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2^{n+1}-1 Level Multilevel Inverter using Reverse Voltage Technique with Reduced Number of Switches

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ABSTRACT: Multilevel Inverters are used for High Power,High Voltage applicationsMultilevel Inverter has more number of switches,Voltage sources,complex PWM and voltage balancing problems. In this paper a novel topology of combination of Reverse voltage component and 2^n voltage sources are effectively used to generate 31 level with reduced number of switches for higher voltage level and also the carrier signals and gate drives are reduced. Hence this topology is Economical for use with higher voltage levels.

KEYWORDS: Multilevel Inverter, 2^n varying voltage sources, Power Electronics, MPWM, Topology.

I. INTRODUCTION

Multilevel power conversion introduced two decades ago. Multilevel Inverters make use of higher number of switches in order to produce small voltage steps for higher voltage levels. dv/dt stress on the load has been reduced with smaller voltage steps and hence electromagnetic compatibility concerns[1].

Recent trend is the best utilization of the multilevel inverter with reduced number of switches and complexity in the control strategies. The mostly used multilevel inverters are cascade converter,neutral point clamped (NPC) inverter and flying capacitor inverter.

These converters are well aided in Industrial drives, FACTS(Flexible Ac Transmission System) and Vehicle propulsion [10], [11]. Multilevel inverters are suitable for renewable photovoltaic energy where the power quality and efficiency are much needed [12].
The voltage sources are not properly used in generating output voltage levels. The topology in [19] can generate only five output levels with four dc sources, while conventional Multilevel inverter can generate upto nine levels with the same number of power supplies.

In a new approach [13] make use of minimum dc sources and inserting transformer instead. Inclusion of transformer in the topology increases the overall cost and volume of the inverter.

A new topology has been introduced for Multilevel inverter with reduced number of components compared with the other types of MLI. This topology requires lesser number of switches to be operated in high switching frequency. Thus the control strategy is more reliable and simpler. A general method of multilevel modulation Phase disposition (PD) MPWM is applied to the inverter.

This paper presents a 31 level multilevel inverter with much reduced voltage sources and switches for higher voltage level. Thus when applied for higher voltage levels it is more reliability and much reduced cost.

II. NOVEL MULTI LEVEL INVERTER

A. General description
Multilevel inverters are in general uses high frequency switches to be operated in both positive and negative polarities. There is no need to utilize all the switches for generating bipolar levels[1].This topology is a combination of 2^n voltage sources, level generation unit and polarity generation unit.

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The adjacent switches are supplied in the ratio of 2^n where n is the level generation unit. The level generation unit produces the required voltage levels in the unipolar mode. This unit requires high frequency switches for its operation.The Polarity generation unit is responsible for generating the required output voltage polarity. This unit makes use of low frequency switches which operates at reference frequency.

The positive voltage levels are generated by the high frequency functioned level generation unit and then it is fed to a Full bridge polarity generation unit where the required output polarity are produced. Thus this type of arrangement decreases the semiconductor switches needed to produce output voltage levels in positive and negative polarities.

The novel topology is 31 levels is shown in figure 1. This topology requires 4 high frequency main switches, 4 low frequency switches, 4 main diodes,8 by passing diodes and 4 isolated dc sources for 1 phase system. The Multilevel inverter's left stage produces the required output levels without polarity and the right side stage produces the polarity for the output voltage.

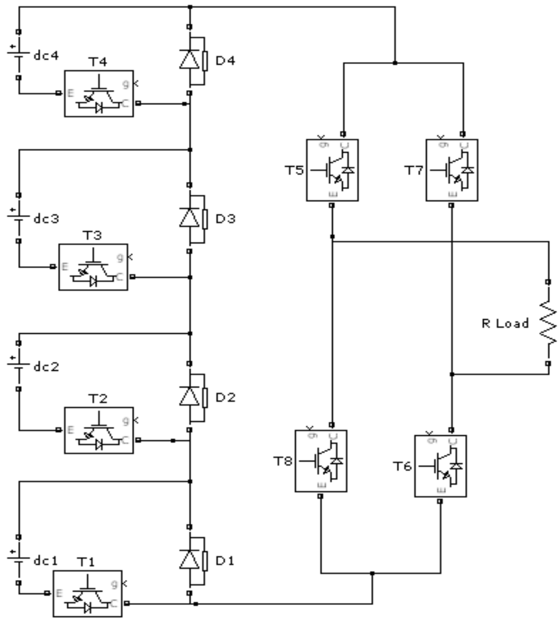

Fig. 1 Circuit diagram of the proposed MLI

The polarity generation unit reverses the voltage direction when voltage polarity to be changed for negative polarity. The function of the diodes is to avoid the short circuit of the DC sources. The DC sources are maintained in adjacent levels as 1: 2: 4: 8.

According to the required output voltage levels, the adjacent dc sources are linked or combined as per their requirements. When compared with the Reverse voltage (RV) topology [1] it requires only 4 Dc sources whereas the RV topology [1] requires 15 Dc sources for generating 31 levels in the output voltage. Thus it is superior to that of the RV topology.

Hence this topology requires fewer components compared with the conventional inverters and RV topology. The main advantage of this topology is that it requires only half of the conventional carriers for MPWM controllers. MPWM carriers for 31 level conventional inverters requires 30 carriers and for this novel topology it needs only 15 carrier as shown in figure 4.The Multilevel inverter with much reduced number of carriers is a great achievement for inverter control. Hence all the switches are not fast switches, the level generation unit only has fast switches and the polarity generation unit make use of slow switches.

B. Switching sequence

The switching sequences of this inverter are easier, since it does not generate negative pulses for negative cycle control. The switching sequence for each level is presented in the Table-I.

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TABLE I Switching Sequences

Level	T1	T2	T3	T4
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

According to the table – I the required output voltage level is achieved by connecting the corresponding adjacent isolated voltage sourceswith the switches.The switching modes are chosen in such a way as to avoid unwanted voltage levels during switching cycles. It aids in reducing the switching power dissipation.

In accordance to the output voltage level 0 to 15 the sequence of switches are as shown in table – I. To produce 31 levels an embedded program has been coined in a microcontroller. In order to improve the efficiency of the inverter during switching states, the transition between modes in each state requires minimum commutation of switches.

The number of switches in proposed topology that conducts the circuit current is lower than that of cascade inverter and hence it has a much better efficiency. These switching sequences can be implemented by embedded program by Microcontroller MCT2E. The signals stage should be isolated from the power stage by optocouplers for control circuits. The driver is also responsible to generate the dead time between each successive cycle across the DC source.

H- Bridge polarity unit at the output stage performs in forward and reverse modes. In the forward mode switches 5 & 6 are conducted to have a positive output polarity. The switches 7 & 8 are switched on for generating negative output polarity. Thus the polarity generating unit decides the output polarity.

The major advantage of the topology is that it requires less high frequency switches. The high frequency switches and diodes are expensive and are more prone to be damaged than low frequency switches. According to the MIL-HDBK-217F standard the reliability of a system is indirectly proportional to the number of its components.

As the number of high frequency switches is increased the reliability of the inverter is decreased. This topology is used in PV array system, UPS, Backup Inverter, FACTS& HVDC. The cost & space availability and complexity in the control strategy are greatly reduced for higher voltage levels.

Switching losses, dv/dt stress on the load, EMI (ElectroMagnetic Interference and THD (Total Harmonic Distortion) are reduced further when comparing cascade inverter for higher voltage levels.

III. SIMULATION RESULTS

This section presents the simulation results of the 1 Phase 31 level inverter with the proposed topology as shown in figure 2.This topology is used to generate 31 voltage levels for a resistive load. The output peak voltage is 230V(VPP). The switching frequency is 4 KHz.The PD SPWM is used as the control strategy for driving the gates of the IGBT'sof high frequency switches (Level generation unit).

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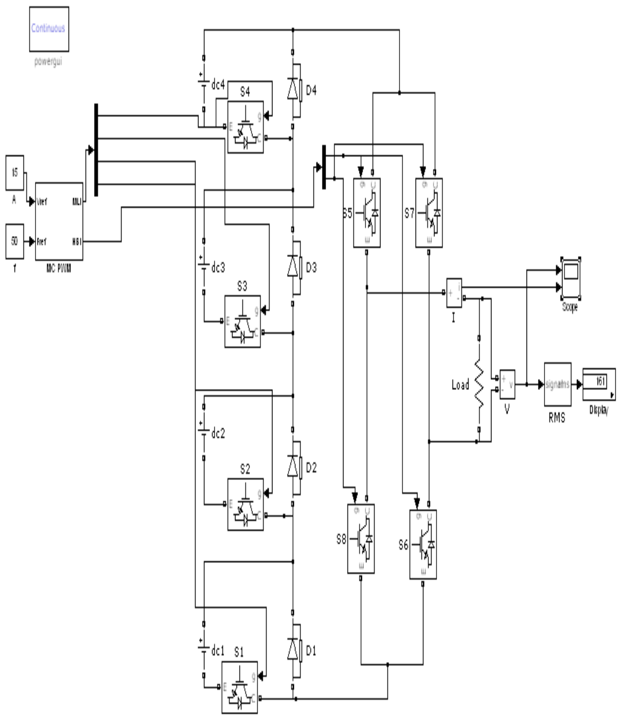

Fig. 2 New topology Multilevel inverter simulation diagram

Figure 3 shows the output voltage and output current.The proposed multilevel topology with an resitive load of 100Ω has a THD of 3.71% as shown in figure 5.

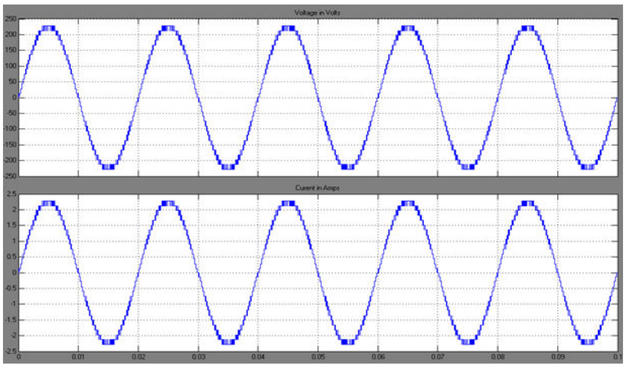

Fig .331 level output voltage & current waveforms of the proposed MLI.

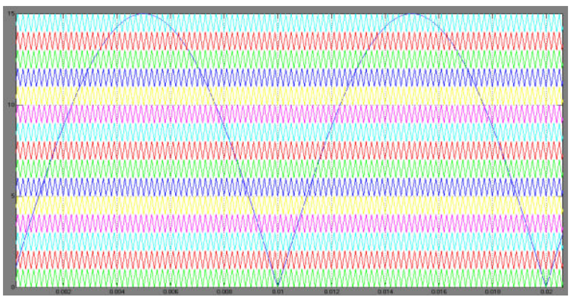

Fig 4 MCPWM carriersfor Proposed topology

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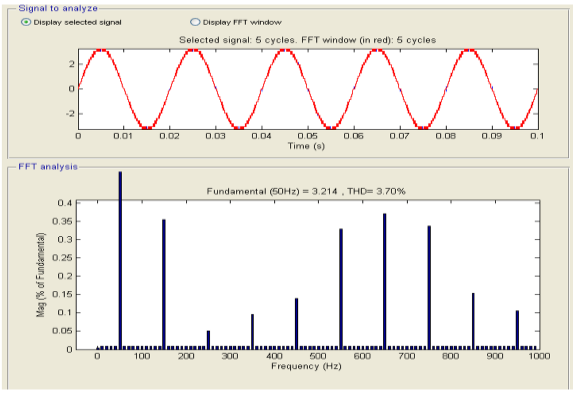

Fig5 FFT analysis of the proposed MLI

IV. CONCLUSION

In this paper a novel inverter topolgy has been proposed which is superior to that of cascade inverter in terms of power switches & isolated DC sources, control requirements, cost and reliability.Better selection for use in FACTS, HVDC , PV systems ,UPS ,etc; By separating the switching operations in to high and low frequency parts, reduces the size and cost of the prototype.

The PD SPWM control method is used to drive the inverter. The PWM for this novel topology of multilevel inverter has much reduced number of carrier signals which facilitates in the reduction of complexities in the control strategy .Thus a novel topology of multilevel inverter with reduced number of switches, isolated dc source and few carriers for PWM has been proposed for further applications.

REFERENCES

1. Ehsam Najafi,Member, IEEE and Abdul Halim Mohamed Yatim, Senior Member “Design and Implementation of a New Multilevel Inverter Topology” , IEEE Transations on Industrial Electronics, Volume 59,No.11, November 2012
2. Young-Min park, Han seong Ryu, Hyun-won Lee, Myung-Gil jung and Se-Hyun Lee “Design of a cascaded H Bridge Multilevel Inverter based on Power Electronics Building blocks and control for High Performance” ,JPE , Volume 10,No.3,May 2010.
3. K.Jang-Hwan,S.K.Sul and P.N.Enjeti,” A Carrier –based PWM method with optimal switching sequence for a multilevel four-leg voltage source inverter”,IEEE Trans.Ind.Appl;Vol.44.no.4,pp.1239-1248,Jul/Aug.2008.
4. C.Nagarajan and M.Madheswaran - ‘Stability Analysis of Series Parallel Resonant Converter with Fuzzy Logic Controller Using State Space Techniques’- Taylor &Francis, Electric Power Components and Systems, Vol.39 (8), pp.780-793, May 2011. DOI: 10.1080/15325008.2010.541746
5. S.Thirunavukkarasu, C. Nagarajan, 2024, “Performance Investigation on OCF and SCF study in BLDC machine using FTANN Controller," Journal of Electrical Engineering And Technology, Volume 20, pages 2675–2688, (2025), doi.org/10.1007/s42835-024-02126-w
6. L.M.Tolbertt,F.Z.Peng and T.G.Habetler,”Multilevel converters for large electric drives,”IEEE Trans.Ind.Appl;vol.35,no.1,pp.36-44,Jan/Feb 1999.
7. K.Y.Lan,M.F.M.Yousof,S.N.M.Arshad,M.Anwari and A.H.M.Yatim,” Performance analysis of hybrid photovoltaic/diesel energy system under Malaysian conditions”,J.Energy,vol.35,no.8,pp.3245-3255,Aug.2010.
8. G.M.Martins,J,A.Pomilio,S.Buso and G.Spiazzi,”Three-phaase low-frequency commutation inverter for renewable energy systems”,IEEE Trans.Ind.Electron.vol.53,no.5,pp.1522-1528,Oct.2000.
9. R.Teodorescu ,F.Blaabjerg,J.K.Pedersen,E.Cengelci and p.n.Enjeti,” Multilevelinverter by cascading industrial VSI”,IEEE Trans.Ind.Electron;vol.49,no.4, pp.832- 838,Aug.2002.
10. D.A.B.Zambra,C.rech and J.R.Pinheiro,” A Comparative analysis between the symmetric and hybrid asymmetric nine-level series connected H-bridge cells inverter”,in Proc.Eur.Conf.Power Electron;vol.22,no.1,pp. 149-159,Jan.2007.
11. E.Baberi,” Optimal topolgies for cascaded sub-multilevel converters”, J.Power Electron.vol.10,no.3,pp. 251-261,May 2010.

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DOI:10.15662/IJEETR.2026.0802328

12. G.Mondal,k.Gopakumar,P.N.Tekwani and E.Levi,"A reduced switch count five level inverter with common-mode voltage elimination for an open-end winding induction motor drive",IEEE Trans.ind.Electron;vol.54,no.4,pp. 2344-2351, Aug.2007.
13. K.Prakashraj, G.Vijayakumar, S.Saravanan and S.Saranraj, "IoT Based Energy Monitoring and Management System for Smart Home Using Renewable Energy Resources," International Research Journal of Engineering and Technology, Vol.7, Issue 2, pp.1790-1797, 2020.
14. Mohammed siddi, A. Senthil kumar, S.Saravanan, M. Swathisriranjani, "Hybrid Renewable Energy Sources for Power Quality Improvement with Intelligent Controller," International Research Journal of Engineering and Technology, Vol.7, Issue 2, pp.1782-1789, 2020.
15. T.R. Vignesh, M.Swathisriranjani, R.Sundar, S.Saravanan, T.Thenmozhi," Controller for Charging Electric Vehicles Using Solar Energy", Journal of Engineering Research and Application, vol.10, Issue.01,pp.49-53, 2020.
16. G. Poovarasan, S. Susikumar, S. Naveen, N. Mohananthini, S. Saravanan," Study of Poultry Fodder Passing Through Trolley in Feeder Box," International Journal of Engineering Technology Research & Management, vol.4, Issue.1, pp.76-83, 2020.
17. M.Revathi, S.Saravanan, R.Raja, P.Manikandan," A Multiport System for A Battery Storage System Based on Modified Converter with MANFIS Algorithm," International Journal of Engineering Technology Research & Management, vol.4, issue 2, pp.217-222, 2020.
18. D Boopathi, S Saravanan, Kaliannan Jagatheesan, B Anand, "Performance estimation of frequency regulation for a micro-grid power system using PSO-PID controller", International Journal of Applied Evolutionary Computation (IJAEC), Vol.12, Issue.4, pp.36-49, 2021.
19. V Kumarakrishnan, G Vijayakumar, D Boopathi, K Jagatheesan, S Saravanan, B Anand," Frequency regulation of interconnected power generating system using ant colony optimization technique tuned PID controller", Control and Measurement Applications for Smart Grid: Select Proceedings of SGESC 2021, pp..129-141.
20. G Vijayakumar, M Sujith, S Saravanan, Dipesh B Pardeshi, MA Inayathullaa," An optimized MPPT method for PV system with fast convergence under rapidly changing of irradiation", 2022 International Virtual Conference on Power Engineering Computing and Control: Developments in Electric Vehicles and Energy Sector for Sustainable Future (PECCON), pp.1-4.
21. VM Geetha, S Saravanan, M Swathisriranjani, CS Satheesh, S Saranraj, "Partial Power Processing Based Bidirectional Converter for Electric Vehicle Fast Charging Stations", Journal of Physics: Conference Series, Vol.2325, Issue.1, pp.012028, 2022.
22. M Santhosh Kumar, G Dineshkumar, S Saravanan, M Swathisriranjani, M Selvakumari, "Converter Design and Control of Grid Connected Hybrid Renewable Energy System Using Neuro Fuzzy Logic Model", 2022 Second International Conference on Computer Science, Engineering and Applications (ICCSEA), pp.1-6, 2022.
23. C Gnanavel, A Johny Renoald, S Saravanan, K Vanchinathan, P Sathishkhanna, "An Experimental Investigation of Fuzzy-Based Voltage-Lift Multilevel Inverter Using Solar Photovoltaic Application", Smart Grids and Green Energy Systems, pp.59-74, 2022.
24. V Kumarakrishnan, G Vijayakumar, D Boopathi, K Jagatheesan, S Saravanan, B Anand, "Optimized PSO technique based PID controller for load frequency control of single area power system", Solid State Technology, Vol.63. Issue.5, pp.7979-7990, 2020.
25. G. Poovarasan, S. Susikumar, S. Naveen, N. Mohananthini, S. Saravanan, "Implementation of IoT Based Poultry Feeder Box", International Journal of Innovative Research In Technology, Vol.6, Issue.2, pp.33-38, 2020.
26. N.Gokulnath, B.Jasim Khan, S.Kumaravel, Dr.A.Senthil Kumar and Dr.S.Saravanan, "Soldier Health and Position Tracking System", International Journal of Innovative Research In Technology, Vol-6 Issues 12, pp.39-45, 2020.
27. P.Navaneetha, R.Ramiya Devi, S.Vennila, P.Manikandan and Dr.S.Saravanan, " IOT Based Crop Protection System against Birds and Wild Animal Attacks", International Journal of Innovative Research In Technology, Vol-6 Issues 11, pp.133-143, 2020.
28. K. Punitha, M. Rajkumar, S. Karthick and Dr. S. Saravanan, " Impact of Solar And Wind Integration on Frequency Control System", International Research Journal of Engineering and Technology, Vol 7 Issue 3, pp.1357-1362,2020.
29. A.Arulkumar, S.Balaji, M.Balakrishnan, G.Dineshkumar and S.Saravanan, "Design And Implementation of Low Cost Automatic Wall Painting Machine" International Journal of Engineering Technology Research & Management, Vol-4 Issues 03, pp.170-176, 2020.
30. V.Periyasamy, S.Surya, K. Vasanth, Dr.G.Vijayakumar and Dr.S.Saravanan, "Design And Implementation of Iot Based Modern Weaving Loom Monitoring System" International Journal of Engineering Technology Research & Management, Vol-4 Issues 04, pp.11-18, 2020.

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DOI:10.15662/IJEETR.2026.0802328

31. M.Yogheshwaran, D.Praveenkumar, S.Pravin, P.M.Manikandan and Dr.S.Saravanan, "IoT Based Intelligent Traffic Control System" International Journal of Engineering Technology Research & Management, Vol-4 Issues 04, pp.59-63, 2020.
32. R.Pradhap, R.Radhakrishnan, P.Vijayakumar, R.Raja and Dr.S.Saravanan, "Solar Powered Hybrid Charging Station For Electrical Vehicle" International Journal of Engineering Technology Research & Management, Vol-4 Issues 04, pp.19-27, 2020.
33. S.Shenbagavalli, T.Priyadharshini, S.Sowntharya, P.Manikandan and Dr.S.Saravanan, "Design and Implementation of Smart Traffic Controlling System" International Journal of Engineering Technology Research & Management, Vol-4 Issues 04, pp.28-36, 2020.
34. M.Pavithra, S.Pavithra, R.Rama Priya, M.Vaishnavee, M.Ranjitha and S.Saravanan, "Fingerprint Based Medical Information System Using IoT" International Journal of Engineering Technology Research & Management, Vol-4 Issues 04, pp.45-51, 2020.
35. A.Ananthan, A.M.Dhanesh, J.Gowtham, R.Dhinesh, G.Jeevitha and Dr.S.Saravanan, "IoT Based Clean Water Supply" International Journal of Engineering Technology Research & Management, Vol-4 Issues 03, pp.154-162, 2020.
36. R.Anbarsan, A.Arsathparvez, K.S.Arunachalam, M.Swathisriranjani and Dr.S.Saravanan, "Automatic Class Room Light Controlling Using Arduino" International Journal of Engineering Technology Research & Management, Vol-4 Issues 03, pp.192-201, 2020.
37. S.Karthikeyan, A.Krishnaraj, P.Magendran, T.Divya and Dr.S.Saravanan , "The Dairy Data Acquisition System" International Journal of Engineering Technology Research & Management, Vol-4 Issues 03, pp.163-169, 2020.
38. M.Amaran, S.Mannar Mannan, M.Madhu, Dr.R.Sagayaraj and Dr. S.Saravanan, "Design And Implementation of Low Cost Solar Based Meat Cutting Machine" International Journal of Engineering Technology Research & Management, Vol-4 Issues 03, pp.202-208, 2020.
39. N.Harish, R.Jayakumar, P.Kalaiyarasan, G.Vijayakumar and S. Saravanan, "IoT Based Smart Home Energy Meter" International Journal of Engineering Technology Research & Management, Vol-4 Issues 03, pp.177-183, 2020.
40. K.Subashchandrabose, G.Moulieshwaran, M.Raghul, V.Dhinesh and S.Saravanan, "Design of Portable Sanitary Napkin Vending Machine", International Journal of Engineering Technology Research & Management, Vol-4 Issues 03, pp.52-58, 2020.
41. D.Hemalatha, S.Indhumathi, V.Myvizhi and S.Saravanan, "Design and Implementation of Intelligent Controller for Domestic Applications", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.4-7, 2023.
42. S. Divyasri, E. Indhu, M. P. Keerthana, M. Selvakumari and S. Saravanan, "Gas Cylinder Monitoring System using IoT", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.67-71, 2023.
43. J.Arul, R.Balaji, S.Jeyamoorthy, M.Manipathra, R.Sundar and S.Saravanan, "IoT based Air Conditioner Control using ESP32", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.48-52, 2023.
44. Vundel Munireddy, J.Prahathesvaran, C.R.Thirunavukarasu, M.Santhosh Kumar and S.Saravanan, "IoT Based Charge Controller for Direct Fast Charging of Electric Vehicles Using Solar Panel", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.77-81, 2023.
45. D.Monish Kumaar, K.Akash, S.Aswinkumar, S.Saravanan and R. Sagayaraj, "IoT based Industry Surveillance and Air Pollution Monitoring using Drones", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.14-18, 2023.
46. T.Silambarasan, R.Surya, J.Pravinkumar, R.Sundar and S Saravanan, "IoT based Monitoring System For Sewage Sweeper", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.88-93, 2023.
47. R.Aravinthan, Alwin.Augustin, P.Divagaran, S.Saravanan and P.Manikandan, "IoT Based Power Consumption and Monitoring System", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.43-47, 2023.
48. S.Partheeban, S.Sundaravel, S.Umapathi, R.Sagayaraj and S.Saravanan, "IoT based Safety Helmet for Mining Workers", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.116-120, 2023.
49. K.Eswaramoorthi, R.Manikandan, R.Balamurugan, C.Ramkumar and S.Saravanan, "Smart Parking System using IoT", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.53-57, 2023.
50. S.Nirmalraj, C.Pranavan, M.Prem and S.Saravanan, "Smart Trolley With IoT Based Billing System", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.111-115, 2023.

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DOI:10.15662/IJEETR.2026.0802328

51. V.Gunasekaran, M.Gowtham , S. Anbubalaji, S.Saravanan and R.Prakash, "Solar based Electric Wheel Chair", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.8-13, 2023.
52. P Thava Prakash, P.Venketesan, D.Vignesh, S.Prakash, S.Saravanan, "Design of Low Cost E-Bicycle using Brushless DC Motor with Speed Regulator", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.148-153, 2023.
53. D.Tamilarasan, V.S.Vairamuthu, Y.Vasanth, K.Umadevi, S.Saravanan, "GSM based Agricultural Motor Control", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.172-177, 2023.
54. P. Vimal, S.Veerasigamani, R.Srihari, C.S.Satheesh, S.Saravanan, "IoT Based Optimal Power Management System For Smart Grid", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.160-165, 2023.
55. S.Abimanyu, P.Jagadheeswaran, S.Jaganath, K.Sanjay, R.Sivapranesh, K.Velmurugan, N.Mohananthini, C.S.Satheesh, S.Saravanan, "Portable Solar Tree", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.154-159, 2023.
56. M.Karthikeyan, S.Bilalahamad, V.A.Chandru, V.Deepika and S.Saravanan, "Design and Development of IoT based Motor Starter", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.178-183, 2023.
57. R.Anbarsan, A.Arsathparvez, K.S.Arunachalam, M.Swathisriranjani and S.Saravanan, "Automatic Class Room Light Controlling Using Arduino" International Journal of Engineering Technology Research & Management (IJETRM), Vol-4 Issues 03, pp.192-201, 2020.
58. S.Karthikeyan, A.Krishnaraj, P.Magendran, T.Divya and S.Saravanan , "The Dairy Data Acquisition System" International Journal of Engineering Technology Research & Management (IJETRM), Vol-4 Issues 03, pp.163-169, 2020.
59. N.Harish, R.Jayakumar, P.Kalaiyarasan, G.Vijayakumar and S. Saravanan, "IoT Based Smart Home Energy Meter" International Journal of Engineering Technology Research & Management (IJETRM), Vol-4 Issues 03, pp.177-183, 2020.
60. G. Poovarasan, S. Susikumar, S. Naveen, N. Mohananthini, S. Saravanan," Study of Poultry Fodder Passing Through Trolley in Feeder Box," International Journal of Engineering Technology Research & Management, vol.4, Issue.1, pp.76-83, 2020.
61. A.Ananthan, A.M.Dhanesh, J.Gowtham, R.Dhinesh, G.Jeevitha and S.Saravanan, "IoT Based Clean Water Supply" International Journal of Engineering Technology Research & Management (IJETRM), Vol-4 Issues 03, pp.154-162, 2020.
62. Ram Kumar C, Saravanan S, and Nagarajan C,"Hybrid LSTM and Deep Reinforcement Learning for Autonomous Battery Health Optimization in Electric Vehicles", Electrical Power Systems Research,
63. Vol-253 Issues 112535, ISSN No:0378-7796,2025.
64. Gopinathan, V. R. (2024). Real-Time Fault-Tolerant Multi-Cloud Database Architectures for High Availability Applications. International Journal of Future Innovative Science and Technology (IJFIST), 7(4), 13148.
65. Chandra, S., Rengarajan, A., Sahoo, G. S., & Sharma, S. (2023, December). Identifying Neuronal Damage and Plasticity by Analyzing Changes in Diffusion Tensor Imaging. In International Conference on Data Science, Machine Learning and Applications (pp. 433-438). Singapore: Springer Nature Singapore.
66. Sugumar, R. (2025). Federated AI in Offline-First Mobile Health Architectures for Privacy-Preserving Clinical Intelligence. International Journal of Science, Research and Technology, 8(4), 14589-14600.
67. Murugeshwari, B., Rajalakshmi, S., & Sudharson, K. (2023). Hybrid Approach for Privacy Enhancement in Data Mining Using Arbitrariness and Perturbation. Computer Systems Science & Engineering, 44(3).
68. Pandey, V. K., Mishra, S., Rengarajan, A., Savita, & Roomi, M. M. (2024, March). Enhancing Weather Forecasting with Machine Learning Techniques. In International Conference on Renewable Power (pp. 147-156). Singapore: Springer Nature Singapore.
69. Soundappan, S. J. (2025). Next Generation AI Enabled Holistic Cognitive Platform for Secure Cloud Network Intelligence Enterprise Systems and Digital Trust Optimization. International Journal of Computer Technology and Electronics Communication, 8(5), 11534-11542.
70. Mathew, A. (2022). Leveraging Big Data Analytics to Power AI and ML (Machine Learning) Automation. Educational Research (IJMCER), 4(5), 131-134.
71. Sugumar, R. (2024). AI-Augmented Quality Engineering for Performance Optimization and Test Orchestration in Distributed Systems. International Journal of Science, Research and Technology, 7(5), 12835-12846.
72. Akila, R. (2024). A deep reinforcement learning approach for optimizing inventory management in the agri-food supply chain. J. Electrical Systems, 20(4s), 2238-2247.
73. Mahendran, M., Anbazhagan, K., Pavithran, G., Nivas, A., & Pandey, S. D. (2022). Earthquake Damage Prediction using Machine Learning. Grenze International Journal of Engineering & Technology (GIJET), 8(1).

International Journal of Engineering & Extended Technologies Research (IJEETR)

|ISSN: 2322-0163| www.ijeetr.com | A Bimonthly, Peer Reviewed, Scholarly Indexed Journal |

| Volume 8, Issue 2, March - April 2026 |

DOI:10.15662/IJEETR.2026.0802328

74. Gopinathan, V. R. (2025). Enterprise AI Frameworks for Financial Data Engineering Behavioural Analytics and Intelligent Cloud Solutions. International Journal of Research Publications in Engineering, Technology and Management (IJRPETM), 8(4), 12499-12506.
75. Kondalsamy, P., & Kaliappan, K. (2025). An Optimal Prediction of Leaf Disease Based on Hybrid Deep Learnings and Metaheuristic Technique. Traitement du Signal, 42(1), 363.
76. Deivendran, P., Babu, P. S., Malathi, G., Anbazhagan, K., & Kumar, R. S. (2023). Emotion Recognition for Challenged People Facial Appearance in Social using Neural Network. arXiv preprint arXiv:2305.06842.
77. Sugumar, R. (2025). Unified AI Framework for Predictive Data Engineering and Real Time Prescription and Billing Systems. International Journal of Advanced Engineering Science and Information Technology (IJAESIT), 8(5), 17261.
78. Vekariya, V., Kumar, S., & Rengarajan, A. (2024). A distinctive and smart agricultural knowledge-based framework using ontology. In Sustainability in Digital Transformation Era: Driving Innovative & Growth (pp. 207-213). CRC Press.
79. Gopinathan, V. R. (2025). Software engineering practices for AI-driven systems: From development to deployment (MLOps perspective). International Journal of Science, Research and Technology, 8(1), 13493-13500.
80. Mathew, A. R. (2022). Threats and protection on E-sim: a prospective study. Novel Perspectives of Engineering Research, 8, 76-81.
81. Naveena, S., & Kavitha, K. (2025). Gossypium herbaceum: Folium disease identification and classification using Efficient Net-Coordinate Convolutional Neural Network (EcoNet). Engineering Applications of Artificial Intelligence, 152, 110701.
82. Rengarajan, A., Mishra, A., Kulhar, K. S., Shrivastava, V. P., & Alawneh, Y. J. J. (2024, March). Role of Deep Reinforcement Learning in Mitigating Cyber Security Issues: A Review. In International Conference on Renewable Power (pp. 37-48). Singapore: Springer Nature Singapore.
83. Achari, A. P. S. K., & Sugumar, R. (2024, November). Performance analysis and determination of accuracy using machine learning techniques for naive bayes and random forest. In AIP Conference Proceedings (Vol. 3193, No. 1, p. 020199). AIP Publishing LLC.
84. Mathew, A., & Alex, H. (2022). Detect & protect-medical device cybersecurity. Curr. Overview Sci. Technol. Res, 1, 60-68.
85. Sammy, F., Chettier, T., Boyina, V., Shingne, H., Saluja, K., Mali, M., ... & Shobana, A. (2025). Deep Learning-Driven Visual Analytics Framework for Next-Generation Environmental Monitoring. Journal of Applied Science and Technology Trends, 114-122.
86. Anbazhagan, K. (2024). Trustworthy and Adaptive AI Systems for Enterprise Analytics Cybersecurity and Decision Optimization Using API-First and Cloud-Native Architectures. International Journal of Technology, Management and Humanities, 10(03), 65-74.
87. Mathew, A. (2021). Deep reinforcement learning for cybersecurity applications. Int J Comput Sci Mob Compu, 10(12), 32-38.
88. Dhinakaran, D. (2022). Joe Prathap P. M, Selvaraj D, Arul Kumar D and Murugeshwari B," Mining Privacy-Preserving Association Rules based on Parallel Processing in Cloud Computing,". International Journal of Engineering Trends and Technology, 70(3), 284-294.
89. Karthika, K., Anusha, K., Kavitha, K., Harshadha, R., Dharshini, D. S., & Sundhar, N. A. (2025, April). Frequency Reconfigurable Antenna using Advanced Materials: A Study. In 2025 3rd International Conference on Advancements in Electrical, Electronics, Communication, Computing and Automation (ICAECA) (pp. 1-6). IEEE.
90. Thavamani, C., & Rengarajan, A. (2024). Clustering related behaviour of users by the use of partitioning and parallel transaction reduction algorithm. International Journal of Advanced Intelligence Paradigms, 29(2-3), 122-132.
91. Sugumar, R. (2025). Unified AI Framework for Predictive Data Engineering and Real Time Prescription and Billing Systems. International Journal of Advanced Engineering Science and Information Technology (IJAESIT), 8(5), 17261.
92. Soundappan, S. J., & Sugumar, R. (2016). Optimal knowledge extraction technique based on hybridisation of improved artificial bee colony algorithm and cuckoo search algorithm. International Journal of Business Intelligence and Data Mining, 11(4), 338-356.
93. SakthiPreetha, A., Kavitha, K., Karthika, K., & Manohari, R. G. (2025, April). A Novel Metasurface-Embedded Antenna for WBAN Communications. In 2025 3rd International Conference on Advancements in Electrical, Electronics, Communication, Computing and Automation (ICAECA) (pp. 1-4). IEEE.
94. Murugeshwari, B., Selvaraj, D., Sudharson, K., & Radhika, S. (2023). Data Mining with Privacy Protection Using Precise Elliptical Curve Cryptography. Intelligent Automation & Soft Computing, 35(1).

|ISSN: 2322-0163| www.ijeetr.com | A Bimonthly, Peer Reviewed, Scholarly Indexed Journal |

| Volume 8, Issue 2, March - April 2026 |

DOI:10.15662/IJEETR.2026.0802328

95. Gopinathan, V. R. (2025). Software engineering practices for AI-driven systems: From development to deployment (MLOps perspective). International Journal of Science, Research and Technology, 8(1), 13493-13500.
96. Anbazhagan, K., Kumar, R., Thilagavathy, R., & Anuradha, D. (2024, March). Shortest Job First with Gateway-based Resource Management Strategy for Fog Enabled Cloud Computing. In 2024 4th International Conference on Data Engineering and Communication Systems (ICDECS) (pp. 1-6). IEEE.
97. Kannadhasan, S., Vasuki, S., Kavitha, K., Karthikeyan, P., & Usha, S. G. A. (Eds.). (2025, April). Preface: Role of Artificial Intelligence and IoT in Engineering, Technology & Science [ICRAETS 2024]. In AIP Conference Proceedings (Vol. 3258, No. 1, p. 010001). AIP Publishing LLC.
98. Dhinakaran, D., Prathap, P. J., Selvaraj, D., Kumar, D. A., & Murugeshwari, B. (2022). Mining privacy-preserving association rules based on parallel processing in cloud computing. International Journal of Engineering Trends and Technology, 70(3), 284-294.