



# An Effective Lossless Compression of Video Display Frames for Medical Image Sequences

K.Navaneedhan<sup>1</sup>, M.Kaniskha<sup>2</sup>, J.Bavatharini<sup>3</sup>, A.Kavitha<sup>4</sup>

Muthayammal Engineering College, Rasipuram, Tamil Nadu, India<sup>1</sup>

Department of Electronics and Communication Engineering, Muthayammal College of Engineering, Rasipuram, Tamil Nadu, India<sup>2, 3, 4</sup>

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**ABSTRACT:** Lossless image compression technique can be used effectively in reconstruction of image sequences possible from the compressed data. Here an efficient image compression scheme is developed based on super-spatial prediction of structural units with interframe coding to acquire higher compression ratio. This so called similar structure block prediction is motivated by motion prediction in video coding, attempting to find an optimal prediction of structure components within previously encoded image regions. Therefore, this paper proposes a method that combines the super spatial prediction, JPEG-LS and an interframe coding with motion vectors to enhance the compression performance. Since the interframe correlation between two adjacent images in a medical image sequence is usually not as high as that in a general video image sequence, the interframe coding is activated only when the interframe correlation is high enough. Finally LZ8 method is also used to enhance the compression ratio.

**KEYWORDS:** Lossless compression, video frames, medical image sequences, data compression, image processing, digital healthcare, storage optimization, signal encoding, frame compression, medical imaging

## I. INTRODUCTION

Digital image and video in their raw form require an enormous amount of storage capacity. Considering the important role played by digital imaging and video, it is necessary to develop a system that produces high degree of compression while preserving critical image/video information. Medical science grows very fast and hence each hospital needs to store high volume of video about the patients. And medical videos are one of the most important video about patients. As a result hospitals have a high volume of images with them and require a huge hard disk space and transmission bandwidth to store these videos. Most of the time transmission bandwidth is not sufficient into storing all the video. Lossless image compression technique can be used effectively in reconstruction of image sequences possible from the compressed data. In [4], the idea of

interframe coding was again adopted; nevertheless, this time they used JPEGLS, the state-of-the-art algorithm for single image compression with interframe coding, through this, a higher compression ratio was achieved. However, this ratio can still be further improved by using super-spatial structure prediction technique used for single image compression, hence replacing the JPEG-LS used for the image sequence. Since correlation among medical image sequences is very high, it can be exploited by using single image coding with interframe coding. In this paper, a new technique is proposed for image compression using interframe coding and LZ8 with super spatial structure prediction.

## II. PROBLEM STATEMENT

Image compression is the process of encoding information using fewer bits (or other information-bearing units) than an un-encoded representation would use through use of specific encoding schemes. Compression is useful because it helps to reduce the consumption of expensive resources, such as hard disk space or transmission bandwidth (computing). For instance, a compression scheme for image may require expensive hardware for the image to be decompressed fast enough to be viewed as its being decompressed (the option of decompressing the image in full before watching it may be inconvenient, and requires storage space for the decompressed image). The design of video compression schemes therefore involves trade-offs among various factors, including the degree of compression, the amount of distortion introduced and the computational resources required to compress and uncompress the video. Video compression is the process of converting video files into smaller ones for efficiency of storage and transmission. Each compression



algorithm has its corresponding decompression algorithm that, given the compressed file, should reproduce the original one. Image compression schemes come under two categories: lossless and lossy compression. Lossless compression uses coding techniques to compress the video while retaining all information content. Lossy image compression, as its name implies, results in the loss of some information content.

There are 3 basic steps for image compression:

**Transformation:** The discrete wavelet transform cuts the image into blocks of 64 pixels ( $8 \times 8$ ) and processes each block independently, shifting and simplifying the colours so that there is less information to encode.

**Quantization:** The values in each block are then divided by a quantization coefficient. This is the compression step where information loss occurs. Pixels are changed only in relation to the other pixels within their block.

**Encoding:** The reduced coefficients are then encoded, usually with Huffman coding (entropy encoding that finds the optimal system of encoding based on the relative frequency of each character). With high ratio compression.

### III. PRINCIPLE OF VIDEO COMPRESSION

The main principle behind the image/video compression technique is to reduce the redundancy. In image compression methodology, generally spectral and spatial redundancy should be reduced as much as possible while for video compression, the temporal redundancy should be reduced. In this work, the still images and the video sequences (as a group of still images) are considered for the analysis. The compression is achieved by reducing the spatial redundancy of the image/frame video.

### IV. EXISTING SYSTEM

Multimedia processing technologies have been widely applied in many systems. These technologies have not only provided existing applications like desktop video/audio but also spawned brand new industries and services like digital video recording, video-on-demand services, high-definition TV, etc. The confluence of hardware and software technologies has given computers the ability to process dynamic media where before they could handle only static media data [4]. A large amount of register files are needed to hold the arriving DRAM accesses, which inevitably increase the area of the design. Second, since the DRAM accesses may be completed out of order, extra circuits are required to reorder the read data back to the original order to maintain data consistency, which in turns might lead to a reduction in the efficiency of the reorder scheme on the memory bandwidth improvement. Compared with conventional in order access scheduling, memory access reordering mechanisms execute these outstanding memory accesses in an order which attempts to reduce execution time. Through exploiting SDRAM row locality and bank parallelism, access reordering mechanisms significantly reduce observed main memory access latency and improve the effective memory bandwidth. Access reordering mechanisms do not require a large amount of chip area and only need modifications to the memory controller[5]. The purpose of image compression is to save storage space and to reduce transmission time for image data. It aims at achieving a high compression ratio (CR) while preserving good fidelity of decoded images. Video codecs, such as MPEG-2, MPEG-4, and H.264/AVC, are one of the most common components equipped in various consumer electronic products. As the demand for high definition (HD) video applications increases, video codec will have to process larger amount of data within a bounded time. On the other hand, lossless algorithms preserve video quality.

### V. PROPOSED SYSTEM

#### 5.1 Sequence Compression with Super Spatial Structure Prediction

Since most of the compression algorithms use a single file compression technique, they do not exploit the interframe correlation of images.[4] The aim of the proposed algorithm is to improve the compression rate by using interframe correlation. In this algorithm, the first image is always compressed using the super-spatial structure prediction algorithm SSP(). The output file of the super-spatial structure prediction algorithm is further compressed using Huffman coding scheme

HMNC(). Now motion estimation and motion compensation is done for these two images. Both methods are established methods for video compression. After motion estimation and motion compensation, the difference of images is processed for compression.[5]

This difference is also compressed using super spatial structure prediction algorithm. After that, Huffman coding is applied to remove those remaining redundancies from the image.[7] Once the compression of the second frame is done, it becomes the reference frame for the third frame and this process goes on until the last frame. Refer fig.1

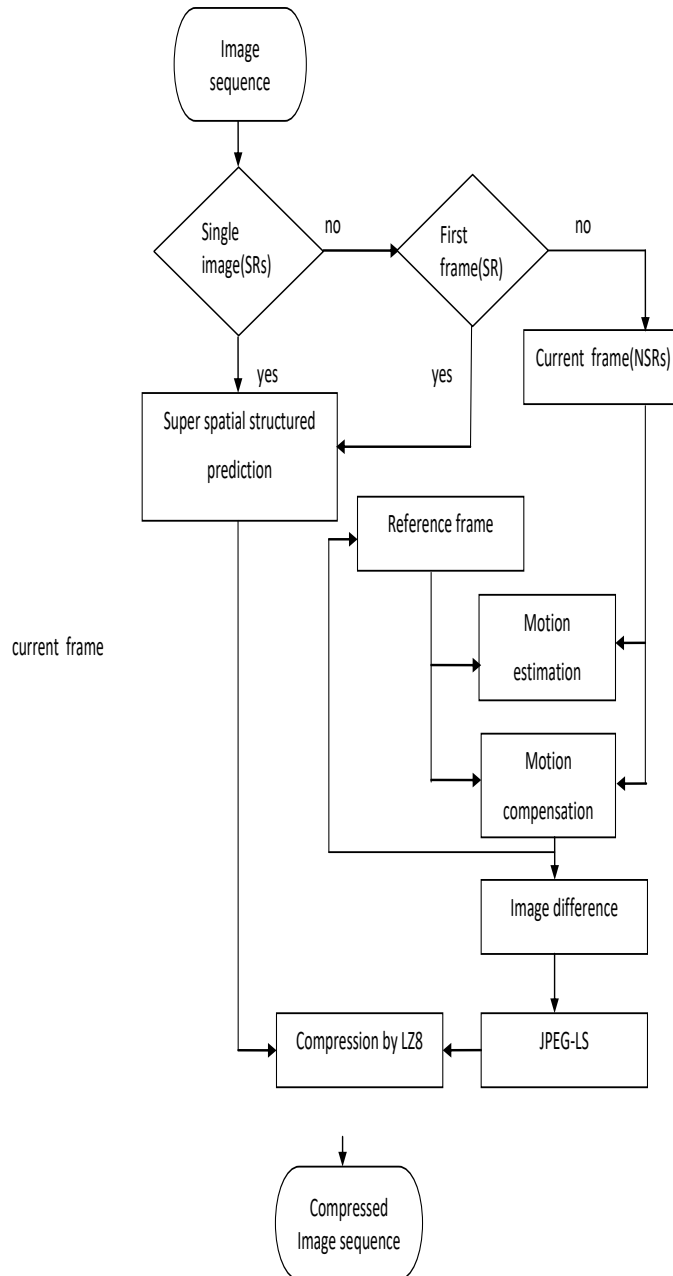


Fig.1 Flow diagram

**5.2 Usability of Motion Estimation and Motion compensation**

Motion estimation means the estimation of the displacement (or velocity) of the predicted structural image from one frame to another in a time sequence of 2-D images. The structure is the group of pixels having direction which can be observed on the 2-D axis and magnitude in terms of pixel intensity value

**5.3 JPEG-LS**

JPEG-LS is a lossless and near-lossless compression standard for continuous-tone images[2]. It is a simple and efficient baseline algorithm which consists of two independent and distinct stages called modeling and encoding. JPEG-LS was developed with the aim of providing a low-complexity lossless and near-lossless image compression standard that could offer better compression efficiency than lossless JPEG. It was developed because at the time,



the Huffman coding-based JPEG lossless standard and other standards were limited in their compression performance. Total decorrelation cannot be achieved by first order entropy of the prediction residuals employed by these inferior standards. JPEG-LS, on the other hand, can obtain good de correlation[5]. It is generally much faster than JPEG 2000 and much better than the original lossless JPEG standard.

## 5.4 LZ8

LZ8 algorithm achieve compression by replacing repeated occurrences of data with references to a dictionary that is built based on the input data stream. Each dictionary entry is of the form  $\text{dictionary}[...] = \{\text{index, character}\}$ , where index is the index to a previous dictionary entry, and character is appended to the string represented by  $\text{dictionary}[\text{index}]$ . For example, "abc" would be stored (in reverse order) as follows:  $\text{dictionary}[k] = \{j, 'c'\}$ ,  $\text{dictionary}[j] = \{i, 'b'\}$ ,  $\text{dictionary}[i] = \{0, 'a'\}$ , where an index of 0 implies the end of a string. The algorithm initializes last matching index = 0 and next available index = 1. For each character of the input stream, the dictionary is searched for a match:  $\{\text{last matching index, character}\}$ . If a match is found, then last matching index is set to the index of the matching entry, and nothing is output. If a match is not found, then a new dictionary entry is created:  $\text{dictionary}[\text{next available index}] = \{\text{last matching index, character}\}$ , and the algorithm outputs last matching index, followed by character, then resets last matching index = 0 and increments next available index. Once the dictionary is full, no more entries are added. When the end of the input stream is reached, the algorithm outputs last matching index. Note that strings are stored in the dictionary in reverse order, which a LZ78 based decoder will have to deal with.[1]

LZ8 is an LZ78-based algorithm that uses a dictionary pre-initialized with all possible characters (symbols), (or emulation of a pre-initialized dictionary). The main improvement of LZ8 is that when a match is not found, the current input stream character is assumed to be the first character of an existing string in the dictionary (since the dictionary is initialized with all possible characters), so only the last matching index is output (which may be the pre-initialized dictionary index corresponding to the previous (or the initial) input character).

## VI. CONCLUSION AND FUTURE WORK

The method presented in this paper makes use of lossless video compression and image compression techniques on medical image sequences to achieve a higher compression rate. The primary goals of the proposed compression method are to minimize the memory resource during storage of compressed data as well as minimize the bandwidth requirement during transmission of compressed data. For achieving these goals, the proposed compression method combines the single-image compression technique called super-spatial structure prediction with interframe coding. The technique that we used for lossless image compression (super-spatial structure prediction) is one of the state-of-the-art techniques and outperformed the JPEG-LS. Also, the two-stage redundant data elimination processes the initial super-spatial structure prediction with fast

block-matching ability and later Huffman coding is used which ultimately reduces the memory resource requirement. Therefore, we conclude that the proposed method produced much better results than the other lossless image compression algorithms for medical image sequence compression. Since this paper has also exploited the interframe correlation in the form of analyzing motion estimation and motion compensation, the proposed method is also compared with the method proposed in [4]. The results produced by the proposed algorithm were also better the earlier interframe coding algorithm for medical images. And also LZ8 is further used to enhance the compression ratio.[1] In the future, the complexity, efficiency and resource optimization of the presented compression method can be explored.

## REFERENCES

- [1] Juan , diego, alvaro angel orozcoXiwen, "Pseudo-periodic surrogate data method on voice signals" 11th International Conference on Information Sciences,2012
- [2] OwenZhao, Zhihai HenryHe, "Lossless Image Compression Using Super-Spatial Structure Prediction", IEEE Signal Processing, Volume. 17, No. 4, April 2010
- [3] Shaou-Gang Miaou, Member, IEEE, Fu-Sheng Ke, and Shu-Ching Chen "A Lossless Compression Method for Medical Image Sequences Using JPEG-LS and Interframe Coding", IEEE transactions on information technology in biomedicine, volume. 13, no. 5, September 2009
- [4] Y. D. Wang, "The implementation of undistorted dynamic compression technique for biomedical image, "Master's thesis, Department of Electrical Engineering at National Cheng Kung University, Taiwan, 2005.



- [5] 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
- [6] C.Nagarajan and M.Madheswaran - 'Experimental verification and stability state space analysis of CLL-T Series Parallel Resonant Converter' - Journal of Electrical Engineering, Vol.63 (6), pp.365-372, Dec.2012. DOI: 10.2478/v10187-012-0054-2
- [7] C.Nagarajan and M.Madheswaran - 'Performance Analysis of LCL-T Resonant Converter with Fuzzy/PID Using State Space Analysis'- Springer, Electrical Engineering, Vol.93 (3), pp.167-178, September 2011. DOI 10.1007/s00202-011-0203-9
- [8] S.Tamilselvi, R.Prakash, C.Nagarajan, "Solar System Integrated Smart Grid Utilizing Hybrid Coot-Genetic Algorithm Optimized ANN Controller" Iranian Journal Of Science And Technology-Transactions Of Electrical Engineering, DOI10.1007/s40998-025-00917-z,2025
- [9] S.Tamilselvi, R.Prakash, C.Nagarajan, " Adaptive sliding mode control of multilevel grid-connected inverters using reinforcement learning for enhanced LVRT performance" Electric Power Systems Research 253 (2026) 112428, doi.org/10.1016/j.epr.2025.112428
- [10] 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
- [11] C. Nagarajan, M.Madheswaran and D.Ramasubramanian- 'Development of DSP based Robust Control Method for General Resonant Converter Topologies using Transfer Function Model'- Acta Electrotechnica et Informatica Journal , Vol.13 (2), pp.18-31, April-June.2013, DOI: 10.2478/aei-2013-0025.
- [12] C.Nagarajan and M.Madheswaran - 'DSP Based Fuzzy Controller for Series Parallel Resonant converter'- Springer, Frontiers of Electrical and Electronic Engineering, Vol. 7(4), pp. 438-446, Dec.12. DOI 10.1007/s11460-012-0212-0.
- [13] C.Nagarajan and M.Madheswaran - 'Experimental Study and steady state stability analysis of CLL-T Series Parallel Resonant Converter with Fuzzy controller using State Space Analysis'- Iranian Journal of Electrical & Electronic Engineering, Vol.8 (3), pp.259-267, September 2012.
- [14] C.Nagarajan and M.Madheswaran, "Analysis and Simulation of LCL Series Resonant Full Bridge Converter Using PWM Technique with Load Independent Operation" has been presented in ICTES'08, a IEEE / IET International Conference organized by M.G.R.University, Chennai.Vol.no.1, pp.190-195, Dec.2007
- [15] Suganthi Mullainathan, Ramesh Natarajan, "An SPSS and CNN modelling based quality assessment using ceramic materials and membrane filtration techniques", Revista Materia (Rio J.) Vol. 30, 2025, DOI: <https://doi.org/10.1590/1517-7076-RMAT-2024-0721>
- [16] M Suganthi, N Ramesh, "Treatment of water using natural zeolite as membrane filter", Journal of Environmental Protection and Ecology, Volume 23, Issue 2, pp: 520-530,2022
- [17] Gerald Schaefer, Roman Starosolski and Shao Ying Zhu, "An evaluation of lossless compression algorithms for medical infrared images," IEEE Engineering Medical Biological Conference, pp. 1673–1676, September 2005.
- [18] Dania Brunello, Giancarlo Calvagno, Gian Antonio Mian, and Roberto Rinaldo, "Lossless compression of video using temporal information," IEEE Transaction on Image processing, Volume 12, No. 2, pp 132-139, February 2003
- [19] M. F. Zhang, J. Hu, and L. M. Zhang, "Lossless video compression using combination of temporal and spatial prediction," IEEE International Conference Neural Network, Signal Processing, volume. 2, pp. 1193–1196, December 2003.
- [20] N.D.Memon and Khalid Sayood, "Lossless compression of video sequences," IEEE Transaction ommun., volume. 44, no. 10, pp. 1340–1345, October. 1996.
- [21] J.R. Jain and A.K. Jain, "Displacement measurement and its application in interframe image coding", IEEE Trans. Commun., Vol. COM-29, No. 12,
- [22] Kiran, A., Rubini, P., & Kumar, S. S. (2025). Comprehensive review of privacy, utility and fairness offered by synthetic data. IEEE Access.
- [23] Gopinathan, V. R. (2024). Real-Time Financial Risk Intelligence Using Secure-by-Design AI in SAP-Enabled Cloud Digital Banking. International Journal of Computer Technology and Electronics Communication, 7(6), 9837-9845.
- [24] Udayakumar, R., Elankavi, R., Vimal, R., & Sugumar, R. (2023). Improved Particle Swarm Optimization with Deep Learning-Based Municipal Solid Waste Management in Smart Cities. Environmental & Social Management Journal, 17(4).
- [25] Anand, L. (2023). An Intelligent AI and ML-Driven Cloud Security Framework for Financial Workflows and Wastewater Analytics. International Journal of Humanities and Information Technology, 5(02), 87-94.
- [26] Soundappan, S. J. (2020). Big Data Analytics in Healthcare: Applications for Pandemic Forecasting. International Journal of Advanced Research in Computer Science & Technology, 3(1), 2248-2253.



- [27] Rajasekar, M. (2024). Real-Time Predictive DevOps Intelligence for Risk-Aware Digital Business Processes in Cloud and SAP Ecosystems. *International Journal of Advanced Research in Computer Science & Technology*, 7(4), 10713-10718.
- [28] Poornima, G., & Anand, L. (2024, May). Novel AI Multimodal Approach for Combating Against Pulmonary Carcinoma. In *2024 5th International Conference for Emerging Technology (INCET)* (pp. 1-6). IEEE.
- [29] Prabha, P. S., & Rengarajan, A. (2025). Adaptive Cloud Resource Allocation Using Attention-Driven Deep Reinforcement Learning. *Engineering, Technology & Applied Science Research*, 15(6), 29334-29340.
- [30] Jagadeesh, S., & Sugumar, R. (2017). A Comparative study on Artificial Bee Colony with modified ABC algorithm. *European Journal of Applied Sciences*, 9(5), 243-248.
- [31] Varma, K. K., & Anand, L. (2025, March). Deep Learning Driven Proactive Auto Scaler for High-Quality Cloud Services. In *International Conference on Computing and Communication Systems for Industrial Applications* (pp. 329-338). Singapore: Springer Nature Singapore.
- [32] Kumar, S. A., & Anand, L. (2025). A Novel EEG-Based Deep Learning Framework for Enhancing Communication in Locked-In Syndrome Using P300 Speller and Attention Mechanisms. *KSII TRANSACTIONS ON INTERNET AND INFORMATION SYSTEMS*, 19(11), 3841-3855.
- [33] Poornima, G., & Anand, L. (2025). Medical image fusion model using CT and MRI images based on dual scale weighted fusion based residual attention network with encoder-decoder architecture. *Biomedical Signal Processing and Control*, 108, 107932.
- [34] Archana, R., & Anand, L. (2025). Residual u-net with Self-Attention based deep convolutional adaptive capsule network for liver cancer segmentation and classification. *Biomedical Signal Processing and Control*, 105, 107665.
- [35] Kumar, S. A., & Anand, L. (2025). A Novel EEG-Based Deep Learning Framework for Enhancing Communication in Locked-In Syndrome Using P300 Speller and Attention Mechanisms. *KSII Transactions on Internet and Information Systems*, 19(11), 3841-3855.
- [35] Rengarajan, A. (2025). Cloud-Based AI-Driven Threat Detection Framework for Smart Grid Cybersecurity. *International Journal of Future Innovative Science and Technology*, 8(6), 16065.
- [36] Murugeswari, B., Sudharson, K., Panimalar, S. P., Shanmugapriya, M., & Abinaya, M. (2020). SAFE–Secure Authentication in Federated Environment using CEG Key code.
- [37] Raj A. A., & Sugumar, R. (2023). Early Detection of COVID-19 with Impact on Cardiovascular Complications using CNN Utilising Pre-Processed Chest X-Ray Images. *2023 International Conference on Applied Intelligence and Sustainable Computing (ICAISC)*, IEEE.
- [38] Jagadeesh, S., & Sugumar, R. (2017). A Comparative study on Artificial Bee Colony with modified ABC algorithm. *European Journal of Applied Sciences*, 9(5), 243-248.
- [39] Selvi, G. V., Anbarasan, A. B., Murthy, B. A., & Prabavathy, S. (2023). An Application Oriented Integrated Unequal Clustering Algorithm for Wireless Sensor Network. In *Underwater Vehicle Control and Communication Systems Based on Machine Learning Techniques* (pp. 140-154). CRC Press.
- [40] Sruthi, R. S., Ananya, S., & Murugeswari, B. (2010). Web Based Virtual Control System Laboratory and On-Line Temperature Control of Electrophoresis Equipment using LabVIEW. *International Journal of Computer Applications*, 975, 8887.
- [41] Vimal Raja, G. (2021). Mining Customer Sentiments from Financial Feedback and Reviews using Data Mining Algorithms. *International Journal of Innovative Research in Computer and Communication Engineering*, 9(12), 14705-14710.
- [42] MATHEW, A. R. (2025). Neurosecurity and Brain-Computer Interfaces.
- [43] Soundappan, S. J. (2024). AI-Driven Customer Intelligence in Enterprise Lakehouse Systems Sentiment Mining Governance-Aware Analytics and Real-Time Data Synchronization. *International Journal of Advanced Engineering Science and Information Technology (IJAESIT)*, 7(5), 14905.
- [44] Mathew, A. (2025). Human–AI Collaboration in Security Operations: Measuring Alert Trust, Automation Bias, and Analyst Upskilling in AI-Augmented SOC Environments. *International Journal of Computer Technology and Electronics Communication*, 8(5), 11375-11380.
- [45] Soundappan, S. J. (2022). AI-Based Fault Detection and Isolation for Reliability in Modern Power Systems. *International Journal of Research Publications in Engineering, Technology and Management (IJRPETM)*, 5(4), 7106-7110.
- [46] Poornima, G., & Anand, L. (2024, April). Effective Machine Learning Methods for the Detection of Pulmonary Carcinoma. In *2024 Ninth International Conference on Science Technology Engineering and Mathematics (ICONSTEM)* (pp. 1-7). IEEE.
- Garg, V. K., Soundappan, S. J., & Kaur, E. M. (2020). Enhancement in intrusion detection system for WLAN using genetic algorithms. *South Asian Research Journal of Engineering and Technology*, 2(6), 62–64.



- [47] Rengarajan, A., Jayakumar, C., & Sugumar, R. (2012). Optimization Of Recent Attacks Using Internet Protocol. National Journal of System and Information Technology, 5(1), 8.
- [48] Mathew, A. (2024). AI TRiSM: Trust, Risk, and Security Management in Cybersecurity. Cybersecurity, 4(3), 84-90.
- [49] Mathew, A. (2025). Deep seek vs. ChatGPT: A deep dive into AI Language mastery. Int J Multidisciplinary Res, 7(1), 1-5.