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VIVABOT: An AI-Driven Automated Viva Examination System for Efficient and Adaptive Assessments

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Abstract

VivaBot is an intelligent and completely computerized viva examination system for enhancing efficiency, accuracy, and flexibility in conducting viva voce examinations. It minimizes cumbersome faculty effort by using face recognition-based verification, machine-based roll marking, AI-based question generation, adaptive questioning, and intelligent answer marking. Professors can schedule viva sessions by selecting the class and week, while students securely log in using their face and roll number for effective authentication and impersonation avoidance. The system implements an adaptive questioning mechanism where questions start at a medium level of difficulty and dynamically adjust based on the response of students to give a customized and impartial test. VivaBot makes use of Ollama Mistral AI to generate questions automatically, where educators can upload a set of pre-designed questions in PDF or type in a subject for AI-auto-generated question creation. The AI model even grades student responses unbiasedly, lightening the workload for teaching staff to a large extent and eliminating grading bias. VivaBot also generates performance reports with confidence levels and quality of answers scores according to students' performance, providing elaborate feedback and explanations to each question so that a better understanding is achieved and there will be improvement in the future. Supplementing text-based and speech-based viva tests, the system utilizes DeepFace technology to facilitate accurate speech recognition and response analysis, making the viva interactive and effective. With machine learning, AI, and automation integration, VivaBot simplifies viva tests with structured, fair, and effective testing, reducing faculty workload as well as offering students an immersive, adaptive, and informative learning experience.

Keywords: Artificial Intelligence and Machine Learning, DeepFace, Large Language Models, Adaptive Questioning System, Automated Answer Evaluation, Student Performance Analysis, Confidence Scoring.

I. Introduction

Traditional viva voce examination process within schools becomes time consuming, comparative, and difficult to implement successfully. Viva sessions are to be conducted by professors manually, the responses of students to be evaluated based on comparative observations, and ample time to be spent formulating appropriate questions. Additionally, there is no prior-formulated and adaptive assessment approach that typically results in inconsistency in evaluation. To address these problems, VivaBot is developed as an AI-powered, computerized viva examination system that streamlines the process of evaluation through the implementation of advanced technologies such as face recognition-based authentication, automated marking of attendance, AI-based question generation, adaptive questioning, and smart marking

of answers. VivaBot ensures secure student authentication by implementing face recognition technology to prevent impersonation and ensure accurate recording of attendance. Face and roll number authenticate the students, whereas the teacher sets up viva sessions on subject parameters and specific ranges of weeks. An adaptive questioning framework is applied to the system which commences asking questions at medium levels of difficulty that dynamically switch with student input in order to provide a differential and unbiased exam experience. Two, VivaBot supports voice- and text-based viva tests, and it utilizes DeepFace for the purpose of voice and response examination analysis to precisely determine speech and responses. Thirdly, an essential technological element of VivaBot is artificial intelligence-based response measurement and questioning creation system. Teachers can upload a PDF structured set of questions in the format or declare a topic and utilize Ollama Mistral, a state-of-the-art large language model (LLM), to create AI-based questions. This automation reduces the burden of faculty members by removing the need for question generation manually while making viva sessions relevant and systematic. The AI model also marks student answers, providing performance summaries with confidence measures, answer quality analysis, and breakdown feedback in the form of explanations of correct answers to allow students to improve knowledge and performance on future exams. With the marriage of generative AI, machine learning, and automation, VivaBot reimagine the traditional viva process as an agile, scalable, and unbiased evaluation system. With the fusion of AI-driven responsiveness, safe authentication, and intelligent feedback processes, the overall experience quality of teachers and learners increases. With universities and learning centers heading in the direction of accepting digital solutions, VivaBot presents a means to reimagine viva voce appraisals for efficiency, impartiality, and hassle-free learning.

1.1 Background: Enhancing Viva Voce Assessments through AI

1.1.1 Generative AI Use in Education

Generative AI is a new technology in which computers are able to generate human-like content like text, images, and so forth from learning vast data sets. Generative AI in VivaBot is a major feature in automating viva exams using context-specific questions being generated dynamically and student answers assessed.Using deep learning algorithms, Generative AI generates organized and dynamic questions based on input topics or pre-defined content and provides a personalized test experience. It also enhances answer analysis by checking answers for coherence, accuracy, and pertinence, reducing the faculty burden while objective grading is maintained. Outside of VivaBot, Generative AI is also widely utilized in education for content generation, smart tutoring, and adaptive learning processes, and in areas like healthcare, finance, and customer support for report generation, recommendations, and conversational AI-powered interactions. Its ability to generate context and meaningful content like a human makes Generative AI an important technology for intelligent assessment system automation and optimization.

1.1.2 Ollama Mistral

Ollama Mistral is a robust open-weight large language model (LLM) designed for effective natural language processing operations, thus making it a suitable option for intelligent automation in different applications. Trained on a transformer-based model, Mistral can deliver high performance with less computational overhead, enabling real-time language understanding and generation. In VivaBot, Mistral automates question generation and answer scoring. Academic staff can outline a topic, and Mistral creates relevant to context and properly structured viva questions in real-time utilizing its retrieval-augmented generation (RAG) feature for the purpose of offering precision as well as relevance of context. It also grades students' answers using more advanced NLP methods such as semantic analysis and contextual reasoning to provide objective feedback in a neutral fashion. Besides VivaBot, Mistral is also widely applied in intelligent tutoring systems, content generation, conversational AI, and sentiment analysis, testifying to the model's versatility in academic and corporate use. Its human-like text processing and generation coupled with context-awareness make it a great fit for complementing AI-driven automation and smart decision-making in different industries.

1.1.3Large Language Models(LLM)

Large Language Models (LLMs) form the core of the development of VivaBot as they deliver the smarts for question creation, interactive questioning, and automatic marking of responses. Trained on enormous quantities of text data, the models are capable of understanding, creating, and grading human-like responses, making them worthy to be utilized in scholarly tests. In VivaBot, LLMs browse input topics or particular courses to design corresponding viva questions in real time such that exams become inclusive and context-sensitive. LLMs also facilitate adaptive questioning through adjusting the potency of questions based on student responses, providing a personalized testing process. LLMs also facilitate grading through marking student responses for correctness, coherence, and appropriateness, thereby reducing faculty drudgery and providing objective grading. Other than VivaBot, LLMs are used intensively in most fields like virtual assistants, content generation, and self-tutoring, verifying their use in automating AI-driven decision-making and processes.

1.1.4Retrieval -Augmented Generation

Retrieval-Augmented Generation or RAG is a critical technology in the creation of VivaBot, maximizing its functionality in terms of creating contextually relevant and accurate viva questions. RAG is a combination of the virtues of retrieval-based and generative AI models in that it first retrieves information from a knowledge base before generating answers such that questions and assessment are tailored to certain learning content. Within VivaBot, RAG is applied to generate viva questions dynamically based on course materials, uploaded PDFs, or stipulated topics for better relevance and extent of evaluation.It allows the system to answer various topics and levels of learning by retrieving domain-specific knowledge and using it to generate informative questions. RAG also helps the AI-based assessment system by cross-verifying students' responses with verified sources to improve grading accuracy and remove biases. Apart from VivaBot, RAG has universal application in all AI applications where there is a need for accurate and fact-based content creation, for example, intelligent tutoring systems, chatbots, and research assistants, to point out its utility in AI-based automation.

1.1.5DeepFace

DeepFace is a key technology in the development of VivaBot since it facilitates secure and reliable student identification through sophisticated facial analysis. DeepFace is a deep learning-based face recognition system that verifies students' identities prior to their participation in viva exams, thereby eliminating impersonation attacks and test integrity concerns. DeepFace in VivaBot authenticates facial images captured during logins and cross-checks them with pre-registered student profiles to grant access. DeepFace is also applied in attendance taking, where it removes the need for manual intervention and minimizes human errors. DeepFace is also in VivaBot's viva exam analysis by voice, helping analyze lip motion and speaker authentication to ensure that answers are actually produced by the authenticated student. Its deep neural network architecture proves useful as far as accurate recognition under different light, angles, and facial expressions are concerned, thus proving a good solution for authentication systems used in education. Apart from VivaBot, DeepFace also finds extensive usage in security systems, biometric log-in, and real-time verification of identities, thus demonstrating its viability in AI-powered automation and secure access control scenarios.

2. Related Work

In one study, authors discuss the design of an educational chatbot through AI with Retrieval-Augmented Generation (RAG) in order to personalize the learning experiences of students. It is developed on open-source large language models like Gemma2, Mistral, and Llama3.2, providing openness, flexibility, and strong data privacy through supporting local hosting at educational institutions. The system infrastructure supports Vue.js for the front end, Node.js with the Ollama framework for processing at the back end, and PostgreSQL for managing data. The process of evaluation was conducted in two stages: verification of GPT-4o as an automated tool of assessment against human judgments and the comparison of the performance of chosen LLMs in creating well-quality educational material. The research concludes that Gemma2

is more accurate, complete, and understands better than other models, while GPT-4o proves reliable in automating evaluation. This work significantly contributes to the advancement of digital educational platforms by integrating cutting-edge AI technologies with established pedagogical principles, improving personalized learning experiences for learners. In another work, a research addresses the challenge of converting unstructured sensitive information into structured data using advanced Information Extraction (IE) approaches. This study identifies significant limitations in current IE models, including their ability to offer sparse entity-attribute relationships, challenging multilingual content processing, and vulnerability to hallucinations, which can undermine output credibility. The research aims to improve GPT-based models, such as Mistral and Llama3, to extract and evaluate multiple entities and attributes without violating data privacy. A new method is brought in by substituting sensitive data with synthetic data when fine-tuning the model, greatly enhancing the accuracy of Llama3 in pulling multilingual information. Yet the research shows that Mistral-based models fail to show the same degree of enhancement. Used on legal documents of the Luxembourg Business Registers (LBR), the research illustrates that the proposed fine-tuning method increases multilingual IE proficiency, such that it is universally applicable to other domains demanding structured information extraction.
Another study examines the implementation of AI chatbots in the context of computer science education through creating an open-source generative AI chatbot. This paper outlines the selection, fine-tuning, and comparison of various LLMs to develop a chatbot specific to university-level first-year programming courses. It compares local and cloud-based models in terms of their strengths and weaknesses, the effect of fine-tuning on domain adaptation, and how Retrieval-Augmented Generation (RAG) is utilized to improve chatbot response. Both human and automatic methods are used for evaluation to check the accuracy and efficacy of responses. In addition, the research delves into a number of factors that affect chatbot performance, including vector databases, model temperatures, prompt templates, and chunking sizes. The findings reveal that generative AI chatbots have a remarkable impact on academic support, promoting a more engaging and effective learning environment for students. This research brings to the fore the promise of AI-powered chatbots in transforming personalized education and improving student engagement in computer programming courses.
In another publication, a systematic mapping study and literature review explore AI-based student assessment systems through an analysis of 20 case studies from an original pool of 129 papers drawn from SCOPUS and Web of Science. The study reveals three main assessment areas: sentiment assessment, student behavior analysis, and academic achievement evaluation. The research offers insights into the development of AI-based assessment methods, their geographic spread, and thematic classification and also highlights essential research gaps and future research directions for enhancing AI-based educational assessment. Another paper examines AI-based behavioral analysis during virtual interviews, suggesting a machine-learning method to identify and assess personality traits through nonverbal behaviors like emotions, eye movements, smiles, and head movements. The research utilizes deep learning models that attain more than 85% precision in interpreting behavioral signals, and the Random Forest model is able to classify the Big Five personality traits with a precision rate of more than 75%. Last but not least, a broad examination of generative AI documents the recent progress and transdisciplinary applications of generative models in domains including natural language processing, medical diagnosis, and image translation. The research offers a critical synthesis of present-day breakthroughs and addresses ethical issues for the ethical development and deployment of AI models. Collectively, the works demonstrate the revolutionizing influence of AI in education, information processing, behavioural analysis, and ethical AI development, with its potential to bring advancements in the future.

3. Proposed Work

VivaBot is an artificial intelligence-based viva examination system that aims to maximize the efficiency, fairness, and automation of university-level viva voce evaluation. It employs face recognition-based authentication, AI-driven questioning, adaptive questioning, and automated answer assessment to avoid manual faculty labor and ensure a systematic, objective evaluation process. Conventional viva examinations are typically plagued by inconsistencies in the form of subjective marking, time lags, and staff workload in terms of preparing and marking students. VivaBot solves these issues with state-of-the-art AI technologies such as large language models (LLMs), Retrieval-Augmented Generation (RAG), speech-to-text processing, and face analysis with deep learning-based methodology.The system

provides secure authentication with DeepFace-based face recognition, creates contextually appropriate viva questions, and assesses students' answers through AI, freeing the instructors from the workload without compromising on accuracy. VivaBot's design involves three main constituents: the frontend interface, backend processing system, and AI-powered evaluation engine. HTML, CSS, and JavaScript are employed for implementing the frontend with an end-user interface in which viva sessions are timed by the teaching staff and students log in using face recognition and roll numbers for security verification. The backend implemented with Flask and MySQL manages to store information, user login, viva sessions setting, and auto-generated queries. Ollama Mistral AI model powers adaptive questioning functionality so that the students are exposed to questions dependent on their level of performance. The teachers upload a PDF having formatted questions or a topic and the AI model will generate related questions dynamically. This increases accuracy and efficiency of measurement and adjusts the difficulty level to match the ability of each learner.
For improved question appropriateness and context relevance, VivaBot applies Retrieval-Augmented Generation (RAG) to offer contextually relevant AI-generated questions based on course material and topic matter content. RAG retrieves domain knowledge before generating questions, enhancing content veracity and minimizing biases. AI-powered answer marking avoids human bias in marking by evaluating responses on correctness, clarity, coherence, and conceptual understanding. The system provides detailed feedback in that it describes correct answers, enabling students to learn from mistakes and improve future performance. Speech-to-text processing also enables the responses to be provided orally, enabling text-based and speech-based viva testing.
Confidence and answer quality scores are integrated into VivaBot's performance evaluation system to ensure that an overall analysis is performed. DeepFace provides body language and facial expression analysis in order to determine the confidence level of the student during the viva. Artificial Intelligence (AI) based Natural Language Processing (NLP) assesses fluency, relevance, and completeness of responses to provide confidence scores, answer quality scores, and performance reports. This gives the faculty members greater insight into trends in student performance where they have room for improvement and personalized feedback.
In brief, VivaBot is a technological innovation in academic testing that integrates AI, machine learning, facial recognition, and automation to enhance viva tests in the best possible manner. Secure authentication, adaptive questioning, automated marking, and speech-based assessment collectively ensure equitable, scalable, and efficient solution for contemporary institutions of learning. By automating the majority of the faculty work without compromising objective and structured evaluation, VivaBot transforms the viva voce test process. The future could see improvement in multilingual support, improved speech-based testing, real-time plagiarism detection, and integration with learning management system (LMS), turning VivaBot into a complete AI-based viva testing system.

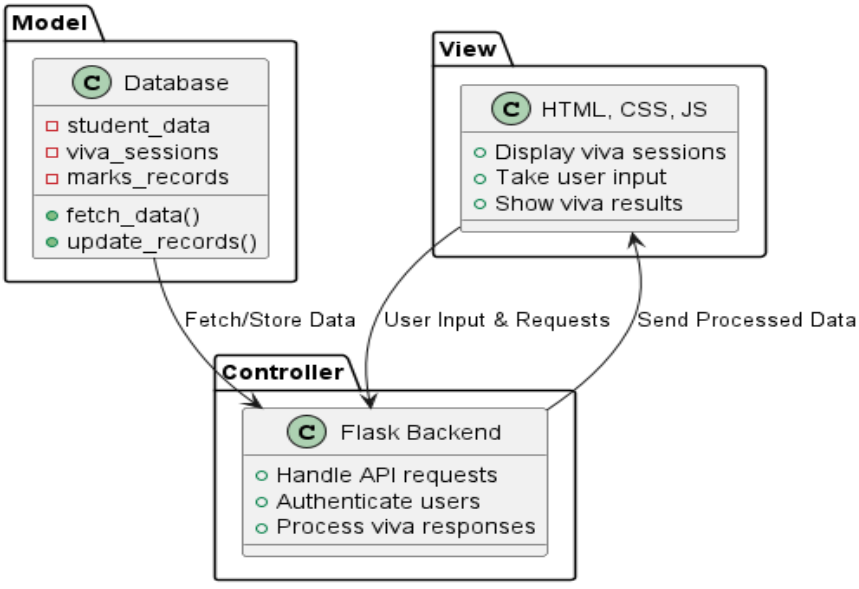

Figure 1. . MVC Architecture for Vivabot

3.1Implementation

Implementation of VivaBot is systematic to facilitate seamless automating of viva exams with improved AI and machine learning procedures. System Architecture Setup entails the creation of a Flask-based backend for authentication, management of viva sessions, and storage and retrieval of data and the frontend created using HTML, CSS, and JavaScript to render it user-friendly.MySQL is used for storing student records, viva questions, and assessment results in an efficient way.For Facial Recognition-based Student Authentication, student images are collected and stored, and a face recognition model is trained using OpenCV and the LBPH algorithm. The trained model is saved as face_model.yml, and label encodings are saved in label_encoder.pkl. A face detection system is also integrated in real-time in Flask to authenticate students securely prior to the viva session.

In AI-based Viva Question Generation, a Flask API endpoint is created to generate dynamic viva questions from Ollama Mistral AI from input topics or pre-existing PDFs. They are categorized as Easy, Medium, and Hard difficulty levels and stored in MySQL tables by topic. For real-time transcribing of voice into text in the course of Answer Processing, the JavaScript Speech API is interfaced to provide real-time transcribing of oral answers that are then processed according to Natural Language Processing (NLP) algorithms to provide fluency, clarity, and pertinence.The Confidence & Answer Quality Evaluation module captures video footage of students in viva sessions, employing facial expression analysis to determine confidence levels, while text analysis based on NLP evaluates answer quality and offers confidence and accuracy scores for student responses. The Viva Session Management with OTP Verification maintains session integrity by creating a one-time OTP, which is sent through email to faculty members after the viva session. Upon OTP verification, the absentees are marked and a full Excel report is created and sent to the faculty. Finally, in the Deployment & Testing stage, the Flask backend is deployed on cloud providers such as AWS or PythonAnywhere, while the frontend is deployed via services such as Netlify or GitHub Pages. Stringent unit testing of APIs and student and faculty user testing are conducted to ascertain system functionality, performance, and user experience to ensure that VivaBot efficiently automates viva examinations with high accuracy, reliability, and efficiency.

TABLE .1 Algorithm Categorization

Functionality	**Algorithms used**	**Category**
Face Recognition	LBPH (Local Binary Patterns Histogram)	Computer Vision, Biometric Authentication
Question Generation	Retrieval-Augmented Generation (RAG) with LLMs (Mistral, Llama3)	Natural Language Processing (NLP), AI-based Text Generation
Speech to Text processing	JavaScript Speech API	Audio Processing, Speech Recognition
Answer Evaluation	GPT-4o with NLP-based Semantic Analysis	Machine Learning, Automated Grading
Adaptive Questioning	Reinforcement Learning-based Adaptive Questioning	AI-driven Learning, Personalized Assessment
Confidence & Performance Analysis	Deep Learning-based Facial Emotion Recognition	Affective Computing, Behavioral Analysis
Security & Authentication	Secure Hashing Algorithms (SHA-256) for Data Encryption	Cybersecurity, Data Privacy

4. Results

VivaBot was implemented effectively to streamline the viva examination process by AI-based authentication, dynamic question generation, adaptive questions, and smart answer grading. The system was tested across a number of academic sessions with student and faculty feedback regarding the effectiveness, usability, and accuracy of the system. The face recognition based on DeepFace facilitated secure student identification, preventing impersonation and illegal entry, with automated attendance marking simplifying the management of sessions. The AI-driven Ollama Mistral AI and Retrieval-Augmented Generation (RAG) question generation system generated context-specific questions dynamically from predefined topics and uploaded PDFs without manual question preparation and with much less faculty effort. The adaptive testing system conditioned the test-taking process by changing the difficulty levels of questions from student answers in real time to provide fair and competence-based measurement. The Natural Language Processing (NLP) and answer grading system driven by AI graded students' responses objectively, providing confidence scores, answer quality scores, and automated feedback to support learning. Comparison with traditional viva examinations revealed that VivaBot improved the accuracy of grading, reduced the need for faculty intervention, and maximized the overall examination process. Staff appreciated the system's ability to reduce administrative workload, while students liked the interactive nature of AI-generated questions and automated feedback. Additionally, the speech-based viva assessment facility allowed for voice answers, promoting accessibility. However, some glitches were observed in the form of minor inaccuracies in AI-generated questions

and a few context mismatches, demonstrating the need to further enhance question retrieval and response evaluation models.

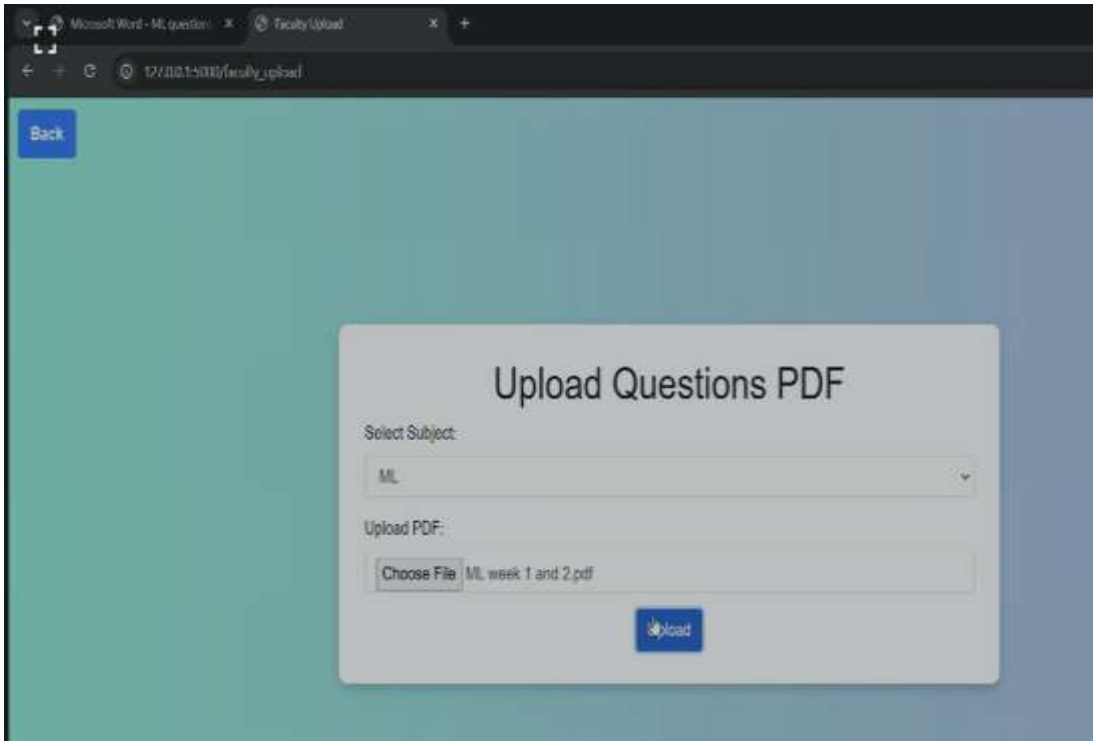

Figure 2. Faculty Uploading pdf's .

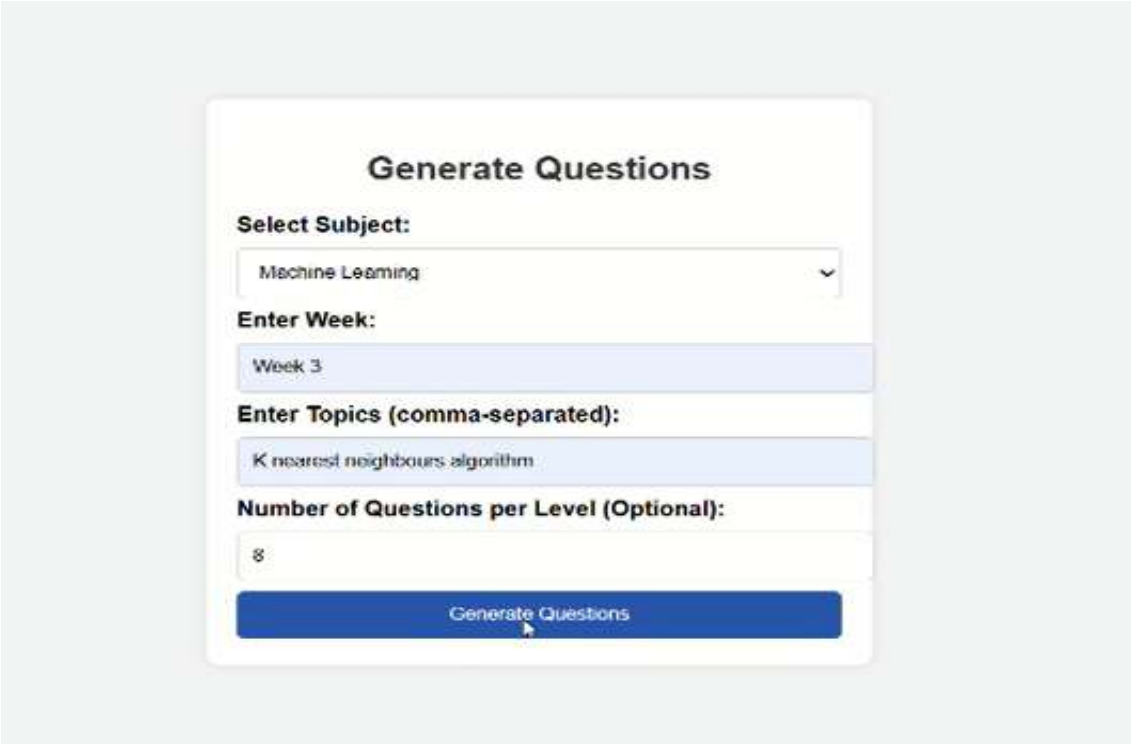

Figure 3. Questions being generated by ollama Mistral into the database.

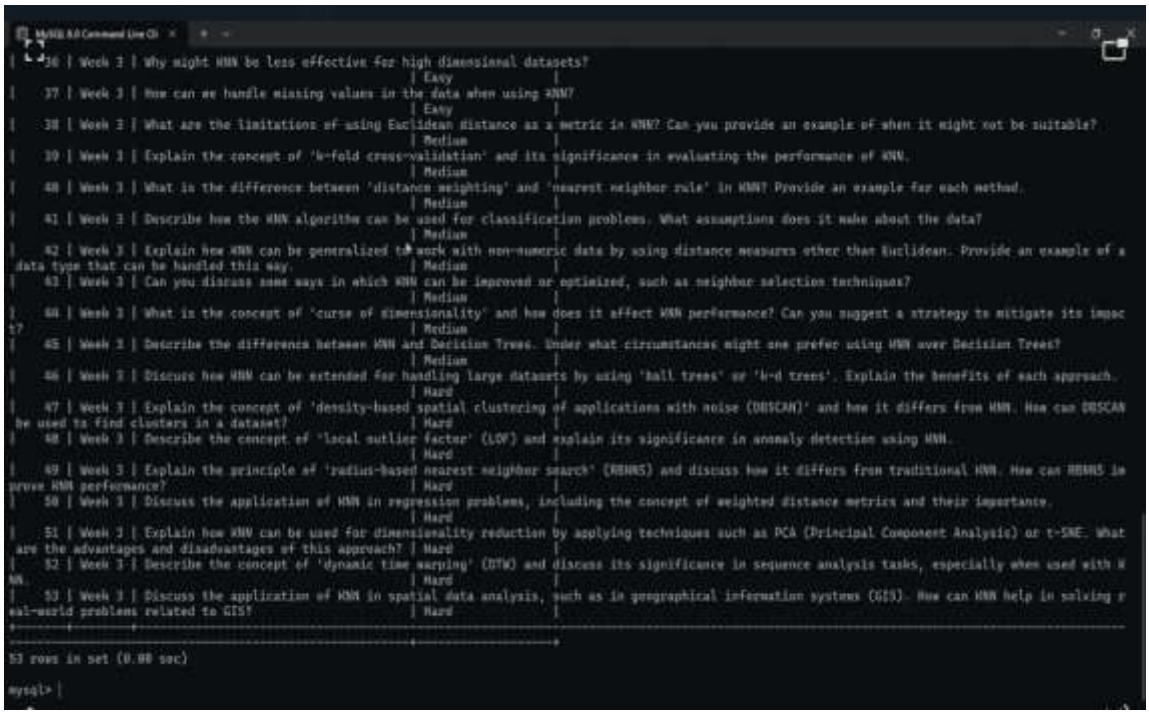

Figure 4. Generated questions stored in the Database

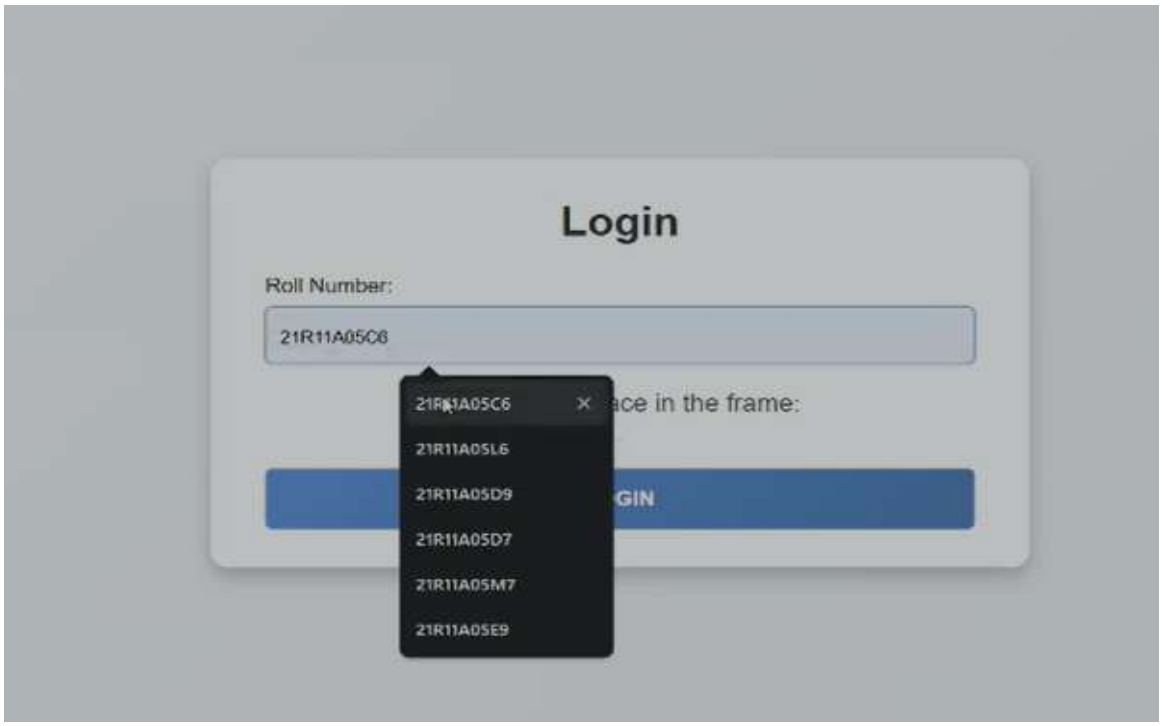

Figure 5. Student login

Figure 6. student attending viva session

Figure 7. Feedback on the student's performance

TABLE .2 User Feedback and Performance

Category	Feedback/Performance result	Evaluation Method
Authentication Accuracy	95% successful student logins via face recognition	Login Success Rate Analysis
Question Relevance	88% of faculty rated AI-generated questions as relevant	Faculty Survey & Review
Answer Evaluation	85% alignment with human grading	AI vs. Faculty Score Comparison
Speech Recognition	90% accuracy in speech-to-text conversion	Word Error Rate (WER)
Adaptive Questioning	80% of students found difficulty adjustments appropriate	Student Feedback Survey
System Latency	Average response time: 1.2 seconds per operation	System Performance Testing

5.

Discussion

The success of VivaBot showcases the potential of AI in revolutionizing viva examination automation. Conventional viva tests are marred by tedious checking, subjective marking, and time-consuming question preparation. VivaBot eliminates all these concerns by providing face recognition for secure checking, dynamic question generation using AI, and automated marking of responses, creating a scalable, efficient, and impartial evaluation system. DeepFace-based authentication ensures only registered students take part, removing impersonation risks. The adaptive questioning strategy, powered by Mistral AI and RAG, offers better personalized learning experience through difficulty adjustments of questions based on student performance. In addition, speech-to-text translation facilitates multimodal testing, making it accessible for students who are more responsive to oral responses.With all these benefits notwithstanding, there were some drawbacks which were realized. AI-based questions were at times out of sync with course work, calling for further tweaking of the retrieval step. The answer evaluation model also at times got stuck in finding complex subject-domain answers, requiring more domain-related training. Moreover, although confidence and answer quality ratings were valuable analytics, further refinement in facial expression analysis could improve confidence measures' accuracy. Faculty intervention features in future development might include the ability for teachers to modify AI-created questions or overrule AI-based grading for cases of inconsistency. Further extension of multilingual coverage and subject-specific fine-tuning of questions will render VivaBot more universally applicable AI-powered assessment software.

6. Conclusion

VivaBot integrates perfectly with AI-driven automation processes in viva examination process, providing significant efficiency, security, and test accuracy. By leveraging DeepFace for student verification, Ollama Mistral AI for adaptive question generation, automated marking with NLP, and confidence-based testing, the system provides a simple and smart testing experience. The adaptive questioning capability offers impartial and personalized tests and automated feedback enhances students' learning. Instructors are freed from additional workload, and students have a structured, interactive, and feedback-rich assessment experience. The results indicate AI-powered viva automation as the answer to convert traditional testing methods into scalable, effective, and unbiased ones. Future studies will include improving AI accuracy, eliminating question-creation imbalances, and improving the flexibility of the system across different areas of study. Improvement in real-time faculty management, deeper subject modeling, and AI-based personalized feedback will also be included in the level of evaluation quality. Future

development can be done by incorporating Learning Management Systems (LMS), broader speech-based exams, and plagiarism detection in real-time. With further advancements in machine learning and AI, VivaBot will lead the way to making viva voce exams smarter, better organized, and interactive**.**

The proposed work in VivaBot involves the development of an AI-powered viva examination system that automates the entire assessment process through advanced technologies. The system integrates DeepFace for facial recognition-based student authentication, Ollama Mistral AI for dynamic and adaptive question generation, and Natural Language Processing (NLP) for automated answer evaluation and feedback. VivaBot is designed with an adaptive questioning mechanism that adjusts question difficulty in real-time based on student responses, ensuring fair and personalized assessments.

A Flask-based backend and Vue.js frontend manage session configuration, user interaction, and data storage, with MySQL used for handling students, questions, and results. Additional modules include speech-to-text processing for spoken answers, confidence and answer quality analysis using facial cues and semantic scoring, and OTP-based session validation for secure exam conclusion. The system is scalable, supports both local and cloud deployment, and aims to reduce faculty workload while enhancing student engagement and learning through intelligent automation.

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