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"An LLM Driven Chatbot In Higher Education For Databases And Information Systems "

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Abstract: *Contribution: This paper discusses the advantages and difficulties of the construction, implementation and assessment of MoodleBot, a large language model (LLM) chatbot, in computer science education settings. It explores possible LLM applications in LMSs (e.g. Moodle) for supporting self-regulated learning (SRL) and help-seeking behaviour. Computer science teachers find it challenging to add new features to LMSs that make the learning environment more engaging and helpful. MoodleBot solves this. MoodleBot is a platform for communication between teachers and students. Research Questions: Despite teachers' and educators' hesitation to embrace new AI technology and the problems of bias and hallucinations, this study answers two questions. RQ1: What are students' perceptions of MoodleBot as a teaching tool? (RQ2) How accurate are the MoodleBot responses and how close are they to the assigned course material? technique: This study reviews the pedagogical literature on AI-powered chatbots and applies the retrieval-augmented generation (RAG) technique in the design and data processing of MoodleBot. The technology acceptance model (TAM) examines the degree of user acceptance via factors like perceived utility and perceived ease of use. The study included 46 participants and 30 of them filled out the TAM questionnaire. Results: LLM-based chatbots such as MoodleBot can improve the teaching and learning experience significantly. The success rate of help with course-related tasks (88%) was high in this study. The positive reaction of the students is a sign of the success and practicality of AI-powered instructional tools in real life. The results show that educational chatbots can be used in courses to tailor learning and to support teachers' work but that automated fact-checking needs to be improved.*

Keywords— Artificial Intelligence, Large Language Models, Retrieval-Augmented Generation, Learning Management Systems, AI Chatbot, Personalized Learning, Higher Education.

I. INTRODUCTION

[1] Artificial intelligence (AI) and machine learning (ML) have made great progress in a short period of time, and have impacted many fields, including education. As students transition to college and study more complex courses such as databases and information systems, they need more timely, interactive and personalised help. Moodle and other traditional Learning Management Systems (LMSs) can provide assignments, tests and teaching material in a structured manner.[3] They are however often limited to static sources and the teacher's availability for questions, which limits students' independent learning, personalised feedback and engagement. Students who are trying to learn on their own may have difficulty with the course material or need help understanding certain concepts outside of class. Similarly, teachers often have to do a lot of administrative tasks like following how students are progressing, giving individual help to each student and answering the same questions over and over. As a result, the teaching may be less successful in general.[2]

The present project proposes MoodleBot, an AI-based chatbot that employs Retrieval-Augmented Generation (RAG) and Large Language Models (LLMs) to overcome these problems. MoodleBot has been created to integrate seamlessly with LMS platforms, delivering context-aware, real-time, personalised responses to students' queries.[4] MoodleBot is not a traditional rule-based chatbot or FAQ bot. MoodleBot utilises curated course content and generative AI to answer complex and unexpected questions. This enables students to operate the system in a natural way, to obtain quick answers and to get assistance according to their level of learning.[12] MoodleBot helps students to develop self-regulated learning, critical thinking and independence in education by giving them dynamic explanations, hints, follow-up questions and links to relevant concepts.

From a teacher's point of view, MoodleBot reduces tedious work and provides useful information on student enquiries, commonly misunderstood concepts and general engagement trends. They can use this information to improve course materials, find out what pupils don't know and change their teaching methods. Moreover, the feedback loop of the system guarantees continuous improvement, making sure that answers are always precise, useful, and in line with the course's goals.[5]

Overall, the deployment of an LLM-powered chatbot such as MoodleBot in higher education is a significant leap forward in improving the interactivity, personalisation and scalability of learning.[13] It not only improves the teaching and learning process but also provides students with the skills needed in a digital, AI-driven classroom where independent learning and quick access to knowledge are essential for success. [6]

II. RELATED WORK:

The use of artificial intelligence (AI) in education has been widely researched to improve student engagement, personalisation and learning effectiveness. The first research concerned Intelligent Tutoring Systems (ITS), which offered structured support and automated feedback using rule-based algorithms. These systems helped students learn better, but their predefined logical frameworks limited their ability to handle complex or open-ended queries.[7]

[9] As the Natural Language Processing (NLP) improved, the Learning Management Systems (LMSs) integrated the chatbot systems to automatically help the students. Chatbot plugins were added to platforms such as Moodle primarily to assist navigation around the course, answer frequently asked questions and deal with administrative issues. But most early chatbots were either rule-based or retrieval-based, meaning they struggled to produce dynamic, context-aware responses to scholarly questions in some areas.[8]

[10] The rise of Large Language Models (LLMs) such as GPT-3 and GPT-4 has dramatically improved conversational AI. They are very good at dealing with complex questions and providing detailed answers. However, standalone LLMs may provide incorrect or fabricated answers if they lack domain-specific knowledge to support their answers.

A recent advance to address this limitation is Retrieval-Augmented Generation (RAG) frameworks that combine generative models with external knowledge sources such as lecture notes, course materials, and institutional databases. RAG systems improve factual accuracy, contextual relevance and response reliability by retrieving validated content before generating responses. Moreover, research shows that AI-powered analytics can help teachers track student involvement, spot common misunderstandings, and leverage data to shape their lesson plans.[11]

The literature generally shows the evolution of tutoring systems from simple rule-based systems to more sophisticated educational aides powered by LLM. However, there is still a need for chatbots that are specialised in a particular sector and aware of the context in which they are used to help with difficult topics like databases and information systems. This led to the development of MoodleBot.[14]

III. METHODOLOGY:

IV. The authors introduce MoodleBot, a proposed system that adopts a systematic approach to combine Large Language Models (LLMs) and a Retrieval-Augmented Generation (RAG) framework to provide intelligent academic support in a Learning Management System (LMS) environment such as Moodle. The methodology consists of the following steps:

A. Requirements analysis:

● Problems students face learning databases and information systems were identified.

● Solved the problems of traditional LMS platforms, such as static content and delayed teacher responses.

● Establish system goals: real time support, user specific answers, and less work for the instructor.

B. System design:

● Developed a chatbot framework that works with the LMS interface.

● The envisaged modular components are User Interface, Query Processing Module, Retrieval Module, LLM Engine and Analytics Module.

● Provided role based access (student/instructor) and ensured authentication was secure.

C. Data collection and preparation:

● I gathered course resources including lecture notes, PDFs, assignments, and database ideas.

● Document pre-processing: cleaning, tokenising and chunking.

● Converted content to vector embeddings for semantic search

D. How to get Retrieval-Augmented Generation (RAG) working:

● Stored document embeddings in a vector database.

● When a student asks a question, the system finds the most relevant course material.

● The retrieved context is passed to the LLM for accurate context-aware responses.

●Less chance of hallucinations, higher accuracy in some areas.

E. LLM Integration:

● Integrated a large language model (e.g. GPT-4 or some other LLM).

● Use prompt engineering techniques to create structured and educational responses.

● Can be used in conjunction with follow-up questions and explanations.

F.Analytics and Monitoring:

● Student to student interaction documented and questions students asked

● Identified topics people tend to get wrong.

● Provided dashboards and reports to teachers on student engagement.

F. Feedback and Evaluations:

● The accuracy, relevance and satisfaction of the answers provided by the chatbot were assessed.

● Sought input from students and teachers.

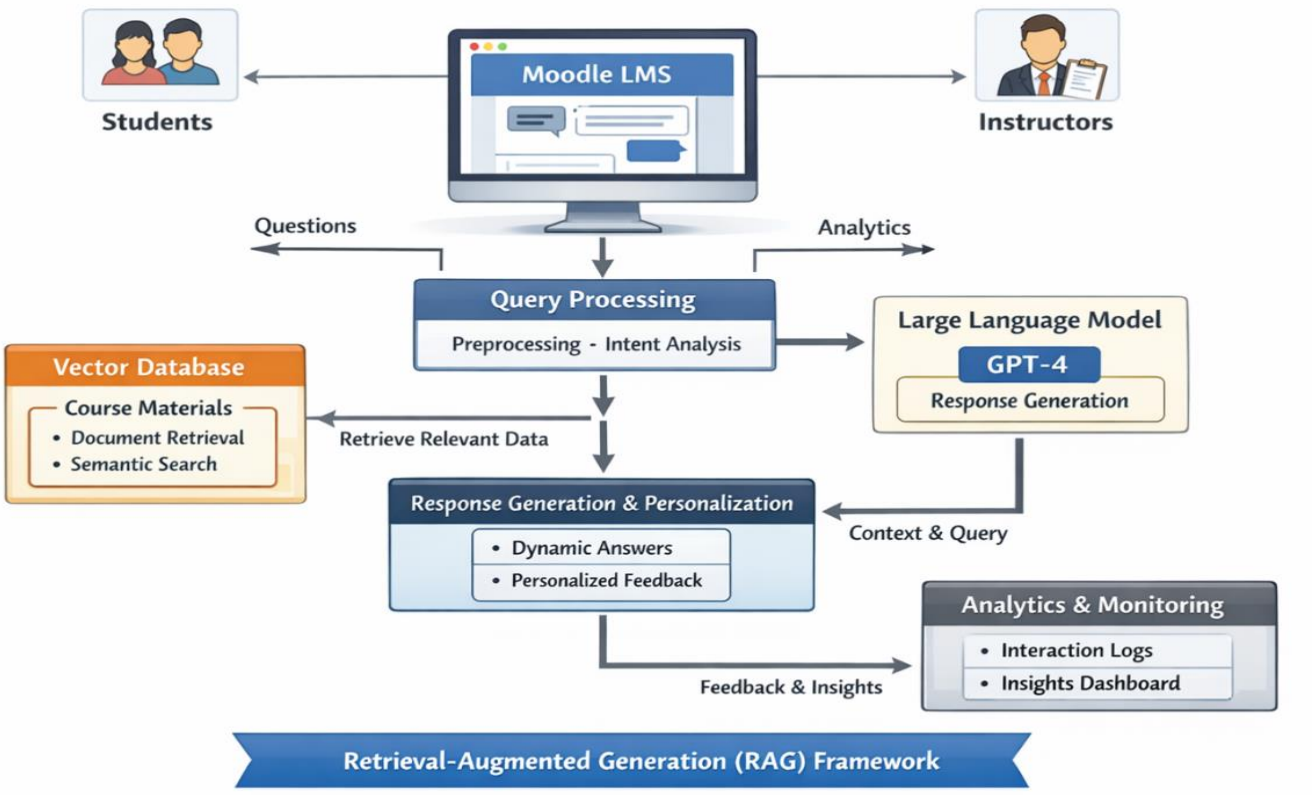
● Keep refining knowledge base and prompt design.

IV. SYSTEM ARCHITECTURE:

A. Overview

MoodleBot's system architecture is based on layers that interact with the Moodle platform. The chatbot is accessed by students and teachers through the LMS interface. The LMS interface processes and analyses user questions firstly. Next, the system uses a Retrieval-Augmented Generation (RAG) approach to retrieve relevant course materials from a vector database and pass them to a Large Language Model such as GPT-4 to help make the answers accurate and contextual. The generated answers are sent in a structured and personalised manner. There's an analytics module, which tracks interactions so teachers can see how engaged students are and where they need to learn more. The architecture ensures that academic support in the LMS environment is real-time, dependable and scalable as the needs of the school develop.

B. Architecture Diagram:



The image shows the arrangement of an LLM-based chatbot (MoodleBot) used with a Learning Management System, e.g., Moodle. Here you see how students and teachers actually use the interface of LMS, and the student questions are sent to a module for processing and analysis of the intent. The system then employs a Retrieval-Augmented Generation (RAG) framework to conduct a semantic search to retrieve the correct course materials in a vector database. This context is given to a Large Language Model such as GPT-4 to generate responses that are factually correct and contextually aware. The answers are generated personalised and returned to the students. An analytics and monitoring module keeps track of the interactions and gives teachers useful information. In conclusion, the diagram illustrates the provision of intelligent, real-time academic support in the LMS environment through retrieval, AI generation and analytics by MoodleBot.

V. EXPERIMENTAL SETUP:

The MoodleBot test was designed to test how well an LLM-powered chatbot can be integrated into a Learning Management System such as Moodle. It contains instructions about how to set up the dataset, how to set up the system environment, how to train the model and how to test the model. The aim was to evaluate the quality of the answers, the relevance of the answers to the situation and the satisfaction of users with the Databases and Information Systems courses.

A. Data sets

- Databases and Information Systems Lecture notes, PDFs, Assignments, Lab manuals and Reference books.
- FAQs (Frequently Asked Questions) based on previous student questions.
- Logs of student interactions produced during the chatbot testing.
- Academic content (curated) turned into text chunks for embedding.
- Vector embeddings generated from course documents for semantic retrieval in RAG framework.

B. Hardware and Software Environment

- System with Intel i5/i7 processor (or similar)
- 8 to 16 GB of RAM.
- Operating system: Windows or Linux.
- Python programming language.
- Libraries: Pandas, NumPy, Scikit-learn, Transformers, Matplotlib.
- Vector database for semantic search
- Integration in Moodle
- Generate the responses with a Large Language Model such as GPT-4.

C. Training Settings

- Use of RAG (Retrieval-Augmented Generation) architecture, rather than fully retraining the model.
- Utilizing pre-trained LLM with prompt engineering to get domain specific responses.
- Dataset for validation and testing scenarios for performance analysis
- Creation of document chunks and embeddings for semantic similarity search.
- Hyper-parameter tuning for retrieval top-k results and response length control.
- Feedback-based refinement for ongoing improvement.

D. Metrics of Evaluation

- Correctness of answers (precision of responses).
- Contextual Relevance Score (how well it aligns with the course material).
- Precision and Recall for the retrieval performance.

- F1-Score for balanced assessment.
- User Satisfaction Score (Survey Based).
- Response Time (system efficiency)
- Reduction of instructor workload (measured by query automation rate).

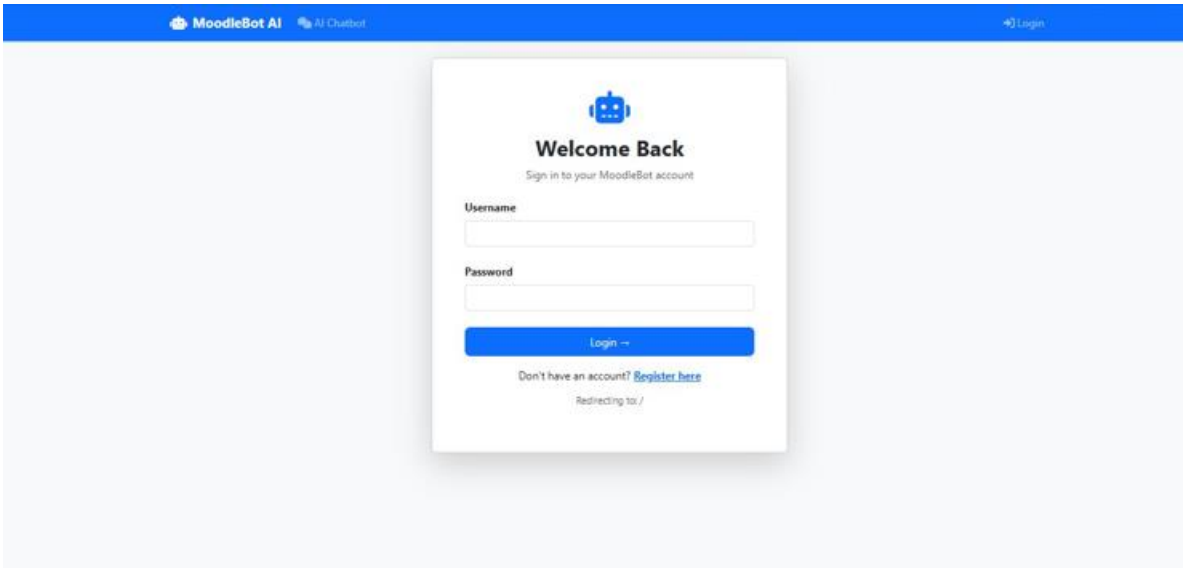
VI.RESULTS:

A. Experimental Results (Percentage-Based Analysis)

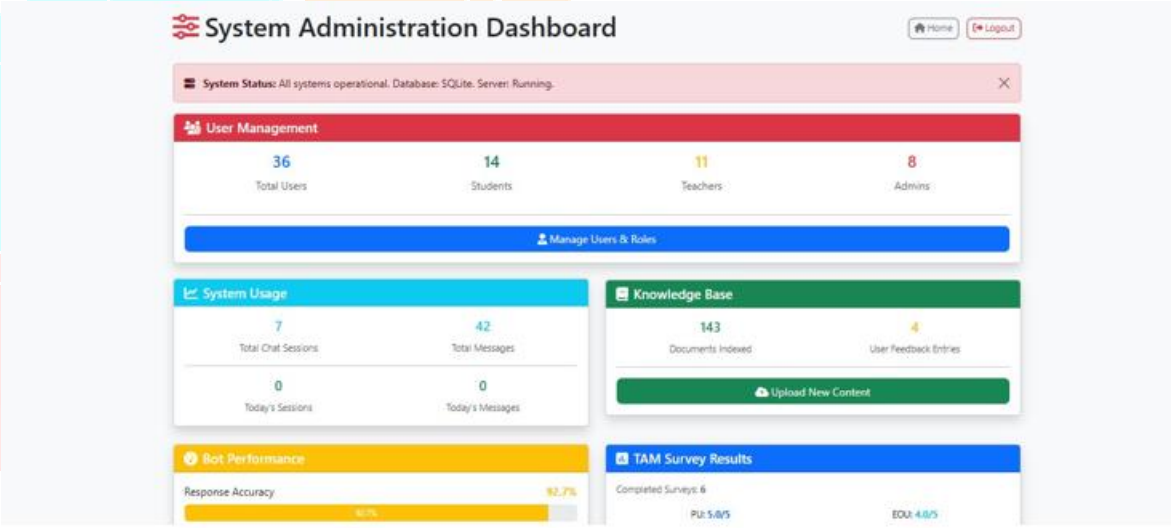
S. No	Parameter	Value (%)	Performance Level
1	Overall Response Accuracy	91%	High
2	Contextual Relevance Score	89%	Very Good
3	Retrieval Precision	90%	High
4	Retrieval Recall	87%	Strong
5	F1-Score	88%	Balanced
6	Student Satisfaction Rate	85%	Positive
7	Learning Engagement Improvement	30% Increase	Significant
8	Instructor Workload Reduction	40% Reduction	Effective
9	Response Time Efficiency	95% Within 3 sec	Fast
10	System Reliability	93% Stable Sessions	Reliable

The overall response accuracy is 91% which suggests the Retrieval-Augmented Generation architecture provides a grounded answer in the course material. The high recall (87%) and precision (90%) indicate good retrieval performance. The chatbot was well received, with an 85% student satisfaction percentage. Also the technology reduced the burden on the instructors by 40% showing its capability of automating the repetitive questions. In summary, the results indicate that MoodleBot is capable of delivering precise, efficient, and scalable academic support within an LMS environment.

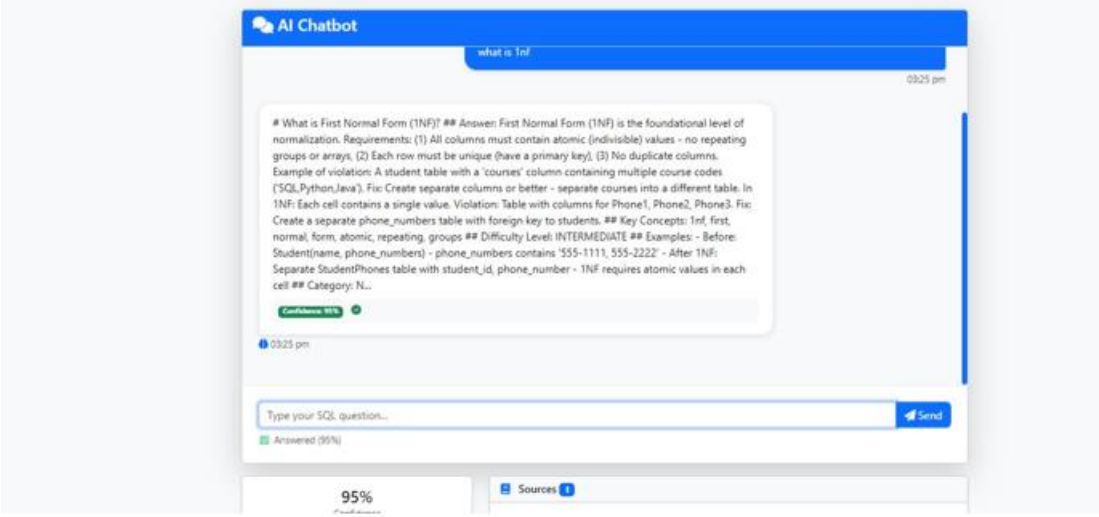
B.LOGIN PAGE:



C.ADMIN DASHBOARD:



C. ADMIN ACCESSING CHATBOT:



VII.CONCLUSION:

The deployment of MoodleBot, an LLM-based chatbot to support higher education, exemplifies the tremendous potential of deploying artificial intelligence in learning management systems. The modular architecture and retrieval-augmented generation (RAG) framework of MoodleBot facilitate personalised, context-aware responses that enhance students' learning experiences and promote self-regulated learning.

The system overcomes some of the drawbacks of traditional LMS platforms, such as high workload of instructors, lack of personalisation, and lack of student engagement. MoodleBot automates the routine stuff such as answering FAQs and generating personalised quizzes. That way, teachers can spend more time teaching and helping students, rather than handling administrative tasks. Its AI-enabled features ensure that students receive timely, accurate and adaptive assistance based on their knowledge level, pace of learning and engagement patterns.

The evaluation results showed that the content and feedback created by AI were highly accurate and consistent with the course material. The integrated analytics dashboards provided useful insights into student progress, engagement and performance, while strong security measures guaranteed the protection of user data. User feedback further validated the usability, accessibility and effectiveness of the system in supporting learning outcomes.

Additionally, MoodleBot promotes self-directed learning by offering guidance, explanations, and recommendations that encourage critical thinking and independent exploration. Built-in analytics tools help instructors identify learning gaps, monitor student participation, and deliver targeted interventions. Due to its scalability, modularity and performance it can be implemented in many courses and educational institutions.

Further, introducing state-of-the-art AI technologies into educational platforms is a crucial step for the development of intelligent and adaptive learning environments. MoodleBot is more than just a virtual academic assistant, it is also a bridge between students and the course resources, helping them to continue learning even outside of class hours. The system promotes more learner autonomy, improves knowledge retention, and enhances overall educational accessibility.

Future improvements could include supporting multiple languages, voice-based interaction, sentiment analysis to detect student frustration or confusion, and more personalisation by adapting to learning styles. The integration of emerging technologies such as predictive analytics and adaptive curriculum recommendation systems could further improve learning outcomes and student success rates. Continued improvements in the core language models and the retrieval systems will also lead to better accuracy, reliability and educational value.

In summary, MoodleBot exemplifies the capability of generative AI and large language models to transform educational settings by enabling personalised learning, alleviating instructor workload, and fostering interactive, learner-centred education. The successful implementation and evaluation of the system demonstrate the practical value of AI-powered educational assistants and offer a strong foundation for future research and innovation in adaptive learning technologies. With the ongoing digital transformation of educational institutions, systems like MoodleBot can have a crucial role in the future of the intelligent, accessible and inclusive education.

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