Vol. 2 No. 4 (2024)

Spectrum of Engineering Sciences

SPECTRUM OF ENGINEERING SCIENCES

Online ISSN
3007-3138
Print ISSN
3007-312X

A Detailed Review of latest Trends, Technologies Applications of Artificial Intelligence in Modern System Network

Saud Ismaeel[1]
Department of Computer Science, Faculty of Computer Science and IT, Superior University Lahore, 54000, Pakistan
Husnain Saleemi[2]
Department of Computer Science, Faculty of Computer Science and IT, Superior University Lahore, 54000, Pakistan
Usman Amir[3]
Department of Computer Science, Faculty of Computer Science and IT, Superior University Lahore, 54000, Pakistan
Sayyam Ashraf[4]
Department of Computer Science, Faculty of Computer Science and IT, Superior University Lahore, 54000, Pakistan
Ameer Hamza[5]
Department of Computer Science, Faculty of Computer Science and IT, Superior University Lahore, 54000, Pakistan
Maryam Siddique[6]
Department of Computer Science, Faculty of Computer Science and IT, Superior University Lahore, 54000, Pakistan

Abstract

The application of artificial intelligence (AI), a cutting-edge technology that emulates human intelligence and learning abilities, holds immense potential for advancing computer networks. This article aims to explore AI-based applications in computer networks, emphasizing their role in improving network security and performance. The study highlights the innovations and advancements brought by AI to network technology by examining its applications in areas such as network operations and maintenance, intelligent security systems, intrusion detection, and performance optimization.

Spectrum of Engineering Sciences
Online ISSN
3007-3138
Print ISSN
3007-312X
SPECTRUM OF ENGINEERING SCIENCES

Additionally, the article provides key recommendations to promote the seamless integration of AI into computer networks, introducing new ideas and strategies for developing secure and efficient network infrastructures.

Introduction

The rapid advancement of the digital age has elevated the significance of computer network technology as an essential societal infrastructure. However, traditional methods of managing and maintaining networks are increasingly inadequate in meeting the demands of modern network environments, especially as the scale and data volume of these networks expand. To address these challenges, artificial intelligence (AI) has emerged as a transformative force within computer networks. By analyzing and learning from extensive network data, AI can detect anomalies, identify vulnerabilities, and provide advanced tools for network management and optimization. This enhances not only the reliability and security of networks but also the efficiency and quality of services [1, 5].

In the context of the modern "Internet+" era, governments worldwide are prioritizing AI technology, recognizing its strategic importance in international competition. The introduction of supportive policies and frameworks has accelerated the integration of AI into network systems [6, 8]. This development transcends technical advancements, significantly influencing societal, economic, and cultural progress. Therefore, exploring the synergy between artificial intelligence and computer networks is critical for driving innovation and fostering the evolution of network environments. This study aims to analyze the implications of this integration and provide strategic recommendations for future network advancements [9].

Artificial Intelligence

Artificial intelligence (AI) is a multidisciplinary field that has gained significant traction in recent years, driven by advancements in science and technology. It draws upon computer science, psychology, physiology, and linguistics. In its early stages, AI development focused on utilizing automated systems to replicate specific human actions and behaviors, reduce labor costs in high-risk areas, enhance work efficiency, and boost economic outcomes for businesses while ensuring worker safety [10, 13].

AI research emphasizes distinguishing between artificial and natural intelligence. The primary objective of AI is to simulate human behaviors and

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

processes through predefined instructions and operator inputs. Key features of AI include improved work efficiency, intelligent networking, and automatic shielding. Automatic shielding enhances task productivity by filtering out irrelevant or redundant data, ensuring the focus remains on valuable information [14, 17].

In terms of networking and intelligence, the integration of AI into networked systems and management models has garnered considerable attention. Advanced technologies and management strategies are employed to optimize AI operations, ensuring these systems perform effectively. By combining AI with computer network technologies, a model of mutual growth and collaboration is achieved. This synergy not only enhances productivity but also eliminates inefficiencies inherent in traditional workflows, resulting in more streamlined and effective work processes [18].

Analysis Of Artificial Intelligence's Feasibility In Computer Network Technology

The core strength of artificial intelligence (AI) lies in its ability to rapidly process data related to unpredictable resources. AI can act as a targeted mechanism for specific datasets, dynamically adapting its processes based on client or environmental changes. This capability enables detailed data analysis with precision and meticulous organization. By providing users with timely and accurate information, AI ensures seamless feedback loops while maintaining coordination in data categorization and resource integration. Furthermore, AI facilitates efficient communication and information dissemination [19, 20]. A key feature of AI is its adaptability, allowing it to modify processing methods based on user preferences or requirements.

When AI is integrated with computer network technologies, it creates a highly accurate and efficient data processing environment. For instance, utilizing AI to develop computer network resource databases reduces the effort required to establish and maintain these databases while improving accuracy and efficiency. This is particularly useful for addressing non-obvious challenges, resource planning and classification, and resource consumption calculations, significantly lowering the labor involved in subsequent database maintenance [21, 25]. The advantages of incorporating AI into computer network technology are evident. AI enhances the system's ability to automatically collect data, supports the development of more comprehensive

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

intelligent management systems, and significantly strengthens the security of network applications. Additionally, real-time management and monitoring help evaluate system usage, prevent errors, and improve operational safety. These benefits underscore the feasibility and value of applying AI to advance computer network technology.

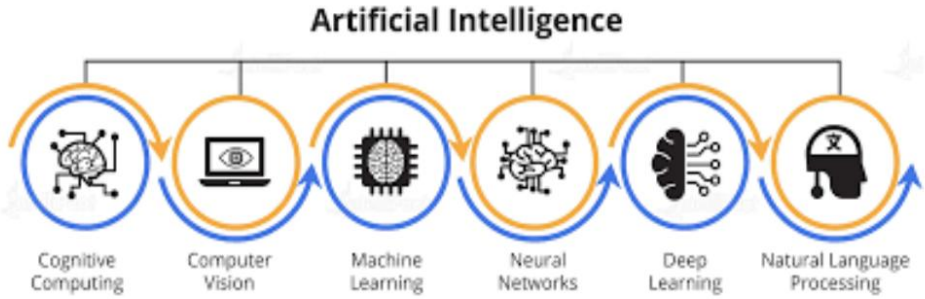

Figure 1. AI based Technologies [26]

Issues With Computer Network Technologies

Computer network applications have become an indispensable part of our daily lives, profoundly impacting both personal and professional spheres. Network technology now influences nearly every aspect of modern living. In the current era of big data, vast amounts of information, including personal and corporate data, are stored in extensive databases. However, this widespread adoption of computer network technology has also brought significant challenges [27, 28].

One major issue is the prevalence of misinformation or misconceptions about the data within these databases. Given the close connection between computer networks and sensitive information, ensuring network security has become a critical priority. A breach in network security can lead to significant personal and societal losses, underscoring the urgent need to address these vulnerabilities [29].

Web-based intelligent network communication system that leverages browser-server architecture to enable real-time monitoring and data transmission over wireless mobile channels, specifically for substation automation. The growing integration of computers and information technology has increased the demand for intelligent network services, with artificial intelligence (AI) becoming an essential and widely discussed innovation in this domain [30].

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

In education, CHe's work explores AI's application in computer-aided instruction systems, which promote collaborative learning and personalized teaching. These systems create a positive virtual learning environment, enhancing students' understanding of the material. RADIUS technology plays a pivotal role in network applications, particularly in authenticating wired and wireless environments. As users face the challenge of managing multiple user IDs and passwords, adversarial attacks remain a significant concern for network security. E Nowroozi analyzed the transferability of adversarial attacks in convolutional neural network (CNN) models and proposed defense mechanisms to mitigate these threats [31].

Information and communication technology (ICT) is often used to optimize and maintain computer networks, enhancing customer experiences and ensuring high-quality services for businesses and institutions. To effectively manage service quality, A Purwanto employed Cisco's PPDIOO methodology as a framework for constructing and optimizing network systems. Furthermore, the evolution of software-defined networking (SDN) technology, with its programmability, elasticity, and flexibility, has become critical for network applications. It also underscores the importance of information security and continues to inspire research in the field [32].

Application of Artificial Intelligence in Network Technology

Firewalls, intrusion detection, and anti-spam systems are key techniques in computer network security management. These methods are highly effective when enhanced by artificial intelligence (AI). The core of a firewall's functionality lies in intelligent information recognition, which involves identifying, classifying, and removing data using probability, statistics, and other mathematical techniques. AI-based recognition technologies replace computationally intensive processes, enabling more efficient data security management. Firewalls can quickly block malicious content upon entry and re-analyze the data to ensure network security. This AI integration allows for the swift separation of spam and effective prevention of malware from invading the network [33].

Intrusion detection plays a critical role in network security, and integrating AI has led to significant improvements. When threats enter a network, AI-powered intrusion detection systems gather information, reduce data, classify behaviors, and process reports on potential risks. The integration

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

of AI with expert systems, based on empirical knowledge, helps create a comprehensive database for managing network security. This system can isolate potential threats using AI identification methods and effectively combat intrusive factors by combining intrusion technology with AI [34].

AI can also mimic human cognitive processes, particularly in understanding how the human nervous system functions. This ability enables AI to process information more like human thought. For example, intelligent voice input systems can correct errors due to human miscommunication or background noise, showcasing AI's error correction capabilities [35]. As we move into the "Internet + era," the demand for efficient information retrieval has grown, and traditional methods, like search engines, can struggle to keep up. AI is transforming information retrieval by making it more intelligent, tailored, and precise. With AI, information retrieval becomes more efficient, enhancing both user experience and sector innovation [36].

Furthermore, AI aids in multimedia indexing, allowing systems to analyze and retrieve data such as images, audio, and video. Users can simply input an image into a search engine to receive relevant information, and AI can also be applied to tasks like watermark removal. Cross-language retrieval technology is also gaining traction as it facilitates the exchange of information across diverse linguistic contexts [37].

In network security, AI can monitor and analyze network data in real-time, identifying and responding to threats such as malware or unusual data flows. By using deep learning and machine learning, AI models can distinguish between normal and anomalous network behaviors, preventing the spread of malicious activities and ensuring network protection [38].

As computer networks become more integral to society, the importance of robust network security and intrusion detection systems is clear. AI technology provides real-time monitoring and rapid responses to network threats, offering enhanced protection for user privacy and network data. AI is capable of identifying various types of intrusion, such as malware or illegal access, and helping develop intelligent models that can quickly detect irregular traffic and implement defense mechanisms [39]. Finally, AI's application in network performance optimization is crucial for detecting and recovering from network failures, which often arise from hardware malfunctions or configuration issues. AI technologies, particularly deep

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

learning, can swiftly detect network outages and initiate corrective actions. By analyzing network traffic and status, AI systems can autonomously identify problems and offer solutions, reducing downtime and protecting users from financial loss [40].

Controlling Network Traffic And Optimizing Performance

It is widely recognized that traffic control and quality of service (QoS) are critical elements in modern network systems. Traffic management involves monitoring, controlling, and improving data flow within the network to ensure seamless transmission and optimal use of resources. The goal of QoS is to meet user demands for network performance by ensuring access to consistent, reliable, and efficient services. Artificial intelligence (AI) can significantly enhance service quality by dynamically adjusting service priorities based on user needs and network conditions, ensuring timely and high-quality delivery of essential business data. For example, in video streaming, AI can automatically adjust the video quality and streaming speed depending on the user's device, network capacity, and other factors, providing a better viewing experience during network congestion or latency issues [41, 45]. As AI continues to advance, intelligent network management is expected to become the standard. The integration of AI in network architecture allows for automated optimization, troubleshooting, and enhanced reliability and efficiency of network operations. Ongoing research will enable network management systems to monitor real-time performance, quickly adapt to changes, and provide intelligent solutions for operations. AI technology will also play a key role in automated threat detection, identification, and response to various security risks, such as intrusion detection systems and intelligent firewalls. Through AI-driven management, network service providers can optimize service quality, dynamically allocate resources based on demand and network load, and improve the overall performance and availability of network services [46, 47].

The rise of the cloud intelligence era marks a new phase in the evolution of computer technology, driven by intelligence, automation, and efficiency. Cloud intelligence will revolutionize the use of computing resources and data processing, enabling intelligent management of network, storage, and processing resources. This will allow cloud platforms to optimize workloads, enhance resource efficiency, and distribute resources intelligently

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

based on real-time data and user demands, improving service quality and performance [48].

Cloud intelligence will also foster cross-border collaboration, innovation, digital transformation, and information upgrading across various industries. With AI-driven cloud technology, businesses can enhance production efficiency and competitiveness by optimizing and managing operations more effectively. The advancement of technologies like the Internet of Things, big data analytics, and AI will benefit from cloud intelligence, driving the growth and widespread adoption of the digital economy [49].

Conclusion

Artificial intelligence (AI) has numerous applications in computer networks, significantly enhancing search efficiency, strengthening network security, optimizing overall performance, and driving the emergence of the cloud intelligence era. AI also supports the intelligent evolution of networks and network architecture. To maximize AI's potential, it is essential to ensure algorithmic transparency, interpretability, and privacy protection while adhering to ethical and legal standards alongside technological advancements. By doing so, AI can become a highly productive tool, reduce human labor, and contribute to the progress of society. The goal is to advance computer network technology toward a smarter and more effective future through in-depth research on AI applications in networking, continuous innovation, and exploration of new areas. This project aims to provide stronger support for the development of digital transformation and information infrastructure.

Funding Statement: The authors received no specific funding for this study.

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

References

[1] Shehreyar Nawaz, Hamayun Khan, Wajiha Salman, Umer Shahid, Momin Latif Khokhar, M Zaid Iqbal, & Abdullah Hamid. (2024). A Survey on Latest Trends and Technologies of Computer Systems Network. Spectrum of Engineering Sciences, 2(4), 85–114

[2] Waleed, A. Ali, S. Tariq, G. Mustafa, H. Sarwar, S. Saif, I. Uddin, "An Efficient Artificial Intelligence (AI) and Internet of Things (IoT's) Based MEAN

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

Stack Technology Applications", Bulletin of Business and Economics (BBE)., vol. 13, no. 2, pp. 200-206, July. 2024

[3] Noor, A. Ilyas, Z. Javaid, H. Khan, "Framing a Knowledge Domain Visualization on Green Human Resource Management: A Bibliometric Analysis from 2008-2022", Pakistan Journal of Humanities and Social Sciences., vol. 11, no. 4, pp. 4200-4212, Aug. 2023

[4] Muhammad Waleed Khawar, Hamayun Khan, Wajiha Salman, Samra Shaheen, Ariba Shakil, Fatima Iftikhar, & Khawaja Muhammad Ismail Faisal. (2024). Investigating the Most Effective AI/ML-Based Strategies for Predictive Network Maintenance to Minimize Downtime and Enhance Service Reliability. Spectrum of Engineering Sciences, 2(4), 115–132

[5] M. Gondal, Z. Hameed, M. U. Shah, H. Khan, "Cavitation phenomenon and its effects in Francis turbines and amassed adeptness of hydel power plant", In 2019 2nd International Conference on Computing, Mathematics and Engineering Technologies (iCoMET), IEEE., pp. 1-9, Mar. 2019

[6] Y. A. Khan, U. Khalil, H. Khan, A. Uddin, S. Ahmed, "Power flow control by unified power flow controller",sss Engineering, Technology & Applied Science Research., vol. 9, no. 2, pp. 3900-3904, Feb. 2019

[7] K. Benzekki, A. El Fergougui, and A. E. Elalaoui, Software-de ned networking (SDN): A survey, Secur. Commun. Netw., vol. 9, no. 18, pp. 58035833, 2016.

[8] Ahmad, S., Lavin, A., Purdy, S., & Agha, Z. (2017). Unsupervised real-time anomaly detection for streaming data.Neurocomputing,262, 134-147.

[9] Akhi, A. B., Kanon, E. J., Kabir, A., &Banu, A. (2019).Network Intrusion Classification Employing Machine Learning: A Survey. (Doctoral dissertation)Department of Computer Science and Engineering, United International University, Bangladesh.

[10] Alizadeh, H., Khoshrou, A., &Zuquete, A. (2015). Traffic classification and verification using unsupervised learning of Gaussian Mixture Models. In2015 IEEE international workshop on measurements & networking (M&N). 1-6. IEEE. Khan, I. Uddin, A. Ali, M. Husain, "An Optimal DPM Based Energy-Aware Task Scheduling for Performance Enhancement in Embedded MPSoC", Computers, Materials & Continua., vol. 74, no. 1, pp. 2097-2113, Sep. 2023

[11] S. Khan, I. Ullah, H. Khan, F. U. Rahman, M. U. Rahman, M. A. Saleem, A. Ullah, "Green synthesis of AgNPs from leaves extract of Salvia Sclarea, their

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

characterization, antibacterial activity, and catalytic reduction ability", Zeitschrift für Physikalische Chemie., vol. 238, no. 5, pp. 931-947, May. 2024

[12] H. Khan, M. U. Hashmi, Z. Khan, R. Ahmad, "Offline Earliest Deadline first Scheduling based Technique for Optimization of Energy using STORM in Homogeneous Multi-core Systems", IJCSNS Int. J. Comput. Sci. Netw. Secur., vol. 18, no. 12, pp. 125-130, Dec. 2018

[13] Y. A. Khan, M. Ibrahim, M. Ali, H. Khan, E. Mustafa, "Cost Benefit Based Analytical Study of Automatic Meter Reading (AMR) and Blind Meter Reading (BMR) used by PESCO (WAPDA)", In 2020 3rd International Conference on Computing, Mathematics and Engineering Technologies (iCoMET), IEEE., pp. 1-7, Aug. 2020

[14] Naz, H. Khan, I. Ud Din, A. Ali, and M. Husain, "An Efficient Optimization System for Early Breast Cancer Diagnosis based on Internet of Medical Things and Deep Learning", Eng. Technol. Appl. Sci. Res., vol. 14, no. 4, pp. 15957–15962, Aug. 2024

[15] Khan, I. Ullah, M. U. Rahman, H. Khan, A. B. Shah, R. H. Althomali, M. M. Rahman, "Inorganic-polymer composite electrolytes: basics, fabrications, challenges and future perspectives", Reviews in Inorganic Chemistry., vol. 44, no. 3, pp. 1-2, Jan. 2024

[16] Khan, M. U. Hashmi, Z. Khan, R. Ahmad, "Offline Earliest Deadline first Scheduling based Technique for Optimization of Energy using STORM in Homogeneous Multi-core Systems", IJCSNS Int. J. Comput. Sci. Netw. Secur., vol. 18, no. 12, pp. 125-130, Oct. 2018

[17] M. S. Abdul Razak, S. P. A. Gothandapani, N. Kamal, and K. Chellappan, "Presenting the Secure Collapsible Makerspace with Biometric Authentication", Eng. Technol. Appl. Sci. Res., vol. 14, no. 1, pp. 12880–12886, Feb. 2024.

[18] H. Khan, M. U. Hashmi, Z. Khan, R. Ahmad, A. Saleem, "Performance Evaluation for Secure DES-Algorithm Based Authentication & Counter Measures for Internet Mobile Host Protocol", IJCSNS Int. J. Comput. Sci. Netw. Secur., vol. 18, no. 12, pp. 181-185, July. 2018

[19] Amangele, P., Reed, M. J., Al-Naday, M., Thomos, N., & Nowak, M. (2019). Hierarchical Machine Learning for IoT Anomaly Detection in SDN. In2019 International Conference on Information Technologies (InfoTech). 1-4. IEEE.

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

[20] Anderson, J. P. (1980). Computer security threat monitoring and surveillance.Technical Report, Fort Washington, PA, James P. Anderson Co.

[21] Aung, Y. Y., & Min, M. M (2018). An analysis of K-means algorithm based network intrusion detection system. Advances in Science, Technology and Engineering Systems Journal,3(1), 496-501. Bauer, F. C., Muir, D. R., &Indiveri, G (2019). Real-Time Ultra-Low Power ECG Anomaly Detection

[22] Bhati, B. S., Rai, C. S., Balamurugan, B., & Al-Turjman, F. (2020). An intrusion detection scheme based on the ensemble of discriminant classifiers.Computers & Electrical Engineering,86, 106742.

[23] Bhattacharyya, D. K., &Kalita, J. K. (2013).Network anomaly detection: A machine learning perspective. CRCPress.

[24] U. Hashmi, S. A. ZeeshanNajam, "Thermal-Aware Real-Time Task Schedulabilty test for Energy and Power System Optimization using Homogeneous Cache Hierarchy of Multi-core Systems", Journal of Mechanics of Continua and Mathematical Sciences., vol. 14, no. 4, pp. 442-452, Mar. 2023

[25] Y. A. Khan, F. Khan, H. Khan, S. Ahmed, M. Ahmad, "Design and Analysis of Maximum Power Point Tracking (MPPT) Controller for PV System", Journal of Mechanics of Continua and Mathematical Sciences., vol. 14, no. 1, pp. 276-288, May. 2019

[26] Jawad Ahmad, Hamayun Khan, Wajiha Salman, Muzamal Amin, Zain Ali, & Shumail Shokat. (2024). A Survey on Enhanced Approaches for Cyber Security Challenges Based on Deep Fake Technology in Computing Networks. Spectrum of Engineering Sciences, 2(4), 133–149

[27] Khan, A. Yasmeen, S. Jan, U. Hashmi, "ENHANCED RESOURCE LEVELING INDYNAMIC POWER MANAGEMENT TECHNIQUEOF IMPROVEMENT IN PERFORMANCE FOR MULTI-CORE PROCESSORS" ,Journal of Mechanics of Continua and Mathematical Sciences., vol. 6, no. 14, pp 956-972, Sep. 2019

[28] Abdul Rafay, Hamayun Khan, Wajiha Salman, Gulzar Yahya, & Uzair Malik. (2024). SD Network based on Machine Learning: An Overview of Applications and Solutions. Spectrum of Engineering Sciences, 2(4), 150–165

[29] Khan, Q. Bashir, M. U. Hashmi, "Scheduling based energy optimization technique in multiprocessor embedded systems", In 2018 International Conference on Engineering and Emerging Technologies (ICEET), IEEE., pp. 1-8, Sep. 2018

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

[30] Y. A. Khan, "A high state of modular transistor on a 105 kW HVPS for X-rays tomography Applications", Sukkur IBA Journal of Emerging Technologies., vol. 2, no. 2, pp. 1-6, Jun. 2019

[31] Khan, S. Ahmad, N. Saleem, M. U. Hashmi, Q. Bashir, "Scheduling Based Dynamic Power Management Technique for offline Optimization of Energy in Multi Core Processors", Int. J. Sci. Eng. Res., vol. 9, no. 12, pp. 6-10, Dec. 2018

[32] Ibrahim Akmal, Hamayun Khan, Ayesha Khushnood, Fatima Zulfiqar, & Eman Shahbaz. (2024). An Efficient Artificial Intelligence (Al) and Blockchain-Based Security Strategies for Enhancing the Protection of Low-Power loT Devices in 5G Networks. Spectrum of Engineering Sciences, 2(3)

[33] Y. A. Khan, "Enhancing Energy Efficiency in Temperature Controlled Dynamic Scheduling Technique for Multi Processing System on Chip", Sukkur IBA Journal of Emerging Technologies., vol. 2, no. 2, pp. 46-53, Jan. 2019

[34] Khan, K. Janjua, A. Sikandar, M. W. Qazi, Z. Hameed, "An Efficient Scheduling based cloud computing technique using virtual Machine Resource Allocation for efficient resource utilization of Servers", In 2020 International Conference on Engineering and Emerging Technologies (ICEET), IEEE., pp. 1-7, Apr. 2020

[35] Hassan, H. Khan, I. Uddin, A. Sajid, "Optimal Emerging trends of Deep Learning Technique for Detection based on Convolutional Neural Network", Bulletin of Business and Economics (BBE)., vol. 12, no. 4, pp. 264-273, Nov. 2023

[36] Khan, A. Ali, S. Alshmrany, "Energy-Efficient Scheduling Based on Task Migration Policy Using DPM for Homogeneous MPSoCs", Computers, Materials & Continua., vol. 74, no. 1, pp. 965-981, Apr. 2023

[37] Shah, S. Ahmed, K. Saeed, M. Junaid, H. Khan, "Penetration testing active reconnaissance phase–optimized port scanning with nmap tool", In 2019 2nd International Conference on Computing, Mathematics and Engineering Technologies (iCoMET), IEEE., pp. 1-6, Nov. 2019

[38] Y. A. Khan, "A GSM based Resource Allocation technique to control Autonomous Robotic Glove for Spinal Cord Implant paralysed Patients using Flex Sensors", Sukkur IBA Journal of Emerging Technologies., vol. 3, no. 2, pp. 13-23, Feb. 2020

[39] Mian Muhammad Abdullah, Hamayun Khan, Sabestean, Muhammad Farhan, Farhan Khadim, & Hafiz-ul-Asad. (2024). An Advance Machine

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

Learning (ML) Approaches for Anomaly Detection based on Network Traffic. Spectrum of Engineering Sciences, 2(3)

[40] Sarwar, H. Khan, I. Uddin, R. Waleed, S. Tariq, "An Efficient E-Commerce Web Platform Based on Deep Integration of MEAN Stack Technologies", Bulletin of Business and Economics (BBE)., vol. 12, no. 4, pp. 447-453, Jun. 2023

[41] Haripriya, L.A., Jabbar, M., &Seetharamulu, B. (2018). A Novel Intrusion Detection System Using Artificial Neural Networks and Feature Subset Selection. International Journal of Engineering and Technology, 7(4), 181. http://doi.org/10.14419/ijet.v7i4.6.20458

[42] Aaraiz Naveed, Hamayun Khan, Zaeem Imtiaz, Wahaj Hassan, & Uneeb Fareed. (2024). Application and Ethical Aspects of Machine Learning Techniques in Networking: A Review. Spectrum of Engineering Sciences, 2(3)

[43] Hafiz M. Saqlain Khan, Hamayun Khan, Ch. Muhammad Akhtar Hayat, Hassan Tayyab, & Kashif Ali. (2024). An Enhanced Cost Effective and Scalable Network Architecture for Data Centers. Spectrum of Engineering Sciences, 2(3).

[44] M. Shahzar Nasir, Hamayun Khan, Ahmad Qureshi, Arslan Rafiq, & Taha Rasheed. (2024). Ethical Aspects In Cyber Security Maintaining Data Integrity and Protection: A Review. Spectrum of Engineering Sciences, 2(3)

[45] Hoang, D. H., & Nguyen, H. D. (2018). A PCA-based method for IoT network traffic anomaly detection. In2018 20th International Conference on Advanced Communication Technology (ICACT), 381-386. IEEE.

[46] Hodo, E., Bellekens, X., Hamilton, A., Dubouilh, P. L., Iorkyase, E., Tachtatzis, C., & Atkinson,
R. (2016). Threat analysis of IoT networks using artificial neural network intrusiondetection system. In2016 International Symposium on Networks, Computers and Communications (ISNCC), 1-6. IEEE.

[47] Blanco, R., Malagón, P., Briongos, S., & Moya, J. M. (2019). Anomaly Detection Using Gaussian Mixture Probability Model to Implement Intrusion Detection System. InInternational Conference on Hybrid Artificial Intelligence Systems, 648-659. Springer, Cham.

[48] Muhammad Abdullah, Hamayun Khan, Ayesha Shafqat, Muhammad Daniyal, Muhammad Bilal, & Muhammad Anas. (2024). Internet of Things (IoT's) in Agriculture: Unexplored Opportunities in Cross – Platform . Spectrum of Engineering Sciences, 2(3)

Spectrum of Engineering Sciences
SPECTRUM OF ENGINEERING SCIENCES
Online ISSN
3007-3138
Print ISSN
3007-312X

[49] Chandola, V., Banerjee, A., & Kumar, V. (2009). Anomaly detection: A survey.ACM Computing Surveys (CSUR),41(3), 1-58.