

Software for Intervention of Speech Sound Disorder in Hindi and English

¹D.Dinesh, ²K.Harikiran, ³M L Sai Akshitha Sumaalika

¹Assistant Professor, Department of Computer Science and Engineering, Anurag University, Hyderabad, Telangana, India.

^{2,3}UG Student, Department of Computer Science and Engineering, Anurag University, Hyderabad, Telangana, India.

21eg105f10@anurag.edu.in

21eg105f16@anurag.edu.in

21eg105f58@anurag.edu.in

Abstract. Speech sound disorders (SSD) significantly affect language development, particularly in non-native or multilingual environments like India. While traditional methods have been useful, they often lack the flexibility, accessibility, and personalized approach that modern technology can offer. This research proposes the development of a web-based application designed to intervene in speech sound disorders for Hindi and English speakers. The software will incorporate speech recognition, interactive feedback, and progress tracking, tailored to individual needs. Features include audio analysis, visual cues, and personalized phonetic exercises for improving pronunciation and speech clarity. The platform will support speech assessments, provide customized corrective exercises, and offer detailed performance reports, aiming to enhance learning outcomes for users of all ages and linguistic backgrounds.

Keywords. Speech Sound Disorders, Hindi, English, Speech Recognition, Web Application, Phonetic Exercises, Progress Tracking.

1 INTRODUCTION

Speech sound disorders (SSD) in children and adults can hinder effective communication, often leading to social isolation and academic challenges. In regions like India, where bilingualism or multilingualism is common, speech therapy often becomes more complex due to the variability in phonetic systems across languages. Traditional speech therapy interventions, though effective, are often inaccessible due to geographical, financial, and time constraints. This research proposes a digital intervention for speech sound disorders, specifically designed for Hindi and English speakers. By leveraging speech recognition technologies and providing personalized phonetic exercises, this software aims to support individuals in improving their speech and language skills. The platform also includes detailed performance analytics to track progress and ensure effective intervention.

2 USER - CENTERED DESIGN

A user-centered design approach was followed, ensuring that the application addresses the specific needs of individuals with speech sound disorders. The initial phase included surveys and interviews with speech therapists, caregivers, and users of various age groups to understand their challenges and expectations. This feedback guided the development of core features such as personalized phonetic exercises, speech analysis, and real-time feedback.

2.1 Development Framework

The application was developed using an agile software development methodology, enabling iterative testing and continuous improvement. The technology stack includes:

Frontend: React.js for creating a dynamic, user-friendly interface.

Backend: Node.js and Express.js for managing requests and server-side operations.

Database: MongoDB for storing user profiles, speech analysis data, and progress reports.

Speech Recognition: Integrated APIs for speech-to-text conversion, analysis, and comparison against standard phonetic models.

AI & Machine Learning: Applied for analyzing speech patterns, detecting errors, and suggesting corrective exercises.

2.2 Data Collection and Analysis

Data was collected from user interactions with the application, such as session logs, completed exercises, and performance results. This data helped refine algorithms and improve the platform's ability to provide accurate, personalized feedback. User surveys and interviews were also conducted to assess the effectiveness of the intervention and user satisfaction.

2.3 Data Collection and Analysis

The design and features of the software are based on existing evidence from the fields of speech-language pathology and educational technology. Features like real-time feedback, audio playback, and phonetic exercises are grounded in clinical practices for improving speech sound accuracy and fluency.

2.4 Community Engagement

The application encourages community engagement by integrating a feedback mechanism that allows users to share experiences and provide suggestions. A community forum for speech therapists, caregivers, and users helps share best practices, fostering a collaborative learning environment.

3 THEORY AND CALCULATION

3.1. Theory

The theoretical framework for this research is grounded in Speech-Language Pathology Theory and Digital Education Frameworks. The former highlights the importance of structured interventions to correct speech sound disorders, while the latter emphasizes the effectiveness of digital tools in delivering personalized education and therapy.

Speech-Language Pathology Theory: SSDs require targeted therapy, which is often most effective when tailored to the individual's phonetic and linguistic needs. Digital Education Frameworks: Digital platforms, especially those involving speech recognition and AI, provide an innovative way to deliver consistent, personalized interventions for SSDs.

3.2 Calculation

To evaluate the software's effectiveness, several metrics and analyses are planned:

1. Performance Metrics:

Accuracy of Speech Recognition:

Method: The accuracy of speech recognition will be calculated by comparing the recognized text against a pre-defined phonetic model. The error rate will be computed as the percentage of misrecognitions.

Expected Outcome: The goal is to achieve a recognition accuracy of over 85% for common phonemes in Hindi and English.

2. User Engagement Assessment:

Method: Progress will be measured by tracking the number of exercises completed, improvement in phonetic accuracy, and consistency over time.

Expected Outcome: Users should show measurable improvement in their ability to pronounce target words and sounds correctly.

3. Engagement Metrics:

Method: Engagement will be measured by analyzing login frequency, session duration, and feature usage (e.g., speech assessments, exercises).

Expected Outcome: Higher engagement is expected to correlate with better speech outcomes.

4 RESULTS AND DISCUSSION

4.1 Results

Preliminary testing of the software has shown that users, particularly those in early stages of speech development, exhibit significant improvements in both phoneme accuracy and speech fluency. Key outcomes include:

Improved Speech Clarity: Users demonstrated a noticeable improvement in the clarity of their speech after practicing with the application.

Engagement with Features: The majority of users consistently used speech analysis and feedback tools, showing a high engagement level.

4.2 Discussion

The results suggest that the software effectively supports the improvement of speech sound disorders in Hindi and English. Key discussion points include:

User Autonomy: The application provides users with control over their learning pace, making it adaptable to individual needs.

Cultural Considerations: The software's design takes into account the linguistic and cultural variations in pronunciation between Hindi and English speakers, ensuring it is effective for bilingual populations.

Potential Challenges: There are challenges related to varying degrees of user familiarity with digital tools, especially among older users or those with limited access to technology.

5 Conclusions

This research demonstrates that a web-based application can significantly enhance speech intervention for individuals with speech sound disorders in both Hindi and English. By leveraging speech recognition,

personalized exercises, and progress tracking, the software empowers users to take charge of their speech development. The initial results indicate that the software is effective in improving speech clarity, and user engagement suggests a positive reception of the platform. Future work will focus on expanding features, improving speech recognition accuracy, and incorporating more languages.

6 Declarations

6.1 Study Limitations

The research team reports no significant limitations in the current study regarding the platform's design, features, or initial testing outcomes. However, some potential limitations are acknowledged for future consideration:

Scalability: While the platform performed well in preliminary testing, future challenges may arise as the user base expands. The infrastructure may need additional resources and optimizations to handle a larger volume of users, particularly for speech recognition and data processing tasks.

User Adaptation and Digital Literacy: Successful adoption of the software by users, particularly those with speech sound disorders, may be influenced by their comfort and familiarity with digital tools. Additional support, such as user tutorials or training sessions, may be necessary to ensure widespread and effective use of the application.

Data Privacy and Security: Although secure authentication and encrypted data storage are in place, safeguarding sensitive user information will be critical as the platform scales. Further investment in cybersecurity measures and regular updates will be necessary to ensure data integrity and maintain user trust.

6.2 Funding Source

The study was conducted without external funding. All resources and support for the project were provided internally by Anurag University's Department of Computer Science and Engineering. The absence of external funding ensures the objectivity of the study, with no financial stakeholders influencing the research outcomes or the development goals of the software.

6.3 Acknowledgements

The authors express sincere gratitude to Dr. Shailaja, Assistant Professor at Anurag University, for her invaluable guidance and support throughout the project. Dr. Shailaja provided critical insights into the research design, helped shape the project's objectives, and offered technical expertise during both the development and testing phases. Her mentorship played a pivotal role in the successful execution of the study and the development of the software.

6.4 Competing Interests

The authors declare no competing interests. There are no conflicts, financial or otherwise, that could have influenced the research outcomes or the presentation of findings. The absence of competing interests ensures that the research was conducted with transparency, integrity, and an unbiased focus on improving speech sound disorder interventions through digital tools.

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. Kooroor, 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., Kooroor, 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. DASTAGIRIAH, 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 (IJEI)*, 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. I. D., BOUHDADI, M., AOUEDE, 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 Thrikoteswara 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 Enabled the 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. 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.
62. 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).
63. Sudhan, K., Deepak, S., & Karthick, R. (2016). SUSTAINABILITY ANALYSIS OF KEVLAR AND BANANA FIBER COMPOSITE.
64. 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).
65. Karthick, R., Pandi, M., Dawood, M. S., Prabakaran, A. M., & Selvaprasanth, P. (2021). ADHAAR: A RELIABLE DATA HIDING TECHNIQUES WITH (NNP2) ALGORITHMIC APPROACH USING X-RAY IMAGES. *3C Tecnologia*, 597-608.
66. 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.
67. Selvan, M. Arul, and S. Miruna Joe Amali. "RAINFALL DETECTION USING DEEP LEARNING TECHNIQUE." (2024).
68. Selvan, M. Arul. "Fire Management System For Indutrial Safety Applications." (2023).
69. Selvan, M. A. (2023). A PBL REPORT FOR CONTAINMENT ZONE ALERTING APPLICATION.
70. Selvan, M. A. (2023). CONTAINMENT ZONE ALERTING APPLICATION A PROJECT BASED LEARNING REPORT.
71. Selvan, M. A. (2021). Robust Cyber Attack Detection with Support Vector Machines: Tackling Both Established and Novel Threats.

72. Arora, P., & Bhardwaj, S. (2021). Methods for Threat and Risk Assessment and Mitigation to Improve Security in the Automotive Sector. *Methods*, 8(2).
73. Arora, P., & Bhardwaj, S. (2020). Research on Cybersecurity Issues and Solutions for Intelligent Transportation Systems.
74. Arora, P., & Bhardwaj, S. (2019). The Suitability of Different Cybersecurity Services to Stop Smart Home Attacks.
75. Arora, P., & Bhardwaj, S. (2017). A Very Safe and Effective Way to Protect Privacy in Cloud Data Storage Configurations.
76. Arora, P., & Bhardwaj, S. (2017). Investigation and Evaluation of Strategic Approaches Critically before Approving Cloud Computing Service Frameworks.
77. Arora, P., & Bhardwaj, S. (2017). Enhancing Security using Knowledge Discovery and Data Mining Methods in Cloud Computing.
78. Arora, P., & Bhardwaj, S. (2019). Safe and Dependable Intrusion Detection Method Designs Created with Artificial Intelligence Techniques. *machine learning*, 8(7).
79. Bhat, S. (2024). Building Thermal Comforts with Various HVAC Systems and Optimum Conditions.
80. Bhat, S. (2020). Enhancing Data Centre Energy Efficiency with Modelling and Optimisation of End-To-End Cooling.
81. Bhat, S. (2016). Improving Data Centre Energy Efficiency with End-To-End Cooling Modelling and Optimisation.
82. Bhat, S. (2015). Deep Reinforcement Learning for Energy-Saving Thermal Comfort Management in Intelligent Structures.
83. Bhat, S. (2015). Design and Function of a Gas Turbine Range Extender for Hybrid Vehicles.
84. Bhat, S. (2023). Discovering the Attractiveness of Hydrogen-Fuelled Gas Turbines in Future Energy Systems.
85. Bhat, S. (2019). Data Centre Cooling Technology's Effect on Turbo-Mode Efficiency.
86. Bhat, S. (2018). The Impact of Data Centre Cooling Technology on Turbo-Mode Efficiency.
87. Bhat, S. (2015). Technology for Chemical Industry Mixing and Processing. *Technology*, 2(2).
88. 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.
89. Karthick, R. (2018). Deep Learning For Age Group Classification System. *International Journal Of Advances In Signal And Image Sciences*, 4(2), 16-22.
90. 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.
91. Karthick, R. (2018). Integrated System For Regional Navigator And Seasons Management. *Journal of Global Research in Computer Science*, 9(4), 11-15.
92. 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.
93. Selvan, M. A. (2023). INDUSTRY-SPECIFIC INTELLIGENT FIRE MANAGEMENT SYSTEM.
94. Selvan, M. Arul. "PHISHING CONTENT CLASSIFICATION USING DYNAMIC WEIGHTING AND GENETIC RANKING OPTIMIZATION ALGORITHM." (2024).
95. Selvan, M. Arul. "Innovative Approaches in Cardiovascular Disease Prediction Through Machine Learning Optimization." (2024).
96. 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.
97. 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.
98. 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.
99. 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.
100. 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.
101. 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.

102. 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.
103. 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.
104. 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.
105. Kumar, D. P., & Kumar, P. G. (2025). Implementation of optimal routing in heterogeneous wireless sensor network with multi-channel Media Access Control protocol using Enhanced Henry Gas Solubility Optimizer. *International Journal of Communication Systems*, 38(1), e5980.
106. Avhankar, Madhavi S., et al. "Mobile ad hoc network routing protocols using opnet simulator." *International Journal on Recent and Innovation Trends in Computing and Communication* 10.1 (2022): 1-7.
107. Pawar, J. A., Avhankar, M. S., Gupta, A., Barve, A., Patil, H., & Maranan, R. (2024, May). Enhancing Network Security: Leveraging Isolation Forest for Malware Detection. In 2024 2nd International Conference on Advancement in Computation & Computer Technologies (InCACCT) (pp. 230-234). IEEE.
108. Avhankar, M. S., Pawar, J., & Byagar, S. (2022, December). Localization Algorithms in Wireless Sensor Networks: Classification, Case Studies and Evaluation Frameworks. In 2022 *Fourth International Conference on Emerging Research in Electronics, Computer Science and Technology (ICERECT)* (pp. 01-07). IEEE.
109. Avhankar, M. S., Pawar, J., Singh, G., Asokan, A., Kaliappan, S., & Purohit, K. C. (2023, May). Simulation Environment for the I9 Vanet Platform. In 2023 *International Conference on Advances in Computing, Communication and Applied Informatics (ACCAI)* (pp. 1-8). IEEE.