RSET
RAJAGIRI SCHOOL OF
ENGINEERING & TECHNOLOGY
(AUTONOMOUS)

Project Report On

Interactive Language Learning Through Cinema

Submitted in partial fulfilment of the requirements for the award of the degree of

Bachelor of Technology

in

Computer Science and Engineering

By

Aarathi Nair (U2003002)

Anitta Mariya Shaji (U2103034)

Anjala Binu (U2103035)

Anushri Dilip (U2103043)

Under the guidance of

Mr. Harikrishnan M

Department of Computer Science and Engineering
Rajagiri School of Engineering & Technology (Autonomous)
(Parent University: APJ Abdul Kalam Technological University)
Rajagiri Valley, Kakkanad, Kochi, 682039
April 2025

CERTIFICATE

This is to certify that the project report entitled ***Interactive Language Learning through Cinema*** *is a bonafide record of the work done by* ***Aarathi Nair (U2003002)***, ***Anitta Mariya Shaji (U2103034)***, ***Anjala Binu (U2103035)*** *and* ***Anushri Dilip (U2103043)*** *submitted to Rajagiri School of Engineering & Technology (RSET) (Autonomous) in partial fulfilment of the requirements for the award of the degree of Bachelor of Technology (B. Tech.) in Computer Science during the academic year 2024-2025.*

Project Guide
Mr. Harikrishnan M
Assistant Professor
Dept. of CSE
RSET

Project Co-ordinator
Mr. Harikrishnan M
Assistant Professor
Dept. of CSE
RSET

Head of the Department
Dr. Preetha K G
Dept. of CSE
RSET

ACKNOWLEDGEMENT

We wish to express our sincere gratitude towards **Rev. Dr. Jaison Paul Mulerikkal CMI**, Principal of RSET, and **Dr. Preetha K G**, Head of the Department of Computer Science for providing us with the opportunity to undertake our project, Interactive Language Learning through Cinema.

We are highly indebted to our project coordinator, **Mr. Harikrishnan M**, Assistant Professor, Dept. of CSE, for his valuable support. We also express our sincere thanks to our project co-coordinator, **Ms. Meenu Mathew**, Assistant Professor, Dept. of CSE, for her support.

It is indeed our pleasure and a moment of satisfaction for us to express our sincere gratitude to our project guide **Mr. Harikrishnan M** for his patience and all the priceless advice and wisdom he has shared with us.

Last but not the least, we would like to express our sincere gratitude towards all other teachers and friends for their continuous support and constructive ideas.

Aarathi Nair

Anitta Mariya Shaji

Anjala Binu

Anushri Dilip

Abstract

The project titled *Interactive Language Learning Through Cinema* aims to revolutionize the way languages are taught by integrating cinematic experiences into the learning process. Traditional language learning methods often fail to engage learners effectively, as they lack real-world context, cultural relevance, and dynamic interaction. This project overcomes these challenges by utilizing movies as the primary medium for language instruction, offering an immersive and interactive approach to language acquisition.

The system incorporates features such as dual-language subtitles, where learners can toggle between their native language and the target language, with a click-to-translate option for real-time vocabulary support. The platform also offers interactive quizzes that are generated from the movie's vocabulary, ensuring active engagement and retention of key linguistic elements.

What sets this project apart from existing solutions is its adaptive learning capabilities. Personalized learning profiles and adaptive difficulty ensure that each user's experience is tailored to their proficiency level, creating a more effective learning environment. By blending entertainment with education, the project makes language learning more enjoyable, motivating, and culturally enriching.

In summary, *Interactive Language Learning Through Cinema* enhances language fluency by bridging the gap between theoretical knowledge and practical application, making learning more engaging and accessible to a broader audience.

Contents

List of Tables

Chapter 1

Introduction

1.1 Background

Traditional methods of language learning do not fully engage learners and give them real-world context, which makes it difficult to understand vocabulary and grammar structures. Exercises in textbooks can help learners understand the rules of language, but this is not enough to prepare learners for practical communication. Conventional methods also lack exposure to cultural and idiomatic nuances that are crucial for true fluency.

This increases the opportunity for language learning because cinema is becoming a global medium. Films are not only used to show real-life language examples but also immerse learners in cultural contexts to understand how language is used in everyday situations. Based on the fact that movies have universal appeal, this project aims to develop an interactive, cinema-based approach to language learning.

Our project, "Interactive Language Learning Through Cinema," addresses some of the major weaknesses of traditional language education by combining dual-language subtitles, vocabulary reinforcement while film watching. The system will make learning more engaging, adaptive, and context-rich with click-to-translate functionality and interactive quizzes. It is highly beneficial for those who are having trouble retaining new vocabulary or keeping themselves motivated using conventional learning techniques.

This project combines linguistic education with cultural immersion by cinema and aims at creating an innovative tool that will promote fluency in language learning and understanding of different cultures. The project also stands out by adapting to different learning needs; it offers feedback and difficulty levels to enhance the overall experience.

1.2 Problem Definition

The Interactive Cinema-Based Language Learning System addresses the problem of making learning more engaging and effective by applying authentic movie content. Traditional learning methods often provide a lack of real-world content and natural patterns of speech; therefore, most students find difficulty in relating such classroom learning with practical application in real life. This project will be developed as an interactive platform, utilizing pre-trained AI models for the analysis of movie scenes. The users will learn languages using authentic content, and the system will process selected movie scenes with real-time translations. This solution will combine entertainment with education, making learners understand cultural nuances, colloquialisms, and native speech patterns in their target language while maintaining high engagement through familiar and enjoyable content.

1.3 Scope and Motivation

The project focuses on developing an interactive platform that uses movie scenes for language learning purposes. The system will introduce real-time translation capabilities within the selected movie scenes. Users are able to interact with scenes through features including vocabulary exploration, and pronunciation, while receiving personalized recommendations based on their progress and proficiency level. The platform will consist of a carefully selected library of movie scenes marked by each difficulty level, language component, and cultural context to support the learning level. The content will be restricted to the properly licensed movie clips provided with clear audio that contains language learning value.

It is a common experience for language learners to find it difficult to make the transition from textbook knowledge to real-life communication skills in the target language. Traditional methods of learning usually fail to reproduce the subtleties of natural conversation, cultural context, and authentic pronunciation patterns. The addition of cinema in language learning provides an excellent opportunity to expose learners to native speech in realistic situations, complete with visual and emotional context. Modern advances in AI and natural language processing make it possible to analyze and interact with movie content in ways that would not have been possible before for educational purposes.

The combination of engaging content from movies with language processing technology presents an opportunity to revolutionize how people learn and practice new languages.

1.4 Objectives

The principal objectives of the project are listed as follows:

1. Provision of dual-language subtitles with a click-to-translate function for real-time learning support
2. Emphasis of key vocabulary and grammar structures that enhance understanding through movie playback
3. Interactive quizzes that allow for an interactive approach to remembering the learned concept
4. Create personalized learning profiles with adaptive difficulty, tailored to each user's needs.
5. Develop a seamless interface that integrates these features into an enjoyable and interactive movie-watching experience.

1.5 Challenges

One of the challenges for this project has been ensuring that subtitles for all different languages synched correctly, especially where speech speeds vary and cultural nuances are employed. Scaling the system up to accommodate multiple languages while maintaining performance and accuracy poses another substantial challenge.

1.6 Assumptions

The following assumptions have been made for the successful completion of the project:

1. Users will be learning a language through comfortable and interesting media, such as movies, and therefore be more engaged and driven.

2. Learners will be better able to retain vocabulary and grammar structures when visual storytelling is combined with dual-language subtitles and click-to-translate features.

1.7 Societal / Industrial Relevance

The Interactive Language Learning Through Cinema project has relevance to society and the industry alike. In terms of society, it adds a flavor to language learning as it makes language learning more accessible, engaging, and culturally immersed. This is very beneficial for multilingual communities and people interested in learning a second language in a context-rich environment. By using cinema, the project bridges cultural gaps and fosters greater understanding between speakers of different languages.

The project has possible applications in the educational technology and entertainment industries. Language learning software can adopt this system to make user experience better, while media houses can use the features to enhance their audience base by offering subtitle support with translation in real-time in multiple languages. It will also help business houses, if they focus on cultural exchange or international relations, to increase fluency in a language among the employees and clients, especially where multilingual communication is of essence.

1.8 Organization of the Report

The report is organized as follows:

- Chapter 1: Introduction - Presents the project background, problem statement, objectives, and challenges
- Chapter 2: Literature Survey - Analyzes existing work in language learning and cinema integration
- Chapter 3: System Design - Details the architecture and components of the proposed solution
- Chapter 4: Results and Discussion - Evaluates the system implementation and outcomes

- Chapter 5: Conclusions and Future Scope - Summarizes findings and suggests potential enhancements

This chapter has introduced the project's context, objectives, and significance. The subsequent chapters will examine related work, system design, implementation results, and future directions.

Chapter 2

Literature Survey

This paper explores the relevant literature and materials on using multimedia, especially movies, to learn a language. In this regard, the technologies and approaches that enable interactive language learning—such as click-to-translate, dual-language subtitles, and adaptive exercises—are the main emphasis of this research review. The current chapter evaluates the advantages and disadvantages of current methods based on this review of past research on multimedia-based language instruction, highlighting successful strategies in the areas of spaced repetition, pronunciation feedback, and cultural annotations. The technological aspects of current systems, including their use of speech recognition, machine learning, and natural language processing to provide adaptive learning experiences, are also assessed in the report. The "Interactive Language Learning Through Cinema" platform, refining its tools to ensure educational effectiveness.

2.1 Dual Subtitles in Language Learning

Gilbert Dizon and Benjamin Thanyawatpokin's research, "Language Learning with Netflix: Exploring the Effects of Dual Subtitles on Vocabulary Learning and Listening Comprehension," examined how dual subtitles, which are native subtitled videos that appear alongside target language captions in a video streaming service, can impact vocabulary learning and listening comprehension. Comparative studies on the effects of L1 subtitling and L2 captioning in different settings have revealed mixed results regarding comprehension and accidental vocabulary acquisition. Both methods were tested in earlier studies. Educators who received L1 subtitles showed an advantage, as noted by Bianchi and Ciabattoni (2008), but some individuals achieved similar or higher vocabulary learning rates between L2 and CPD. Dual subtitles have been little studied in terms of the unique advantages that may arise from their ability to engage both verbal and visual processing-theory,

following Mayer's multimedia learning model.

2.1.1 Significance of Video Streaming Platforms for Language Learning

With the development of streaming sites like Netflix, language learning apps have started using features such as dual subtitles. Such platforms give learners more accessible and authentic exposure to the target language than language media. Initial evidence of better engagement through services like Netflix has been documented, but the systematic analysis of the impact of dual subtitles is yet to be fully explored. As Peters and Webb (2018) note, developing an understanding of how longer video content supports vocabulary acquisition and listening comprehension is essential to maximize these digital tools in formal education.

2.1.2 Empirical Findings on Subtitles and Captions

The effectiveness of L1 subtitles and corresponding L2 captions is linked to the level of knowledge and familiarity with content, which in turn affects the vocabulary gains and comprehension. Raine (2013) suggests that the use of dual subtitles may not be as effective for vocabulary acquisition as L1 subtitled, but rather may enhance comprehension. The improvements in comprehension that have been observed suggest the support that dual subtitles can provide for incidental language acquisition, especially by beginning learners outside their local environment.

2.1.3 Limitations and Future Directions

The content and testing conditions will also only reflect in the present study, with possible biases on the learner sample. For example, to further carry out longitudinal studies or real-time comprehension tracking using tools like eye-tracking software are possible areas for further research to examine how distribution of attention is there between L1 and L2 texts. Conducting a study on dual subtitles in various linguistic and cultural settings can bring about a better understanding of their universal applicability.

2.1.4 Conclusion

The study has pointed out that dual subtitles can be a means of increasing vocabulary acquisition and listening comprehension through the use of both visual and verbal pro-

cessing channels. However, despite the easy availability of dual subtitles on platforms such as Netflix, more research is needed to establish their long-term effectiveness and suitability for use in different cultural backgrounds and languages.

2.2 Joint-Subtitle Extraction and Frame Inpainting

A deep learning model can extract subtitles from videos with burnt-in subtitle(s) and inpainch video frames, as demonstrated by "Joint Subtitle Extraction and Frame Inpainting for Videos with Burned-In Subtitels", by Haoran Xu, Yanbai He, Yingqiang, Chuanyan Hao, and Bo Jiang. Based on three neural networks, namely CTPN, (CRNN), or EdgeConnect, the authors' pipeline comprises text detection, text recognition, and frame inpainting. The network has four layers.

2.2.1 Challenges in Subtitle Extraction and Video Reconstruction

Replenishing with color thresholding or gradient filtering has been the traditional method of subtitle extraction from burned-in and video restoration. However, such techniques often suffer from error propagation associated with complex detection processes and thus suffer low levels of strength and reliability. For example, inpainting techniques such as Patch-based or diffusion-derived are not helpful in handling complicated details and destroyed regions. Yet, they are problematic. While deep learning has been instrumental in the development of sophisticated methods for text recognition and inpainting, the lack of a complete subtitle extraction orinting pipeline has prevented some effective solutions from being found. This was ultimately rectified.

2.2.2 Deep Learning Approaches for Text Detection, Recognition, and Inpainting

The device uses CTPN for text detection and uses both CNN and LTM architectures to provide high-quality results while improving efficiency through the use of its vertical anchor mechanism.et. CRNN, which is made up of a CNN and RNN layers, is used by it for text recognition. Instead of using a fixed vocabulary, this can predict subtitles of varying lengths and match different subtitle contents. The EdgeConnect GAN-based inpainting model is used to remove subtitles from restored frames. That results in the reconstruction being quite coherent and rich in details. The system therefore provides a

package for removing subtitles and restoring video.

2.2.3 Limitations and Future Prospects

The study successfully implements subtitle extraction and frame inpainting methods for videos with burned-in subtitles, thus pointing out areas that may be improved in future research. Such areas include an improvement in the correctness of text recognition by including audio recognition or grammar-checking components, and the optimization of procedures when it comes to intermediate contour extraction may best benefit the removal of subtitles and data integrity. These will make the system capable of editing such a much wider range of multimedia content, including videos containing adverts, logos, or other types of occlusions inside videos.

2.2.4 Conclusion

This paper "Joint Subtitle Extraction and Frame Inpainting for Videos with Burned-In Subtitles" proposes a novel deep-learning framework that can handle the challenges of subtitle extraction and video frame restoration. Combining CTPN for text detection, CRNN for text recognition, and EdgeConnect for frame inpainting, the proposed method attains high precision in subtitle removal and video restoration. This can be further optimized with continued research for higher accuracy of text recognition. This framework provides promising advancements toward editing and translation of videos with subtitles generated within them, which may be further extended for more applications in multimedia content editing.

2.3 Interactive Language Learning through Cinema: A Dual Subtitle Approach

In the research paper titled "Effects of Dual Subtitle: A Study on Comparative Assessment of English Learners" (PDF), Hao, Sheng, Ardasheva, and Wang examine the effects of dual subtitles on the listening comprehension and vocabulary acquisition of Chinese students in the English language. This study uses dual subtitles, L1 and L2, to present content in both the native language of the participants and the target language to promote vocabulary identification and listening comprehension. To improve educational results, the authors

investigated the effect of cognitive load and redundancy effect using multimedia learning theories in the design of subtitles. They found that the utilization of dual subtitles could enhance the retention of vocabulary for advanced learners without increasing the cognitive load; thus, a positive application of subtitled multimedia to film experience and language acquisition may be indicated.

2.3.1 Effectiveness of Dual Subtitles in Language Acquisition

It investigates key factors that make the use of dual subtitles meaningful, particularly for higher-school students who have both L1 and L2 assignments simultaneously. Hao et al. have also found that dual subtitles aid in vocabulary building, since the student can cross link unfamiliar words between languages to increase comprehension and retention. Mayer (2001) suggests that the combination of auditory and visual stimuli enhances language learning by increasing recall and retention. The research demonstrated that dual subtitles have a different effect on proficiency, with high proficiency students receiving more benefits than low proficiency learners who only used two subtitleds due to reduced cognitive load during use of two languages. This reinforces the idea that language learners can be systematically engaged in context-related interactions outside of the classroom by using film content with subtitles in two languages.

2.3.2 Cognitive Load Management in Subtitle Learning

The authors suggest that to avoid cognitive overload, the learner should be given dual subtitles according to their level of expertise and use theories on cognitive load in conjunction with findings that efficient loading distribution leads to better retention. Advanced learners who are more adept at handling dual inputs demonstrated no redundancy effect, suggesting that dual subtitles may be the most advantageous option for those with advanced proficiency.

2.3.3 Immersive Learning through Cinematic Content

The research proposes the use of immersive, high-contextual content such as TED Talks to simulate exposure to real language. Students can interact with academic and conversational language in a classroom by using cinematic material with dual subtitles, which supports theories like Krashen's easy input for vocabulary building.

2.3.4 Conclusion

According to Hao et al, dual subtitles can be an effective tool for advanced learners, increasing vocabulary and comprehension through managed cognitive load and contextual exposure. Future studies could explore how subtitles are used to target different levels of proficiency for broader language learning in cinema.

2.4 Immersive AI-Driven Language Learning

In "Immersive AI-Driven Language Learning: Animating Languages through Gamified Encounters", Karolina Winzer analyzes the evolution of digital language learning applications that incorporate artificial intelligence and gamification to enhance the user experience. OpenAI's ChatGPT-4 model, which has enabled limitless personalized content and conversation practice, is a notable advancement in the research. The study highlights this breakthrough. The adoption of gamification, which involves the use of game-like elements like rewards, storylines, and quests, has altered language learning by providing an adaptive and enjoyable environment for vocabulary and grammar. With this approach, AI is utilized to tailor language learning to the requirements of individual learners, enabling easy and enjoyable language-learning through both mobile and desktop applications like Duolingo.

2.4.1 Effectiveness of Gamification in Language Learning

According to Winzer, gamified learning is enhanced by various components, including personalized instruction through personal experiences, storytelling, and rewards. According to the paper, gamified applications utilize multimodal formats such as audio, visuals and interactive elements to manage all language abilities (reading/writing/speaking/listening). The app also incorporates multiple-touch interfaces for interaction. Through these features, learners can engage in a systematic practice of language acquisition and enhance their memory retention through continuous interaction. Stott and Neustaedter (2013) suggest that learning skills like freedom to fail, immediate feedback, and reward-based motivation are crucial for retaining learner engagement and language retention.

2.4.2 AI-Driven Personalization and Conversation Practice

With the help of AI and, more especially, generative language models, applications now come with dynamic practice in conversation skills tailored to an individual learner's needs. These tools, including ChatGPT-4, allow learners to engage in a target language at various levels of difficulty, offering a realistic interactive environment for the practice of speaking skills. Unlike the previous methods, these AI-based models come with a number of personalization features. It provides feedback in the learner's native language and adapts vocabulary according to the user's progress. One such AI-based language learning tool, as discussed in this paper, is yourteacher.ai, which gives the learners the opportunity for interactive practice with immediate feedback to help improve practical language skills in conversation.

2.4.3 The Role of Immersive Learning in Language Acquisition

The paper promotes immersion-based approaches to language learning, much like those that are used in child acquisition of language. Using Krashen's comprehensible input, among others, Winzer explores how immersive activities, including the viewing of content created by native speakers and changing devices to run in the target language, can significantly build vocabulary and grammatical structures. While some gamified applications do have some limited immersion functionalities, Winzer ventures that more developments will include more immersive techniques within gamified, AI-driven applications to offer a holistic and productive learning experience.

2.4.4 Conclusion

Karoline Winzer's article highlights the potential value of combining artificial intelligence and gamification in foreign language learning, where AI and gamification components make learning attractive and adaptive for learners. From the current, beneficial apps there is a likelihood that future further developments will intensify language acquisition through the development of immersive methods on AI-driven systems with gamification.

2.5 Summary and Gaps Identified

2.5.1 Summary Table

The summary can be tabulated as follows:

Research Area	**Advantages**	**Disadvantages**
Dual Subtitles in Language Learning	Enhanced L1/L2 vocabulary learning. Better listening comprehension. Effective for advanced learners. Real exposure to the language	Limited improvement over L1 subtitles. Cognitive load for beginners. Lacks long-term effectiveness data. Varies with proficiency
Joint-Subtitle Extraction & Frame Inpainting	Accurate extraction methods. Fast recovery of frames. All-in-one pipeline. Video translation	Error propagation risks. Issues with damaged areas. High computational needs. Text recognition limitations
Interactive Cinema-Based Learning	Immersive learning. Strong vocabulary retention. Benefits advanced learners. Real-world exposure	Overwhelming for beginners. Needs careful content selection. Limited proficiency adaptation. Variable content effectiveness
AI-Driven Language Learning	Personalized feedback. Gamified engagement. Unlimited practice. Adaptive learning	Limited cultural context. Basic immersion features. AI model dependence. Artificial interaction

Table 2.1: Summary of Literature Survey

2.5.2 Gaps Identified in Current Research

1. **Longitudinal Research Gap:** A considerable gap exists in the extensive research on the long-term effectiveness of dual subtitles and AI-assisted self-learning techniques. Most current studies appear to concentrate on short-term results without follow-up on long-term retention and language proficiency development.

2. **Proficiency-Level Optimization:** While studies show that novice and advanced

learners behave differently, there is no information on how to actually optimize the subtitle and content presentation with regard to various skill levels. Scholarly endeavor has yet to engage the construct of gradual transitions between subtitle types.

3. **Integration Framework:** Comprehensive frameworks that effectively integrate all approaches (dual subtitles, AI-learned, gamification, and immersive content) are still lacking. Most research endeavors adopted the fragmented approach of investigating the above mentioned methods without their synergistic effects.

4. **Cross-Cultural Applicability:** Such frameworks are still not available, which would fully integrate all those approaches (as dual subtitles, AI-learned, or gamified with immersive content). Most of the time in current research, such strategies are studied separately and often left out of the synergistic benefits that they will yield.

5. **Real-Time Learning Analytics:** Real-time tracking and analysis of engagement and comprehension have not yet made their way into articles on dual embedded subtitles. Very little eye-tracking and cognitive load assessment research is available under more natural viewing conditions.

2.6 Conclusion

The analysis of current literature makes it evident that great advancements in language learning technologies have occurred, from dual subtitles and advances toward AI-driven platforms; while all methods are unique with regard to their advantages—dual subtitles add to vocabulary acquisition and listening comprehension, frame inpainting could lead to better content adaptation, interactive cinema could provide immersive learning, and AI offers personalized learning—there remain important gaps. This refers to the lack of longitudinal studies, limited proficiency-level optimization, absence of integrated frameworks, insufficient cross-cultural research, and inadequate real-time analytics. These gaps describe future research opportunities. They lead actually to the development of our platform "Interactive Language Learning Through Cinema"; it endeavors to offer combinations in diverse methodologies toward flexible adaptation in accommodating different learners and proficiency levels.

Chapter 3

System Design

This chapter involves the system designs used for our interactive language learning system through cinemas.

3.1 System Architecture

The system architecture, shown in Figure 3.1, integrates components like natural language processing, adaptive learning algorithms, and interactive user features to enhance the language learning experience.

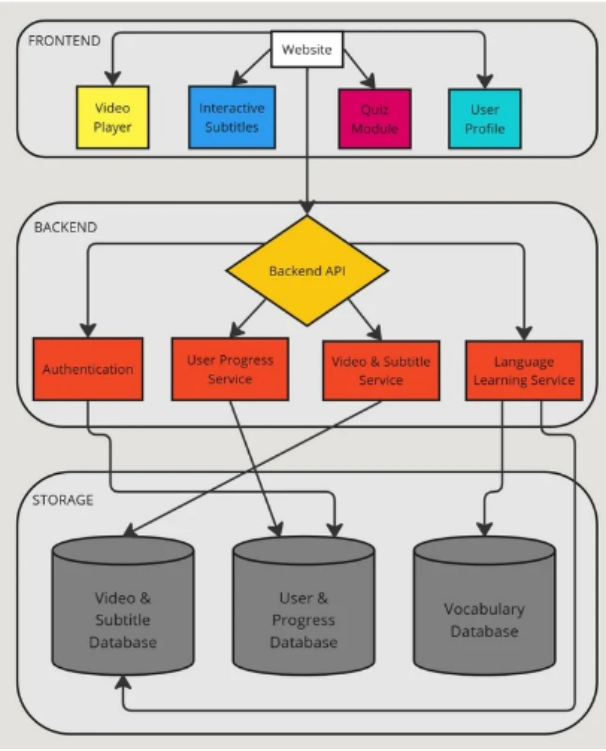


Figure 3.1: System Architecture for Interactive Language Learning through Cinema

3.2 Component Design

This section outlines the design of the main components of an interactive language learning system to ensure functionality, scalability, and user engagement.

3.2.1 Video Input and Processing

The system extracts subtitles directly from video files using embedded subtitle tracks. This ensures accurate retrieval of textual content without requiring additional processing methods.

3.2.2 Subtitle Translation

APIs are integrated to generate subtitles in two languages, enhancing comprehension and facilitating bilingual learning.

3.2.3 Interactive Subtitle Display

A custom video player displays clickable subtitles, allowing retrieval of word information.

3.2.4 Retrieval of Word Information

Dictionary APIs provide word definitions and pronunciation details to aid learning.

3.2.5 User Vocabulary Management

The system tracks learned words and offers review options. These words are stored in a database based on user profiles.

3.2.6 Quiz Generation and Administration

The system generates dynamic quizzes based on subtitle content, testing users on vocabulary encountered in videos.

3.2.7 User Interface

An intuitive and responsive front-end interface facilitates trouble-free navigation and interaction.

3.2.8 Backend and Database

A scalable backend (Node.js) ensures system functionality, while a robust database (MySQL) administers user profiles, vocabulary, and performance data.

3.3 Use Case Diagram

This outlines the interactions between the user and the system.The diagram emphasizes user engagement with various tools provided by the system.

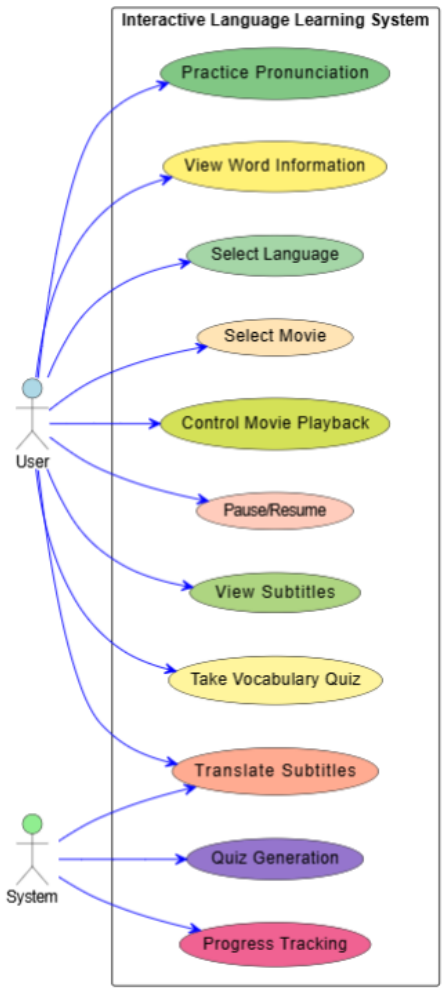


Figure 3.2: Use Case Diagram for Interactive Language Learning System

3.4 Tools and Technologies

3.4.1 Hardware Requirements

- Powerful Computer or Server.
- Minimum 16 GB of RAM.
- Dedicated GPU.
- High-Speed Internet Connection

3.4.2 Software Requirements

- Scalable backend framework (e.g.Node.js)
- Responsive front-end (e.g.React)
- Database System (e.g.MySQL)
- Translation API (e.g.Google Translate API for subtitle translation)
- Cloud-based storage solution

3.5 Identified Dataset

The primary data for this project consists of videos and subtitles obtained from ClipCafe. To support bilingual learning, the subtitles were translated into multiple languages using a powerful translation API. Additionally, dictionary APIs were used to retrieve word definitions and examples, improving vocabulary learning. Cloud storage solutions were used to efficiently manage videos, subtitles, and user data with scalability and availability.

3.6 Module Divisions and Work Breakdown

3.6.1 Modules

1. **Video Input and Processing:** The system extracts subtitles directly from video files using embedded subtitle tracks. This ensures accurate retrieval of textual content, which serves as the foundation for further processing.

2. **Subtitle Translation:** APIs, such as Google Translate API, are integrated to generate subtitles in two languages. This feature enhances comprehension by providing translations alongside the original subtitles.

3. **Interactive Subtitle Display:** A custom video player presents subtitles in an interactive format. Users can click on words within the subtitles to instantly retrieve definitions, translations, and contextual information.

4. **Word Information Retrieval:** Dictionary APIs provide real-time access to word definitions, pronunciation, example sentences, and related linguistic details to aid language learning.

5. **User Vocabulary Management:** The system tracks words that users interact with and stores them for future review. Additional features, such as spaced repetition algorithms, can be incorporated to reinforce long-term vocabulary retention.

6. **Quiz Generation and Management:** The system dynamically generates quizzes based on words from the subtitles. Adaptive algorithms adjust the difficulty of questions based on the user's learning progress, ensuring a personalized assessment experience.

7. **User Interface:** The platform features a responsive and intuitive design that allows seamless navigation. All interactive elements, including subtitles and quizzes, are designed for an engaging and user-friendly experience.

8. **Database Management:** A MySQL database is used to efficiently store and manage user profiles, vocabulary progress, quiz results, and other relevant learning data. This ensures smooth data retrieval and system scalability.

3.6.2 Work Breakdown Responsibilities

- Video Input and Processing, Subtitle Translation : Anushri Dilip
- Interactive Subtitle display, Word information : Anitta Mariya Shaji
- User Vocabulary Management, User interface and Responsive UI components : Aarathi Nair

- Quiz generation, User Profile and Database management: Anjala Binu

3.7 Key Deliverables

The expected outcomes from the Interactive Language Learning System through cinemas are:

1. **Multilingual Movie Experience**
    - Seamless language switching
    - Synchronized subtitles and audio
2. **User Progress Tracking**
    - Personalized learning statistics
    - Vocabulary retention metrics
3. **Interactive Vocabulary Learning**
    - Scene-specific word lists
    - Real-time translations
4. **Cultural Insight**
    - Context-based cultural notes
    - Idiomatic expression breakdowns

3.8 Project Timeline

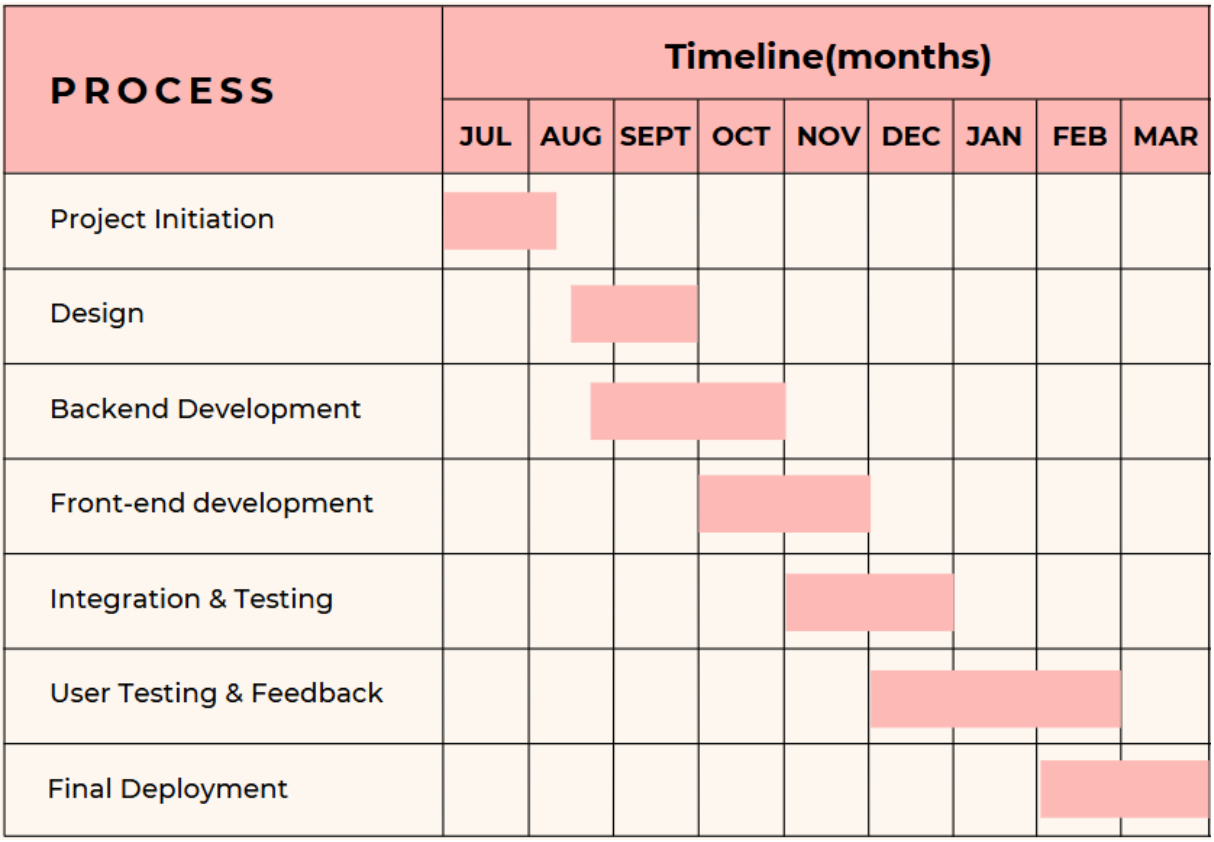


Figure 3.3: Gantt chart: Interactive Language Learning System (July 2024 - March 2025)

3.8.1 Conclusion

In conclusion, this chapter detailed the system design components, architecture, tools, and methodologies integral to the development of the Interactive Language Learning System. These designs ensure functionality, scalability, and an engaging user experience.

Chapter 4

Results and Discussions

This chapter assesses the developed "Take Two" system in terms of the results it has achieved through the comparison with the alternatives available and deducing the effect on language learning.

4.1 System Outcomes

The implemented prototype demonstrates successful integration of:

- Real-time double subtitle synchronization for Hindi and English feed
- Click to translate vocabulary support
- Quiz generation from movie transcripts

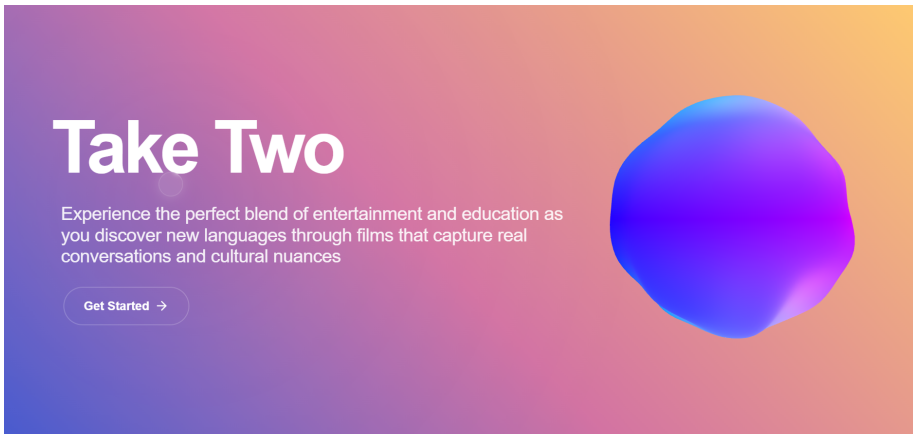


Figure 4.1: Take Two landing page introducing the language learning platform

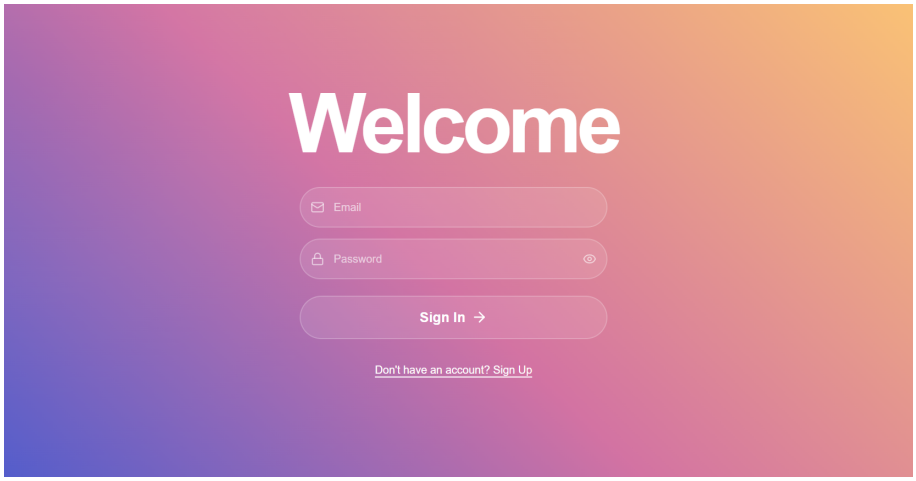


Figure 4.2: User authentication interface with login/signup functionality

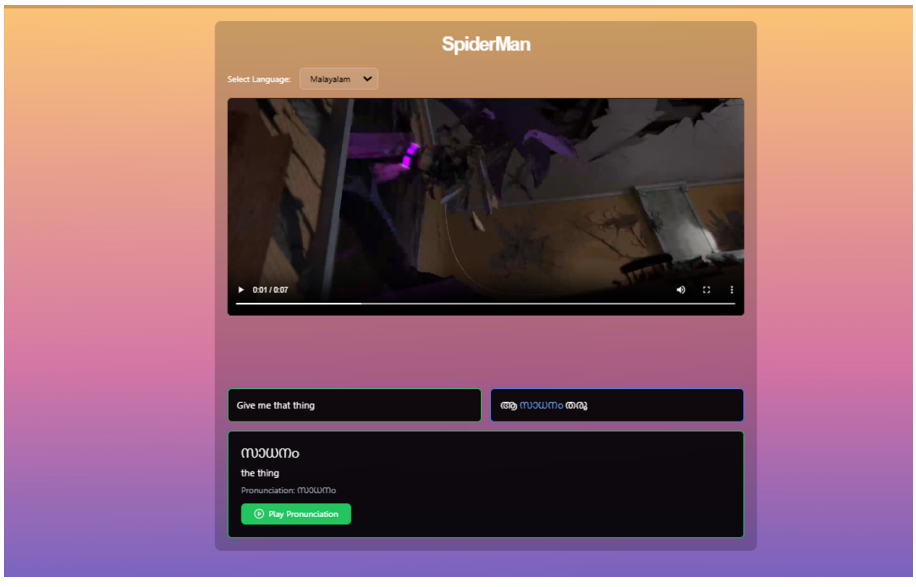


Figure 4.3: Operational prototype showing Malayalam-English learning interface

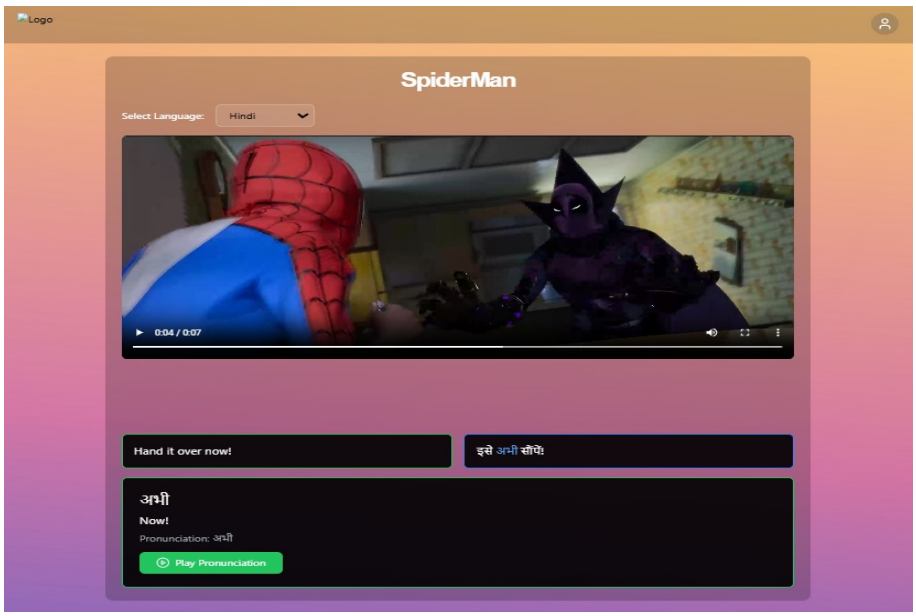


Figure 4.4: Operational prototype showing Hindi-English learning interface

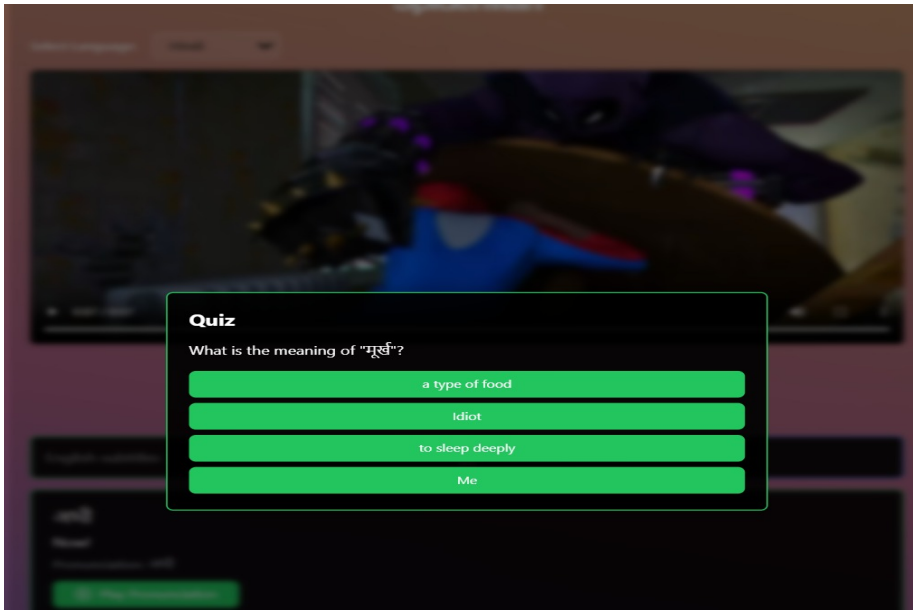


Figure 4.5: Quiz interface for interactive language learning

4.2 Comparative Analysis

Key differentiators identified:

- **Content Authenticity:** Provides real movie dialogues unlike Duolingo's artificial exercises.
- **Educational Tools:** Adds learning features that Netflix/YouTube lack.
- **Cultural Relevance:** Focuses on Indian languages and contexts missing in global platforms.

Feature	**Take Two**	**Duolingo**	**Netflix**	**YouTube**
Authentic movie content	✓	×	✓	✓
Dual-language subtitles	✓	×	×	×
Interactive vocabulary	✓	✓	×	×
Contextual quizzes	✓	✓	×	×
Cultural context	✓	×	✓	✓
Indian language focus	✓	×	×	×

Table 4.1: Feature comparison with major platforms

The Take Two prototype demonstrates precisely how cinematic material is cracked up into productive learning. Though this facility is much smaller in size relative to the commercial sites, such a thrilling combination of real content, cultural appropriateness, and interactive facilities is future potential for learning Indian languages. Future development should focus on content expansion and technical fine-tuning based on user response.

Chapter 5

Conclusions and Future Scope

5.1 Conclusions

The project "Interactive Language Learning through Cinema" has constructed a web platform which turns films into interactive lessons . Key achievements include:

- Working dual-subtitle system (English-Hindi/Malayalam) with click-to-translate.
- Adaptive learning features: vocabulary tracking, contextual quizzes
- Robust architecture integrating video processing, translation APIs, and user progress tracking.

The system bridges entertainment and education, offering authentic language exposure through various cinematic content.

5.2 Future Scope

Potential enhancements include:

- Adding other languages such as Tamil, Telugu, Bengali, etc and other forms of media such as TV programs, news programs, documentaries.
- Develop mobile apps and add advanced speech recognition.
- Culture guides , grammar notes and gamification
- Emotional recognition and learning outcomes studies

The platform creates an scalable foundation for future multimedia language learning.

References

[1] Gilbert Dizon and Benjamin Thanyawatpokin. Language learning with netflix: Exploring the effects of dual subtitles on vocabulary learning and listening comprehension. *Computer-Assisted Language Learning Electronic Journal*, 22(3):52–65, 2021.

[2] Tao Hao, Huixiao Sheng, Yuliya Ardasheva, and Zhe Wang. Effects of dual subtitles on chinese students' english listening comprehension and vocabulary learning. *Asia-Pacific Education Researcher*, 31(5):529–540, 2022.

[3] Alejandro Martin, Israel González-Carrasco, Victor Rodríguez-Fernandez, Mónica Souto-Rico, David Camacho, and Belén Ruiz-Mezcua. Deep-sync: A novel deep learning-based tool for semantic-aware subtitling synchronisation. *Neural Computing and Applications*, 2021.

[4] Karoline Winzer. *Immersive AI-Driven Language Learning: Animating languages through gamified encounters.* 2024.

[5] H. Xu, Y. He, X. Li, X. Hu, C. Hao, and B. Jiang. Joint subtitle extraction and frame inpainting for videos with burned-in subtitles. *Information*, 12(3):233, 2021.

Appendix A: Presentation

TAKE TWO

INTERACTIVE LANGUAGE LEARNING THROUGH CINEMA

Project Guide :
Mr. Harikrishnan M
Assistant Professor, DCE

Aarathi Nair - U2003002
Anitta Mariya Shaji - U2103034
Anjala Binu - U2103035
Anushri Dilip - U2103043

CONTENTS

1. PROBLEM DEFINITION

- Traditional methods fail to captivate learners effectively.
- Learners don't experience language in practical, everyday situations.
- Traditional approaches overlook the cultural context essential for true language fluency.
- Learners often find it hard to stay motivated with conventional methods.
- Retaining new vocabulary and grammar structures is challenging without real-world examples.

2. PURPOSE & NEED

PURPOSE

- Use cinema to make language learning more engaging and effective.
- Teach language through real-world conversations and cultural context.
- Incorporate features like dual subtitles, translation, and quizzes.

NEED

- Make learning enjoyable by using movies.
- Boost memory with immersive, contextual learning.
- Adapt to individual learning needs.
- Keep language learning fun and relevant.

3. PROJECT OBJECTIVES

- Implement dual-language subtitles with click-to-translate functionality for real-time learning support.
- Highlight key vocabulary and grammar structures to reinforce understanding.
- Interactive quizzes for active engagement.
- Provide pronunciation feedback through scene reenactments to improve speaking skills.
- Create personalized learning profiles with adaptive difficulty to tailor the learning experience to each user's needs.

4. LITERATURE SURVEY

1)Dizon, Gilbert, and Benjamin Thanyawatpokin. "Language learning with Netflix: Exploring the effects of dual subtitles on vocabulary learning and listening comprehension." Computer-Assisted Language Learning Electronic Journal 22.3 (2021): 52-65.

- Dual subtitles (L1 and L2) improve vocabulary learning and listening comprehension.
- Supports using dual-language subtitles with click-to-translate for real-time vocabulary retention

2)Xu, H., He, Y., Li, X., Hu, X., Hao, C., & Jiang, B. "Joint subtitle extraction and frame inpainting for videos with burned-in subtitles." Information 12.3 (2021): 233.

- Automate subtitle extraction from videos without soft-coded subtitles.
- Translate extracted subtitles for dual-language integration.
- Use text detection to process burned-in subtitles.
- Enable interactive subtitles with click-to-translate for real-time vocabulary learning

4. LITERATURE SURVEY

3) Hao, Tao, Huixiao Sheng, Yuliya Ardasheva, and Zhe Wang. "Effects of dual subtitles on Chinese students' English listening comprehension and vocabulary learning." Asia-Pacific Education Researcher (2022)

- Dual subtitles improve vocabulary learning and listening comprehension.
- Highlighting key vocabulary in subtitles reduces cognitive load.
- Adapting subtitle modes based on user proficiency enhances learning: native language subtitles for beginners, dual subtitles for advanced learners

4) Karoline Winzer. Immersive AI-Driven Language Learning: Animating languages through gamified encounters. 2024

- Gamification enhances engagement and motivation.
- Cultural immersion and real-world context are crucial.
- Interactive features like dual-language subtitles and pronunciation feedback support real-time learning.

4. LITERATURE SURVEY

5)Martín, Alejandro, Israel González-Carrasco, Victor Rodriguez-Fernandez, Mónica Souto-Rico, David Camacho, and Belén Ruiz-Mezcua. "Deep-Sync: A novel deep learning-based tool for semantic-aware subtitling synchronisation." Neural Computing and Applications (2021)

- Automated subtitle alignment with audio-visual content.
- Integration of deep language representation models.
- Use of real-time voice recognition for accurate subtitle synchronization.

5. PROPOSED METHODOLOGY

1.Movie Selection and Subtitle Processing

- Provide users with a selection of movies sourced from ClipCafe.
- Each movie is accompanied by an SRT subtitle file
- Convert the SRT subtitle file into Subtitles.js format for interactive features.

Algorithm

- ClipCafe API : Fetches movie content and associated subtitle files (SRT).
- Subtitle.js Converter: Transforms SRT files into Subtitles.js format, allowing for real-time translation and interactivity.

5. PROPOSED METHODOLOGY

2. Subtitle Translation

- Integrate with translation APIs
- Translate extracted subtitles to the user's target language
- Align translated subtitles with original subtitles for synchronization

Algorithm

- Googletrans: This script uses the Google Translate API through the googletrans Python library for translation
- Dynamic Time Warping (DTW): For aligning translated subtitles with original ones. It's effective for synchronizing sequences that may vary in speed.

5. PROPOSED METHODOLOGY

3. Interactive Subtitle Display

- Develop a custom video player with synchronized subtitle display
- Implement clickable/tappable words in the subtitles
- Create a system to fetch and display word information on click/tap

Algorithm

- HTML5 Video API: For custom video player development. It provides native browser support and good performance.
- JavaScript Event Handling: For implementing clickable words. It's the standard for creating interactive web elements.

5. PROPOSED METHODOLOGY

4. Word Information Retrieval

- Integrate with dictionary APIs or create a custom database
- Retrieve word definitions, pronunciations, synonyms, and usage examples
- Display retrieved information in an easily readable format

Algorithm

- Google Translate API :Translates Hindi/Malayalam → English. Provides pronunciation (if available).
- Google Text-to-Speech (gTTS): Generates MP3 audio for pronunciation.

5. PROPOSED METHODOLOGY

5. User Vocabulary Management

- Develop a system for users to save words they encounter
- Implement a spaced repetition algorithm for vocabulary review
- Create user interfaces for vocabulary management and review

Algorithm

- SuperMemo Algorithm (SM-2): For spaced repetition. It's a well-established algorithm for optimizing review intervals.
- Database (MySQL): For efficient word storage and retrieval. These data structures offer fast access and good space efficiency.

5. PROPOSED METHODOLOGY

6. Quiz Generation and Assessment

- Use an algorithm to generate quizzes based on user's saved vocabulary
- Develop a scoring system and progress tracking for quizzes

Algorithm

- Item Response Theory (IRT): For adaptive quiz difficulty. It helps in estimating question difficulty and user ability.
- Fisher-Yates Shuffle Algorithm: For randomizing quiz questions. It provides an unbiased shuffle with optimal time complexity.

5. PROPOSED METHODOLOGY

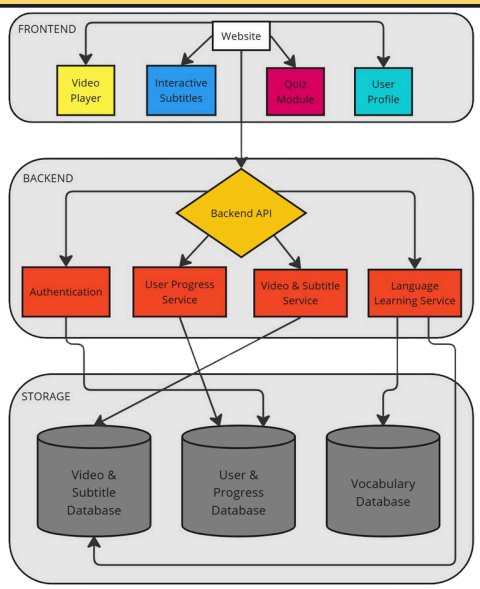
7. User Interface and Experience Design

- Create an intuitive, responsive interface for all features
- Ensure smooth navigation between video playback, word info, quizzes, and pronunciation practice
- Implement progress tracking and visualization for user motivation

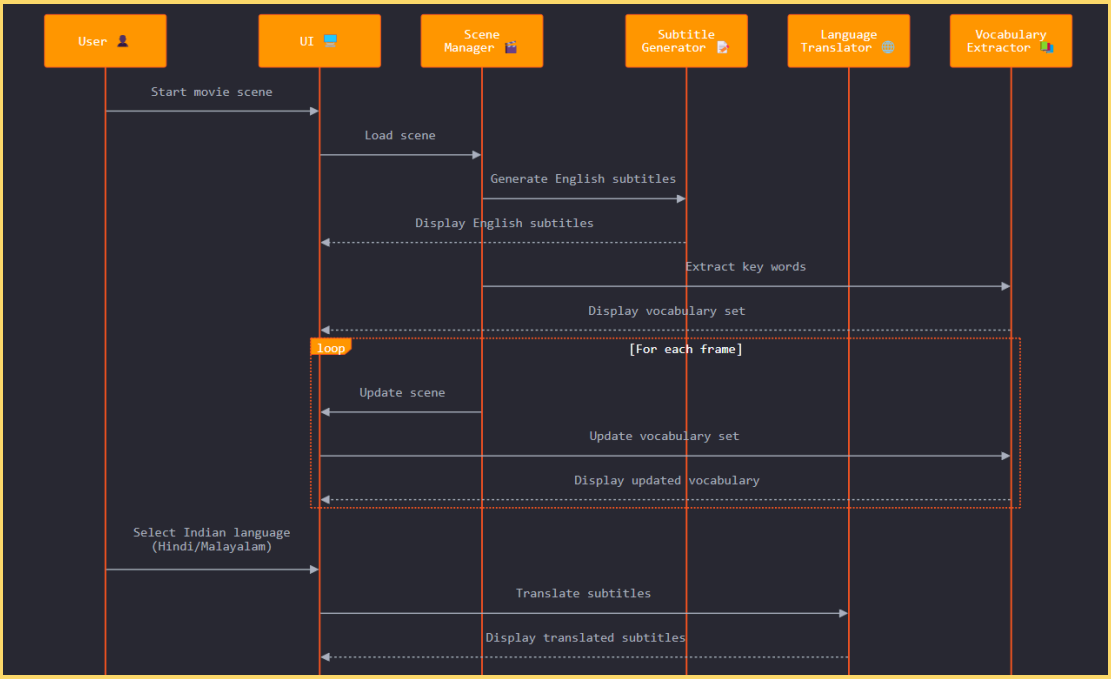
Algorithm

- Responsive Web Design (RWD) techniques: For creating adaptable layouts. It ensures a consistent experience across different devices.
- Exponential Moving Average (EMA): For smooth progress tracking visualization. It provides a responsive yet stable representation of user progress over time.

6. ARCHITECTURE DIAGRAM

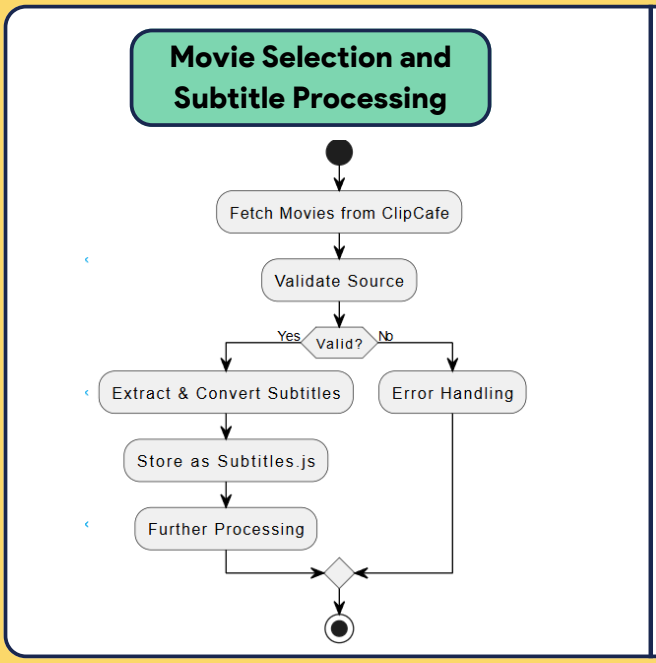


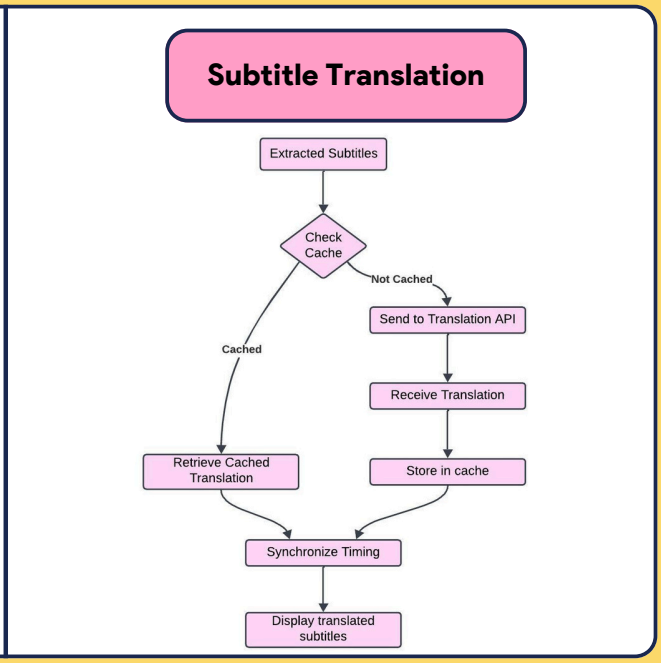
7. SEQUENCE DIAGRAM

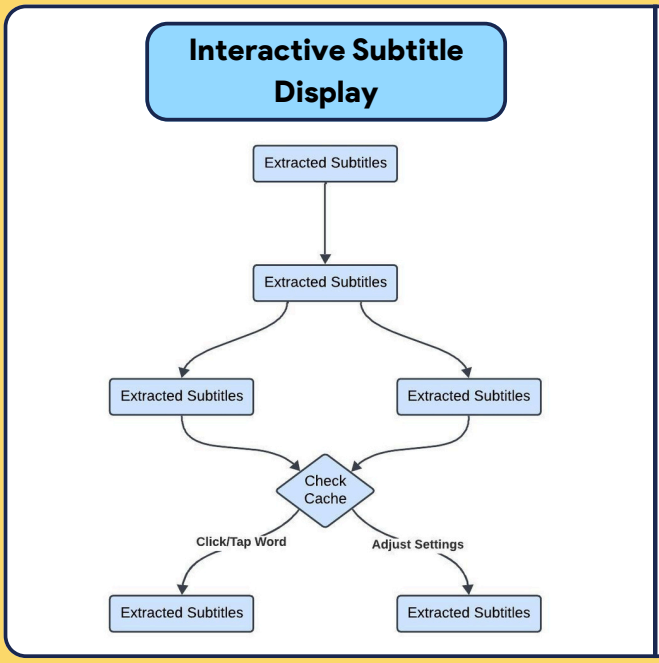


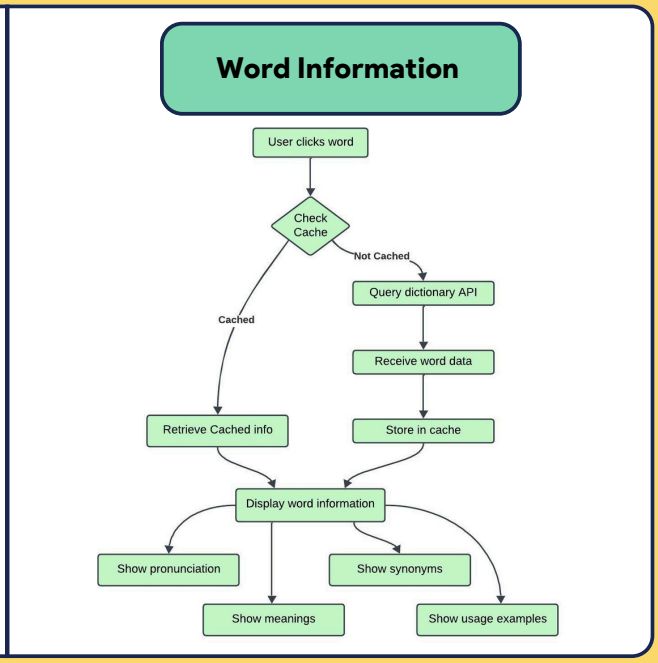
8. MODULES

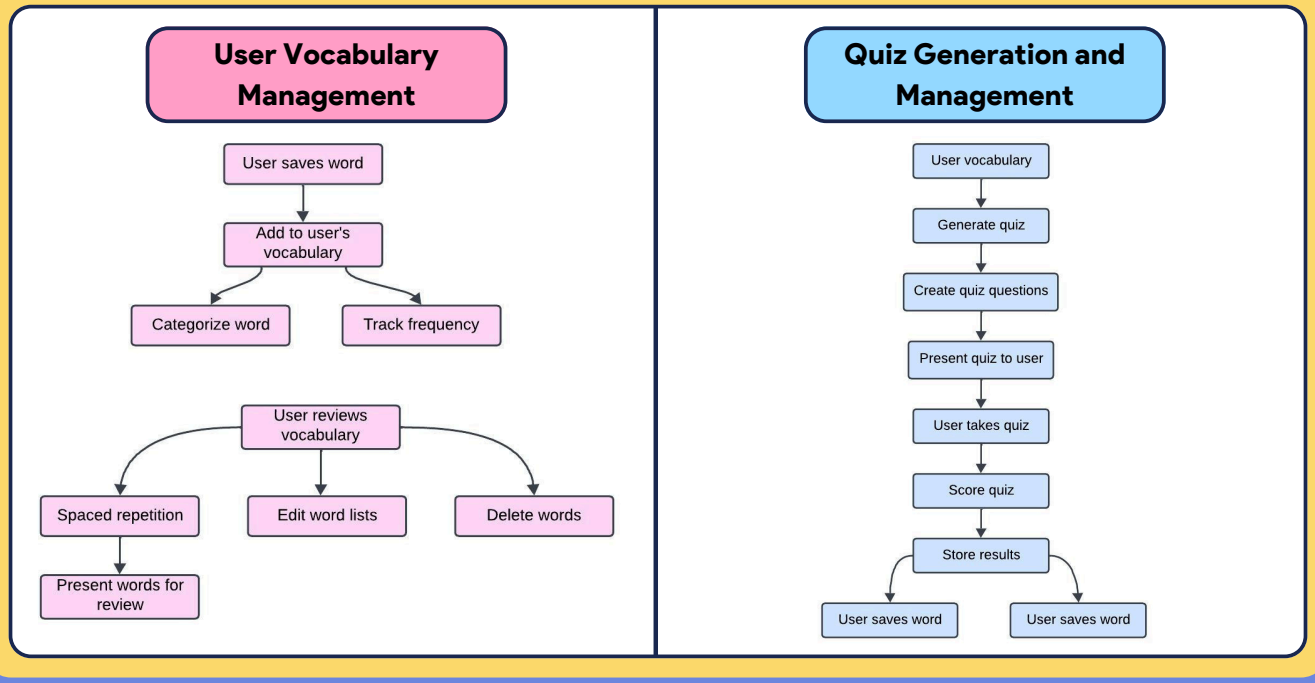
1. **Video Input and Processing Module**
2. **Subtitle Translation Module**
3. **Interactive Subtitle Display Module**
4. **Word Information Module**
5. **User Vocabulary Management Module**
6. **Quiz Generation and Management Module**
7. **User Interface Module**
8. **Database Module**

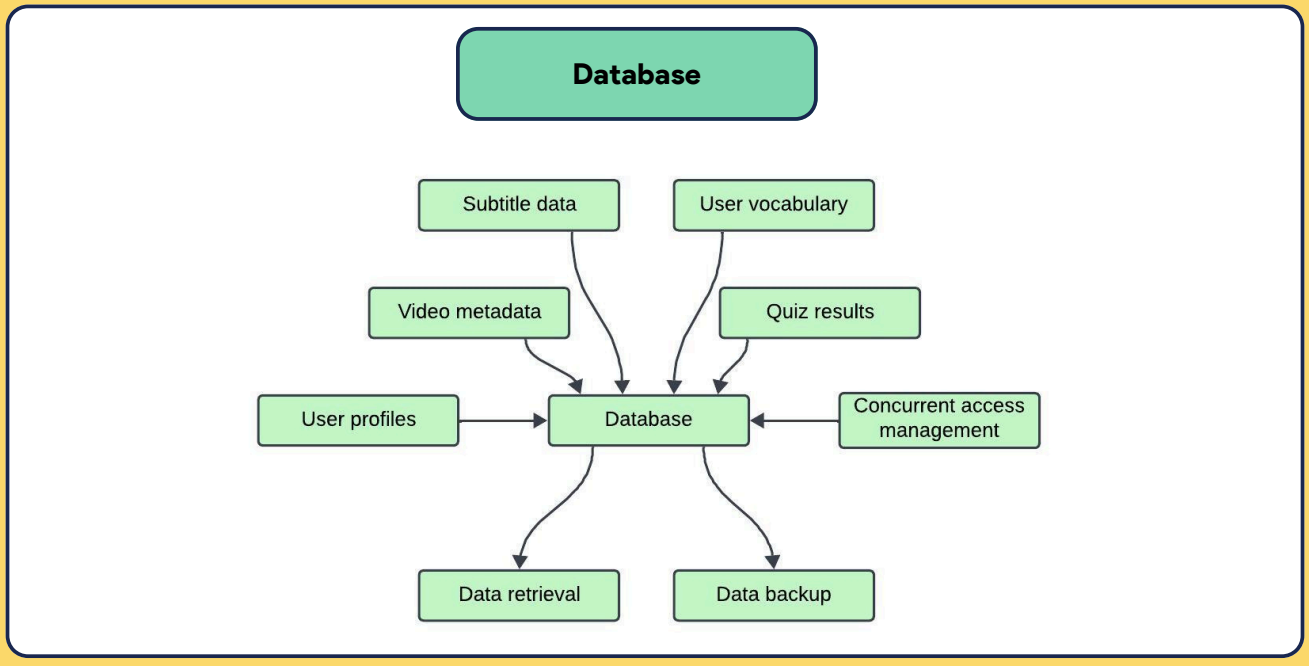

Movie Selection and Subtitle Processing
Fetch Movies from ClipCafe
Validate Source
Yes
Valid?
No
Extract & Convert Subtitles
Error Handling
Store as Subtitles.js
Further Processing


Subtitle Translation
Extracted Subtitles
Check Cache
Not Cached
Send to Translation API
Cached
Receive Translation
Retrieve Cached Translation
Store in cache
Synchronize Timing
Display translated subtitles


Interactive Subtitle Display
Extracted Subtitles
Extracted Subtitles
Extracted Subtitles
Extracted Subtitles
Check Cache
Click/Tap Word
Adjust Settings
Extracted Subtitles
Extracted Subtitles


Word Information
User clicks word
Check Cache
Not Cached
Query dictionary API
Cached
Receive word data
Retrieve Cached info
Store in cache
Display word information
Show pronunciation
Show synonyms
Show meanings
Show usage examples


User Vocabulary Management
User saves word
Add to user's vocabulary
Categorize word
Track frequency
User reviews vocabulary
Spaced repetition
Edit word lists
Delete words
Present words for review
Quiz Generation and Management
User vocabulary
Generate quiz
Create quiz questions
Present quiz to user
User takes quiz
Score quiz
Store results
User saves word
User saves word


Database
Subtitle data
User vocabulary
Video metadata
Quiz results
User profiles
Database
Concurrent access management
Data retrieval
Data backup

9. ASSUMPTIONS

- **Learner Engagement**: Users will be more motivated and engaged in language learning when it is presented through a familiar and entertaining medium like cinema.
- **Vocabulary Retention**: Combining visual storytelling with dual-language subtitles and click-to-translate functionality helps learners retain vocabulary and grammar structures more effectively.
- **Pronunciation**: Providing pronunciation feedback by encouraging learners to improve their speaking and listening skills.
- **Cultural Context**: Language learners benefit from exposure to cultural nuances, idiomatic expressions, and real-life dialogue situations, which traditional learning tools lack.
- **Technical Compatibility**: This system will be compatible with various devices and operating systems.

10. WORK BREAKDOWN AND RESPONSIBILITIES

Anushri Dilip
- Video input and processing
- Subtitle translation

Aarathi Nair
- User vocabulary management
- User interface and Responsive UI components

Anitta Mariya Shaji
- Interactive subtitle display
- Word information

Anjala Binu
- Quiz generation
- User Profile and Database management

12. Hardware and Software Requirements

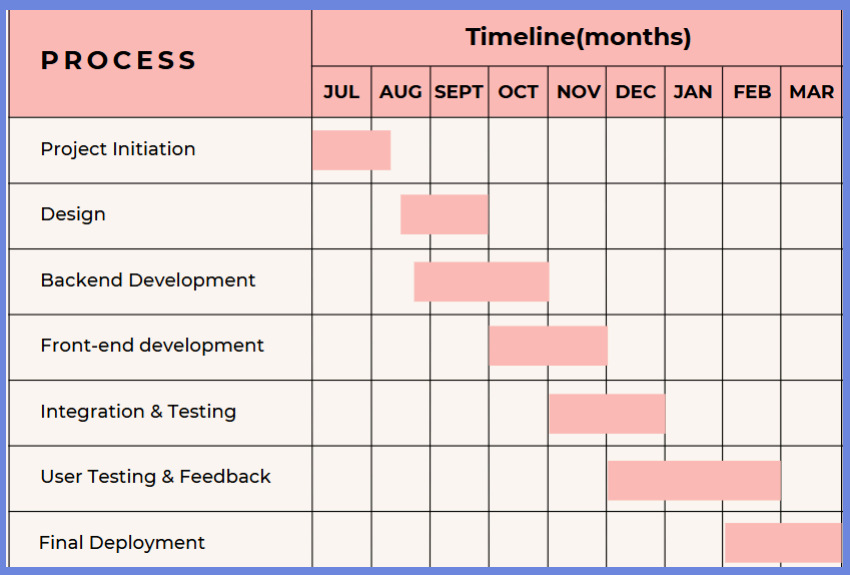
Hardware

- High-performance computer or server
- Minimum 16GB RAM (32GB recommended)
- Dedicated GPU
- High-speed internet connection

Software

- Scalable backend framework (e.g., Django, Node.js)
- Responsive front-end (e.g., React, Vue.js)
- Pre-trained NLP models
- Database system (e.g., PostgreSQL, MongoDB)
- Cloud storage solution
- Audio processing libraries

13. GANTT CHART



15. RISKS AND CHALLENGES

- **Content Acquisition**: Identifying content that can be legally used for educational purposes without violating copyright laws could be difficult, especially for a broad, diverse library of films.
- **Language and Cultural Sensitivity**: Selecting films that are culturally appropriate and avoid stereotypes can be challenging.
- **Scalability**: Scaling the platform to accommodate a large number of users while maintaining quality can be difficult.

16. EXPECTED OUTPUTS

Multilingual Movie Experience
- Seamless language switching
- Synchronized subtitles and audio

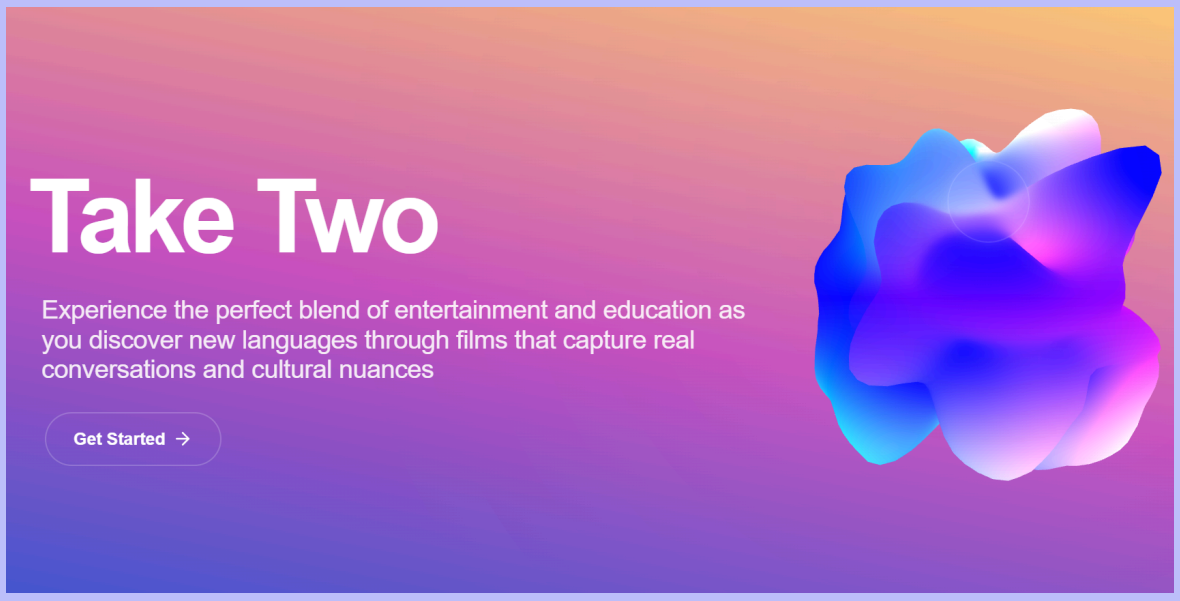
User Progress Tracking
- Personalized learning statistics
- Vocabulary retention metrics

Engagement Analytics
- Most watched scenes and movies
- Language preference patterns

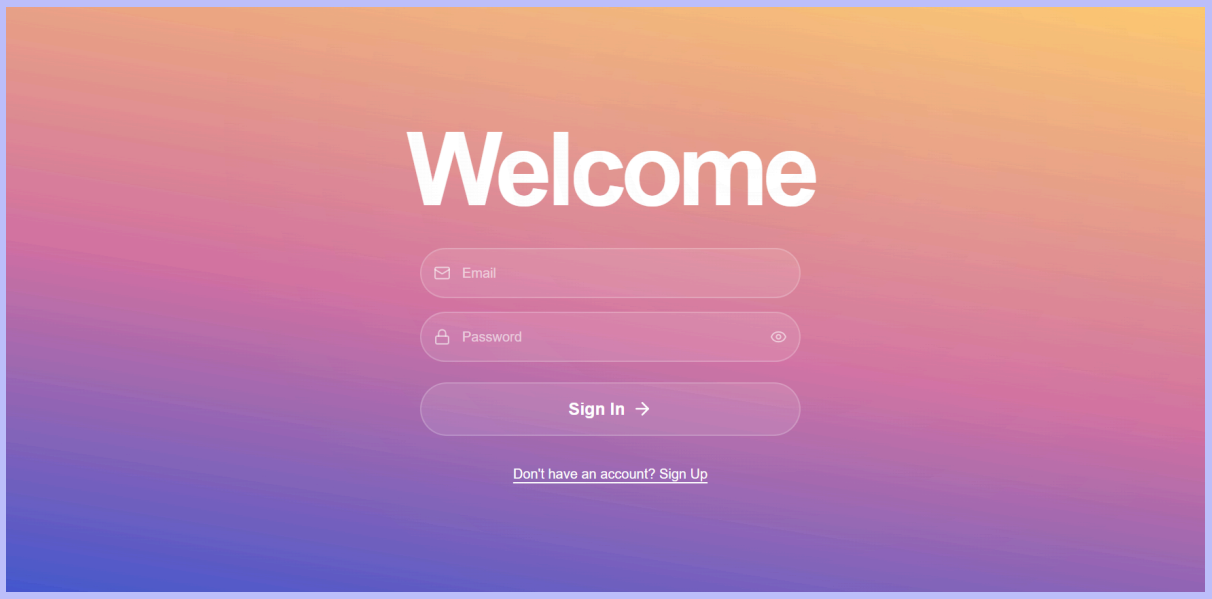
Interactive Vocabulary Learning
- Scene-specific word lists
- Real-time translations

Cultural Insight
- Context-based cultural notes
- Idiomatic expression breakdowns

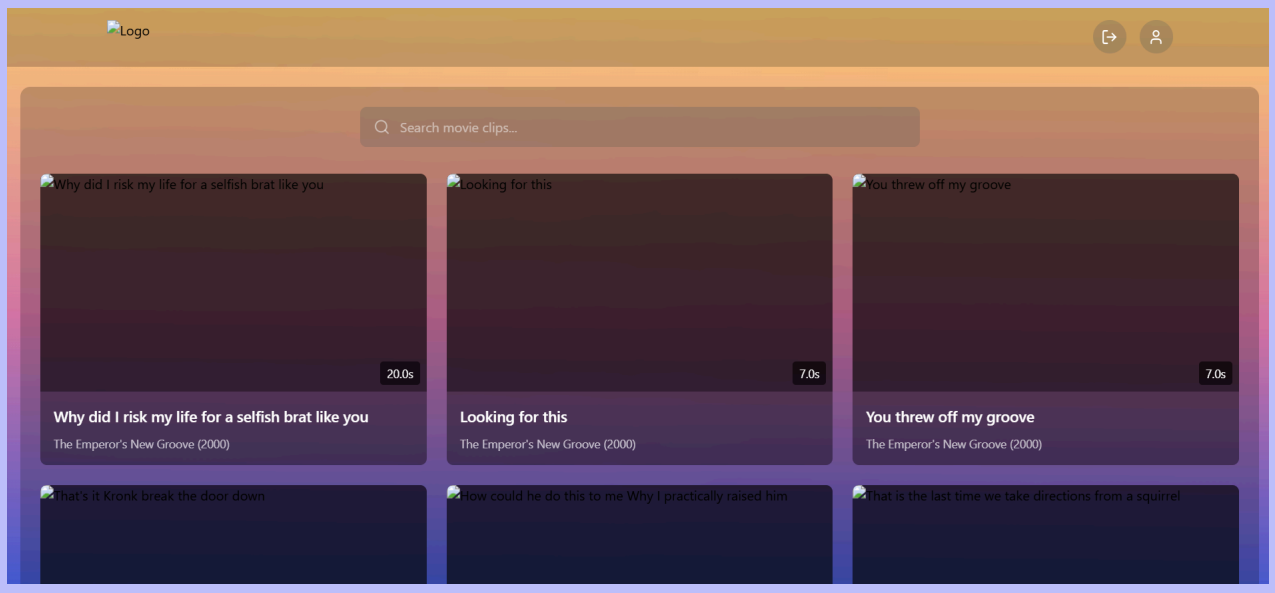
16. OUTPUTS



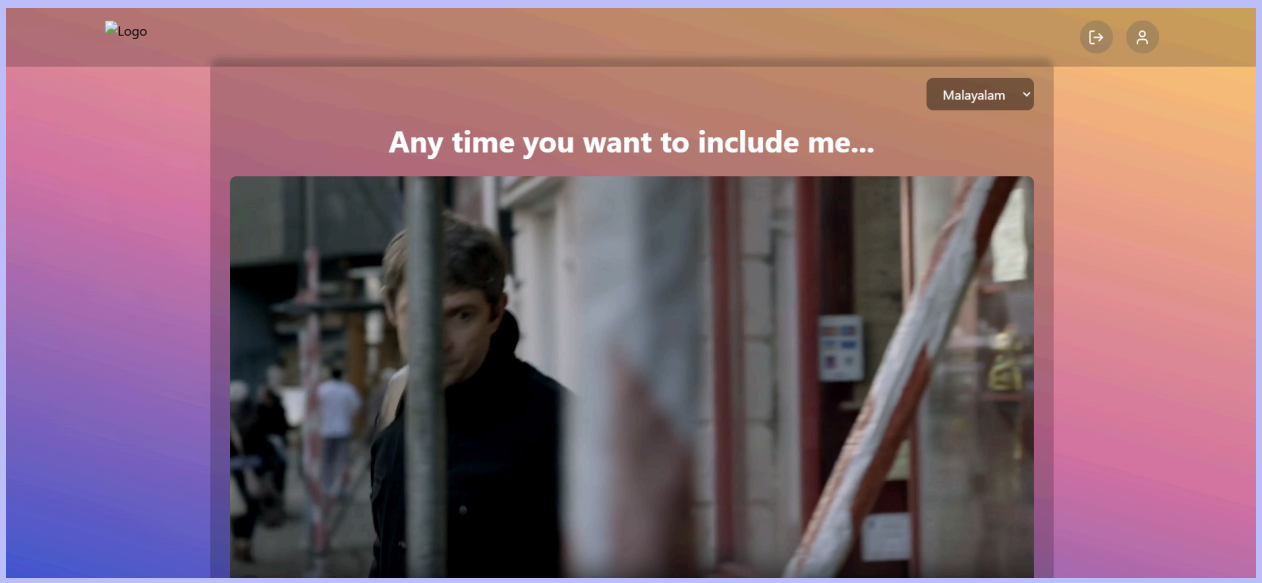
16. OUTPUTS



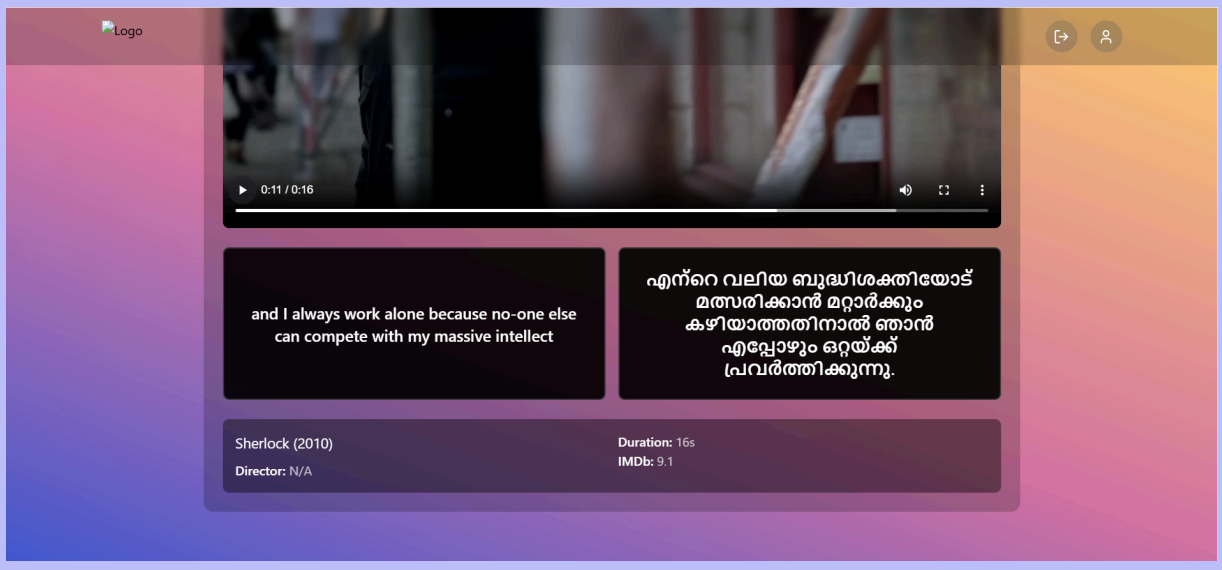
16. OUTPUTS



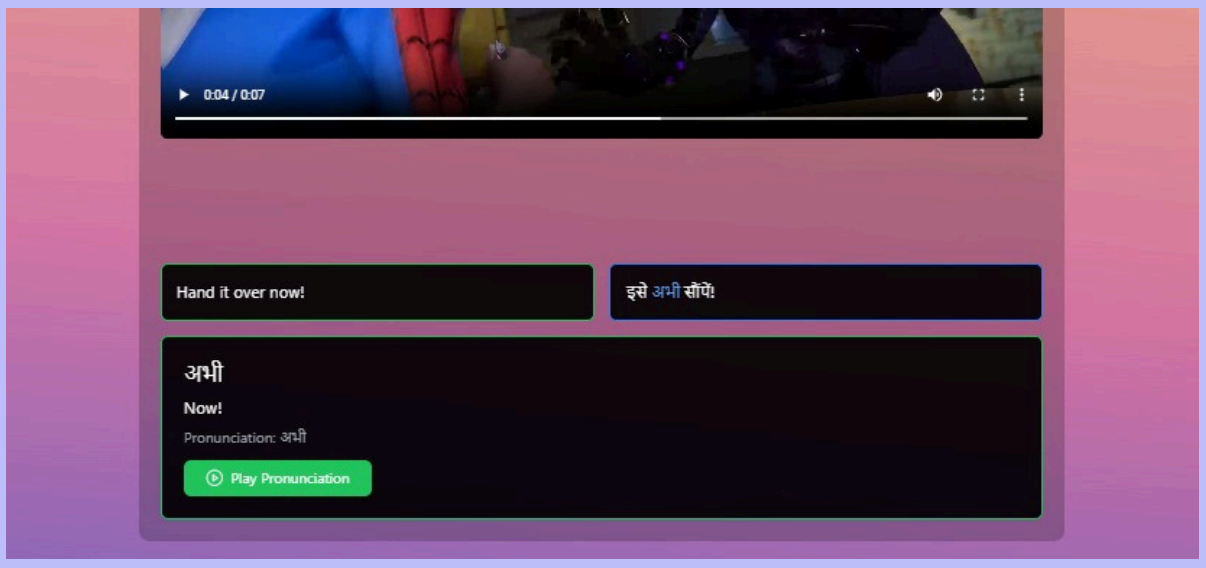
16. OUTPUTS



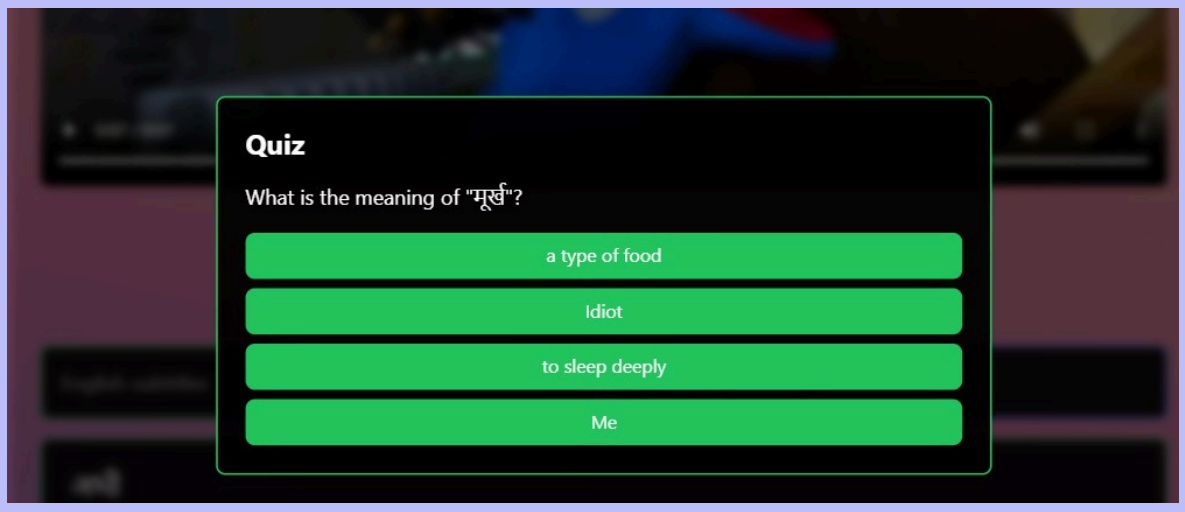
16. OUTPUTS



16. OUTPUTS



16. OUTPUTS



17. CONCLUSION

- This project successfully integrates cinema with dual-language interactive subtitles, creating an innovative and engaging learning experience.
- The system provides seamless transitions between English and Indian languages, enhancing the language learning process.
- Dynamic vocabulary building, tied directly to movie scenes, offers contextual and memorable language acquisition.
- By utilizing the universal appeal of cinema, this tool goes beyond mere language learning to promote cultural understanding.
- The project paves the way for more immersive and personalized approaches to language education in an increasingly connected world.
- The application fosters global connections through shared cinematic experiences, effectively transforming language barriers into opportunities for cultural exchange.
- In conclusion, this innovative approach is transforming language learning, one scene at a time, making it more accessible, engaging, and culturally enriching

18. REFERENCES

1)Dizon, Gilbert, and Benjamin Thanyawatpokin . "Language learning with Netflix: Exploring the effects of dual subtitles on vocabulary learning and listening comprehension." Computer-Assisted Language Learning Electronic Journal 22.3 (2021): 52-65.

2)Xu, H., He, Y., Li, X., Hu, X., Hao, C., & Jiang, B. "Joint subtitle extraction and frame inpainting for videos with burned-in subtitles." Information 12.3 (2021): 233.

3)Hao, Tao, Huixiao Sheng, Yuliya Ardasheva, and Zhe Wang. "Effects of dual subtitles on Chinese students' English listening comprehension and vocabulary learning." Asia-Pacific Education Researcher 31.5 (2022): 529-540.

4)Martín, Alejandro, Israel González-Carrasco, Victor Rodriguez-Fernandez, Mónica Souto-Rico, David Camacho, and Belén Ruiz-Mezcua. "Deep-Sync: A novel deep learning-based tool for semantic-aware subtitling synchronisation." Neural Computing and Applications (2021).

5)Karoline Winzer. Immersive AI-Driven Language Learning: Animating languages through gamified encounters. (2024)

Appendix B: Vision, Mission, Programme Outcomes and Course Outcomes

Vision, Mission, Programme Outcomes and Course Outcomes

Institute Vision

To evolve into a premier technological institution, moulding eminent professionals with creative minds, innovative ideas and sound practical skill, and to shape a future where technology works for the enrichment of mankind.

Institute Mission

To impart state-of-the-art knowledge to individuals in various technological disciplines and to inculcate in them a high degree of social consciousness and human values, thereby enabling them to face the challenges of life with courage and conviction.

Department Vision

To become a centre of excellence in Computer Science and Engineering, moulding professionals catering to the research and professional needs of national and international organizations.

Department Mission

To inspire and nurture students, with up-to-date knowledge in Computer Science and Engineering, ethics, team spirit, leadership abilities, innovation and creativity to come out with solutions meeting societal needs.

Programme Outcomes (PO)

Engineering Graduates will be able to:

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and Team work: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

10. Communication: Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Programme Specific Outcomes (PSO)

A graduate of the Computer Science and Engineering Program will demonstrate:

PSO1: Computer Science Specific Skills
The ability to identify, analyze and design solutions for complex engineering problems in multidisciplinary areas by understanding the core principles and concepts of computer science and thereby engage in national grand challenges.

PSO2: Programming and Software Development Skills
The ability to acquire programming efficiency by designing algorithms and applying standard practices in software project development to deliver quality software products meeting the demands of the industry.

PSO3: Professional Skills
The ability to apply the fundamentals of computer science in competitive research and to develop innovative products to meet the societal needs thereby evolving as an eminent researcher and entrepreneur.

Course Outcomes (CO)

Course Outcome 1: Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: Apply).

Course Outcome 2: Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: Apply).

Course Outcome 3: Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: Apply).

Course Outcome 4: Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: Apply).

Course Outcome 5: Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: Analyze).

Course Outcome 6: Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: Apply).

Appendix C:
CO-PO-PSO Mapping

Course Outcomes

After completion of the course the student will be able to:

SL.NO	Description	Bloom's Taxonomy Level
CO1	Model and solve real-world problems by applying knowledge across domains.	Level 3: Apply
CO2	Develop products, processes, or technologies for sustainable and socially relevant applications.	Level 3: Apply
CO3	Function effectively as an individual and as a leader in diverse teams to comprehend and execute designated tasks.	Level 3: Apply
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms.	Level 3: Apply
CO5	Identify technology/research gaps and propose innovative/creative solutions.	Level 4: Analyze
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms.	Level 3: Apply

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
1	2	2	1	1	-	2	1	-	-	-	-	3
2	3	3	2	3	-	2	1	-	-	-	-	3
3	3	2	-	-	3	-	-	1	-	2	-	3
4	3	-	-	-	2	-	-	1	-	3	-	3
5	3	3	3	3	2	2	-	2	-	3	-	3

CO-PSO Mapping

CO	PSO 1	PSO 2	PSO 3
1	3	1	2
2	3	2	2
3	2	2	-
4	3	-	3
5	3	-	-

Justification for CO-PO Mapping

Mapping	Level	Justification
101003/CS722U.1-PO1	M	Knowledge in the area of technology for project development using various tools results in better modeling.
101003/CS722U.1-PO2	M	Knowledge acquired in the selected area of project development can be used to identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions.
101003/CS722U.1-PO3	M	Can use the acquired knowledge in designing solutions to complex problems.
101003/CS722U.1-PO4	M	Can use the acquired knowledge in designing solutions to complex problems.
101003/CS722U.1-PO5	H	Students are able to interpret, improve and redefine technical aspects for design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
101003/CS722U.1-PO6	M	Students are able to interpret, improve and redefine technical aspects by applying contextual knowledge to assess societal, health and consequential responsibilities relevant to professional engineering practices.
101003/CS722U.1-PO7	M	Project development based on societal and environmental context solution identification is the need for sustainable development.
101003/CS722U.1-PO8	L	Project development should be based on professional ethics and responsibilities.
101003/CS722U.1-PO9	L	Project development using a systematic approach based on well-defined principles will result in teamwork.
101003/CS722U.1-PO10	M	Project brings technological changes in society.
101003/CS722U.1-PO11	H	Acquiring knowledge for project development gathers skills in design, analysis, development and implementation of algorithms.
101003/CS722U.1-PO12	H	Knowledge for project development contributes engineering skills in computing and information gatherings.
101003/CS722U.2-PO1	H	Knowledge acquired for project development will also include systematic planning, developing, testing, and implementation in computer science solutions in various domains.
101003/CS722U.2-PO2	H	Project design and development using a systematic approach brings knowledge in mathematics and engineering fundamentals.
101003/CS722U.2-PO3	H	Identifying, formulating, and analyzing the project results in a systematic approach.
101003/CS722U.2-PO5	H	Systematic approach is the tip for solving complex problems in various domains.

Mapping	Level	Justification
101003/CS722U.2-PO6	H	Systematic approach in the technical and design aspects provides valid conclusions.
101003/CS722U.2-PO7	H	Systematic approach in the technical and design aspects demonstrates the knowledge of sustainable development.
101003/CS722U.2-PO8	M	Identification and justification of technical aspects of project development demonstrates the need for sustainable development.
101003/CS722U.2-PO9	H	Apply professional ethics and responsibilities in engineering practice of development.
101003/CS722U.2-PO11	H	Systematic approach also includes effective reporting and documentation which gives clear instructions.
101003/CS722U.2-PO12	M	Project development using a systematic approach based on well-defined principles will result in better teamwork.
101003/CS722U.3-PO9	H	Project development as a team brings the ability to engage in independent and lifelong learning.
101003/CS722U.3-PO10	H	Identification, formulation and justification in technical aspects will be based on acquiring skills in design and development of algorithms.
101003/CS722U.3-PO11	H	Identification, formulation and justification in technical aspects provides the betterment of life in various domains.
101003/CS722U.3-PO12	H	Students are able to interpret, improve and redefine technical aspects with mathematics, science and engineering fundamentals for the solutions of complex problems.
101003/CS722U.4-PO5	H	Students are able to interpret, improve and redefine technical aspects with identification, formulation and analysis of complex problems.
101003/CS722U.4-PO8	H	Students are able to interpret, improve and redefine technical aspects to meet the specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.
101003/CS722U.4-PO9	H	Students are able to interpret, improve and redefine technical aspects for design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
101003/CS722U.4-PO10	H	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools for better products.
101003/CS722U.4-PO11	M	Students are able to interpret, improve and redefine technical aspects by applying contextual knowledge to assess societal, health and consequential responsibilities relevant to professional engineering practices.
101003/CS722U.4-PO12	H	Students are able to interpret, improve and redefine technical aspects for demonstrating the knowledge of, and need for sustainable development.

Mapping	Level	Justification
101003/CS722U.5-PO1	H	Students are able to interpret, improve and redefine technical aspects, apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
101003/CS722U.5-PO2	M	Students are able to interpret, improve and redefine technical aspects, communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
101003/CS722U.5-PO3	H	Students are able to interpret, improve and redefine technical aspects to demonstrate knowledge and understanding of the engineering and management principle in multidisciplinary environments.
101003/CS722U.5-PO4	H	Students are able to interpret, improve and redefine technical aspects, recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
101003/CS722U.5-PO5	M	Students are able to interpret, improve and redefine technical aspects in acquiring skills to design, analyze and develop algorithms and implement those using high-level programming languages.
101003/CS722U.5-PO12	M	Students are able to interpret, improve and redefine technical aspects and contribute their engineering skills in computing and information engineering domains like network design and administration, database design and knowledge engineering.
101003/CS722U.6-PO5	M	Students are able to interpret, improve and redefine technical aspects and develop strong skills in systematic planning, developing, testing, implementing and providing IT solutions for different domains which helps in the betterment of life.
101003/CS722U.6-PO8	H	Students will be able to associate with a team as an effective team player for the development of technical projects by applying the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
101003/CS722U.6-PO9	H	Students will be able to associate with a team as an effective team player to identify, formulate, review research literature, and analyze complex engineering problems.
101003/CS722U.6-PO10	M	Students will be able to associate with a team as an effective team player for designing solutions to complex engineering problems and design system components.
101003/CS722U.6-PO11	M	Students will be able to associate with a team as an effective team player to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data.

Mapping	Level	Justification
101003/CS722U.6-PO12	H	Students will be able to associate with a team as an effective team player, applying ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
101003/CS722U.1-PSO1	H	Students are able to develop Computer Science Specific Skills by modeling and solving problems.
101003/CS722U.2-PSO2	M	Developing products, processes or technologies for sustainable and socially relevant applications can promote Programming and Software Development Skills.
101003/CS722U.3-PSO3	H	Working in a team can result in the effective development of Professional Skills.
101003/CS722U.4-PSO3	H	Planning and scheduling can result in the effective development of Professional Skills.
101003/CS722U.5-PSO1	H	Students are able to develop Computer Science Specific Skills by creating innovative solutions to problems.
101003/CS722U.6-PSO3	H	Organizing and communicating technical and scientific findings can help in the effective development of Professional Skills.