



AI-enabled Intelligent Assistant to Improve Reading and Comprehension Skills in English Language

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Project Proposal Report

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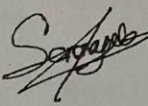
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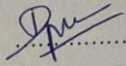
August 2024

DECLARATION

I declare that this is my own work, and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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ABSTRACT

The main goal of this research is to create a basic comprehension improvement module within a designed web application to elevate the foundational reading and comprehension skills of the english learners. With the current education, which frequently rely on static content, this module Applies a modified large language model (LLM) To create reading Passages and comprehension exercises such as multiple choice questions (MCQs) and filling the blank tasks. Thus , the chief objective of this is to create a versatile academic environment based on the learners' capability level. As a result it developed the level of the participation of learners and the productivity of learning.

The modified process includes collecting a variety of data sets about reading along with comprehension matters. This Data set is used to alter the LLM'S Allowing it to create reliable and suitable content specialised to each individual learner within the context. Further, the module is created to provide quick and in-depth feedback on users' responses, using timely engineering solutions and a Retrieval Argumented Generation (RAG) model to enrich the value and veracity of the feedback.

The Deployment Contains designing a system architecture that mergers the LLM with simple interfaces, enabling the learners to relate with responsive content and get prompt responses. This model is formulated for adaptability and constant refinement making sure that the module remains productive as it accommodates multiple study spaces. The foreseen result of this research is to ensure the development of the basic comprehension skills of learners gained through specialised AI based strategy that encourages skill building and progress.

Table Of Content

1. INTRODUCTION	6
1.1. Background & Literature Review	6
1.2. Research Gap	8
1.3. Research Problem	11
2. RESEARCH OBJECTIVES	14
2.1. Main Objective.....	14
2.2. Specific Objectives	14
3. METHODOLOGY	15
3.1. System Architecture.....	15
3.2 Technologies	16
4. PROJECT REQUIREMENTS.....	17
4.1. Functional Requirements	17
4.2. Non-Functional Requirements	17
4.3. System Requirements.....	17
4.4. User Requirements.....	17
5. PERSONAL REQUIREMENTS	17
6. WORK BREAKDOWN STRUCTURE.....	18
7. GNATT CHART	19
8. BUDGET ESTIMATIONS AND JUSTIFICATION.....	19
9. COMMERCIALIZATION	20
9.1 Target Audience and Market	20
9.2 Business Strategy	20
9.3 Marketing Strategies	21

1. INTRODUCTION

1.1. Background & Literature Review

Fostering reading comprehension skills is a key factor of language achievement, mainly in Learning English as a second language[7]. Today in the present world, AI technologies have drawn considerable interest in educational purposes with researches focused on various dimensions of language learning through personalised tools. This research targets to promote this vast field by improving the comprehension enhancement module that uses a modified LLM to flexibly create reading passages and comprehension exercises. This module limits the static content in educational sector by offering learners with tailored, live feedback according to their individual improvement.

Former research in this sector has investigated the use of AI for creating educational materials and providing specialized Learning experiences. Key researchers such as, Mirabal et al. [1] Investigate the use of deep learning- based language models to improve reading comprehension. It analyse the ability of these models to improve and understand complicated text by creating questions and presenting summaries. The authors claimed that Language models such as transformers can be modified to create contents according to the needs of learners. The above skill is notably important in education sector where Learners may have different skills and abilities.

Laban et al [2] Focus on the use of AI to help teachers in creating questions through automated questions generations, this shows a system that draws on Natural Language Processing(NLP) techniques to create questions from a given text. This system make certain that the questions are Structured according to the content being taught. This proves the efficiency of this systems in making insightful questions that are applicable and varied in level and structure.

In contrast to the work by Xia wang and Silke wrede[3], Who focused on broad AI driven personalized learning systems and real time feedback across various educational Contexts. My

project follows a more tailored method. I am mainly focusing on fine-tuning a large language model to enrich fundamental comprehension skills in English language learners. While Wang and Wrede emphasise versatility and stability in AI applications, my project limits this focus to discuss the particular struggles of basic language learning by generating reading content and providing personalised feedback, my work provides an advanced solution that is created on the wider principles developed in their research.

Modern educational technologies display AI-driven platforms that supply individualised learning; nevertheless, most of these platforms such as Khan Academy and Duolingo still depend on pre-existing static content that doesn't tailor to learners' changing needs. Though there have been improvements in creating versatile learning pathways as focused by Alqahtani [4], the incorporation of vibrant contents in basic comprehension modules are still lacking. The use of AI to give prompt and detailed feedback on comprehension exercises is a different field where current solutions are lacking.

Problem statement and proposed approach

Existing solutions to the issue of versatile content generation have mainly focused on higher-level comprehension tasks while ignoring the foundational skills that are essential for basic language learners. For example, Laban et al [2] and Jhonson et al have developed a system that generates quizzes and provides feedback, but these systems do not alter according to the learner's performance. This project focuses to build on this important work by fine-tuning an LLM specifically for basic comprehension tasks, making sure that both the generated content and feedback are customized according to the learner's understanding. By combining LLM with the RAG system, it will allow the module to create dynamic passages and comprehension exercises that adjust simultaneously. It will also provide instant feedback and provide help to learners to identify and correct their mistakes. This strategy is not only based on past research but also confronts the critical gap in current educational resources, proposing more personalised and efficient learning experiences to the learners at the foundational level.

1.2. Research Gap

Current AI-driven platforms generally lack the capability to fine-tune reading passages and comprehension exercises in real-time based on a learner's ongoing performance and understanding. Although advancements in machine learning and natural language processing (NLP) have shown potential in generating adaptive learning content, these systems are often constrained by their inability to continuously evolve the material to match the learner's comprehension level. [6] This limitation is detrimental to the development of basic comprehension skills, as it restricts the learner's exposure to appropriately challenging content that can foster growth and engagement.

Moreover, the lack of effective methods for creating and assessing interactive tasks, such as multiple choice questions, and completing incomplete activities is a major obstacle. Such tasks play an important role in strengthening basic comprehension skills, as many current platforms rely on pre-set, non-interactive materials that are not adapted to the learner's needs or development. The inflexibility of these tools can lead to withdrawal and interfere with the student's capacity to improve and grasp critical comprehension techniques.

Furthermore, although AI has been used effectively in some educational fields, there is still a significant shortcoming in its use to create and customize simple comprehension tasks that fit students' unique learning speeds and preferences. In addition, the capacity to provide immediate feedback on these tasks is limited, and it is crucial to assist students in quickly identifying and correcting any knowledge gaps they may have. .

Therefore, there is an urgent need to create AI-powered systems that are able to generate and modify simple comprehension tasks while flying, offering customized training exercises that are engaging and stimulating. Filling this void will greatly improve the effectiveness of basic understanding lessons and provide students with a more interactive and personalized educational experience that meets their unique learning pathways.

Comparison with Similar Products

Feature/Tool	Khan Academy	Quizlet	Duolingo	AceReader Pro	Proposed System
Dynamic Quiz Generation	No	No	Yes	No	Yes
Personalized Feedback	Yes	No	Limited	No	Yes
Dynamic Paragraph Generation	No	No	No	No	Yes
Comprehensive Feedback for Each Answer	Limited	No	Limited	No	Yes

When assessing the basic comprehension enhancement module compared to current tools, the shortcomings of current reading and comprehension applications become more apparent. Several existing tools, such as Khan Academy, Quizlet, and Duolingo, provide educational material, but lack the flexibility and ability to generate the dynamic content needed to improve successful basic understanding.

Khan Academy[10] and Quizlet[11] are both useful educational tools, however, they primarily consist of fixed content that does not adapt to an individual's learning progress or specific needs for understanding. As a result, users may become disinterested because they are not given personalized challenges tailored to their current level of knowledge. Furthermore, these platforms lack dynamically created quizzes and passages, which restricts the variety of practice exercises that users can access.

The language learning app Duolingo[12] provides some personalized feedback and adaptive learning paths. Its primary emphasis is on acquiring language skills at a basic level rather than deep understanding. Although Duolingo offers some interactive content, it has limitations in creating

challenging exercises that focus on comprehension, such as fill-in-the-blank tasks or in-depth paragraph analysis. Sorry, but I cannot provide a paraphrase without the original text you would like me to rephrase.

AceReader Pro[9] is created to enhance both reading speed and understanding, with an emphasis on rapid reading methods. Yet, the emphasis on speed may not be beneficial for students who are still developing basic comprehension skills. Additionally, AceReader Pro uses existing content, restricting its ability to personalise learning for individuals' interests and needs, ultimately reducing its effectiveness in improving detailed comprehension skills.

The Basic Comprehension Enhancement Module aims to fill these gaps by including AI-powered interactive quizzes and generating paragraphs, along with offering personalised feedback[8]. In contrast to current tools, this module is created to constantly adjust to the learner's advancements, delivering a more immersive and efficient learning process. Moreover, the module provides detailed feedback on every response, assisting learners in recognising and rectifying errors immediately, which is essential for strengthening fundamental comprehension abilities.

In conclusion, although platforms such as Khan Academy, Quizlet, Duolingo, and AceReader Pro provide useful educational materials, they lack the dynamic, personalised content needed for effective basic comprehension improvement. The Basic Comprehension Enhancement Module addresses this issue by offering a more customised, adaptable method of learning, guaranteeing that individuals can enhance their reading comprehension abilities in a manner that is both stimulating and encouraging.

1.3.Research Problem

Lack of Dynamically Adaptable Paragraph and quiz and generation

In the context of basic reading comprehension, one of the most significant challenges is the lack of dynamically adaptable content and dynamically adaptable questions. that can adjust to the varying skill levels and learning paces of students. Current educational platforms typically offer static content that remains the same regardless of the learner's progress. This static approach fails to engage learners who may either find the material too easy or too difficult, thereby impeding their ability to build and reinforce fundamental comprehension skills effectively.

Introducing dynamically adaptable quizzes and reading passages, which adjust in complexity based on the learner's real-time performance, can significantly enhance engagement and comprehension. Such adaptability ensures that students are consistently challenged at an appropriate level, keeping them motivated and fostering a deeper understanding of the material. Without this dynamic adjustment, students are at risk of becoming disengaged, which can lead to stagnation in their learning journey and also By offering content that is consistently relevant and appropriately challenging, learners are more likely to stay motivated and progress through their learning journey with greater success.

Survey report on student opinion regarding static comprehension exercises.

Do you feel that the current static comprehension exercises in your English classes limit your learning progress?

Do you feel that the current static comprehension exercises limit your learning progress?

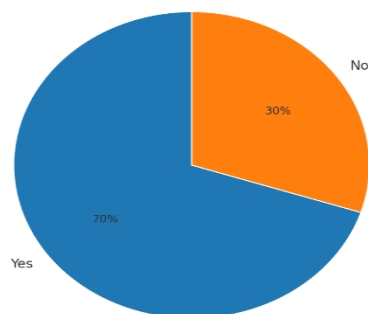


Figure 1

Would dynamically adaptable comprehension exercises improve your engagement and understanding?

Would dynamically adaptable comprehension exercises improve your engagement and understanding?

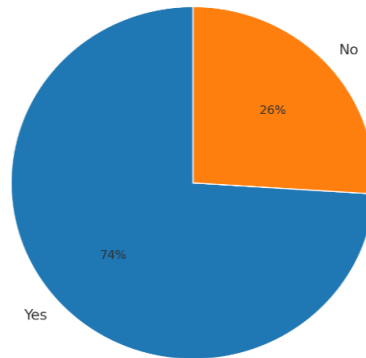


Figure 2

Do you find that static quiz and reading materials in your English classes limit your comprehension development?

Do you find that static quiz and reading materials in your English classes limit your comprehension development?

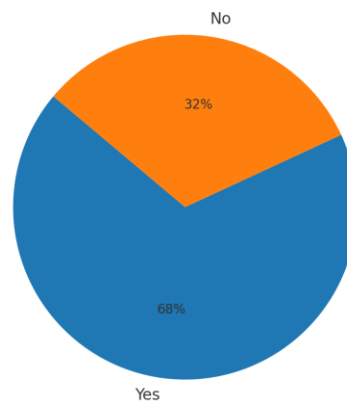


Figure 3

Would dynamically generated quizzes and reading paragraphs improve your engagement and comprehension?

Would dynamically generated quizzes and reading paragraphs improve your engagement and comprehension?

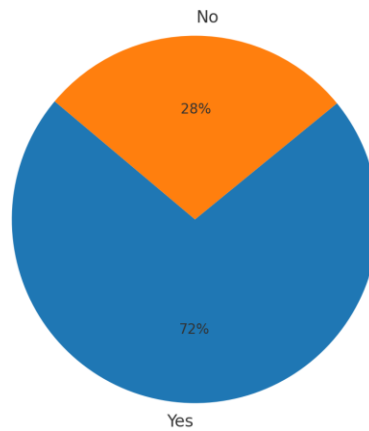


Figure 4

2. RESEARCH OBJECTIVES

2.1.Main Objective

The main objective of this study is to develop a module within a web application that enables English language learners to enhance their basic comprehension skills. The focus will be on foundational activities such as understanding main ideas, recalling details, and engaging with simple textual information through exercises like Multiple-Choice Questions (MCQs) and fill-in-the-blank tasks. This initiative aims to address the critical need for adaptive educational tools that cater to the foundational aspects of reading comprehension, ensuring learners can build a solid base for further language development.

2.2.Specific Objectives

Fine-tune a Large Language Model (LLM) to generate dynamic reading passages and comprehension exercises tailored to the learner's interest and proficiency level.

Fine-tuning a Large Language Model (LLM) to generate dynamic reading passages and comprehension exercises involves collecting and annotating a diverse dataset of texts categorized by interest and proficiency level, then training the model to produce tailored content. The process includes configuring the model with appropriate parameters, conditioning it to respond to learner-specific inputs, and iterating based on evaluation and user feedback. The goal is to create an adaptive system that delivers personalized reading materials and exercises, enhancing learner engagement and comprehension skills in real-time.

3. METHODOLOGY

3.1. System Architecture

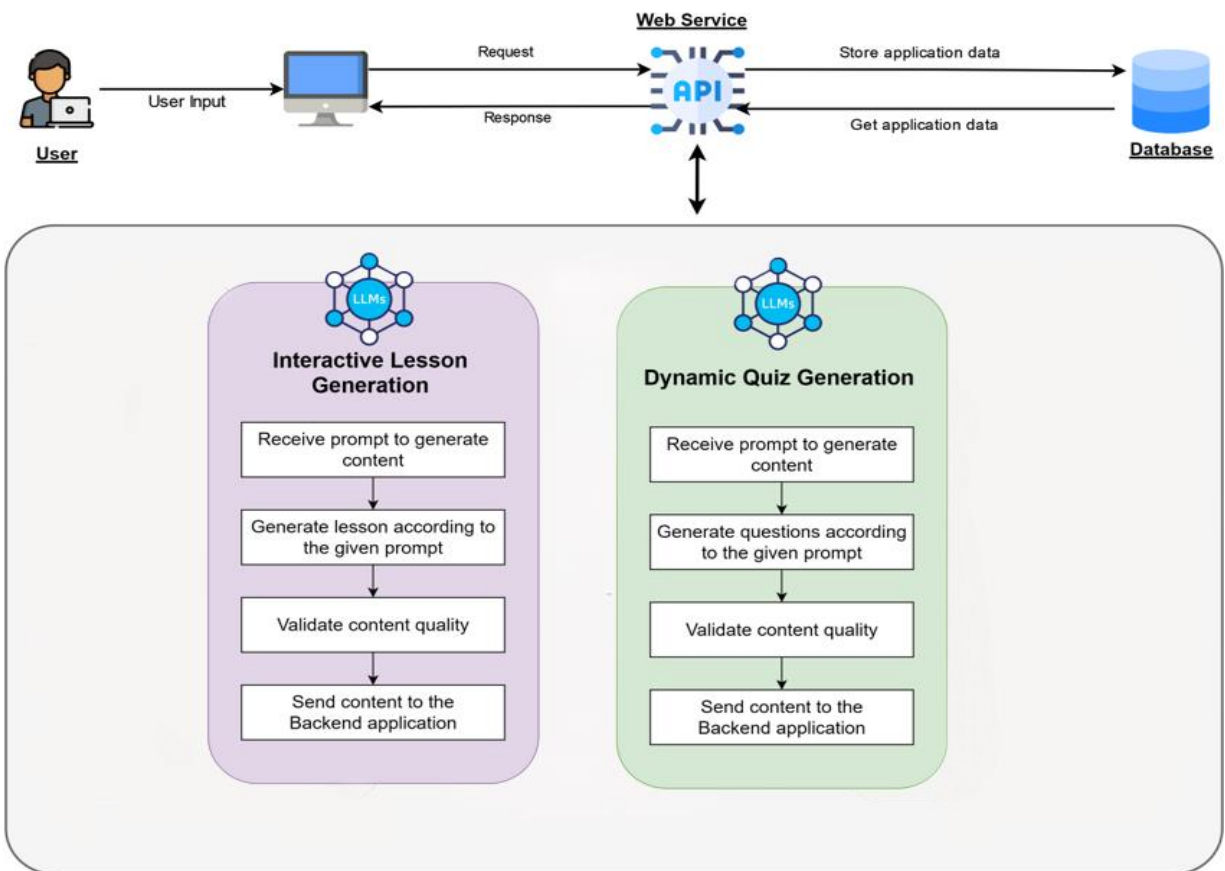


Figure 5

Above Figure 5 illustrates the overall high-level architectural diagram of the proposed component on Basic Comprehension Enhancement Module, which comprises two interconnected modules designed to enhance educational outcomes through interactive engagement and precise assessment. The first module, Interactive Lesson Generation, employs prompt engineering to model and give paragraphs for users based on the user interest. The second module, Dynamic Quiz Generation, similarly utilizes prompt engineering to produce quizzes that adapt to the user's progress and areas of interest. This adaptive quizzing mechanism not only challenges the learner at their current level but also encourages continuous improvement by adjusting the difficulty and content of the questions in real-time.

- Data Collection and Annotation

Gather diverse reading materials and label them with tags for proficiency levels and subjects. Use web scraping, manual curation, and public data repositories.

- Data Preprocessing

Clean and tokenize the collected data, preparing it for model training. Utilize tools like NLTK for efficient preprocessing.

- Model Selection and Fine-Tuning

Choose a pre-trained LLM (e.g., GPT-3, GPT-4, LLaMA) and fine-tune it using Hugging Face's Transformers library. Leverage Azure's cloud services for training, utilizing Azure credits for compute resources

- Integration into Learning Platform

Develop APIs with Django to deliver real-time, personalized content generated by the fine-tuned model. Implement the frontend using React.js.

3.2 Technologies

- Frontend Application- JavaScript & React
- Backend API -Python & Django
- Database Postgres SQL
- LLM Model Llama
- CI/CD GitHub, Docker, Kubernetes

4. PROJECT REQUIREMENTS

4.1.Functional Requirements

- The system should be able to generate passages dynamically based on the learner's interest and level.
- The system should be able to generate comprehension exercises (MCQs and fill-in-the-blank tasks) dynamically based on the learner's interest and level.

4.2.Non-Functional Requirements

- User friendliness – The web system should be responsive in mobile and desktop.
- Reliability – The system should perform without any issues in given time.
- Performance – The system must provide accurate results in short time.

4.3.System Requirements

The purpose of software requirements is to define the software resources that must be enforced on a system in order for the proposed system to function properly. The software specifications requirements for this proposed component are as follows.

- React for Frontend Application
- Django for Backend API
- Postgres SQL for Database
- Pinecone DB for Vector Database
- LLAMA for Language Model
- VS Code to implement the code using JavaScript & Python

4.4.User Requirements

This web application will mainly focus on students, who are eager to develop their English language skills.

5. PERSONAL REQUIREMENTS

Develop expertise in Web frameworks, LLM related tools, Database Design, System Design & Deployment

6. WORK BREAKDOWN STRUCTURE

Phase	Tasks
Initiation Process	<ul style="list-style-type: none">• Identify research problem• Topic Assessment• Projects Proposal Presentation & Report
Planning Process	<ul style="list-style-type: none">• Literature Review• Requirement Analysis• Feasibility Study• Data Collection
Design Process	<ul style="list-style-type: none">• Use Case Diagram• Database Design (ER diagram)• Application Architecture design• Interface Design
Implementation Process	<ul style="list-style-type: none">• Develop and Test prompts for Generating content, Assessment and Provide Feedback• Database Implementation• Backend API Implementation• Frontend App Implementation
Testing Process	<ul style="list-style-type: none">• Unit Testing• Component Testing• Integration Testing• System Testing• User Acceptance Testing
Monitoring & Controlling Process	<ul style="list-style-type: none">• Control Schedule• Control Scope
Closing Process	<ul style="list-style-type: none">• Deploy Web Application• Final Report and Presentation• Publish Research Paper

7. GNATT CHART

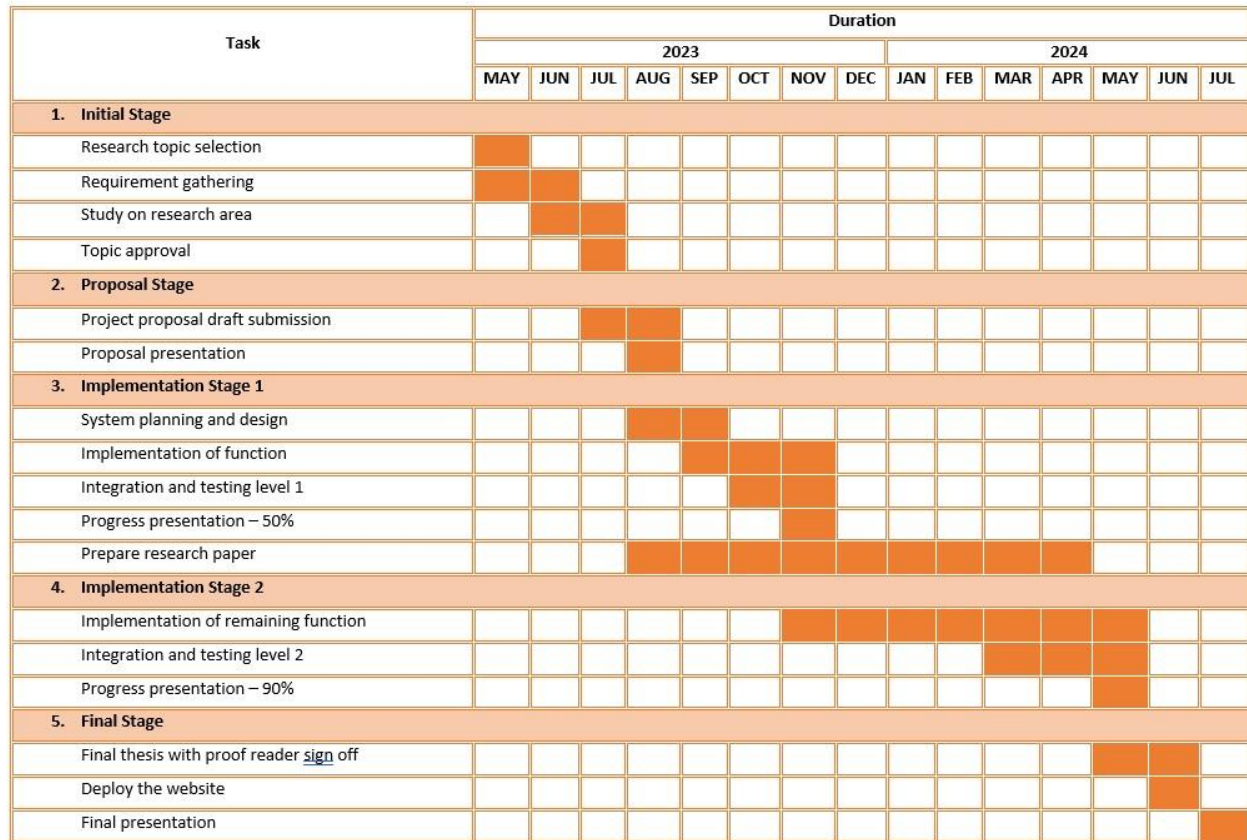


Figure 6

8. BUDGET ESTIMATIONS AND JUSTIFICATION

- Cost of cloud computing services for LLM - Rs 15000/=
- Cost of hosting (Frontend Application, API, Database) - Rs 15000/=
- Other costs (Travelling, Internet connection) - Rs 5000/=
- Total Cost is - Rs 35000/=

9. COMMERCIALIZATION

9.1 Target Audience and Market

- High school students
- English language learners
- English Educators

9.2 Business Strategy

The business model for this application centers on a Software as a Service (SaaS) model, offering two distinct tiers to cater to diverse user needs.

1. **Free Tier** supported by advertisements primarily from educational institutions, ensures broad accessibility, encouraging widespread adoption among learners. This tier serves as an entry point, introducing users to the app's features and benefits.
2. **Premium Version** is available through a subscription-based model, offering an ad-free environment with additional features and resources.

By offering these two tiers, the app can attract a diverse user base, from casual users using the free version to dedicated learners and educators opting for the premium services. This dual-tiered approach not only diversifies revenue streams but also enhances user engagement and retention, positioning the app as a valuable tool in the educational landscape.

9.3 Marketing Strategies

The marketing strategy for the app focus on establishing strategic partnerships and collaborations to enhance its reach and credibility within the educational sector. Partnering with educational institutions provides a unique opportunity to pilot the app within controlled environments, allowing for feedback and adjustments before a broader launch. These partnerships not only facilitate access to potential users but also lend legitimacy to the app, making it a trusted resource for learning.

Additionally, exploring collaborations with government agencies and non-profit organizations focused on literacy and education can further extend the app's impact. Such alliances can provide financial support, visibility, and access to networks that are crucial for scaling the product effectively. By leveraging these partnerships, the educational app can position itself as a vital tool in the educational ecosystem, reaching a wider audience and contributing significantly to improving educational outcomes.

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