AI-Powered Interactive Learning Assistant for Classrooms

BY

Team NOX

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Team Details

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Introduction

The increase in demand for interactive and personalised education has driven the development of advanced AI tools, which aim to enhance classroom learning. This project addresses the challenge of creating an AI powered interactive learning assistant capable of processing real time queries from students to deliver contextual and adaptive responses, thereby improving their engagement. Our proposed solution is a web based application with dedicated interfaces for administrators, teachers, and students. It facilitates seamless course management, resource sharing, and AI driven query resolution. The system ensures efficient performance and scalability that are suitable for diverse classroom environments by integrating optimised AI models. The platform emphasizes data privacy and security with a scope of future expansion.

Problem Statement

Modern classrooms often lack real time, interactive tools to address diverse student needs and sustain engagement. The challenge is to develop a multimodal AI powered learning assistant that processes students real time text, voice, and visual queries, delivering contextual responses with textual explanations and visual aids like charts. It also aims to monitor student engagement through facial expression analysis, suggesting adaptive interventions. Key challenges include integrating multimodal inputs for consistent, context-aware responses, ensuring low-latency processing for seamless interactions, and handling diverse accents, noisy environments, and variations in facial expressions.

Objectives

The primary objective of this project is to develop a multimodal AI powered learning assistant capable of dynamically responding to student queries through text, voice, and visual inputs. The assistant aims to provide personalised and context-aware responses that enhance student engagement, clarity, and overall understanding of the subject matter. Additionally, the system incorporates facial expression analysis to monitor signs of disengagement or confusion in real time. It enables it to suggest adaptive interventions such as content rephrasing, breaks, or motivational prompts to support continuous and practical learning.

Expected Outcomes

The expected outcomes of this project include the successful development of a multimodal AI assistant capable of processing real-time student queries across text, voice, and visual inputs. The assistant will be equipped to deliver responses enriched with visual aids such as diagrams and charts to enhance conceptual understanding and retention. Furthermore, the system will include a feature to monitor student engagement through facial expression analysis. It will enable it to dynamically adapt teaching strategies in response to signs of confusion, distraction, or disengagement, creating a more interactive and responsive learning environment.

Application Workflow

Technology Stack:

1. **Front End:**
    - HTML
    - CSS
    - Java Script
2. **Back End:**
    - Flask
    - Python
    - PyPDF2
    - Werkzeug
3. **Database Management:**
    - Pandas
    - File System
4. **AI Models:**
    - Mistral- 7B-Instruct-v0.1 Open VINO optimized INT8 versions, integrated via Hugging Face Transformers
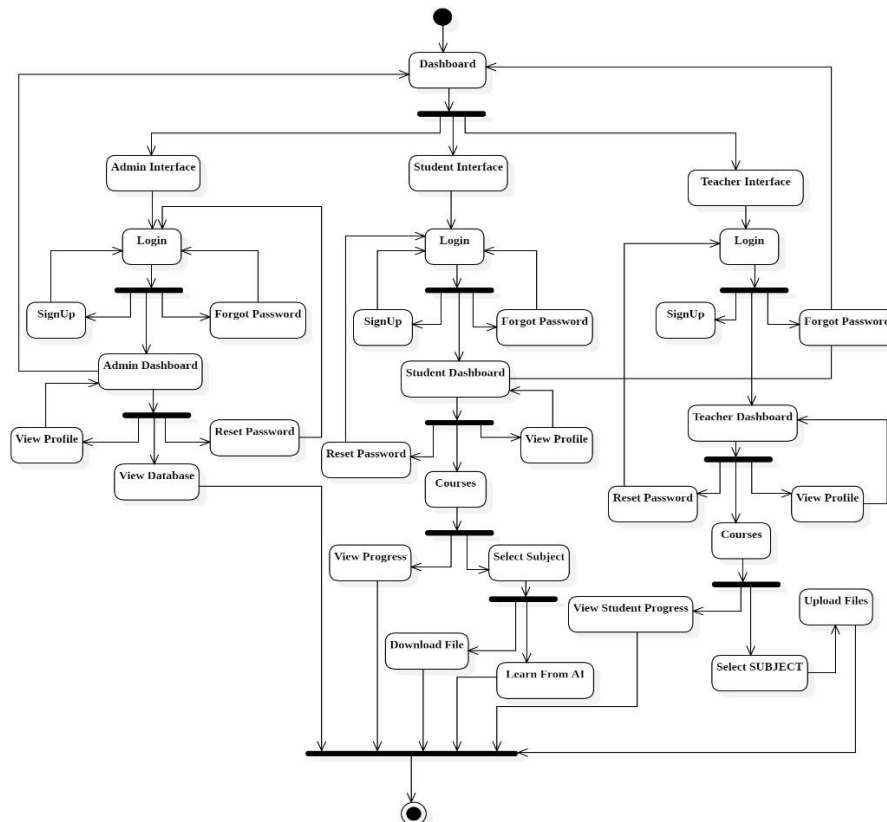
Application Functionality:

Fig – 01: Application flow

The web based application enhances classroom learning through tailored interfaces for administrators, teachers, and students, supported by a robust database management system using CSV files and PDFs.

1. **Admin Workflow:**
   Admin starts at the dashboard, picks their role and goes to the login page. They enter their employee ID and password, which must be strong. A warning will pop up if the account has not been created yet. The admin can then sign up for the account on the signup page, where the admin enters their ID and email, which are checked against Admins.csv. If they match, the account is created, and they can log in. After logging in, a greeting can be seen at the top left of the web page and a logout button at the top right. The interface has three cards first is My Profile, where the admins can see their details, second is Manage Database, where the admin can view all CSV files like Admins.csv and Student_Teacher_Subject_Mapping.csv, and third is Reset Password where the admin can change his password.

2. **Teacher Workflow:**
   Teacher starts at the dashboard, picks their role and goes to the login page. They enter their employee ID and password, which must be strong. A warning will pop up if the account has not been created yet. The Teacher can then sign up for the account on the signup page, where the their ID and email are entered which are checked against Teachers.csv. If they match, the account is created, and they can log in. After logging in, a greeting can be seen at the top left of the web page and a logout button at the top right. The interface has three cards first is My Profile, where the teachers can see their details, second is Courses where the teacher picks a subject from Student_Teacher_Subject_Mapping.csv, upload PDF files, and can check student progress. Third is Reset Password where the Teacher can change his password.

3. **Student Workflow:**
   Student starts at the dashboard, picks their role and goes to the login page. They enter their student ID and password, which must be strong. A warning will pop up if the account has not been created yet. The Student can then sign up for the account on the signup page, where the their ID and email are entered which are checked against Students.csv. If they match, the account is created, and they can log in. After logging in, a greeting can be seen at the top left of the web page and a logout button at the top right. The interface has three cards first is My Profile, where the students can see their details, second is Courses where the student picks a subject from Student_Teacher_Subject_Mapping.csv, download PDFs if available, and use "Study with AI." Where they ask questions, and the app reads the PDF with PyPDF2 and answers with the OpenVINO-optimized Mistral-7B. After finishing, they can mark a module complete, changing "No" to "Yes" in the CSV. Third is Reset Password where the student can change his password.

4. **Database Management:**
   The application employs a hybrid database system. Admins.csv, Teachers.csv, and Students.csv store user details updated during signup and password resets via Pandas. Student_Teacher_Subject_Mapping.csv tracks module and subject mappings, synchronized across interfaces. PDFs are stored in subject specific using the file system,

with Werkzeug ensuring secure uploads. PyPDF2 extracts text for AI queries, linking file system data to the CSV-based user and progress tracking, ensuring seamless data integration and accessibility.

Models Used

Model Environment:

The models were executed in an environment powered by a high-performance Intel Xeon W-10885M CPU operating at 2.40 GHz, with Windows selected as the underlying operating system.

Model Comparison:

1. **Original Model (Mistral-7B-Instruct-v0.1):**

    - **Loading time:** 13.66 seconds

    - **Space used:** 13.49 GB

    - **Question asked:** Tell me how to make coffee in exactly 30 words

    - **Time taken to answer the question:** 23.83 seconds

    - **Answer word Count:** 21 words

    - **Tokens count**: 2.27 tokens/second

    - **Memory used:** 14200.21 MB memory

2. **Optimized Model (Mistral-7b-Instruct-v0.1-int8-ov):**

    o **Loading time:** 3.87 seconds

    o **Space used:** 6.79 GB (including extra data)

    o **Question asked:** Tell me how to make coffee in exactly 30 words

    o **Time taken to answer the question:** 14.56 seconds

    o **Answer word Count:** 32 words

    o **Tokens count**: 5.01 tokens/second

    o **Memory used:** 14209.69 MB memory

Project Resources and Showcase

Application and Model Demo:

https://drive.google.com/file/d/1mRZ5H5wC5wO8wK6znHcqriHzXYJSvuP7/view?usp=drive_link

GitHub Link:

https://github.com/Adibhatla-Vaishnavi-Amulya/Intel-Unnati-Project-AI-Powered-Interactive-Learning-Assistant-for-Classrooms

Future Scope

In the current stage of development, our model is capable of understanding content from a given PDF and generating appropriate answers in text format. However, due to system constraints and resource limitations, we were unable to implement support for audio, video, or image-based explanations in response to user queries. As part of future enhancements, we aim to extend the system's capabilities to include multimodal output formats, enabling the assistant to provide explanations using spoken responses, visual diagrams, instructional videos, and contextual images. These additions will significantly improve the interactivity and accessibility of the learning experience, making the system more engaging and inclusive for diverse learners.

Conclusion

This project presents the development of an AI powered learning assistant aimed at making classroom interactions more engaging and effective through intelligent, context aware responses. The system currently handles text based queries from PDF documents and offers a user-friendly interface for students, teachers, and administrators to manage courses and learning resources efficiently. Despite hardware constraints, our optimized Mistral-7B model delivers quick and personalized answers, marking a strong foundation for AI-integrated learning.