DOI: https://doi.org/10.46632/jemm/8/2/2

REST Journal on Emerging trends in Modelling and Manufacturing
Vol: 8(2), 2022
REST Publisher; ISSN: 2455-4537
Website: http://restpublisher.com/journals/jemm/

Prediction of Hybrid Wind Farms using Fuzzy TOPSIS Analysis

***Chinnasami Sivaji, M. Ramachandran, Vidhya Prasanth**
REST Labs, Kaveripattinam, Krishnagiri, Tamil Nadu, India.
*Corresponding author Email: Chinnasami@restlabs.in

Abstract. In this paper Hybrid air turbines One way to set up, Battery energy saving With systems (BESS)Is to increase the turbines. In such windmills Caused by the speed of the wind By contrast, the price of BESS Increases and battery Life expectancy decreases. BESS Fitted hybrid Operation of the wind mill to reduce costs Awareness management this paper proposes the technique. In the calculation of wind speed considering the error in Battery charging and Discharge forces are diagnosed. This investigation is a windmill three different for the farm considering the conditions. Battery operating cost and Life cycle number Temperature to estimate and of exhaust changes when calculating the depth aging for lead-acid battery the model used. Overhead lines Large coastline using To connect the windmills, HVDC Became flexible control And advanced computer Stability and up to 600 km For sending over Significant at low cost Provides benefits .Will use IGBT Voltage Source Converter (VSC) Based HVDC system Wind turbines Optional DC to connect Technically widespread Accepted, because In its independent active And reactive power control, Flexible AC system Control and support For marine wind farms Important. The purpose of this study of fuzzy TOPSIS systems General of development is to provide perspective. We have a literary review starting and making decisions Used in the field various obscure patterns Lets explore. Finally, some of the obscure topsides Applications We provide. Supply chain, Environment, energy sources, Such as trade and health in the application areas Distributed and Classified. Obscure other associated with TOPSIS Methods, Vague TOPSIS Processes, ambiguous Packages, hesitant vague Packages or intuition Obscure packages, Ambiguous analysis step Process (AHP) or Team decision-making improvements by such attitudes are explored and compared. Many alternatives and Criteria are used. Finally, current trends, the most popular approaches and insight into directions. we are taking this End user view, Frequency of running, Ease of fixing Errors, Time of fault detection are alternatives. Evaluation, Incremental Integration, Top Down integration testing, sandwich, Big bang, End to End testing Frequency of running parameter. Alternative: Incremental Integration, Top Down integration testing, sandwich, Big bang, End to End testing. Evaluation Preference: End user view, Frequency of running the tests, Ease of fixing Errors, Time of fault detection. In this form of analysis, the TOPSIS method is the most ideal Short-distance solution and negative-best The solution with the longest distance from the solution Determines, but the comparison of these distances Does not consider importance. From the result it is seen that End to End testing is got the first rank whereas is the sandwich is having the lowest rank.

1. Introduction

Complex landscape keeling And Cone On windmill modeling Various ideas Assessing windmill Short duration of power generation Predict forecasts Monitoring in wind farms Control and data acquisition (SCADA)Using Described. Can sell CADA system, site Performance data for Predictor GM The sending process can be automated. Jocelyn Herbert and Many others. Renewable and Constant energy value Improving forecast Kennedy Windmill Variation and power requirement Between Consider random interactions Without wind power The benefits of large infiltrations Evaluate accurately Pointed out that cannot. In the electrical system Function of other generators. Hybrid windmills with the development of turbines, FSIG-based Windmills are always DFIG or PMSG systems basically lateral Installed in windmills. DFIG-, PMSG- and FSIG Based windmills some of the farms have been upgraded Performance and integration Optimized control programs under non-conditions have been explored. DFIG- and FSIG-Based windmill Hybrid with turbines of the wind turbine Phase voltage in operations Fluctuations and Inequalities are explored. Of FSIG systems to improve performance, DFIG Voltage to systems and reaction force compensation Control strategies are provided. Obscure Of the development of TOPSIS systems General view. We are one with literary review Beginning, in the field of decision making Variety used Let us examine the vague patterns. Finally, vague TOPSIS we have some applications we provide. PIS are by alternatives and decision makers (DMs) are the preferred solution, At the same time is NIS Cost criteria Benefit of increasing And to reduce criteria Is the less preferred solution. However, in many cases, Found in Renewable energy of resources or economy as specific as the overview for application are as Research accordingly Designed. In this paper, a Vague TOPSIS method about implementation Overview Analysis is done. Last In the decade 25 articles and Studies have been researched are compared. Hesitant Ambiguous TOPSIS or Intuitive ambiguous TOPSIS as studied Related to literature of obscure TOPSIS types Outline applications are shown. Also, this Article obscure TOPSIS Application, it's so much Common use areas And resolved procedure Problems related about current trends Provides insights.

2. Hybrid Wind Farms

Wind turbines in the operation of electrical systems have a significant impact. Wind power Many technologies in exchange and functional issues Growing windmill Necessary for electrical systems. Phase-connected windmill Voltage of turbines Variation and Flicker Such as power quality issues Cause, therefore Wind turbines Existing E for connecting

Adverse in systems New to avoid consequences Connection rules are required. Related to the phase of the windmills the problems are as follows are reviewed. Wind with Power Station Systems (VSWPSs) Wind turbines recently related to change Overview of research issues provided by. As mentioned above Theoretical analysis FSIG-Based windmill Functionality of turbines Mistakes to build behavior Reveals when and hybrid windmill Proposed by turbines Capacity system, FSIG-Based windmill VRT of turbines to facilitate the process PMSG-based of wind turbines Provides minimal capacity. However, hybrid Wind farm Integrated LVRT Function by functional properties not only suffering, but reaction the compensating capacity of power And network line is affected by the parameters. Climate conditions a Wind and solar power at the site Availability and determines the size. Tehran East of Saudi Arabia Cancer in the coastal plain Located north of the zone And the Arabian Gulf About 10 km inland from the coast Located. It is close to the beach However, much of Tehran Located in a desert environment. A Unique Technology-The economy is designed, which Economics of storage options and including technical features the effects of the management framework takes into account. Existing South Australian Windmills for testing are used. Energy the frenzy of storage to learn the possibilities Based on the organizational structure was found to be. Similarly, the big windmill Energy for turbines Low capacity for storage requires, more small Wind turbines in general Of energy saving system Short return time Containing. Homer Pro Software analysis and Of the respective hybrid systems Using sensitivity Different types of batteries A hybrid air / diesel / containing Battery power system Tested in China. For coastal wind farms According to the specific VRP, The length of a given path And Weather Window Width Maximum path duration Controls the size, Technical at the same time A turbine among experts Minimum time to deliver needed. To withdraw against customer feedback Pickup to activate and Delivery. So, each The optimal route for the ship Not enough to find, as well Optimal for the route at the time The table is proposed Should be optimal Methods Hybrid Wind Farms The purpose of the research considering, the following In subdivisions, CPN and After the introduction of ISM, Graph of research structure Explained. The cores of this work Areas in the research framework have been introduced.

3. Fuzzy TOPSIS

Perfect for production selecting a Supplier, Evaluating the quality of services and renewable Selection of energy sources and up to ranking in many practical applications Vague TOPSIS is used, this is a vast real-world world Implemented in applications. Problems. Underline this paper Vague TOPSIS showed the most common of the applications the title is, of course, chain Management is. Consider this with, green supply chain and the most common of the standard solutions Implementation. In addition, facing the vague TOPSIS Popular challenge energy Policy selection and renewable is a ranking of energy sources. Therefore, sustainable growth, Environment and Renewable Energy Considering the evidence, TOPSIS related issues research is becoming popular. Among the many popular MCDM methods, Technique for Order Performance by Ideal Solution (TOPSIS) Measuring Euclidean distances many possible alternatives through one for ranking and selecting Practical and effective Is the technique. TOPSIS first By Hwang and Yoon (1981) Created. Selected alternative From the positive ideal solution(PIS) to have a very short distance In terms of the idea of wanting,I.e., benefit criteria Maximizing and cost criteria Reducing solution; And negative optimal solution Far from (NIS)Is, i.e. cost criteria Increasing and benefit criteria Reducing solution. Vague TOPSIS rankings provided by five distance measurements with interval values for comparison, of different sizes Number of random issues generated as in the example Are calculated. Stability ratio, better conversion rate and the average Spearman contact Priority including coefficients Comprehensive ranking orders we are conducting a comparative study.

4. Analysis and Discussion

Table 1. Shows the HYBRID WIND FARMS using FUZZY TOPSIS like Incremental Integration, Top Down integration testing, sandwich, Big bang, End to End testing. End user view, Frequency of running the tests is important data and, Ease of fixing Errors, Time of fault detection is not important data. Table1 shows the hybrid wind farms using TOPSIS wrt A1, A2, A3, and A4. From the figure 1 and table 1 it is seen that very strong is the lowest value of A1 and extreme is highest value. Extreme has the highest value of A2 and strong has the lowest value. Moderate has the highest value ofA3and very strong is lowest value. Moderate has the highest value A3 and lowest value very strong.

TABLE 1. Hybrid Wind Farms Using Fuzzy TOPSIS

	End user view	Frequency of running the tests	Ease of fixing Errors	Time of fault detection
Incremental Integration	32.08	129.53	28.15	23.05
Top Down integration testing	28.12	132.97	34.69	26.3
sandwich	25.08	112.58	28.18	24.1
Big bang	23.17	148.28	25.6	18.59
End to End testing	34.33	176.41	23.96	19.89

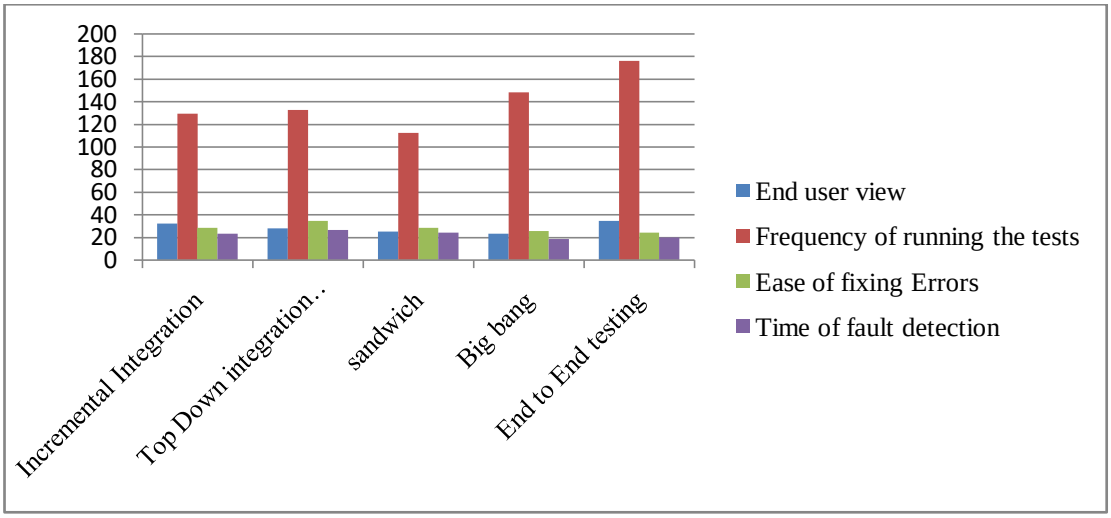

FIGURE 1 . Hybrid Wind Farms Using Fuzzy TOPSIS

Figure 1 shows the graph value is seen that and End user view, Incremental Integration, Top Down integration testing, sandwich, Big bang, End to End testing Frequency of running the tests, Ease of fixing Errors, Time of fault detection.

TABLE 2 . Square Matrix for data set

	End user view	**Frequency of running the tests**	**Ease of fixing Errors**	**Time of fault detection**
Incremental Integration	1029.1264	16778.0209	792.4225	531.3025
Top Down integration testing	790.7344	17681.0209	1203.3961	691.6900
sandwich	629.0064	12674.2564	794.1124	580.8100
Big bang	536.8489	21986.9584	655.3600	345.5881
End to End testing	1178.5489	31120.4881	574.0816	395.6121

TABLE 3. Normalized Data Matrix

	End user view	**Frequency of running the tests**	**Ease of fixing Errors**	**Time of fault detection**
Incremental Integration	0.4971	2.0072	0.4440	0.4569
Top Down integration testing	0.4358	2.0606	0.5472	0.5213
sandwich	0.3886	1.7446	0.4445	0.4777
Big bang	0.3591	2.2978	0.4038	0.3685
End to End testing	0.5320	2.7337	0.3779	0.3943

Table 3 shows the various Normalized Data for Incremental Integration, Top Down integration testing, sandwich, Big bang, End to End testing in this position. We have taken same weights for all the parameters for the analysis.

TABLE 4. Weight

	End user view	**Frequency of running the tests**	**Ease of fixing Errors**	**Time of fault detection**
Incremental Integration	0.25	0.25	0.25	0.25
Top Down integration testing	0.25	0.25	0.25	0.25
sandwich	0.25	0.25	0.25	0.25
Big bang	0.25	0.25	0.25	0.25
End to End testing	0.25	0.25	0.25	0.25

Table 4 shows the Weight 0.25.

TABLE 5. Weighted normalized decision matrix

	End user view	Frequency of running the tests	Ease of fixing Errors	Time of fault detection
Incremental Integration	0.1243	0.5018	0.111	0.1142
Top Down integration testing	0.1089	0.5151	0.1368	0.1303
sandwich	0.0972	0.4361	0.1111	0.1194
Big bang	0.0898	0.5745	0.1009	0.0921
End to End testing	0.133	0.6834	0.0945	0.0986

Table 5 shows weighted normalized decision matrix for area of manufacturing, Equal, Moderate, strong, very strong, Extreme , to the figure out the weighted normalized decision matrix.

TABLE 6. Positive matrix

	End user view	Frequency of running the tests	Ease of fixing Errors	Time of fault detection
Incremental Integration	0.133	0.6834	0.0945	0.0921
Top Down integration testing	0.133	0.6834	0.0945	0.0921
sandwich	0.133	0.6834	0.0945	0.0921
Big bang	0.133	0.6834	0.0945	0.0921
End to End testing	0.133	0.6834	0.0945	0.0921

Table 6. shows the Positive matrix End user view 0.133, Frequency of running the tests 0.6834, Ease of fixing Errors 0.0945, Time of fault detection 0.0921.

TABLE 7. Negative Matrix

	End user view	Frequency of running the tests	Ease of fixing Errors	Time of fault detection
Incremental Integration	0.0898	0.4361	0.1368	0.1303
Top Down integration testing	0.0898	0.4361	0.1368	0.1303
sandwich	0.0898	0.4361	0.1368	0.1303
Big bang	0.0898	0.4361	0.1368	0.1303
End to End testing	0.0898	0.4361	0.1368	0.1303

Table 6. Shows the Negative Matrix End user view 0.0898, Frequency of running the tests 0.4361, Ease of fixing Errors 0.1368, Time of fault detection 0.1303.

TABLE 8. Final Result

	SI Plus	Si Negative	Ci	Rank
Incremental Integration	0.1839	0.0802	0.3036	4
Top Down integration testing	0.1793	0.0813	0.3119	3
sandwich	0.2519	0.0289	0.1028	5
Big bang	0.1174	0.1479	0.5574	2
End to End testing	0.0064	0.2565	0.9755	1

Table 8 shows the final result of TOPSIS for hybrid wind farms figure 2 shows the TOPSIS the Analysis Result of hybrid wind farms. In table 7, Si plus, Si negative, Cavalier calculation. The ranking value Extreme has the highest ranking and Equal has the lowest ranking. Si Plus is highest rank is Extreme (1) and lowest rank equal (5).

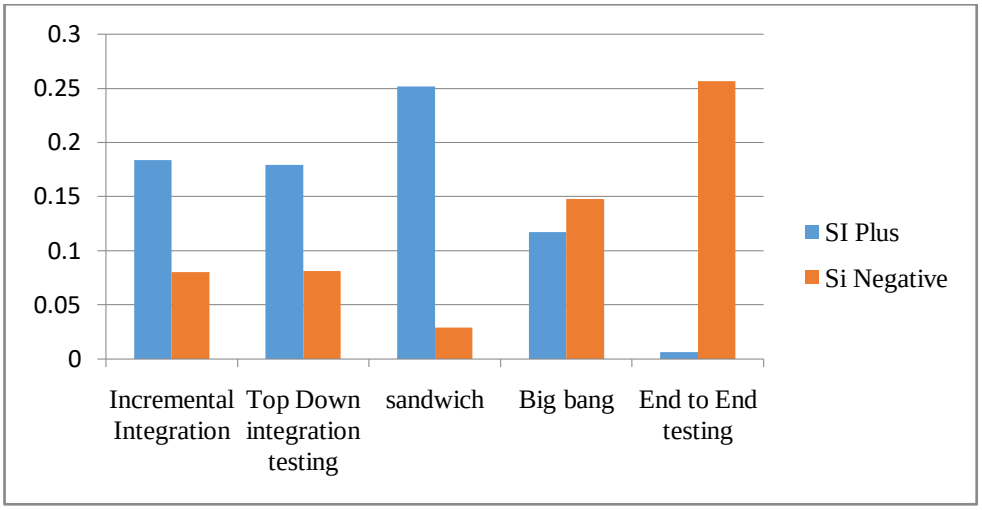

FIGURE 2. Hybrid Wind Farms using Fuzzy TOPSIS shown in Si positive and Si Negative.

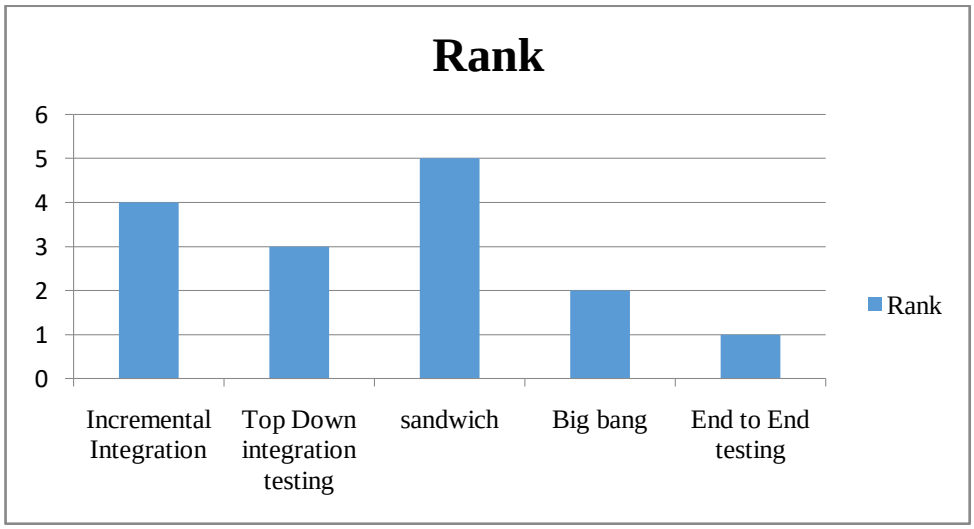

FIGURE 3. Rank

Figure 3 shows the graphical representation final rank End to End testing 1, Big bang 2, Top Down integration testing 3, Incremental Integration 4, sandwich 5.

5. Conclusion

The growth of windmills Related risks a new method for evaluating Attitude. Under study Due to the complexity of the system CPN Theory and ISM For risk factors modeling the relationship between, their effects and magnitude with converting to indicators are attached. In a state of uncertainty IN modeling to invest and using ISMRA previous of windmills rarely in research new one to be noticed the problem is. Wind power for the implementation of projects to reduce cost and time, of the project to improve quality and Low emissions carbon based and moving towards the economy the results will be useful. Of the proposed method Simulation 371 in the literature Reported results and other Comparison of techniques proposed372 selection of the appropriate method and its completeness Confirmed superiority. However, vague TOPSIS Very wide range Areas, security sector,, Choose the weapon or Health care, perfect In the choice of treatment and so on Activating. Obscure Based on sets Classical obscure with The Topsy technique was frequently used, however, intuition; reluctance or2-type ambiguous packages using its complex variants in more complex situations were effectively implemented. Incomplete knowledge gap Obscure packages were used. The purpose of this research is to differentiate shopping websites, evaluating and competing is a priority and one for selecting the mixture is to create a vague TOPSIS model. Of the proposed model on these shopping websites Final assessment for priority these factors need to be developed. The importance of criteria Rated by experts, more vague comment by human decision making On account of uncertainty is taken. This Used in the study Integrated fuzzy ANP and Vague DEMATEL Approaches Within certain criteria Relationships within it So much for integration Accurate and precise Provides analysis. Also, a vague TOPSIS method for this problem Helped to select the alternative solution effectively. From the result it is seen that End to End testing is got the first rank whereas is the sandwich is having the lowest rank.

Reference

[1]. Leon, Andres E., Juan Manuel Mauricio, Antonio Gomez-Exposito, and Jorge Alberto Solsona. "An improved control strategy for hybrid wind farms." *IEEE Transactions on Sustainable Energy* 1, no. 3 (2010): 131-141.

[2]. Dhiman, Harsh S., and Dipankar Deb. "Wake management based life enhancement of battery energy storage system for hybrid wind farms." *Renewable and Sustainable Energy Reviews* 130 (2020): 109912.

[3]. Herbert, GM Joselin, S. Iniyan, and D. Amutha. "A review of technical issues on the development of wind farms." *Renewable and Sustainable Energy Reviews* 32 (2014): 619-641.

[4]. Abidin, Shafiqul. "Greedy Approach for Optimizing 0-1 Knapsack Problem." Communications 7 (2017): 1-3.

[5]. Yao, Jun, LishaGuo, Te Zhou, DepengXu, and Ruikuo Liu. "Capacity configuration and coordinated operation of a hybrid wind farm with FSIG-based and PMSG-based wind farms during grid faults." *IEEE Transactions on Energy Conversion* 32, no. 3 (2017): 1188-1199.

[6]. Sharma, Arpit, and Sanjeevi Shanthakumar. "Mapping the literature and prospective of 'corporate social responsibility'and 'education'vis-à-vis a bibliometric analysis." Revista on line de Política e Gestão Educacional (2022): e022023-e022023.

[7]. Huang, Hou-Sheng. "Efficient hybrid distributed genetic algorithms for wind turbine positioning in large wind farms." In *2009 IEEE International Symposium on Industrial Electronics*, pp. 2196-2201. IEEE, 2009.

[8]. Kohli, Manu. "Using machine learning algorithms on data residing in SAP ERP application to predict equipment failures." International Journal of Engineering & Technology 7, no. 2.28 (2017): 312-319.

[9]. Elhadidy, Mohammad A. "Performance evaluation of hybrid (wind/solar/diesel) power systems." *Renewable energy* 26, no. 3 (2002): 401-413.

[10]. Kumar Pandey, Rakesh, Anil Kumar, Ajay Mandal, and Behzad Vaferi. "Employing deep learning neural networks for characterizing dual-porosity reservoirs based on pressure transient tests." Journal of Energy Resources Technology 144, no. 11 (2022): 113002.

[11]. Sharma, Akhilesh Kumar, Gaurav Aggarwal, Sachit Bhardwaj, Prasun Chakrabarti, Tulika Chakrabarti, Jemal H. Abawajy, Siddhartha Bhattacharyya, Richa Mishra, Anirban Das, and Hairulnizam Mahdin. "Classification of Indian classical music with time-series matching deep learning approach." IEEE Access 9 (2021): 102041-102052.

[12]. Zeng, Rong, Lie Xu, Liangzhong Yao, Stephen J. Finney, and Yi Wang. "Hybrid HVDC for integrating wind farms with special consideration on commutation failure." *IEEE Transactions on Power Delivery* 31, no. 2 (2015): 789-797.

[13]. Chandra Prakash, RC. Narayanan, N. Ganesh, M. Ramachandran, S. Chinnasami, R. Rajeshwari. "A study on image processing with data analysis. "In AIP Conference Proceedings, vol. 2393, no. 1, p. 020225. AIP Publishing LLC, 2022.

[14]. Abidin, Shafiqul. "Enhancing security in WSN by artificial intelligence." In International Conference on Intelligent Data Communication Technologies and Internet of Things, pp. 814-821. Springer, Cham, 2018.

[15]. Dhiman, Harsh S., Dipankar Deb, VladMuresan, and Mihaela-LigiaUnguresan. "Multi-criteria decision making approach for hybrid operation of wind farms." *Symmetry* 11, no. 5 (2019): 675.

[16]. Murugan, S., A. Sampathkumar, S. Kanaga Suba Raja, S. Ramesh, R. Manikandan, and Deepak Gupta. "Autonomous Vehicle Assisted by Heads up Display (HUD) with Augmented Reality Based on Machine Learning Techniques." In Virtual and Augmented Reality for Automobile Industry: Innovation Vision and Applications, pp. 45-64. Springer, Cham, 2022.

[17]. K Ram Chandra, M. Ramachandran, Sathiyaraj Chinnasamy, Manjula Selvam," Recent trends in Workplace learning Methodology", Contemporaneity of Language and Literature in the Robotized Millennium, 4(1), (2022): 28-36.

[18]. Shaahid, S. M. "Review of research on autonomous wind farms and solar parks and their feasibility for commercial loads in hot regions." *Renewable and Sustainable Energy Reviews* 15, no. 8 (2011): 3877-3887.

[19]. Kohli, Manu. "Predicting Equipment Failure on SAP ERP Application Using Machine Learning Algorithms." Int. J. Eng. Technol. 7, no. 2.28 (2018): 306.

[20]. Boopathi, K., S. Ramaswamy, V. Kirubakaran, K. Uma, G. Saravanan, S. Thyagaraj, and K. Balaraman. "Economic investigation of repowering of the existing wind farms with hybrid wind and solar power plants: a case study." *International Journal of Energy and Environmental Engineering* 12, no. 4 (2021): 855-871.

[21]. Yao, Jun, Ruikuo Liu, Te Zhou, Weihao Hu, and Zhe Chen. "Coordinated control strategy for hybrid wind farms with DFIG-based and PMSG-based wind farms during network unbalance." *Renewable Energy* 105 (2017): 748-763.

[22]. Zeinalnezhad, Masoomeh, AbdoulmohammadGholamzadehChofreh, FeybiArianiGoni, Leila Sadat Hashemi, and JiříJaromírKlemeš. "A hybrid risk analysis model for wind farms using Coloured Petri Nets and interpretive structural modelling." *Energy* 229 (2021): 120696.

[23]. Gupta, Karan, Deepak Kumar Sharma, Koyel Datta Gupta, and Anil Kumar. "A tree classifier based network intrusion detection model for Internet of Medical Things." Computers and Electrical Engineering 102 (2022): 108158.

[24]. Fan, Dongming, Yi Ren, Qiang Feng, Bingyu Zhu, Yiliu Liu, and Zili Wang. "A hybrid heuristic optimization of maintenance routing and scheduling for offshore wind farms." *Journal of Loss Prevention in the Process Industries* 62 (2019): 103949.

[25]. Kohli, Manu, and Swati Kohli. "Increasing target behavior of children with developmental disorders by designing innovative multistage tablet games." In 2016 IEEE Region 10 Humanitarian Technology Conference (R10-HTC), pp. 1-6. IEEE, 2016.

[26]. N. Hemamalini, M. Ramachandran, Kurinjimalar Ramu," Exploring the Effects of Work Place Learning in the Robotised Millennium", Contemporaneity of Language and Literature in the Robotized Millennium, 4(1), (2022): 51-56.

[27]. Chhipa, Abrar Ahmed, Vinod Kumar, Raghuveer Raj Joshi, Prasun Chakrabarti, Michal Jasinski, Alessandro Burgio, Zbigniew Leonowicz, Elzbieta Jasinska, Rajkumar Soni, and Tulika Chakrabarti. "Adaptive neuro-fuzzy inference system-based maximum power tracking controller for variable speed WECS." Energies 14, no. 19 (2021): 6275.

[28]. Fegade, Vishal, M. Ramachandran, S. Madhu, C. Vimala, R. Kurinji Malar, and R. Rajeshwari. "A review on basalt fibre reinforced polymeric composite materials." In AIP Conference Proceedings, vol. 2393, no. 1, p. 020172. AIP Publishing LLC, 2022.

[29]. Esfetang, NaserNourani, and RasoolKazemzadeh. "A novel hybrid technique for prediction of electric power generation in wind farms based on WIPSO, neural network and wavelet transform." *Energy* 149 (2018): 662-674.

[30]. Ramesh, S., S. Sasikala, S. Gomathi, V. Geetha, and V. Anbumani. "Segmentation and classification of breast cancer using novel deep learning architecture." Neural Computing and Applications (2022): 1-13.

[31]. Nădăban, Sorin, SimonaDzitac, and IoanDzitac. "Fuzzy TOPSIS: A general view." *Procedia computer science* 91 (2016): 823-831.

[32]. Bhoopathy, V., Aradhana Behura, V. Lokeswara Reddy, Shafiqul Abidin, D. Vijendra Babu, and Anitha Juliette Albert. "WITHDRAWN: IOT-HARPSECA: A SECURE DESIGN AND DEVELOPMENT SYSTEM OF ROADMAP FOR DEVICES AND TECHNOLOGIES IN IOT SPACE." (2021): 104044.

[33]. Sun, Chia-Chi. "A performance evaluation model by integrating fuzzy AHP and fuzzy TOPSIS methods." *Expert systems with applications* 37, no. 12 (2010): 7745-7754.

[34]. Molia, Tarkesh J., Vikash Kumar Upadhyay, and Arpit Sharma. "Evidentiary value of archaeological evidence: Judicial approach of the Supreme Court of India with special reference to M. Siddiq (Dead) through legal representative vs. Mahant Suresh Das (1 SCC 1)." Passagens: Revista Internacional de História Política e Cultura Jurídica (2021): 180-190.

[35]. N. Hemamalini, M. Ramachandran, Kurinjimalar Ramu, "Analysis of E- Learning using MOORA Method", Contemporaneity of Language and Literature in the Robotized Millennium, 4(1), (2022): 44-50.

[36]. Salih, Mahmood M., B. B. Zaidan, A. A. Zaidan, and Mohamed A. Ahmed. "Survey on fuzzy TOPSIS state-of-the-art between 2007 and 2017." *Computers & Operations Research* 104 (2019): 207-227.

[37]. Kumar, Anil, Saleh A. Alghamdi, Abolfazl Mehbodniya, Julian L. Webber, and Shavkatov Navruzbek Shavkatovich. "Smart power consumption management and alert system using IoT on big data." Sustainable Energy Technologies and Assessments (2022): 102555.

[38]. Palczewski, Krzysztof, and WojciechSałabun. "The fuzzy TOPSIS applications in the last decade." *Procedia Computer Science* 159 (2019): 2294-2303.

[39]. Solanki, Yogendra Singh, Prasun Chakrabarti, Michal Jasinski, Zbigniew Leonowicz, Vadim Bolshev, Alexander Vinogradov, Elzbieta Jasinska, Radomir Gono, and Mohammad Nami. "A hybrid supervised machine learning classifier system for breast cancer prognosis using feature selection and data imbalance handling approaches." Electronics 10, no. 6 (2021): 699.

[40]. Ramesh, S., and R. Seshasayanan. "Design and implementation of high throughput, low-complexity MIMO-OFDM transciever." In 2015 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT), pp. 637-642. IEEE, 2015.

[41]. Wang, Ying-Ming, and Taha MS Elhag. "Fuzzy TOPSIS method based on alpha level sets with an application to bridge risk assessment." *Expert systems with applications* 31, no. 2 (2006): 309-319.

[42]. Kohli, Manu. "Supplier evaluation model on SAP ERP application using machine learning algorithms." Int J Eng Technol 7, no. 28 (2017): 306-311.

[43]. Gupta, Krishnakumar, Vishal Fegade, Jeevan Kittur, M. Ramachandran, S. Madhu, S. Chinnasami, and M. Amudha. "A review on effect of cooling rate in fiber reinforced polymeric composites." In AIP Conference Proceedings, vol. 2393, no. 1, p. 020106. AIP Publishing LLC, 2022.

[44]. K Ram Chandra, M. Ramachandran, Kurinjimalar Ramu, Soniya Sriram, "Exploring the Possibilities of Web Based Learning", Contemporaneity of Language and Literature in the Robotized Millennium, 4(1), (2022): 19-27.

[45]. Wang, Tien-Chin, and Hsien-Da Lee. "Developing a fuzzy TOPSIS approach based on subjective weights and objective weights." *Expert systems with applications* 36, no. 5 (2009): 8980-8985.

[46]. Thangamani, Thulasimani, R. Prabha, M. Prasad, Usha Kumari, K. V. Raghavender, and Shafiqul Abidin. "WITHDRAWN: IoT Defense Machine Learning: Emerging Solutions and Future Problems." (2021): 104043.

[47]. Dymova, Ludmila, PavelSevastjanov, and Anna Tikhonenko. "An approach to generalization of fuzzy TOPSIS method." *Information Sciences* 238 (2013): 149-162.

[48]. Kumar, Anil, Julian L. Webber, Mohd Anul Haq, Kamal Kumar Gola, Pritpal Singh, Sathishkumar Karupusamy, and Malik Bader Alazzam. "Optimal cluster head selection for energy efficient wireless sensor network using hybrid competitive swarm optimization and harmony search algorithm." Sustainable Energy Technologies and Assessments 52 (2022): 102243.

[49]. Ramesh, S., S. Nirmalraj, S. Murugan, R. Manikandan, and Fadi Al-Turjman. "Optimization of energy and security in mobile sensor network using classification based signal processing in heterogeneous network." Journal of Signal Processing Systems (2021): 1-8.

[50]. Shatjit yadav, M. Ramachandran, Vimala Saravanan, S. Sowmiya, Soniya Sriram, "Exploring Recent Trends in Solar Energy Application", Renewable and Nonrenewable Energy, 1(1), (2022): 30-38.

[51]. Chen, Ting-Yu, and Chueh-Yung Tsao. "The interval-valued fuzzy TOPSIS method and experimental analysis." *Fuzzy sets and systems* 159, no. 11 (2008): 1410-1428.

[52]. Kohli, Manu, and Swati Kohli. "Electronic assessment and training curriculum based on applied behavior analysis procedures to train family members of children diagnosed with autism." In 2016 IEEE Region 10 Humanitarian Technology Conference (R10-HTC), pp. 1-6. IEEE, 2016.

[53]. Mahdavi, Iraj, NezamMahdavi-Amiri, ArmaghanHeidarzade, and RaheleNourifar. "Designing a model of fuzzy TOPSIS in multiple criteria decision making." *Applied Mathematics and Computation* 206, no. 2 (2008): 607-617.

[54]. Ramesh, S., S. Gomathi, S. Sasikala, and T. R. Saravanan. "Automatic speech emotion detection using hybrid of gray wolf optimizer and naïve Bayes." International Journal of Speech Technology (2021): 1-8.

[55]. Fegade, Vishal, Krishnakumar Gupta, M. Ramachandran, S. Madhu, C. Sathiyaraj, R. Kurinji< alar, and M. Amudha. "A study on various fire retardant additives used for fire reinforced polymeric composites." In AIP Conference Proceedings, vol. 2393, no. 1, p. 020107. AIP Publishing LLC, 2022.

[56]. Wahlang, Imayanmosha, Arnab Kumar Maji, Goutam Saha, Prasun Chakrabarti, Michal Jasinski, Zbigniew Leonowicz, and Elzbieta Jasinska. "Deep Learning Methods for Classification of Certain Abnormalities in Echocardiography." Electronics 10, no. 4 (2021): 495.

[57]. S. Suresh, M. Ramachandran, Sathiyaraj Chinnasamy, "Evaluation of Unreliable Retrial G-queue Using Fuzzy ARAS Method", Data Analytics and Artificial Intelligence, 2(2), (2022): 97-108

[58]. Ashtiani, Behzad, FarzadHaghighirad, Ahmad Makui, and GolamaliMontazer. "Extension of fuzzy TOPSIS method based on interval-valued fuzzy sets." *Applied Soft Computing* 9, no. 2 (2009): 457-461.

[59]. Sharma, Arpit, and Sanjeevi Shanthakumar. "ACCOUNTABILITY OF CORPORATE TOWARDS ENVIRONMENTAL ISSUES THROUGH THE LENS OF CORPORATE SOCIAL RESPONSIBILITY (FINANCIAL) AND BUSINESS RESPONSIBILITY (NON-FINANCIAL) REGULATIONS WITH REFERENCE TO TOP 30 COMPANIES ON NIFTY."

[60]. Sun, Chia-Chi, and Grace TR Lin. "Using fuzzy TOPSIS method for evaluating the competitive advantages of shopping websites." *Expert Systems with Applications* 36, no. 9 (2009): 11764-11771.

[61]. Pandey, Prashant, A. P. Prathosh, Manu Kohli, and Josh Pritchard. "Guided weak supervision for action recognition with scarce data to assess skills of children with autism." In Proceedings of the AAAI Conference on Artificial Intelligence, vol. 34, no. 01, pp. 463-470. 2020.

[62]. Sekar, K. R., Anil Kumar, Priyanka Dahiya, Mohd Anul Haq, S. V. Subiksha, and S. Sethuvarsha. "An innovative framework to forecast the best inventory management system module by hesitant fuzzy VQA-TOPSIS technique for textile industry." The International Journal of Advanced Manufacturing Technology (2022): 1-16.

[63]. Awasthi, Anjali, Satyaveer S. Chauhan, and HichemOmrani. "Application of fuzzy TOPSIS in evaluating sustainable transportation systems." *Expert systems with Applications* 38, no. 10 (2011): 12270-12280.

[64]. Abidin, Shafiqul, Vikas Rao Vadi, and Ankur Rana. "On Confidentiality, Integrity, Authenticity, and Freshness (CIAF) in WSN." In Advances in Computer, Communication and Computational Sciences, pp. 87-97. Springer, Singapore, 2021.

[65]. Nisha Bansal, M. Ramachandran, Sathiyaraj Chinnasamy, "A Study on Prediction Using Machine Learning", Data Analytics and Artificial Intelligence, 2(2), (2022): 82-88

[66]. Deepa, N., Asmat Parveen, Anjum Khurshid, M. Ramachandran, C. Sathiyaraj, and C. Vimala. "A study on issues and preventive measures taken to control Covid-19." In AIP Conference Proceedings, vol. 2393, no. 1, p. 020226. AIP Publishing LLC, 2022.

[67]. Singh, Arjun, and Prasun Chakrabarti. "Ant based resource discovery and mobility aware trust management for Mobile Grid systems." In 2013 3rd IEEE International Advance Computing Conference (IACC), pp. 637-644. IEEE, 2013.

[68]. Büyüközkan, Gülçin, and GizemÇifçi. "A novel hybrid MCDM approach based on fuzzy DEMATEL, fuzzy ANP and fuzzy TOPSIS to evaluate green suppliers." *Expert Systems with Applications* 39, no. 3 (2012): 3000-3011.

[69]. Ramesh, S., S. Sasikala, and Nirmala Paramanandham. "Segmentation and classification of brain tumors using modified median noise filter and deep learning approaches." Multimedia Tools and Applications 80, no. 8 (2021): 11789-11813.

[70]. Kahraman, Cengiz, NüferYasinAteş, SeziÇevik, Murat Gülbay, and S. AyçaErdoğan. "Hierarchical fuzzy TOPSIS model for selection among logistics information technologies." *Journal of Enterprise Information Management* (2007).