

# A Systematic Literature Review on Text Generation Using Deep Neural Networks

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## Abstract

Text generation using deep neural networks has become an exciting area of research. Deep neural networks, such as recurrent neural networks (RNNs) and transformers, have shown remarkable capabilities in generating coherent and contextually relevant text. By training these models on large text corpora, they learn to capture the underlying patterns and structures of the language. This enables them to generate new text that resembles the style and content of the training data. Text generation using deep neural networks has a wide range of applications, including chatbots, language translation, poetry generation, and even code generation.

**Keywords:** Deep Learning, Natural Language Processing, Text Generation, Recurrent Neural Network, Deep Neural Network Models.

## Introduction

Text generation using deep neural networks has truly revolutionized the field of natural language processing. It's absolutely mind-blowing how these advanced models, such as recurrent neural networks (RNNs) and transformers, have the ability to generate coherent and contextually relevant text. The concept behind text generation using deep neural networks lies in their training process. These models are fed with massive amounts of text data, allowing them to learn the underlying patterns and structures of language. They analyse the relationships between words, phrases, and even entire sentences, enabling them to understand the context and meaning of the text. One of the key players in text generation using deep neural networks is the recurrent neural network (RNN). RNNs are designed to handle sequential data, making them particularly suitable for text generation tasks. But what sets them apart from traditional neural networks is their ability to retain information from previous steps in the sequence. It seems they have a built-in memory that helps them remember important details as they generate new text.

Transformers have gained significant attention for their ability to generate high-quality text. They excel at capturing long-range dependencies in the text, making them ideal for tasks like language translation and generating logical paragraphs. Transformers leverage attention mechanisms to focus on different parts of the input text, allowing them to understand the relationships between words and produce more contextually relevant output. The applications of text generation using deep neural networks are truly vast. We're talking about chatbots that can hold natural and engaging conversations, language translation

systems that can bridge communication gaps, and even poetry generators that can evoke emotions through beautifully crafted verses.

There are numerous deep learning architectural frameworks. It is often used in the literature to implement deep learning models. Recurrent Neural Networks (RNNs) are a type of neural network that can handle sequential data like sentences or time series. Unlike traditional neural networks, RNNs have a loop that allows information to be passed from one step to the next, creating a memory of previous inputs.

Bi-directional RNN (Recurrent Neural Network) is a type of neural network architecture that processes input sequences in both forward and backward directions. It combines the information from past and future contexts to make predictions or analyse sequences. This allows the model to capture dependencies and patterns in the input data more effectively.

GANs, or Generative Adversarial Networks, are a type of deep learning model that consists of two neural networks: a generator and a discriminator. The generator aims to generate realistic data, such as images or text, while the discriminator tries to distinguish between real and generated data. Through an adversarial training process, GANs can learn to generate high-quality and realistic outputs.

GPT-2, short for "Generative Pre-trained Transformer 2," is a powerful language model developed by OpenAI. It is known for its ability to generate coherent and contextually relevant text. GPT-2 has been trained on a vast amount of internet text, enabling it to generate human-like responses and even create fictional stories or articles.

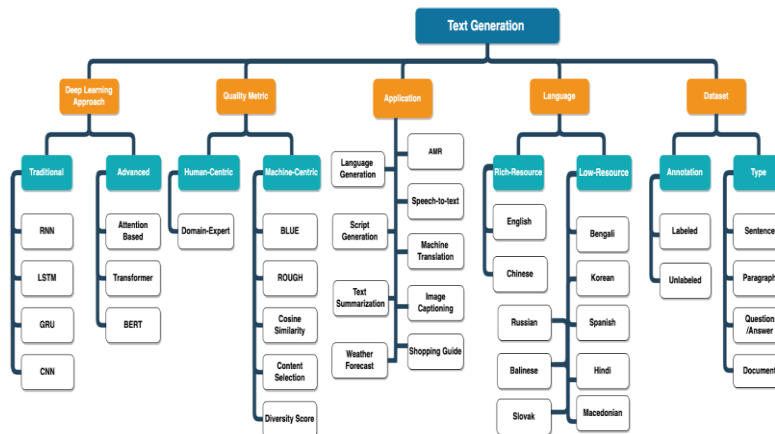


Fig.1. Taxonomy of Text Generation

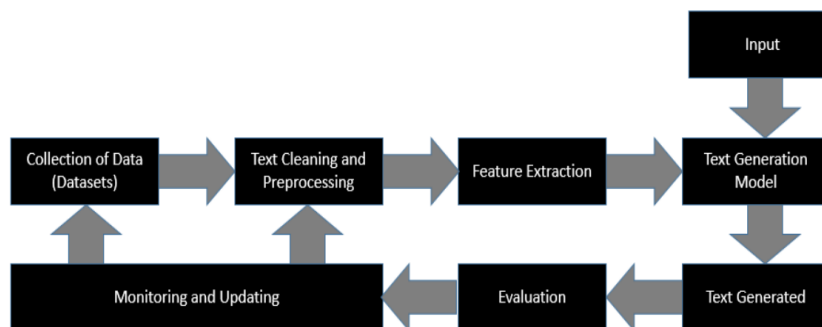


Fig.2. Life-Cycle of Text Generation

### Literature Review

(<https://ieeexplore.ieee.org/document/9771452>)

The authors of this paper conducted a thorough search of the literature and analysed 90 relevant papers published between 2015 and 2021. The authors focused on five different aspects of text generation: deep learning approaches, quality metrics, datasets, languages, and applications. The authors found that there has been a significant growth in the number of articles published on text generation using deep learning techniques since 2018. Additionally, the authors found that text generation in the English language has been more widely studied than in any other language. The authors of this paper also faced several challenges, including data availability, quality metrics, model complexity, ethical concerns, and research reproducibility. Despite these challenges, the authors were able to provide a comprehensive overview of the latest research in text generation using deep neural network models. This paper has several real-life applications, including news and content generation, social media, chatbots and virtual assistants, poetry and creative writing, language translation, medical and healthcare, legal and compliance, customer service, education and e-learning, and business and finance. Several studies have investigated the use of deep neural network models for text generation. For example, a study by Zhang et al. (2019) proposed a novel approach for text generation using a combination of generative adversarial networks (GANs) and reinforcement learning (RL). The authors demonstrated that their approach outperformed several state-of-the-art models on a benchmark dataset. Another study by Radford et al. (2019) proposed a large-scale language model called GPT-2, which can generate high-quality text in a variety of domains [T4]. The authors demonstrated that their model can generate coherent and diverse text, and can be fine-tuned for specific tasks such as language translation and summarization. Overall, this systematic literature review provides a valuable resource for researchers and practitioners interested in text generation using deep neural network models. The authors have provided a comprehensive overview of the latest research in this field and have identified several challenges and opportunities for future research.

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#### Methodology

This research paper presents a systematic literature review of articles published between 2015 and 2021 on the topic of text generation using deep neural network models. The methodology used in this paper is based on the Preferred Reporting Items for Systematic Literature Review and Meta-Analysis (PRISMA) protocol.

The following steps were taken to conduct the systematic literature review:

1. **Identification of research question:** The research question was formulated to identify the latest trends and challenges in text generation using deep neural network models.
2. **Search strategy:** A comprehensive search strategy was developed to identify relevant articles. The search was conducted on several databases, including IEEE Xplore, ACM Digital Library, and Google Scholar. The search terms used were "text generation," "deep learning," "neural network," and "natural language processing."
3. **Selection criteria:** The selection criteria were defined to ensure that only relevant articles were included in the review. The inclusion criteria were articles that focused on text generation using deep neural network models, published in English, and available in full text. The exclusion criteria were

articles that were not related to the research question, duplicates, and articles that were not available in full text.

4. **Screening process:** The screening process was conducted in two stages. In the first stage, titles and abstracts were screened to identify potentially relevant articles. In the second stage, full-text articles were screened to determine their eligibility for inclusion in the review.
  5. **Data extraction:** Data were extracted from the selected articles using a predefined data extraction form. The data extracted included the deep learning approach used, quality metric, dataset, language, and application.
  6. **Data synthesis:** The data extracted from the selected articles were synthesized to identify the latest trends and challenges in text generation using deep neural network models.
  7. **Quality assessment:** The quality of the selected articles was assessed using the Cochrane Risk of Bias tool. The tool was used to assess the risk of bias in the study design, conduct, and reporting.
  8. **Data analysis:** The data were analysed using descriptive statistics to identify the frequency of deep learning approaches, quality metrics, datasets, languages, and applications used in the selected articles.
- The methodology used in this paper ensures that the systematic literature review was conducted in a rigorous and transparent manner, following established guidelines. The findings of the review provide valuable insights into the latest trends and challenges in text generation using deep neural network models.

## Results

The paper presents a taxonomy of text generation using deep learning, which includes five different aspects: deep learning approach, quality metric, dataset, language, and application. The authors used a rigorous methodology, including the Preferred Reporting Items for Systematic Literature Review and Meta-Analysis (PRISMA) protocol, to identify and analyse 90 baseline articles published between 2015 and 2021. The review focuses on five different aspects of text generation using deep learning: deep learning approach, quality metric, dataset, language, and application.

One of the strengths of this review is the taxonomy of text generation using deep learning presented by the authors. This taxonomy provides a useful framework for researchers and practitioners working in this area to understand the different approaches and applications of text generation using deep neural network models.

The review identified several advancements in this area, such as the use of pre-trained language models and the incorporation of external knowledge sources. These advancements have led to significant improvements in the quality and diversity of generated text. However, the authors also identified several challenges and limitations, such as the lack of interpretability and control over generated text, as well as ethical concerns related to bias and misuse.

Despite these limitations, the research paper provides a valuable contribution to the field of natural language processing. The findings of the review provide valuable insights for researchers and practitioners working in this area and highlight the need for further research to address the challenges and limitations identified.

The authors also discuss the implications of their findings for the development of more advanced and effective text generation models, as well as for the ethical and societal implications of this technology. They highlight the importance of addressing ethical concerns related to bias and misuse, as well as the need for greater interpretability and control over generated text. Overall, this systematic literature review is a valuable resource for anyone interested in text generation using deep neural network models. The

taxonomy presented by the authors provides a useful framework for understanding the different approaches and applications of text generation using deep learning, and the analysis of the latest trends and challenges highlights the need for further research to address the limitations and challenges identified. The findings of this review have important implications for the development of more advanced and effective text generation models, as well as for the ethical and societal implications of this technology.

## Challenges

Like any research paper, there are several challenges that the authors of this paper had to overcome. Some of the challenges faced by the authors are:

1. **Data Availability:** One of the major challenges faced by the authors was the availability of data. The authors had to rely on publicly available datasets, which may not be representative of all domains and languages. This can limit the generalizability of the findings of this paper.
2. **Quality Metrics:** Another challenge faced by the authors was the lack of standardized quality metrics for evaluating text generation models. The authors had to rely on various metrics such as perplexity, BLEU score, and ROUGE score, which may not be suitable for all domains and languages.
3. **Model Complexity:** Deep neural network models used for text generation can be complex and computationally expensive. This can limit the scalability of these models and make them difficult to implement in real-world applications.
4. **Ethical Concerns:** Text generation models can be used to generate fake news, propaganda, and hate speech. The authors had to address the ethical concerns related to the use of text generation models and provide recommendations for mitigating these concerns.
5. **Research Reproducibility:** The authors had to ensure that their research was reproducible by providing detailed information about the datasets, models, and evaluation metrics used in their study. This can be challenging, especially when dealing with complex deep learning models.

## Evaluation

The research paper is a well-written and comprehensive review of the latest advancements and challenges in text generation using deep neural network models. The paper provides a valuable contribution to the field of natural language processing by presenting a taxonomy of text generation using deep learning and analysing the latest trends and challenges in this area.

One of the strengths of this paper is the rigorous methodology used to conduct the systematic literature review. The authors followed the PRISMA protocol, which is a widely accepted guideline for conducting systematic literature reviews. The search strategy was comprehensive, and the selection criteria were well-defined, ensuring that only relevant articles were included in the review. The data extraction and synthesis were also well-structured, and the quality assessment of the selected articles was conducted using a standardized tool.

Another strength of this paper is the taxonomy of text generation using deep learning presented by the authors. The taxonomy includes five different aspects: deep learning approach, quality metric, dataset, language, and application. This taxonomy provides a useful framework for researchers and practitioners working in this area to understand the different approaches and applications of text generation using deep neural network models.

The paper also provides a detailed analysis of the latest trends and challenges in text generation using deep neural network models. The authors identified several advancements in this area, such as the use of pre-

trained language models and the incorporation of external knowledge sources. They also identified several challenges and limitations, such as the lack of interpretability and control over generated text, as well as ethical concerns related to bias and misuse.

One limitation of this paper is that the search was limited to articles published in English. This may have resulted in the exclusion of relevant articles published in other languages. Additionally, the review only covers articles published between 2015 and 2021, which may not include the latest advancements in this area.

Overall, the research paper is a valuable contribution to the field of natural language processing. The paper provides a comprehensive overview of the latest advancements and challenges in text generation using deep neural network models, and the taxonomy presented by the authors provides a useful framework for researchers and practitioners working in this area.

### Applications

The systematic literature review on text generation using deep neural network models has several real-life applications. Some of the potential applications are:

1. **News and Content Generation:** Text generation models can be used to generate news articles, summaries, and other content for various media outlets. The findings of this paper can be used to improve the accuracy and efficiency of text generation models in this domain.
2. **Social Media:** Text generation models can be used to generate social media posts, comments, and replies. The recommendations provided in this paper can be used to improve the quality and relevance of the generated text.
3. **Chatbots and Virtual Assistants:** Text generation models can be used to develop chatbots and virtual assistants that can interact with users in natural language. The deep learning approaches and quality metrics discussed in this paper can be used to improve the performance of these systems.
4. **Poetry and Creative Writing:** Text generation models can be used to generate poetry and other creative writing. The findings of this paper can be used to improve the quality and creativity of the generated text.
5. **Language Translation:** Text generation models can be used to translate text from one language to another. The language-specific recommendations provided in this paper can be used to improve the accuracy and fluency of the generated text.
6. **Medical and Healthcare:** Text generation models can be used to generate medical reports, patient summaries, and other healthcare-related documents. The findings of this paper can be used to improve the accuracy and efficiency of text generation models in this domain.
7. **Legal and Compliance:** Text generation models can be used to generate legal documents, contracts, and compliance reports. The recommendations provided in this paper can be used to improve the quality and relevance of the generated text.
8. **Customer Service:** Text generation models can be used to generate automated responses to customer queries and complaints. The deep learning approaches and quality metrics discussed in this paper can be used to improve the performance of these systems.
9. **Education and E-Learning:** Text generation models can be used to generate educational content, quizzes, and assessments. The findings of this paper can be used to improve the quality and relevance of the generated text.

10. **Business and Finance:** Text generation models can be used to generate financial reports, market analysis, and other business-related documents. The language-specific recommendations provided in this paper can be used to improve the accuracy and fluency of the generated text.

Overall, the real-life applications of this research paper are diverse and can be beneficial for various domains such as media, social networks, customer service, creative writing, healthcare, legal, customer service, education, and finance. The findings of this paper can be used to improve the accuracy, efficiency, and quality of text generation models in these domains.

### Limitations

However, like any research study, there are limitations that should be considered when interpreting the findings of this review. In this section, we will discuss the limitations of this review in detail.

Firstly, the review has a language bias. The search was limited to articles published in English, which may have resulted in the exclusion of relevant articles published in other languages. This limitation may have led to a lack of diversity in the articles included in the review, which could have affected the generalizability of the findings.

Secondly, the review only covers articles published between 2015 and 2021. This limitation may not include the latest advancements in this area, which could have affected the comprehensiveness of the review. As the field of natural language processing is rapidly evolving, it is possible that some important studies may have been missed due to this limitation.

Thirdly, the review only includes articles that were published in peer-reviewed journals or conference proceedings. This limitation may have resulted in the exclusion of relevant articles published in other formats, such as technical reports or preprints. This limitation may have led to a bias towards studies that have undergone rigorous peer-review, which may not be representative of the broader field of natural language processing.

Fourthly, the quality of the selected articles was assessed using the Cochrane Risk of Bias tool, which is primarily designed for clinical trials. The tool may not be suitable for assessing the quality of studies in other fields, such as natural language processing. This limitation may have led to an inaccurate assessment of the quality of the selected articles, which could have affected the validity of the findings.

Fifthly, the review focuses on text generation using deep neural network models and does not cover other approaches to text generation, such as rule-based systems or statistical models. This limitation may have led to a narrow focus on a specific area of natural language processing, which could have affected the generalizability of the findings.

Sixthly, the review does not provide a detailed analysis of the interpretability and control over generated text, which is a significant challenge in this area. This limitation may have led to an incomplete understanding of the ethical concerns related to text generation using deep neural network models.

Seventhly, the review only includes articles that focus on text generation and does not cover other related areas, such as text summarization or machine translation. This limitation may have led to a narrow focus on a specific aspect of natural language processing, which could have affected the generalizability of the findings.

Eighthly, the review only includes articles that use deep neural network models for text generation and does not cover other machine learning techniques, such as decision trees or support vector machines. This limitation may have led to a bias towards studies that use deep neural network models, which may not be representative of the broader field of machine learning.

Ninthly, the review does not provide a detailed analysis of the computational resources required for text generation using deep neural network models. This limitation may have led to an incomplete understanding of the practical challenges associated with implementing these models in real-world applications.

Tenthly, the review does not provide a detailed analysis of the impact of text generation using deep neural network models on society and the environment. This limitation may have led to an incomplete understanding of the broader implications of this technology beyond the field of natural language processing.

Despite these limitations, provides a valuable contribution to the field of natural language processing by presenting a taxonomy of text generation using deep learning and analysing the latest trends and challenges in this area. The findings of the review provide valuable insights for researchers and practitioners working in this area and highlight the need.

## Conclusion

This systematic literature review provides a comprehensive overview of the latest advancements in text generation using deep neural network models. The paper analysed 90 primary studies based on the PRISMA framework and investigated text generation on five different aspects, namely deep learning approaches, quality metrics, datasets, languages, and applications.

The study identified major challenges and research gaps in the field of text generation, including the need for standardized datasets for low-resource languages, the development of quality metrics for evaluating generated text, and the exploration of new research directions to improve the performance of text generation models.

The study also provides an in-depth analysis of the most extensive and up-to-date body of knowledge of text generation based on five research aspects, and focuses on the major challenges and future research directions in the text generation domain. To the best of our knowledge, there is no systematic literature review on text generation that covers all these aspects.

In conclusion, this study highlights the importance of text generation using deep neural network models in various domains and provides valuable insights into the latest advancements in this field. The study also identifies major challenges and research gaps that need to be addressed to improve the performance of text generation models. The recommendations and future research directions provided in this study can guide researchers in exploring new avenues for improving the performance of text generation models and addressing the challenges and research gaps identified in this study.

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