper, voltage\_e stability of a multi apparatus system\_e is scrutinized by applying PV\_E theto cell. The proficiency of the device is advanced whilst it uses PV\_E mobile. The foremost gain of the PV\_E cell is their brief response to the device's balance recovery. Among numerous devices PV\_E cellular a is a greater reliable device. In PV\_E mobile, there is no transferring detail and rotating detail. In this take a look, PV\_E mobile is used to decorate the maximum load\_e capability parameter and voltage\_e stability.

Voltage\_e stability upgrading is achieved by using many repayment devices even if the machine undergoes fault. DG devices and the breeze forms' position are also used to gain the voltage\_e solidity. It is enlightened in some papers [1], [2], [3] and [4].

In a few studies works, how the aggregate of Energy Storage System (ESS) and STATCOM boost the steadiness, is enlightened [5]. Modal evaluation and continuation of electric city glide is used to analyze the combination of Energy Storage System (ESS) and STATCOM. Nearest Centroid Classification (NCC) approach based on supervised machine learning with the goal of spotting new app problems via review analysis [17]. In some studies, and papers works, foremost power float analysis is used for the voltage\_e solidity enrichment [6], [7], [8] and [9]. It is important to select the energy-efficient cluster head for maintaining the cluster structure and balance the load effectively [13] and [16]. To balance the resource consumption weight based leader election model is used, which elected an optimal collection of leaders to minimize the overall resource consumption [14] and [15].

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## II. PHOTO VOLTAIC SYSTEM\_E

A sun mobile, or photovoltaic mobile, is an electrical tool that converts the energy\_e of mild immediately into strength by using the photovoltaic influence, that's a physical and chemical phenomenon. It is a form of photoelectric mobile, defined as a device whose electrical traits, together with modern, voltage\_e, or resistance, vary while exposed to mild. Individual sun mobile gadgets can be combined to form modules, otherwise known as solar panels. The commonplace intersection of sun cellular can produce a maximum open-circuit voltage\_e of about 0.5 to 0.6 volts. Cosmological chambers are described as being photovoltaic, irrespective of whether or not the supply is sunlight or an aesthetic mild. In addition to producing energy\_e, they may be used as photo light detectors for example infrared detectors), detecting light or another electromagnetic emission close to the visible variety, or measuring light intensity.

## III. CONTI. POWER FLOW

The Conti. Power drift [10], [11] is an influential tool that is employed to investigate the voltage\_e balance and most load\_e proficiency of electricity system\_e. Forecast The forecasted corrector step is used to invest investigating system\_e. The important factor or most point presents the most loading of the machine. It is also entitled as fall or most point. Beyond this point, the gadgadget' ability will collapse. It is proven in fig.1.The PV\_E mobile has a dominant impact on ton voltage\_e profile, actual energy\_e, reactive energy\_e and balance of the gadget. This paper inspects the impact of PV\_e on load\_e capacity and balance within the IEEE 57.

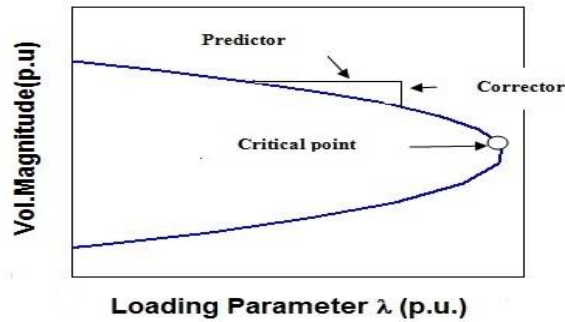


Fig. 1 CPF curve Nomenclature Bus\_e-bus Energy\_e-energy Load\_e\_e-load Pv\_e-pv System\_e-system Voltage\_e-voltage GH-Grasshopper PSO-particle swarm optimization

## IV. FITNESS FUNCTION

The independent purpose is to maximize the extreme loading parameter. It is used to raise the extreme load\_e ability. The fitness function,

$$\text{Fitness} = \max(\lambda) \quad \text{--} \quad (1)$$

Here, real power injection is chosen to tune as per the algorithmic procedure. Table I and II gives GH parameters.

Table I Parameter boundaries

Location Detail.	Real power at bus_e (in MW)
Low. bound	1
Up. bound	5

## V. GRASSHOPPER ALGORITHM

Grasshopper [12] are bugs. They are considered a pest due to their harm to crop production and agriculture. Although grasshoppers are generally visible in my opinion in nature, they be part of in one in all the largest swarm of all creatures.

**Pseudo code:**

Step1: Initialize the swarm  $X_i$  ( $i=1, 2, 3, \dots, n$ )

Step 2: Initialize cmax, cmin and maximum no. of iterations  
 Step 3: calculate the fitness of each search agent (T= the best search agent)  
 Step 4: if  $l < \text{max no. of iterations}$  , update c  
 Step 5: Normalize the distance between the grasshoppers  
 Step 6: update the position of the current search agent  
 Step 7: update T if there is better solution  
 Step 8:  $l=l+1$

Table II Optimal solutions of the Grasshopper algorithm and PSO

PSO	Grasshopper Algorithm
29	30

VI. LEARNING OF IEEE 57 BUS\_E TEST SYSTEM\_E

The CPF simulations are prepared in MATPOWER software which is used to work out and plot the displays of the system\_e. The effectiveness of the PV\_E can be appraised through the system\_e. The PV\_E has been applied at bus\_e 30 of IEEE 57 bus\_e system\_e.

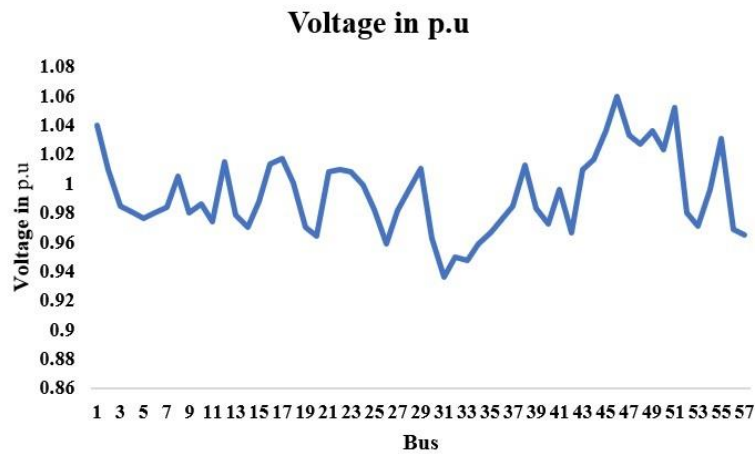


Fig.2.voltage\_e magnitude sketch of the system\_e without PV\_E

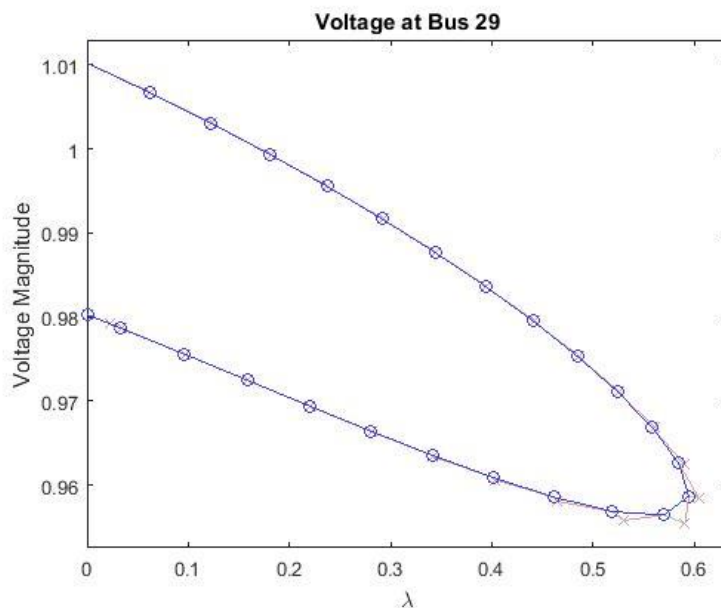


Fig.3 Load ability of the system\_e without PV\_E

The voltage sketch of the system without PV is shown in fig.2. The load ability curve displays are shown in fig.3. The considerations of the system without PV are shown in table III.

Table III System Without considerations with PV cell (GH)

Bus_e	V	phase
	[p.u.]	[rad]
Bus_e 1	1.04	0
Bus_e 2	1.01	-1.1882
Bus_e 3	0.985	-5.9881
Bus_e 4	0.9808	-7.3374
Bus_e 5	0.9765	-8.5464
Bus_e 6	0.98	-8.6741
Bus_e 7	0.9842	-7.6014
Bus_e 8	1.005	-4.4779
Bus_e 9	0.98	-9.5847
Bus_e 10	0.9862	-11.4497
Bus_e 11	0.974	-10.1932
Bus_e 12	1.015	-10.4712
Bus_e 13	0.9789	-9.8035
Bus_e 14	0.9702	-9.3503
Bus_e 15	0.988	-7.1902
Bus_e 16	1.0134	-8.8589
Bus_e 17	1.0175	-5.3959
Bus_e 18	1.0007	-11.7296
Bus_e 19	0.9702	-13.2265
Bus_e 20	0.9638	-13.4443
Bus_e 21	1.0085	-12.929
Bus_e 22	1.0097	-12.8743
Bus_e 23	1.0083	-12.9396
Bus_e 24	0.9992	-13.2921
Bus_e 25	0.9825	-18.1732
Bus_e 26	0.9588	-12.9813
Bus_e 27	0.9815	-11.5136
Bus_e 28	0.9967	-10.4816
Bus_e 29	1.0102	-9.7718
Bus_e 30	0.9627	-18.7196
Bus_e 31	0.9359	-19.3838
Bus_e 32	0.9499	-18.5123
Bus_e 33	0.9476	-18.552
Bus_e 34	0.9592	-14.149
Bus_e 35	0.9662	-13.9062
Bus_e 36	0.9758	-13.6348

Bus_e 37	0.9849	-13.4459
Bus_e 38	1.0128	-12.7346
Bus_e 39	0.9828	-13.491
Bus_e 40	0.9728	-13.6582
Bus_e 41	0.9962	-14.0767
Bus_e 42	0.9665	-15.5328
Bus_e 43	1.0096	-11.3544
Bus_e 44	1.0168	-11.8565
Bus_e 45	1.036	-9.2701
Bus_e 46	1.0598	-11.1161
Bus_e 47	1.0333	-12.5116
Bus_e 48	1.0274	-12.6107
Bus_e 49	1.0362	-12.9361
Bus_e 50	1.0233	-13.4127
Bus_e 51	1.0523	-12.5334
Bus_e 52	0.9804	-11.4976
Bus_e 53	0.9709	-12.2526
Bus_e 54	0.9963	-11.7097
Bus_e 55	1.0308	-10.8011
Bus_e 56	0.9684	-16.0651
Bus_e 57	0.9648	-16.5837

VII. WITH PV\_E CELL (TUNED BY PSO)

The voltage\_e sketch load\_e ability curve of the system\_e (PSO) is shown in figure 4,5 and 6. The voltage sketch and load ability curve (PSO) displays are shown in fig.7 and 8. The considerations of the system\_e with PV\_E are shown in Table IV.

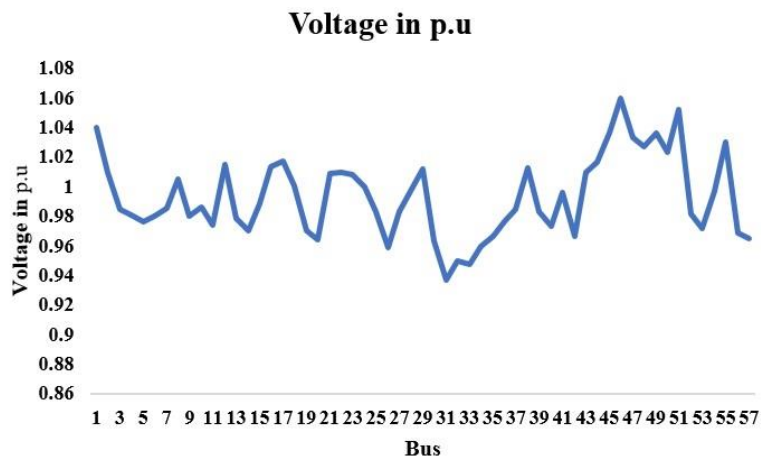


Fig.4 Voltage\_e sketch of the system\_e with PV\_E (tuned by PSO)

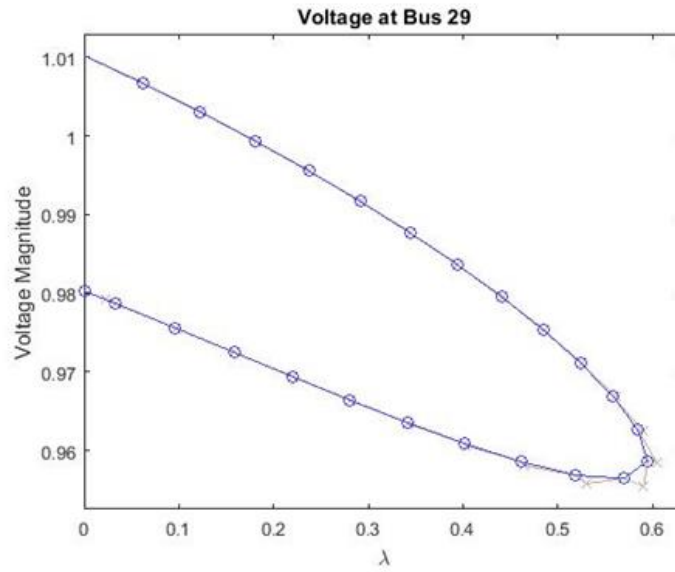


Fig.5 Load ability of the system\_e with PV\_E

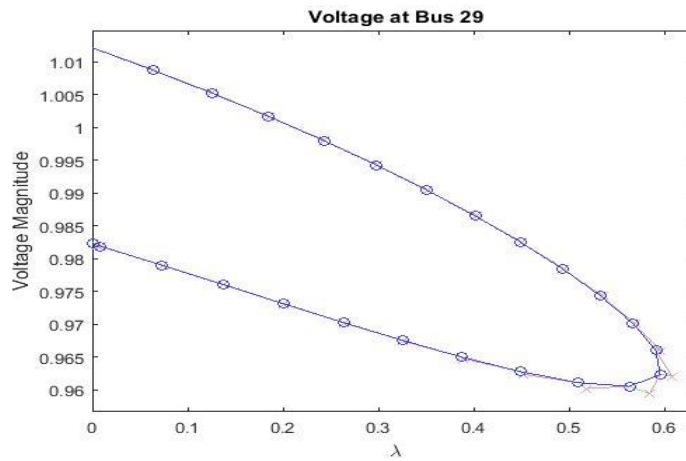


Fig.6 Load ability of the system\_e with PV\_E(PSO)

Table IV System\_e considerations with PV\_E cell (GH)

Bus_e	V	phase
	[p.u.]	[rad]
Bus_e 1	1.0400	0.0000
Bus_e 2	1.0100	-1.1338
Bus_e 3	0.9850	-5.7594
Bus_e 4	0.9808	-7.0603
Bus_e 5	0.9765	-8.2015
Bus_e 6	0.9800	-8.2963
Bus_e 7	0.9850	-7.1437
Bus_e 8	1.0050	-4.0699
Bus_e 9	0.9800	-9.2079
Bus_e 10	0.9864	-11.1053
Bus_e 11	0.9746	-9.8336
Bus_e 12	1.0150	-10.1955
Bus_e 13	0.9796	-9.4807
Bus_e 14	0.9713	-9.0275
Bus_e 15	0.9888	-6.9405
Bus_e 16	1.0136	-8.6618
Bus_e 17	1.0177	-5.2934
Bus_e 18	1.0010	-11.4061
Bus_e 19	0.9727	-12.7950

Bus_e 20	0.9675	-12.9432
Bus_e 21	1.0130	-12.2876
Bus_e 22	1.0146	-12.2167
Bus_e 23	1.0137	-12.2475
Bus_e 24	1.0138	-12.0223
Bus_e 25	1.0027	-14.2475
Bus_e 26	0.9724	-11.8023
Bus_e 27	0.9879	-10.7276
Bus_e 28	1.0002	-9.8386
Bus_e 29	1.0119	-9.2100
Bus_e 30	0.9934	-13.9309
Bus_e 31	0.9590	-15.3989
Bus_e 32	0.9599	-15.8790
Bus_e 33	0.9576	-15.9178
Bus_e 34	0.9685	-13.1534
Bus_e 35	0.9739	-13.0371
Bus_e 36	0.9821	-12.8515
Bus_e 37	0.9903	-12.7161
Bus_e 38	1.0167	-12.1395
Bus_e 39	0.9882	-12.7642
Bus_e 40	0.9789	-12.8804
Bus_e 41	0.9980	-13.5989
Bus_e 42	0.9695	-15.0127
Bus_e 43	1.0106	-10.9638
Bus_e 44	1.0199	-11.3323
Bus_e 45	1.0373	-8.8921
Bus_e 46	1.0613	-10.7039
Bus_e 47	1.0355	-12.0169
Bus_e 48	1.0301	-12.0892
Bus_e 49	1.0381	-12.4577
Bus_e 50	1.0246	-12.9737
Bus_e 51	1.0525	-12.1650
Bus_e 52	0.9816	-10.9732
Bus_e 53	0.9720	-11.7497
Bus_e 54	0.9968	-11.2606
Bus_e 55	1.0308	-10.4010
Bus_e 56	0.9725	-15.5051
Bus_e 57	0.9695	-15.9922

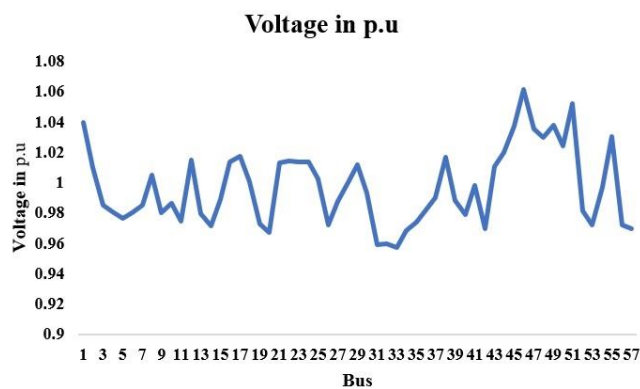


Fig.7 voltage sketch of the system\_e bus\_e with PV\_E (tuned by GH)

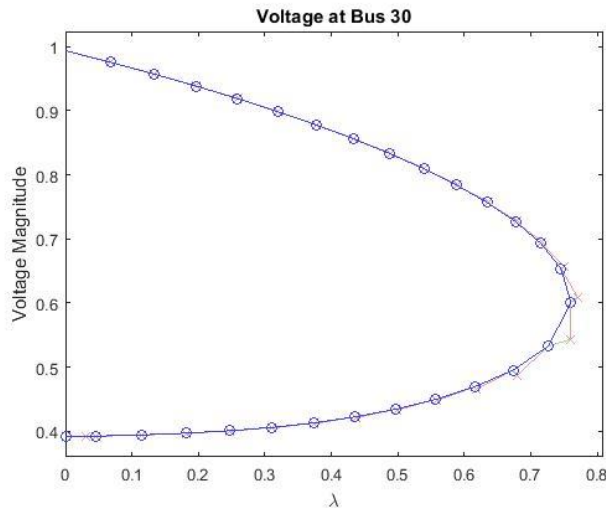


Fig.8 Load\_e ability curve of the system\_e bus\_e 92 with PV\_E (tuned by GH)

Table V Comparison of Loading parameter

Method	Maximum Loading parameter
	[p.u]
Without PV_E	<b>0.4611</b>
With PV_E (GH)	<b>0.7605</b>
With PV_E (PSO)	<b>0.5955</b>

The system\_e with PV\_E cell (GH) has given the best Result (table IV) than the system\_e without PV\_E cell & PSO based system. It is shown in table V.

VIII. CONCLUSION

The voltage\_e steadiness of the system\_e using PV\_E cell is investigated through the continuation power flow simulations. The suggested algorithm is used to find best placement of bus for the PV system. The Grasshopper Algorithm process has improved the voltage\_e stability than the system\_e without PV\_E. It improves the maximum loading parameter. By appropriate placement of the PV\_E system using the Grasshopper algorithm, voltage\_e steadiness of the system\_e is settled.

ACKNOWLEDGMENT

The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression, “One of us (R.B.G.) thanks . . .” Instead, try “R.B.G. thanks”. Put applicable sponsor acknowledgments here; DO NOT place them on the first page of your paper or as a footnote.

REFERENCES

[1] S.Remha, S.Chettih, S.Arif, “Optimal placement of different DG units type in distribution networks based on voltage\_e stability maximization and minimization of power losses”. 8th International Conference on Modelling, Identification and Control (ICMIC), 2016.

[2] Adriatic Arief; Muhammad Bachtiar Nappu, “DG placement and size with continuation power flow method”. International Conference on Electrical Engineering and Informatics (ICEEI), 2015.

[3] Oum El Fadhel Loubaba Bekri, Mohamed Karim Fellah, “Placement of wind farms for enhancing voltage\_e stability based on continuation power flow technique”. 3rd International Renewable and Sustainable Energy\_e Conference (IRSEC), 2015.

- [4] M.S.V.Phanikumar, P.Kanta Rao .“Comparison of voltage\_e stability and loss reduction by Modal analysis and Sensitivity methods”. Journal of electrical engineering, Volume 16, 2016.
- [5] Advanced Jalali; Mohammad Aldeen,“Placement and operation of STATCOM-storage for voltage\_e stability enhancement of power system\_es with embedded wind farms”.
- [6] Venkateswara Rao Bathina, Venkata Nagesh Kumar Gundavarapu “Firefly Algorithm based Optimal Power Flow for Sizing of Thyristor Controlled Series Capacitor to enhance line based voltage\_e stability”.Journal of electrical engineering, Volume 16, 2016.
- [7] Sung-Hwan Song, Jung-Uk Lim, Seung-II Moon, “FACTS operation scheme for enhancement of power system\_e security,”. IEEE Bologna Power Tech Conference, Vol. 3, pp. 36-41, June 2003.
- [8] R. benabid, M. Boudoir, M.A. Abido, “Optimal location and setting of SVC and TCSC devices using nondominated sorting particle swarm optimization”.Electric Power System\_es Research 79, 1668-1677, July 2009.
- [9] Anwar S. Siddiqui, Tanmoy Deb,” Voltage\_e Stability Improvement using STATCOM and SVC”. International Journal of Computer Applications, Volume 88 – No.14, February 2014.
- [10] ElFadil Zakaria, Kamal Ramadan, Dalia Eltigani “Method of computing maximum load\_eability, using continuation power flow, case study Sudan national grid”. International Conference on Computing, Electrical and Electronics Engineering (ICCEEE), 2013.
- [11] Ahvandjalali, Mohammadaldeen, “Novel Continuation Power Flow algorithm”. International Conference on Power System\_e Technology (POWERCON), 2016.
- [12] S. Saremi, S. Mirjalili, and A. Lewis, “Grasshopper Optimisation Algorithm: Theory and application,” Advances in Engineering Software, vol. 105, pp. 30–47, Mar. 2017, doi: 10.1016/j.advengsoft.2017.01.004.
- [13] M Kaliappan, E Mariappan, MV Prakash, B Paramasivan, Load Balanced Clustering Technique in MANET using Genetic Algorithms. Defence Science Journal 66 (3), 251-258
- [14] GS Kumar, M Kaliappan, LJ Julus, Enhancing the Performance of MANET using EESCP, Pattern Recognition, Informatics and Medical Engineering (PRIME), 2012
- [15] S Vimal, YH Robinson, M Kaliappan, K Vijayalakshmi, S Seo , A method of progression detection for glaucoma using K-means and the GLCM algorithm toward smart medical prediction. The Journal of Supercomputing, PP.1-17
- [16] M Sivaram, M Kaliappan, SJ Shobana, MV Prakash, V Porkodi Secure storage allocation scheme using fuzzy based heuristic algorithm for cloud, Journal of Ambient Intelligence and Humanized Computing, pp.1-9.
- [17]. Geojini, G. & Muthusamy, Ramnath & Rubavathi, C.. (2023). Feature Adaptive Developmental Mechanisms for Mobile Apps Recommendations System using the Nearest Centroid Classification Algorithm. 1479-1485. 10.1109/ICOEI56765.2023.10125664.