

**AI-DRIVEN WEB APPLICATION FOR ENHANCED VOCABULARY LANGUAGE  
LEARNING**

BY

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A REPORT

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for the degree of

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Faculty of Information and Communication Technology

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UNIVERSITI TUNKU ABDUL RAHMAN

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**Academic Session:** JUNE 2024

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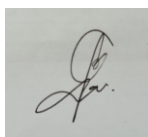
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## **ABSTRACT**

In an increasingly connected world, language proficiency is more than a skill; it's a gateway to global communication and cultural exchange. Yet, traditional and many digital language learning platforms fail to fully address the individual needs and engagement levels of users, particularly when it comes to practical language application. This project introduces a revolutionary AI-Driven Language Learning Vocabulary Web Application, designed to make language acquisition a personalized, intuitive, and interactive experience for users of all backgrounds. Utilizing the advanced capabilities of OpenAI's GPT-4 for natural language processing, coupled with innovative technologies like the Google Web Speech Application Programming Interface (API) for voice recognition and interaction, as well as image recognition functionalities, the application offers a multifaceted approach to learning. It is aimed at helping users not just to memorize vocabulary but to effectively integrate new words into their everyday language use through a responsive AI chatbot. This user-friendly platform supports learning across various devices, promoting consistent practice, immediate application, and ultimately, fluency in the target language. By bridging the gap between memorization and practical usage, this project sets a new standard for digital language learning tools, catering to the modern learner's need for an engaging, accessible, and efficient way to learn new languages.

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## LIST OF ABBREVIATIONS

<i>AI</i>	Artificial Intelligence
<i>AGI</i>	Artificial General Intelligence
<i>API</i>	Application Programming Interface
<i>CMS</i>	Content Management System
<i>CSS</i>	Cascading Style Sheet
<i>GPT</i>	Generative Pretrained Transformer
<i>HBS</i>	HandleBars
<i>HTML</i>	Hypertext Markup Language
<i>JSON</i>	JavaScript Object Notation
<i>LLM</i>	Large Language Model
<i>LMS</i>	Learning Management System
<i>NLP</i>	Natural Language Processing
<i>XML</i>	Extensible Markup Language

# Chapter 1

## Introduction

### 1.1 Introduction

In this digital age, the pursuit of knowledge and self-improvement has changed and evolved drastically from traditional methods and boundaries, extending learning opportunities beyond classrooms and textbooks. As globalization bridges the divides between nations and cultures, the ability to communicate in multiple languages has become an invaluable asset. It is a common occurrence that a job interview nowadays will require candidates to know proficient English in addition to their native language, and any additional proficiencies in other languages are considered a big advantage. Damari et al. [1] presented survey results from over 2,100 U.S. employers regarding their requirements for multilingual employees. The findings reveal a significant demand for multilingual skills across various industries, emphasizing the value of language skills alongside other professional competencies [1].

Since the importance of multilingual proficiency cannot be overstated, there have been a heightened demand in recent times for efficient and easy-to-use digital language learning tools as technological advancements continue to rise. The field of language learning in particular, is witnessing a revolutionary transformation through technology, especially with the most recent developments of advanced Artificial Intelligence (AI) tools in the market such as ChatGPT, Google Bard and Claude AI. These advancements allow for the language learning experience to be even more streamlined and in some cases, personalized to each person's fluency and pace in language learning.

Research highlights the substantial impact of computer-assisted language teaching and learning, emphasizing the importance of e-learning resources in facilitating second language acquisition [2]. Furthermore, the advancements in natural language processing have been pivotal in creating tools that support learning through understanding, producing, and interacting with human language, thereby making technology an indispensable ally in language education [3].

This project proposal introduces an AI-driven approach to language learning, in particular, vocabulary building. In order to revolutionize language learning, a web-based

platform incorporating OpenAI's groundbreaking GPT-4 will be created. Leveraging the advanced natural language processing capabilities of OpenAI's GPT-4, it promises a dynamic and immersive learning experience that adapts in real-time to the learner's progress. As the world becomes increasingly interconnected, the value of such an application is undeniable. This proposal outlines the objectives, design, and implementation strategy for creating a language learning solution that goes beyond memorization to deliver a comprehensive, nuanced, and genuinely enjoyable learning experience.

### **1.2 Problem Statement and Motivation**

Language learning apps and tools are not a novel concept, the market is full of products that promise solutions aiming to equip users with new language skills. However, a significant gap still remains for providing a truly engaging and adaptive learning environment that can imitate the nuances of in-person teaching and natural conversation. The static algorithms used in many current applications lack the capability to customize the learning process to each user's individual speed, preferences, and contextual usage. As a result, students are left desiring a platform that does more than just impart knowledge—rather, it reacts and changes as they progress through language learning. This project identifies the need for a sophisticated, AI-driven language learning solution that can overcome the shortcomings of common applications, offering a personalized, interactive, and context-aware platform for vocabulary and language learning.

The motivation for this project is further fueled by recent advancements in AI, particularly with the emergence of more generalized intelligence models like GPT-4. Studies like those by Bubeck et al. [4] suggest that GPT-4 exhibits a broad spectrum of capabilities that approach human-level performance, positioning it as a precursor to artificial general intelligence (AGI). Such capabilities include understanding and generating human language, which could revolutionize the way we learn and interact with new languages. Additionally, the application of GPT-4 in software development and programming mentorship provides a blueprint for its potential in educational settings. By adapting these capabilities, this project aims to serve as an automated mentor for language learners, offering real-time feedback and conversational practice [5].



### 1.3 Project Scope and Direction

The main deliverable of this project is an innovative vocabulary language learning web application that is driven by AI, specifically the GPT-4 model created by OpenAI with all of its advanced capabilities to deliver a personalized and interactive educational experience. This web application is designed to address the critical gaps in current language learning platforms by offering a solution that adapts to individual learner's needs, preferences, and learning paces, thereby transforming the traditional approach to vocabulary learning and usage.

Through features such as a sophisticated AI chatbot for real-time text and voice interactions that also incorporates the vocabulary learned by the user through the app, object recognition for visual vocabulary learning whereby users can upload photos of objects, and gamified elements to enhance user engagement and usability while learning new vocabulary, this application aims to make language learning more accessible, efficient, and enjoyable. The project's focus on creating an intuitive and user-friendly interface will ensure that learners of varying technological competencies can easily navigate and benefit from the platform, overcoming one of the major barriers present in existing systems.

The web application will be developed using contemporary web development technologies, including HTML, CSS, and JavaScript for the frontend, with Node.js for the backend integration, including the incorporation of the GPT-4 API created by OpenAI for AI functionalities. This project sets out to not only develop a model of an advanced language learning system but also to produce a working prototype that demonstrates the practical application of AI in educational technology. By incorporating real-time AI interactions and personalized learning paths, the project aims to deliver a comprehensive solution that significantly improves upon the limitations of existing language learning tools. This includes addressing the need for real-time feedback, the incorporation of AI to facilitate natural language usage, and the enhancement of user experience through interactive and engaging learning modalities. The development and deployment of this web application represent a significant step forward in the use of AI to meet the evolving needs of global language learners.

## 1.4 Project Objectives

The primary objective of this project is to develop an AI-driven vocabulary language learning web application that significantly enhances the efficiency, engagement, and personalization of acquiring new languages through the integration of OpenAI's GPT-4 technology. This application aims to address the prevalent challenges in existing language learning platforms by offering a dynamic and adaptive learning environment that caters to the individual preferences and learning styles of users. By leveraging advanced AI capabilities, the project seeks to overcome traditional memorization techniques, facilitating a deeper understanding and practical application of the language in conversational contexts.

Specifically, the project focuses on the following sub-objectives:

- **Create a Personalized AI-Based Vocabulary Learning Path:**

Develop an AI-powered learning algorithm that tracks user progress and identify user mistakes, and responds to the user in a natural but personalized way by analyzing the proficiency and difficulty levels achieved by a certain user's vocabulary list.

- **Develop a Gamified Learning Experience:**

Introduce a game-based learning experience that makes the learning experience of new vocabularies fun and more memorable such as the introduction of mini games like fill in the blanks, match the picture etc. These will help the user have higher retention rates for new vocabularies.

- **Integrate Conversational AI for Real-time Practice:**

Build a conversational chatbot that generates context-based scenarios using user-specific vocabulary themes, allowing users to practice in both text and voice formats. The chatbot will adapt to user responses and correct grammar or spelling mistakes. The target is to provide feedback for 90% of user interactions within five seconds, enhancing real-time learning.

- **Implement Object Recognition for Vocabulary Learning:**

Create an object recognition tool that allows users to photograph everyday objects and learn their corresponding vocabulary. The tool will supports various types of objects

and aim for an 80% accuracy rate in recognizing and providing the correct word, measured through internal tests and user feedback.

- **Design a User-Friendly and Accessible Interface:**

Develop an intuitive interface with easy-to-navigate features for users. Not only should the user interface be intuitive and easy to navigate, it should be visually appealing with a consistent colour scheme, font and more. The goal is to ensure users of varying technological abilities can easily access and use the platform.

What is not covered by this project:

- The project will not extend its initial release to cover all languages but will focus on English, with plans for gradual expansion.
- It will not provide offline functionality in its initial version, as the AI-driven features require internet connectivity for real-time interaction and feedback.
- The development of hardware devices or peripherals for language learning is outside the project's scope, focusing instead on web-based application delivery.
- Customization or integration with existing educational institutions' learning management systems (LMS) is not included in the project's initial objectives but may be considered for future development phases.

By achieving these objectives, the project aspires to revolutionize the way languages are learned, making it more interactive, enjoyable, and aligned with the needs of today's global learners.

### **1.5 Impact, Significance and Contribution**

The AI-Driven Vocabulary Language Learning Web Application project introduces a series of novelties and significant contributions to the field of educational technology, particularly in language learning. The primary innovation lies in the integration of OpenAI's GPT-4 to create a highly personalized and interactive platform that goes beyond mere vocabulary memorization. The GPT-4 model has truly been revolutionary and its capabilities have not been fully harnessed in the language learning space. Unlike existing language learning tools, which often lack the adaptability to cater to individual learning styles and needs, this project seeks to bridge this gap by offering a dynamic learning environment that evolves in real-time according to user progress and engagement.

This project aims to make a substantial impact on the way languages are learned and taught. By leveraging advanced AI capabilities, it offers a solution that is not only more engaging and effective but also accessible to a broader audience. The incorporation of voice and image recognition features for practical vocabulary application represents a leap forward in making language learning more intuitive and contextually relevant. Furthermore, the gamification of the learning process and the introduction of an AI chatbot for conversational practice are designed to significantly enhance user motivation and retention rates, addressing two of the most critical challenges in language education.

As globalization continues to draw cultures and economies closer together, the ability to communicate across language barriers becomes increasingly critical. This project not only presents a novel approach to overcoming these barriers but also contributes to the broader topic on the potential of AI in the future of education. It showcases how technology can be harnessed to create more inclusive, effective, and enjoyable learning experiences.

In essence, by making new and sophisticated AI technology accessible to the average user and focusing on the practical application of learned vocabulary, it promises to empower language learners everywhere. This initiative is relevant due to the recent leaps in advancements of AI in the world of technology, offering valuable insights and tools for educators, learners, and technology developers alike. It embodies the potential of AI to transform educational methodologies and highlights the importance of innovative solutions in an increasingly globalized and technological world.

### **1.6 Report Organization**

This report is organised into 7 chapters: Chapter 1 Introduction, Chapter 2 Literature Review, Chapter 3 System Methodology/Approach, Chapter 4 System Design, Chapter 5 System Implementation, Chapter 6 System Evaluation and Discussion and Chapter 7 Conclusion and Recommendation. The first chapter is the introduction of this project which includes problem statement, project background and motivation, project scope, project objectives, project contribution, highlights of project achievements, and report organisation. The second chapter is the literature review carried out on several existing language and vocabulary learning applications in the market to evaluate the strengths and weaknesses of each platform or application. The third chapter is discussing the system methodology for the project.

## CHAPTER 1: INTRODUCTION

The fourth chapter discusses the overall system design of the project. The fifth chapter is regarding the details on how to implement the design of the system. Furthermore, the sixth chapter evaluates the metrics of the system and discusses the outcome of the project, while the seventh chapter is about the final conclusion, thoughts and recommendations to further improve the project.

## Chapter 2





### Literature Review

#### 2.1 Review of the Technologies

##### 2.1.1 Software

##### OpenAI's GPT-4 API

**Sec. 8.1 Read Emotion from Facial Expressions**

<p><b>Prompt:</b> Identify and read emotions of people from their faces as shown in the image below.</p>  <p><b>GPT-4V:</b> The person in the image appears to be displaying a combination of emotions. The furrowed brows and downturned mouth suggest anger or frustration, while the tense jaw and narrowed eyes could indicate disgust or contempt. Overall, it seems like the person is experiencing negative emotions and is likely upset or unhappy.</p>	<p><b>Prompt:</b> Identify and read emotions of people from their faces as shown in the image below.</p>  <p><b>GPT-4V:</b> The emotion shown in the image is fear or anxiety. The person's eyes are wide open and their mouth is slightly open, indicating a sense of shock or surprise. Their hands are covering their mouth, which could suggest that they are trying to suppress a scream or gasp.</p>
<p><b>Prompt:</b> Identify and read emotions of people from their faces as shown in the image below.</p>  <p><b>GPT-4V:</b> The person in the image is displaying a happy emotion. This can be seen from the wide smile and the crinkles around the eyes.</p>	<p><b>Prompt:</b> Identify and read emotions of people from their faces as shown in the image below.</p>  <p><b>GPT-4V:</b> The person in the image appears to be experiencing a negative emotion, likely frustration or disappointment. This is evident from the furrowed brows, downward gaze, and hand on the forehead.</p>

**Figure 2.1.1.1: Example of GPT-4 Vision [6]**

OpenAI shocked the world with the release of ChatGPT, a large language model (LLM) that revolutionized the way AI can be used practically in our daily lives. Just shy of a year later, OpenAI releases GPT-4, a more advanced model of their LLM that has features and functionalities never seen before that is a testament to the monumental leaps in artificial intelligence. GPT-4, with its advanced Natural Language Processing (NLP) powers, signifies an evolution from its predecessors by integrating an extensive range of skills that span

multiple domains. Its proficiency in tasks that include, but are not limited to, software development, creative writing, and even intricate fields like medicine and law, marks a stride towards artificial general intelligence (AGI) [7].

Furthermore, GPT-4's enhanced multimodal functionalities, which extend to understanding and generating content from visual inputs, position the system as a potentially transformative tool in the educational sector. Just as an example, Figure above shows GPT-4 vision being able to even understand the nuance and complexity of emotions from blurry pictures of human faces. Its application in providing diagnostic support in medicine further exemplifies its precision and utility, opening doors for similar use cases in language education. In the context of this web app, GPT-4 will act as the cornerstone for developing a nuanced AI mentor that engages in meaningful dialogues, refines learners' language skills, and provides targeted feedback based on individual performance. However, this integration does not come without challenges, as ethical considerations, data requirements, and bias mitigation demand vigilant oversight and continuous refinement [8].

By incorporating GPT-4, the application will not only leverage its language capabilities but also explore its potential in interpreting visual inputs, which could revolutionize vocabulary learning through image recognition. The AI's ability to provide descriptive content for uploaded images can greatly enhance the vocabulary learning process, making it interactive and engaging. This capability to excel in various domains with a near-human performance level allows for an adaptive and responsive interaction with users within the language learning web application, offering a tailored and immersive educational experience.

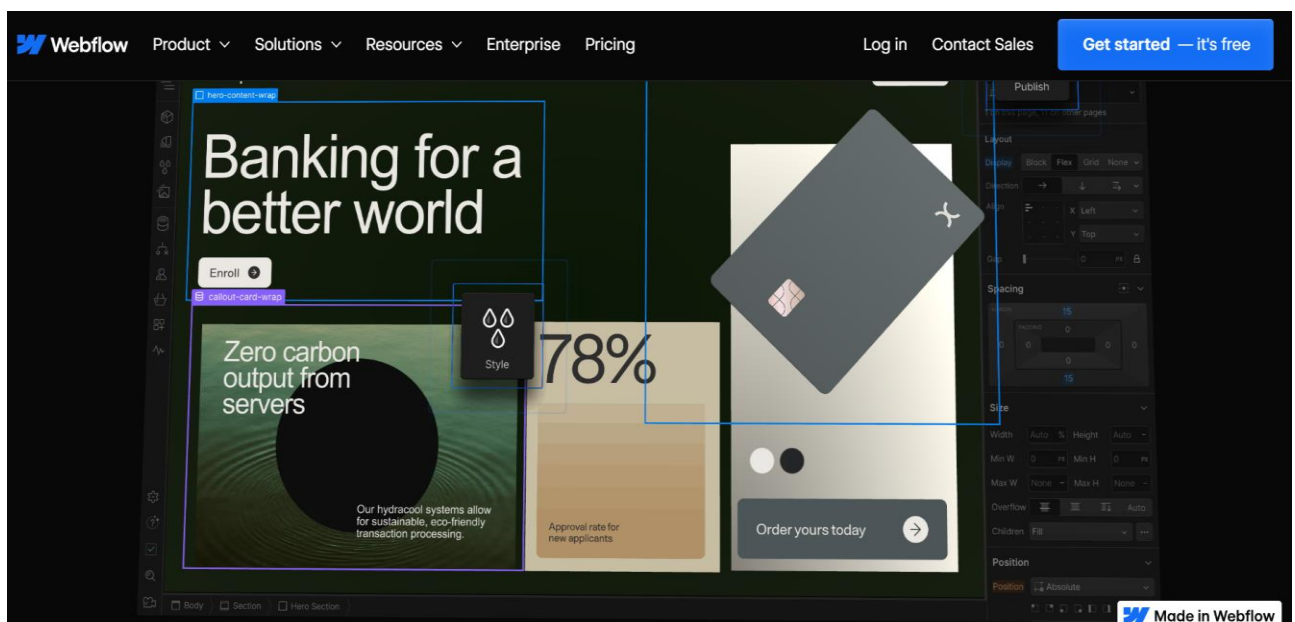
### **Google Web Speech API**

The Google Web Speech API is a powerful tool designed for integrating voice recognition and synthesis capabilities into web applications. It provides two distinct services: Speech Recognition and Speech Synthesis. Speech Recognition allows developers to convert spoken language into text by leveraging Google's advanced voice recognition technology, making it possible for users to interact with web applications through voice commands. Speech Synthesis, on the other hand, enables applications to read text aloud, offering an interactive and accessible user experience. This API opens up a myriad of possibilities for enhancing web applications, from creating more accessible interfaces for users with

disabilities to developing innovative, voice-driven applications. It operates through the user's web browser, requiring no additional software installations, and supports a wide range of languages and dialects, reflecting Google's commitment to global accessibility and user-friendly web experiences.

In the language learning vocabulary web application, this API will be used mainly for the voice conversation feature with the AI chatbot. The Speech Recognition feature will convert whatever users speak into text for the AI chatbot powered by GPT-4 to respond to, then the Speech Synthesis function will be utilized to voice out the response from the chatbot back to the user [9].

## Webflow



**Figure 2.1.1.2: Webflow Website [10]**

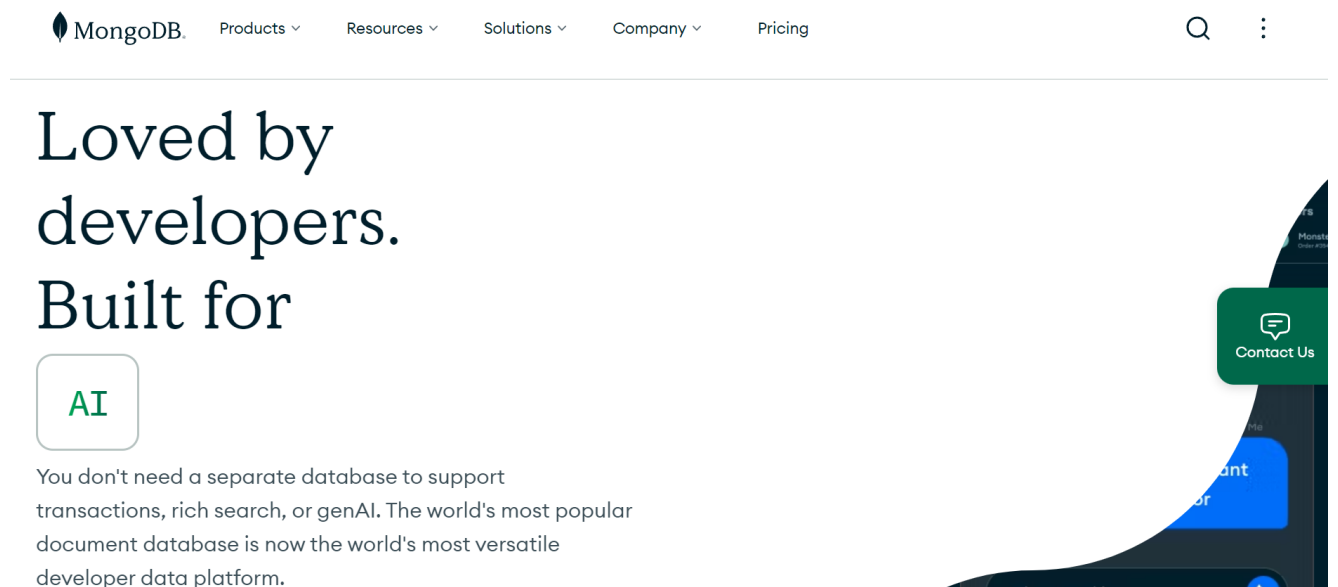
Webflow is a comprehensive web development platform that empowers users to design, build, and launch custom websites without the need for coding. It combines a range of tools into a single platform, including design, animation, content management, marketing, and ecommerce, making it accessible for both non-coders and coders alike. By providing a unique and intuitive page builder, Webflow offers extensive design options and customizable elements, enabling users to create visually stunning and functional websites. This cloud-based Content Management System CMS facilitates a collaborative and efficient workflow, significantly enhancing the website creation process. Its ability to integrate various web



development aspects into one accessible platform marks Webflow as a powerful tool for creating custom websites. Thus, Webflow will be used to create the frontend development design of the web application in order to make it visually appealing, intuitive and sophisticated.

## 2.1.2 Database

### MongoDB



**Figure 2.1.2.1: MongoDB Website [11]**

MongoDB is an open-source NoSQL database known for its flexibility and scalability, making it a popular choice for modern web applications. As a document-oriented database, it stores data in JSON-like formats with dynamic schemas, meaning that unlike traditional relational databases, it can handle large volumes of unstructured and semi-structured data with ease.

In the context of this project's language learning web application, MongoDB can serve as the primary database for storing user profiles, tracking progress, managing the vast vocabulary database, and recording user interactions. Its flexible data model is well-suited for the varied and complex data that a language learning application may generate. Additionally, MongoDB's powerful querying capabilities enable sophisticated search functionalities that can enhance the user experience by allowing for quick retrieval of personalized learning

content, analytics, and user settings. With features such as real-time analytics and automated scaling, MongoDB can efficiently support the evolving needs of the application.

### **2.1.3 Programming Language**

#### **Node.js**

Node.js is a powerful server-side JavaScript runtime environment built on Google Chrome's V8 engine. It allows developers to write server-side code using JavaScript, enabling a unified language for both client and server-side applications. Node.js excels in handling asynchronous, non-blocking I/O operations, making it highly efficient for applications that require high concurrency, such as real-time web apps and network applications. This architecture avoids the performance bottlenecks associated with traditional multithreaded environments, making Node.js well-suited for scalable applications [12]. Its asynchronous nature also simplifies tasks like managing multiple requests simultaneously without delays, enhancing overall performance [13].

#### **Handlebars.js (HBS)**

Handlebars.js is a simple and efficient templating engine often used in conjunction with Node.js to create dynamic HTML content. It allows developers to write templates that include JavaScript expressions and placeholders for data, which is injected into the template at runtime. This logic-less templating system ensures a clear separation between the logic of the application and the presentation layer, making it easier to maintain. Handlebars.js simplifies the process of rendering HTML by binding data and templates dynamically, which makes it an excellent tool for building single-page applications or server-side rendered pages [14].

#### **HTML/CSS**

HTML (Hypertext Markup Language) and CSS (Cascading Style Sheets) are foundational technologies for web development. HTML provides the structure of web pages, defining elements like headers, paragraphs, and images, while CSS is responsible for the styling and layout of these elements. Together, they enable developers to create visually appealing and responsive websites. Modern web design heavily relies on CSS3 and HTML5, which introduce new features like flexible layouts, animations, and improved media support to enhance user experience across different devices [15][16].

#### 2.1.4 Vocabulary Source

The **New General Service List (NGSL)** is an updated version of the original General Service List (GSL) from 1953, which aimed to provide a core vocabulary for English language learners. The NGSL consists of around 2,800 high-frequency words and was designed to offer better coverage of modern English texts than the original GSL. The list was developed by analyzing large, contemporary corpora, such as the British National Corpus and EnTenTen12, which represent different varieties of English and modern language use. The NGSL offers around 80-92% coverage of general English texts, making it highly efficient for learners to understand a significant portion of everyday language with a relatively small vocabulary set [17][18].

For my vocabulary learning application, I chose to incorporate the NGSL due to its relevance and efficiency in helping users achieve fluency faster. The NGSL's words are carefully selected based on their frequency and usefulness in everyday communication, covering a wide variety of topics, making it ideal for learners who want to gain proficiency in general English. By focusing on the NGSL, users can master the most essential words that appear frequently in both written and spoken texts, ensuring that their learning efforts yield maximum benefits [19].

#### 2.1.5 Summary of Technologies Review

In summary, the AI-driven vocabulary learning web application is built using a robust combination of cutting-edge technologies designed to enhance user experience, improve performance, and ensure scalability. The core of the application leverages **OpenAI's GPT-4 API**, which provides advanced natural language processing capabilities that enable the AI chatbot to engage in personalized, context-based conversations. This technology not only helps users improve their language proficiency but also allows for grammar correction, spelling checks, and scenario-based learning. The integration of **Google Web Speech API** adds voice recognition and synthesis functionalities, enabling users to interact with the AI using both text and speech, enhancing accessibility and interaction within the app.

The backend of the system is powered by **Node.js**, a high-performance server-side runtime environment well-suited for handling asynchronous tasks and high-concurrency applications. Alongside, **MongoDB**, a flexible NoSQL database, manages user profiles, vocabulary lists, and interaction history, ensuring quick retrieval of personalized learning

data. To render dynamic content efficiently, **Handlebars.js** is used for templating, providing seamless integration between the backend and frontend.

On the frontend, the application uses **HTML/CSS** for structuring and styling web pages, ensuring a visually appealing and responsive interface. Additionally, the design is complemented by **Webflow**, a comprehensive web development tool that simplifies the design process, ensuring intuitive navigation and an engaging user experience.

Lastly, the vocabulary content is sourced from the **New General Service List (NGSL)**, which provides a modern and highly efficient set of high-frequency words for English language learners. This selection ensures that users can quickly achieve proficiency by focusing on the most commonly used words in everyday communication. Collectively, these technologies offer a comprehensive, interactive, and scalable solution for vocabulary acquisition, ensuring that the application is effective in both content delivery and user engagement.

## 2.2 Review of Existing Systems/Applications

### 2.2.1 Duolingo

#### Brief Overview



SITE LANGUAGE: ENGLISH ▾



The free, fun, and effective way to  
learn a language!

GET STARTED

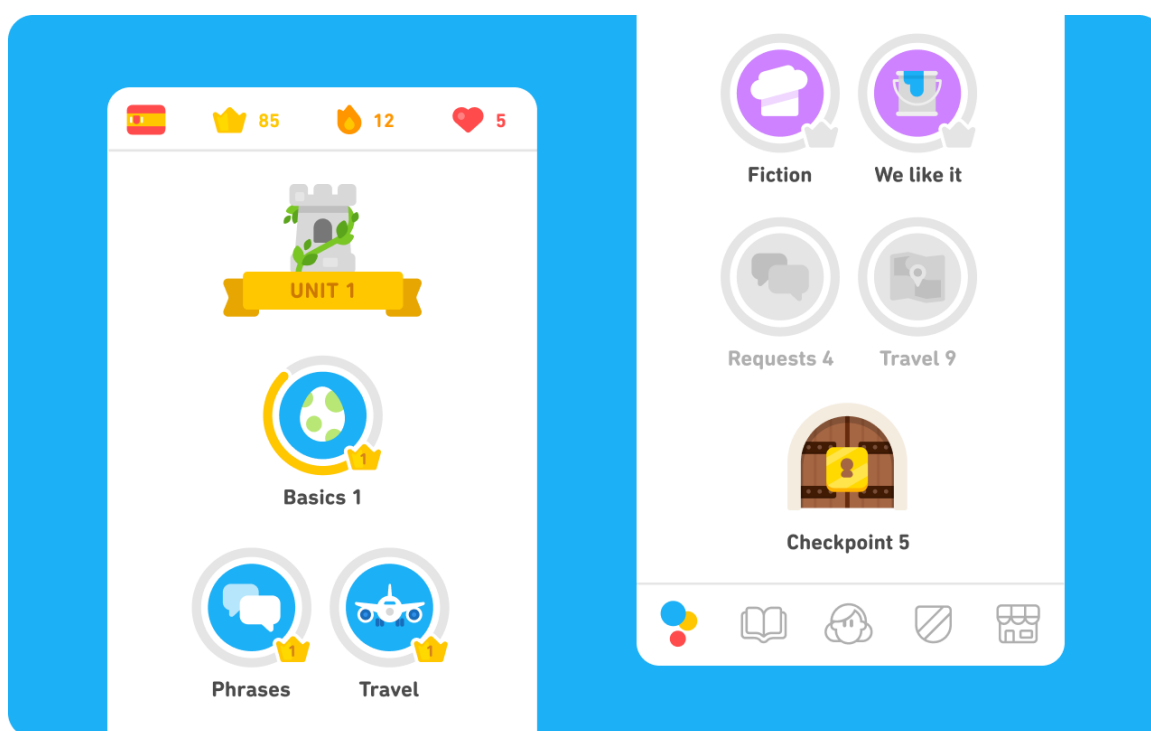
I ALREADY HAVE AN ACCOUNT

**Figure 2.2.1.1: Duolingo Website [20]**

Duolingo is one of the first ever applications made in the field mobile-assisted language learning that gained traction, fundamentally transforming the way individuals engage with new languages. Launched in 2012 to the public, it has rapidly expanded its offerings to include over 30 languages, from widely spoken ones such as Spanish and French to less commonly taught languages like Hawaiian and Welsh [21]. The application's core philosophy revolves around making language learning accessible, enjoyable, and effective for everyone, anywhere, without the cost barriers typically associated with traditional language education. Its user-friendly design and gamified learning process engage users in daily lessons that are short, interactive, and varied, contributing to a learning experience that is as addictive as it is educational. Studies, including those by Loewen et al. [22] have documented the positive impact of consistent Duolingo use on language acquisition, underscoring the app's effectiveness in improving linguistic skills over time [22].

The structure of Duolingo's lessons is based on a combination of gamification principles and educational methodologies such as spaced repetition and immediate feedback. This approach encourages users to make learning a daily habit, significantly enhancing

retention and progression. Each lesson is crafted to build on previous knowledge while introducing new concepts, ensuring a balanced progression through the language. The application's emphasis on community-based learning also stands out; users can share achievements, compete in leagues, and learn from each other, creating a supportive and motivating learning environment. The adaptability of Duolingo's model to various learning styles, combined with the flexibility it offers users to learn at their own pace, makes it a model example of how technology can help education, particularly in the realm of language learning [22]. The figure below shows an example of Duolingo's user interface which is bright, colourful and intuitive.



**Figure 2.2.1.2: Example of Duolingo User Interface [23]**

### **Strengths**

- **Engagement through Gamification:** Duolingo incorporates gamification elements that significantly enhance learner engagement. The use of points, levels, and rewards makes the learning process more enjoyable and motivating, encouraging continuous learning habits among users [22].
- **Flexibility and Accessibility:** The app offers a flexible learning experience, allowing users to study at their own pace and on their own schedule. This accessibility makes it

an attractive option for learners with busy schedules or those who prefer mobile learning platforms [24].

- **Wide Range of Languages:** Duolingo provides courses in a diverse range of languages, catering to a broad audience. This variety enables users to explore languages for travel, work, or personal interest, making language learning more inclusive and accessible to all [25].
- **Effective for Vocabulary Acquisition:** Numerous studies have highlighted Duolingo's effectiveness in improving users' vocabulary. The structured progression and repeated exposure to new words help solidify learners' understanding and recall of vocabulary [22].
- **Utilization of AI:** Duolingo recently has utilized AI in creating and delivering highly-personalized language lessons for their users. It utilizes OpenAI's GPT-4 model, however the lesson content is curated by language experts [23].

### Weaknesses

- **Limited Depth for Advanced Learners:** While Duolingo excels at teaching beginners and intermediate learners, its content can be too basic for advanced learners. The platform may not offer the depth or complexity needed to challenge those with higher proficiency levels, potentially limiting its effectiveness for this group [24].
- **Lack of Speaking Practice:** Although Duolingo offers exercises for listening, reading, and writing, opportunities for speaking practice are limited. This can result in a gap in conversational skills, as users may not receive adequate practice or feedback on pronunciation and fluency [25].
- **Overemphasis on Gamification:** While gamification is a strength, its overemphasis may detract from the learning experience for some users. The focus on earning rewards and advancing through levels might overshadow the intrinsic motivation to learn the language itself, potentially affecting long-term retention and deep learning.
- **Inconsistencies in Course Quality:** The quality and comprehensiveness of Duolingo courses can vary significantly across different languages. Some languages have more developed courses with richer content and cultural insights, while others may lack

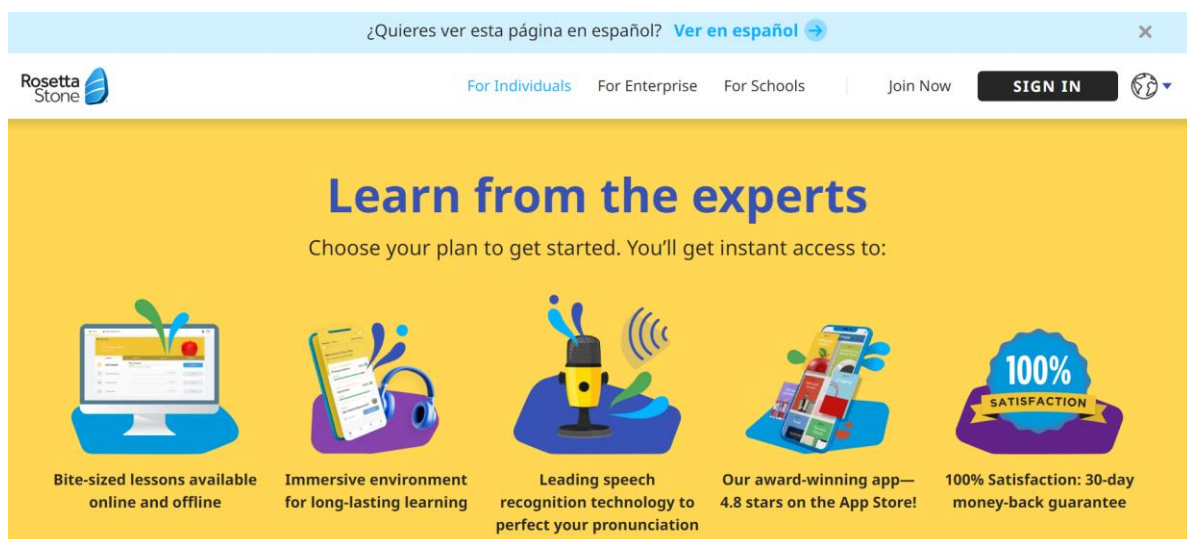
depth and breadth, impacting the uniformity of the learning experience across different language courses.

### **Recommendations**

- **Enhancing Instructional Content:** Duolingo could benefit from enriching its instructional materials with clearer explanations and more context for vocabulary and grammar, potentially incorporating insights from linguistic research.
- **Broadening Learning Approaches:** To cater to advanced learners, the app could introduce more sophisticated exercises that focus on conversational skills, cultural nuances, and advanced grammar.
- **Integrating Supplementary Resources:** Offering additional resources or linking to external content could provide learners with a more rounded learning experience, addressing the current limitations in depth and scope.

## 2.2.2 Rosetta Stone

### **Brief Overview**

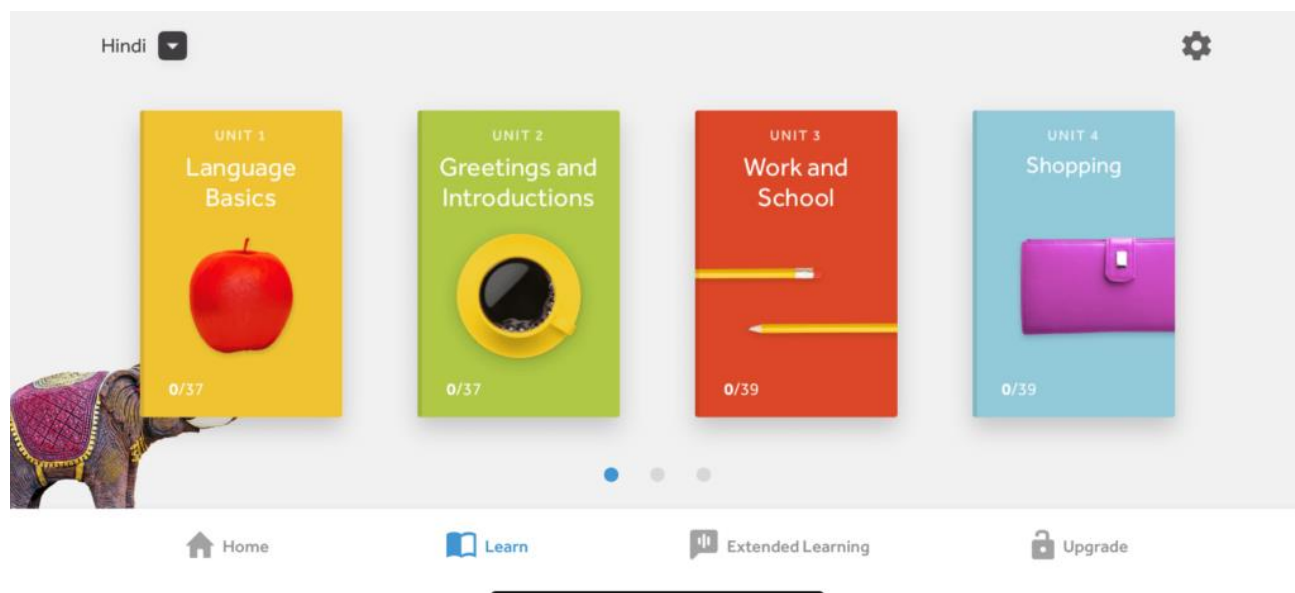


**Figure 2.2.2.1: Rosetta Stone Website [26]**



Rosetta Stone, named after the ancient artifact that unlocked the secrets of Egyptian hieroglyphs, has established itself as a pioneer in the field of language learning technology. Founded in 1992 by Allen Stoltzfus, Rosetta Stone was driven by the idea of using computer technology to simulate the way people naturally acquire languages. The company launched its first language learning software in 1999, aiming to offer an immersive learning experience devoid of translations, instead relying on images, text, and sound to teach languages through intuitive association.

Over the years, Rosetta Stone has expanded its offerings to include a wide range of languages, adapting its software to evolving technological advancements and user needs. Transitioning from physical CD-ROMs to a cloud-based service, it has embraced mobile technology, making language learning accessible anytime and anywhere. Despite facing competition from free and freemium models like Duolingo and Busuu, Rosetta Stone has maintained its position in the market through its comprehensive curriculum and emphasis on pronunciation, speaking, and listening skills, supported by speech recognition technology. Its approach caters to a broad audience, from individual learners to educational institutions and corporations, underscoring its mission to change lives through the power of language and literacy education [27]. The figure below shows an example of the Rosetta Stone user interface.



**Figure 2.2.2.2: Example of Rosetta Stone User Interface [28]**

### **Strengths**

- **Enhanced Pronunciation Skills:** Rosetta Stone's use of speech recognition technology has been identified as a key strength, helping learners improve their pronunciation. This technology provides immediate feedback, allowing users to adjust and improve their speech in real-time [29].
- **Flexibility and Convenience:** The application facilitates independent learning, allowing users to study at their own pace and schedule. This flexibility makes it a popular choice among busy learners who require a more adaptable approach to language learning [30].
- **User-Friendly Design:** Rosetta Stone is appreciated for its intuitive and engaging user interface, making language learning accessible to beginners. The program's design encourages prolonged engagement, contributing to a positive learning experience [31].
- **Comprehensive Learning Experience:** The platform offers a holistic approach to language learning, covering various aspects of a language including vocabulary, grammar, and conversational skills. This comprehensive coverage ensures that learners acquire a well-rounded understanding of the language [32].
- **Utilization of AI:** The platform also utilizes the emerging technology of AI by introducing AI-driven language assessments. However, these are more specific and formal as it focuses on giving marks based on the global language standards (CEFR, ACTFL, and TOEFL) [33].

### Weaknesses

- **Limited Interaction:** The self-paced nature of Rosetta Stone might limit opportunities for interactive learning with native speakers or other learners. This can prevent the development of conversational skills and cultural competencies that are crucial for mastery of a language [32].
- **Not Cost Effective:** The premium pricing of Rosetta Stone can be a barrier for individuals and institutions with limited budgets. This restricts access to the platform for a portion of potential learners who cannot afford the subscription fees that are on average \$15 a month, compared to freemium apps like Duolingo and Busuu where it is free but you can choose to upgrade for premium features. [34].

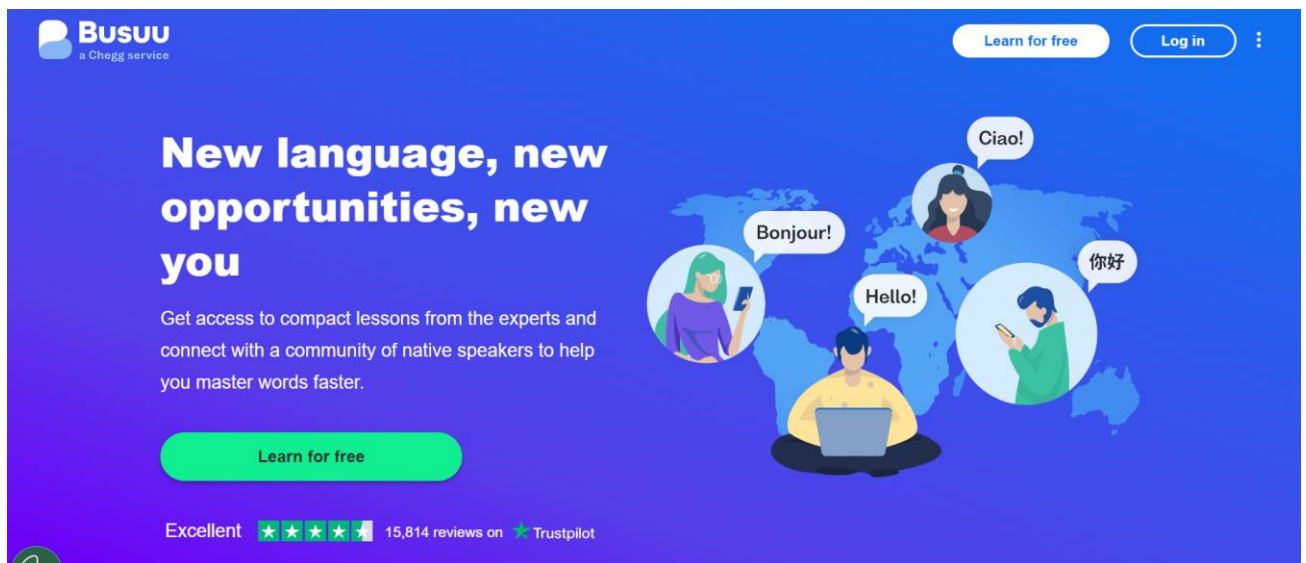
- **Technical Challenges:** Users may encounter technological issues such as software bugs or compatibility problems with their devices. These technical challenges can disrupt the learning process and deter users from continuing their language studies [32].
- **Limited Customization:** While Rosetta Stone offers a structured curriculum, there might be limited scope for personalizing the learning experience to match individual learner needs and preferences. This one-size-fits-all approach may not be effective for all learners [31].

### **Recommendations**

- **Enhance Interactive Features:** Introducing more interactive elements such as live tutoring sessions, discussion forums, or language exchange programs could enrich the learning experience by providing real-life communication practice.
- **Implement a More Flexible Pricing Model:** Offering a wider range of subscription options or a free tier with limited features could make Rosetta Stone more accessible to a broader audience, including budget-conscious learners.
- **Address Technical Issues:** Continuous investment in software development and user support can help minimize technical glitches and improve the overall user experience.
- **Increase Customization Options:** Allowing learners to tailor their learning paths according to their specific goals, interests, and proficiency levels could enhance engagement and outcomes.

### 2.2.3 Busuu

#### Brief Overview



**Figure 2.2.3.1: Busuu Website [35]**

Busuu, launched in 2008, has grown to become one of the prominent online language learning platforms, emphasizing social interaction and practical language use. The platform was designed to facilitate language learning through a blend of self-study courses and community interaction, allowing learners to practice with native speakers. This combination of learning strategies aims to enhance linguistic skills effectively and efficiently, supported by the findings of Rosell-Aguilar [36] in a large-scale survey which revealed that users appreciate the app for its ability to improve language knowledge, particularly in vocabulary, highlighting its popularity and utility among learners worldwide. Busuu's approach is grounded in the belief that language learning is more effective and enduring when learners engage actively with the language in communicative situations [36].

The platform's design incorporates elements from social networking to create an immersive learning environment, offering courses in multiple languages that cater to a diverse range of learners. According to Álvarez Valencia [37], Busuu represents an ecological system of nested semiotic spaces where structural, interactional, and ecological views of language interweave, providing a rich and multifaceted learning experience. This emphasis on social learning aspects, along with the flexible, user-friendly design, positions Busuu as a valuable tool for learners seeking to improve their language skills in a more interactive and

engaging manner. The app's success and continued growth fulfill the demand for innovative approaches to language learning that leverage technology and social connectivity to facilitate language learning. [36][37]. The figure below shows an example of Busuu's user interface.

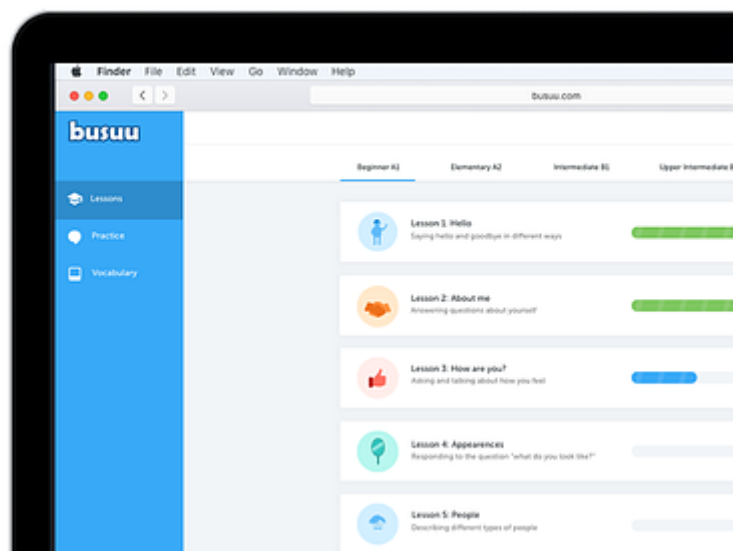


Figure 2.2.3.2: Example of Busuu User Interface [38]

### Strengths:

- **Enhanced Vocabulary Acquisition:** Fernando Rosell-Aguilar's large-scale survey highlighted that Busuu effectively improves users' language knowledge, particularly in vocabulary, demonstrating the platform's effective approach to vocabulary teaching and retention [36].
- **Flexible and User-Friendly Design:** Busuu's design facilitates a learner-friendly environment that encourages continuous and engaged learning. The platform's structured yet flexible approach caters to various learning styles and paces [37].
- **Social Learning Features:** The integration of social learning through interactions with native speakers and other learners worldwide is a unique strength. This social aspect not only enhances language practice but also introduces cultural learning components, making the experience more immersive and practical [37].
- **Autonomy in Learning:** Busuu supports learner autonomy by allowing users to manage their study schedules and select topics of interest, which is crucial for adult learners who may have other commitments. The app's design enables learners to take

charge of their learning process, fostering a more personalized learning experience [39].

- **Utilization of AI:** Busuu has also jumped on the trend of utilizing AI in language learning although it is still newly developed. With each session, it generates a completely customized set of study materials based on an intelligence calculation of each learner's individual language strengths and limitations [40].

### **Weaknesses:**

- **Limited Feedback on Errors:** While Busuu offers interactive exercises, the feedback on errors can sometimes be limited, not providing enough detail to help learners understand their mistakes fully and learn from them. This aspect could be enhanced to offer more in-depth explanations or alternative learning strategies.
- **Variation in Content Quality:** The quality of language learning content can vary, especially since some of it is generated by users. While peer learning is valuable, there might be inconsistencies in the accuracy or quality of the language content, which could potentially mislead learners.
- **Cost Barrier for Full Access:** Although Busuu offers free access to some of its features, full access requires a subscription. This cost barrier might limit access for learners who cannot afford the premium version, restricting them from utilizing the app's full potential.
- **Limited Speaking Practice:** While Busuu incorporates speaking exercises, opportunities for live conversation practice with feedback are limited. Increasing real-time speaking opportunities could significantly enhance the learning experience and speaking proficiency of users.

### **Recommendations**

- **Enhance Feedback Mechanisms:** Implementing more detailed feedback for exercises, especially for incorrect answers, could help learners understand their mistakes better and improve more rapidly.

- **Standardize Content Quality:** While maintaining the social aspect of learning, Busuu could implement more rigorous checks or review systems by language experts to ensure the accuracy and quality of user-generated content.
- **Expand Accessibility Options:** Offering more comprehensive free access or a tiered pricing model could make the platform accessible to a broader audience, thereby making the application more accessible and inclusive for more people.
- **Increase Real-time Speaking Opportunities:** Introducing more features for live conversation practice, possibly through integration with native speakers or language exchange partners, could significantly improve speaking skills and real-world language application.

## 2.3 Summary

**Table 2.3.1: Summary of Different Systems**

<b>Feature/Function</b>	<b>Duolingo</b>	<b>Rosetta Stone</b>	<b>Busuu</b>
Engagement through Gamification	Yes (Points, levels, rewards)	No	Yes (but less emphasized)
Flexibility and Accessibility	High (Learn at own pace)	High (Learn at own pace)	High (Structured yet flexible)
Wide Range of Languages	Yes	Yes	Yes
Effective for Vocabulary Acquisition	Yes	Moderate (Focus more on immersion)	Yes
Pronunciation Practice	Limited	Yes (Speech recognition technology)	Limited
Speaking Practice	Limited	Moderate (Focused on pronunciation)	Yes (via social interactions)

Consistency in Course Quality	Moderate (Varies by language)	High	Varies (Some content user-generated)
Depth for Advanced Learners	Limited	Moderate	Moderate
User-Friendly Design	Yes	Yes	Yes
Cost Effectiveness	Free with premium options	Subscription-based	Free with premium options
Technical Challenges	Minimal	Possible (Software bugs)	Minimal
Customization of Learning Path	Limited	Limited	Yes
AI-powered	Yes (Uses AI to tailor lessons)	Limited (Mainly uses speech recognition)	Yes (AI-driven exercises and feedback)

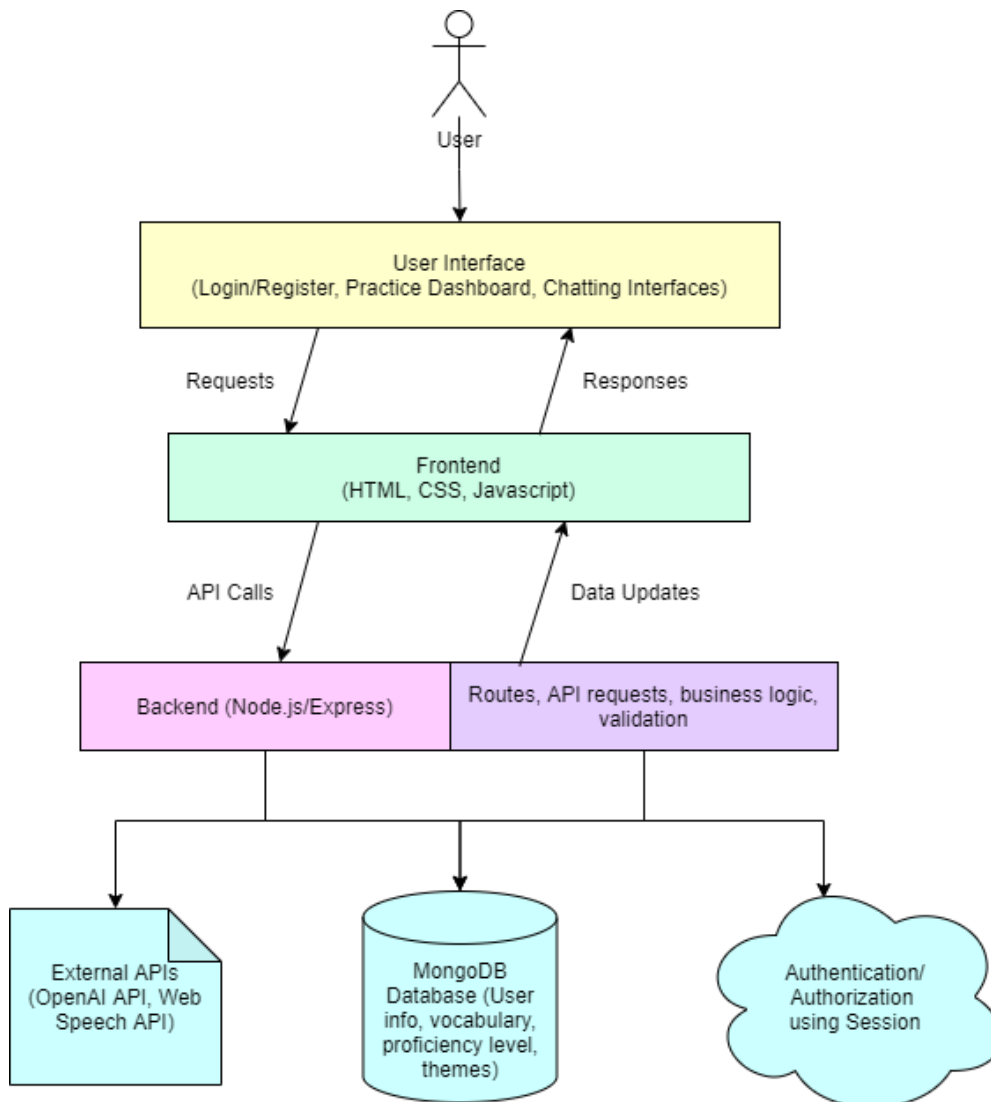


## Chapter 3

### System Methodology/Approach

#### 3.1 System Design Diagram/Equation

##### 3.1.1 System Architecture Diagram



**Figure 3.1.1.1: System Architecture Diagram**

This project is a vocabulary learning assistant platform that allows users to practice vocabulary through chat-based interactions, incorporating features such as grammar and spelling analysis, proficiency tracking, and AI-generated conversation scenarios. The system

architecture consists of several key components that work together to deliver a seamless experience to the user, from user interface interactions to backend processing, database management, and external API integrations.

The **User Interface (UI)** serves as the main point of interaction between the user and the system. It presents the web pages where users can log in or register, navigate the practice dashboard, and engage in chat-based interactions with the AI assistant. The UI is built using HTML, CSS, JavaScript, and Bootstrap, offering an easy-to-use and responsive interface. On the practice dashboard, users can select vocabulary themes they have learned, while the chat interface allows them to converse with the AI in real time.

The **Frontend Layer** handles the client-side interactions and is responsible for collecting user input, such as login credentials or chat messages, and sending these requests to the backend server. Additionally, it manages the responses received from the backend, displaying the AI-generated content to the user. JavaScript and the Fetch API are used to manage these interactions and ensure that users receive real-time updates without page reloads.

The **Backend Layer**, developed using Node.js and Express, acts as the central hub for managing server-side logic. It is responsible for handling user requests, managing user sessions, interacting with the database, and communicating with external APIs for features like scenario generation and grammar/spelling correction. The backend routes requests such as user login, registration, and practice chat, processes business logic such as updating vocabulary proficiency, and manages user sessions to ensure only authenticated users can access certain features. This layer also integrates with OpenAI's GPT-4 API for generating conversational scenarios and analyzing user input.

The **Database Layer**, built with MongoDB, stores all essential user data, including account details, vocabulary learned, themes, and user proficiency levels. It tracks the user's progress in terms of how often they practice each vocabulary word and their current proficiency level (beginner, intermediate, advanced). MongoDB's NoSQL structure allows for flexible and scalable data management, while Mongoose ORM is used to model schemas and simplify database operations. The database plays a critical role in tracking user performance, allowing the system to present personalized learning experiences based on the user's progress.

The integration of **External APIs**, particularly OpenAI's GPT-4, adds intelligence to the system by enabling AI-driven features such as scenario generation, grammar and spelling correction, and interactive conversation. When a user selects a theme, the system sends the learned vocabulary to GPT-4, which generates a simple conversation scenario involving those words. The AI then engages the user in a conversation, providing feedback on mistakes and encouraging them to use the words they have learned. GPT-4 is also used to analyze the user's input, offering real-time corrections for any grammar or spelling errors.

**Authentication and Authorization** mechanisms ensure that user data remains secure and that only authorized users can access protected features such as vocabulary practice. The system uses session-based authentication, with user credentials verified during login and a session created upon successful authentication. Middleware is used to ensure that only logged-in users can access specific routes, like the practice dashboard and chat features, enhancing security.

In terms of data flow, the system begins with the user accessing the login or registration page. Upon successful authentication, the user is granted access to the practice dashboard, where they can choose a theme to practice. The selected theme's vocabulary is sent to OpenAI for scenario generation, and the AI engages the user in conversation through the chat interface. The backend monitors these interactions, analyzing the user's responses for grammar and spelling errors and updating the proficiency level of any vocabulary words they use. The database is updated accordingly to reflect the user's progress.

### 3.1.2 Use Case Diagram and Description



**Figure 3.1.2.1 Use Case Diagram**

The use case diagram for this project outlines the interaction between the **User** and the **System** (comprising the AI API and the vocabulary database) through several key processes. The user's journey begins with the **Register/Login** use case, where they create an account or log into the system to access its features. After logging in, the user can select vocabulary learning options such as learn, practice, snapshot or voice chat to improve or learn

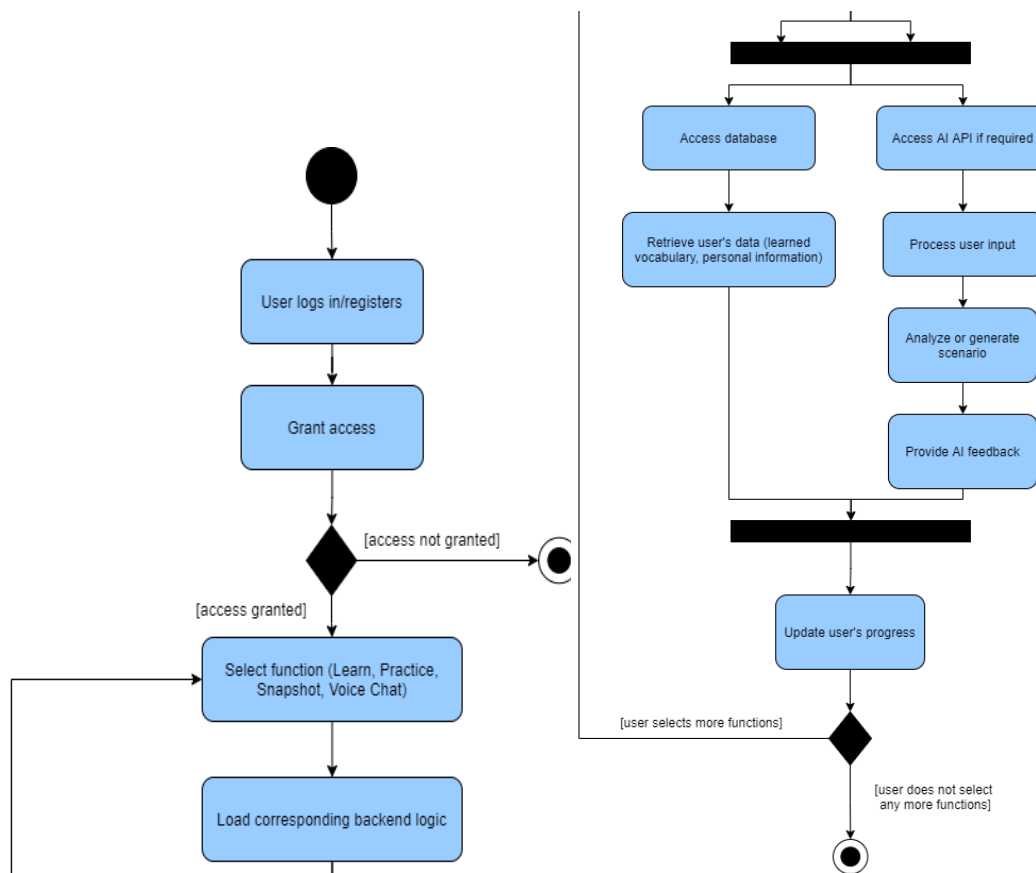
some new vocabularies. They can select different themes as well through the **Select Theme** use case.

The main functionality centers on the **Practice Vocabulary (AI Chat)** use case, where the system engages the user in interactive vocabulary practice sessions. The AI-driven system generates scenarios for the user to practice using learned words. This leads to the first sub-task, **Generate Scenario**, where the AI creates conversation prompts based on the user's selected theme and learned words. The second sub-task, **Analyze User Response**, involves the AI system evaluating the user's responses, checking for both grammar and spelling accuracy. The system provides corrections and feedback through the **Correct Mistake** use case, helping the user improve their language skills by offering suggestions on how to correct their mistakes.

As the user progresses through the practice session, the system continuously monitors their performance in the **Track Progress** use case. This function updates the user's proficiency levels for each learned word, rewarding progress with points and upgrading vocabulary proficiency from beginner to intermediate or advanced levels, based on usage.

Overall, the **System** leverages the AI API (GPT-4) and the vocabulary database to drive the core functionality of generating scenarios, analyzing input, providing corrections, and tracking the user's progress, creating a seamless and interactive learning experience.

### 3.1.3 Activity Diagram



**Figure 3.1.3.1: Activity Diagram**

The activity diagram illustrates the flow of user interactions with the system, starting from the point where the user logs in or registers. Upon accessing the system, the user's credentials are verified, and access is granted. If the user is denied access, the process terminates, while successful access leads to the main interaction.

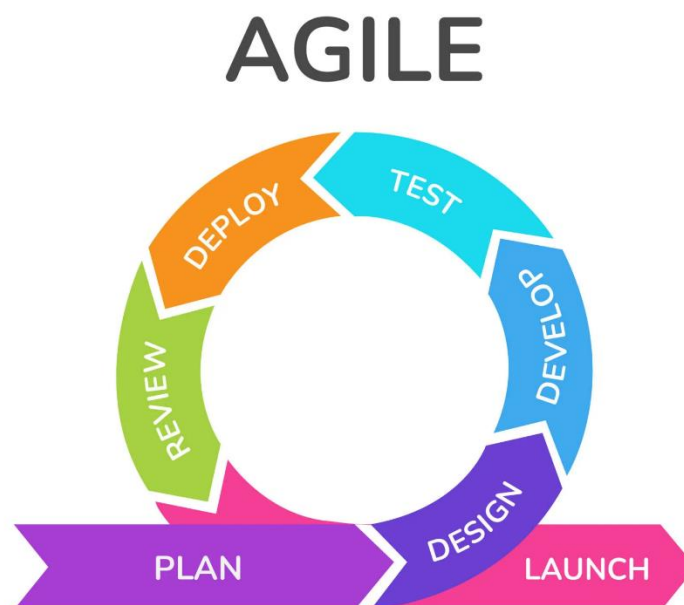
Once the user is granted access, they are presented with multiple options, including the functions "Learn," "Practice," "Snapshot," or "Voice Chat." Depending on the user's selection, the corresponding backend logic is loaded to process their request. If a function such as "Practice" or "Voice Chat" requires AI functionality, the system integrates with the AI API to analyze user input, generate scenarios, or provide feedback based on vocabulary learning.

In the next stage, the system retrieves the user's data from the database, including learned vocabulary or personal information. This is essential for customizing the user's experience in features like vocabulary practice. As the user interacts with the system, their

input is processed, and the system uses AI models to analyze grammar, spelling, or vocabulary usage, providing feedback in real time. For example, in a conversation, AI may create a scenario based on learned words and analyze the user's response for correctness.

After the interaction, the system updates the user's progress in the database, modifying elements such as vocabulary proficiency levels or points gained from practicing specific words. At this point, the user can either choose to interact with another function or end the session. If no further functions are selected, the process terminates, marking the end of the user's session. The diagram shows a continuous feedback loop where the user can perform multiple interactions before completing their session, with the system continuously updating their learning progress and providing relevant feedback.

### 3.2 System Methodology



**Figure 3.2.1: Agile Methodology General Workflow Diagram [41]**

In this project, the methodology to be implemented will be Agile Methodology given the specific requirements and objectives that were outlined in the previous section. Agile Methodology is a common methodology used in software development that aims to deliver functioning software on a regular schedule using an iterative and incremental approach,

called Sprints that usually span anywhere from 2-4 weeks. It is usually used for flexibility any adaptation to any changing requirements in the fast-paced business world [42].

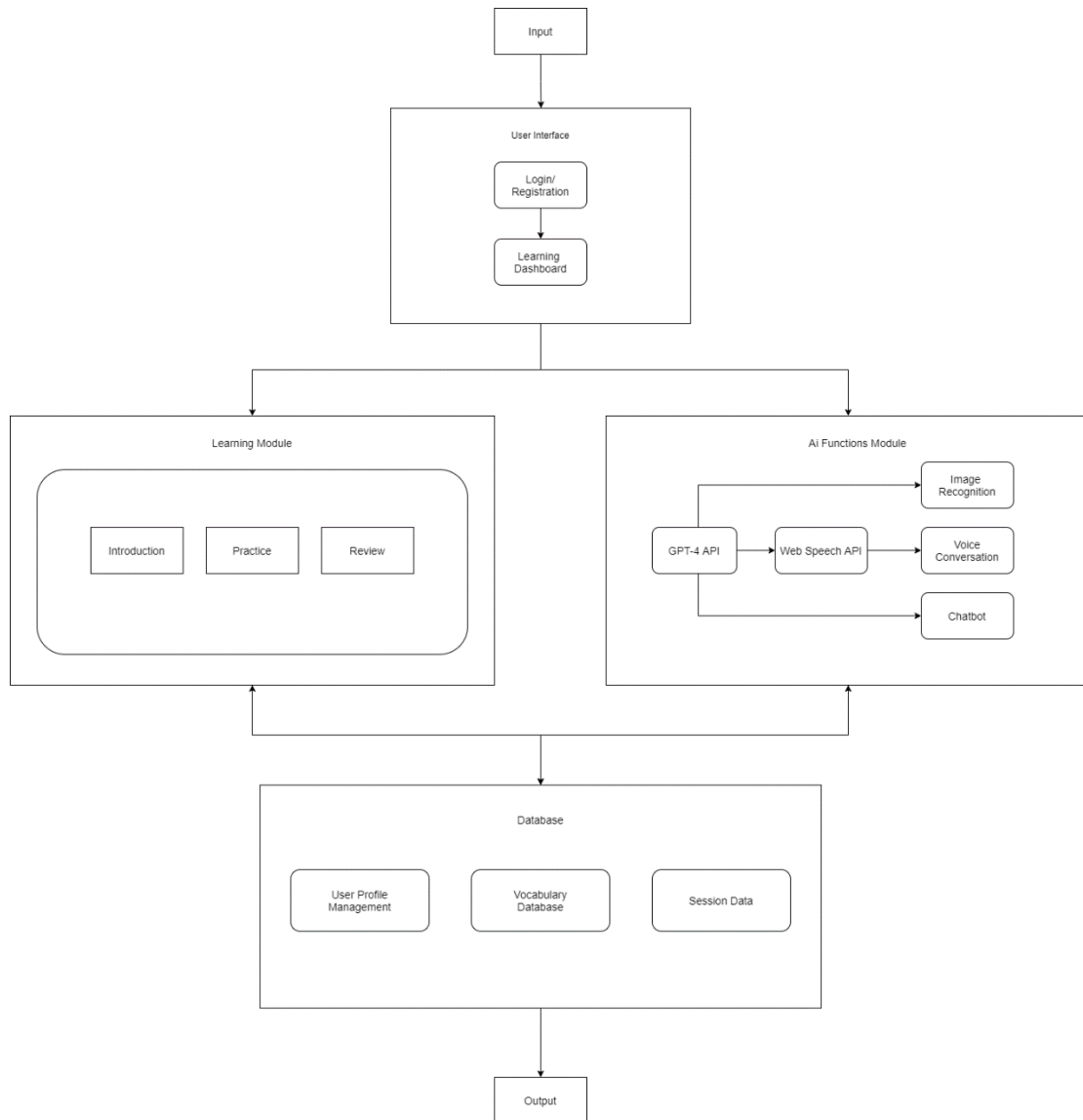
Agile Methodology's iterative and incremental approach is suitable for this project's goals as this system needs continuous and incremental progress in the system. After the planning phase, a simple system design will be created just to map out the overall flow and structure of the project. Then, a small function or iteration of the project will be developed, tested and reviewed. This project entails the development of an AI-driven vocabulary language learning web application and there may be changing requirements or new insights as the project progresses and Agile Methodology provides the flexibility to adjust the project scope and priorities accordingly without disrupting the overall development process. Therefore, every few weeks, a new iteration or improvement of the project will be completed to be tested upon.



# Chapter 4

## System Design

### 4.1 System Block Diagram



**Figure 4.1.1: General Block Diagram of Proposed Project**

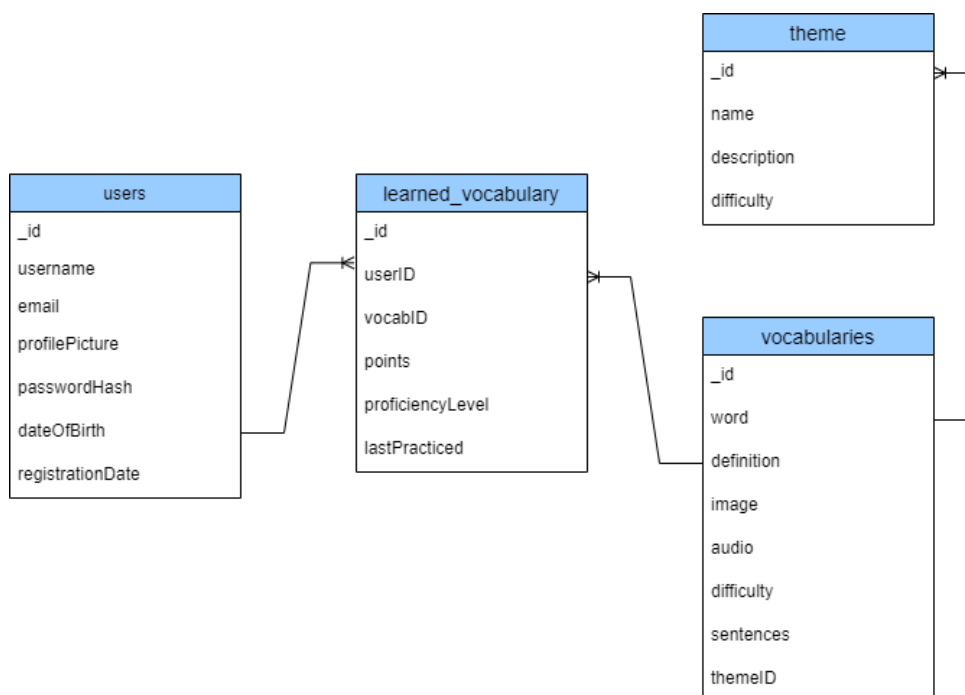
The figure above shows the general block diagram of the project system. In the User Interface Module, it is the gateway for users interacting with the app, consisting of a "Login/Registration" component that leads to a "Learning Dashboard." Here, users begin their journey, setting up their profiles and accessing the educational content. Moving on in the

Learning Module, it is further subdivided into "Introduction," "Practice," and "Review," this module is where the core language learning takes place. Users are introduced to new vocabulary, practice it through various exercises, and then review to consolidate their learning. In the AI Functions Module lies the heart of the application which is the GPT-4 API, which drives the chatbot functionality, enabling natural language conversations that adapt to the user's learning progress. The Web Speech API is integrated here to facilitate voice recognition and speech synthesis, providing a platform for users to practice speaking and listening. The Image Recognition component allows for visual learning, connecting images uploaded by users to relevant vocabulary.

As for the backend, the Database Module serves as the repository for all data in the application. "User Profile Management" stores user details and preferences, the "Vocabulary Database" holds the words and phrases learned, and "Session Data" logs user interactions, which are pivotal for tracking progress and personalizing the learning experience. Last but not least, the output is what users see as a result of their interactions with the app—progress reports, quizzes results, and chatbot conversations, among other outputs.

## 4.2 System Components Specifications

### 4.2.1 Database Schema



### Figure 4.2.1.1: Database Schema

The database schema for the AI-Driven Web Application for Enhanced Vocabulary Language Learning is thoughtfully structured into four primary collections to streamline data management and provide a personalized and interactive user experience.

At the core of user management is the **users** collection, which is integral to personalization and authentication within the application. Each user is assigned a unique identifier (**\_id**), which is utilized throughout the application to reference their activities and data. Usernames and email addresses provide the basis for user identification, while the **passwordHash** field stores secure encrypted passwords to maintain user privacy and security. Additionally, the schema caters to personalization through fields such as **profilePicture** and **nativeCountry**, which allow users to express individuality within the platform. Biographical information (**bio**) and the date of birth (**dateofbirth**) enrich user profiles, offering potential for community building and tailored learning experiences. To track user engagement, the **registrationdate** timestamps provide insights into the duration of user engagement.

Next, the **learned\_vocabulary** collection is designed to capture and reflect each user's learning journey, creating a dynamic record of vocabulary acquisition and proficiency. It ties users to the vocabularies they are studying or have mastered through a relational link to the **users** collection using **userID**. The **vocabID** connects the learned items to the central **vocabularies** repository. The **proficiencyLevel**, **points** and **lastPracticed** fields are pivotal for tracking learning progress and scheduling review sessions, ensuring that users are provided with an adaptive learning experience that responds to their individual needs and study habits.

The **vocabularies** collection is the repository of all vocabulary data, serving as the application's educational backbone. It houses details such as word definitions, associated images, and audio files that are essential for a comprehensive and multi-sensory learning experience. The **difficulty** level assists in tailoring content to the user's language proficiency, while example sentences (**sentences**) contextualize vocabulary, enhancing retention and practical usage. The **themeID** field links each vocabulary item to a broader thematic category housed within the **theme** collection.

The **theme** collection organizes the vocabulary into thematic groups like "workplace" or "school," enabling users to concentrate on areas of specific interest or relevance. Each theme is uniquely identified and described, allowing for the structured presentation of learning materials and the design of thematic learning modules within the application.

Together, these collections form a comprehensive database schema that supports the functionality of a sophisticated language learning platform. The schema is designed not only to facilitate current application features but also to allow scalability for future enhancements, such as adding new vocabulary themes, extending user profile attributes, or incorporating advanced user interactions.

### 4.2.2 Backend Components

The backend is built using **Node.js** and **Express**, which allows for efficient routing, handling of user requests, and integration with external APIs. The backend communicates with the MongoDB database and manages the business logic of the system.

- **Framework:**

The backend is structured with **Express** to handle HTTP requests, and **Mongoose** is used for interacting with MongoDB. Each route is designed to process specific functions like handling user authentication, querying the database, and communicating with external APIs (e.g., OpenAI).

- **AI Integration:** The system integrates with **OpenAI's GPT-4 API** to generate dynamic scenarios and analyze user responses for grammar and spelling mistakes. This integration is handled through **HTTP POST requests** to the OpenAI API, which returns AI-generated content to the user.

For example, when a user starts a practice session, the backend sends a request to OpenAI to generate a scenario based on the user's learned vocabularies:

```
const openaiResponse = await openai.chat.completions.create({  
  
  model: 'gpt-4',  
  
  messages: [{ role: 'system', content: `Create a scenario involving the words:  
${themeVocabularies.join(', ')} ` } ]
```

```
});
```

The response is then parsed and displayed to the user, forming the basis of the practice interaction.

### 4.2.3 Frontend Components

The frontend of the system is designed using **HTML**, **CSS**, **JavaScript**, and **Bootstrap** for a responsive and interactive user experience. The user interface provides easy navigation between features like Learn, Practice, Snapshot, and Voice Chat.

- **Interface Design:** The frontend is designed to be responsive and user-friendly. The use of **Bootstrap** ensures that the layout adapts to various screen sizes, providing a consistent experience across devices. Custom **CSS** is used to define the look and feel of different components, such as chat boxes, buttons, and theme selection cards.

For example, in the **Practice Dashboard**, themes are presented as cards, each containing a description and a button to start practicing that theme. The layout adapts seamlessly to different screen sizes:

```
<div class="theme-box">
  <h2>{{this.name}}</h2>
  <p>{{this.description}}</p>
  <a href="/practice?themeID={{this._id}}" class="practice-btn">Practice This Theme</a>
</div>
```

- **JavaScript Functions:** Each feature relies on core JavaScript functions to handle user interactions and communicate with the backend. These functions send user input to the backend and retrieve responses, which are then dynamically displayed.

For example, in the **practice chat** feature, the user's input is sent to the backend using `fetch`, and the response from the AI is displayed in the chatbox:

```
sendBtn.addEventListener('click', async () => {
  const userMessage = userInput.value.trim();
```

```
const response = await fetch('/practice-chat', {
  method: 'POST',
  headers: { 'Content-Type': 'application/json' },
  body: JSON.stringify({ userInput: userMessage })
});

const data = await response.json();

addChatBubble(data.aiReply, 'ai');
});
```

- **Libraries:** Several third-party libraries are used to enhance the user experience:
  - **Bootstrap:** Provides responsive grid layouts, styling components like buttons, forms, and navigation bars.
  - **AOS (Animate On Scroll):** This library is used to add subtle animations to elements as they appear on the screen, making the interface more engaging and dynamic.

```
<div data-aos="slide-up" data-aos-duration="1000">Your learned words are:
{{learnedWords}}</div>
```

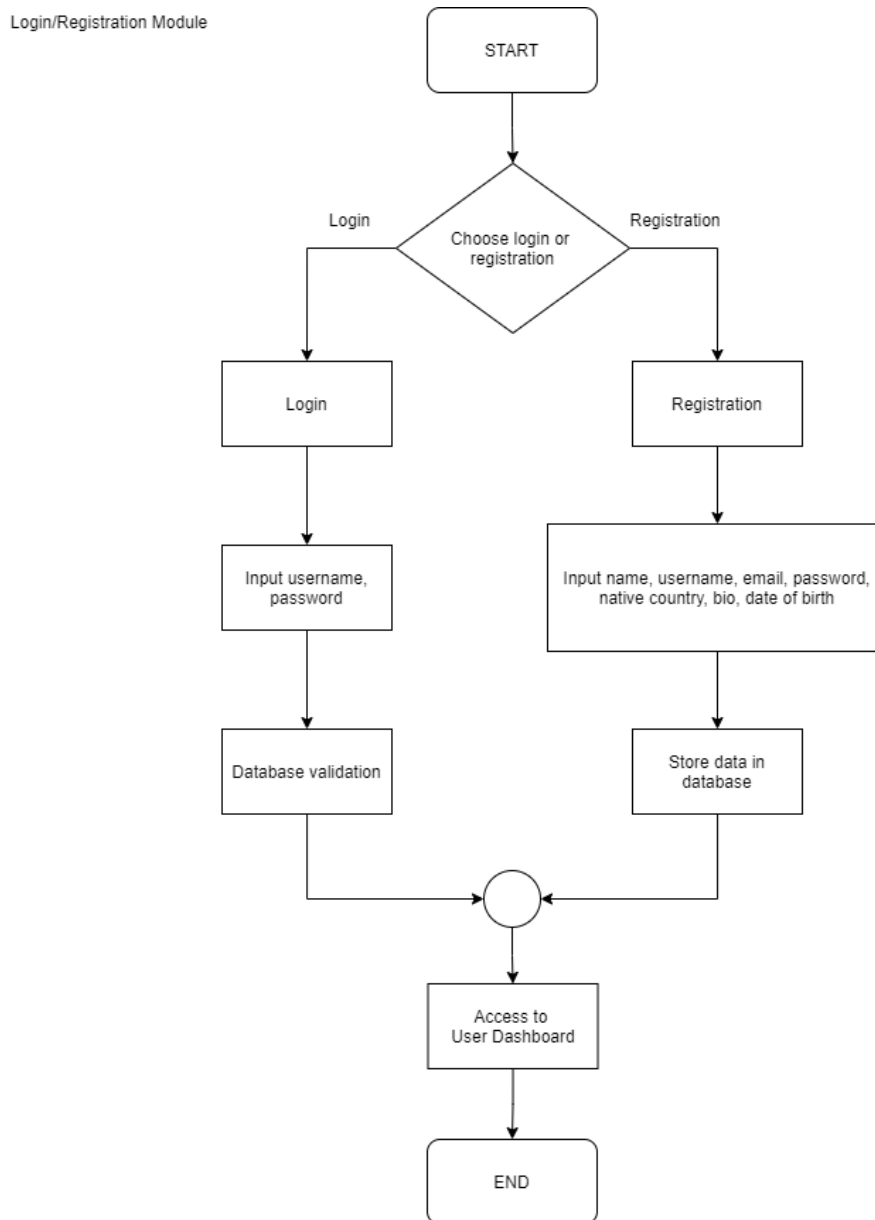
- **SpeechRecognition:** For the voice chat feature, the **Web Speech API** is used to transcribe speech input into text. This text is then processed by the backend for further interactions with the AI.

By combining these components, the frontend delivers a smooth, interactive experience, while the backend handles the business logic and data storage, ensuring a fully functional system.

### 4.3 System Components Interaction Operations

#### 4.3.1 Module Flowcharts

##### 4.3.1.1 User Interface Module

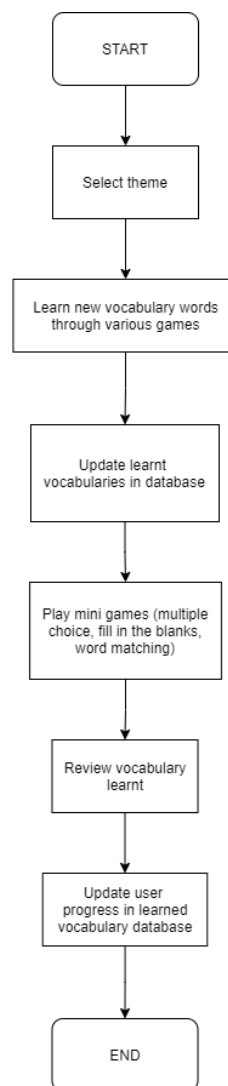


**Figure 4.3.1.1: User Interface Module Flowchart**

When first accessing the application, the user is presented with the option to either log in or register their account. If the user chooses to log in, they input their username and password, which the system validates against the database. Successful validation grants access to the user dashboard, where they can engage with the learning modules. Alternatively,

if a new user opts to register, they are prompted to input their name, username, email, password, native country, bio, and date of birth. This information is stored in the database, and upon completion of the registration, the user is directed to the user dashboard, where they can choose what they want to do next within the application and marking the end of the registration process and the beginning of the learning journey.

### 4.3.1.2 Learning Module



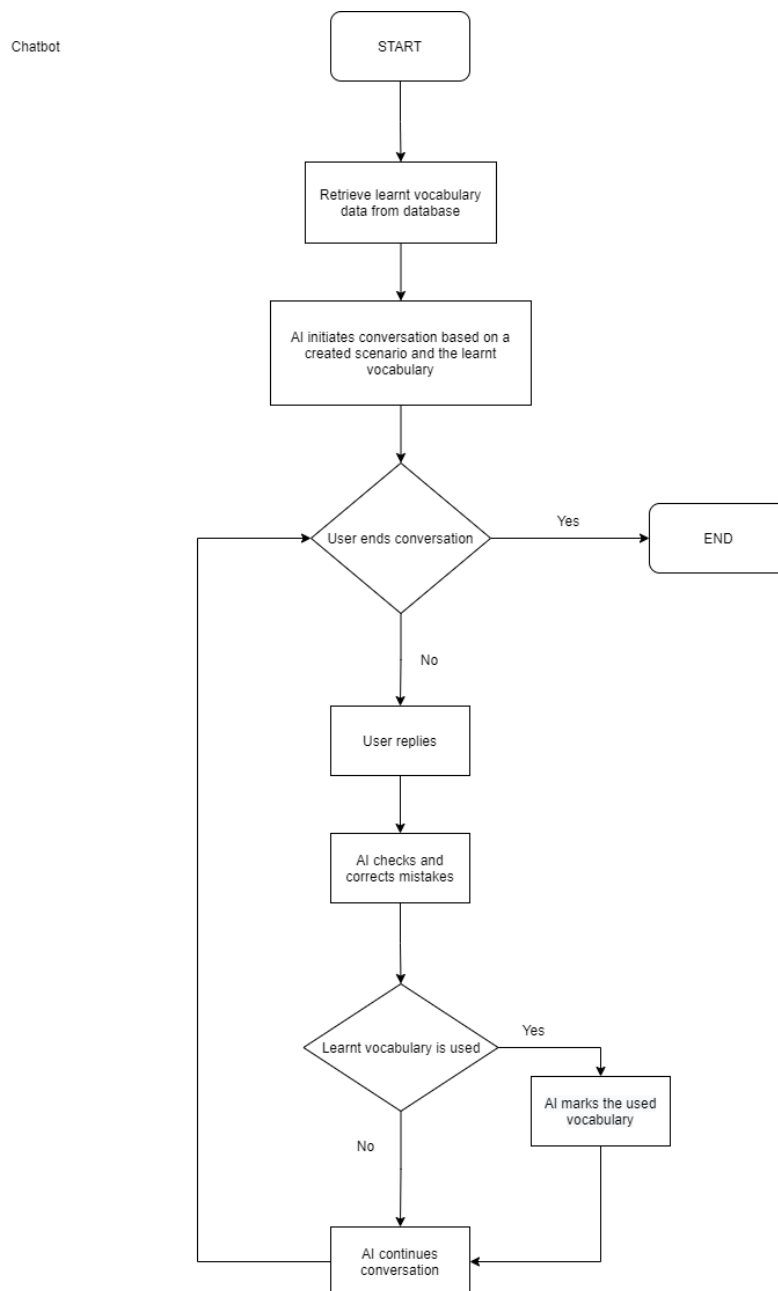
**Figure 4.3.1.2: Learning Module Flowchart**

The learning module's flow begins when a user selects a specific theme to study. After the selection, the user is presented with new vocabulary words to learn, complete with definitions, imagery, and usage examples. As the user engages with the learning material,



their interactions and new knowledge are updated in the vocabulary database, ensuring that their progress is tracked and saved. Subsequently, the user is given the opportunity to reinforce their learning through mini-games like multiple-choice questions, fill-in-the-blanks, and word matching. The final step involves reviewing the vocabulary to cement the user's understanding before the system updates their overall progress. The process is designed to be a comprehensive learning cycle that facilitates vocabulary acquisition and application.

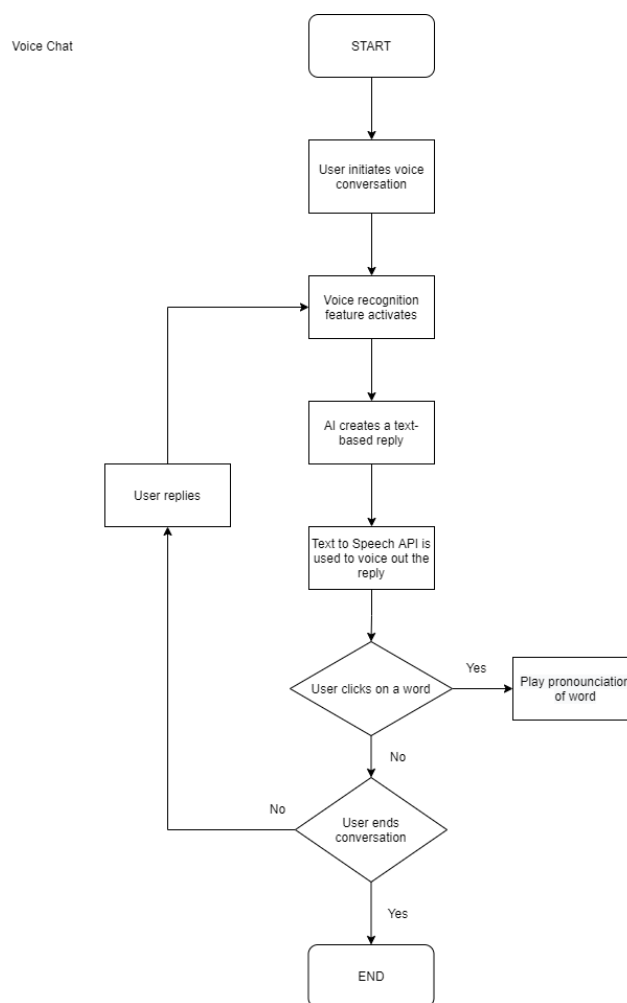
### 4.3.1.3 Chatbot Module



**Figure 4.3.1.3: Chatbot Module Flowchart**

The Chatbot flowchart delineates the steps involved when a user interacts with the chatbot for conversational practice in the application. It starts with the system retrieving the user's learned vocabulary data from the database to personalize the interaction. The user can also choose which theme of the learned vocabulary they want to practice with. The AI, leveraging the GPT-4 model, then initiates a conversation based on a scenario that incorporates the user's learned vocabulary, facilitating an engaging and relevant dialogue. The conversation progresses with the user responding to the AI's prompts, which may involve the use of learned vocabulary. If the user employs the newly learned words correctly, the AI marks the vocabulary as used, reinforcing the learning process. If not, it simply continues with the conversation until the user chooses to end the conversation.

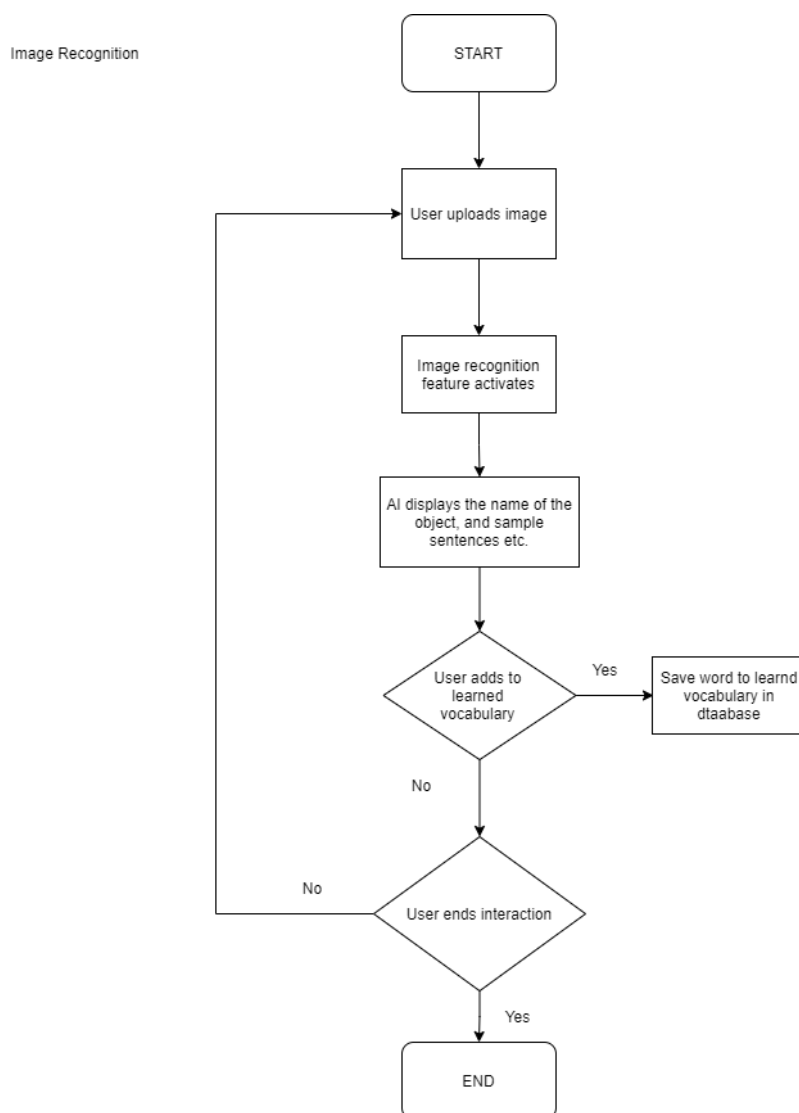
#### 4.3.1.4 Voice Conversation Module



**Figure 4.3.1.4: Voice Conversation Module Flowchart**

The Voice Conversation flowchart outlines the interaction between the user and the application's AI through voice communication. This interaction starts with the user initiating a voice conversation, which triggers the voice recognition feature of the system. As the user speaks, their voice input is captured and converted into text by the voice recognition module. The AI then processes this text to create an appropriate text-based reply, relevant to the context of the conversation. This reply is then converted back into speech using the Text-to-Speech API, which is played back to the user. The conversation continues in this manner, with the user replying and the AI responding, until the user decides to end the conversation.

#### 4.3.1.5 Image Recognition Module



**Figure 4.3.1.5: Image Recognition Module Flowchart**

The Image Recognition flowchart begins when a user initiates the process by uploading an image to the application. Following the upload, the image recognition feature is activated, which analyzes the image using advanced AI algorithms. The application, through its AI functions module, then displays relevant information extracted from the image, such as the name of the object, its definition, and sample sentences incorporating the identified vocabulary. The user is presented with a choice to either end the interaction or continue exploring more objects and vocabulary. If the user chooses to continue, the flow loops back to the image upload step, enabling the user to learn additional vocabulary through further image recognition.

## Chapter 5

# System Implementation

### 5.1 Hardware Setup

**Table 5.1.1: Hardware Specifications**

<b>Hardware Specifications</b>	
<b>Device Model Name</b>	Acer Swift SF314-43
<b>Operating System</b>	Windows 11
<b>System Type</b>	64-bit operating system, x64-based processor
<b>Graphics Processor</b>	AMD Radeon Graphics
<b>Processor</b>	AMD Ryzen 7 5700U
<b>RAM</b>	16.0GB
<b>SSD Capacity</b>	512GB PCIe NVMe SSD
<b>Network/Connectivity Technology</b>	802.11a/b/g/n+ax wireless LAN -Dual Band (2.4GHz and 5GHz) -Supports MU-MIMO RX technology -Supports Bluetooth 5.2

### 5.2 Software Setup/Specifications

- Diagram Drawing Tools:

### **Draw.io**

Draw.io is a useful tool to create diagrams with various shapes, texts and colours. It has a user-friendly interface and can export the diagrams as various high quality image formats such as PNG or JPG.

- Programming Tools:

### **HTML:**

The standard markup language for creating web pages, HTML forms the structural layer of web applications, allowing for the organization and presentation of content on the internet.

### **CSS:**

The style sheet language used to describe the presentation of a document written in HTML or XML, CSS specifies how elements should be rendered on screen, providing the look and design of web pages.

### **JavaScript:**

A versatile scripting language that enables interactive web features. It is used to enhance user experiences by allowing dynamic content execution on web pages.

### **Node.js:**

An open-source, cross-platform, JavaScript runtime environment that executes JavaScript code outside a web browser, enabling server-side scripting and creating dynamic web page content.

### **Express.js:**

A web application framework for Node.js, it simplifies the server development process by providing a robust set of features for web and mobile applications.

### **Visual Studio Code:**

An extensible code editor provided by Microsoft that supports a variety of programming languages, VS Code is known for its powerful features such as debugging, task running, and version control.

**Webflow:**

A design tool that allows developers and designers to construct responsive websites using a visual editor, which translates design choices into clean HTML, CSS, and JavaScript.

**Postman:**

An API platform for building and using APIs. Postman simplifies each step of the API lifecycle and streamlines collaboration so you can create better APIs faster.

**MongoDB:**

A document-oriented NoSQL database used for high volume data storage. It is known for its flexibility and scalability, often used in modern web applications for dynamic data storage.

**Google Web Speech API:**

The Google Web Speech API is a powerful tool designed for integrating voice recognition and synthesis capabilities into web applications.

**OpenAI GPT-4 API:**

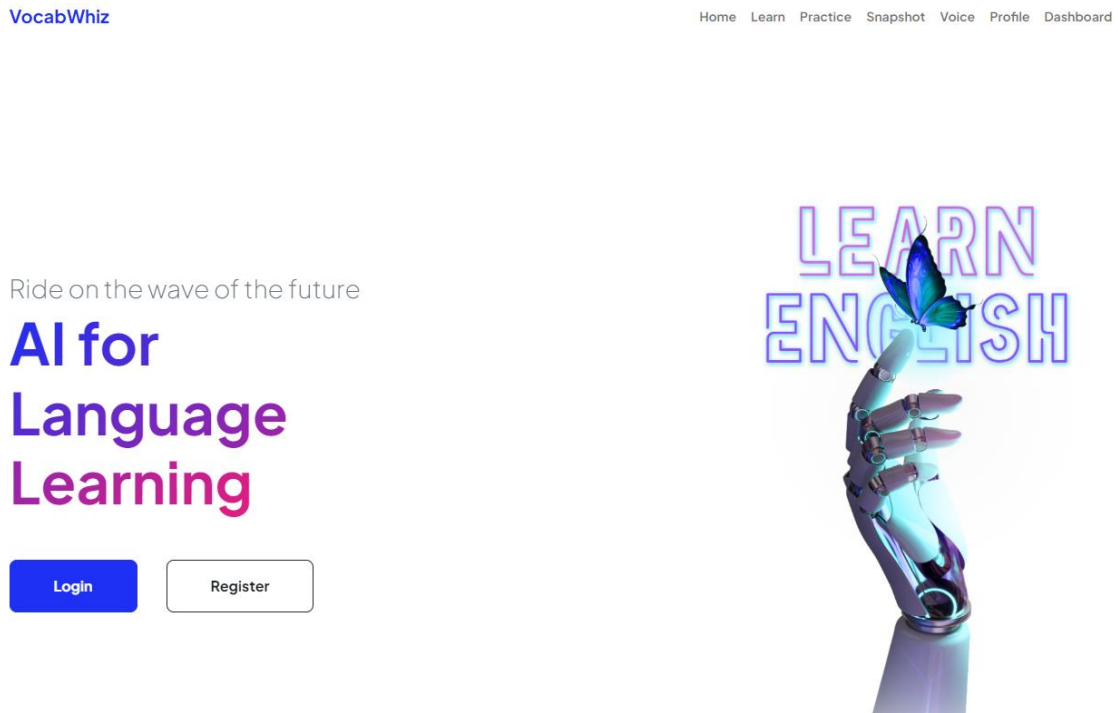
The fourth in OpenAI's line of GPT foundation models, GPT-4 is a powerful multimodal large language model that had advanced NLP capabilities as well as image generation and image recognition capabilities.

**Voiceflow:**

A platform that allows users to build and deploy chatbots with multiple functionalities powered by AI such as OpenAI's GPT models or even Anthropic's Claude models.

## 5.3 System Operation (Screenshots)

### 5.3.1 Home Page



**Figure 5.3.1.1: Home Page**

The homepage of "VocabWhiz" showcases a sleek and modern interface with a clear focus on futuristic language learning through AI. In this page, users can click on either the login or register button to sign up for an account and access their user profile. The top navigation includes Home, Learn, Practice, and Contact, suggesting a comprehensive learning structure. If the user is not logged in, they would not be able to access the learn, practice or dashboard sections.



### 5.3.2 Vocabulary Learning Feature

## Learning Dashboard

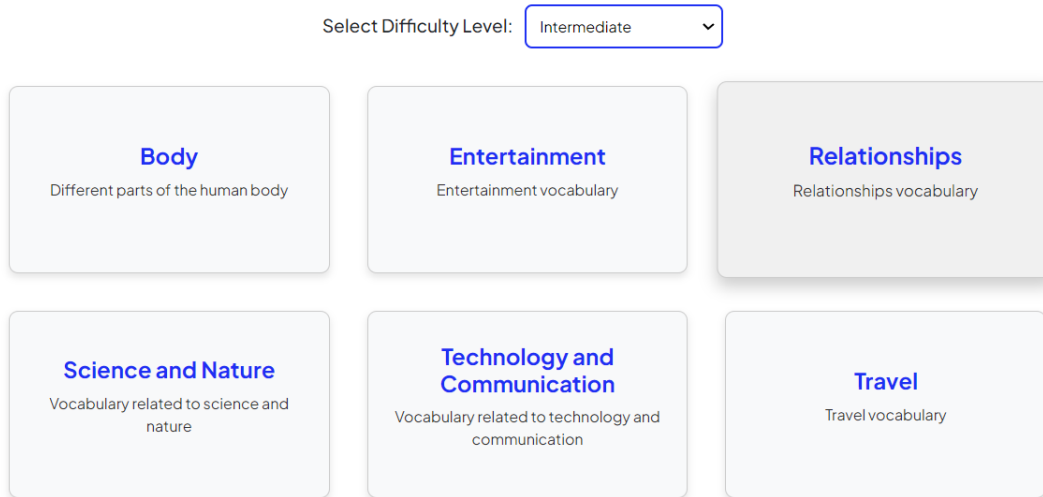


Figure 5.3.2.1: Learning Dashboard

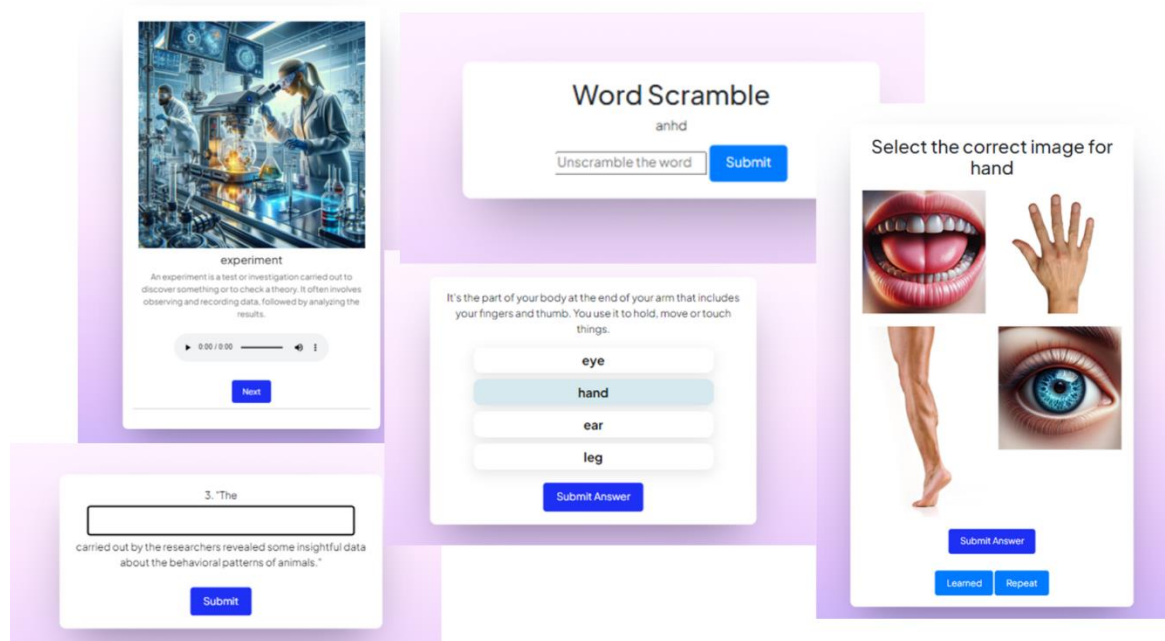
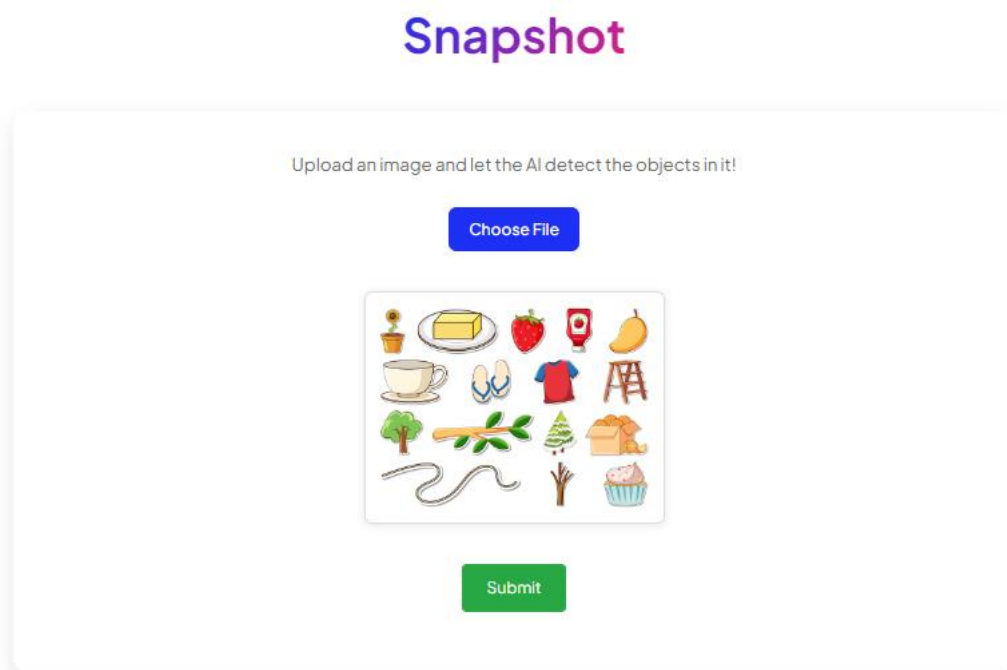


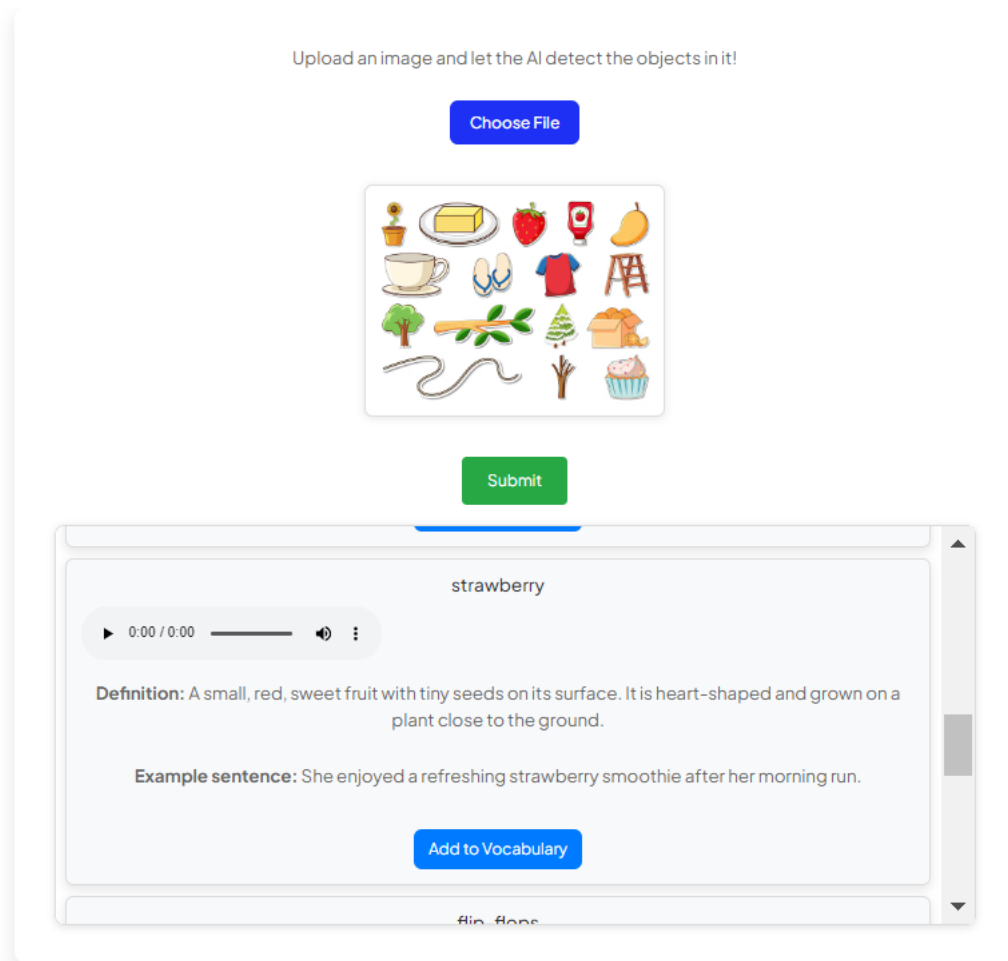
Figure 5.3.2.2: Learning Mini Games

Based on Figure 5.3.2.1 and Figure 5.3.2.2, these are the sample language learning interface section that showcases the basic functions of the language learning web application. In the dashboard, users can choose the difficulty level of the vocabularies they wish to learn, and for each difficulty level, there are various themes that users can choose to learn. After choosing a theme, the user will be redirected to the learning games where it randomly iterates through mini games to help the user learn the vocabulary. The user will be shown the word, the definition, the picture, and the audio file to play before moving on to other mini games. These sections are made to gamify the user learning experience as well as improve the retention of the learned vocabulary.

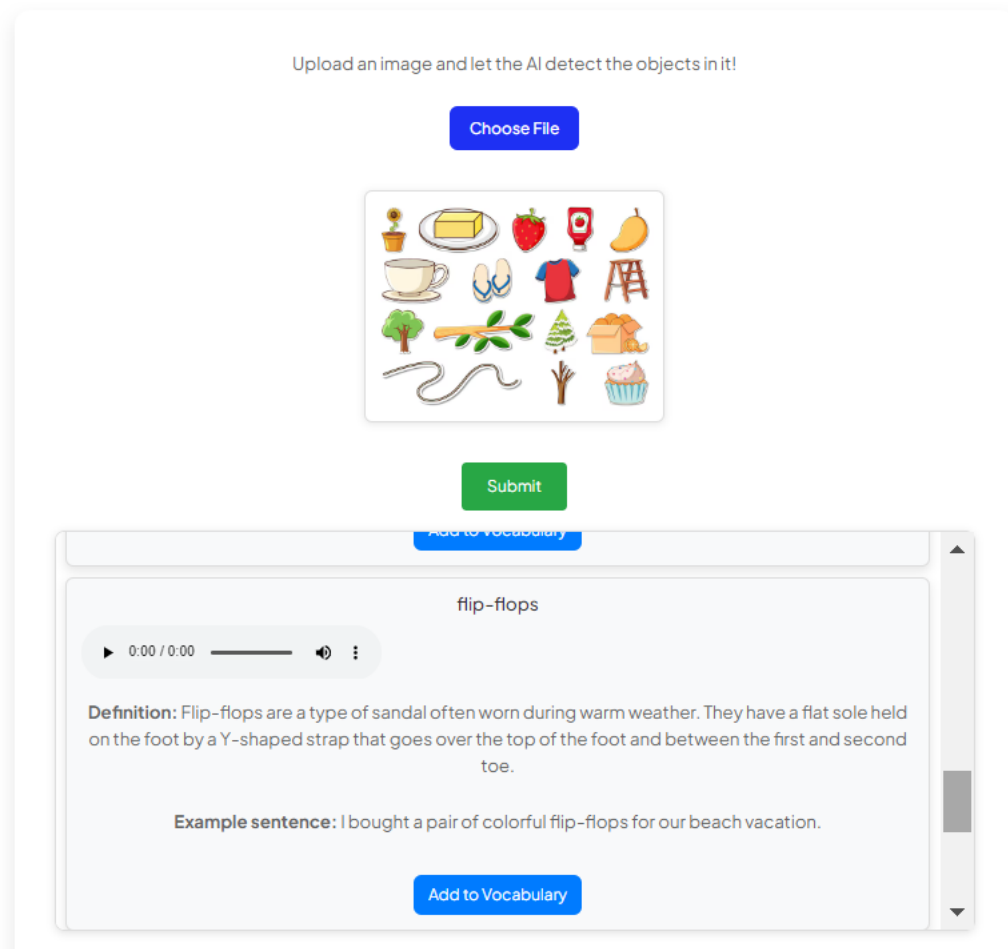
### 5.3.3 Snapshot



**Figure 5.3.3.1 Image Uploaded on Snapshot Feature**



**Figure 5.3.3.2 Word “Strawberry” Definition, Pronunciation and Audio**



**Figure 5.3.3.3 Word “Flip-Flops” Definition, Pronunciation and Audio**

In the Snapshot feature, the AI plays a heavy role in object and image recognition in images. So users can upload pictures or their own images that they capture from everyday life and ask the AI to analyze the different vocabularies that are present in the picture. For example, in Figure 5.3.3.1, an image of various objects is uploaded to the Snapshot interface. Then, the AI will analyze it and display the different vocabularies in the picture, as well as display how to pronounce the word, what it means and an example sentence depicting the usage of the word as shown in Figure 5.3.3.2 and 5.3.3.3 with the word “Strawberry” and “Flip-Flops”.

### 5.3.4 Practice Feature

## Your Learned Vocabularies

### Miscellaneous

Miscellaneous vocabulary

**necklace:** A necklace is a piece of jewelry that people wear around their necks, often made of materials like gold, silver, or beads and sometimes has a pendant or charm hanging from it.  
Points:

**curtain:** A piece of cloth hung up to cover a window, door, or other opening. It can stop light from coming in or people from looking in.  
Points:

[Practice This Theme](#)

### Family

Vocabulary related to different members of a family

**mother:** A woman who has given birth to a child or, in some cases, acts as a parent to a child.  
Points:

[Practice This Theme](#)

### Technology and Communication

Vocabulary related to technology and communication

**computer:** A machine that carries out instructions to process data in a fast and accurate manner, used for a variety of tasks such as creating documents, browsing the internet, and playing video games.  
Points:

**Figure 5.3.4.1 Practice Dashboard**

## Chat with Lexi

Your learned vocabularies for this theme are: theatre, performance, game, sport. Let me create a scenario!

Two friends are at a theatre where they watch a captivating performance. Later, they discuss the act as well as their common interests: a football game happening the next day and their favourite sport. They aspire to create their own theatrical performance based on this sport.

Yes, I am satisfiedNo, create another scenario

Send

Figure 5.3.4.2 AI Generates Practice Scenario

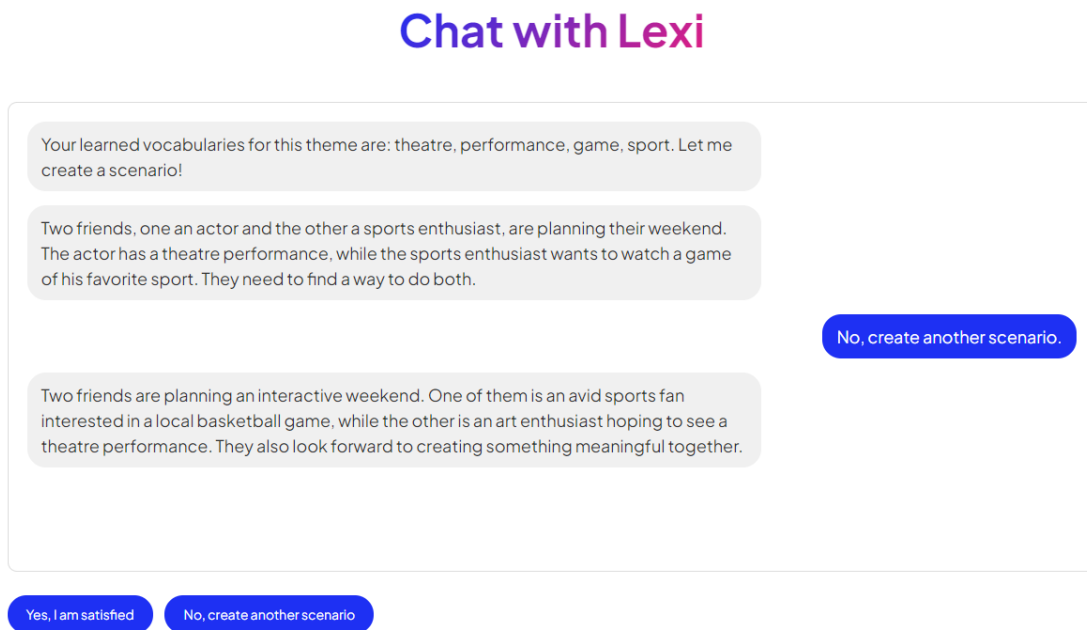


Figure 5.3.4.3: User is Not Satisfied With Scenario Generated

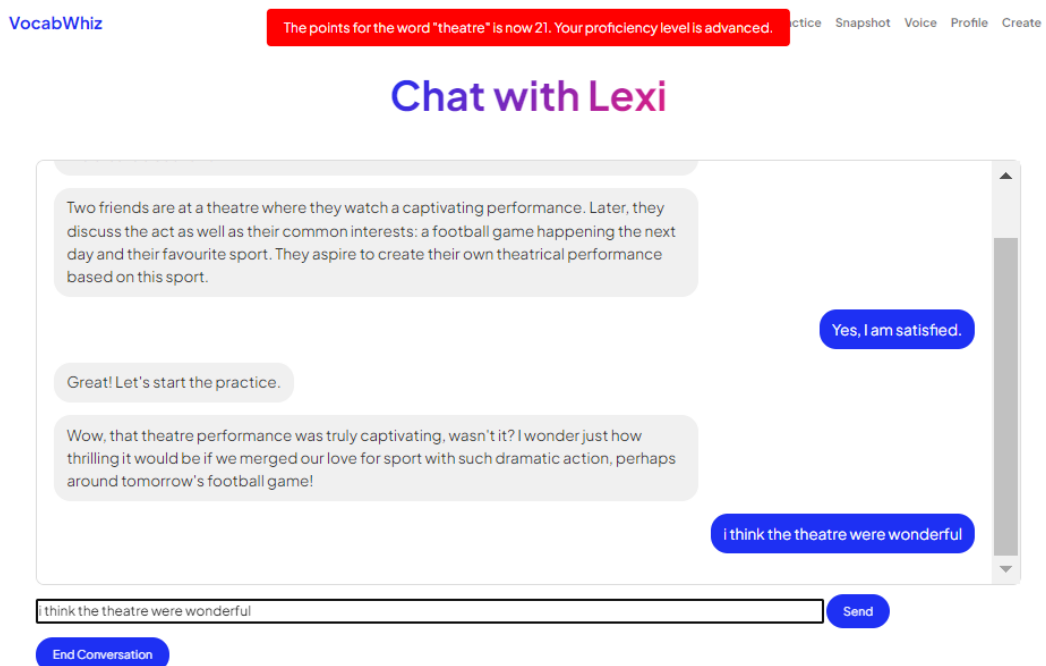
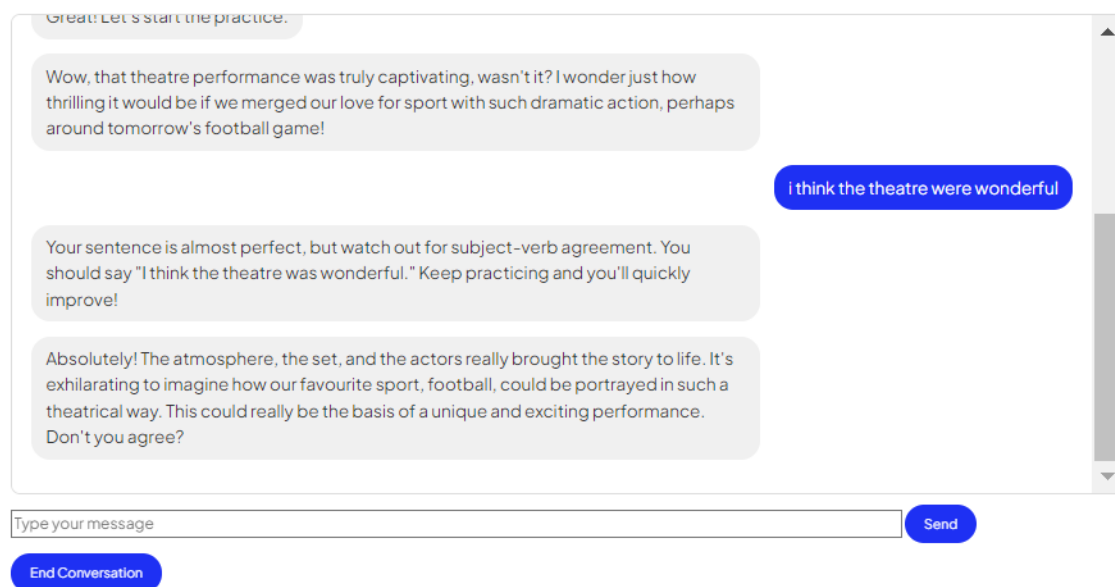


Figure 5.3.4.4 User is Satisfied With Scenario and Progress Tracking

## Chat with Lexi

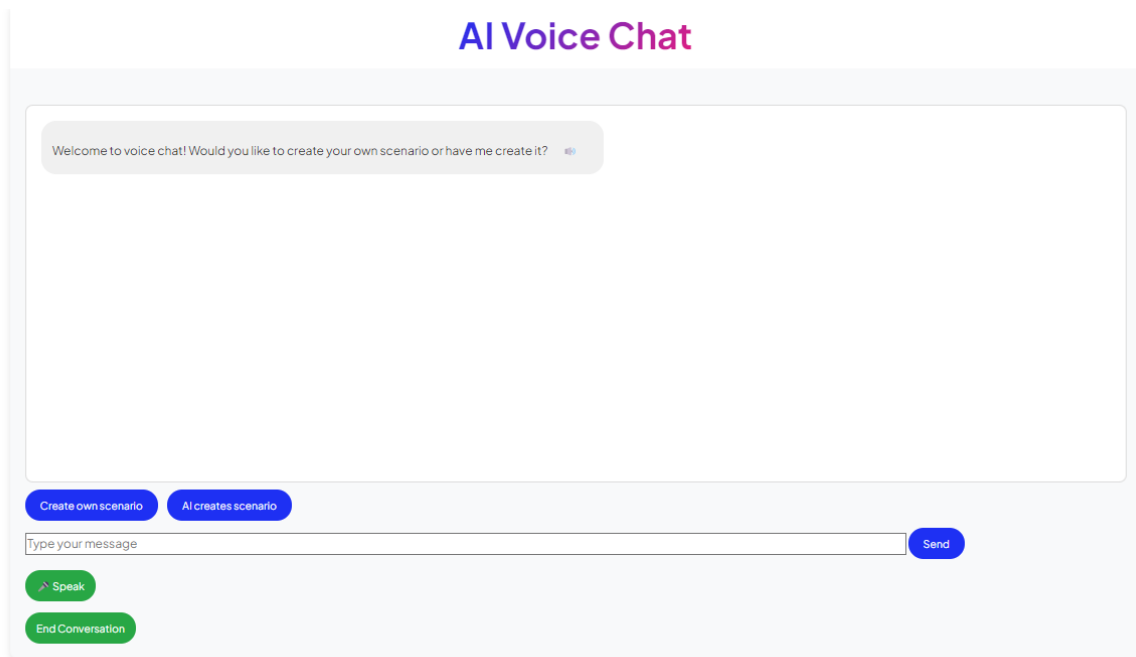


**Figure 5.3.4.5 Chatbot Corrects Mistakes and Continues Conversation**

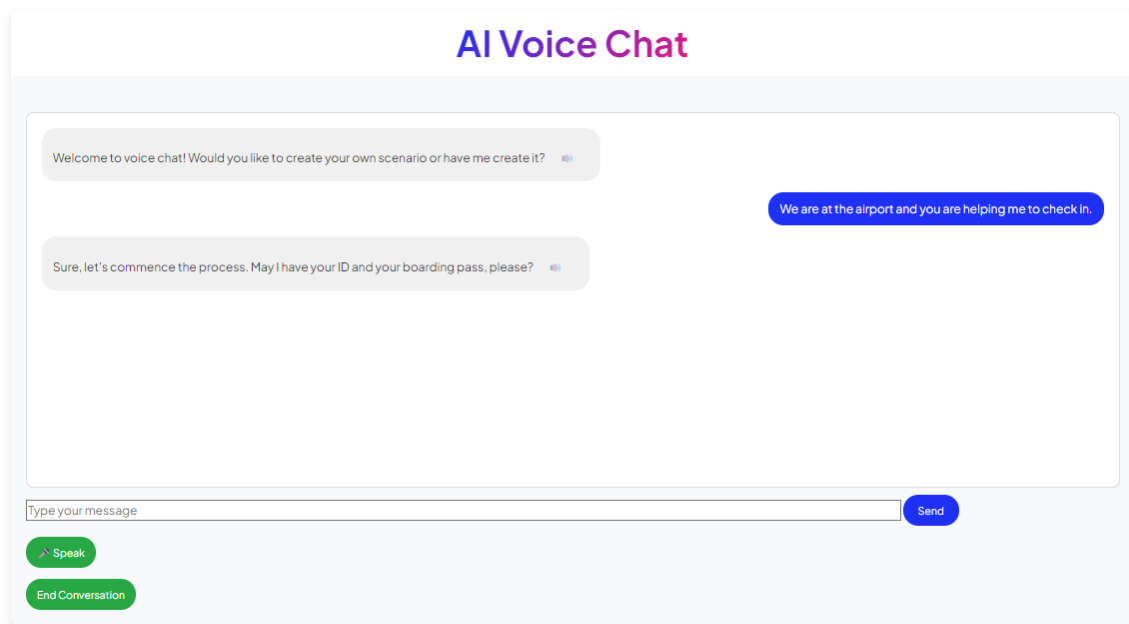
The AI chatbot function is primarily to allow users to test and improve their English writing skills and it is powered by OpenAI's GPT API. As seen in Figure 5.3.4.1, there is a dashboard that shows all the learned vocabularies of the user separated by theme. The user can even choose individual words to practice from different themes. When the user does choose, the list of vocabulary is sent to the chatbot and it will come up with a scenario to help facilitate a conversation with the user based on the words as shown in Figure 5.3.4.2. After that, user can choose whether they are satisfied with the given scenario. If they are not, the AI will generate another scenario as shown in Figure 5.3.4.3.

Once the user is satisfied, the AI starts the conversation and also tracks the user's responses for usage of learned vocabularies. For example, the user uses the word "theatre" as shown in Figure 5.3.4.4, and the usage is detected and their proficiency level point for that word is increased in the database. This progress tracking helps users track which vocabularies they use more often, and how proficient they are at using it. Other than that, as shown in Figure 5.3.4.5, the AI also checks and analyses the user's response for any grammatical or spelling mistakes and errors. Then, it proceeds to correct the user and continues on with the conversation. This practice feature is greatly useful for users to implement the vocabularies that they have learnt in actual conversation.

### 5.3.5 Voice Chat Feature

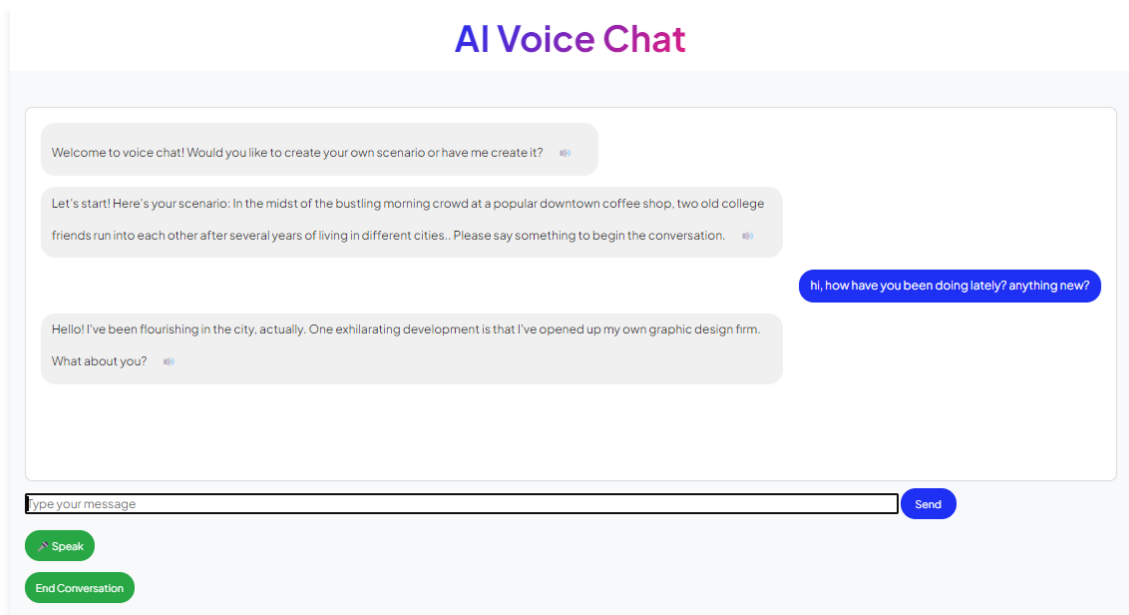


**Figure 5.3.5.1: Voice Chat Initialization**

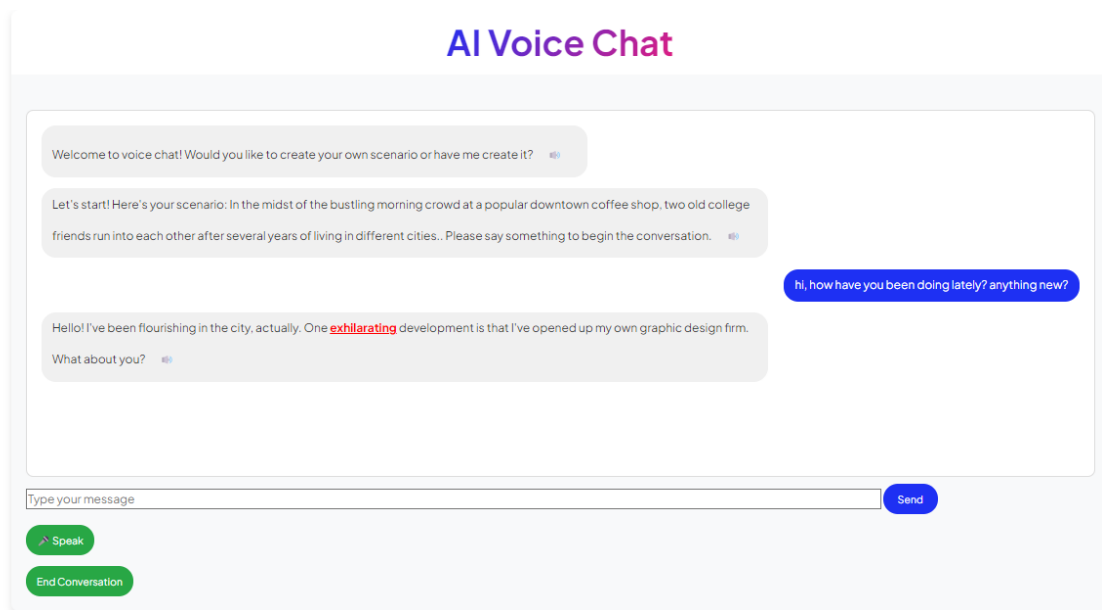


**Figure 5.3.5.2: User Creates Scenario**





**Figure 5.3.5.3: AI Creates Scenario**









**Figure 5.3.5.4: Choose Words to Pronounce**

The AI voice chat feature is designed to help users with their pronunciation and verbal communication skills. It is similar to the practice feature but with extra functions. For example, in Figure 5.3.5.1, there is an speaker image next to the text from the AI, and this can be clicked to play the pronunciation of the AI response. There is also a green “Speak” button that users can click to reply to the AI and their speech will be converted to text for the AI to analyze and respond to. Or if the user chooses not to speak, they can also type their

responses. Scenarios will also be created either by the user or the AI. So in this case, the user can choose to generate their own scenario such as “We are at the airport”, or “Help me get ready for a job interview” as shown in Figure 5.3.5.2. In figure 5.3.5.3, it is an example of the AI generating the scenario for the user. Similar to the practice feature, progress tracking is also implemented to track whether a user uses learned vocabularies and it is updated in the database. Since this feature helps with pronunciation, users can also click on any word in the chat bubbles and the pronunciation audio of that word will be highlighted played as shown in Figure 5.3.5.4. This is an extra nifty feature for users who want to repeat the pronunciation of certain advanced words.

### 5.3.6 Learned Vocabularies Dashboard

#### Your Learned Vocabularies

WORD	POINTS	PROFICIENCY LEVEL	BADGE
mother	3	beginner	
necklace	0	Beginner	
computer	11	intermediate	
curtain	17	advanced	
theatre	0	beginner	
performance	0	beginner	

**Figure 5.3.6.1: Learned Vocabularies Dashboard**

The learned vocabularies dashboard will display the various learned vocabularies of each user, as well as their points and proficiency level and a corresponding badge. The more a user practices a certain word, the higher the points, and over 8 points is considered intermediate level, while anything over 12 points is considered advanced level. This handy feature helps users to keep track of the vocabularies they’ve learned and which one they use the most frequently, which ones they can try to use more, and gives a sense of satisfaction if they can reach the advanced level.

### 5.3.7 User Management

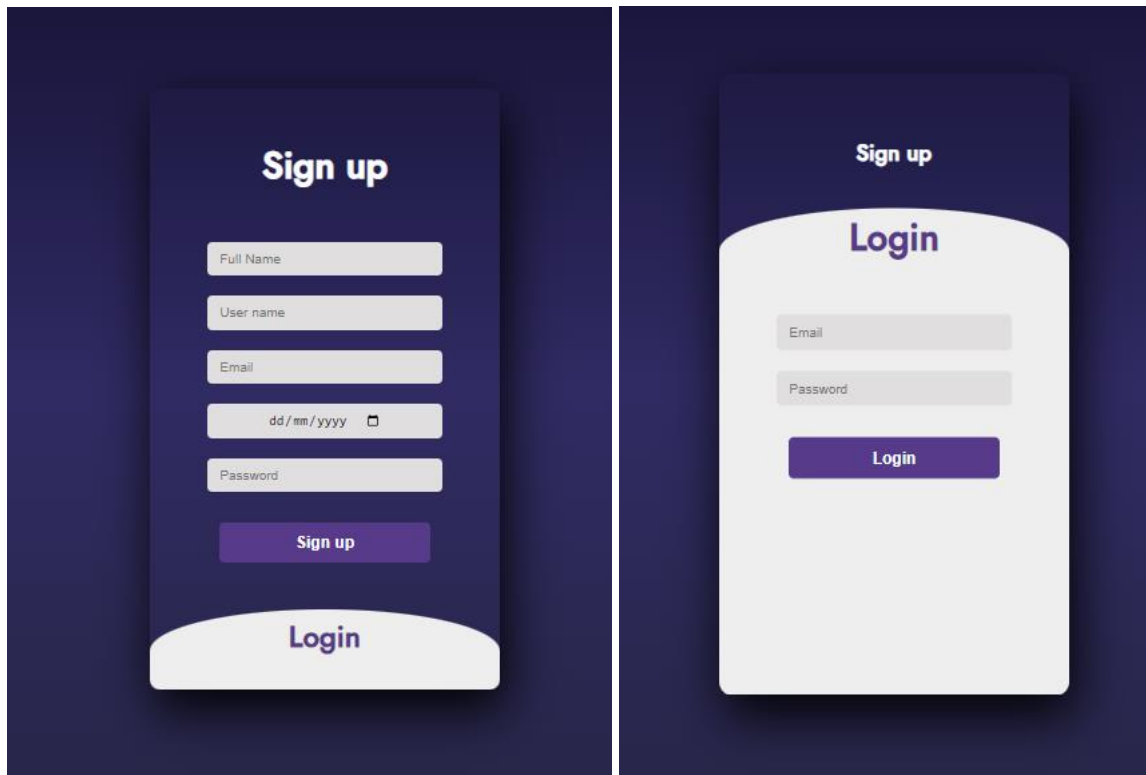
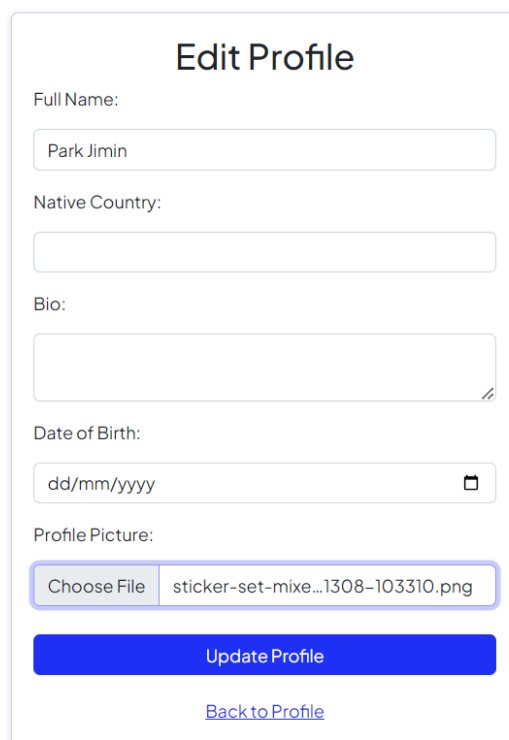


Figure 5.3.7.1: Sign Up/Login Interface



Figure 5.3.7.2: User Profile



**Edit Profile**

Full Name:  
Park Jimin

Native Country:

Bio:

Date of Birth:  
dd/mm/yyyy

Profile Picture:  
Choose File sticker-set-mixe...1308-103310.png

**Update Profile**

[Back to Profile](#)

**Figure 5.3.7.3: Edit Profile Interface**

For user management and differentiating between different users, new users can register their information or login if they already have an account as shown in Figure 5.3.7.1 by filling in their name, username, date of birth etc. Once they have logged in, users can access their profile, the various features of VocabWhiz, and even edit their profile by adding customizations such as uploading a profile picture and writing a short bio entry. These all add to the personalization and customization of the application so that users are able to connect more to the application.

#### 5.4 Implementation Issues and Challenges

The development of an AI-Driven Web Application for Enhanced Vocabulary Language Learning presents several implementation issues and challenges that need to be addressed to ensure a successful and functional final product. One of the foremost challenges lies in the integration of various APIs, including the GPT-4 API for natural language processing and the Google Web Speech API for voice recognition and interaction. Ensuring seamless communication and data exchange between these independent services is important but difficult, as inconsistencies or delays in processing can significantly detract from user

experience. This integration becomes more complex with the need to maintain high accuracy in language processing and a swift, responsive interface that users expect from modern applications.

Another significant challenge is the need to navigate through multiple programming paradigms and structures simultaneously. The development process encompasses front-end and server-side coding, database management, and ensuring real-time updates to user data without impacting the user's learning progress. Each of these components involves different technologies and frameworks that developers must be proficient in. For instance, the front-end development requires a keen understanding of user interface design and interactivity, which is starkly different from the logic and data-driven focus of server-side development and database management.

A notable challenge during the project was managing the logic for tracking user progress, particularly when handling learned vocabularies. This required designing a flexible database schema that could track user-specific vocabularies, proficiency levels, and usage patterns across different learning modules (such as practice, snapshot, and voice chat). Ensuring that real-time progress updates were reflected accurately without impacting the user's interaction flow was complex, as it required synchronizing data retrieval, updates, and user feedback seamlessly. The added need for detecting the use of learned vocabularies in user responses during practice and voice chat further complicated the data handling logic, requiring optimized database queries and efficient comparison algorithms to ensure the user's progress was correctly tracked.

Building a conversational AI system for practice sessions that could dynamically generate scenarios based on learned vocabularies presented its own set of challenges. Integrating the GPT-4 model to generate relevant conversational prompts while maintaining coherence with the user's learned words was a difficult balance to strike. Furthermore, developing the backend logic to analyze user responses for spelling and grammar mistakes, while offering constructive feedback in real-time, required the system to handle both natural language understanding and educational feedback without introducing delays or inaccuracies.

Testing the system for performance and reliability also posed a challenge, particularly due to the need for handling multiple user interactions concurrently while maintaining a smooth user experience. Real-time communication between the backend, database, and AI services,

along with the need for error handling, led to extensive debugging and optimization work. Any lag in response times or inaccurate feedback could diminish the educational value of the application, making this a critical aspect of development.

### **5.5 Concluding Remark**

In conclusion, the implementation of the AI-Driven Web Application for Enhanced Vocabulary Language Learning successfully integrates advanced technologies such as GPT-4 and Google Web Speech API to create an interactive and dynamic learning environment. The development process involved overcoming challenges related to API integration, database management, real-time user interaction, and tracking progress across multiple learning modules. Through careful planning, testing, and optimization, the system provides an effective platform for users to improve their language skills, with features that offer personalized feedback and track their learning journey. The project demonstrates the potential of AI-driven solutions in the field of language education, offering a comprehensive and user-friendly tool for vocabulary learning.

## Chapter 6

# System Evaluation and Discussion

### 6.1 System Testing and Performance Metrics

#### 6.1.1 User Requirements

##### Functional Requirements

##### Registration and Authentication:

1. **Registration:** Users should be able to register for a new account by providing a username, email, and password.
2. **Login:** Users should be able to log in to their account using their registered email and password.

##### Main Dashboard:

1. **View Vocabulary Themes:** Users should be able to browse and select different themes like "fantasy", "workplace", "school" to learn associated vocabulary.
2. **Learning Sessions:** Users should be able to start vocabulary learning sessions based on chosen themes and difficulty levels.

##### Vocabulary Learning:

1. **Interactive Learning:** Users should be able to engage with vocabulary through interactive exercises, including multiple-choice questions and fill-in-the-blank tests.
2. **Progress Tracking:** Users should be able to view their learning progress, including new words learned and proficiency levels.

##### AI Interaction:

1. **Chatbot Conversations:** Users should be able to practice vocabulary in a conversational context with an AI chatbot.
2. **Voice Recognition:** Users should be able to speak to the chatbot and receive voice feedback for pronunciation and conversation practice.

3. **Image Recognition:** Users should be able to upload image files of objects and the AI will tell them what the object is using image recognition technology.

#### **User Profile Management:**

1. **Edit Profile:** Users should be able to update personal details like their profile picture, native country, and bio.

#### **Non-functional Requirements**

##### **Accuracy:**

**Correct Data Retrieval:** The system should consistently provide accurate vocabulary example and exercises.

##### **Reliability:**

**Consistent Uptime:** The system should maintain a high level of uptime with minimal service disruptions or downtime.

##### **Usability:**

**Intuitive Interface:** The system interface should be intuitive, allowing users to navigate and use features without confusion or the need for extensive instructions.

##### **Performance:**

**Device Compatibility:** The system should be optimized to run effectively across various devices and platforms, ensuring responsive design and interaction.

### **6.1.2 System Performance Definition**

The AI-Driven Web Application for Enhanced Vocabulary Language Learning is designed to deliver a highly accurate and responsive educational experience. The system's core functionality hinges on the precision of its language processing, ensuring that vocabulary words, translations, and usage examples are presented with exactness that mirrors real-world language use. Moreover, the application is optimized for performance, with vocabulary exercises and AI interactions loading swiftly, maintaining a response time of less than two seconds, crucial for sustaining user engagement and facilitating a seamless learning



flow. When users engage with the learning modules, including interactive exercises and chatbot conversations, the system is designed to adapt and update content without latency, thus providing an uninterrupted and cohesive learning experience. The synchronization of user progress across various devices and sessions is meticulously maintained, ensuring that learners can pick up exactly where they left off, with all their learned vocabulary, proficiency levels, and settings intact. This performance reliability fosters user trust and supports the continuity of language learning endeavors.

### **6.1.3 Verification Plan**

The validation plan for the AI-Driven Web Application for Enhanced Vocabulary Language Learning will be conducted through a series of systematic and thorough testing procedures aimed at ensuring the application functions as intended and provides a seamless user experience.

#### **1. Registration and Login Validation:**

The application's registration and login functionalities will be rigorously tested using both valid and invalid data inputs. This will include testing various edge cases for user input, such as email formats, password strength requirements, and handling of incorrect credentials. The system's response to these inputs will be measured against expected outcomes, such as successful account creation or appropriate error messages.

#### **2. Interactive Learning Modules Validation:**

The core vocabulary learning modules, including lessons, quizzes, and AI chatbot interactions, will undergo extensive testing. This will involve validating the system's ability to present accurate vocabulary data, track user progress, and adaptively respond to the learner's proficiency level. Tests will include the verification of the AI's responsiveness to user inputs in both text and speech, ensuring that the voice recognition software accurately interprets and processes various accents and dialects within an acceptable error margin.

#### **3. User Profile Management Validation:**

Changes to user profiles and preferences will be tested to ensure they are reflected accurately across the platform. This includes updates to personal details like profile pictures, native country, and bio, as well as settings such as language preferences. The system will be

assessed on its ability to save these changes correctly and to maintain user data integrity across sessions.

#### 4. Non-Functional Aspects Validation:

Apart from functional correctness, the application's non-functional aspects, such as load times and system stability will also be tested. Performance benchmarks will be set to evaluate the application under various conditions and user loads to ensure it meets the standards set forth in the system performance definition.

### 6.2 Testing Setup and Result

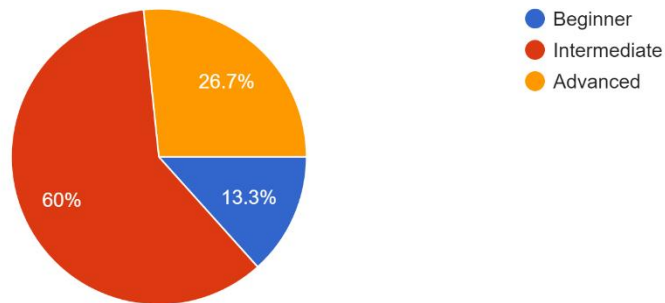
For the testing setup, I used Google Forms to create a survey aimed at evaluating the experience and effectiveness of my web application. Below shows the form created on Google Form along with the various questions and answers and elaborations on the insights derived from the survey answers. A total of 15 respondents participated in the survey.

The image shows a screenshot of a Google Form titled "AI-Driven Web Application for Enhanced Vocabulary Language Learning Survey Form". The form is displayed on a light purple background. The title is in a large, bold, black font. Below the title, there is a paragraph of text explaining the survey's purpose: "This survey is part of a research project aimed at evaluating the effectiveness of a language learning web application. Your participation is voluntary, and all responses will be kept confidential. The information collected will only be used for research purposes and to improve the functionality and user experience of the application. No personally identifiable information will be shared or published." Below this paragraph, there is another paragraph: "Please note that by submitting your responses, you consent to the collection and use of your feedback in this study. If you have any concerns or would like to withdraw your participation, you may do so at any time by contacting the researcher." At the bottom of the form, there is a thank you message: "Thank you for your participation and valuable input." Below the thank you message, there is a line with the email address "michellemalindo@gmail.com" and a "Switch account" link. To the right of the email address, there is a small icon of a cloud with a checkmark. At the bottom of the form, there is a red asterisk followed by the text "\* Indicates required question".

**Figure 6.2.1: Survey Form**

What would you rate your English level of proficiency?

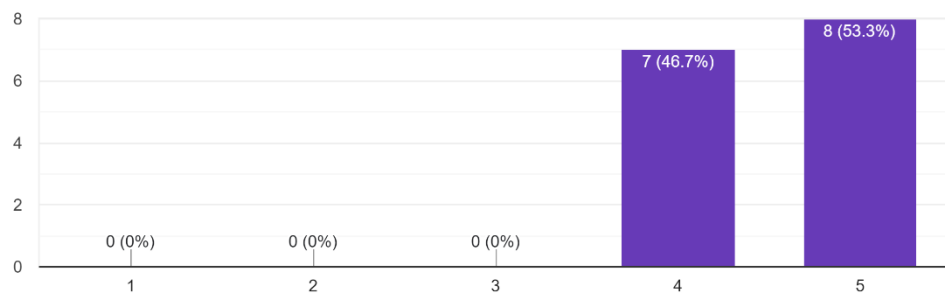
15 responses



**Figure 6.2.2: Survey Question 1**

How easy was it to navigate the vocabulary learning web application?

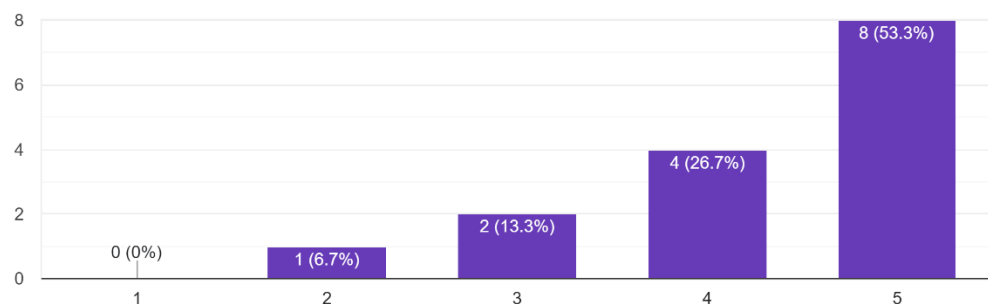
15 responses



**Figure 6.2.3: Survey Question 2**

Did you find the design of the application visually appealing?

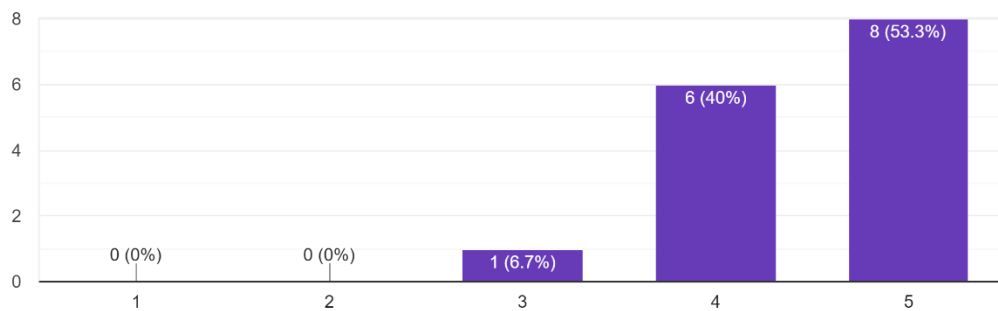
15 responses



**Figure 6.2.4: Survey Question 3**

How satisfied are you with the overall user experience?

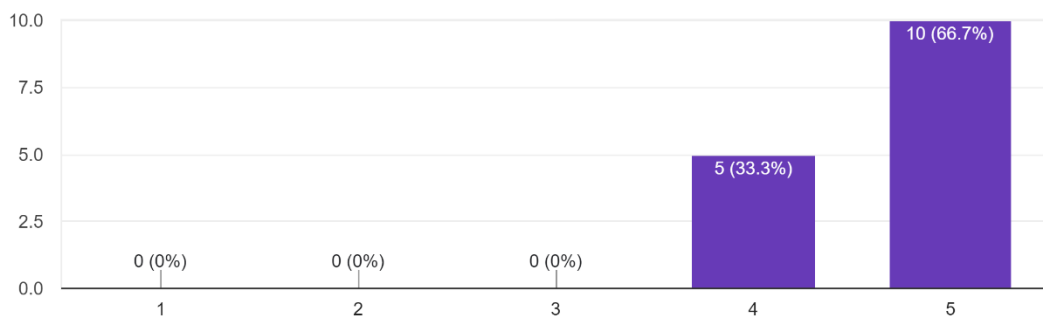
15 responses



**Figure 6.2.5: Survey Question 4**

Do you feel that using this web application helped improve your vocabulary skills?

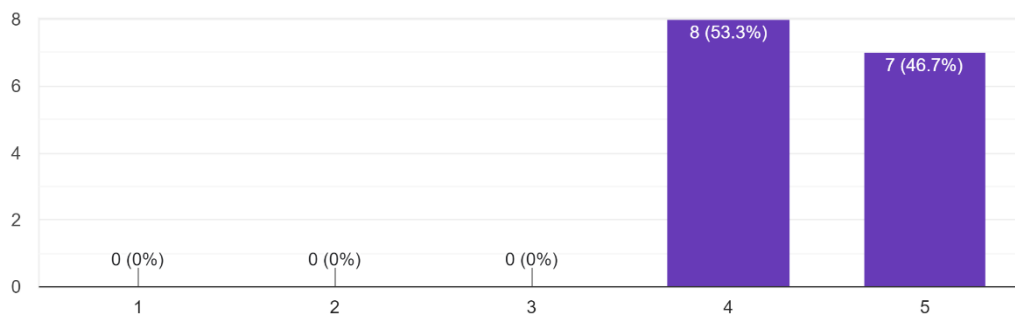
15 responses



**Figure 6.2.6: Survey Question 5**

Did you think the "Learn" feature was useful in enhancing your vocabulary skills?

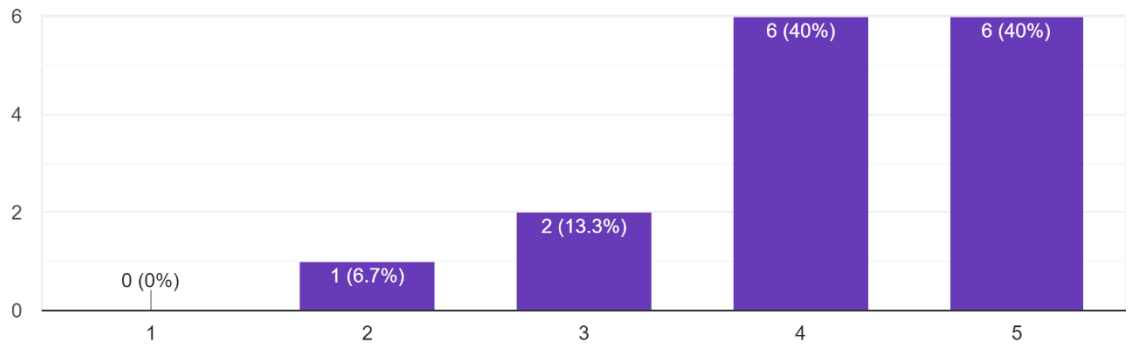
15 responses



**Figure 6.2.7: Survey Question 6**

Did you think the "Snapshot" feature was useful in enhancing your vocabulary skills?

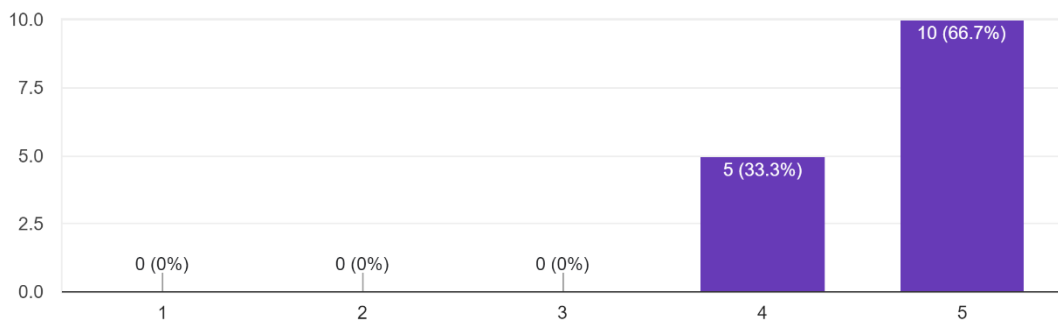
15 responses



**Figure 6.2.8: Survey Question 7**

Did you think the "Practice" feature was useful in enhancing your vocabulary skills?

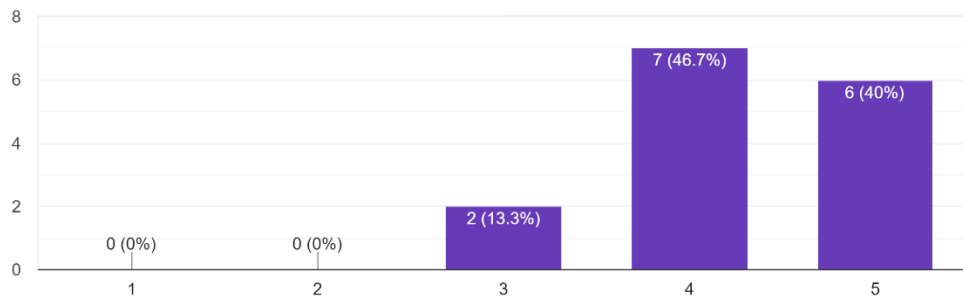
15 responses



**Figure 6.2.9: Survey Question 8**

Did you think the "Voice Chat" feature was useful in enhancing your vocabulary skills?

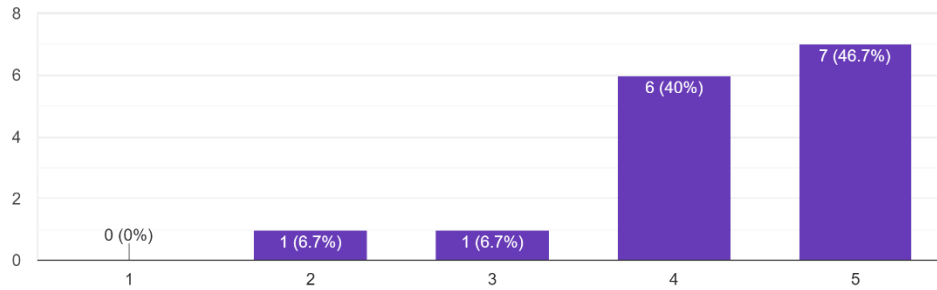
15 responses



**Figure 6.2.10: Survey Question 9**

Did the interactive features (like AI responses or speech recognition) keep you engaged during your learning sessions?

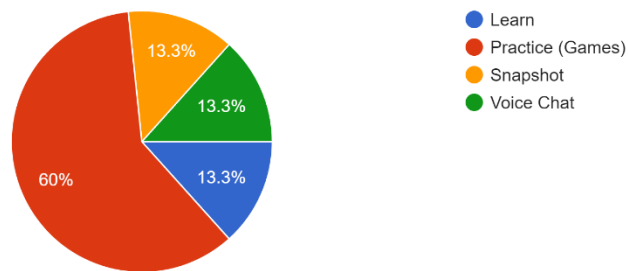
15 responses



**Figure 6.2.11: Survey Question 10**

What features did you find most helpful for vocabulary learning?

15 responses



**Figure 6.2.12: Survey Question 11**

Any additional comments or feedback about the web application?

15 responses



**Figure 6.2.13: Survey Question 12**

### **User Satisfaction and Engagement:**

From the responses, it is clear that the majority of users found the application engaging, with ratings ranging between 4 and 5. Users indicated that they enjoyed interacting with the AI and found the chatbot helpful. This shows that the AI-driven components, such as vocabulary practice and conversational AI, were well-received. The high satisfaction levels (4s and 5s) suggest that the application succeeds in providing an engaging experience, particularly in areas like gamified learning and AI interaction.

### **Ease of Navigation and Usability:**

A significant insight from the survey is the positive feedback regarding the ease of navigation, where users rated it between 4 and 5. The fact that users can access the various different features mean that they had no problem with logging in and creating new accounts which are needed to access the features as well. This suggests that the application's interface was intuitive and easy to use. Even without explicitly testing for issues related to navigation or profile management, we can infer that users did not encounter significant obstacles while moving through different sections of the application, such as practice modules or learning dashboards. The layout and organization of the features seem to be meeting user expectations, which is a critical factor for the success of any educational tool.

### **Effectiveness of AI Interaction:**

The positive ratings related to the AI functionality (mostly 4s and 5s) indicate that users found the AI-generated scenarios and conversational interactions beneficial. The AI seemed to meet user expectations in terms of providing meaningful vocabulary practice. This is a strong validation of the application's core feature — using AI to enhance learning engagement and provide tailored language-learning experiences. This feedback also highlights that the AI-driven system managed to keep users motivated and engaged in their learning process.

### **Visual Design and Aesthetic Appeal:**

In the survey, participants rated the visual appeal of the application highly, with ratings mostly in the 4 to 5 range. This shows that the design choices, such as using Bootstrap for responsiveness and custom CSS for layout, resonated well with the users. The visual attractiveness of an application is important for keeping users engaged and encouraging

repeated use. The design's success in this area suggests that aesthetic factors are playing a positive role in the overall user experience.

### **Potential Areas for Improvement:**

Although the survey results are overwhelmingly positive, it's worth noting that a couple of participants rated some aspects with a 3. While the specific issues were not directly mentioned, these could be areas for potential improvement. A comment in the last question also mentioned a smoother reaction as well so that can be improved upon on the responsiveness and time.

### **Overall Insights:**

The overall positive feedback demonstrates that the application is functioning as expected, providing a good mix of ease of use, engagement, and learning efficiency. The AI-powered chat features and vocabulary learning modules seem to be the highlights, keeping users interested and making the learning experience enjoyable. However, even with such positive feedback, there is always room for improvement. The small percentage of lower ratings indicates that there might be minor issues related to user experience, which could be further refined in future iterations of the application.

## **6.3 Project Challenges**

The development of the AI-Driven Vocabulary Language Learning Web Application presented several challenges across various stages, particularly in the integration of AI technologies, maintaining system performance, and ensuring a seamless user experience. One of the primary challenges was the integration of OpenAI's GPT-4 API to facilitate the natural language processing required for interactive conversations. Implementing the API and ensuring that it responded accurately to a variety of user inputs—both grammatically correct and incorrect—proved to be complex. Fine-tuning the AI to detect and correct grammar and spelling errors without producing excessive or irrelevant corrections required iterative testing, prompt engineering and adjustments to maintain balance between helpful feedback and user engagement.

Another significant challenge involved managing user inputs through voice recognition. Integrating the Google Web Speech API presented technical difficulties, particularly in



ensuring that voice inputs were accurately interpreted in real-time and mapped to the corresponding responses from the AI. Handling different accents, speech speeds, and background noise while maintaining accuracy added another layer of complexity. This was especially important, as the voice-based features are core components of the system, providing users with a more immersive language learning experience. Overcoming these challenges involved rigorous testing and calibration to achieve an acceptable level of voice recognition accuracy.

Additionally, balancing the need for real-time interaction with the system's backend posed another challenge. The application's structure required seamless data exchange between the front-end and back-end components, particularly when managing user data such as learned vocabularies, progress tracking, and interaction history. Ensuring that user data was saved and updated without causing delays in system responses was critical to providing a smooth user experience. Addressing this challenge required optimizing database queries and structuring the back-end logic to minimize latency, especially during high-load periods.

System performance and scalability were other areas of concern. Since the application involves processing multiple data points (including user inputs, AI responses, and backend database operations), ensuring that the system remains stable and responsive during heavy usage was a major challenge. I had to test and optimize the application's performance under various load conditions, identifying potential bottlenecks and mitigating them by refining the database schema and optimizing API requests. Achieving a balance between scalability and performance was crucial for ensuring that the application would be able to accommodate growing user numbers without compromising its responsiveness.

### **6.4 Objectives Evaluation**

The development of the AI-driven vocabulary language learning web application successfully achieved all the primary objectives and sub-objectives, leading to a comprehensive and highly interactive language learning platform. The first objective, to create a personalized AI-based vocabulary learning path, has been realized through the implementation of a dynamic learning algorithm that tracks user progress and identifies mistakes in real-time. The system analyzes each user's proficiency and difficulty levels based on their vocabulary list, delivering personalized feedback and tailoring the learning

experience accordingly. This functionality has enhanced the overall learning process by adapting to individual user needs.

The second sub-objective, to develop a gamified learning experience, has been successfully integrated into the application. Various mini-games, such as fill-in-the-blanks and picture-matching exercises, have been introduced to make vocabulary retention more enjoyable and effective. These interactive activities have proven to be valuable in increasing user engagement and improving vocabulary retention rates, as users can learn through a more interactive and fun experience.

In terms of conversational AI integration, the third sub-objective, the application has successfully incorporated a chatbot capable of generating real-time, context-based scenarios. This allows users to practice their vocabulary in both text and voice formats. The AI chatbot not only provides contextual scenarios but also detects and corrects grammar and spelling errors in real-time. This functionality has been tested and meets the goal of providing feedback for most of user interactions within five seconds, making it a key feature that promotes instant learning and improvement.

The implementation of object recognition for vocabulary learning, another core sub-objective, has also been achieved. The object recognition tool enables users to capture images of everyday objects and learn the corresponding vocabulary. This feature adds a visual dimension to language learning, making it easier for users to connect words with real-world objects.

Finally, the application meets the goal of designing a user-friendly and accessible interface. The platform has been created with simplicity and ease of use in mind, ensuring that users of varying technological abilities can seamlessly navigate the system. The interface is visually appealing, with consistent color schemes and fonts that contribute to a positive user experience. Overall, the application's design ensures that users can focus on learning without being hindered by complicated navigation or technical issues.

### **6.5 Concluding Remark**

In conclusion, the system evaluation, testing outcomes, and user survey results collectively affirm the successful development and functionality of the AI-driven vocabulary language learning web application. Through a series of tests and user feedback, it is evident

that the application meets its key objectives of providing a personalized, engaging, and adaptive learning experience. The integration of AI for real-time feedback, gamified learning modules, and interactive voice and text-based practice has been well-received, with users highlighting the system's ease of use, responsiveness, and educational impact. The survey data also indicates high user satisfaction with the platform's intuitive interface and effective learning tools, further validating the design choices made throughout the project. Overall, the system has proven to deliver on its core objectives, offering a comprehensive, engaging, and adaptive solution for vocabulary acquisition, and setting a solid foundation for future enhancements and expansions.

## Chapter 7

# Conclusion and Recommendation

### 7.1 Conclusion

This project successfully aimed to develop an AI-driven web application designed to enhance vocabulary language learning using modern AI technologies like OpenAI's GPT-4. The primary goal of creating an adaptive, interactive, and personalized learning platform was achieved through the integration of advanced features such as real-time conversational practice, speech recognition, and gamification elements. By leveraging GPT-4's natural language processing capabilities, the application enables dynamic conversations, scenario-based learning, and immediate feedback, offering users a more practical and immersive language learning experience.

A key achievement was the implementation of various learning modes like practice chat, voice interaction, and snapshot-based vocabulary recognition. The system design effectively combined a user-friendly front-end with highly capable backend support using technologies like Node.js, MongoDB, and Express, while maintaining flexibility and scalability. Through the use of an intuitive interface, users can seamlessly navigate through different vocabulary themes, track their progress, and engage in meaningful conversations with the AI chatbot.

Challenges such as integrating multiple APIs, ensuring real-time feedback, and managing data synchronization were overcome through iterative testing and optimization. The user feedback collected during the testing phase indicated a positive reception of the app's functionality, particularly in its ability to adapt to individual learning styles and provide immediate corrections and suggestions.

In conclusion, the AI-driven web application has demonstrated the potential to revolutionize vocabulary learning, offering users a dynamic and efficient platform that promotes deeper language retention and practical usage. As AI technologies continue to evolve, this project sets a foundation for future enhancements, such as expanding to additional languages and incorporating more sophisticated AI-driven language tutoring.

## 7.2 Recommendations

While this AI-driven vocabulary learning web application has successfully met its objectives, there are several areas where future improvements could enhance the overall user experience and effectiveness. First, expanding the vocabulary base beyond the current New General Service List (NGSL) to include specialized terminologies from fields such as business, technology, or medicine would allow the platform to cater to users with specific professional language needs. This expansion would enable users to learn vocabulary tailored to their career paths or interests, further personalizing their learning journey.

Another improvement would be the integration of more advanced personalization techniques, such as machine learning algorithms that continuously adapt the difficulty and content of lessons based on user performance. While the current application provides real-time feedback and tracks user progress, future versions could include predictive analytics that forecast a learner's potential challenges and proactively adjust the curriculum to address those areas. Additionally, incorporating AI-generated quizzes and tests that align with each user's proficiency could provide more targeted practice sessions and further enhance language retention.

### Recommendations for Future Projects

For future projects aiming to develop AI-based language learning tools, it is highly recommended to explore multimodal learning experiences. Combining textual, visual, and auditory learning elements could lead to more comprehensive learning. Future developers might consider adding augmented reality (AR) or virtual reality (VR) features, allowing users to practice vocabulary in immersive environments, which could make language learning more engaging and contextually relevant.

Moreover, ensuring that such applications can cater to a global audience is essential. Expanding language support to include more dialects and accents, particularly in voice recognition, would make the platform more accessible to non-native speakers from diverse regions. Future developers should also focus on integrating more robust language models that can handle the nuances of multiple languages, making the platform multilingual and more inclusive.

Lastly, developers should continue to focus on improving accessibility features, such as offering customizable interface options for users with disabilities or cognitive impairments. Additionally, incorporating feedback loops where the AI evolves based on aggregate user data could continuously improve the platform's language teaching capabilities, ensuring it remains cutting-edge and user-centric.

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## **Appendix A – Report and Poster**

### **A.1 Weekly Report**

## FINAL YEAR PROJECT WEEKLY REPORT

*(Project II)*

<b>Trimester, Year: Trimester 2, Year 3</b>	<b>Study week no.: Week 2</b>
<b>Student Name &amp; ID: Ler Mei Xuan, 21ACB00689</b>	
<b>Supervisor: Dr. Ng Hui Fuang</b>	
<b>Project Title: AI-DRIVEN WEB APPLICATION FOR ENHANCED VOCABULARY LANGUAGE LEARNING</b>	

### 1. WORK DONE

- Connected and experimented with basic CRUD (Create, Read, Update, Delete) operations in MongoDB, focusing on understanding how the database communicates with the application.
- Set up the MongoDB environment, ensuring that the connection between the application and the database was stable and scalable for future operations.
- Experimented with different queries to validate the proper functioning of CRUD functionalities, such as inserting user data and retrieving entries.

### 2. WORK TO BE DONE

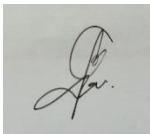
- Integrate MongoDB with the core features, such as user authentication and profile management.

### 3. PROBLEMS ENCOUNTERED

- Faced initial challenges in connecting MongoDB with the application, primarily related to network configurations and database permissions.

### 4. SELF EVALUATION OF THE PROGRESS

Progress was satisfactory. Successfully established a working database connection and explored MongoDB CRUD operations.



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Student's Signature



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Supervisor's Signature

## FINAL YEAR PROJECT WEEKLY REPORT

*(Project II)*

<b>Trimester, Year: Trimester 2, Year 3</b>	<b>Study week no.: Week 3</b>
<b>Student Name &amp; ID: Ler Mei Xuan, 21ACB00689</b>	
<b>Supervisor: Dr. Ng Hui Fuang</b>	
<b>Project Title: AI-DRIVEN WEB APPLICATION FOR ENHANCED VOCABULARY LANGUAGE LEARNING</b>	

### 1. WORK DONE

- Developed and implemented the user login and registration functionalities, using MongoDB to store user credentials securely.
- Integrated authentication features, including error handling for invalid inputs and secure password encryption.
- Tested the login/register functions to ensure the system handled valid and invalid cases (e.g., incorrect credentials, weak passwords).

### 2. WORK TO BE DONE

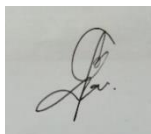
Expand on the user management system, allowing users to customize their profiles.

### 3. PROBLEMS ENCOUNTERED

- Encountered issues related to session management and persistent login features, which took extra time to resolve.
- Needed to ensure that password encryption was strong and secure.

### 4. SELF EVALUATION OF THE PROGRESS

Progress was positive, with the successful implementation of the registration and login features.



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Student's Signature



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Supervisor's Signature

## FINAL YEAR PROJECT WEEKLY REPORT

*(Project II)*

<b>Trimester, Year: Trimester 2, Year 3</b>	<b>Study week no.: Week 4</b>
<b>Student Name &amp; ID: Ler Mei Xuan, 21ACB00689</b>	
<b>Supervisor: Dr. Ng Hui Fuang</b>	
<b>Project Title: AI-DRIVEN WEB APPLICATION FOR ENHANCED VOCABULARY LANGUAGE LEARNING</b>	

### 1. WORK DONE

- Implemented a comprehensive user management system that included profile editing features, allowing users to update their personal details and preferences.
- Added functionality for users to upload profile pictures and customize account settings (e.g., language preferences, profile visibility).
- Tested the system's ability to handle large media files, ensuring proper validation and error handling.

### 2. WORK TO BE DONE

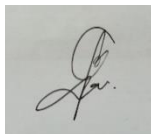
- Begin implementing the core learning features of the application, focusing on incorporating different difficulty levels (beginner, intermediate, advanced).
- Continue testing user management features and improve the user interface.

### 3. PROBLEMS ENCOUNTERED

Faced issues with image upload functionality

### 4. SELF EVALUATION OF THE PROGRESS

Overall progress was good.




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Student's Signature




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Supervisor's Signature

## FINAL YEAR PROJECT WEEKLY REPORT

*(Project II)*

<b>Trimester, Year: Trimester 2, Year 3</b>	<b>Study week no.: Week 5</b>
<b>Student Name &amp; ID: Ler Mei Xuan, 21ACB00689</b>	
<b>Supervisor: Dr. Ng Hui Fuang</b>	
<b>Project Title: AI-DRIVEN WEB APPLICATION FOR ENHANCED VOCABULARY LANGUAGE LEARNING</b>	

### 1. WORK DONE

- Developed the core "Learn" feature of the application, incorporating various difficulty levels (beginner, intermediate, advanced) to cater to different user proficiencies.
- Designed and implemented a system that automatically adjusts the difficulty level based on the user's learning progress and performance.
- Tested the learn feature to ensure smooth transitions between levels and accurate progress tracking.

### 2. WORK TO BE DONE

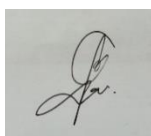
Begin working on the snapshot feature.

### 3. PROBLEMS ENCOUNTERED

Minor bugs in adjusting difficulty levels dynamically, particularly in tracking user performance accurately across sessions.

### 4. SELF EVALUATION OF THE PROGRESS

Average satisfaction with the progress.



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Student's Signature



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Supervisor's Signature

## FINAL YEAR PROJECT WEEKLY REPORT

*(Project II)*

<b>Trimester, Year: Trimester 2, Year 3</b>	<b>Study week no.: Week 6</b>
<b>Student Name &amp; ID: Ler Mei Xuan, 21ACB00689</b>	
<b>Supervisor: Dr. Ng Hui Fuang</b>	
<b>Project Title: AI-DRIVEN WEB APPLICATION FOR ENHANCED VOCABULARY LANGUAGE LEARNING</b>	

### 1. WORK DONE

- Experimented with integrating AI functionalities to automate the process of creating new vocabulary entries, such as generating definitions, audio pronunciations, and images.
- Implemented AI-generated definitions and successfully integrated them into the database to reduce manual input efforts.
- Worked on improving the system's ability to automatically add contextually relevant images and audios.

### 2. WORK TO BE DONE

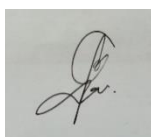
- Begin implementing the snapshot feature that utilizes AI-powered image recognition for vocabulary learning.
- Continue refining the AI-generated content to ensure consistency in quality and relevance.

### 3. PROBLEMS ENCOUNTERED

A bit of difficulty with AI API

### 4. SELF EVALUATION OF THE PROGRESS

Successful integration of AI for generating vocabulary content.




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Student's Signature




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Supervisor's Signature



## FINAL YEAR PROJECT WEEKLY REPORT

*(Project II)*

<b>Trimester, Year: Trimester 2, Year 3</b>	<b>Study week no.: Week 7</b>
<b>Student Name &amp; ID: Ler Mei Xuan, 21ACB00689</b>	
<b>Supervisor: Dr. Ng Hui Fuang</b>	
<b>Project Title: AI-DRIVEN WEB APPLICATION FOR ENHANCED VOCABULARY LANGUAGE LEARNING</b>	

### 1. WORK DONE

- Developed the "Snapshot" feature, enabling users to take or upload images of objects and learn their corresponding vocabulary.
- Integrated AI-based image recognition, allowing the system to identify objects in the images and provide the correct word.
- Conducted internal testing to measure the accuracy of the object recognition model.

### 2. WORK TO BE DONE

- Begin developing the voice chat function that allows users to practice vocabulary through real-time conversations with the AI.
- Continue testing the snapshot feature and enhance object recognition accuracy.

### 3. PROBLEMS ENCOUNTERED

Faced some challenges in logic of API.

### 4. SELF EVALUATION OF THE PROGRESS

Average satisfaction with the progress.




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Student's Signature




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Supervisor's Signature

## FINAL YEAR PROJECT WEEKLY REPORT

*(Project II)*

<b>Trimester, Year: Trimester 2, Year 3</b>	<b>Study week no.: Week 8</b>
<b>Student Name &amp; ID: Ler Mei Xuan, 21ACB00689</b>	
<b>Supervisor: Dr. Ng Hui Fuang</b>	
<b>Project Title: AI-DRIVEN WEB APPLICATION FOR ENHANCED VOCABULARY LANGUAGE LEARNING</b>	

### 1. WORK DONE

- Worked on the voice chat feature, allowing users to practice vocabulary through real-time conversations with the AI.
- Integrated the Google Web Speech API for speech recognition and synthesis, enabling users to interact with the chatbot via voice commands.
- Successfully tested the feature to ensure smooth transitions between text and voice modes.

### 2. WORK TO BE DONE

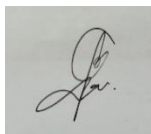
Begin implementing a progress tracking system for both the snapshot and voice chat features, focusing on user engagement metrics.

### 3. PROBLEMS ENCOUNTERED

Implementing smooth transitions between voice and text-based interactions proved challenging.

### 4. SELF EVALUATION OF THE PROGRESS

Average satisfaction with the progress.



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Student's Signature



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Supervisor's Signature

## FINAL YEAR PROJECT WEEKLY REPORT

*(Project II)*

<b>Trimester, Year: Trimester 2, Year 3</b>	<b>Study week no.: Week 9</b>
<b>Student Name &amp; ID: Ler Mei Xuan, 21ACB00689</b>	
<b>Supervisor: Dr. Ng Hui Fuang</b>	
<b>Project Title: AI-DRIVEN WEB APPLICATION FOR ENHANCED VOCABULARY LANGUAGE LEARNING</b>	

### 1. WORK DONE

- Developed and implemented a progress tracking system for the snapshot and voice chat features, allowing users to monitor their vocabulary learning achievements over time.
- Integrated data points such as vocabulary usage, proficiency levels, and engagement times to give users a comprehensive overview of their progress.

### 2. WORK TO BE DONE

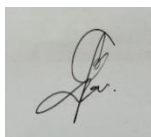
Implement pronunciation tracking for individual words in the voice chat feature.

### 3. PROBLEMS ENCOUNTERED

Encountered issues with real-time data synchronization, causing occasional delays in displaying user progress updates.

### 4. SELF EVALUATION OF THE PROGRESS

Average satisfaction with the progress.



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Student's Signature



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Supervisor's Signature

## FINAL YEAR PROJECT WEEKLY REPORT

*(Project II)*

<b>Trimester, Year: Trimester 2, Year 3</b>	<b>Study week no.: Week 10</b>
<b>Student Name &amp; ID: Ler Mei Xuan, 21ACB00689</b>	
<b>Supervisor: Dr. Ng Hui Fuang</b>	
<b>Project Title: AI-DRIVEN WEB APPLICATION FOR ENHANCED VOCABULARY LANGUAGE LEARNING</b>	

### 1. WORK DONE

- Worked on individual word pronunciation logic within the voice chat feature, enabling users to receive detailed pronunciation feedback for each word they practice.
- Integrated text-to-speech and speech-to-text functionalities to allow users to both speak and hear correct pronunciations.

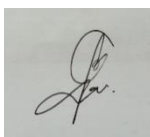
### 2. WORK TO BE DONE

- Improve the user interface and experience (UI/UX) design based on user feedback.
- Start preparing the survey and final report.

### 3. PROBLEMS ENCOUNTERED

### 4. SELF EVALUATION OF THE PROGRESS

Average satisfaction with the progress.



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Student's Signature



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Supervisor's Signature

## FINAL YEAR PROJECT WEEKLY REPORT

*(Project II)*

<b>Trimester, Year: Trimester 2, Year 3</b>	<b>Study week no.: Week 11</b>
<b>Student Name &amp; ID: Ler Mei Xuan, 21ACB00689</b>	
<b>Supervisor: Dr. Ng Hui Fuang</b>	
<b>Project Title: AI-DRIVEN WEB APPLICATION FOR ENHANCED VOCABULARY LANGUAGE LEARNING</b>	

### 1. WORK DONE

- Focused on cleaning up the UI/UX design, making the interface more intuitive and visually appealing based on initial user feedback.
- Conducted a user survey to gather feedback on the application's performance, user experience, and overall satisfaction.
- Began writing the final project report.

### 2. WORK TO BE DONE

Finalize the report and make any last adjustments to the system based on user feedback.

### 3. PROBLEMS ENCOUNTERED

- Incorporating user feedback into the design while maintaining simplicity and functionality was a bit challenging.
- Survey participation was slower than expected, requiring follow-ups.

### 4. SELF EVALUATION OF THE PROGRESS

Average satisfaction with the progress.




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Student's Signature




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Supervisor's Signature

## FINAL YEAR PROJECT WEEKLY REPORT

*(Project II)*

<b>Trimester, Year: Trimester 2, Year 3</b>	<b>Study week no.: Week 12</b>
<b>Student Name &amp; ID: Ler Mei Xuan, 21ACB00689</b>	
<b>Supervisor: Dr. Ng Hui Fuang</b>	
<b>Project Title: AI-DRIVEN WEB APPLICATION FOR ENHANCED VOCABULARY LANGUAGE LEARNING</b>	

### 1. WORK DONE

- Finalized the system, ensuring all features were fully operational and polished for the final review.
- Finalized the project report, incorporating findings from the user survey and final testing phases.
- Ensured all system functionalities were stable and tested one last time for any inconsistencies or bugs.

### 2. WORK TO BE DONE

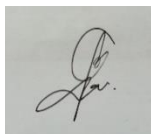
Prepare for the final project submission and presentation..

### 3. PROBLEMS ENCOUNTERED

Minor bug fixes and last-minute adjustments slowed down the finalization process slightly, but no major issues were encountered.

### 4. SELF EVALUATION OF THE PROGRESS

Average satisfaction with the progress.



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Student's Signature



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Supervisor's Signature

A.2 Poster

# AI-DRIVEN WEB APPLICATION FOR ENHANCED VOCABULARY LEARNING

By: Ler Mei Xuan 21ACB00689  
Supervised by: Dr. Ng Hui Fuang

### Introduction

This project proposal introduces an AI-driven approach to language learning, in particular, vocabulary building. In order to revolutionize language learning, a web-based platform incorporating OpenAI's groundbreaking GPT-4 will be created with functionalities like a chatbot, voice conversation and image recognition as well as the a fun language learning experience.

### Project Objectives & Scope

The main deliverable of this project will be an innovative vocabulary language learning web application that is driven by AI, as well as:

- Create a Personalized AI-Based Vocabulary Learning Path
- Develop a Gamified Learning Experience:
- Integrate Conversational AI for Real-time Practice:
- Implement Object Recognition for Vocabulary Learning:
- Design a User-Friendly and Accessible Interface:

### Method

- Agile Methodology
- Voiceflow for building the chatbot
- HTML, CSS and Javascript for the frontend
- Node.js and MongoDB for backend

### Main Functions

- Learn New Vocabulary
- Image Recognition Feature
- Voice Conversation Feature
- Chatbot Practice Feature

### Conclusion

This web application leverages the use of AI in language learning to make the experience more personalized and adaptable to the user. The images shown are the screenshots of the system such as different features and dashboards.

PLAGIARISM CHECK RESULT

AI-DRIVEN WEB APPLICATION FOR ENHANCED VOCABULARY LANGUAGE LEARNING

ORIGINALITY REPORT

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SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

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10	Stuart Webb. "The Routledge Handbook of Vocabulary Studies", Routledge, 2019 Publication	<1 %
11	Submitted to University of West London Student Paper	<1 %
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15	Tim Stoeckel, Phillip Bennett. "A test of the new general service list", Vocabulary Learning and Instruction, 2015 Publication	<1 %
16	Submitted to University of Hertfordshire Student Paper	<1 %
17	www3.dfc.gov Internet Source	<1 %
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20	I. de Zarzà, J. de Curtò, Gemma Roig, Carlos T. Calafate. "Optimized Financial Planning: Integrating Individual and Cooperative Budgeting Models with LLM Recommendations", AI, 2023 <small>Publication</small>	<1%
21	Reka R. Jablonkai, Eiko Csomay. "The Routledge Handbook of Corpora and English Language Teaching and Learning", Routledge, 2022 <small>Publication</small>	<1%
22	Submitted to University of Greenwich <small>Student Paper</small>	<1%
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28	Submitted to CTI Education Group <small>Student Paper</small>	<1%

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29	Rebecca Fox, Olga Corretjer, Kelley Webb. "Benefits of foreign language learning and bilingualism: An analysis of published empirical research 2012–2019", Foreign Language Annals, 2019 Publication	<1 %
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		<1 %
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FACULTY OF INFORMATION AND COMMUNICATION  
TECHNOLOGY

<b>Full Name(s) of Candidate(s)</b>	Ler Mei Xuan
<b>ID Number(s)</b>	21ACB00689
<b>Programme / Course</b>	Bachelor of Computer Science (Honours)
<b>Title of Final Year Project</b>	AI-Driven Web Application for Enhanced Vocabulary Language Learning

<b>Similarity</b>	<b>Supervisor's Comments (Compulsory if parameters of originality exceed the limits approved by UTAR)</b>
<b>Overall similarity index: <u>7</u> %</b>  <b>Similarity by source</b> Internet Sources: <u>5</u> % Publications: <u>1</u> % Student Papers: <u>4</u> %	
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<b>Parameters of originality required, and limits approved by UTAR are as Follows:</b> (i) Overall similarity index is 20% and below, and (ii) Matching of individual sources listed must be less than 3% each, and (iii) Matching texts in continuous block must not exceed 8 words <i>Note: Parameters (i) – (ii) shall exclude quotes, bibliography and text matches which are less than 8 words.</i>	

Note: Supervisor/Candidate(s) is/are required to provide softcopy of full set of the originality report to Faculty/Institute

***Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.***

  
\_\_\_\_\_  
Signature of Supervisor

Name: Dr. Ng Hui Fuang  
\_\_\_\_\_

Date: 13/092024

\_\_\_\_\_  
Signature of Co-Supervisor

Name: \_\_\_\_\_

Date:



## UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY

(KAMPAR CAMPUS)

### CHECKLIST FOR FYP2 THESIS SUBMISSION

Student ID	21ACB00689
Student Name	Ler Mei Xuan
Supervisor Name	Dr. Ng Hui Fuang

TICK (✓)	DOCUMENT ITEMS
Your report must include all the items below. Put a tick on the left column after you have checked your report with respect to the corresponding item.	
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✓	Signed Report Status Declaration Form
✓	Signed FYP Thesis Submission Form
✓	Signed form of the Declaration of Originality
✓	Acknowledgment
✓	Abstract
✓	Table of Contents
✓	List of Figures (if applicable)
✓	List of Tables (if applicable)
N/A	List of Symbols (if applicable)
✓	List of Abbreviations (if applicable)
✓	Chapters / Content
✓	Bibliography (or References)
✓	All references in bibliography are cited in the thesis, especially in the chapter of literature review
✓	Appendices (if applicable)
✓	Poster
✓	Signed Turnitin Report (Plagiarism Check Result – Form Number: FM-IAD-005)
✓	I agree 5 marks will be deducted due to incorrect format, declare wrongly the ticked of these items, and/or any dispute happening for these items in this report.

\*Include this form (checklist) in the thesis (Bind together as the last page)

I, the author, have checked and confirmed all the items listed in the table are included in my report.

\_\_\_\_\_  
(Signature of Student)

FYP2 CHECKLIST

Date: 12/09/2024