

Review: Study of Generative Pre-Trained Transformers (GPT) Approach Used in Various Application Domains.

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DOI: <https://doi.org/10.51244/IJRSI.2026.1313CS007>

Received: 12 April 2026; Accepted: 18 April 2026; Published: 05 May 2026

ABSTRACT

Generative Pre-trained Transformer (GPT) are large language models that have transformed natural language processing by enabling machines to understand and generate human-like text. This paper presents a comprehensive review of GPT models and their applications across multiple domains, including education, healthcare, cybersecurity, finance, sentiment analysis, and academic research.

Keywords: GPT, LLM, ChatGPT, NLP

INTRODUCTION

In recent years, **Generative Pre-trained Transformer (GPT)** models have emerged as a transformative advancement in the field of artificial intelligence and **Natural Language Processing (NLP)**. GPT belongs to a class of **large language models (LLMs)** that leverage deep learning techniques to generate human-like text by learning patterns from vast amounts of data. Currently the , Generative Pre-trained Transformer (GPT) is a type of large language model (LLM) that uses deep learning to produce human-like text. The GPT model functions as a complex network of artificial neurons organized in layers to process information similar to the human brain. Its architecture is known as a transformer which is a neural network design. It was invented by the Google researchers and open-sourced in 2017[1]. Currently, GPT can be used for content creation, chatbots, code generation and in the education sector. GPT is mainly used to bridge the gap between humans and machines using language. Its ability to generate human like text for communication and automation is noteworthy. GPT is a general-purpose prediction model. GPT was developed by the AI research laboratory OpenAI in 2018. Since then OpenAI has officially released three iterations of the GPT model: GPT-2, GPT-3 and GPT-4

Goal of GPT

The primary goal of Generative Pre-trained Transformer (GPT) models is to develop an intelligent system capable of understanding and generating human-like language with high accuracy and contextual relevance. GPT aims to bridge the gap between human communication and machine understanding by enabling computers to process natural language efficiently.

GPT is mainly used to overcome common challenges in goal setting, such as lack of clarity, unrealistic expectations, and demotivation. When a user enters a text-based prompt, GPT creates the most likely response based on its training data. The main goal of ChatGPT is to understand and respond to a wide range of prompts and questions. It also follows our instructions and completes requests. GPT is used to create a versatile, scalable, and intelligent language model that can understand context, generate meaningful responses, and support a wide range of real-world applications, thereby advancing the capabilities of artificial intelligence in natural language processing.

Purpose & Need of GPT

Purpose

Generative Pre-trained Transformers (GPT) aim to create machines capable of understanding, processing, and generating human language, thereby closing the gap between humans and computers. At their core, GPT models are designed to do the following:

- Generate human-like text: This includes creating articles, stories, poems, emails, and even codes based on the input they receive.
- Comprehend and respond to natural language: GPT models can analyze and interpret human language with context and nuance, enabling them to understand the intent behind queries and provide relevant responses.
- Automated tasks: By generating content, summarizing text, translating languages, or powering chatbots, GPT models automate various tasks, streamline workflows, and boost efficiency.

Need

The need for GPT stems from several key areas.

- Bridging the communication gap: GPT's proficiency in understanding and generating human-like text enables more natural and efficient communication between humans and machines.
- Driving productivity and innovation: By automating tasks and providing creative assistance, GPT models allow individuals and organizations to focus on more complex and strategic work.
- Enabling new applications and experiences: GPT opens up possibilities for personalized learning experiences, enhanced customer service, and innovative tools for various industries.
- Improving efficiency and accuracy: GPT models can process vast amounts of data quickly and generate accurate outputs, leading to more informed decision-making and better results in various applications.

METHODOLOGY:

This study follows a literature review approach. The authors downloaded and screened multiple research articles related to GPT models and their applications. Out of these, 32 articles were initially collected, and after relevance filtering, 24 articles were selected for a detailed study.

The methodology focused on the following aspects:

- Selection criteria: Relevance to GPT, its applications, approach, and language use.
- Analysis dimensions: Each selected paper was analyzed according to
 - GPT type (e.g., GPT-2, GPT-3, GPT-3.5, GPT-4, ChatGPT),
 - Application domain (e.g., education, healthcare, finance, NLP, cybersecurity),
 - Approach used (e.g., NLP, machine learning, systematic review, PRISMA guidelines),
 - Language context.
- Synthesis: The findings were summarized in a comparative table (Table 1.1), highlighting application trends, strengths, and limitations.

Thus, the methodology is essentially a narrative literature review combined with article categorization and a comparative analysis.

LITERATURE REVIEW:

1. Katikapalli Subramanyam Kalyan [2] focused on GPT-3 large language models. He discussed the performance of these models in various domains and tasks. It will serve as a good resource for academics and industry professionals to stay updated.
2. Oğuz 'Oz' Buruk[3] proposed the experience of using GPT-3.5 as a tool for academic writing. He has shared his reflections on the efficacy of the tool and elaborated on ethical considerations of using GPT-3.5 for academic writing. He identified six ways of using GPT-3.5 for academic writing :Chunk Stylist, Research Buddy, Talk Textualizer, Bullet-to-Paragraph, Polisher and Rephraser.
3. Kalla et al[4] proposed ChatGPT technology for interaction with humans. Its natural processing capabilities enable it to generate human-like responses. They stated that ChatGPT has an impact over a wide range of fields such as academics, cyber security, and customer service.
4. Sakshi Aggarwal[5] stated various roles of ChatGPT in different domains. She highlighted ChatGPT as a tool to revolutionize economic thinking. It also acts like as tool to identify bugs in ML systems. It is a tool for learning in the field of education. It gives timely response to pandemic. etc.
5. Rahib Imamguluyeva[6] focused on GPT-3 and it's future vision. It is a milestone in the field of NLP with a wide range of applications. One of the key implementation in the field of continued research and development of NLP. He stated that GPT-3 also poses challenges and ethical concerns including the potential for bias and the need for robust evaluation and benchmarking.
6. Fahim Sufi[7] proposed timeline analysis of existing literature on the use of GPT in research stated GPT for research. He followed PRISMA guidelines. Fahim Sufi's 2024 systematic review stands out by providing a comprehensive lens on GPT's role in research beyond writing applications.
7. Jiang & Bosch's (2024)[8] work meaningfully advances the understanding of GPT-4's capabilities in automated short-answer grading. Through rigorous prompt design and evaluation, it demonstrates both the promise and the limitations of LLMs in educational assessment.
8. DANIAL KHOSH KHOLGH AND PANOS KOSTAKOS[9] focused on PAC-GPT which marks a meaningful early step in applying GPT-based LLMs to the generation of synthetic network traffic. Through its modular architecture and command-line accessibility, it shows practical promise for cybersecurity training, testing, and machine learning data augmentation. However, its limited protocol coverage, fine-tuning depth, and evaluation consistency present clear areas for future improvement
9. Zoltán Szabo and Vilmos Bilicki[10] Szabó & Bilicki (2023) offered a compelling proof-of-concept: GPT-based models can assist in static security analysis of web application code. By structuring code outputs and using reasoning prompts, they demonstrate potential in vulnerability detection
10. Rathje et al.'s[11] study represents a pivotal step in adapting GPT-based models for democratic, multilingual psychological text analysis. Its findings suggest that GPT—through zero-shot prompting—offers both accuracy and inclusivity, outperforming legacy methods while easing adoption for global scholars.
11. Megawati et al. (2023) [12] made a compelling case that GPT-chat technologies substantively support scientific article writing across multiple stages—from idea generation to polishing. Their systematic methodology lays a foundation, but importantly, the broader literature underscores the need for built-in checks and structured guidelines.
12. Ana Lúcia Oliveira et al.[13] study provides empirical evidence that ChatGPT-4 offers significantly improved performance over ChatGPT-3.5 in supporting patient queries around DBS for Parkinson's disease, with higher accuracy and no detected harmful responses.
13. Altamimi's[14] study delivers a well-rounded exploration of stakeholder sentiment toward ChatGPT in higher education, revealing predominantly positive attitudes—especially among administrators and students—toward its implementation.
14. Markus Leippold's[15] Sentiment Spin study demonstrated that GPT-3 can effectively undermine traditional sentiment analysis tools in finance, emphasizing the urgent need for adopting context-sensitive approaches to maintain analytical integrity.
15. Kortemeyer's[16] study offered an important benchmark: GPT-4's general-purpose capabilities enable meaningful grading performance, even without targeted training—but surpassable by specialized, fine-tuned systems. It's a promising validation of LLM versatility, while reinforcing the continued value of task-specific model development.

16. Mohammad Mahdi Jahani Yekta’s [17] study provided a thoughtful and timely reflection on GPT-4’s role as a transformative AI system. By examining its cognitive abilities, societal reach, and governance challenges, the author provides a comprehensive roadmap for future discussion and policymaking.
17. Oğuzhan KATAR et al [18] concluded that GPT-3 can be effectively used as a supportive writing tool in academic research—helping with idea generation, structure, language flow, and drafting. However, they caution that GPT-3 should not replace human judgment and oversight, especially for ensuring factual accuracy and maintaining rigorous academic standards.
18. D.SANTHAKUMAR et al.[19] presented Book GPT, a system designed to help users interact with PDF documents—particularly academic books, research papers, and technical documents—using natural language queries. Instead of manually searching, users can ask questions conversationally and retrieve relevant passages.
19. Diego Magdaleno et al.[20]’s research introduced a promising hybrid solution, blending the interpretive power of GPT-3.5 with structured regression analysis to predict bakery ratings from natural language reviews—with impressive accuracy. It stands as a noteworthy contribution to sentiment analysis and rating prediction, showcasing how LLMs can be effectively integrated into domain-specific AI systems.
20. Alec Radford et al.[21] introduced a highly effective and efficient paradigm for natural language processing—a single pre-trained model adapted with minimal fine-tuning can excel across diverse tasks. It shifted the field toward transfer learning using unsupervised pre-training, setting the stage for modern large language models.
21. Yonchanok Khaokaew et al.[22] delivered a promising fusion of advanced predictive modeling and human-centered interaction, addressing real-world challenges in sleep tracking—particularly user retention and actionable insights. By harnessing LLMs both for data enrichment and for guiding user behavior, the system represents a forward-looking application of AI for personalized health.
22. Will Yeadon et al.[23] focused on Human students maintain superior coding proficiency, significantly outperforming AI across assignments. Prompt engineering markedly enhances AI performance, particularly for GPT-4.GPT-4 remains below human level, though it shows impressive capabilities for an AI.AI work is still detectable: markers can distinguish AI-generated code with reasonable accuracy.
23. Adriana Caraeni et al.[24] offered a promising early investigation into GPT-4’s capacity to grade handwritten math solutions. While leveraging rubrics and reference answers improves performance, current limitations—especially in visual-text understanding and reasoning nuance—mean it’s not yet suitable for unsupervised deployment. It represents an important step toward grading automation, with clear areas needing further development.
24. Bjarne Sievers proposed an innovative method: using GPT-2 not to directly answer comparative questions, but to guide information retrieval by generating a target representation for re-ranking results—an intelligent way to bring deeper semantics into search systems.

Review Analysis:

Article No. & Reference Paper	GPT Type	Approach used	Domain	Language
Article 1 [2]	GPT-3	Systematic literature survey	Academics	English
Article 2 [3]	GPT-3.5	NLP	Academic Writing	English
Article 3 [4]	ChatGPT	Narrative, literature-based analysis	Academics, Cyber Security, customer support, software development, jobs, and information technology	English
Article 4 [5]	ChatGPT	Deep Learning Approach	Customer Service, Entertainment, Education, finance, healthcare etc.	English
Article 5 [6]	GPT-3	Narrative literature review on GPT-3	Natural Language Processing	English
Article 6 [7]	GPT	PRISMA Method	NLP and Research	English
Article 7 [8]	GPT-4		Short Answer Scoring	English

Article 8 [9]	GPT-3	ML Approach	Synthetic Network Traffic generation	English
Article 9 [10]	GPT 3.5 Turbo, GPT-4, GPT-4 Turbo	ML Approach	Psychological Text Analysis	English and Indonesian
Article 10 [11]	GPT Models	Categorization, Evaluation, Detection	Web Application Security	English
Article 11 [12]	ChatGPT 3.5 & 4	Systematic Literature Review (SLR)	Tool for patient support in healthcare	English
Article 12 [13]	ChatGPT	NLP Approach	Higher Education-in teaching & learning	English
Article 13 [14]	GPT-3	NLP Approach	Financial Sentiment Analysis	English
Article 14 [15]	GPT-3	GPT-3-driven adversarial reformulation	Automatic short answer grading	English
Article 15 [16]	GPT-4	SciEntsBank, Beetle	Societal Influence	English
Article 16 [17]	GPT-3	NLP approach	Research Paper Writing	English
Article 17 [18]	BookGPT	Hybrid NLP Approach	Information Retrieval from PDFs, Segmentation	English
Article 18 [19]	GPT-3.5-Turbo	ML Approach	Sentiment Analysis & Bakery Rating Prediction	English
Article 19 [20]	GPT	NLP approach	Language Understanding	English
Article 20 [21]	GPT	ML & LLM	Sleep Quality Enhancement	English
Article 21 [22]	GPT-3.4, GPT-4	Experimental Evaluation	University level Coding Course	English
Article 22 [23]	GPT-4o	Evaluation with Rubrics	Maths Exam	English
Article 23 [24]	GPT-2	LM, Implementation, word-based approach, Evaluation,	Question-Answering	English
Article 24 [25]	GPT Chat	PRISMA Guidelines	Writing Scientific Articles	English

Table 1.1

RESULTS AND DISCUSSION

The review of 24 selected articles shows that GPT models (GPT-2, GPT-3, GPT-3.5, and GPT-4) are widely applied across domains such as academics, healthcare, finance, cybersecurity, sentiment analysis, and education. GPT-3.5 and GPT-4, in particular, demonstrate significant improvements in accuracy, reasoning, and contextual understanding, making them suitable for tasks like short-answer grading, patient support, and academic writing.

Findings also reveal that GPT is not only effective in generating human-like text and automating tasks, but also in enabling new applications like synthetic data generation, security analysis, and personalized learning. However, limitations such as bias, ethical concerns, dependency risks, and weaker performance in mathematical or domain-specific reasoning remain.

Overall, the results highlight GPT’s transformative potential, while also stressing the need for responsible use and continuous evaluation to address challenges in fairness, reliability, and applicability.

CONCLUSION

In this paper, we found the important points for the study of literature related to GPT and its various models. In this study, we found that in various application domain areas, GPT models are used widely. GPT gives fabulous performance while used in Maths exams, Question-answering, academic writing etc. We studied approaches and methodologies applied by researchers and its experimental work performed by them.

The Generative Pre-trained Transformer (GPT) approach has made significant strides in Natural Language Processing (NLP) and is impacting various domains through its ability to generate human-like text and perform diverse language-related tasks. However, challenges related to accuracy, bias, ethics, and resource requirements need to be addressed to ensure responsible and equitable development and deployment of this transformative technology. Continued research and development efforts, coupled with collaborative initiatives among researchers, developers, ethicists, and policymakers, are vital to harness the full potential of GPT while mitigating associated risks.

In conclusion, GPT models represent a major advancement in artificial intelligence, offering powerful tools for automation, analysis, and human-AI collaboration. However, to fully realize their potential, it is essential to address existing limitations and adopt responsible AI practices. Continued research in this direction will play a crucial role in shaping the future of intelligent systems and their integration into real-world applications.

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