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DESIGNING AN EDUCATIONAL CHATBOT FOR ENHANCED LEARNING IN PROGRAMMING COURSES

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ABSTRACT

Programming education poses significant challenges due to the abstract nature of concepts and the lack of personalized support in traditional learning environments. To address this issue, this paper presents the design and implementation of an AI-powered educational chatbot aimed at enhancing learning outcomes in programming courses. The proposed system leverages Natural Language Processing (NLP) techniques and machine learning models to provide instant responses, syntax correction, code explanations, and debugging assistance. The chatbot is implemented using a Flask-based web framework with MongoDB for data storage and integrates a large language model API for real-time interaction. Experimental evaluation demonstrates improved student engagement, faster doubt resolution, and enhanced learning effectiveness. The results indicate that AI-driven chatbots can serve as effective virtual tutors, supporting self-paced and interactive programming education.

Keywords

Educational Chatbot, Programming Education, Natural Language Processing, Machine Learning, Intelligent Tutoring Systems, AI in Education

INTRODUCTION

Programming is a vital skill in the digital age, but many students struggle with its abstract concepts. Traditional teaching methods often lack personalized, real-time support, leading to disengagement and

learning gaps. Advances in AI and NLP have enabled interactive educational chatbots that can provide instant feedback, tailored explanations, and ongoing assistance. This paper introduces an AI-powered chatbot designed to help programming students by answering questions, correcting syntax errors, explaining concepts, and guiding problem-solving, with the goal of enhancing accessibility, engagement, and learning efficiency.

LITERARTURE SURVEY

Several studies have explored the use of educational chatbots to enhance learning by providing personalized and interactive support to students. Conversational agents integrated with artificial intelligence have been shown to improve student engagement and motivation in programming courses. Research highlights the effectiveness of Natural Language Processing techniques in enabling chatbots to understand and respond to programming-related queries accurately. Machine learning-based intent classification has been widely used to deliver relevant explanations and coding assistance. Prior works also demonstrate that chatbots can assist in syntax error detection and debugging, reducing students' dependency on instructors. Some studies focus on integrating chatbots with online learning platforms to support self-paced learning environments. However, many existing systems lack adaptability and real-time feedback for diverse learner needs. This project builds upon previous research by proposing an intelligent chatbot that offers instant, personalized, and interactive programming support.

RELATED WORK

Several studies have explored the use of conversational agents in education. Smutny and Schreiber ova analyzed the effectiveness of educational chatbots in enhancing engagement and personalized learning. Rodríguez et al. demonstrated the use of AI-powered chatbots for syntax correction and debugging in programming education. Brown and Wilson highlighted the role of NLP in intelligent tutoring systems. Although existing systems provide partial support, most lack real-time adaptability, personalized feedback, and integration with modern AI models. This motivates the need for an intelligent chatbot that offers interactive and adaptive learning support for programming students.

EXISTING SYSTEM

The existing methods of learning programming mainly rely on traditional classroom teaching and online learning platforms. In classroom-based learning, instructors explain concepts through lectures, and students receive limited

individual attention due to large class sizes. Online platforms provide video tutorials and static learning materials, but they often lack interactive and real-time doubt clarification. Students usually depend on instructors, peers, or discussion forums for resolving programming errors, which can be time-consuming. Feedback on coding mistakes is often delayed, affecting the learning process. These methods do not adapt to individual learning speeds or styles. As a result, many students face difficulties in fully understanding programming concepts and debugging code effectively.

PROPOSED SYSTEM

The proposed system is an AI-driven educational chatbot designed to assist learners in programming courses. It processes user queries using NLP techniques to identify intent and generate relevant responses. The chatbot provides syntax checking, code explanations, debugging assistance, and concept clarification. The system is developed using Python and Flask for backend services, MongoDB for data storage, and an AI-based language model API for conversational intelligence. User queries are analyzed and forwarded to the AI engine, which generates context-aware responses in real time.

SYSTEMARCHITECTURE

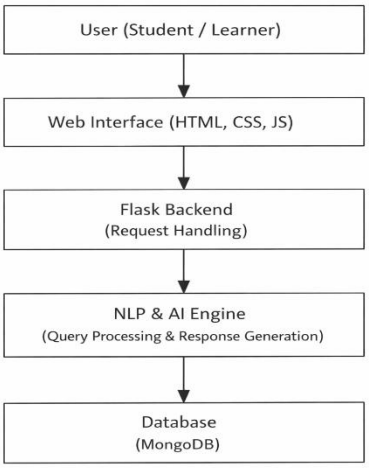

Fig1: **Designing An Educational Chatbot for Enhanced Learning in Programming Courses**

RESULTS AND DISCUSSIONS

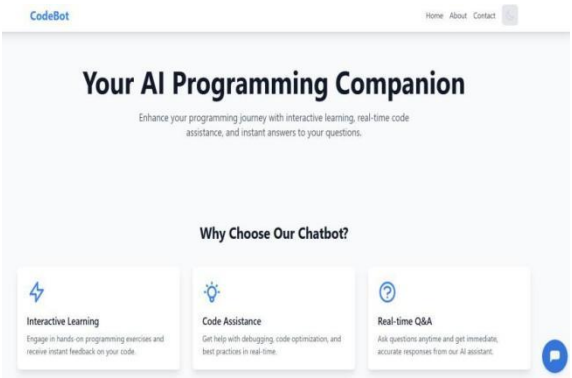

Fig2: Home page

This screenshot showcases CodeBot, an AI chatbot designed to support programmers with interactive learning, real-time code

assistance, and instant Q&A. It highlights key features that enhance coding efficiency and engagement through intelligent support.

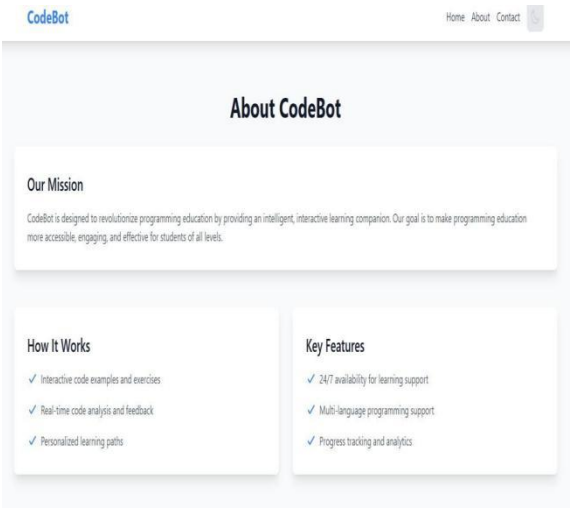

Fig3: About page

This screenshot presents the "About CodeBot" section, outlining its mission to transform programming education through intelligent, interactive support. It highlights how CodeBot works and its key features like 24/7 availability, multi-language support, and progress tracking.

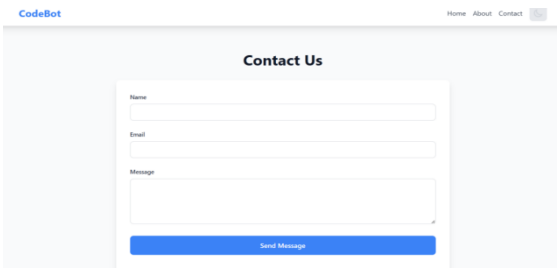

Fig4: Contact page

This screenshot displays the "Contact Us" form on the CodeBot website, allowing users to submit their name, email, and message. It features a clean interface with a highlighted navigation bar and a prominent "Send Message" button for easy communication.

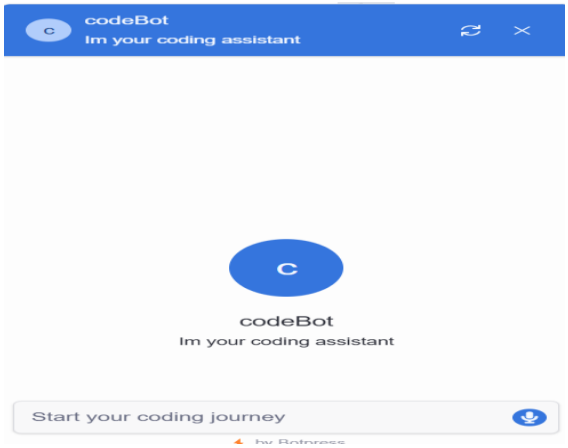

Fig5: Code bot

This screenshot features the CodeBot assistant interface with a clean design and welcoming message, "I'm your coding assistant." It includes a simple input field labeled "Start your coding journey," inviting users to begin interacting for coding help.

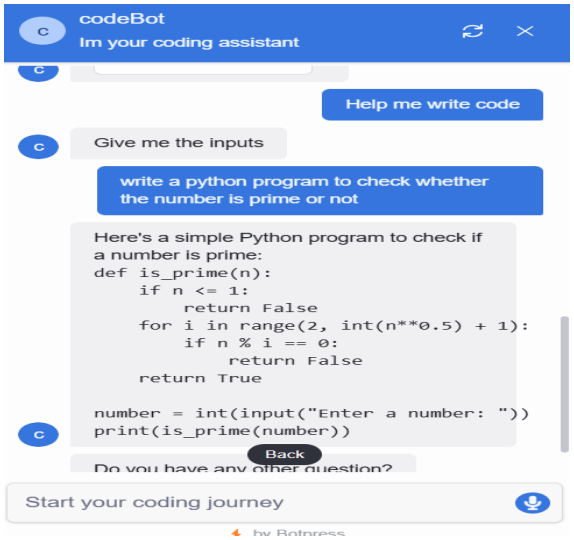

Fig6: Help me writing code

This screenshot shows a CodeBot chat session where the user requests a Python program to check for prime numbers. The

bot responds with a complete and functional code snippet, demonstrating its coding assistance capabilities.

CONCLUSION

This project successfully demonstrates the design and implementation of an AI-powered educational chatbot to support programming learning. By providing instant responses, syntax correction, and concept explanations, the chatbot enhances student engagement and self-paced learning. The system shows strong potential as an effective virtual tutor for improving programming education outcomes.

FUTURE SCOPE

In the future, the chatbot can be enhanced by integrating voice-based interaction and multimodal learning features. It can also be connected with Learning Management Systems to track student progress and automate assessments. Additionally, expanding support for more programming languages and adaptive learning techniques will further improve its effectiveness.

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