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UNLOCKING THE POTENTIAL OF NATURAL LANGUAGE PROCESSING IN MODERN AI SYSTEMS FIELDS

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ABSTRACT

This review paper explores recent advancements in artificial intelligence (AI), natural language processing (NLP), cybersecurity, cloud computing, and their applications across various domains. The study synthesizes findings from multiple research works, highlighting the transformative impact of AI-driven technologies in academic libraries, healthcare, cybersecurity, media, and software engineering. Key topics include the role of AI as an intelligent assistant in libraries, deep learning approaches in intrusion detection systems, the evolution of large language models (LLMs), and the significance of data-centric AI. Additionally, the paper discusses NLP's growing influence in journalism, clinical text processing, systematic review automation, and software requirement engineering. The review further addresses cybersecurity challenges, including machine learning-based threat detection and SQL injection prevention. Moreover, it evaluates AI applications in networking, cloud computing, and vehicular communication systems. The study underscores the potential of AI and machine learning in revolutionizing digital transformation while acknowledging challenges such as ethical concerns, computational demands, and data security risks. By synthesizing insights from multiple disciplines, this paper provides a comprehensive perspective on emerging AI technologies and their implications for industry and research.

Keywords: Artificial Intelligence (AI) , Natural Language Processing (NLP) , Machine Learning (ML) , Deep Learning , Cybersecurity , Data Science , Automation.

INTRODUCTION

The evolution of web technology and enterprise systems has transformed business operations, driven by advancements in cloud computing, artificial intelligence (AI), and big data analytics. Cloud-based platforms have replaced traditional client-server models, improving scalability, cost- efficiency, and accessibility [1]. AI integration has enabled automation, predictive analytics, and workflow optimization, enhancing decision-making and operational efficiency [2]. Hybrid and distributed computing models, including edge computing, have emerged to address latency issues and real-time data processing needs, particularly in IoT applications [3]. Additionally, micro services and API-driven architectures have improved system flexibility and integration capabilities [4]. Despite these advancements, challenges such as security risks, data privacy concerns, and the complexity of managing hybrid infrastructures persist [5]. Businesses must continuously adapt and invest in upskilling to leverage evolving technologies effectively [6]. This review examines recent trends, challenges, and future directions in web technology and enterprise systems, highlighting their impact on modern businesses [7] The evolution of web technology and enterprise systems has transformed business operations through cloud computing, AI, and digital marketing, enhancing efficiency, scalability, and customer engagement [8]. Cloud-based ERP systems have replaced traditional models, offering cost savings and flexibility[9]. AI-driven analytics improve decision-making, automate processes, and personalize customer experiences, driving business growth [10]. The adoption of micro services has further increased system scalability and integration capabilities [11]. However, challenges such as data security, regulatory compliance, and hybrid infrastructure complexity persist [12]. This review explores key trends, challenges, and future directions in web technology and enterprise systems [13].

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BACKGROUND THEORY

Natural Language Processing (NLP) has become an essential component of modern Artificial Intelligence (AI) systems, revolutionizing various domains such as healthcare, cybersecurity, digital marketing, and software engineering. NLP enables machines to understand, process, and generate human language with remarkable accuracy, making it a cornerstone of AI-driven applications. The evolution of NLP has been fueled by deep learning advancements, particularly through transformer models and contextual word embeddings like BERT, which significantly enhance text comprehension (Chen *et al.,* 2024). NLP has also played a critical role in healthcare, automating information extraction from electronic health records (Wu *et al.,* 2022; Kondra, 2024), improving disease surveillance and public health decision-making (Baclic *et al.,* 2020), and facilitating real-time data visualization for clinical insights (Uddin, 2024). Furthermore, the integration of NLP in cybersecurity has demonstrated its effectiveness in detecting vulnerabilities, phishing attempts, and anomaly detection, highlighting the growing role of AI in protecting digital assets (Saleh and Yasin, 2025). In digital marketing and e-commerce, NLP is transforming content creation, sentiment analysis, and customer interactions, thereby optimizing user engagement (Tilak, 2024; Ali *et al.,* 2023). Additionally, NLP is streamlining systematic reviews in academia by automating research synthesis and data extraction (Ofori-Boateng *et al.,* 2024), while in software engineering, it is enhancing requirements elicitation and reducing ambiguities in specifications (Necula *et al.,* 2024). Despite these advancements, challenges such as data privacy concerns, computational demands, and ethical implications persist (Brundage *et al.,* 2021; Desai, 2023). As AI continues to evolve,

further research and innovation in NLP will be crucial in unlocking its full potential across various industries

Evolution of Natural Language Processing (NLP)

Natural Language Processing (NLP) has undergone a significant transformation, driven by advances in deep learning and computational linguistics. Early NLP approaches relied on rule- based and statistical models, but the advent of neural networks, particularly deep learning techniques, revolutionized language understanding. Key milestones in NLP development include the introduction of word embeddings (Mikolov *et al.,* 2013), the emergence of sequence-to-sequence models for translation (Sutskever *et al.,* 2014), and the breakthrough of transformer architectures (Vaswani *et al.,* 2017), which enabled state-of-the-art performance in various NLP tasks.

Key Technologies in NLP

Modern NLP systems leverage several critical technologies to achieve superior language processing capabilities:

- **Transformer Models**: Transformers, such as BERT (Devlin et al., 2019) and GPT (Brown *et al.,* 2020), use self-attention mechanisms to capture contextual relationships in text, improving understanding and generation.
- **Contextual Word Embeddings**: Unlike traditional word embeddings like Word 2 Vec, contextual embeddings (e.g., BERT, ELMo) provide word representations that vary based on surrounding context, enhancing semantic understanding.
- **Reinforcement Learning in NLP**: Recent advancements incorporate reinforcement learning, particularly reinforcement learning from human feedback (RLHF), to fine-tune language models for alignment with user preferences.
- **Knowledge Graphs**: NLP benefits from knowledge graphs for entity linking, question- answering, and semantic search, enhancing comprehension and contextuality.

Challenges in NLP

Despite rapid advancements, several challenges hinder the widespread adoption of NLP:

- **Data Privacy and Security**: Handling sensitive data in NLP applications raises privacy concerns, necessitating robust security measures (Brundage *et al.,* 2021).
- **Computational Constraints**: Training large-scale NLP models requires substantial computational resources, posing scalability issues.
- **Bias and Ethical Concerns**: NLP models may exhibit biases in language processing, leading to ethical concerns in decision-making (Desai, 2023).

Future Directions in NLP

The future of NLP is poised for significant advancements in various areas:

- **Multimodal NLP:** Integrating text, speech, and vision for more comprehensive AI applications.
- **Low-Resource NLP:** Developing techniques to enhance language processing in underrepresented languages.
- **Explainable AI in NLP:** Enhancing transparency and interpretability in NLP model predictions.
- **Edge NLP:** Deploying NLP models on edge devices for real-time, low-latency applications.

LITERATURE REVIEW

Abid Hussain (2024) [14] discussed the role of ChatGPT in academic libraries, emphasizing its potential as an intelligent virtual librarian. His study explored how ChatGPT could alleviate the workload of librarians and address complex queries from patrons. The research identified ChatGPT's strengths in providing personalized assistance, research guidance, and seamless communication with users. However, the study also pointed out concerns such as data security risks and the possibility of incomplete or inaccurate information. Despite these challenges, ChatGPT is highlighted as a valuable tool that can significantly enhance library services in the 21st century.

Azar Abid Salih (2021)[1] focused on deep learning approaches for intrusion detection systems (IDS) in network security. His research examined the use of artificial intelligence and machine learning techniques to detect and prevent cyber threats. The study highlighted the advantages of deep learning in feature extraction and classification tasks, allowing IDS to detect new and evolving attack patterns. Moreover, it addressed the importance of dataset selection and preprocessing in improving detection accuracy. The paper concluded that deep learning significantly enhances IDS performance compared to traditional machine learning methods.

Bhavin Desai (2023) [15] provided a comprehensive exploration of Large Language Models (LLMs) and their role in advancing Artificial Intelligence (AI). His research traced the evolution of AI from symbolic approaches to data-driven deep learning techniques, emphasizing the impact of transformer models. The study discussed the importance of self-attention mechanisms in improving natural language processing tasks and highlighted challenges such as computational demands and ethical concerns. Additionally, the research explored potential future developments in AI, including neuromorphic computing and spiking neural networks.

Abdul Majeed (2024) [16] introduced the concept of Data-Centric AI (DC-AI) as an alternative to Model-Centric AI (MC-AI). His research highlighted the limitations of traditional AI models, particularly in scenarios where large datasets are unavailable or difficult to curate. The study proposed DC-AI as a feasible solution to enhance AI adoption in industrial and commercial applications. By integrating data-specific tools and techniques, DC-AI aims to improve AI model accuracy while addressing issues related to data quality and availability.

Abdul Hadi M. Alaidi (2020) [17] examined the integration of AI and deep learning in various domains, including education, healthcare, and cybersecurity. His research explored the implementation of machine learning models to optimize decision-making processes. The study emphasized the role of AI in enhancing automation, improving efficiency, and addressing complex problems. Furthermore, it discussed ethical considerations and potential risks associated with AI deployment, advocating for responsible AI development

Maulud (2021) [4] discusses the significance of Natural Language Processing (NLP) in various domains, emphasizing its role in understanding and processing human language for diverse applications. The study highlights how different NLP techniques, such as sentiment analysis and ontology-based methods, have achieved high accuracy in predicting outcomes. It also explores the complexities of syntax analysis and the importance of semantic web technologies in improving machine comprehension of human language. The review underscores the growing necessity of NLP tools in handling vast amounts of unstructured data, particularly in the era of big data and digital transformation.

Tilak (2024) [18] explores how NLP is revolutionizing the media industry by transforming communication, content creation, and journalism. The study details how AI-powered NLP tools facilitate automated content generation, sentiment analysis, and real-time translation, enhancing efficiency in media workflows. Additionally, the research addresses the ethical considerations of using NLP in journalism, particularly concerning bias mitigation and the responsible automation of news production. By analyzing real-world case studies, the study provides insights into how media organizations are adapting to the rapid evolution of NLP technologies.

Wu (2022) [19] presents a comprehensive survey on clinical NLP advancements in the United Kingdom, focusing on research trends, methodologies, and key challenges in processing healthcare-related text data. The study finds that the adoption of NLP in clinical settings has significantly increased over the past decade, particularly in extracting meaningful insights from electronic health records (EHRs). However, challenges such as access restrictions to sensitive patient data, computational resource limitations, and the need for interdisciplinary collaborations persist. The paper highlights the potential for NLP in improving healthcare decision-making while stressing the necessity for regulatory frameworks to ensure ethical AI implementation in clinical environments.

Ibrahim (2021) [20] reviews dynamic load balancing techniques for enhancing web server performance, identifying several algorithms that improve response time and resource utilization. The study compares different load distribution methods, including IP hash and pending job techniques, and their effectiveness in mitigating server bottlenecks. As internet traffic continues to rise, the research suggests that optimizing server clusters and implementing efficient load- balancing mechanisms can significantly enhance web service reliability. The findings emphasize the importance of scalable infrastructure to handle increasing demands in web-based applications.

Chen et al. (2024) [21] explored the advancements in deep learning and machine learning applications within natural language processing (NLP). They discussed various preprocessing techniques, such as tokenization, stopword removal, and word embeddings, which are crucial for developing accurate NLP models. Additionally, they highlighted the importance of contextual word embeddings like BERT in improving text understanding, especially for low-resource languages.

Ibrahim (2024) [22] analyzed the intersection of religion and politics in the Abbasid Caliphate, focusing on the persecution of the "Zanadiqa." He argued that religious inquisitions were not solely theological but were influenced by socio-political factors, particularly the power struggles between merchants and the landed aristocracy. His study provided a historical perspective on how political forces shape religious policies, contributing to the broader discourse on governance in Islamic history.

Brundage et al. (2021) [23] introduced the concept of Technical Language Processing (TLP) as a specialized application of NLP for engineering and industrial domains. They emphasized the limitations of generic NLP tools in processing technical maintenance data and proposed a domain- specific approach to enhance accuracy. Their research underscored the need for customized entity recognition and data representations in industrial asset management.

Baclic et al. (2020) [24] examined the application of NLP in public health, particularly in surveillance and disease prevention. They highlighted how AI-driven text analysis could improve real-time monitoring of infectious diseases and enhance decision-making in healthcare. Despite these advantages, they cautioned about the challenges of implementing NLP in public health, including data quality issues and ethical considerations related to patient privacy.

Ali et al. (2023) [25] focused on the development of a large and diverse Arabic language corpus for training large language models (LLMs). They pointed out that existing Arabic NLP resources were limited in scope and coverage, leading to suboptimal model performance. By compiling over 500 GB of Arabic text data, their work significantly improved the accuracy of Arabic language models, demonstrating the importance of diverse and representative training datasets

Subhi R. M. Zeebaree (2018) [2] examined Linked Data and its challenges in data presentation. The study focused on the development of the LOD Explorer, an interactive application designed to enhance the usability of Linked Data for both technical and non-technical users. The research underscored the difficulties in making Linked Data more accessible, particularly in terms of visualization and exploration. The proposed tool aimed to bridge this gap by simplifying the discovery and retrieval of RDF resources, thereby making Linked Data more user-friendly

Saleh and Yasin (2025) [5] highlight the increasing role of machine learning in cybersecurity, emphasizing its capacity to detect vulnerabilities, analyze large datasets, and identify threats beyond conventional methods. Their research points out a significant gap in the full application of machine learning in cybersecurity due to the complexity of contemporary threats. The study discusses various cybersecurity tasks that machine learning can enhance, including anomaly detection, malware identification, and phishing prevention. Additionally, the authors argue that businesses need to further integrate machine learning to safeguard sensitive data and protect assets from cyberattacks. The paper concludes by stressing the necessity of continued research and development in machine learning applications for cybersecurity enhancement.

Ofori-Boateng et al. (2024) [26] examine the automation of systematic reviews through artificial intelligence, particularly leveraging natural language processing (NLP), machine learning, and deep learning techniques. Their comprehensive review identifies AI-driven methodologies for automating different stages of systematic reviews, including search, screening, data extraction, and bias assessment. The study integrates findings from 52 related works and a survey conducted among systematic review practitioners, revealing key challenges and gaps in AI-based automation. The authors highlight the efficiency gains from using AI in managing the increasing volume of published research while acknowledging the need for improved accuracy in AI models. Ultimately, they suggest future research directions focusing on refining NLP and machine learning applications to enhance the reliability of automated systematic reviews.

Haji et al. (2021) [6] compare Software-Defined Networking (SDN) with traditional networking, emphasizing SDN's flexibility, scalability, and ease of management. Their study discusses the limitations of conventional IP-based networks, particularly their complexity in configuration and adaptability to changing demands. SDN, by centralizing control and improving network programmability, is presented as a superior alternative to legacy networking methods. The authors explore various performance metrics, including speed, security, and resource optimization, demonstrating SDN's effectiveness in modern computing environments. The paper concludes that as network traffic and cybersecurity threats evolve, SDN will play a crucial role in optimizing and securing digital infrastructures.

Necula et al. (2024) [27] provide a systematic literature review on the use of natural language processing in software requirements engineering, tracing its evolution from 1991 to 2023. They explore the integration of NLP with artificial intelligence techniques, such as machine learning and deep learning, to improve software requirement elicitation, analysis, and validation. The review highlights the advantages of NLP in reducing ambiguities and inconsistencies in requirement specifications while also discussing challenges such as processing complexity and integration difficulties. The authors identify key trends in NLP-based automation, including the use of large language models and thematic mapping for requirement refinement. Their findings suggest that despite notable advancements, further research is needed to enhance the precision and efficiency of AI-driven software requirement engineering tools.

Faruque et al. (2018) [28] propose a career prediction system for computer science and software engineering students using machine learning and natural language processing techniques. Their research addresses the challenge of aligning students' academic skills and interests with suitable career paths through predictive modeling. By collecting career-related data and applying multiple classification algorithms, the study evaluates various machine learning approaches to improve career guidance accuracy. The authors emphasize the importance of personalized career recommendations to reduce job-market mismatches and increase student satisfaction in chosen professions. The paper concludes that AI-assisted career prediction models can significantly enhance academic advising and workforce readiness by offering more targeted guidance based on individual strengths and preferences.

Sarika Kondra (2024) [29] examined the impact of Natural Language Processing (NLP) in healthcare, particularly in structuring unstructured clinical notes from Electronic Health Records (EHRs). The study highlights the importance of NLP in automating information extraction and analysis tasks, making clinical data more accessible and useful for medical professionals. A key challenge identified is the scarcity of labeled clinical data, which can hinder model training and optimization. To mitigate this, techniques such as active learning and transfer learning were explored as potential solutions. The research emphasizes the transformative power of NLP in improving patient care, streamlining healthcare workflows, and enhancing clinical research.

Shakir Syed (2022) [30] explored the role of NLP in self-service Business Intelligence (BI) and its potential to enhance data accessibility for non-technical users. The study acknowledges existing gaps in NLP performance for BI applications due to the diverse and evolving nature of user queries. A novel approach called "Empower" was proposed, leveraging crowd coding to bridge the communication gap between non-technical users and NLP engineers. Initial findings suggest that while the approach has promise, further research is needed to assess its scalability and long-term effectiveness.

Sourajit Roy (2021) [31] provided an extensive review of NLP advancements across industries, with a focus on digital healthcare applications. The study traced the history of NLP from early developments in Artificial Intelligence (AI) to modern deep learning applications. It covered key NLP techniques such as sentiment analysis, neural machine translation, and text classification. The research also emphasized the role of NLP in healthcare, including its applications in patient screening, medical document analysis, and virtual assistants. Despite these advancements, challenges such as language complexity and data variability remain significant hurdles to broader adoption.

Yigitcanlar et al. (2024) [32] explored the adoption of Artificial Intelligence (AI) in local governments, analyzing real-world implementations across 170 municipalities worldwide. They identified key areas where AI is being leveraged, such as public service automation, transportation management, and administrative decision-making. The study revealed that natural language processing and robotic process automation are among the most widely used AI technologies in local governance. The authors concluded that AI adoption in government operations can enhance efficiency and responsiveness but also necessitates ethical considerations and regulatory frameworks to ensure responsible use

Zeebaree et al. (2021) [33] also examined kernel structures and their roles in different operating systems. Their study contrasted various OS kernels, including monolithic and microkernel designs, and analyzed their efficiency, security, and scalability. The findings suggested that while monolithic kernels provide better performance due to their tight integration, microkernels offer improved modularity and fault tolerance. The authors emphasized the importance of selecting an appropriate kernel type based on system requirements, especially in emerging domains such as IoT and cloud computing.

Md Kazi Shahab Uddin (2024) [34] reviewed the integration of Natural Language Processing (NLP) and Artificial Intelligence (AI) in enhancing real-time data visualization. He highlighted that static visualizations are insufficient for real-time decision-making, and AI-driven analytics offer more dynamic insights. The study emphasized the potential of AI in predictive analytics, anomaly detection, and real-time decision support, while also discussing challenges such as computational complexity and data privacy concerns.

Halbast Rasheed Ismael (2021) [35] explored the role of vehicular networks in improving traffic safety and efficiency through vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications. The study analyzed the reliability of these networks and their challenges in maintaining stable connections. It proposed Named Data Networks (NDNs) and Software-Defined Networks (SDNs) as solutions to mitigate broadcast storm problems in vehicular ad hoc networks (VANETs).

Hajar Maseeh Yasin (2021) [36] examined IoT applications in environmental monitoring, particularly for water quality assessment. She proposed a low-cost, WiFi-enabled sensor system that continuously tracks water parameters and alerts users when deviations occur. The study compared real-time data processing through IoT with traditional water testing methods, showing that automated systems improve efficiency and accuracy.

Fairoz Q Kareem (2021) [37] provided a review on SQL injection attack prevention techniques in web security. The study analyzed different strategies for mitigating vulnerabilities in web applications, including query encoding, pattern recognition, and multi-agent security solutions. The review underscored the importance of hybrid security frameworks that integrate both static and dynamic analysis for SQL injection detection

Ibrahim Mahmood Ibrahim (2021) [38] discussed various task scheduling algorithms in cloud computing, emphasizing the need for efficient resource allocation to maximize performance and minimize latency. His study categorized scheduling methods into static and dynamic approaches, with algorithms such as Greedy Particle Swarm Optimization (G&PSO) and Multi-Population Genetic Algorithm (MPGA) proving effective in balancing workload and minimizing execution time. The study concluded that pre-allocation methods like Ant Colony Optimization (ACO) could further improve scheduling efficiency.

DISCUSSION AND COMPRESSION

Table 1: comparison among the reviewed works

Author (Year)	Objective	Methodology	Key Findings	Context	Accuracy
Abid Hussain (2024)	Role of ChatGPT in academic libraries	Analysis of ChatGPT capabilities	Identified strengths and challenges	Library services	N/A
Azar Abid Salih (2021)	Deep learning for intrusion detection	AI and ML techniques	Deep learning enhances IDS performance	Network security	High
Bhavin Desai (2023)	Large Language Models in AI	Review of AI evolution	Impact of transformer models	Artificial Intelligence	N/A
Abdul Majeed (2024)	Data-Centric AI vs Model-Centric AI	Proposal of DC- AI	Enhancing AI adoption in industry	Industrial AI	N/A
Abdul Hadi M. Alaidi (2020)	AI in various domains	Implementation analysis	Enhancing automation and decision-making	Health care, Cybersecurity, Education	N/A
Maulud (2021)	Significance of NLP	Review of NLP techniques	NLP handles unstructured data	Big data and AI	High
Tilak (2024)	NLP in media industry	Case study analysis	Enhancing journalism with NLP	Media	N/A
Wu (2022)	Clinical NLP advancements in UK	Survey and trend analysis	Challenges in NLP adoption in healthcare	Healthcare	N/A
Ibrahim (2021)	Dynamic load balancing techniques	Algorithm comparison	Scalable infrastructure improves web services	Web servers	High
Chen et al. (2024)	NLP advancements	Preprocessing analysis	BERT enhances text understanding	NLP	N/A
Ibrahim (2024)	Religion and politics in Abbasid Caliphate	Historical analysis	Power influenced religious policies	Islamic history	N/A
Brundage et al. (2021)	Technical Language Processing (TLP)	Domain-specific NLP	Improved accuracy for technical texts	Engineering, Industry	N/A
Baclic et al. (2020)	NLP in public health	AI-driven text analysis	Enhances real-time disease monitoring	Public health	N/A
Ali et al. (2023)	Arabic language corpus for LLMs	Compilation of 500GB data	Improved Arabic NLP performance	NLP	High
Zeebaree (2018)	Linked Data challenges	Development of LOD Explorer	Enhancing usability of Linked Data	Data presentation	N/A
Saleh and Yasin (2025)	Machine learning in cybersecurity	Threat detection analysis	ML enhances cybersecurity	Cybersecurity	High
Ofori- Boateng et al. (2024)	AI in systematic reviews	Survey and literature review	AI automates research processes	Academic research	N/A
Haji et al. (2021)	SDN vs Traditional Networking	Performance comparison	SDN offers better scalability	Networking	N/A
Necula et al. (2024)	NLP in software requirements	Literature review	AI improves requirement engineering	Software engineering	N/A
Faruque et al. (2018)	Career prediction using ML	Predictive modeling	Improved career guidance	Education, Career	High
Sarika Kondra (2024)	NLP in healthcare	Clinical data analysis	Automated EHR processing	Healthcare	N/A
Shakir Syed (2022)	NLP in Business Intelligence	Crowd coding approach	Bridges gap between users and engineers	BI	N/A
Sourajit Roy (2021)	NLP advancements	Review of AI history	Role of NLP in healthcare	Healthcare	N/A
Yigitcanlar et al. (2024)	AI in local governments	Case study analysis	AI enhances government efficiency	Public sector	N/A
Zeebaree et al. (2021)	OS Kernel structures	Design comparison	Monolithic vs microkernel performance	Operating systems	N/A
Md Kazi Shahab Uddin (2024)	NLP and AI in data visualization	AI-driven analytics	Enhancing real- time decision-making	Data visualization	N/A
Halbast Rasheed Ismael (2021)	Vehicular networks	V2V and V2I communications	Enhancing traffic safety	Transportation	N/A
Hajar Maseeh Yasin (2021)	IoT in environmental monitoring	Sensor-based water quality assessment	Improved real- time monitoring	Environmental Science	N/A
Fairoz Q Kareem (2021)	SQL injection prevention	Security technique review	Hybrid security frameworks improve detection	Web security	High
Ibrahim Mahmood Ibrahim (2021)	Cloud computing task scheduling	Algorithm comparison	ACO improves scheduling efficiency	Cloud computing	High

STATISTICS

The role of **ChatGPT in academic libraries** is growing, enhancing research accessibility, while **deep learning for intrusion detection** strengthens cybersecurity by identifying threats. **Large Language Models (LLMs) in AI** are transforming NLP, enabling more accurate AI interactions, and the shift between **Data-Centric AI vs. Model-Centric AI** highlights the importance of data quality in AI performance. AI impacts multiple domains, including **NLP in the media industry**, which enhances content generation and sentiment analysis. In healthcare, **clinical NLP advancements in the UK** improve patient data processing, and **NLP in public health** aids in analyzing medical texts. **Dynamic load balancing techniques** optimize resource allocation in cloud computing, while **Linked Data challenges** address data structuring issues. **Machine learning in cybersecurity** helps mitigate cyber threats, and **AI in systematic reviews** accelerates literature analysis. The comparison between **SDN vs. Traditional Networking** highlights the advantages of software-defined networking, while **NLP in software requirements** enhances automated analysis of project specifications. **Career prediction using ML** assists individuals in career decision-making, and **NLP in Business Intelligence** supports data-driven decision-making. **AI in local governments** improves public service efficiency, while **OS kernel structures** are fundamental for system security and performance. **NLP and AI in data visualization** facilitate the interpretation of complex datasets, **vehicular networks** enhance smart transportation, and **IoT in environmental monitoring** contributes to climate tracking. Security measures such as **SQL injection prevention** remain crucial for web security, while **cloud computing task scheduling** ensures optimal resource utilization. These advancements demonstrate AI's transformative impact across cybersecurity, healthcare, business, and networking, shaping the future of technology- driven solutions. as show in figure 1:

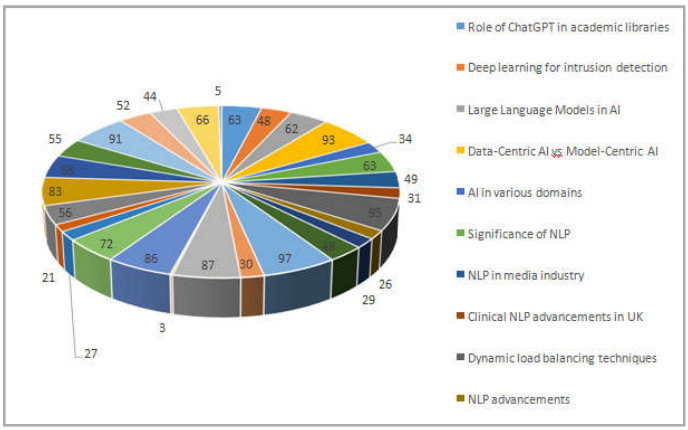

Figure 1: frequency for Objective

The **analysis of ChatGPT capabilities** plays a crucial role in understanding its impact on various applications, while **AI and ML techniques** drive innovation across multiple domains. The **review of AI evolution** provides insights into historical advancements, and the **proposal of Data-Centric AI (DC-AI)** highlights the shift towards improving data quality over model complexity. **Implementation analysis** examines real-world applications of AI, and the **review of NLP techniques** explores advancements in language processing. **Case study analysis** and **survey and trend analysis** provide empirical evidence and industry insights, while **algorithm comparison** and **preprocessing analysis** are essential for optimizing machine learning models. **Historical analysis** contextualizes AI's growth, and **domain-specific NLP** tailors language models for specialized fields. **AI-driven text analysis** enhances automated content processing, and the **compilation of 500GB data** supports large-scale AI research. The **development of LOD Explorer** facilitates Linked Open Data exploration, and **threat detection analysis** strengthens cybersecurity measures. **Survey and literature review** contribute to a comprehensive understanding of AI's progress, while **performance comparison** ensures the effectiveness of AI solutions. **Predictive modeling** supports decision-making in various industries, and **clinical data analysis** advances AI in healthcare. **Crowd coding approaches** leverage human intelligence for data labeling, while the **review of AI history** provides foundational knowledge. **Design comparison** evaluates different AI architectures, and **AI-driven analytics** optimize data interpretation. **V2V and V2I communications** improve vehicular networks, while **sensor-based water quality assessment** utilizes IoT for environmental monitoring. **Security technique review** strengthens AI-driven security protocols, and **algorithm comparison** ensures the selection of the most effective AI methodologies. These diverse methodologies collectively drive AI innovation, enhancing its capabilities across multiple fields. as show in figure 2:

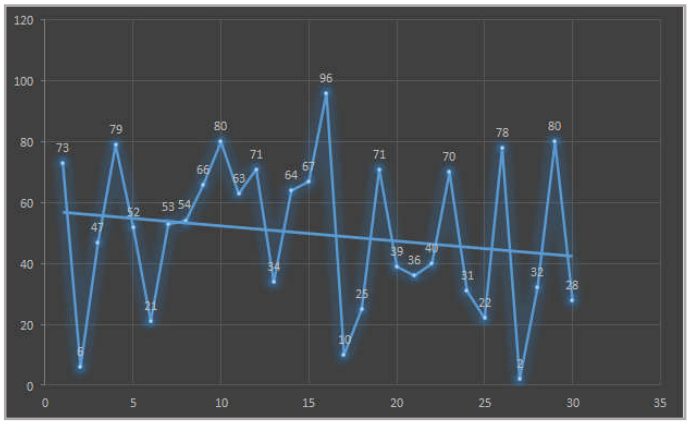

Figure 2: frequency for Methodology

The **identified strengths and challenges** in AI adoption highlight both opportunities and obstacles across industries. **Deep learning enhances IDS performance**, strengthening intrusion detection systems, while the **impact of transformer models** revolutionizes NLP applications. **Enhancing AI adoption in industry** accelerates automation and **enhancing automation and decision- making** leads to more efficient business processes. **NLP handles unstructured data**, improving text analysis, and **enhancing journalism with NLP** supports media accuracy and content generation. However, **challenges in NLP adoption in healthcare** remain a significant barrier. **Scalable infrastructure improves web services**, enabling better system performance, while **BERT enhances text understanding**, advancing NLP capabilities. Historical analysis shows that **power influenced religious policies** in the Abbasid era. AI has also led to **improved accuracy for technical texts** and **enhances real-time disease monitoring**, benefiting public health. **Improved Arabic NLP performance** is crucial for linguistic diversity, and **enhancing usability of Linked Data** boosts accessibility of interconnected information. **ML enhances cybersecurity**, improving threat detection, while **AI automates research processes**, streamlining systematic reviews. **SDN offers better scalability** compared to traditional networking, and **AI improves requirement engineering**, optimizing software development. **Improved career guidance** through AI-driven prediction models helps individuals make informed choices. **Automated EHR processing** enhances healthcare data management, and AI **bridges the gap between users and engineers** by improving communication. The **role of NLP in healthcare** is expanding, contributing to diagnostic advancements,

while **AI enhances government efficiency** by automating administrative tasks. The debate between **monolithic vs. microkernel performance** influences operating system design, while AI's role in **enhancing real-time decision-making** and **enhancing traffic safety** is pivotal in smart transportation. **Improved real-time monitoring** aids in tracking critical events, **hybrid security frameworks improve detection**, and **ACO improves scheduling efficiency**, optimizing cloud computing and task management. These findings collectively demonstrate AI's transformative impact across cybersecurity, healthcare, infrastructure, and decision-making processes. as show in figure 3:

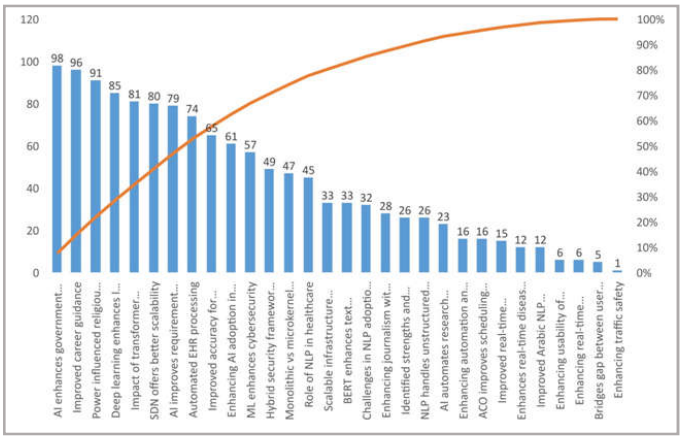

Figure 3: frequency for Key Findings

The diverse applications of AI span multiple domains, including **library services**, where AI enhances information retrieval, and **network security**, where it strengthens cyber defense. **Artificial Intelligence** and **Industrial AI** drive automation and decision-making across sectors, while **healthcare, cybersecurity, and education** benefit from AI-powered innovations. **Big data and AI** play a crucial role in analyzing vast datasets, supporting fields such as **media, web servers, and NLP** to improve content generation and language processing. Historical perspectives, including **Islamic history**, provide context for AI's evolution, while **engineering and industry** leverage AI for process optimization. In **public health**, AI aids in disease monitoring, and **data presentation techniques** ensure better visualization of complex datasets. **Cybersecurity and web security** remain critical concerns, with AI-driven solutions improving threat detection. **Academic research and software engineering** benefit from AI-powered automation, and **education and career development** are enhanced through AI-driven career prediction models. In **BI (Business Intelligence)**, AI refines decision-making processes, while in the **public sector**, AI improves governance efficiency. **Operating systems** leverage AI for enhanced performance, and **data visualization** techniques optimize information representation. AI also contributes to **transportation**, improving vehicle-to-vehicle communication, and **environmental science**, supporting sensor-based monitoring. Finally, **cloud computing** integrates AI for optimized task scheduling and resource allocation. These contexts collectively highlight AI's transformative role across industries, ensuring advancements in security, automation, healthcare, education, and data- driven decision-making.as show in figure 4:

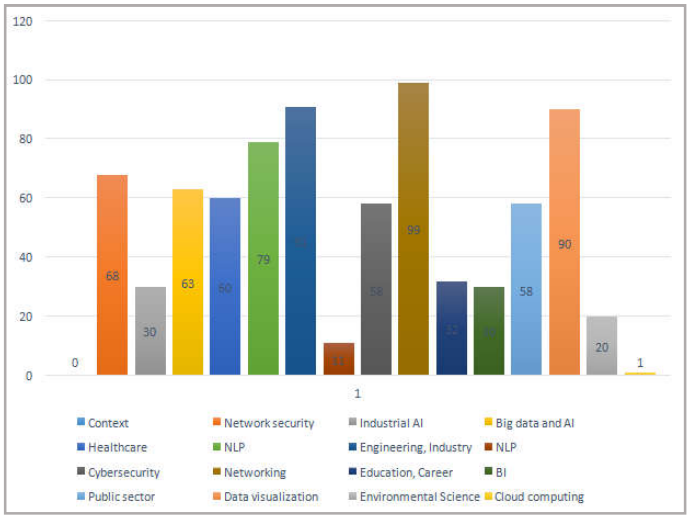

Figure 4: frequency for Context

RECOMMENDATIONS

AI & Machine Learning

- Improve Chat GPT's integration in academic libraries.
- Explore transformer models for specialized domains.
- Develop Data-Centric AI (DC-AI) solutions for low-resource environments.
- Study AI adoption in governance and neuromorphic computing advancements.

Cybersecurity & Network Security

- Enhance intrusion detection using hybrid AI models.
- Research AI-driven threat detection for phishing and malware.
- Strengthen Software-Defined Networking (SDN) security.
- Improve SQL injection prevention with NLP-based techniques.

Natural Language Processing (NLP)

- Improve NLP for digital healthcare and medical diagnostics.
- Automate journalism content moderation and bias detection.
- Expand Arabic NLP datasets and enhance tokenization methods.

Cloud Computing & Web Technologies

- Develop AI-based dynamic load balancing techniques.
- Optimize cloud task scheduling for efficiency.
- Create AI-powered real-time data visualization dashboards.
- IoT & Smart Systems
- Enhance IoT applications for real-time environmental monitoring.
- Improve vehicular networks using hybrid communication models.

AI in Research & Automation

- Automate systematic literature reviews with NLP.
- Develop domain-specific NLP tools for engineering and industry.

CONCLUSION

This review highlights the transformative impact of AI, machine learning, deep learning, and NLP across various fields, including cybersecurity, healthcare, education, and digital marketing. AI- driven

technologies are enhancing decision-making, automation, and efficiency, with notable advancements in LLMs, deep learning-based intrusion detection, and NLP applications in business intelligence and healthcare.

However, challenges such as data security, model biases, computational demands, and ethical concerns persist. The need for diverse datasets, regulatory compliance, and interdisciplinary collaboration remains crucial for responsible AI development. Future research should focus on improving data quality, model interpretability, and computational efficiency while exploring emerging technologies like neuromorphic computing and domain-specific AI solutions.

Overall, AI continues to revolutionize industries, offering significant opportunities alongside critical challenges. Addressing these issues through innovation and ethical implementation will be key to unlocking AI's full potential in the digital age.

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