iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** IV **Month of publication:** April 2026

DOI: https://doi.org/10.22214/ijraset.2026.80462

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue IV Apr 2026- Available at www.ijraset.com

ChatterPal: An Intelligent Educational Chatbot with Content Moderation for Children

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Abstract: ***As Artificial Intelligence continues to become a part of education and interactive environments, most implementations of AI today are designed for adults or general users and therefore do not give children easy access to fun and safe educational resources developed with AI. ChatterPal: Your AI Companion for Fun and Learning was created to provide children with an engaging voice-activated chat partner that enables them to learn through play while providing a secure learning environment.***
ChatterPal utilizes Natural Language Processing (NLP) in combination with Speech Recognition to allow for seamless communication between children and computers. The software provides numerous methods of delivering education including; AI-driven storytelling using media, providing one-on-one academic tutoring, providing entertaining quizzes, providing assistance in creating drawings, and having a friendly chat feature. All content will be organized by age group to ensure safety and age appropriateness. The backend utilizes FastAPI alongside MongoDB for secure data management, whereas the frontend is created with React.js to ensure a vibrant and responsive user interface.
ChatterPal is designed to create a new way of combining education with play (edutainment) using the latest technology in AI and is designed to stimulate childhood curiosity and communication skills and to nurture creativity in children while giving parents a safe and trustworthy AI partner in the development of their child. This project showcases how AI can be a major influence in the future of preschool educational development by providing smart, fun and engaging technology to children.
Keywords: AI, Edutainment, NLP, Voice Recognition, Interactive Education, AI Chatbot, Children's Learning, Story Creation, EdTech, FastAPI, React.js, MongoDB, Child-friendly AI, Voice Assistant, Human-Computer Interaction.

I. INTRODUCTION

Artificial Intelligence (AI) has transformed multiple sectors including healthcare, finance, and automation, and it is currently having a notable influence in the area of education. Yet, the majority of AI-driven applications concentrate on adult users or professional fields, resulting in minimal access for children to engaging and secure AI educational resources. Meanwhile, today's children are being raised in a digital landscape and need intelligent educational platforms that are both captivating and advantageous for their learning.

ChatterPal: Your AI Friend for Fun & Learning is a kid-friendly chatbot created to bridge this gap by merging education and entertainment in a secure and engaging manner. It serves as a digital learning partner for kids, able to involve them in valuable discussions, learning exercises, imaginative storytelling, and fun interactions. In contrast to conventional learning applications, ChatterPal leverages Natural Language Processing (NLP) and Speech Recognition to engage with children in a natural manner, enhancing the interactivity and enjoyment of the learning experience.

The system offers various distinctive features including AI-created narratives with visuals, an educational tutoring module for topics like math and science, a creative drawing helper, and a chat companion for casual dialogue. It guarantees a safe setting by providing suitable content for various age groups of children. The system's backend is constructed with FastAPI utilizing MongoDB for data storage, whereas the frontend employs React.js to provide a responsive and attractive user interface.

ChatterPal seeks to improve children's creativity, learning capabilities, and communication skills by utilizing an interactive and intelligent AI platform. It shows how technology can be effectively utilized to enhance early education and make learning more fun.

II. LITERATURE REVIEW

Automating response systems is now becoming a very common use case for chatbots in improving user engagement, automating the response process for larger audiences, and making user engagement more accessible. Continuation to this, several studies are observed in this section regarding the development of conversational agents and dialogue agents and the use of personalized AI assistants. For example, Bharathee et al. (2023), created an AI-powered student assistance chatbot to assist Class 12 students through the college application process.

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The AI chatbot was built using BotPress and used Natural Language Understanding (NLU) to help identify user intent in order to respond appropriately when answering student questions associated with the college application process. The system operated through a WordPress platform via JavaScript so that students could access the AI-powered chatbot on a web-based platform. The results published are reported to show approximately 90.6% of the responses provided by the AI chatbot were correctly identified as being an appropriate response to the student's request [1]. While the responses generated by the AI chatbot to students were relevant and appropriate for the specific use case of college admission and therefore met the accuracy, they also lacked certain features (i.e., adaptive learning or advanced personalization) that many developers look to include when designing systems like AI chatbots.

Another study conducted by Gao et al. (2023) investigated the performance of a multi-turn dialogue agent in tele marketing settings [2]. The researcher highlighted a novel architecture – a Deep Attention Matching Network (DAM) combined with the use of SimBERT – to provide data augmentation to increase the accuracy of response selection using the DAM model as a predicate, compared to earlier chatbots. The aim of the design was not to interface directly with customers. Instead, it provided assistance to human agents in conducting their activities through real-time analyses of conversations taking place between them and their customers while providing suggestions for responses to be made by the agent. The use of real-world datasets in the research validated the utility of this design approach [2]. While the planned use is for tele marketing/business usage, the resulting system is specific to that domain and is not transferable to other domains or uses (e.g., educational) or for use with children.

In a previous study, Easin et al. (2022) proposed an intelligent personalized digital banking assistant using large language models (LLMs), LangGraph and Chain-of-Thought prompt techniques [3]. The goal of this study was to improve user satisfaction and increase user engagement through the delivery of personalized and contextually relevant responses. A multi-agent system was used to analyze and generate responses to the question from the primary user and to provide an opportunity for multiple users to access the generated response. The DAM model demonstrated strong capability for personalization and context management across multiple users; however, regardless of the demonstrated capabilities, the focus of the design was on financial applications; therefore, issues of child-appropriate interaction and content safety were not considered in the overall process [3].

Existing chatbots are currently successful at providing an accurate response and performing effectively for a given domain; however, they all have limitations. Most chatbot systems are developed for a specific application (i.e., Helping an individual enroll into a school or assist with telemarketing and banking) and these systems will not generalize to a broader educational context. Creating child-friendly interactions, mechanisms to filter inappropriate content for children (i.e.safety), and the ability to learn via different types of children are our primary concerns when we developed this product.

The new product, “Chatter Pal,” is an AI-enabled chat agent that provides accurate answers to questions based on the needs of children while ensuring safe contact with the child and provides personal learning experiences through content filtering and response adaptation.

III. METHODOLOGY

The AI Agent designed for children utilizes a client-server framework that integrates artificial intelligence, naturallanguage processing, and real-time engagement technologies. Kids engage with the system by using text or voice commands via an interactive interface featuring an animated character.

Voice inputs are transformed into text through Speech-to-Text, whereas Text-to-Speech creates pleasant audio replies. Techniques in Natural Language Processing are utilized to comprehend user intent, identify language, and categorize inquiries like math questions, poetry, factual information, or general uncertainties.

According to the detected intent, the backend handles the request with established logic modules or an AI language model to create responses that are safe and suitable for all ages. Language detection and translation APIs enable multilingual support.

IV. PROPOSED SYSTEM AND SPECIFICATION

The platform is an AI-powered online tool created to serve as a creative and educational ally for young students, constructed on a modular, multi-service framework.

1) Dual Functionality and Personalization

The system is specifically crafted to offer both Creative Generation and Adaptive Tutoring features within one, cohesive environment. The AI models will tailor the output according to the user's age and grade level to ensure optimal effectiveness and engagement.

2) Essentialmodules &features

Text Chatterbot: A natural language processing (NLP) model generates conversational replies, serving as a helpful assistant and addressing basic inquiries. The model implements rigorous content filtering and moderation to guarantee safety.

Creative Tale Creator: A large language model (LLM) optimized for story crafting, generates narratives following user-specified criteria (e.g., "a dog that travels to the stars").

Image Creator: A text-to-image model produces unique visuals, limited to cartoon, fantasy, and adorable styles to ensure an age-appropriate look.

Adaptive Math/ Science/ Reading Tutor: This tailored module employs a flexible learning algorithm to assess a child's responses, deliver step-by-step explanations, give hints, and automatically modify the challenge level of future questions.

3) Architecture and Technical Stack (Conceptual)

Frontend/UI: Created with a contemporary framework (e.g., ReactJS) for an engaging, adaptive, and vibrant interface.

Backend/API: A server framework (such as Flask or Django in Python) will manage the main logic and provide REST APIs for the frontend

Machine Learning Model and Algorithms:Python with libraries like Hugging Face Transformers for the chatbot and story generator, and an open-source or commercial API for the image generator.

Data Storage: A lightweight database (MongoDB or SQLite) is used to store user profiles, progress tracking data (for the tutor), and logs for content moderation.

V. RESULTS AND DISCUSSION

The created AI Agent for Children effectively showcased engaging and kid-friendly interaction via text and voice interfaces. The system could precisely comprehend user inquiries, categorize them into areas like simple math, fact-based questions, poem recitation, and general conversational uncertainties, and provide suitable replies instantaneously. Multilingual communication enhanced accessibility, enabling children to express themselves easily in their chosen language.

The combination of live chat and an avatar greatly improved user engagement, rendering interactions more instinctive and attractive to younger users. Speech recognition and text-to-speech systems worked well for brief and straightforward inputs, which are common in conversations among children. Content filtering guaranteed that answers stayed suitable for all ages and secure.

In general, the findings demonstrate that the suggested system serves well as a learning and dialogue partner for kids. The initiative showcases the capabilities of AI-driven agents in early educational settings, while also emphasizing possibilities for future enhancements like emotion detection, customization, and adaptive learning practices

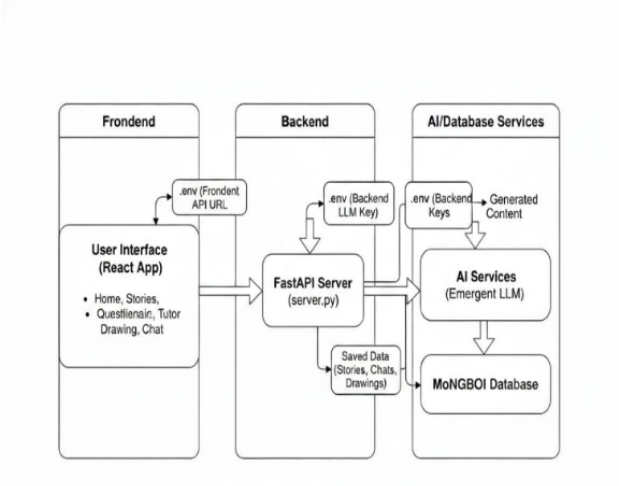


Fig. 1 Block Diagram

The block diagram of ChatterPal represents a three-layer architecture consisting of the frontend, backend, and AI/database services working together to deliver an interactive learning experience for children.

The frontendlayer, built using React, acts as the user-facing interface where children interact with the system. It includes different modules such as stories, quizzes, tutoring, drawing, and chat. User inputs, whether typed or selected, are sent to the backend through defined API endpoints.

The backendlayer, implemented using FastAPI, serves as the core processing unit of the system. It receives user requests, manages application logic, and communicates with AI services. Environment configurations such as API keys are securely handled at this level. The backend also manages data flow, ensuring that user interactions and generated outputs are properly stored.

The AI and database layer is responsible for generating intelligent responses and maintaining data. The AI service processes user prompts to generate outputs like stories, answers, or creative content. At the same time, the MongoDB database stores important information such as chat history, generated stories, and user interactions for future reference and analysis.

VI. WORKING OF THE SYSTEM

When a user interacts with the model, the request is first captured by the frontend and sent to the backend server. The backend processes the request and forwards it to the AI service for response generation. Once the AI generates the output, it is sent back to the backend, which stores relevant data in the database and returns the final result to the frontend. The response is then displayed to the user in an interactive format, completing the cycle.

This structured flow ensures smooth communication between components, efficient data handling, and a responsive user experience.

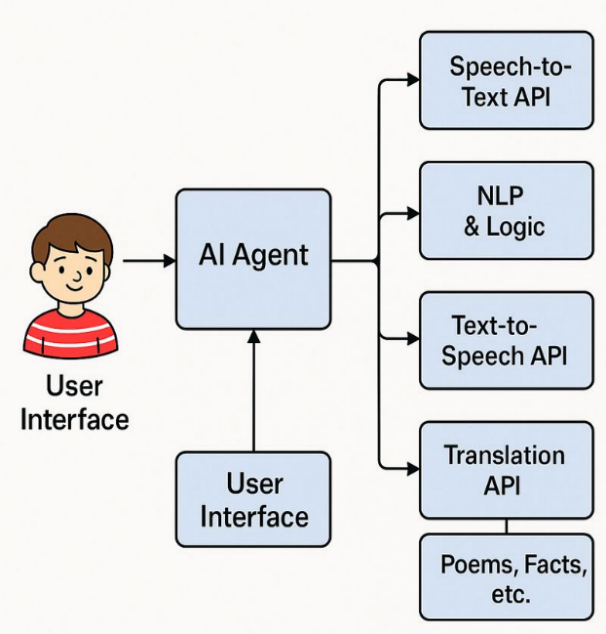


Fig. 2 Flow Diagram

VII. CONCLUSION

The ChatterPal AI for Kids initiative effectively showcases the use of Artificial Intelligence and Natural Language Processing to develop an enjoyable, secure, and instructive environment for children.

The system achieves its aim of creating engaging and informative AI interactions by blending storytelling, games, and Q&A sessions in a child-friendly setting.

Combining Speech Recognition (STT) with Text-to-Speech (TTS) modules boosts interaction, and the Parental Dashboard guarantees secure oversight.

The modular design allows for scalability for future improvements such as emotion recognition and multilingual features, establishing a solid base for ongoing research and advancement in AI-based educational systems.

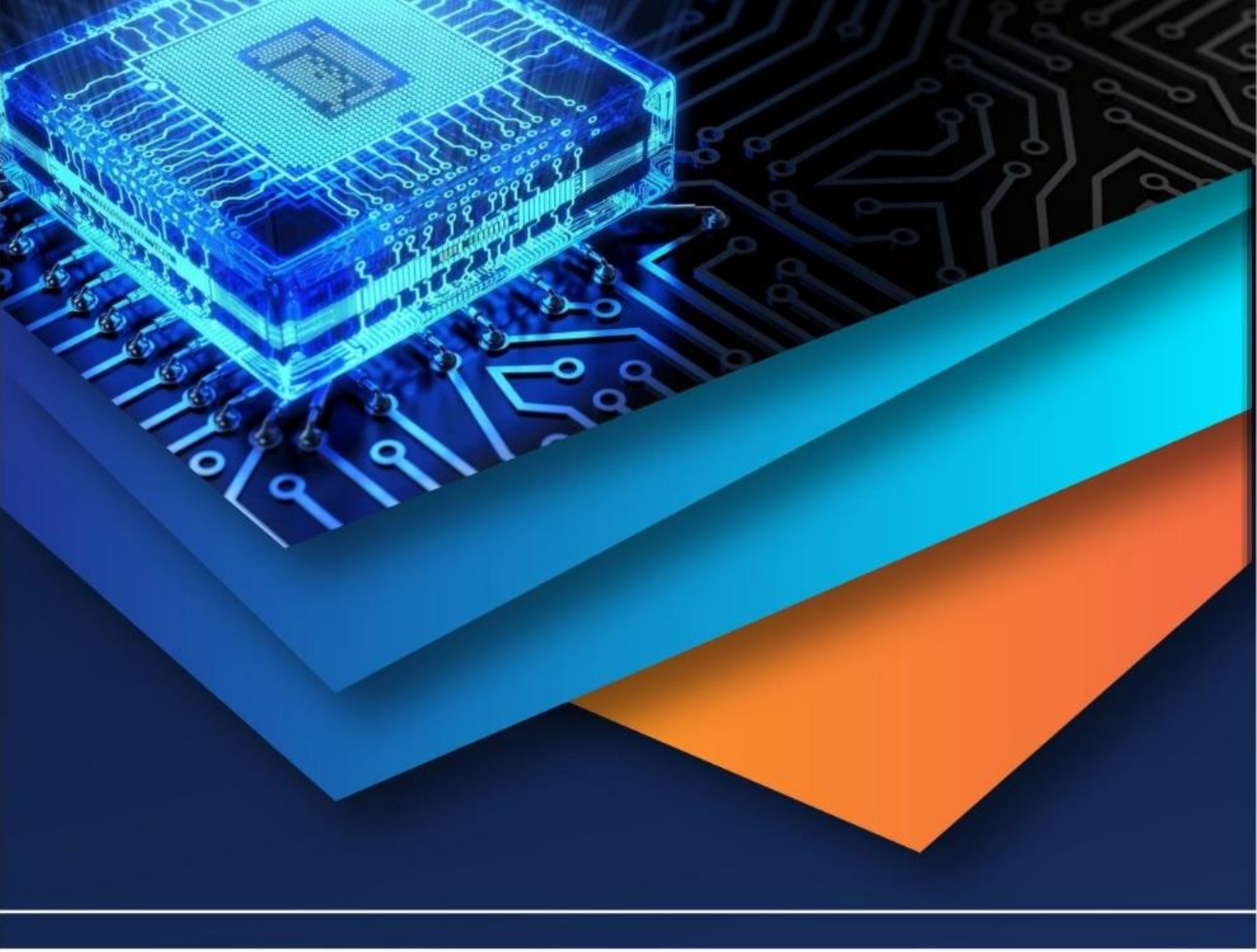
VIII. ACKNOWLEDGEMENT

The authors sincerely thank their project supervisor and faculty members for their constant guidance, support, andencouragement throughout this work. They also acknowledge the institution for providing essential resources and infrastructure that enabled successful project completion. Appreciation is further extended to researchers and academic communities whose published studies and reference materials contributed to the development and refinement of this research.

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