Securing IoT Networks: Machine Learning-Based Malware Detection and Adaption

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Abstract. Although Internet of Things (IoT) devices are being rapidly embraced worldwide, there are still several security concerns. Due to their limited resources, they are susceptible to malware assaults such as Gafgyt and Mirai, which have the ability to interrupt networks and infect devices. This work looks into methods based on machine learning to identify and categorize malware in IoT network activity. A dataset comprising both malware and benign traffic is used to assess different classification techniques, such as Random Forest, XGBoost, Logistic Regression, etc., for multi-class malware detection. After a great deal of empirical testing, XGBoost comes out on top, providing 99.9% recall and accuracy. Both known and unknown malware can be detected by the trained model with remarkable precision. The use of transfer learning, where the XGBoost model is used as a basis for the rapid construction of new malware detection models, is one of the major innovations put forth. This makes it possible to quickly adjust to new dangers. More information about how real-time network traffic can be monitored with the help of the created model to find irregularities and sound the alarm. An intelligent and proactive security solution for IoT environments is offered by the machine learning technique that is being discussed. This is an efficient defense against malware because of its high accuracy, low false positive rate, real-time detection capability, and adaptability to new malware varieties changing risks associated with IoT. The suggested methods will assist in securing susceptible IoT devices and networks from obstructive malware assaults.

Keywords. IoT security ,Malware detection ,Machine learning ,XGBoost , Transfer learning, Network traffic Analysis, IoT Malware.

1. INTRODUCTION

A new era of unmatched connection marked by the growth of the Internet of Things (IoT) has redefined how we interact with technology. Our daily lives are now completely dependent on IoT gadgets, which range from industrial sensors to smart home appliances. These ubiquitously present devices are the means through which our environments are evolving to be more intelligent and responsive. IoT device dependency and ubiquity have not been without problems, particularly in cybersecurity. The way we live, and work has undergone a profound shift because of the Internet of Things. From the automated management of our homes to the optimization of industrial operations, it permeates almost every aspect of our existence. IoT gadgets have crept into our daily lives and workplaces in the pursuit of better efficiency, convenience, and connectivity.

However, security presents a significant difficulty because of this pervasiveness and interconnection. IoT devices frequently function with limited resources due to their nature. Numerous IoT manufacturers place a higher priority on usefulness than strong security features in their quest for accessibility and cost. These devices are now exposed to a variety of cybersecurity risks, and malware attacks have been shown to be among the most damaging of these risks. Unauthorized access, data leaks, and network interruptions pose a serious threat to not only the security of individual devices but also the entire foundation of the networks they make up. The necessity for thorough security measures is becoming more critical as the number of IoT devices continues to increase tremendously. IoT devices must rely on intelligent network defenses to recognize and mitigate emerging threats because they have no capacity for self-defense. The risks are great because botnet-powered attacks that disrupt networks can have catastrophic effects on both specific users and entire sectors. IoT devices are pervasive and frequently mission-critical, thus network security must be proactive and adaptable. This

research project explores the potential of predictive machine learning models to address this impending security threat. To create a strong defense against potential threats, a proactive strategy that takes lessons from previous attacks is needed. We seek to build models that can recognize malware attacks in real-time by utilizing transfer learning techniques and historical attack data. This strategy is predicated on the idea that comprehending the strategies used by malicious actors in the past would enable us to recognize and stop their behavior in the future.

2. RESEARCH METHODOLOGY

The research methodology for the project Securing IoT Networks: Machine Learning-Based Malware Detection and Adaption follows a structured approach to ensure the effective design, development, and implementation of the system. The methodology can be broken down into the following key steps:

2.1 Data Preprocessing

The target variable "Class" distinguishes between benign, Mirai, and Gafgyt data for supervised learning.

Malware data from Gafgyt and Mirai are combined, and class imbalance is addressed to enhance malware detection.

The dataset is split into features (X) and target (Y), and saved for efficiency.

2.2 Feature Selection

Exploratory Data Analysis (EDA) helps understand the dataset.

Dimensionality reduction is done to manage memory, balancing class samples for model accuracy.

The target variable categorizes traffic as benign, Mirai, or Bashlite.

2.3 Model Selection & Training

Models: Decision Tree, KNN, Random Forest, XGBoost, and Logistic Regression.

Evaluation metrics include accuracy, recall, and confusion matrices.

2.4 Real-Time Detection

The trained model monitors IoT network traffic, identifies malware patterns, and triggers alerts, allowing for real-time threat responses.

3. RESULTS AND DISCUSSION

The conclusion of the model selection and training phase marks a crucial turning point where the efficacy and applicability of the model are evaluated. Several machines learning models, including Logistic Regression, Decision Tree, KNN Classifier, Random Forest, and XGBoost, are being evaluated in this study. The accuracy of each model's predictions is assessed by examining and contrasting them. Two models, Random Forest and XGBoost, stood out among the examined models as potential winners with an accuracy of 99.953%. The effectiveness of the model's computations is a key consideration. Random Forest demonstrated strong predictive ability, but it also showed increased computing demands. In contrast, XGBoost achieved a compromise between predicted accuracy and computing efficiency by utilizing gradient descent methods. Because of its effective use of gradient descent methods, which ensures faster training times without

compromising prediction accuracy, XGBoost was chosen as the final model. A perfect balance of modern performance and ease of training is offered by XGBoost.

3.1 Challenges and Limitations

One of the primary challenges in IoT malware detection is ensuring the scalability of the system as the number of IoT devices and the volume of network traffic continue to grow. Real-time analysis of large datasets can become computationally expensive, potentially affecting the performance of the detection system. Furthermore, the diversity of IoT devices presents another significant challenge. With varying architectures, communication protocols, and device capabilities, developing a universal detection model that performs consistently across different devices is difficult. In terms of limitations, the study relies on a specific dataset for training and testing, which may limit the generalizability of the model to other datasets or real-world environments where new or unseen malware may appear. The model may also be prone to false positives, where benign traffic is incorrectly flagged as malicious, leading to potential disruptions. Additionally, the model's accuracy is highly dependent on the quality of data preprocessing, which can be difficult to maintain consistently in real-time, especially in dynamic network environments.

3.2 Future Improvements

While the results are promising, further work can be done to expand the approach. The system can be trained on more diverse and recent IoT malware sample data. Hardware-optimized versions can enable embedded and edge deployment. Automated mitigation responses can be incorporated beyond just alerts. AI-driven anomaly detection can be added to detect zero-day threats. End-to-end encryption support is needed for privacy. The model can be iteratively refined before large-scale production rollout. With future enhancements, the intelligent malware detection techniques proposed can help secure the exponentially growing IoT ecosystem.

4. CONCLUSION

This research demonstrates a machine learning based approach to detect and classify malware in IoT networks with high accuracy. The performance of various classification algorithms was evaluated on a dataset containing benign and malware traffic. XGBoost emerged as the top performer with near perfect accuracy and recall. A key innovation proposed is the use of transfer learning where XGBoost acts as a base model for rapid development of new malware detection models. This enables quick adaptation to new threats. The techniques presented provide an intelligent and proactive security solution for resource constrained IoT devices that are highly vulnerable to malware attacks. Real-time network traffic analysis to detect anomalies, malware classification, and automated alerts allows early identification and mitigation of threats. The high accuracy, low false positives, real-time detection capability, and flexibility to new malware variants make this an effective defence for securing IoT environments.

5. DECLARATIONS

4.1 Study Limitations

The study relies on a specific dataset for training and testing, which may limit the generalizability of the model to other datasets or real-world environments where new or unseen malware may appear. The model may also be prone to false positives, where benign traffic is incorrectly flagged as malicious, leading to potential disruptions. Additionally, the model's accuracy is highly dependent on the quality of data preprocessing, which can be difficult to maintain consistently in real-time, especially in dynamic network environments.

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4.3 Funding source

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4.4 Competing Interests

The authors declare that there are no potential conflicts of interest related to this publication. All authors have disclosed their affiliations and any potential financial or personal relationships that could influence the research.

6. HUMAN AND ANIMAL RELATED STUDY

5.1 Ethical Approval

Ethical approval was not required for the Securing IoT Networks: Machine Learning-Based Malware Detection and Adaption, as it did not involve human or animal subjects. An exemption letter confirming this can be provided upon request.

5.2 Informed Consent

Since the project did not involve direct interaction with human participants, formal informed consent was not needed. Feedback collected during testing was done with the understanding that participants knew their input would help improve the tool, without collecting any personal information. A statement confirming the absence of a need for informed consent can be provided if required.

REFERENCES

1. Mukiri, R. R., Kumar, B. S., & Prasad, B. V. V. (2019, February). Effective Data Collaborative Strain Using RecTree Algorithm. In *Proceedings of International Conference on Sustainable Computing in Science, Technology and Management (SUSCOM), Amity University Rajasthan, Jaipur-India*.
2. Rao, B. T., Prasad, B. V. V. S., & Peram, S. R. (2019). Elegant Energy Competent Lighting in Green Buildings Based on Energetic Power Control Using IoT Design. In *Smart Intelligent Computing and Applications: Proceedings of the Second International Conference on SCI 2018, Volume 1* (pp. 247-257). Springer Singapore.
3. Someswar, G. M., & Prasad, B. V. V. S. (2017, October). USVGM protocol with two layer architecture for efficient network management in MANET'S. In *2017 2nd International Conference on Communication and Electronics Systems (ICCES)* (pp. 738-741). IEEE.
4. Alapati, N., Prasad, B. V. V. S., Sharma, A., Kumari, G. R. P., Veeneetha, S. V., Srivalli, N., ... & Sahitya, D. (2022, November). Prediction of Flight-fare using machine learning. In *2022 International Conference on Fourth Industrial Revolution Based Technology and Practices (ICFIRTP)* (pp. 134-138). IEEE.
5. Alapati, N., Prasad, B. V. V. S., Sharma, A., Kumari, G. R. P., Bhargavi, P. J., Alekhya, A., ... & Nandini, K. (2022, November). Cardiovascular Disease Prediction using machine learning. In *2022 International Conference on Fourth Industrial Revolution Based Technology and Practices (ICFIRTP)* (pp. 60-66). IEEE.
6. Narayana, M. S., Babu, N., Prasad, B. V. V. S., & Kumar, B. S. (2011). Clustering Categorical Data--Study of Mining Tools for Data Labeling. *International Journal of Advanced Research in Computer*

Science, *2*(4).

7. Shankar, G. S., Onyema, E. M., Kavin, B. P., Gude, V., & Prasad, B. S. (2024). Breast Cancer Diagnosis Using Virtualization and Extreme Learning Algorithm Based on Deep Feed Forward Networks. *Biomedical Engineering and Computational Biology*, *15*, 11795972241278907.
8. Kulkarni, R., & Prasad, B. S. (2022). Predictive Modeling Of Heart Disease Using Artificial Intelligence. *Journal of Survey in Fisheries Sciences*, 791-801.
9. Gowda, B. M. V., Murthy, G. V. K., Upadhye, A. S., & Raghavan, R. (1996). Serotypes of Escherichia coli from pathological conditions in poultry and their antibiogram.
10. Balasubbareddy, M., Murthy, G. V. K., & Kumar, K. S. (2021). Performance evaluation of different structures of power system stabilizers. *International Journal of Electrical and Computer Engineering (IJECE)*, *11*(1), 114-123.
11. Murthy, G. V. K., & Sivanagaraju, S. (2012). S. Satyana rayana, B. Hanumantha Rao," Voltage stability index of radial distribution networks with distributed generation,". *Int. J. Electr. Eng*, *5*(6), 791-803.
12. Anuja, P. S., Kiran, V. U., Kalavathi, C., Murthy, G. N., & Kumari, G. S. (2015). Design of elliptical patch antenna with single & double U-slot for wireless applications: a comparative approach. *International Journal of Computer Science and Network Security (IJCSNS)*, *15*(2), 60.
13. Murthy, G. V. K., Sivanagaraju, S., Satyanarayana, S., & Rao, B. H. (2015). Voltage stability enhancement of distribution system using network reconfiguration in the presence of DG. *Distributed Generation & Alternative Energy Journal*, *30*(4), 37-54.
14. Reddy, C. N. K., & Murthy, G. V. (2012). Evaluation of Behavioral Security in Cloud Computing. *International Journal of Computer Science and Information Technologies*, *3*(2), 3328-3333.
15. Madhavi, M., & Murthy, G. V. (2020). Role of certifications in improving the quality of Education in Outcome Based Education. *Journal of Engineering Education Transformations*, *33*(Special Issue).
16. Varaprasad Rao, M., Srujan Raju, K., Vishnu Murthy, G., & Kavitha Rani, B. (2020). Configure and management of internet of things. In *Data Engineering and Communication Technology: Proceedings of 3rd ICDECT-2K19* (pp. 163-172). Springer Singapore.
17. Murthy, G. V. K., Suresh, C. H. V., Sowjankumar, K., & Hanumantharao, B. (2019). Impact of distributed generation on unbalanced radial distribution system. *International Journal of Scientific and Technology Research*, *8*(9), 539-542.
18. Balram, G., & Kumar, K. K. (2022). Crop field monitoring and disease detection of plants in smart agriculture using internet of things. *International Journal of Advanced Computer Science and Applications*, *13*(7).
19. Balram, G., & Kumar, K. K. (2018). Smart farming: Disease detection in crops. *Int. J. Eng. Technol*, *7*(2.7), 33-36.
20. Balram, G., Rani, G. R., Mansour, S. Y., & Jafar, A. M. (2001). Medical management of otitis media with effusion. *Kuwait Medical Journal*, *33*(4), 317-319.
21. Balram, G., Anitha, S., & Deshmukh, A. (2020, December). Utilization of renewable energy sources in generation and distribution optimization. In *IOP Conference Series: Materials Science and Engineering* (Vol. 981, No. 4, p. 042054). IOP Publishing.
22. Hnamte, V., & Balram, G. (2022). Implementation of Naive Bayes Classifier for Reducing DDoS Attacks in IoT Networks. *Journal of Algebraic Statistics*, *13*(2), 2749-2757.
23. Prasad, P. S., & Rao, S. K. M. (2017). HIASA: Hybrid improved artificial bee colony and simulated annealing based attack detection algorithm in mobile ad-hoc networks (MANETs). *Bonfring International Journal of Industrial Engineering and Management Science*, *7*(2), 01-12.
24. Prasad, PVS Siva, and S. Krishna Mohan Rao. "A Survey on Performance Analysis of ManetsUnder Security Attacks." *network* 6, no. 7 (2017).
25. Reddy, B. A., & Reddy, P. R. S. (2012). Effective data distribution techniques for multi-cloud storage in cloud computing. *CSE, Anurag Group of Institutions, Hyderabad, AP, India*.

26. Srilatha, P., Murthy, G. V., & Reddy, P. R. S. (2020). Integration of Assessment and Learning Platform in a Traditional Class Room Based Programming Course. *Journal of Engineering Education Transformations*, *33*(Special Issue).
27. Reddy, P. R. S., & Ravindranadh, K. (2019). An exploration on privacy concerned secured data sharing techniques in cloud. *International Journal of Innovative Technology and Exploring Engineering*, *9*(1), 1190-1198.
28. Reddy, P. R. S., Bhoga, U., Reddy, A. M., & Rao, P. R. (2017). OER: Open Educational Resources for Effective Content Management and Delivery. *Journal of Engineering Education Transformations*, *30*(3).
29. Madhuri, K., Viswanath, N. K., & Gayatri, P. U. (2016, November). Performance evaluation of AODV under Black hole attack in MANET using NS2. In *2016 international conference on ICT in Business Industry & Government (ICTBIG)* (pp. 1-3). IEEE.
30. Kovoor, M., Durairaj, M., Karyakarte, M. S., Hussain, M. Z., Ashraf, M., & Maguluri, L. P. (2024). Sensor-enhanced wearables and automated analytics for injury prevention in sports. *Measurement: Sensors*, *32*, 101054.
31. Rao, N. R., Kovoor, M., Kishor Kumar, G. N., & Parameswari, D. V. L. (2023). Security and privacy in smart farming: challenges and opportunities. *International Journal on Recent and Innovation Trends in Computing and Communication*, *11*(7 S).
32. Madhuri, K. (2023). Security Threats and Detection Mechanisms in Machine Learning. *Handbook of Artificial Intelligence*, 255.
33. Madhuri, K. (2022). A New Level Intrusion Detection System for Node Level Drop Attacks in Wireless Sensor Network. *Journal of Algebraic Statistics*, *13*(1), 159-168.
34. DASTAGIRAIAH, D. (2024). A SYSTEM FOR ANALYSING CALL DROP DYNAMICS IN THE TELECOM INDUSTRY USING MACHINE LEARNING AND FEATURE SELECTION. *Journal of Theoretical and Applied Information Technology*, *102*(22).
35. Sukhavasi, V., Kulkarni, S., Raghavendran, V., Dastagiraiah, C., Apat, S. K., & Reddy, P. C. S. (2024). Malignancy Detection in Lung and Colon Histopathology Images by Transfer Learning with Class Selective Image Processing.
36. Sudhakar, R. V., Dastagiraiah, C., Pattem, S., & Bhukya, S. (2024). Multi-Objective Reinforcement Learning Based Algorithm for Dynamic Workflow Scheduling in Cloud Computing. *Indonesian Journal of Electrical Engineering and Informatics (IJEEI)*, *12*(3), 640-649.
37. PushpaRani, K., Roja, G., Anusha, R., Dastagiraiah, C., Srilatha, B., & Manjusha, B. (2024, June). Geological Information Extraction from Satellite Imagery Using Deep Learning. In *2024 15th International Conference on Computing Communication and Networking Technologies (ICCCNT)* (pp. 1-7). IEEE.
38. Rani, K. P., Reddy, Y. S., Sreedevi, P., Dastagiraiah, C., Shekar, K., & Rao, K. S. (2024, June). Tracking The Impact of PM Poshan on Child's Nutritional Status. In *2024 15th International Conference on Computing Communication and Networking Technologies (ICCCNT)* (pp. 1-4). IEEE.
39. Sravan, K., Gunakar Rao, L., Ramineni, K., Rachapalli, A., & Mohmmad, S. (2023, July). Analyze the Quality of Wine Based on Machine Learning Approach. In *International Conference on Data Science and Applications* (pp. 351-360). Singapore: Springer Nature Singapore.
40. LAASSIRI, J., EL HAJJI, S. A. Ï. D., BOUHDADI, M., AOUDE, M. A., JAGADISH, H. P., LOHIT, M. K., ... & KHOLLADI, M. (2010). Specifying Behavioral Concepts by engineering language of RM-ODP. *Journal of Theoretical and Applied Information Technology*, *15*(1).
41. Ramineni, K., Harshith Reddy, K., Sai Thrikoteshwara Chary, L., Nikhil, L., & Akanksha, P. (2024, February). Designing an Intelligent Chatbot with Deep Learning: Leveraging FNN Algorithm for Conversational Agents to Improve the Chatbot Performance. In *World Conference on Artificial Intelligence: Advances and Applications* (pp. 143-151). Singapore: Springer Nature Singapore.

42. Samya, B., Archana, M., Ramana, T. V., Raju, K. B., & Ramineni, K. (2024, February). Automated Student Assignment Evaluation Based on Information Retrieval and Statistical Techniques. In *Congress on Control, Robotics, and Mechatronics* (pp. 157-167). Singapore: Springer Nature Singapore.
43. Sekhar, P. R., & Sujatha, B. (2020, July). A literature review on feature selection using evolutionary algorithms. In *2020 7th International Conference on Smart Structures and Systems (ICSSS)* (pp. 1-8). IEEE.
44. Sekhar, P. R., & Sujatha, B. (2023). Feature extraction and independent subset generation using genetic algorithm for improved classification. *Int. J. Intell. Syst. Appl. Eng*, *11*, 503-512.
45. Sekhar, P. R., & Goud, S. (2024). Collaborative Learning Techniques in Python Programming: A Case Study with CSE Students at Anurag University. *Journal of Engineering Education Transformations*, *38*(Special Issue 1).
46. Pesaramelli, R. S., & Sujatha, B. (2024, March). Principle correlated feature extraction using differential evolution for improved classification. In *AIP Conference Proceedings* (Vol. 2919, No. 1). AIP Publishing.
47. Amarnadh, V., & Moparthi, N. R. (2023). Comprehensive review of different artificial intelligence-based methods for credit risk assessment in data science. *Intelligent Decision Technologies*, *17*(4), 1265-1282.
48. Amarnadh, V., & Moparthi, N. R. (2024). Prediction and assessment of credit risk using an adaptive Binarized spiking marine predators' neural network in financial sector. *Multimedia Tools and Applications*, *83*(16), 48761-48797.
49. Amarnadh, V., & Moparthi, N. R. (2024). Range control-based class imbalance and optimized granular elastic net regression feature selection for credit risk assessment. *Knowledge and Information Systems*, 1-30.
50. Amarnadh, V., & Akhila, M. (2019, May). RETRACTED: Big Data Analytics in E-Commerce User Interest Patterns. In *Journal of Physics: Conference Series* (Vol. 1228, No. 1, p. 012052). IOP Publishing.
51. Ravinder Reddy, B., & Anil Kumar, A. (2020). Survey on access control mechanisms in cloud environments. In *Advances in Computational Intelligence and Informatics: Proceedings of ICACII 2019* (pp. 141-149). Springer Singapore.
52. Reddy, M. B. R., Nandini, J., & Sathwik, P. S. Y. (2019). Handwritten text recognition and digital text conversion. *International Journal of Trend in Research and Development*, *3*(3), 1826-1827.
53. Reddy, B. R., & Adilakshmi, T. (2023). Proof-of-Work for Merkle based Access Tree in Patient Centric Data. *structure*, *14*(1).
54. Reddy, B. R., Adilakshmi, T., & Kumar, C. P. (2020). Access Control Methods in Cloud Enabledthe Cloud-Enabled Internet of Things. In *Managing Security Services in Heterogenous Networks* (pp. 1-17). CRC Press.
55. Reddy, M. B. R., Akhil, V., Preetham, G. S., & Poojitha, P. S. (2019). Profile Identification through Face Recognition.
56. Dutta, P. K., & Mitra, S. (2021). Application of agricultural drones and IoT to understand food supply chain during post COVID-19. *Agricultural informatics: automation using the IoT and machine learning*, 67-87.
57. Matuka, A., Asafo, S. S., Eweke, G. O., Mishra, P., Ray, S., Abotaleb, M., ... & Chowdhury, S. (2022, December). Analysing the impact of COVID-19 outbreak and economic policy uncertainty on stock markets in major affected economies. In *6th Smart Cities Symposium (SCS 2022)* (Vol. 2022, pp. 372-378). IET.
58. Saber, M., & Dutta, P. K. (2022). Uniform and Nonuniform Filter Banks Design Based on Fusion Optimization. *Fusion: Practice and Applications*, *9*(1), 29-37.
59. Mensah, G. B., & Dutta, P. K. (2024). Evaluating if Ghana's Health Institutions and Facilities Act 2011

(Act 829) Sufficiently Addresses Medical Negligence Risks from Integration of Artificial Intelligence Systems. *Mesopotamian Journal of Artificial Intelligence in Healthcare*, *2024*, 35-41.

60. Aydın, Ö., Karaarslan, E., & Gökçe Narin, N. (2023). Artificial intelligence, vr, ar and metaverse technologies for human resources management. *VR, AR and Metaverse Technologies for Human Resources Management (June 15, 2023)*.
61. Thamma, S. R. (2025). Transforming E-Commerce with Pragmatic Advertising Using Machine Learning Techniques.
62. Thamma, S. R. T. S. R. (2024). Optimization of Generative AI Costs in Multi-Agent and Multi-Cloud Systems.
63. Thamma, S. R. T. S. R. (2024). Revolutionizing Healthcare: Spatial Computing Meets Generative AI.
64. Thamma, S. R. T. S. R. (2024). Cardiovascular image analysis: AI can analyze heart images to assess cardiovascular health and identify potential risks.
65. Thamma, S. R. T. S. R. (2024). Generative AI in Graph-Based Spatial Computing: Techniques and Use Cases.
66. Harinath, D., Bandi, M., Patil, A., Murthy, M. R., & Raju, A. V. S. (2024). Enhanced Data Security and Privacy in IoT devices using Blockchain Technology and Quantum Cryptography. *Journal of Systems Engineering and Electronics (ISSN NO: 1671-1793)*, *34*(6).
67. Harinath, D., Patil, A., Bandi, M., Raju, A. V. S., Murthy, M. R., & Spandana, D. (2024). Smart Farming System–An Efficient technique by Predicting Agriculture Yields Based on Machine Learning. *Technische Sicherheit (Technical Security) Journal*, *24*(5), 82-88.
68. Masimukku, A. K., Bandi, M., Vallu, S., Patil, A., Vasundhara, K. L., & Murthy, M. R. (2025). Innovative Approaches in Diabetes Management: Leveraging Technology for Improved Healthcare Outcomes. *International Meridian Journal*, *7*(7).
69. Bandi, M., Masimukku, A. K., Vemula, R., & Vallu, S. (2024). Predictive Analytics in Healthcare: Enhancing Patient Outcomes through Data-Driven Forecasting and Decision-Making. *International Numeric Journal of Machine Learning and Robots*, *8*(8), 1-20.
70. Moreb, M., Mohammed, T. A., & Bayat, O. (2020). A novel software engineering approach toward using machine learning for improving the efficiency of health systems. *IEEE Access*, *8*, 23169-23178.
71. Ravi, P., Batta, G. S. H. N., & Yaseen, S. (2019). Toxic comment classification. *International Journal of Trend in Scientific Research and Development (IJTSRD)*.
72. Pallam, R., Konda, S. P., Manthripragada, L., & Noone, R. A. (2021). Detection of Web Attacks using Ensemble Learning. *learning*, *3*(4), 5.
73. Reddy, P. V., Ravi, P., Ganesh, D., Naidu, P. M. K., Vineeth, N., & Sameer, S. (2023, July). Detection and Evaluation of Cervical Cancer by Multiple Instance Learning. In *2023 2nd International Conference on Edge Computing and Applications (ICECAA)* (pp. 627-633). IEEE.
74. Ravi, P., Haritha, D., & Niranjan, P. (2018). A Survey: Computing Iceberg Queries. *International Journal of Engineering & Technology*, *7*(2.7), 791-793.
75. Chidambaram, R., Balamurugan, M., Senthilkumar, R., Srinivasan, T., Rajmohan, M., Karthick, R., & Abraham, S. (2013). Combining AIET with chemotherapy–lessons learnt from our experience. *J Stem Cells Regen Med*, *9*(2), 42-43.
76. Karthick, R., & Sundhararajan, M. (2014). Hardware Evaluation of Second Round SHA-3 Candidates Using FPGA. *International Journal of Advanced Research in Computer Science & Technology (IJARCST 2014)*, *2*(2).
77. Sudhan, K., Deepak, S., & Karthick, R. (2016). SUSTAINABILITY ANALYSIS OF KEVLAR AND BANANA FIBER COMPOSITE.
78. Karthick, R., Gopalakrishnan, S., & Ramesh, C. (2020). Mechanical Properties and Characterization of Palmyra Fiber and Polyester Resins Composite. *International Journal of Emerging Trends in Science & Technology*, *6*(2).

79. Karthick, R., Pandi, M., Dawood, M. S., Prabaharan, A. M., & Selvaprasanth, P. (2021). ADHAAR: A RELIABLE DATA HIDING TECHNIQUES WITH (NNP2) ALGORITHMIC APPROACH USING X-RAY IMAGES. *3C Tecnologia*, 597-608.
80. Deepa, R., Karthick, R., Velusamy, J., & Senthilkumar, R. (2025). Performance analysis of multiple-input multiple-output orthogonal frequency division multiplexing system using arithmetic optimization algorithm. *Computer Standards & Interfaces*, *92*, 103934.
81. Selvan, M. Arul, and S. Miruna Joe Amali. "RAINFALL DETECTION USING DEEP LEARNING TECHNIQUE." (2024).
82. Selvan, M. Arul. "Fire Management System For Indutrial Safety Applications." (2023).
83. Selvan, M. A. (2023). A PBL REPORT FOR CONTAINMENT ZONE ALERTING APPLICATION.
84. Selvan, M. A. (2023). CONTAINMENT ZONE ALERTING APPLICATION A PROJECT BASED LEARNING REPORT.
85. Selvan, M. A. (2021). Robust Cyber Attack Detection with Support Vector Machines: Tackling Both Established and Novel Threats.
86. Reddy, A. S., Prathap, P., Subbaiah, Y. V., Reddy, K. R., & Yi, J. (2008). Growth and physical behaviour of Zn1− xMgxO films. *Thin Solid Films*, *516*(20), 7084-7087.
87. Ambujam, S., Audhya, M., Reddy, A., & Roy, S. (2013). Cutaneous angiosarcoma of the head, neck, and face of the elderly in type 5 skin. *Journal of Cutaneous and Aesthetic Surgery*, *6*(1), 45-47.
88. Reddy, K. R., Prathap, P., Revathi, N., Reddy, A. S. N., & Miles, R. W. (2009). Mg-composition induced effects on the physical behavior of sprayed Zn1− xMgxO films. *Thin Solid Films*, *518*(4), 1275-1278.
89. Prathap, P., Reddy, A. S., Reddy, G. R., Miles, R. W., & Reddy, K. R. (2010). Characterization of novel sprayed Zn1− xMgxO films for photovoltaic application. *Solar energy materials and solar cells*, *94*(9), 1434-1436.
90. Babbar, R., Kaur, A., Vanya, Arora, R., Gupta, J. K., Wal, P., ... & Behl, T. (2024). Impact of Bioactive Compounds in the Management of Various Inflammatory Diseases. *Current Pharmaceutical Design*, *30*(24), 1880-1893.
91. Lokhande, M., Kalpanadevi, D., Kate, V., Tripathi, A. K., & Bethapudi, P. (2023). Study of Computer Vision Applications in Healthcare Industry 4.0. In *Healthcare Industry 4.0* (pp. 151-166). CRC Press.
92. Parganiha, R., Tripathi, A., Prathyusha, S., Baghel, P., Lanjhiyana, S., Lanjhiyana, S., ... & Sarkar, D. (2022). A review of plants for hepatic disorders. *J. Complement. Med. Res*, *13*(46), 10-5455.
93. Tripathi, A. K., Soni, R., & Verma, S. (2022). A review on ethnopharmacological applications, pharmacological activities, and bioactive compounds of Mimosa pudica (linn.). *Research Journal of Pharmacy and Technology*, *15*(9), 4293-4299.
94. Tripathi, A. K., Dwivedi, C. P., Bansal, P., Pradhan, D. K., Parganiha, R., & Sahu, D. An Ethnoveterinary Important Plant Terminalia Arjuna. *International Journal of Health Sciences*, (II), 10601-10607.
95. Mishra, S., Grewal, J., Wal, P., Bhivshet, G. U., Tripathi, A. K., & Walia, V. (2024). Therapeutic potential of vasopressin in the treatment of neurological disorders. *Peptides*, *174*, 171166.
96. Koliqi, R., Fathima, A., Tripathi, A. K., Sohi, N., Jesudasan, R. E., & Mahapatra, C. (2023). Innovative and Effective Machine Learning-Based Method to Analyze Alcoholic Brain Activity with Nonlinear Dynamics and Electroencephalography Data. *SN Computer Science*, *5*(1), 113.
97. Tripathi, A. K., Diwedi, P., Kumar, N., Yadav, B. K., & Rathod, D. (2022). Trigonella Foenum Grecum L. Seed (Fenugreek) Pharmacological Effects on Cardiovascular and Stress Associated Disease. *NeuroQuantology*, *20*(8), 4599.
98. Sahu, P., Sharma, G., Verma, V. S., Mishra, A., Deshmukh, N., Pandey, A., ... & Chauhan, P. (2022). Statistical optimization of microwave assisted acrylamide grafting of Linum usitatissimum Gum. *NeuroQuantology*, *20*(11), 4008.

99. Biswas, D., Sharma, G., Pandey, A., Tripathi, A. K., Pandey, A., Sahu, P., ... & Chauhan, P. (2022). Magnetic Nanosphere: Promising approach to deliver the drug to the site of action. *NeuroQuantology*, *20*(11), 4038.
100. Ramya, S., Devi, R. S., Pandian, P. S., Suguna, G., Suganya, R., & Manimozhi, N. (2023). Analyzing Big Data challenges and security issues in data privacy. *International Research Journal of Modernization in Engineering Technology and Science*, *5*(2023), 421-428.
101. Pandian, P. S., & Srinivasan, S. (2016). A Unified Model for Preprocessing and Clustering Technique for Web Usage Mining. *Journal of Multiple-Valued Logic & Soft Computing*, *26*.
102. Muthukumar, K. K. M., & Pandian, S. Analyzing and Improving the Performance of Decision Database with Enhanced Momentous Data Types. *Asia Journal of Information Technology*, *16*(9), 699-705.
103. Pandian, P. S. (2023). RETRACTED: Adopting security checks in business transactions using formal-oriented analysis processes for entrepreneurial students. *International Journal of Electrical Engineering & Education*, *60*(1_suppl), 1357-1365.
104. Karthick, R., & Pragasam, J. (2019). D "Design of Low Power MPSoC Architecture using DR Method" Asian Journal of Applied Science and Technology (AJAST) Volume 3, Issue 2.
105. Karthick, R. (2018). Deep Learning For Age Group Classification System. *International Journal Of Advances In Signal And Image Sciences*, *4*(2), 16-22.
106. Karthick, R., Akram, M., & Selvaprasanth, P. (2020). A Geographical Review: Novel Coronavirus (COVID-19) Pandemic. *A Geographical Review: Novel Coronavirus (COVID-19) Pandemic (October 16, 2020). Asian Journal of Applied Science and Technology (AJAST)(Quarterly International Journal) Volume*, *4*, 44-50.
107. Karthick, R. (2018). Integrated System For Regional Navigator And Seasons Management. *Journal of Global Research in Computer Science*, *9*(4), 11-15.
108. Kavitha, N., Soundar, K. R., Karthick, R., & Kohila, J. (2024). Automatic video captioning using tree hierarchical deep convolutional neural network and ASRNN-bi-directional LSTM. *Computing*, *106*(11), 3691-3709.
109. Selvan, M. A. (2023). INDUSTRY-SPECIFIC INTELLIGENT FIRE MANAGEMENT SYSTEM.
110. Selvan, M. Arul. "PHISHING CONTENT CLASSIFICATION USING DYNAMIC WEIGHTING AND GENETIC RANKING OPTIMIZATION ALGORITHM." (2024).
111. Selvan, M. Arul. "Innovative Approaches in Cardiovascular Disease Prediction Through Machine Learning Optimization." (2024).
112. Kumar, T. V. (2024). A Comparison of SQL and NO-SQL Database Management Systems for Unstructured Data.
113. Kumar, T. V. (2024). A Comprehensive Empirical Study Determining Practitioners' Views on Docker Development Difficulties: Stack Overflow Analysis.
114. Kumar, T. V. (2024). Developments and Uses of Generative Artificial Intelligence and Present Experimental Data on the Impact on Productivity Applying Artificial Intelligence that is Generative.
115. Kumar, T. V. (2024). A New Framework and Performance Assessment Method for Distributed Deep Neural NetworkBased Middleware for Cyberattack Detection in the Smart IoT Ecosystem.
116. Sharma, S., & Dutta, N. (2024). Examining ChatGPT's and Other Models' Potential to Improve the Security Environment using Generative AI for Cybersecurity.
117. Sharma, S., & Dutta, N. (2016). Analysing Anomaly Process Detection using Classification Methods and Negative Selection Algorithms.
118. Sakshi, S. (2023). Development of a Project Risk Management System based on Industry 4.0 Technology and its Practical Implications.
119. Arora, P., & Bhardwaj, S. (2021). Methods for Threat and Risk Assessment and Mitigation to Improve Security in the Automotive Sector. *Methods*, *8*(2).

120. Arora, P., & Bhardwaj, S. (2020). Research on Cybersecurity Issues and Solutions for Intelligent Transportation Systems.
121. Arora, P., & Bhardwaj, S. (2019). The Suitability of Different Cybersecurity Services to Stop Smart Home Attacks.
122. Arora, P., & Bhardwaj, S. (2017). A Very Safe and Effective Way to Protect Privacy in Cloud Data Storage Configurations.
123. Arora, P., & Bhardwaj, S. (2017). Investigation and Evaluation of Strategic Approaches Critically before Approving Cloud Computing Service Frameworks.
124. Arora, P., & Bhardwaj, S. (2017). Enhancing Security using Knowledge Discovery and Data Mining Methods in Cloud Computing.
125. Arora, P., & Bhardwaj, S. (2019). Safe and Dependable Intrusion Detection Method Designs Created with Artificial Intelligence Techniques. *machine learning*, *8*(7).
126. Sharma, S., & Dutta, N. (2024). Examining ChatGPT's and Other Models' Potential to Improve the Security Environment using Generative AI for Cybersecurity.
127. Sakshi, S. (2023). Development of a Project Risk Management System based on Industry 4.0 Technology and its Practical Implications.
128. Sharma, S., & Dutta, N. (2018). Development of New Smart City Applications using Blockchain Technology and Cybersecurity Utilisation. *Development*, *7*(11).
129. Sharma, S., & Dutta, N. (2017). Classification and Feature Extraction in Artificial Intelligence-based Threat Detection using Analysing Methods.
130. Sharma, S., & Dutta, N. (2017). Development of Attractive Protection through Cyberattack Moderation and Traffic Impact Analysis for Connected Automated Vehicles. *Development*, *4*(2).
131. Sharma, S., & Dutta, N. (2016). Analysing Anomaly Process Detection using Classification Methods and Negative Selection Algorithms.
132. Sharma, S., & Dutta, N. (2015). Evaluation of REST Web Service Descriptions for Graph-based Service Discovery with a Hypermedia Focus. *Evaluation*, *2*(5).
133. Sharma, S., & Dutta, N. (2015). Cybersecurity Vulnerability Management using Novel Artificial Intelligence and Machine Learning Techniques.
134. Sharma, S., & Dutta, N. (2015). Distributed DNN-based Middleware for Cyberattack Detection in the Smart IOT Ecosystem: A Novel Framework and Performance Evaluation Technique.
135. Sakshi, S. (2024). A Large-Scale Empirical Study Identifying Practitioners' Perspectives on Challenges in Docker Development: Analysis using Stack Overflow.
136. Sakshi, S. (2023). Advancements and Applications of Generative Artificial Intelligence and show the Experimental Evidence on the Productivity Effects using Generative Artificial Intelligence.
137. Bhat, S. (2024). Building Thermal Comforts with Various HVAC Systems and Optimum Conditions.
138. Bhat, S. (2020). Enhancing Data Centre Energy Efficiency with Modelling and Optimisation of End-To-End Cooling.
139. Bhat, S. (2016). Improving Data Centre Energy Efficiency with End-To-End Cooling Modelling and Optimisation.
140. Bhat, S. (2015). Deep Reinforcement Learning for Energy-Saving Thermal Comfort Management in Intelligent Structures.
141. Bhat, S. (2015). Design and Function of a Gas Turbine Range Extender for Hybrid Vehicles.
142. Bhat, S. (2023). Discovering the Attractiveness of Hydrogen-Fuelled Gas Turbines in Future Energy Systems.
143. Bhat, S. (2019). Data Centre Cooling Technology's Effect on Turbo-Mode Efficiency.
144. Bhat, S. (2018). The Impact of Data Centre Cooling Technology on Turbo-Mode Efficiency.

145. Bhat, S. (2015). Technology for Chemical Industry Mixing and Processing. *Technology*, *2*(2).

146. Bauri, K. P., & Sarkar, A. (2016). Flow and scour around vertical submerged structures. *Sādhanā*, *41*, 1039-1053.

147. Bauri, K. P., & Sarkar, A. (2020). Turbulent bursting events within equilibrium scour holes around aligned submerged cylinder. *Journal of Turbulence*, *21*(2), 53-83.

148. Bauri, K. P., & Sarkar, A. (2019). Turbulent burst-sweep events around fully submerged vertical square cylinder over plane bed. *Environmental Fluid Mechanics*, *19*, 645-666.

149. Bauri, K. P. (2022). Coherent structures around submerged circular and square cylinders due to change of orientation angle in steady current over plane bed. *Acta Geophysica*, *70*(5), 2223-2250.

150. Polamarasetti, A. (2024, November). Research developments, trends and challenges on the rise of machine learning for detection and classification of malware. In *2024 International Conference on Intelligent Computing and Emerging Communication Technologies (ICEC)* (pp. 1-5). IEEE.

151. Polamarasetti, A. (2024, November). Machine learning techniques analysis to Efficient resource provisioning for elastic cloud services. In *2024 International Conference on Intelligent Computing and Emerging Communication Technologies (ICEC)* (pp. 1-6). IEEE.

152. Polamarasetti, A. (2024, November). Role of Artificial Intelligence and Machine Learning to Enhancing Cloud Security. In *2024 International Conference on Intelligent Computing and Emerging Communication Technologies (ICEC)* (pp. 1-6). IEEE.

153. Gollangi, H. K., Bauskar, S. R., Madhavaram, C. R., Galla, E. P., Sunkara, J. R., & Reddy, M. S. (2020). Echoes in Pixels: The intersection of Image Processing and Sound detection through the lens of AI and Ml. *International Journal of Development Research*, *10*(08), 39735-39743.

154. Reddy, M. S., Sarisa, M., Konkimalla, S., Bauskar, S. R., Gollangi, H. K., Galla, E. P., & Rajaram, S. K. (2021). Predicting tomorrow's Ailments: How AI/ML Is Transforming Disease Forecasting. *ESP Journal of Engineering & Technology Advancements*, *1*(2), 188-200.

155. Boddapati, V. N., Sarisa, M., Reddy, M. S., Sunkara, J. R., Rajaram, S. K., Bauskar, S. R., & Polimetla, K. (2022). Data migration in the cloud database: A review of vendor solutions and challenges. *Available at SSRN 4977121*.

156. Boddapati, V. N., Sarisa, M., Reddy, M. S., Sunkara, J. R., Rajaram, S. K., Bauskar, S. R., & Polimetla, K. (2022). Data migration in the cloud database: A review of vendor solutions and challenges. *Available at SSRN 4977121*.

157. Patra, G. K., Rajaram, S. K., Boddapati, V. N., Kuraku, C., & Gollangi, H. K. (2022). Advancing Digital Payment Systems: Combining AI, Big Data, and Biometric Authentication for Enhanced Security. *International Journal of Engineering and Computer Science*, *11*(08), 10-18535.

158. Patra, G. K., Rajaram, S. K., & Boddapati, V. N. (2019). Ai And Big Data In Digital Payments: A Comprehensive Model For Secure Biometric Authentication. *Educational Administration: Theory and Practice*.

159. Boddapati, V. N., Galla, E. P., Sunkara, J. R., Bauskar, S., Patra, G. K., Kuraku, C., & Madhavaram, C. R. (2021). Harnessing the Power of Big Data: The Evolution of AI and Machine Learning in Modern Times. *ESP Journal of Engineering & Technology Advancements*, *1*(2), 134-146.

160. Singh, K., & Neeru, N. (2023). A COMPREHENSIVE STUDY OF THE IOT ATTACKS ON DIFFERENT LAYERS. *Journal Punjab Academy of Sciences*, *23*, 140-155.

161. Singh, K., & Neeru, N. (2023). A COMPREHENSIVE STUDY OF THE IOT ATTACKS ON DIFFERENT LAYERS. *Journal Punjab Academy of Sciences*, *23*, 140-155.

162. Ravi, P., Haritha, D., & Obulesh, A. (2022). Average Iceberg Queries Computation Using Bitmap Indexes On Health Care Data. *Journal of Pharmaceutical Negative Results*, 3724-3731.

163. Singh, V., Sharma, M. P., Jayapriya, K., Kumar, B. K., Chander, M. A. R. N., & Kumar, B. R. (2023). Service quality, customer satisfaction and customer loyalty: A comprehensive literature review. *Journal of Survey in Fisheries Sciences*, *10*(4S), 3457-3464.