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Original Article

A Literature Review on Natural Language Processing (NLP) in Aiding Industry to Progress

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Abstract *- The study of Artificial Intelligence (AI) is a rapidly developing topic that has expanded into several corporate and academic fields. Artificial intelligence (AI) encompasses machine learning, deep learning, and Natural Language Processing (NLP) to handle many data processing and modeling elements. Researchers have collected data from studies on a wide range of topics about Artificial Intelligence (AI), specifically Natural Language Processing (NLP). The goal of this study is to identify possible topics about the adaption of NLP in aiding the industry to improve, summarize the trend of topics, and interpret the evolution of topics within the last 5 years. This review article gives a general summary of the effects of AI on several uses in a variety of industries while also highlighting available opportunities in the fields of education, law in practice, health, finance, marketing, and social sciences. As AI and NLP continue to advance, we can expect to see even more innovative applications in various industries and fields, ultimately transforming how we live, work, and interact with the world. However, with the increasing use of AI and NLP, it is important to consider ethical and privacy concerns and ensure these technologies are used responsibly and ethically. Within the more than 5,000 articles published between 2018 and 2023, we identified 33 topics.*

Keywords *- Artificial Intelligence (AI), Natural Language Processing (NLP), Intelligent machines, Ethical practices.*

1. Introduction

The adoption of the new Internet of Things (IoT), artificial intelligence, other information and communication technologies, and blockchain technology is causing the global technological and industrial revolution to accelerate. The government, business, and academic communities have all paid close attention to artificial intelligence [1]. According to (Jordan, 2019), Artificial Intelligence (AI) is the mantra of the current era. It quickly opens up a new area for business, corporate behavior, and governmental policy [3]. [4], it defined Artificial Intelligence (AI) as a system's ability to correctly grasp external information, to learn from such data, and to utilize those learnings to carry out certain activities and goals through flexible implementation. Building intelligent machines capable of performing actions that often require human intelligence, such as understanding natural language, identifying patterns, and making decisions, is the goal of Artificial Intelligence (AI), a rapidly developing field. Several sectors, including healthcare, banking, and transportation, can be transformed by AI. Machine learning, natural language processing, and robotics are some of their subfields. A popular and intriguing area of AI is natural language processing. For several reasons, Natural Language Processing (NLP) is acknowledged as a significant and rapidly developing field of Artificial Intelligence (AI).

Natural Language Processing (NLP) is quickly revolutionizing the way businesses work. Industries are turning to AI and NLP to help them analyze, interpret, and use data more effectively as a result of the exponential growth of data. Industries can make informed decisions, increase operational effectiveness, and customize the customer experience by utilizing AI and NLP technologies. Even though the use of AI in a variety of sectors has increased recently, there is still a large body of study to be done on the moral implications and socioeconomic effects of broad AI integration. Businesses are using AI technology more and more for creativity and efficiency. However, few thorough studies examine the wider effects on data privacy, social inequality, and job displacement. Further academic inquiry is necessary to guarantee a more comprehensive and ethical adoption of AI across sectors. Two key areas of concern are understanding the long-term implications and building frameworks for responsible AI deployment. Unintended consequences are gradually becoming more apparent as the advantages and applications of AI within the auditing profession continue to grow [5]. The majority of the attention is on AI ethics problems that are easiest to explain in technical terms. These include concerns about data security and privacy as well as ways to improve the interpretability and reliability of machine learning systems [6].

Numerous studies have chosen to concentrate on this worldwide data source to answer a variety of research topics in various areas, including NLP adapted by many industries around the globe and how this technology shapes their financial profit.

2. Related Works

Initially, it is essential to create automated systems that can perform tasks as efficiently and correctly as a human (for a limited amount of text) [7]. Second, NLP makes creating deep learning techniques like neural networks, machine translation, sentiment analysis, and question-answering easier [8]. Finally, the Big Four Voice Assistants: Google Assistant, Amazon's Alexa, Microsoft's Cortana, and Apple's Siri have all become more popular thanks to the development of useful NLP applications, such as chatbots and voice assistants [9] and now the known ChatGPT technology. Overall, the rising need for automated text analysis, advances in deep learning, advancements in real-world applications, and interdisciplinary collaboration have all contributed to the rapid development of natural language processing and its significance as a key area of research in AI. NLP has several uses in a variety of industries. The extraction of useful data that can aid decision-making, administrative reporting, and research is crucial [10]. In the healthcare sector, it extracts data from medical records. The study by [11] applied NLP to extract therapeutically valuable data from Chinese electronic medical records. With the help of these details, including patient symptoms, they assessed the HCC staging. Data from EHR and EMR were utilized in the study. It plays an essential role in the clinical environment to assist doctors in cancer diagnosis [12] and in therapies, an application developed by [13] that makes real-time treatment strategy recommendations to a therapist throughout a psychotherapy session. This NLP project aimed to complement clinical judgment and improve patient care.

Additionally, it enabled AI to track patient requests and find occurrences on platforms like Health Map and Copweb [14]. NLP can analyze news articles and social media data to inform investment decisions and identify emerging market trends [15]. It can also automate customer support that replies to users' queries by analyzing them using NLP and assists them in every way it can [16]. The finance domains frequently present textual documents designed to convey various messages regarding management's evaluation of the firm's present and future performance about corporate financial performance, analysts' evaluations of a company's performance, industry norms and laws, and proof of adherence to the necessary regulations and requirements. NLP applications have been utilized to mine these texts to get insights, conclude, and develop various approaches and artifacts to enhance knowledge in accounting, auditing, and finance [17]. In the study of [18], it was concluded that the number of NLP methods for forecasting financial markets is rapidly growing, developing the field of "Natural Language-based Financial Forecasting" (NLFF) or, from the perspective of applications, "stock market prediction." Another study was conducted by [19], and their investigation demonstrated that NLP could fully use its benefits in the banking sector. One technology that substantially affected financial industries is text-mining technologies. With the advent of big data resources and the analysis of large amounts of financial data, text mining has become more popular [20]. Because the Internet and social media are widely used, consumers research and compare information about goods and services online before purchasing. Hence, online reviews and social media data are crucial in the sales, marketing, business, tourism, and airline industries [21]. Overall, NLP has the potential to transform the financial sector by automating many tasks and providing new insights into market trends and customer behavior.

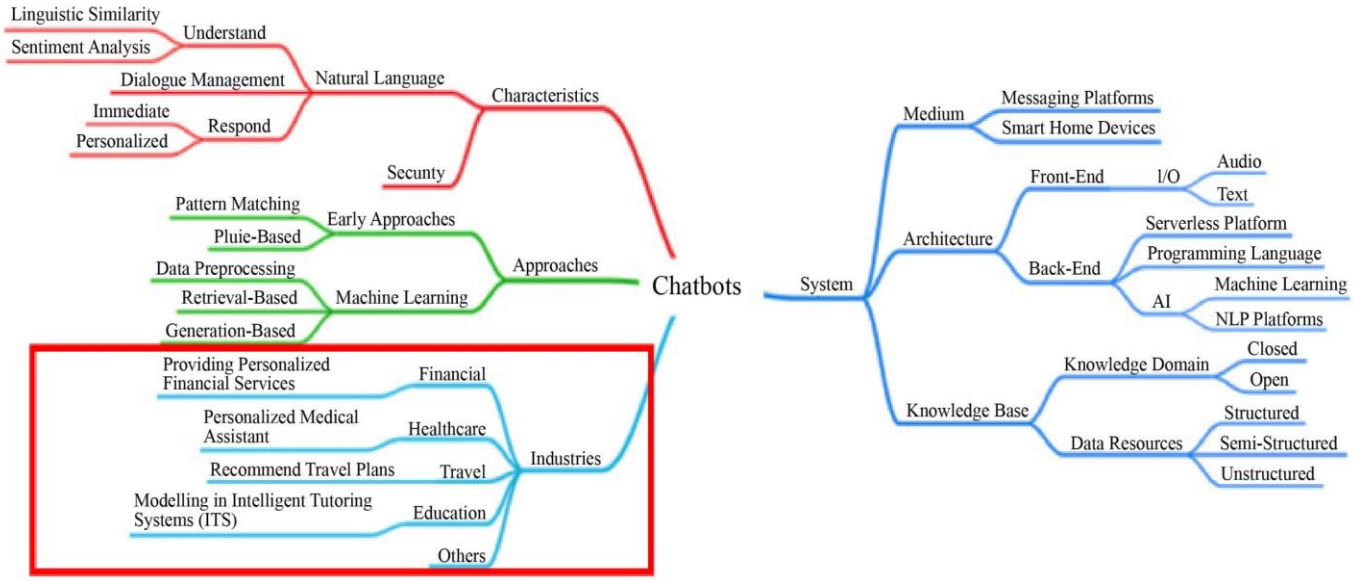

Fig. 1 Overview of the properties of ChatBots

Bot	Where is used	Target age of student	Service-oriented	Teaching-oriented
Lola	University of Murcia	18+	✓	-
AutoTutor	High School	12-17	-	✓
Dina	Dian N. Semarang University	18+	✓	-
Chatbot	"Dale aceptar" contest	12-17	-	✓
NerdyBot	WWW	-	-	✓
StudyBuddy	WWW	-	-	✓
SmarterChild	WWW	-	-	✓
CourseQ	Cornell University	18+	✓	-
Differ	Norwegian Business School	18+	✓	-
LTKABot	Students of Computer Science and Electrical Engineering	18+	✓	-
CEUBot	Cardenal Herrera University	-	✓	-
FITEBot	Science University Vietnam	18+	✓	-
Duolingo	WWW	18+	-	✓
Whatsapp Bot	Telkom University	-	✓	-
CALMsystem	UK Students	18+	-	✓
CSIEC	University, Middle School Beijing	8+	-	✓
NDLTutor	University Students	18+	-	✓
ScratchThAI	Thailand Students	From children to teens	-	✓
*ChatGPT	OpenAI	18+	-	-

*New Bot

Fig. 2 Some chatbots have been discovered in educational environments [23]

Court	Machine learning methods									
	Baseline		DT		RF		SVM		DL	
	Acc.	F1	Acc.	F1	Acc.	F1	Acc.	F1	Acc.	F1
Constitutional Court	79.4	0.51	85.1	0.62	87.6	0.57	83.5	0.61	**91.8**	**0.67**
Civil Court of Appeal	50.8	0.49	61.5	0.60	68.7	0.67	64.7	0.64	**69.0**	**0.68**
Criminal Court of Appeal	68.5	0.49	82.4	0.73	81.8	0.73	80.1	0.70	**85.6**	**0.77**
Administrative Court of Appeal	78.9	0.51	86.3	0.72	86.7	0.73	83.2	0.72	**91.1**	**0.77**
Court of Appeal on Taxation	76.7	0.54	89.9	0.81	89.4	0.80	92.4	0.86	**93.2**	**0.87**

Fig. 3 Cross-comparison utilizing machine learning methods [28]

In education, NLP can analyze student writing and provide feedback on grammar, syntax, and vocabulary. According to the study [22], the teachers' motivation, communication abilities, and performance all improved due to the NLP technique. It offers an integrated learning analytics solution that uses a distributed technological infrastructure to help academic leaders and advisors at educational institutions make decisions regarding particular students [23]. It was also found in the study of [24] that NLP chatbots can help students study in conditions akin to those of a human tutor while researching additional options and methods for judging chatbot quality. It is essential to collect data on student input to determine the benefits and drawbacks of the current student services. Regarding learning management systems, instructional strategies, and study settings, AI can help discover areas for development. The data analysis demonstrates in-game schooling [25], showing that the educational game featuring this NPC receives an overall user rating of more than 75%. Therefore, NPCs in instructional games can be said to improve player interest.

Overall, NLP has the potential to transform education by providing new ways to personalize instruction, assess student learning, and provide support for students with diverse needs. More cutting-edge NLP applications in education are something we may anticipate as technology develops.The legal profession's demise is predicted by academics, practitioners, and critics, who provide concrete examples of instances in which Artificial Intelligence (AI) systems surpass attorneys at a specific task [26]. Since it is necessary for the government, the law has long been a desirable topic for language and semantic technology. It tests the limitations of Natural Language Processing (NLP) technology [27]. NLP can be applied in law for document analysis, legal research, contract management, and litigation support. These approaches have recently received attention in the legal systems of several countries [28]. The findings of [26] stated that the ones that make use of deep learning techniques are more beneficial. It appears that these models can perform at least as well as others since they can capture relationships between words in addition to information buried in each word.

Fig. 4 Improving emotional algorithm [31]

For lawyers and judges, this can be useful as an assisting tool to identify cases and rapidly extract patterns to certain decisions. Based on their study, High accuracy can be achieved when predicting court decisions in the Turkish legal system, mainly when using deep learning-based techniques. The study offers a path for future studies to increase the use of NLP for processing legal documents in the construction industry [29]. NLP has the potential to transform the field of law by automating many tasks and providing new insights into legal documents and data. As technology advances, we can expect to see even more innovative applications of NLP in Law.

In the marketing area, NLP has the potential to transform marketing by providing new ways to understand customer behavior, optimize marketing content, and improve customer engagement. We may anticipate seeing even more cutting-edge NLP marketing applications as technology develops. People use their voice assistants to search, shop, and communicate their demands; they extract signals from company press releases to help them make better investment decisions [30].

The prediction explains how to utilize NLP to enhance stock price prediction and demonstrates a connection between stock price prediction and news headlines. It also provides valuable insights for financial market analysis and prediction [32].

Lastly, in Social Sciences, NLP can analyze social media data to understand patterns and trends in public opinion and sentiment. This can be useful for understanding public attitudes toward social issues, political campaigns, and consumer preferences.

Today, the term “social media” refers to a wide range of websites and Internet-based services that let users communicate with one another and generate content. Natural Language Processing (NLP) research has long focused on various technologies, such as multi-party chats, discussion forums, blogs, and online reviews [33]. According to [34], the outcome of NLP experiments and applications can directly affect individual users’ lives.

Figure 5 shows the worldwide market providing AI revenue to businesses was expanding significantly at the time of my previous report in early 2022, and this growth was expected to continue. Revenue from AI was produced in several industries, including technology, healthcare, banking, retail, and automobiles [35].

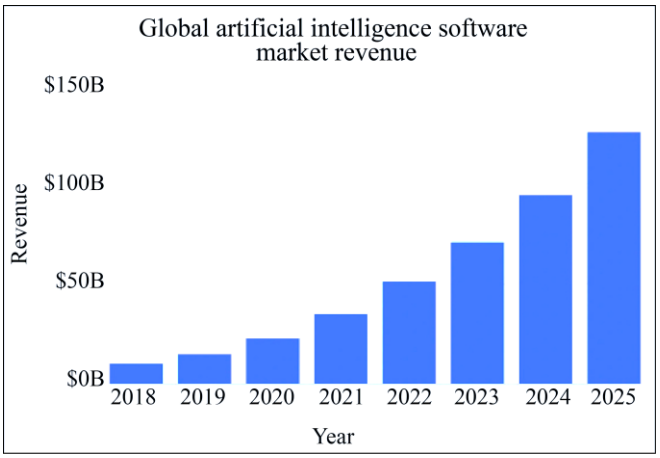

Fig. 5 Global AI software market revenue [35]

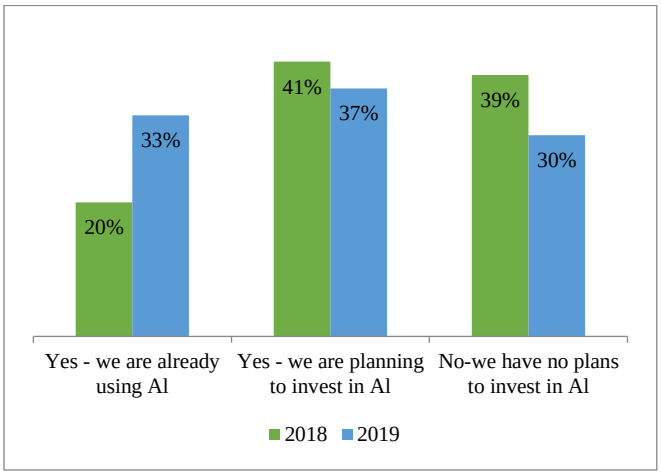

Fig. 6 Global AI adoption by organizations [35]

Prominent technology corporations such as Google, Microsoft, Amazon, and IBM were among the top earning substantial money from artificial intelligence. These businesses provided AI-driven goods and services, including machine learning tools, cloud-based AI platforms, computer vision solutions, natural language processing, and AI-powered apps that met the demands of many industries. As a matter of fact, from 2022 to 2030, enterprises worldwide should employ more AI [35].

Moreover, it was not only well-established IT companies that dominated the AI revenue scene. A portion of the industry was being carved out by startups and smaller businesses focusing on specialized AI applications, such as cybersecurity, robotic process automation, and AI-driven healthcare diagnostics. These businesses were also generating income.

3. Conclusion

In conclusion, Artificial Intelligence (AI) and Natural Language Processing (NLP) have revolutionized many fields, including finance, education, Law, marketing, and social sciences. These technologies have enabled the automation of many tasks, such as document analysis, legal research, customer profiling, content optimization, and social media analysis, while providing new insights and ways to understand large volumes of data. As AI and NLP continue to advance, we can expect to see even more innovative applications in various industries and fields, ultimately transforming how we live, work, and interact with the world. However, with the increasing use of AI and NLP, it is important to consider ethical and privacy concerns and ensure these technologies are used responsibly and ethically. AI and NLP are effective instruments that may help growth in the industry in various ways. By increasing the analysis of data, efficiency in operations, personalized service, and predictive analytics, industries can make informed decisions that drive business development and achievement. Future applications of these technologies will likely be even more creative as they develop. Better decision-making in a sector is made possible by natural language processing. Decision-makers may get valuable insights into users' and consumers' wants, desires, and orientations by using this abundant supply of behavior and sentiment analysis data.

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