Mini Review

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Educational content generation using multi-LLM agents

Abstract

This paper presents a framework for generating educational content using a multi-agent architecture powered by Large Language Models (LLMs). Leveraging the Crew AI framework, the system coordinates multiple autonomous agents, each with specific roles, to produce cohesive educational materials. The agents work collaboratively to generate, detail, direct, and refine content aimed at children under 13, ensuring the inclusion of moral lessons and engaging narratives. This approach enhances the efficiency and effectiveness of content creation, providing a scalable solution for educational material generation.

Keywords: LLama-3, GPT4o, multi-agent systems, crew AI, langchain, langgraph, dall-E

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Introduction

Artificial intelligence (AI) has made significant strides in recent years, particularly in the domain of natural language processing (NLP). Large language models, such as Open AI's GPT-3 and META's LLAMA3, have demonstrated the ability to generate coherent, contextually appropriate text, making them valuable tools for content creation. However, the complexity involved in generating educational content, such as children's stories, necessitates a more sophisticated approach than what a single model can provide. Our goal is to make education more appealing and interactive, boosting engagement among the users. This paper introduces a multi-agent system that employs multiple LLMs, each with a specific role, to collaboratively produce high-quality educational stories for children.

Literature review

The concept of multi-agent systems in AI is not new; it has been extensively studied in fields such as robotics, distributed systems, and game theory. However, its application in the domain of content generation, particularly educational content, is relatively novel. Previous research has highlighted the potential benefits of using multiple agents to handle different aspects of content generation, thereby improving the overall quality and coherence of the output.

For instance, Vinyals et al.,[1] explored the use of multi-agent systems in reinforcement learning scenarios, demonstrating how agents can collaborate to achieve complex tasks. Similarly, Ramesh et al.,[2] introduced a multi-agent framework for generating interactive narratives, where each agent contributed to different narrative elements such as dialogue, plot progression, and character development. This work builds upon these foundations by applying a similar multi-agent approach to the generation of educational content.

Moreover, the use of LLMs in education has been a growing area of interest. Huang et al.,[3] investigated the application of LLMs in generating personalized educational content, highlighting the challenges of maintaining pedagogical integrity and ensuring that the content is age-appropriate. In the context of children's literature, Johnson and Martinez[4] discussed the importance of moral education in early childhood and how AI-driven content generation can be tailored to reinforce positive values. This paper extends these ideas by focusing on the architectural design of a multi-agent system for producing children's stories that are not only engaging but also morally instructive.[5,6]

System architecture

The proposed system architecture is designed to efficiently generate high-quality children's stories by utilizing multiple LLM agents, each with a distinct role. The system leverages Crew AI, a framework that orchestrates the interactions between autonomous agents, ensuring that each agent contributes effectively to the final output.

a) Story writer agent

The Story Writer Agent is tasked with creating the initial draft of the story. This agent uses prompts designed to generate narratives that are engaging, age-appropriate, and imbued with moral lessons. The agent is fine-tuned on a dataset of children's stories, enabling it to generate content that resonates with young readers. The prompt for this agent typically includes a basic plot outline and specific requirements such as the inclusion of a moral lesson.

Example prompt: "Write a children's story based on the following idea: A dog, a monkey, and a dragon embark on an adventure in a forest. The story should be suitable for children under 13, include a strong moral lesson, and incorporate elements of fantasy. Ensure the story is engaging and includes meaningful dialogue."

b) Character detailer agent

The Character Detailer Agent is responsible for enriching the narrative by providing detailed descriptions of the characters. This includes their physical appearance, personality traits, and roles within the story. The agent is trained to enhance the relatability and depth of the characters, ensuring that they are well-developed and integral to the plot.

Example prompt: "Given the story: [story], provide detailed descriptions of the main characters, including their physical appearance, personality traits, role in the story, and any unique abilities or features."

c) Director agent

The Director Agent focuses on creating vivid scene descriptions, setting the atmosphere, and providing visual cues that could be used

in a potential video adaptation of the story. This agent ensures that the scenes are immersive and enhances the storytelling experience by incorporating sensory details and mood-setting elements.

Example prompt: "Here is the story: [story]. Create vivid scene descriptions for a video adaptation, including key locations, atmosphere, mood, important visual details, and suggested camera angles and movements."

d) Editor agent

The Editor Agent is tasked with reviewing and refining the entire script. This includes checking for plot coherence, ensuring that the narrative flows smoothly, and making sure the content is appropriate for the target audience. The Editor Agent plays a crucial role in the final quality assurance of the story, ensuring that the output meets the high standards required for educational content.

Example prompt: "Review the draft story: [script]. Ensure the script covers the entire plot comprehensively, has no missing parts or plot holes, flows smoothly and logically, and is appropriate for children under 13."

e) NVIDIA guardrails

To ensure the ethical integrity of the content generated, the system incorporates NVIDIA Guardrails. These guardrails monitor and control the behavior of the language models, preventing the generation of harmful or biased content. This step is crucial in the context of children's stories, where the content must be safe, appropriate, and aligned with educational goals.

f) DALL-E integration

After the content passes through NVIDIA Guardrails, the system employs Open AI's DALL-E model to generate high-quality images for the scenes described in the story. The Director Agent's scene descriptions serve as input prompts for DALL-E, which creates visually engaging illustrations that complement the narrative. These images canbe used to enhance the storytelling experience, making the stories more interactive and appealing to young audiences.

Example prompt for DALL-E: "Generate an image of a forest where a dog, a monkey, and a dragon are exploring. The scene should be vibrant, with a magical atmosphere suitable for a children's story."
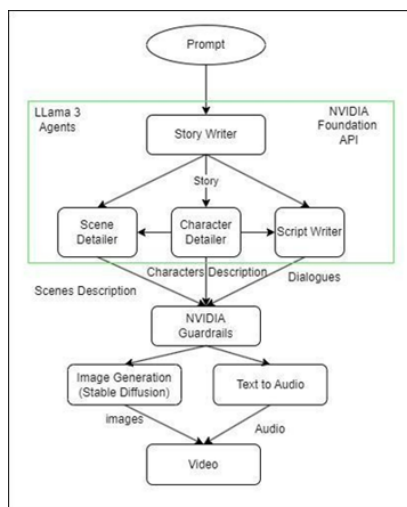

Figure 1 Overview of system architecture.

Figure 2 Image generated by Dall E from the example prompt.

Integration and workflow

The multi-agent system operates in a sequential manner, where the output of one agent becomes the input for the next. This workflow ensures that each aspect of the story—plot development, character detailing, scene setting, image generation, and final editing—is handled meticulously by the respective agents. The use of CrewAI to manage these interactions allows for seamless coordination among the agents, ensuring that the final product is a well-rounded and coherent story.

Additionally, the integration of NVIDIA Guardrails and DALL-E adds layers of quality assurance and visual enhancement, respectively, making the final output not only safe and educational but also visually captivating.

Practical applications

The multi-agent system for educational content generation presents numerous practical applications across various domains, particularly in education and digital learning environments. It can be integrated into educational platforms to create personalized learning materials tailored to individual students' needs, enhancing engagement and motivation, especially in early childhood education. Additionally, the system can be employed to develop interactive digital content, such as story-driven educational games or apps, providing immersive learning experiences that combine education with entertainment. In traditional classroom settings, teachers can use the system to quickly generate stories and teaching materials that align with specific curriculum goals, supported by visually engaging images produced by the DALL-E model. The system also offers significant potential for content creators in the educational media industry, automating the generation of scripts and scenes to streamline the production of storybooks, animated series, and educational videos. Furthermore, the system can be adapted to address the needs of students with learning disabilities, ensuring that educational content is accessible and effective for all learners. Its flexibility extends to cross-cultural and multilingual education, allowing for the generation of culturally relevant and linguistically diverse content that resonates with audiences around the world. These practical applications underscore the system's versatility and its potential to enhance the quality and accessibility of educational content across a broad spectrum of educational contexts.

Conclusion

The multi-agent LLM system presented in this paper offers a robust framework for generating high-quality educational content, specifically children's stories with moral lessons. By leveraging the strengths of specialized agents, the system ensures that the generated

content is not only engaging but also pedagogically sound. The incorporation of NVIDIA Guardrails ensures the ethical integrity of the content, while the integration of OpenAI's DALL-E enhances the visual appeal of the stories, making them more engaging for young readers. This approach represents a significant advancement in the field of AI-driven content generation, particularly in the domain of children's education. Future research could explore the integration of additional agents focused on diversity, cultural sensitivity, and interactive storytelling to further enhance the system's capabilities.

Acknowledgments

Conflicts of interest

Authors declare that there is no conflict of interest.

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