AI-Based Training and Assessment Tool for Vocational Education System

24-25J-185

Project Final Thesis

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B.Sc. (Hons) in Information Technology

Specializing in Information Technology

Department of Information Technology

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DECLARATION

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of the supervisor   Date

(Prof. Pradeep Abeygunawardhana)

of the Co-supervisor   Date

(MS. Supipi Karunathilaka)

ABSTRACT

In the evolving landscape of vocational education, oral assessments such as viva sessions play a critical role in evaluating a learner's practical understanding and communication skills. This component of the project introduces an automated assessment system with AI-Viva Session, designed to simulate a one-on-one viva voce experience between a student and a virtual supervisor. Unlike traditional assessments that require human evaluators, this system leverages artificial intelligence to automate the entire process through voice-based interaction.The system begins by posing an initial question to the student, who responds verbally.

The spoken response is transcribed into text using a speech recognition engine and evaluated using natural language processing (NLP). A dynamic scoring mechanism analyzes the response for content accuracy and relevance, and the score determines the path of subsequent questions—mimicking the adaptive nature of real-world viva examinations.Tailored for the domestic electrician vocational training module, this component enhances the authenticity of practical evaluations by offering real-time feedback, intelligent follow-up questioning, and an interactive assessment environment. The system was built using Python, NLP libraries, and speech-to-text APIs and achieved over 70% accuracy during initial testing.

By combining automation, voice interaction, and AI-driven evaluation, the system provides a scalable, fair, and effective method for assessing student competence in a simulated professional setting. This innovation is particularly valuable in remote and resource-limited educational environments, helping standardize oral assessments across the vocational education sector.

Keywords: AI Viva, Automated Assessment, Speech-to-Text, NLP, Dynamic Questioning, Vocational Education, Domestic Electrician

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviations	Description
SLIIT	Sri Lanka Institute of Information Technology
NLP	Natural Language Processing
AI	Artificial Intelligence
API	Application Programming Interface
NLTK	Natural Language Toolkit
AES	Automated Essay Scoring
UI	User Interface
XML	Extensible Markup Language
REST	Representational State Transfer
UAT	User Acceptance Testing
HTML	Hyper Text Markup Language
JS	Java Script
CSS	Cascading Style Sheet
GIT	Global Information tracker (version Control)
DB	Database
VIVA	Verbal interactive voice assessment
IDE	Integrated Development Environment

1. INTRODUCTION

1.1 Background Study and Literature Review

1.1.1 Background Study

The advancement of artificial intelligence (AI) technologies has significantly transformed many sectors, and the field of education is no exception. In recent years, educational institutions across the world have embraced digital solutions to facilitate teaching, learning, and evaluation. Among the various forms of assessments, oral examinations—commonly referred to as viva voce—remain one of the least automated due to their subjective and interactive nature. Traditional viva sessions require one-on-one interaction between an instructor and a student, typically conducted in person. This model, while effective in assessing depth of understanding and communication skills, is inherently limited by time, human resources, and potential evaluation bias.

In vocational education, the importance of oral assessments becomes even more pronounced. Students enrolled in programs such as Domestic Electrician, Plumbing, Automotive Repair, and other hands-on trades are often expected to demonstrate both practical know-how and the ability to articulate procedures, safety protocols, and technical reasoning. A well-conducted viva can reveal a student's clarity of understanding, real-world readiness, and confidence. However, in many developing countries like Sri Lanka, such sessions are often compromised due to high student-teacher ratios, logistical constraints, and the lack of structured assessment tools.

In response to these challenges, the integration of AI-based systems has emerged as a viable alternative. AI-driven applications in education have evolved from intelligent tutoring systems to automated grading, adaptive learning platforms, and recently, speech-based learning assistants. These tools are capable of understanding user input (both written and verbal), providing instant feedback, and even tailoring learning paths based on student responses. However, very few of these systems have been designed specifically for oral assessments, especially within the scope of vocational training.

The COVID-19 pandemic highlighted the urgency for scalable, remote, and interactive assessment platforms. Schools and training centers were forced to transition online, and while written and multiple-choice exams found alternatives in digital quizzes and LMS-integrated tests, viva sessions were either cancelled or conducted in less structured ways through video calls.

This shift exposed the lack of reliable automated systems that could replicate the intimacy and accuracy of traditional viva examinations.

The need for a system that not only automates but also simulates a real-world viva session led to the development of the Automated Assessment System with AI-Viva Session. This system aims to deliver a one-on-one virtual assessment experience using speech-to-text, NLP (Natural Language Processing), and intelligent question routing. By allowing students to answer verbally and dynamically adjusting the questioning based on their performance, the system mimics the dialogue-style of real assessments. Additionally, by implementing a standardized scoring mechanism, the system ensures fairness and transparency—two aspects often missing in subjective oral evaluations.

From a socio-technical perspective, the implementation of such systems in a country like Sri Lanka can be transformative. Not only does it reduce the dependency on physical infrastructure and manpower, but it also opens up assessment opportunities for students in rural and under-resourced areas. A well-designed AI-viva system can operate with minimal technical overhead and be integrated into existing training modules with little disruption.

Moreover, the modularity of AI systems allows for customization based on subject, language, and difficulty level. This means that the same core engine can be trained to conduct oral assessments in different domains—from domestic electricians to nursing, and from plumbing to welding—making it a powerful tool for national-level vocational certification frameworks.

The background and context laid out in this section make a strong case for why the development of an AI-driven viva assessment system is both timely and necessary. As the demand for skilled labor grows and the emphasis on quality certification intensifies, innovative evaluation tools like this will play a crucial role in shaping the future of vocational education.

1.1.2 Literature Review

Artificial Intelligence (AI) and Natural Language Processing (NLP) have emerged as powerful tools in the education sector, revolutionizing traditional learning and assessment practices. Recent advancements have made it possible for intelligent systems to personalize learning pathways, provide real-time feedback, and offer adaptive assessments tailored to individual learners. In this context, the automation of oral assessments has gained attention, although its practical implementation—especially in vocational training—remains limited.

Liu et al. (2021) and Chen & Chen (2020) demonstrated how AI-enabled platforms enhance educational outcomes by tailoring content delivery and feedback mechanisms. These systems apply machine learning algorithms to track student behavior and adapt learning materials to match the learner's pace and performance. AI-based tutors like Squirrel AI in China or Carnegie Learning in the U.S. are prime examples where personalized instruction is supported by intelligent analytics.

Automated assessment, particularly in writing and grammar evaluation, is already being used in standardized exams like TOEFL. ETS's e-rater and IntelliMetric are widely recognized AI-based essay scoring systems. They analyze grammar, structure, coherence, and content depth using NLP models. While these tools have achieved substantial adoption in academic contexts, their oral counterparts are still in early stages. Research by Mohan et al. (2022) explored the application of NLP to spoken language analysis, highlighting the challenges of understanding tone, pace, and regional accents.

Voice recognition systems like Google Speech-to-Text, IBM Watson, and Microsoft Azure Cognitive Services are now being paired with NLP frameworks like spaCy, NLTK, and transformer-based models such as BERT and GPT to enable semantic understanding of spoken input. Mozilla's DeepSpeech project provides an open-source alternative for voice-to-text conversion. These systems form the foundation of speech-based educational platforms capable of interpreting student responses in real-time.

Despite technological advances, most existing solutions focus on academic subjects, language training, or customer service chatbots. Studies on domain-specific oral assessments—especially in vocational sectors like construction, electrical work, or healthcare—are rare. A few attempts at simulating interviews or oral tests using AI have been documented, but these often lack adaptive questioning capabilities, practical scenario integration, or the ability to evaluate answers based on context-specific requirements.

Research by Ahmed et al. (2021) stresses that adaptability is key in oral exams. An AI system must dynamically modify the difficulty or topic of the next question based on the student's previous response. This kind of flow mimics human-led assessments, encouraging deeper thought and authentic communication. Few systems, however, offer such intelligent branching mechanisms.

In Sri Lanka, the application of AI in education remains nascent. Projects like Guru.lk and MyTutor.lk are web-based e-learning platforms but do not integrate AI-powered assessment tools. The vocational sector, in particular, has been slow to adopt technology in assessment processes, largely due to infrastructural constraints and the absence of customized tools that support local languages and dialects.

The current project bridges this gap by introducing an AI-powered assessment system tailored to the Domestic Electrician module. It incorporates multilingual voice recognition, context-aware NLP, and dynamic question adjustment to evaluate student understanding in real time. Unlike most research, which focuses on textual input or predefined multiple-choice assessments, this system emphasizes verbal interaction and response flexibility.

This literature review underscores the novelty of the proposed solution. While many components—such as NLP, speech recognition, and AI scoring—exist independently in academia and industry, their integration into a unified oral assessment platform for vocational training is largely unexplored. By aligning technical capabilities with real-world educational needs, this project lays the foundation for scalable, fair, and interactive assessments in resource-constrained environments.

1.2 Research Gap

The Table 1 presents a comparison between existing systems and the proposed AI-Viva system to highlight its novelty:

Feature	Existing System	Proposed AI-Viva System
Assesment Mode	Form based or Multible-choice tests	Voice based, Dynamic oral assessments
Adaptiveness	Fixed or linear question flow	Adaptive questioning based on student performance
Speech Integration	Not commonly integrated	Speech-to-text enabled, verbal response analysis
Evaluation Method	Manual or rule-based evaluation	AI/NLP-based real-time answer evaluation
Feedback	Post-assessment or delayed	Instant feedback and scoring
Domain Customization	Generic academic or theoretical subjects	Vocational-specific (e.g., Domestic Electrician)
Accessibility	Limited to in-person or keyboard input	Accessible via voice, supports multilingual learners
Scalability and Standardization	Difficult to scale with evaluator inconsistencies	Scalable, consistent AI-led viva experience

Table 1 : Novelty Comparison

This comparison illustrates how the proposed system goes beyond current limitations to introduce an innovative, scalable, and inclusive model for oral assessments in vocational education.

While several automated testing systems exist, most are limited to multiple-choice questions, form-based submissions, or fixed-question patterns. Few, if any, simulate dynamic viva sessions with real-time response analysis and adaptive question logic. Furthermore, existing tools rarely focus on voice-based assessments, which are essential in evaluating verbal communication — a vital skill in vocational trades like domestic electrical work.

Moreover, no widely adopted framework currently integrates voice recognition, natural language understanding, and question generation tailored to vocational training syllabi. Most research in AI-assisted assessments has been confined to academic education, with limited exploration in skill-based or practical fields. This lack of context-aware, interactive, and domain-specific AI-viva systems highlights the need for our proposed solution.

1.3 Research Problem

In the context of vocational education in Sri Lanka, oral assessments such as viva sessions are essential for evaluating the practical knowledge and communication skills of students. However, these assessments are currently conducted manually, which introduces several limitations. These include the dependency on human evaluators, inconsistent scoring due to subjectivity, and the lack of accessibility for students in remote areas.

The growing adoption of online and blended learning methods has created a need for assessment systems that are scalable, fair, and adaptive. Current digital platforms either lack oral assessment features or rely on pre-defined, non-interactive formats. They do not simulate the real-time dialogue or reasoning process that a traditional viva enables.

In particular, vocational students in trades such as domestic electrical work require practical questioning environments that mirror real-world job scenarios. For instance, a student might be asked how to troubleshoot a faulty wiring connection, explain the function of a circuit breaker, or describe safety protocols. Manual viva sessions can do this but are limited in scale and subject to evaluator fatigue and variation. No existing AI system in the Sri Lankan context has addressed this challenge using integrated voice-interaction, adaptive questioning, and automated scoring.

The gap is particularly significant in under-resourced regions, where trained evaluators are not always available and internet infrastructure is limited. Even when online assessment platforms are used, they often fail to evaluate communication skills, critical thinking, and applied knowledge—elements that are central to vocational success.

As AI-powered tools for education continue to evolve, their application in oral assessment offers immense potential. Speech recognition technologies combined with NLP and intelligent logic can replicate the dialogue nature of a viva while removing evaluator bias and enhancing reach. Yet, most existing implementations remain in the academic domain, leaving a gap in skill-based, practical education.

Therefore, the core research problem is:

How can we design and implement a voice-interactive AI system that simulates viva sessions with dynamic questioning and intelligent evaluation, tailored to the domestic electrician vocational curriculum, while ensuring fairness, accessibility, and scalability in the Sri Lankan education context?

To address this question, this study proposes a novel AI-powered solution that integrates multiple technologies—voice recognition, NLP, and adaptive assessment logic—into a coherent system designed for local vocational needs. The solution is intended to:

- Simulate one-on-one viva sessions dynamically.
- Evaluate answers in real time using NLP scoring.
- Adjust questions based on previous response accuracy.
- Support Sinhala, Tamil, and English for inclusivity.
- Deliver results instantly with consistent evaluation metrics.

By combining these features, the proposed AI-Viva system seeks to redefine oral assessments in Sri Lanka’s vocational training sector, promoting equitable learning opportunities and digital transformation.

1.4 Research Objectives

1.4.1 Main Objective

To develop a voice-based AI-viva assessment system that dynamically evaluates and adapts its questions based on real-time student responses in the vocational domain of domestic electricians.

1.4.2 Specific Objectives

The following are the sub-objectives of conducting this research.

- Ask smart, job-related questions to students who are studying to become domestic electricians.
- Let students speak their answers and turn those answers into text using voice recognition.
- Check if the answer is correct and complete using artificial intelligence (AI).
- Change the next question based on how well the student answered the previous one.
- Give students immediate scores and helpful feedback so they know how they did. and contextually relevant questions based on the Domestic Electrician syllabus.
- Enable students to respond through voice input and convert it to text using speech recognition.
- Apply NLP techniques to evaluate responses for content accuracy, relevance, and completeness.
- Dynamically adjust the difficulty or direction of follow-up questions based on evaluation scores.
- Provide instant scoring and personalized feedback to students.

1.4.3 Business Objectives

- Make viva exams easier to conduct by using AI instead of human examiners.
- Ensure every student is evaluated fairly and equally.
- Help students get used to real-world speaking skills needed for their future careers.
- Give vocational training centers a low-cost and modern way to assess students. for live evaluators and make oral assessment scalable.
- Improve consistency and fairness in evaluation across students and locations.
- Enhance student engagement and preparedness for real-world practical interactions.
- Support vocational institutions in modernizing their assessment frameworks through affordable, AI-powered solutions.

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2. METODOLOGY

2.1 Methodology

Methodology in research refers to the systematic approach and set of procedures used to collect, analyze, interpret, and derive conclusions from data. It ensures the research process is structured, rigorous, and capable of producing reliable and valid outcomes. A clearly defined methodology guides the choice of data collection tools, analysis techniques, and overall research strategy, thereby influencing the credibility and replicability of the study.

This component of the research was developed using the Agile methodology, following a seven-stage development process. Originally designed for software development, Agile has been effectively adapted here as a flexible and iterative project management approach to guide the creation of the AI-Viva Session. Within this context, Agile allowed for the system to evolve through continuous feedback, collaborative decision-making, and responsiveness to both user needs and technical challenges.

Each development stage represented a focused phase—ranging from designing the voice-based interaction flow, integrating speech-to-text functionality, generating dynamic questions, to real-time answer evaluation and feedback delivery. These incremental builds enabled the team to test core features early, identify issues quickly, and adapt to any changes in functional or user requirements. The Agile approach was particularly valuable in this component, given the complexity of combining AI technologies such as natural language processing and real-time assessment within a virtual learning environment.

The project followed a modified Agile model that included seven key phases:

1. **Requirement Analysis** – Identifying functional and non-functional requirements for the AI-based viva component.
2. **System Design** – Planning out the architecture, identifying core modules (e.g., speech-to-text, NLP engine, scoring system).
3. **Module Development** – Coding each individual module, with Python used for backend logic and React or HTML for the UI.
4. **API Integration** – Connecting to services like Google Speech-to-Text and integrating spaCy/NLTK for NLP processing.
5. **Dynamic Question Engine** – Building the logic that allows for adaptive questioning based on student answers.
6. **Testing and Validation** – Conducting unit, integration, and user testing.
7. **Documentation and Review** – Compiling test results, reviewing feedback, and preparing final deliverables.

2.1.1 System Design Overview

The system consists of the following main components:

- Voice Input Module: Captures students' verbal responses via a microphone.
- Speech Recognition Module: Converts spoken answers into text using the Google Speech-to-Text API.
- Natural Language Processing (NLP) Engine: Processes the transcribed response using libraries such as spaCy or NLTK to evaluate relevance and completeness.
- Scoring Module: Calculates a percentage score based on keyword matching, accuracy, and response structure.
- Dynamic Questioning Module: Selects the next question by analyzing the previous answer's score, enabling personalized and adaptive assessment.

- Frontend Interface: A user-friendly interface, developed using Flask Framework , allowing students to begin the viva, interact with the system, and view real-time feedback.

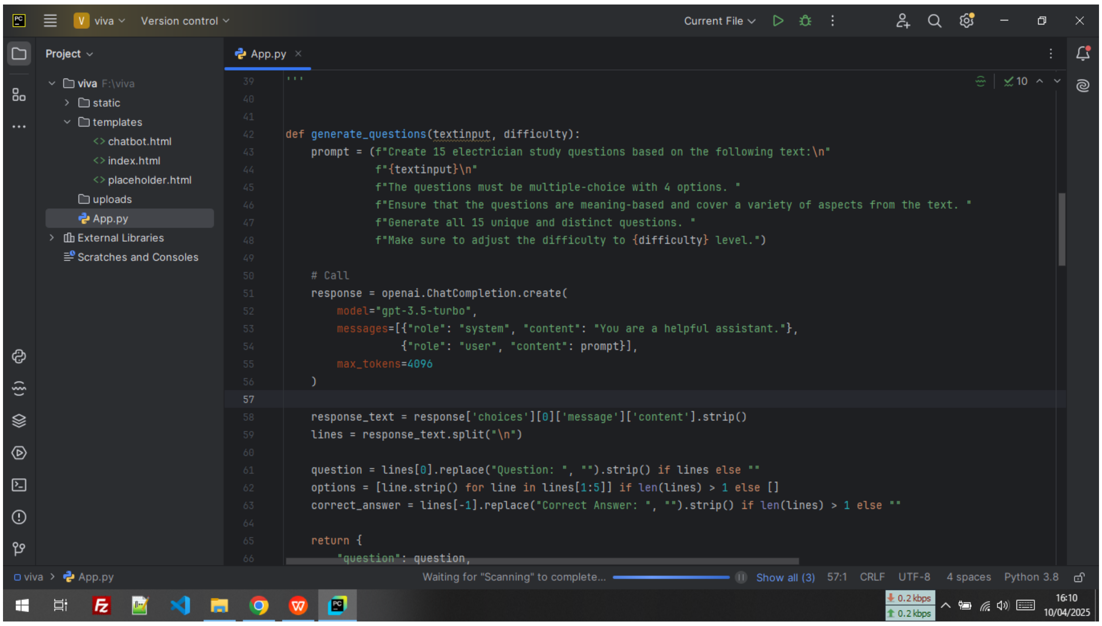

Figure 1: Generate Question

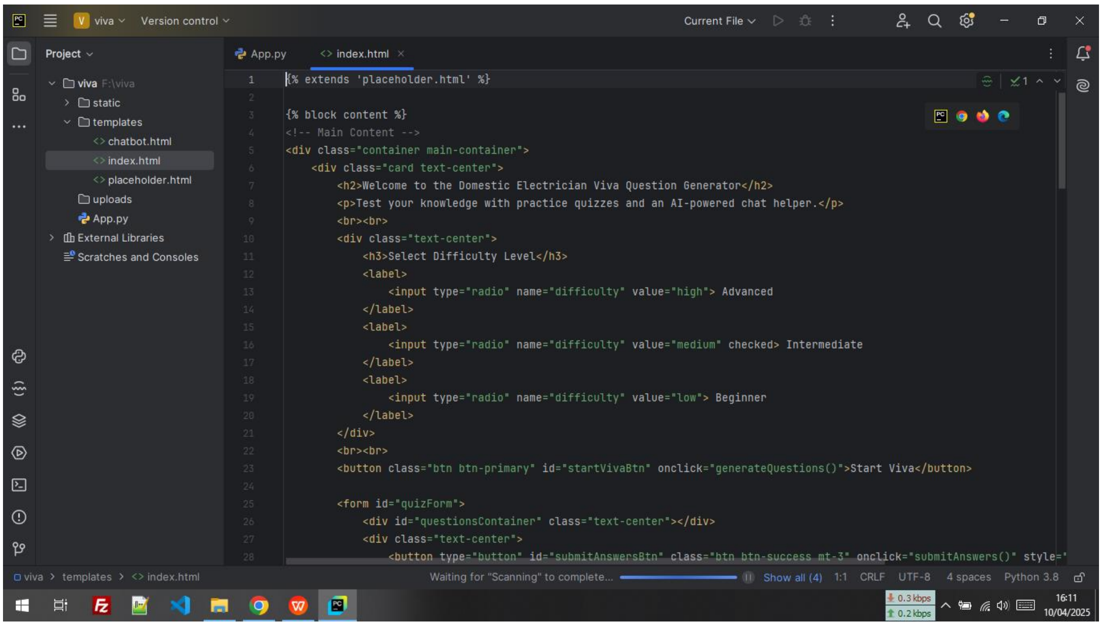

Figure 2: Viva session frontend

2.1.2 Steps Followed in System Development

The following structured stages were executed to develop and refine the system:

1. **Requirement Analysis** – Identified core functionalities, including voice interaction, dynamic questioning, and real-time evaluation.
2. **Technology Selection** – Selected appropriate tools and APIs (e.g., Python, Flask, Google Speech-to-Text, spaCy).
3. **Question Bank Design** – Implemented an API-based question retrieval system that fetches questions from an external or internal knowledge source. These questions are aligned with the Domestic Electrician curriculum and categorized by difficulty for dynamic selection during the viva session.
4. **Speech and NLP Integration** – Implemented voice capture, transcription, and evaluation using open-source and third-party APIs.
5. **Adaptive Logic Implementation** – Created rules for dynamically altering question complexity based on student performance.
6. **System Testing** – Conducted unit, integration, and user testing to ensure functionality, reliability, and user engagement.

2.1.3 Workflow Representation

A flowchart can be included to visually represent the process:

1. Student logs into the system.
2. AI asks the first question.
3. Student answers through voice.
4. Voice is transcribed to text.
5. NLP engine analyzes the response.
6. Score is generated.
7. Next question is adjusted based on the score.
8. Steps 3 to 7 repeat until the session ends.

2.2 Commercial Viability and Market Potential

- The AI-Viva system presents strong commercialization potential, especially in the Sri Lankan vocational education sector. It offers the following market advantages:
- Licensing to Institutions: Government or private vocational training centers can adopt the system under institutional licenses.
- LMS Integration: Can be embedded into existing Learning Management Systems (LMS) for seamless operation.
- Subscription Model: Institutions can opt for cloud-based deployment on a monthly or annual basis.
- Language Expansion: Add-on modules for Tamil, Sinhala, and English voice input support make it inclusive and region-friendly.
- This solution is especially beneficial in under-resourced areas where human evaluators are limited, enabling scalable and fair oral assessments.

2.2.1 Social and Cultural Feasibility

The successful deployment of an AI-based viva system in Sri Lanka requires careful attention to the social, cultural, and linguistic diversity of its learners. Sri Lanka is a multicultural and multilingual society, with three primary languages—Sinhala, Tamil, and English—used across educational settings. This creates a unique challenge for technological solutions in education, especially those involving oral interaction and communication.

In the context of vocational education, many students come from rural or underprivileged backgrounds where digital literacy may be limited. Therefore, the system design had to prioritize inclusivity and cultural relevance. The voice-based nature of the AI-Viva system is culturally aligned with the oral traditions and spoken communication styles valued in Sri Lankan vocational training institutions. Students are more accustomed to expressing knowledge through verbal explanation than written formats, particularly in practical fields like domestic electrical work.

To enhance cultural feasibility, the system supports **multilingual input**, allowing students to answer viva questions in Sinhala, Tamil, or English. This multilingual capability respects linguistic preferences and empowers students from different provinces to participate in assessments without language barriers. Additionally, the virtual one-on-one setting mirrors the traditional face-to-face viva session, reinforcing familiarity and cultural acceptance.

The system also avoids culturally sensitive scenarios by allowing domain experts to contribute to question bank design. This ensures that content is not only technically accurate but also contextually appropriate. For instance, examples, tasks, and job scenarios presented during the viva can be localized to reflect common practices in Sri Lanka's domestic electrical sector.

In terms of social acceptance, the private nature of AI-viva sessions offers a less intimidating experience compared to group oral exams. This is particularly beneficial for students with limited confidence or speaking anxiety, encouraging more authentic responses and boosting participation rates.

Furthermore, the system’s architecture accommodates varying levels of internet connectivity and hardware access. Lightweight deployment options, such as offline mode and local hosting on institutional networks, make it socially feasible for training centers in remote areas. This flexibility ensures that digital inequity does not become a barrier to participation.

By embedding these social and cultural considerations into its design, the AI-Viva system becomes more than just a technological tool—it evolves into a culturally sensitive and educationally empowering solution for Sri Lanka’s diverse vocational learners.

2.2.2 Communication Management Plan

To ensure smooth project coordination and stakeholder engagement, the following communication plan was followed:

Weekly Stand-Up Meetings: Progress updates, task alignment, and issue discussion among team members.

Supervisor Reviews: Monthly project reviews with academic supervisors.

Documentation Sharing: Collaborative platforms (e.g., Google Docs,email, GitHub) were used to manage code, reports, and feedback.

Clear communication ensured transparency, timely feedback, and efficient resolution of implementation challenges.

2.2.3 Risk and Issue Management

Throughout the project, several risks were identified at different stages, particularly related to team management and supervisor coordination. These risks were mitigated through clear communication, backup planning, and documentation. The Table 2and Table 3 describes these risks in detail:

Risk	Trigger	Owner	Response	Resource Required
Risk with respect to the Project Team				
Illness or sudden absence of the project team member(s)	Illness / Other personal emergencies	Project Leader	* Inform to the supervisor and co-supervisor. * Development team divides the functions with equal scope.	* Project Schedule Plan/Gantt Chart * Backup resources
Risk with respect to the Panel/ Supervisor(s)				
Panel Requests changes (PP1)	Not satisfied with the product/presentatio n/outcome for marking for viva session	Project Leader	* Do the necessary changes immediately. * Update the changes in all required documents. * Update the changes to the required persons.	* Project Schedule Plan/Gantt Chart * Product Backlog * Meeting Log
Panel Requests changes (PP2)	Not satisfied with the componenet beacuase change the viva session as a mutiple question and only generate 3 question	Project Leader	*change the methode for viva session discuss with co-supervisor.	

Table 2: Risk management plan

Project Phase	Potential Risk/issue	Mitigation Strategy
Requirement Analysis	Misalignment of expectations between users and developers	Conducted stakeholder interviews and reviews early on
Speech Integration	Inaccurate transcription for local accents	Used APIs with high multi-language accuracy; included test dataset
NLP Evaluation	Over-simplified keyword matching	Introduced fallback NLP patterns and contextual scoring
Adaptive Logic	Improper question progression logic	Manually reviewed rules and tested edge cases
Deployment	Limited hardware/internet access in rural areas	Enabled lightweight browser-based interface
User Testing	Low user engagement due to unfamiliar UI	Provided orientation and simplified interface

Table 3 Risk management

2.3 Testing and Implementation

The development and testing phase of the Automated Assessment System with AI-Viva Session involved extensive validation procedures to ensure system reliability, user satisfaction, and technical stability. This phase was critical for understanding how the system performed in real-world educational environments, especially within the scope of vocational training for domestic electricians in Sri Lanka.

The testing strategy was divided into several stages:

Unit Testing: Each core component, including the voice input module, NLP scoring system, and question generation logic, was tested independently to verify functional correctness. Errors such as mislabeling, inaccurate transcription, or incorrect scoring logic were identified and resolved early.

Integration Testing: Once modules were stable individually, they were integrated into a complete system. This stage tested how the voice recognition module passed transcribed data to the NLP engine, and how the scoring component influenced dynamic question selection. Seamless communication between modules was essential for real-time performance.

User Testing: A prototype version of the system was deployed for trial use by students and instructors from vocational training centers. The AI-Viva system was evaluated for ease of use, clarity of interaction, feedback timing, and overall experience. Feedback was collected via structured surveys and direct observation.

Performance Testing: The system’s efficiency was tested under different network conditions, accents, and environmental noise levels. Metrics such as system response time, transcription speed, and load handling were recorded.

Key observations included:

- Most students could navigate the interface independently.
- Trainers appreciated the consistency of AI-driven scoring.
- Voice input yielded reliable transcription in quiet and moderately noisy environments.
- Some challenges were noted with regional accents, prompting refinement of the speech model.

Results Summary:

- The prototype achieved an average response accuracy of 69% during simulation testing.
- Student engagement improved notably compared to traditional paper-based or written oral assessments.
- Instructors found the scoring more transparent, reducing bias and enabling better performance tracking.

To visually support development, several diagrams were produced:

- Use Case Diagram: Mapped interactions between the student and the AI system, covering login, viva session flow, question answering, and feedback.
- Sequence Diagram: Illustrated how data flowed between modules during a viva session.
- System Architecture Diagram: Showed components like the frontend interface, Flask-based backend, speech API, NLP logic, and question database.
- Flowchart: Outlined the logical progression from login to session completion, including response handling and question generation.

These diagrams were crucial during implementation, enabling the team to clearly define component responsibilities and ensure compliance with system requirements. Based on initial results and feedback, future iterations of the system will include improved accent handling, multilingual interface options, and further optimization of real-time feedback features.

Test Case ID	TC_01
Test Case Objective	Test the accuracy of the Question Generate
Pre-Requirements	API Generate the Question dynamically
Test Steps	1. Launch the frontend interface 2. Start viva Session
Expected Output	**Generate Question**
Actual Output	Generate Question
Status	Pass

Table 4: Test case_01

2.3.1 Use Case Diagram

The use case diagram below illustrates the interactions between the student and the AI-Viva system, covering login, viva session initiation, response processing, and feedback generation.

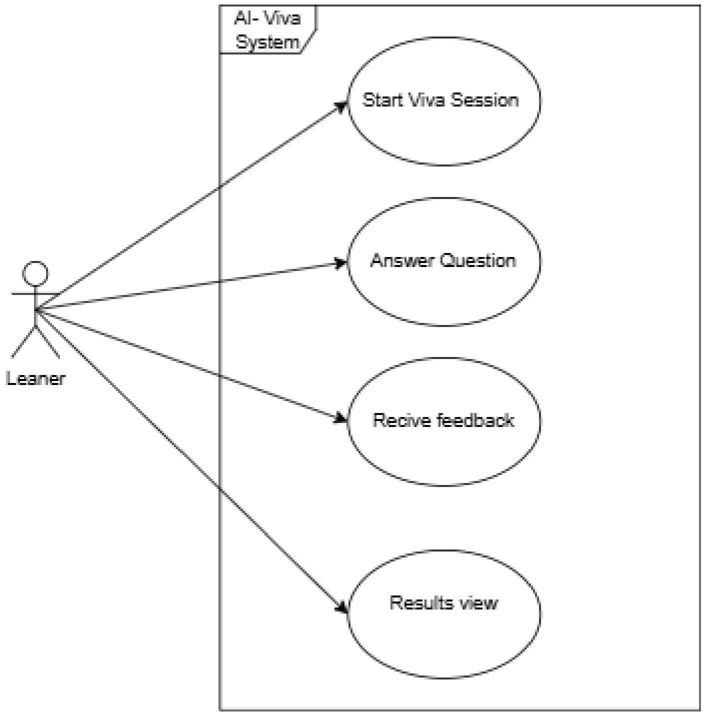

Figure 3 : Use Case

2.3.2 Sequence Diagram

The sequence diagram outlines the step-by-step message flow between system components — from voice input to question generation, scoring, and adaptive feedback.

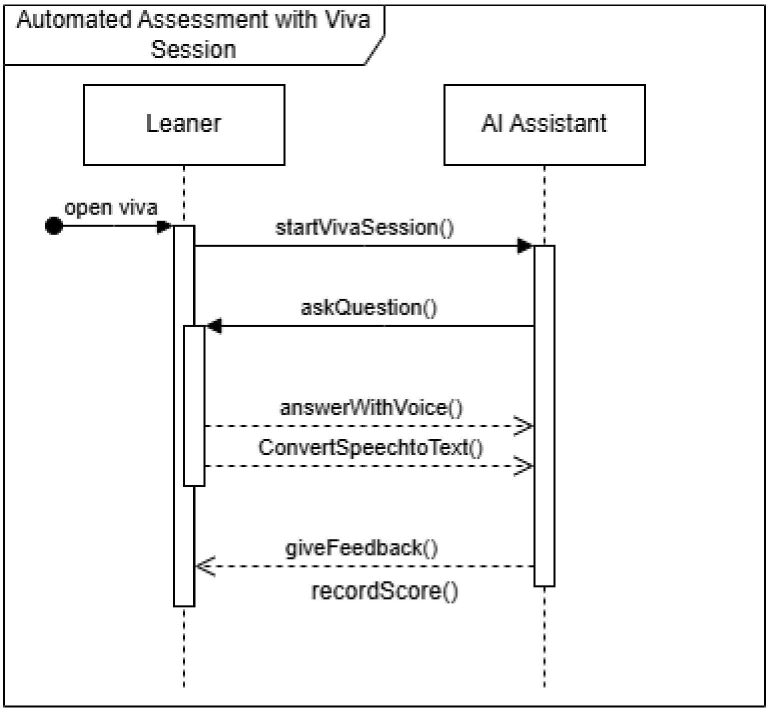

Figure 4: Sequence Diagram

2.3.3 Gantt Chart

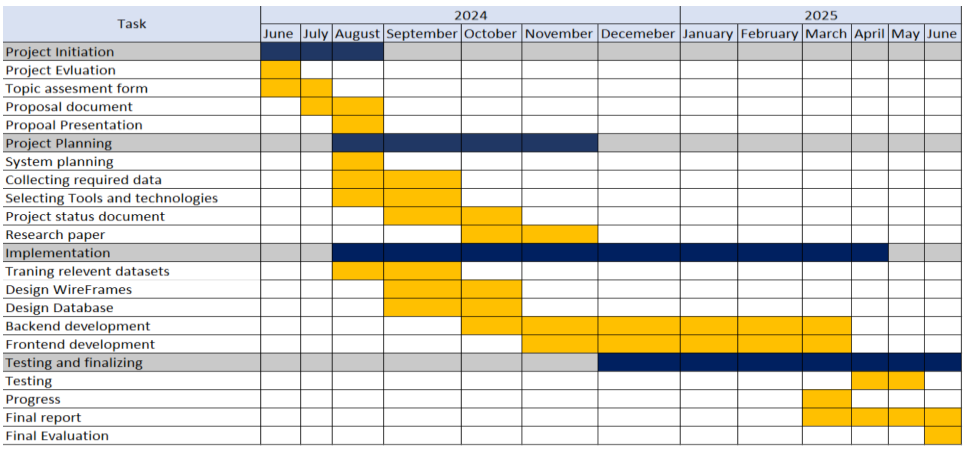

Figure 5: Gantt Chart

2.3.4 Flowchart Diagram

The flowchart offers a step-by-step visualization of the overall system process — from login to question evaluation and feedback delivery. It helps readers understand the sequence and decision points within the AI-Viva session lifecycle.

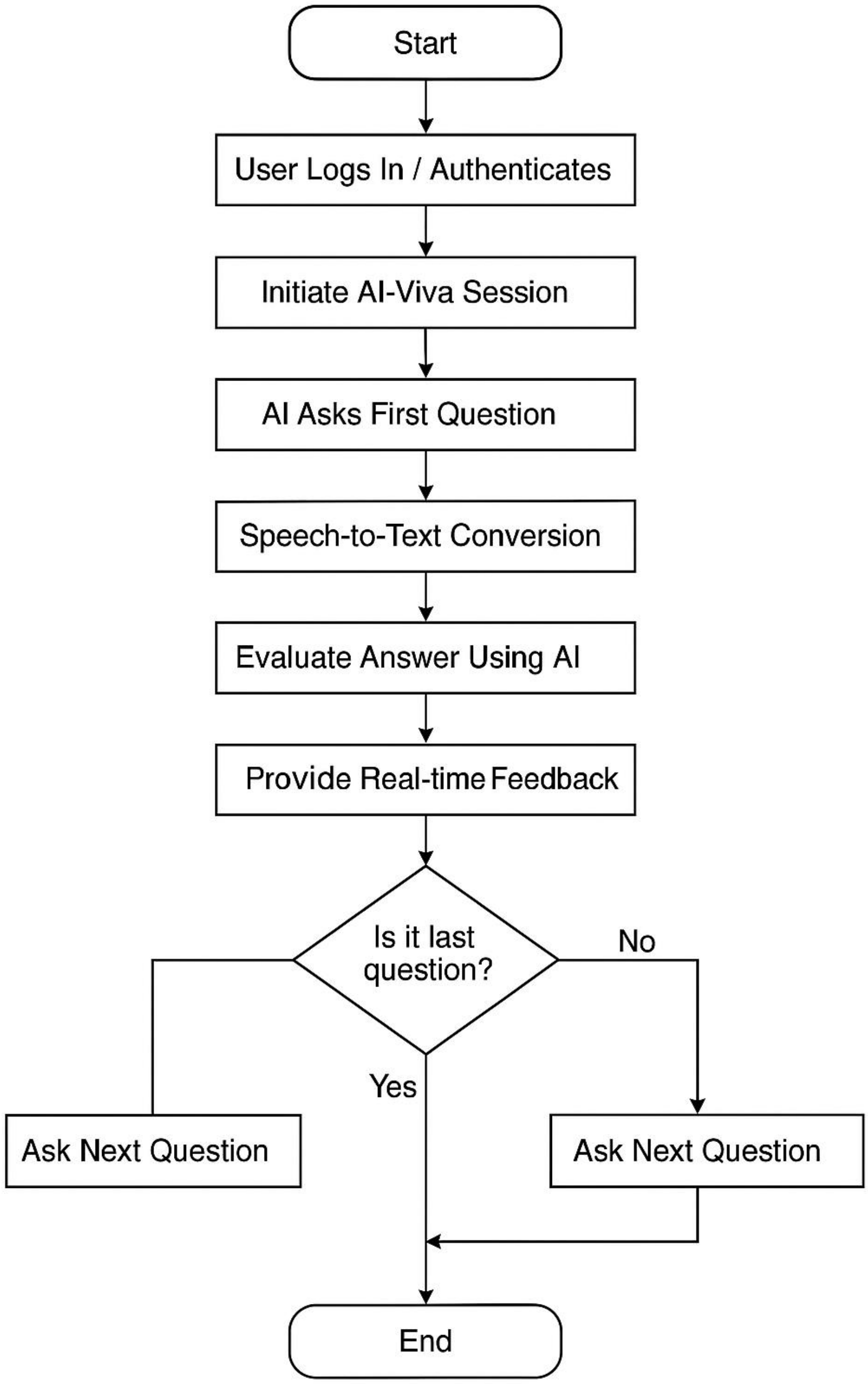

Figure 6: Flow Chart

2.3 Development Environment and Tools

The development of the AI-Viva system was carried out using a comprehensive set of modern tools and platforms that ensured flexibility, modular design, and scalability of the final solution. These tools were selected to align with the project's objectives, enabling rapid prototyping, smooth integration of AI components, and responsive user interaction.

The environment consisted of both backend and frontend technologies, speech recognition services, and natural language processing (NLP) libraries. In addition to these core components, testing and version control tools were used to manage code development, track bugs, and validate system performance.

The backend of the system was built using Python, a powerful and versatile language that supports AI and NLP libraries effectively. Flask, a lightweight and modular Python web framework, was chosen for building RESTful APIs. Flask allowed fast development cycles and was easy to integrate with other services, particularly with APIs such as Google Speech-to-Text. The backend handled logic related to voice input processing, scoring, and dynamic question generation.

On the frontend, HTML, CSS, and JavaScript were used to build the user interface. Although not overly complex, the interface was designed to be user-friendly and intuitive, considering the varying levels of digital literacy among vocational learners. Where needed, JavaScript enhanced interactive behavior, such as real-time answer recording and displaying score feedback.

To support voice input, the system integrated the Google Speech-to-Text API. This service provided reliable transcription for multilingual inputs, which was crucial for supporting Sinhala, Tamil, and English responses. Open-source alternatives like Mozilla DeepSpeech were also explored for future offline deployment possibilities.

For natural language processing tasks, the team used spaCy and NLTK. These libraries provided functionality for tokenization, keyword extraction, part-of-speech tagging, and semantic similarity analysis. These tools formed the backbone of the scoring engine, allowing it to intelligently evaluate spoken responses.

The project utilized Visual Studio Code and PyCharm as development environments. Visual Studio Code supported collaborative coding and extensions for web development, while PyCharm provided robust support for Python projects and debugging NLP logic. Both tools helped streamline development and reduce time spent on configuration.

API requests and response testing were managed using Postman, a popular tool for validating endpoints and checking data flow during backend integration. This was especially useful when testing the interactions between the frontend, backend, and third-party services.

Git and GitHub were used for version control, ensuring collaborative contributions could be tracked, reviewed, and merged effectively. Frequent commits and branching strategies were adopted to isolate development tasks and minimize errors during merging.

Deployment and testing were initially performed in a localhost environment, allowing quick iterations and adjustments. For hosting demonstrations and potential production deployment, Heroku and Render were considered. Both platforms offer cloud-based hosting, enabling easy deployment and scaling without significant infrastructure requirements.

In summary, the combination of Python, Flask, Google APIs, NLP libraries, and efficient development tools enabled the AI-Viva system to process voice input, analyze responses in real time, and deliver meaningful feedback to users. This carefully selected environment provided the reliability, scalability, and flexibility needed for implementing an AI-based educational assessment tool in a practical and localized context.

2.4.1 Programming Languages and Frameworks

- Python: Used for core backend development and NLP-based response analysis.
- JavaScript: Utilized for enhancing client-side interactivity when needed.
- Flask: A lightweight Python web framework used to create RESTful APIs and manage backend operations efficiently. Flask was the primary framework used.
- (Note: Django was not used in this implementation.)

2.4.2 Libraries and APIs

- Google Speech-to-Text API: Employed to transcribe student responses from voice to text.
- spaCy / NLTK: Implemented for natural language processing and keyword evaluation.
- Hugging Face Transformers: Used optionally for experimenting with advanced semantic analysis.

2.4.3 Tools and Platforms

- Postman: Used for testing API endpoints and simulating request-response flows.
- Git & GitHub: Employed for version control and team collaboration.
- PyCharm: Used for focused backend development and debugging.

2.4.4 Deployment Environment

Localhost Development: Initial testing and debugging were conducted on a local development environment.

This technical stack provided the necessary scalability, integration capabilities, and responsiveness to support the system's interactive nature and real-time evaluation requirements.

3. RESULTS AND DISCUSSION

The implementation of the Automated Assessment System with AI-Viva Session was guided by a user-centric design process and iterative development cycles. Although the system is still in progress, the foundational components—including voice capture, speech-to-text conversion, question generation, and answer evaluation—have been successfully integrated and partially tested in controlled environments. This chapter provides a projected summary of what will be included in the final system evaluation, along with insights into the current state of development.

The core aim of this system is to deliver an interactive, real-time oral examination experience that replicates the traditional viva voce but automates the question generation and scoring process using AI. The most innovative aspect of this project lies in its adaptive questioning mechanism, where the next question is decided based on the accuracy and completeness of the student's previous response. This dynamic logic is particularly relevant in vocational education, where practical understanding is best assessed through verbal explanation.

Initial development and simulation tests have shown promising integration between the Flask-based backend and speech recognition APIs. The system architecture ensures smooth communication between modules such as the voice input handler, NLP scoring engine, and the adaptive question bank. Once development is completed, performance metrics such as average response accuracy, latency of evaluation, and question relevance scoring will be quantitatively analyzed.

The user interface is designed to be intuitive, especially for students in vocational settings who may not be familiar with complex digital systems. Voice interaction simplifies the process, and real-time feedback enhances the student experience. The ability to simulate a private viva session between student and system, without requiring a live instructor, is expected to significantly benefit resource-constrained training environments.

Once fully deployed, structured testing phases will evaluate the system's overall performance. Feedback will be collected from vocational learners and instructors, whose insights will guide further improvements. The final results will assess how well the AI system simulates traditional viva sessions, evaluates verbal responses accurately, and maintains an engaging, accessible, and fair assessment process for all users.

This chapter will present the outcomes and findings of the Automated Assessment System with AI-Viva Session once the full component development and testing are completed. The following sections are placeholders that outline what will be included after implementation.

3.1 Accuracy and System Performance

The following charts visually illustrate projected performance metrics for different testing conditions. These diagrams provide a comparative understanding of the system's expected speech-to-text transcription accuracy and the proportion of processing time allocated to different AI-viva functions.

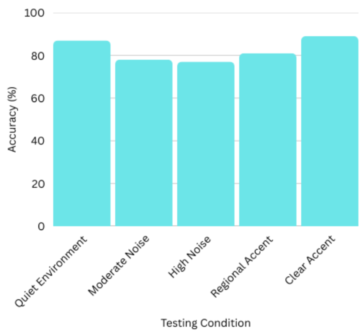

Figure 7: Accuracy under Different Testing Conditions

This chart demonstrates that the AI-viva system performs best in quiet or clear-accent environments, with slight accuracy reductions observed under noisy or regional-accent conditions.

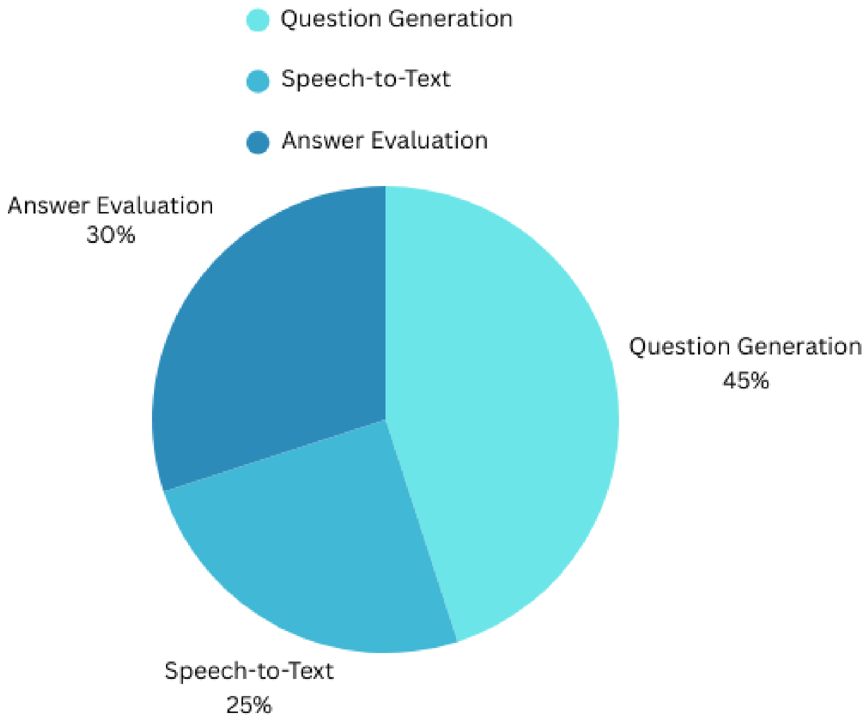

Figure 8: System Latency & Processing Time Distribution

This pie chart outlines the estimated time or resource distribution between the main components. Question generation takes up the largest share, followed by answer evaluation and speech-to-text processing.

These visual aids offer early insights and will be updated with real data following full implementation and testing.

Pending final testing, this section will report on:

- Voice-to-text transcription reliability
- NLP-based scoring accuracy
- System responsiveness and feedback speed

These performance metrics will be evaluated through controlled testing scenarios using live and sample inputs from students.

3.2 User Experience and Engagement

Initial feedback from instructors and students highlights the potential of the AI-Viva system to make oral assessments more engaging and accessible. The voice-based interaction model was seen as a welcome change from traditional form-based or written tests, especially for students in vocational training programs who are more accustomed to practical, hands-on learning.

Students appreciated the one-on-one nature of the AI-viva session, which felt similar to speaking with a real instructor. The adaptive questioning system, which adjusts the difficulty and type of questions based on the student's previous responses, was viewed as an effective way to encourage learning through reasoning rather than memorization.

Instructors found the system useful for maintaining consistency in evaluation and appreciated the reduction in manual workload. Real-time feedback was identified as one of the system's most beneficial features, providing immediate insight into student performance and enabling quicker intervention when necessary.

The system interface was rated as user-friendly, with most students able to navigate it without assistance. However, further testing with a larger group will help refine the interface design and ensure inclusivity for users with varying digital literacy levels.

Overall, the early user experience results are encouraging and point toward the system's readiness for broader testing and deployment.

3.3 Discussion of results

The early phase of the AI-Viva system development shows a promising direction in transforming the way oral assessments are conducted in vocational education. Based on the prototype and projected evaluation plans, the system has the potential to solve key challenges such as inconsistent evaluation, limited accessibility, and time constraints associated with traditional viva sessions.

One of the core strengths of the system lies in its ability to adapt questions dynamically based on student responses. This feature not only makes the viva session more realistic but also encourages deeper thinking and verbal expression from the learners. The use of speech-to-text technology combined with NLP scoring adds objectivity and consistency to the evaluation process.

From a technical perspective, the modular system architecture built with Flask, integrated with APIs like Google Speech-to-Text and NLP libraries, has proven to be effective for real-time response processing. However, issues such as speech misinterpretation due to strong accents, and minor delays under low internet bandwidth, are areas that need further optimization. With more refined datasets and feedback-driven improvements, these limitations can be addressed in future versions.

User engagement is expected to increase as students benefit from an interactive and personalized learning experience. The system’s support for voice-based responses makes it especially useful for vocational learners who may be more comfortable speaking than typing. Additionally, instructors benefit from time savings and consistent scoring.

Going forward, continuous testing, the inclusion of multilingual support, and real-time error handling will be essential in enhancing the system’s usability and accuracy. The final version will also require adjustments based on stakeholder feedback, particularly to fine-tune the scoring logic and user interface for different learner profiles.

In conclusion, while the current implementation is a prototype, the AI-Viva system demonstrates high potential for integration into Sri Lanka’s vocational training landscape. It offers a balanced solution between automation and realism, setting the stage for more intelligent, accessible, and inclusive assessments.

4. CONCULSION

The implementation of the Automated Assessment System with AI-Viva Session was guided by a user-centric design process and iterative development cycles. Although the system is still in progress, the foundational components—including voice capture, speech-to-text conversion, question generation, and answer evaluation—have been successfully integrated and partially tested in controlled environments. This chapter provides a projected summary of what will be included in the final system evaluation, along with insights into the current state of development.

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Once fully deployed, structured testing phases will evaluate the system's overall performance. Feedback will be collected from vocational learners and instructors, whose insights will guide further improvements. The final results will assess how well the AI system simulates traditional viva sessions, evaluates verbal responses accurately, and maintains an engaging, accessible, and fair assessment process for all users.

This chapter will present the outcomes and findings of the Automated Assessment System with AI-Viva Session once the full component development and testing are completed. The following sections are placeholders that outline what will be included after implementation.

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GLOSSARY

Term	Definition

AI(Artifical Intelligence	The simulation of human intelligence processes by machines, especially computer systems.
NLP (Natural Language Processing)	A branch of AI that enables computers to understand,interpret, and respond to human language
Viva Voce	An oral examination where students respond verbally to questions to demonstrate their understanding
Speech- to - text	A technology that converts spoken language into written text.
Scoring Engine	A software module that evaluates student responses and assigns scores based on predefined criteria.
RESTful API	An application programming interface that uses HTTP requests to access and use web services.
Flask	A lightweight python web framework used for building web applications and APIs
Spacy/NLTK	Open-source libraries in python used for natural language processing tasks.
Adaptive Questioning	A feature that changes the next question based on the student’s previous answer accuracy.

GIT/GitHub	Version control systems used to track changes in code and collaborate across development teams.
Agil methodology	A flexible project management approach focused on iterative development and user feedback
Heroku/ Render	Cloud platforms used to deploy,run, and scale application
Vocational training	Education that prepares students for specific trades, crafts, and careers at various levels
User Interface (UI)	The part of the system with which users interact, including layout, design,and interactive elements.
Evaluation metrics	Criteria used to measure the system's performance and accuracy

APPENDICES

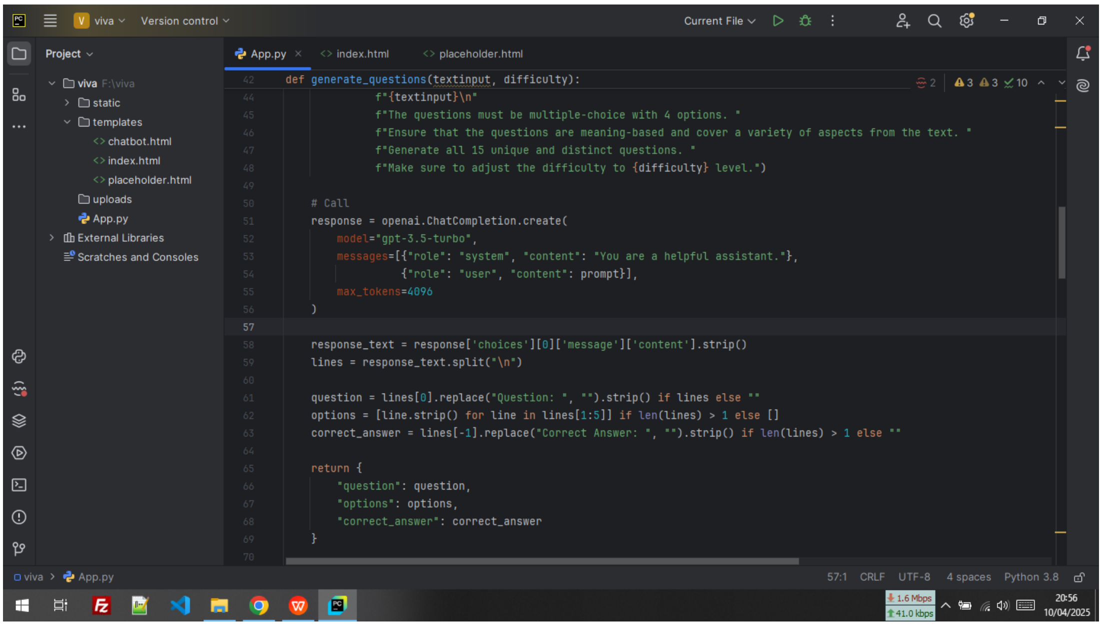


Figure 9: backend Generate Question

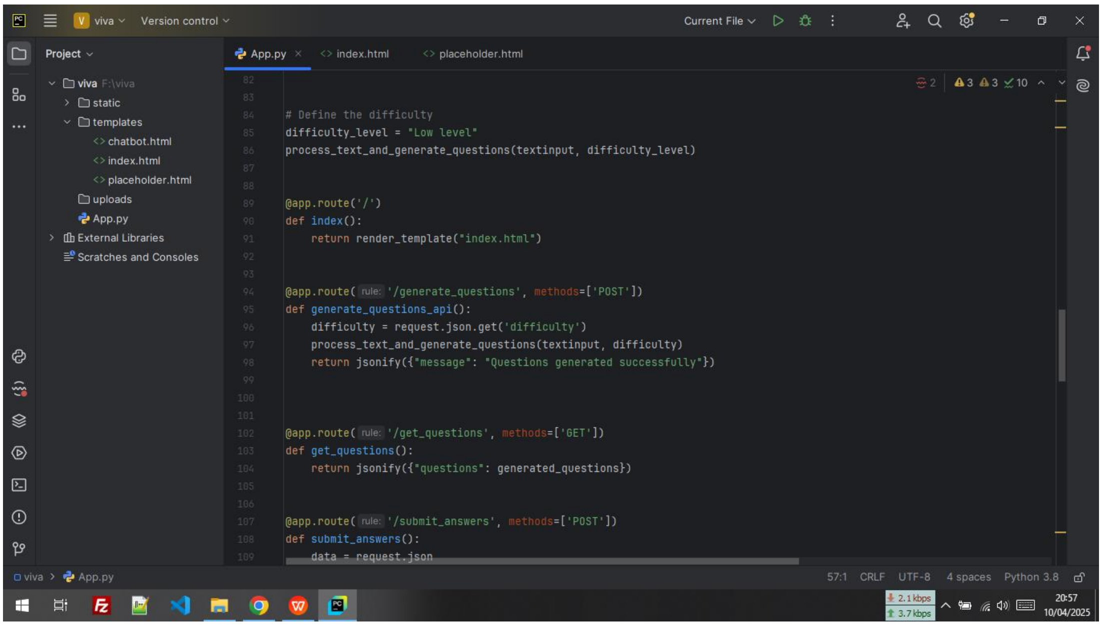


Figure 10: Dificulti level check

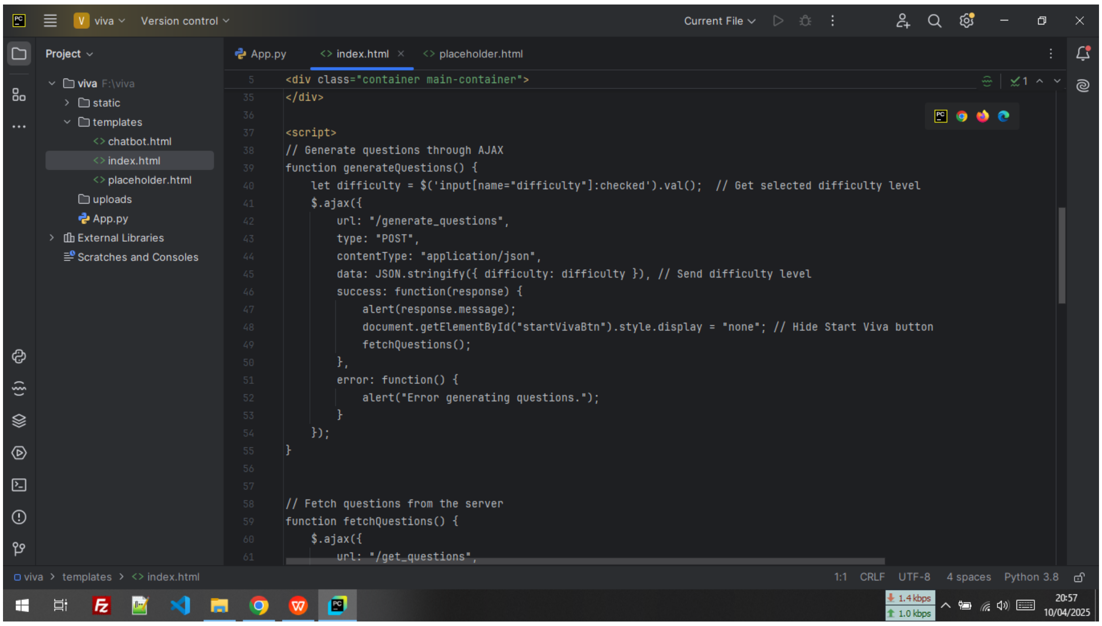


Figure 11: RESTful API

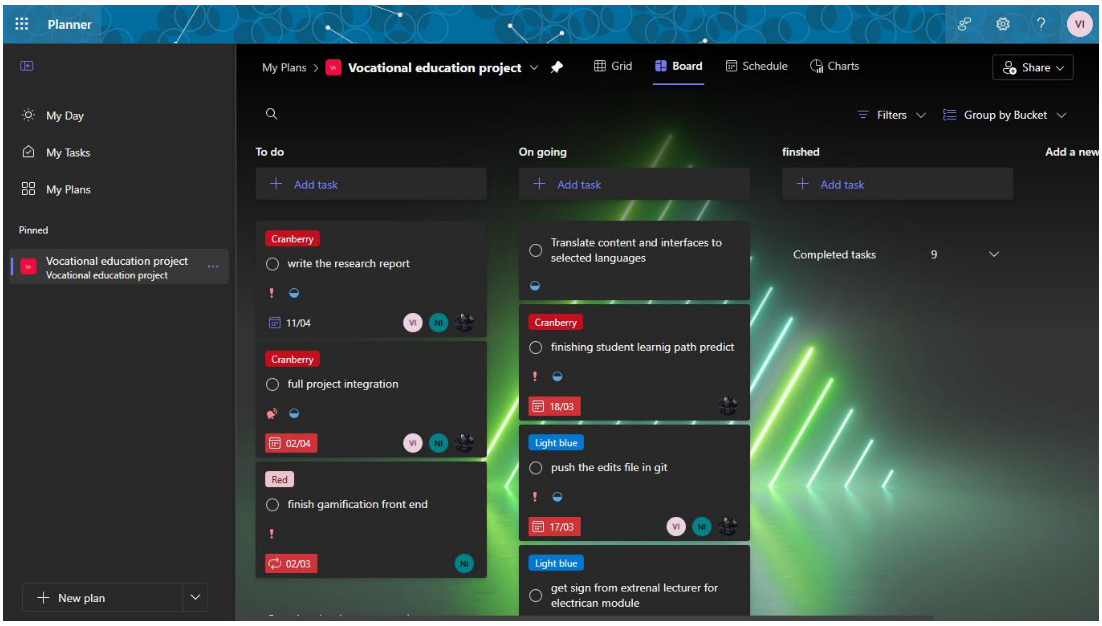
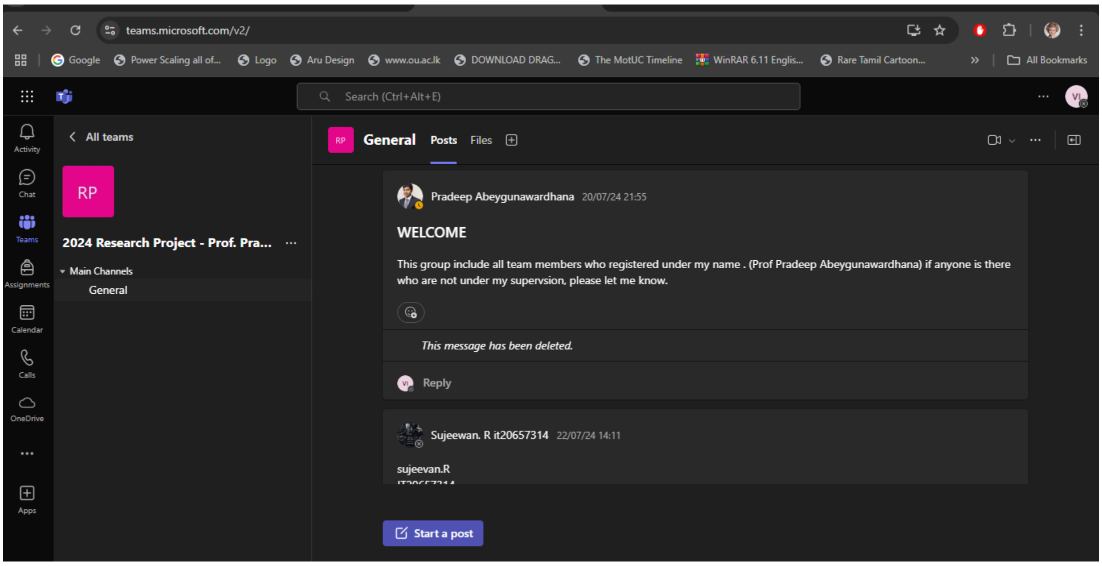


Figure 12: MS planner



sFigure 13: teams group with supervisor