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Project report On

Interactive Learning with Generative AI - Interlearn.AI

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

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in

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CERTIFICATE

This is to certify that the project report entitled ***"Interactive Learning with Generative AI - Interlearn.AI"*** *is a bonafide record of the work done by* ***Allain John Thomas (U2008010), Ansel Kanjirappallil Thomas (U2008017), Batton Zacarias (U2008020) and Joswin C Raju (U2008038)****, submitted to the Rajagiri School of Engineering & Technology (RSET) (Autonomous) in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology (B. Tech.) in Artificial Intelligence and Data Science during the academic year 2023-2024.*

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Abstract

"Interlearn.AI" is a groundbreaking project focused on transforming the education landscape through the innovative integration of artificial intelligence and advanced natural language processing techniques.With a commitment to enhancing the educational journey, "Interlearn.AI" redefines how students engage with academic content.

The conventional learning process often faces obstacles, especially in the context of remote education. "Interlearn.AI" addresses these challenges by utilizing NLP-driven topic modeling to extract key insights from class materials, allowing students to navigate through the content effortlessly. The incorporation of a sophisticated chatbot, powered by GPT-3.5, further enhances the learning experience by providing interactive fail-and-learn sessions. This unique feature generates auto-questions, checks responses, and offers detailed explanations through video-based tutorials. By fostering a dynamic and responsive learning environment, "Interlearn.AI" aims to empower students to overcome educational barriers and regain control over their academic journey.

The project places a strong emphasis on user interaction and customization, offering students the flexibility to learn at their own pace. Through an intuitive user interface, students can engage with the content, ask questions, and receive tailored explanations, fostering a deeper understanding of the topics. Additionally, the platform incorporates video-based explanations that convert text to speech, providing a multi-sensory learning experience. By seamlessly combining these elements, "Interlearn.AI" stands as a testament to the future of education, where technology plays a pivotal role in making learning accessible, engaging, and tailored to individual needs.

In conclusion, "Interlearn.AI" is a forward-thinking educational platform that harnesses the power of AI and NLP to revolutionize the learning experience. By prioritizing user interaction, customization, and accessibility, the project sets a new standard for educational technology, envisioning a future where students can embrace learning in a personalized and interactive manner.

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Chapter 1

Introduction

1.1 Preamble

"Interlearn.AI" stands at the forefront of educational evolution, embodying a transformative fusion of Artificial Intelligence (AI) and technologies to reshape the traditional learning landscape. In the realm of education, this project aims to revolutionize the way students engage with academic content by introducing personalized learning experiences, leveraging advanced Natural Language Processing (NLP) and AI-driven methodologies.

Traditional educational models often grapple with challenges such as language barriers, accessibility issues, and rigid learning structures. "Interlearn.AI" addresses these concerns by harnessing the power of NLP-driven topic modeling, providing students with tailored insights and interactive learning experiences. The integration of a sophisticated chatbot, powered by GPT-3.5, further amplifies the educational journey, offering fail-and-learn sessions that generate auto-questions, assess responses, and provide comprehensive explanations through video-based tutorials.

A distinguishing feature of the project lies in its commitment to user interaction and customization, allowing students to learn at their own pace and ask questions intuitively. The platform's user-friendly interface facilitates a dynamic learning environment, where students can engage with the content seamlessly.

As education technology continues to evolve, "Interlearn.AI" seeks to redefine the boundaries of learning accessibility and engagement. By seamlessly combining AI, NLP, and interactive features, the project envisions a future where education becomes a personalized, adaptive, and enriching experience for every student, regardless of geographical constraints.

1.2 Scope and Motivation

Interlearn.AI is a transformative educational platform designed to reshape the learning experience for students across diverse backgrounds. The scope of this project is expansive, focusing on leveraging Artificial Intelligence (AI) and Natural Language Processing (NLP) to personalize and enhance the learning journey. The platform encompasses NLP-driven topic modeling, fail-and-learn sessions powered by a sophisticated chatbot (GPT-3.5), and video-based explanations to create an interactive and adaptive learning environment. Interlearn.AI aims to address challenges in traditional education models, including language barriers, accessibility issues, and the need for personalized learning experiences.

The platform's scope extends to user-centric features, allowing students to learn at their own pace and customize their learning paths. With a dynamic user interface, students can intuitively interact with the content, ask questions, and receive detailed explanations. The integration of video-based explanations, converting text to speech, enriches the learning experience, catering to different learning styles. Interlearn.AI is committed to providing a comprehensive and personalized educational solution that goes beyond conventional methods.

The motivation behind Interlearn.AI arises from the recognition of the limitations and challenges in traditional education. Language barriers often hinder effective learning, and accessibility issues create disparities in educational opportunities. Traditional learning methods may not cater to individual learning preferences, and the lack of interactive elements can lead to disengagement. Interlearn.AI addresses these motivations by harnessing advanced technologies to provide personalized, interactive, and accessible learning experiences. By offering fail-and-learn sessions and video-based explanations, the platform aims to make education more engaging and tailored to the needs of individual learners. The commitment to inclusivity and personalization reflects Interlearn.AI's dedication to redefining the future of education for a diverse global audience.

1.3 Objectives

1. NLP-driven Topic Modeling: Implement advanced Natural Language Processing (NLP) techniques for topic modeling, allowing for insightful content extraction.

2. Fail-and-Learn Sessions: Develop a sophisticated chatbot, powered by GPT-3.5, to generate auto-questions, assess responses, and provide comprehensive explanations through video-based tutorials.

3. User-Centric Learning: Design a dynamic and intuitive user interface to facilitate personalized, user-centric learning experiences.

4. Video-Based Explanations: Integrate text-to-speech functionality for video content, providing a multi-sensory learning experience.

5. Seamless Integration: Ensure seamless integration of different modules, including NLP, chatbot, and video explanations, for a cohesive learning platform.

6. Customization and Interaction: Allow students to learn at their own pace, ask questions, and receive tailored explanations, fostering deeper understanding.

7. Accessibility and Inclusivity: Address accessibility issues, providing an inclusive educational solution for diverse learners.

1.4 Organization of the Report

The report unfolds in several key sections. Beginning with an Introduction, it delves into the Area of Research, shedding light on the various methods for Generative AI in education and outlining the limitations of current technologies. A detailed Literature Review follows, encompassing a thorough Literature Survey, Comparative Study, and a conclusive Summary. The Conclusion summarizes the research, and Future Directions suggest avenues for extended exploration. The report culminates with a comprehensive list of References.

1.5 Summary of the Chapter

The "Introduction" chapter of the Interlearn.AI project report sets the stage for a revolutionary educational platform that combines Artificial Intelligence (AI) and Natural Language Processing (NLP) to redefine traditional learning methods. Positioned at the forefront of educational evolution, Interlearn.AI aims to overcome challenges such as language barriers and rigid learning structures by introducing personalized learning experiences. The integration of advanced NLP-driven topic modeling and a sophisticated

GPT-3.5-powered chatbot underscores the commitment to interactive and tailored learning.

This transformative project addresses the limitations of conventional education models and is driven by a motivation to enhance accessibility, engagement, and personalization in learning. By leveraging cutting-edge technologies, Interlearn.AI strives to create a dynamic learning environment where students can learn at their own pace, ask questions intuitively, and receive comprehensive explanations through fail-and-learn sessions and video-based tutorials. The chapter outlines the scope, objectives, and organizational structure of the report, providing a comprehensive overview of the project's ambitions.

The scope of Interlearn.AI is expansive, encompassing NLP-driven topic modeling, fail-and-learn sessions, and video-based explanations to create an interactive and adaptive learning environment. The project's objectives are outlined to emphasize its commitment to user-centric learning, accessibility, and inclusivity. The chapter sets the tone for a detailed exploration of the project's components, methodologies, and impact on the future of education.

Chapter 2

Area of the Research

2.1 Current State of Art

1. **SmartEd AI (2023)**: SmartEd AI is an innovative AI-driven educational platform that personalizes learning experiences using advanced NLP and machine learning algorithms. It focuses on adaptive learning paths, real-time feedback, and interactive content creation to enhance the overall educational journey.

2. **LearnMate (2023)**: LearnMate utilizes AI to provide intelligent tutoring services, offering personalized learning plans, content recommendations, and progress tracking for students. The platform integrates natural language understanding to facilitate interactive communication between students and the AI tutor.

3. **EduBot (2023)**: EduBot is an AI-powered chatbot designed for educational support. It leverages natural language processing to assist students with queries, provide learning resources, and engage in interactive learning conversations, creating an immersive learning environment.

4. **CogniLearn (2022)**: CogniLearn is an AI-based educational tool that employs cognitive science principles for personalized learning. It adapts content delivery based on individual learning styles, strengths, and weaknesses, optimizing the learning experience.

5. **StudySphere (2023)**: StudySphere integrates AI to offer a comprehensive educational ecosystem. It includes features like personalized course recommendations, collaborative learning spaces, and AI-driven assessments, aiming to create a holistic and engaging learning environment.

6. **EduGenius (2023)**: EduGenius is an AI-driven educational platform focusing on personalized learning paths. It incorporates adaptive learning algorithms to tailor

educational content based on individual progress, ensuring effective understanding and retention.

7. **AI Tutor Pro (2023)**: AI Tutor Pro is an advanced tutoring platform utilizing AI to assess students' strengths and weaknesses. It offers targeted learning materials, practice sessions, and real-time feedback, creating a customized learning experience.

8. **AdaptLearn (2023)**: AdaptLearn employs machine learning and AI to dynamically adjust learning materials based on students' evolving needs and performance. It aims to enhance engagement and comprehension by providing tailored educational content.

9. **KnowledgeFlow (2023)**: KnowledgeFlow is an AI-powered educational assistant that helps students organize and comprehend complex topics. It utilizes natural language understanding to assist with content summarization, note-taking, and concept clarification.

10. **NeuroLearn (2023)**: NeuroLearn is a neuroscience-informed AI platform for education. It incorporates cognitive science principles to optimize learning experiences, offering personalized content, memory-enhancing techniques, and interactive learning modules.

11. **LearnCraft (2023)**: LearnCraft leverages AI to create a gamified learning environment. It incorporates adaptive learning paths, real-time assessments, and interactive challenges to make learning engaging and effective for students.

12. **EduVisionary (2023)**: EduVisionary uses AI to provide predictive analytics on student performance, helping educators identify potential challenges early on. It aims to support teachers in tailoring their teaching approaches to meet individual student needs.

13. **CogniTrack (2023)**: CogniTrack is an AI-powered learning analytics platform that tracks and analyzes students' learning patterns. It provides insights to educators for personalized interventions and curriculum adjustments.

14. **MindSync (2023)**: MindSync utilizes AI for collaborative learning experiences. It facilitates group projects, real-time collaboration, and personalized feedback,

fostering a sense of community in online learning environments.

2.2 Issues and Threats

1. **Privacy Concerns:** The utilization of AI and NLP technologies involves processing textual data from educational materials. Addressing privacy concerns related to user data, especially considering the sensitive nature of educational content, is crucial.

2. **Data Security Risks:** Safeguarding user data, including learning preferences and interactions, from potential security breaches is a paramount concern. Implementing robust data security measures to prevent unauthorized access or data leaks is imperative.

3. **Algorithmic Bias:** AI algorithms might inadvertently introduce bias in topic modeling or question generation based on the training data. Ensuring diversity and fairness in content recommendations is essential for providing a comprehensive learning experience.

4. **Technical Limitations:** The effectiveness of the platform relies on the accuracy of NLP and chatbot technologies. Technical limitations, such as misinterpretation of user queries or inadequate responses, could impact the quality of the learning experience.

5. **User Adoption Challenges:** Students accustomed to traditional learning methods may face challenges in adapting to the AI-driven approach. Resistance to technology or difficulties in navigating the platform might hinder user adoption.

6. **Local Business Integration:** While the project aims to support local businesses, challenges may arise in onboarding and maintaining partnerships with educational institutions. Resistance to integrating with the platform or difficulties in establishing seamless connections could hinder success.

7. **Content Availability Assurance:** Ensuring real-time availability and accuracy of educational content, especially from diverse curricula, is a challenge. Users might face frustration if the desired content is not readily accessible, impacting the credibility of the platform.

8. **Regulatory Compliance:** Adhering to data protection and privacy regulations, particularly concerning educational materials, is essential. Staying compliant with evolving laws and regulations is crucial to avoid legal complications.

9. **User Overreliance on Technology:** There is a risk of students overly relying on AI-driven features, potentially diminishing critical thinking and independent learning. Balancing the role of technology with fostering student creativity and engagement is crucial.

10. **Cost and Accessibility:** The integration of advanced technologies may result in development and maintenance costs. Ensuring the platform remains accessible to a diverse user base, including those with limited financial resources, is a consideration for long-term sustainability.

2.3 Potential Applications

Interlearn.AI encompasses a wide range of applications within the realm of education, aiming to revolutionize the learning experience for diverse student demographics. The primary application of the platform is in personalized learning, providing students with tailored content recommendations and interactive learning experiences. It serves as a valuable tool for students seeking to overcome language barriers and accessibility issues, offering a user-centric approach to education.

Educational institutions can integrate Interlearn.AI to enhance their teaching methods, providing adaptive learning paths and fail-and-learn sessions. The platform can be utilized by teachers to create engaging and interactive lessons, fostering a dynamic learning environment. Additionally, Interlearn.AI can be applied as a supplementary tool for students with different learning styles, offering a multi-sensory learning experience through video-based explanations.

The potential applications extend to self-paced learning, where individuals can utilize the platform for continuous skill development and knowledge acquisition. Interlearn.AI can serve as a valuable resource for lifelong learners, professionals seeking to upskill, or anyone looking to explore new areas of knowledge.

Furthermore, the platform can be integrated into corporate training programs, providing companies with a tool to deliver personalized training content to employees. The

adaptability of Interlearn.AI makes it a versatile solution for various educational contexts, promoting accessibility, engagement, and inclusivity in the learning process.

2.4 Summary of the Chapter

Advantages and Disadvantages of Existing Systems

Existing System	Advantage	Disadvantage
SmartEd AI	Personalizes learning experiences using advanced NLP and machine learning, focusing on adaptive learning paths.	May face challenges in catering to highly unique learning preferences and styles; potential reliance on technology over traditional teaching methods.
LearnMate	Utilizes AI for intelligent tutoring services, offering personalized learning plans and interactive communication.	Reliance on NLP may pose challenges in handling diverse student queries; potential limitations in addressing non-standard learning styles.
EduBot	An AI-powered chatbot for educational support, leveraging natural language processing for interactive learning conversations.	Limited in-depth content understanding; potential challenges in addressing complex subject matter.
CogniLearn	Utilizes cognitive science principles for personalized learning, adapting content delivery based on individual learning styles.	May face challenges in real-time adaptation to rapidly changing learning preferences; potential need for continuous updates based on evolving educational methodologies.

Existing System	Advantage	Disadvantage
StudySphere	Integrates AI for a comprehensive educational ecosystem, offering personalized course recommendations.	Potential challenges in balancing personalized learning with standardized curriculum requirements; may face resistance in traditional educational settings.
EduGenius	Utilizes AI for personalized learning paths, incorporating adaptive learning algorithms.	Challenges may arise in accurately assessing individual learning needs; potential limitations in addressing highly specialized subjects.
AI Tutor Pro	Utilizes AI for targeted learning materials, practice sessions, and real-time feedback.	May face challenges in adapting to diverse learning styles; potential limitations in addressing non-standard learning preferences.
AdaptLearn	Employs machine learning and AI for dynamically adjusting learning materials based on students' evolving needs.	Challenges may arise in predicting rapidly changing learning preferences; potential need for continuous updates based on evolving educational methodologies.

Existing System	Advantage	Disadvantage
KnowledgeFlow	AI-powered educational assistant for organizing and comprehending complex topics.	Potential challenges in handling highly specialized subjects; may require continuous updates based on evolving educational methodologies.
NeuroLearn	Neuroscience-informed AI platform for education, optimizing learning experiences.	Challenges in accurately aligning content with individual learning preferences; potential need for continuous updates based on evolving educational methodologies.
LearnCraft	Leverages AI for a gamified learning environment, incorporating adaptive learning paths.	Balancing gamification with educational content may pose challenges; potential need for continuous updates based on evolving educational methodologies.
EduVisionary	Uses AI to provide predictive analytics on student performance, supporting personalized interventions.	Challenges in accurately predicting rapidly changing learning preferences; potential limitations in addressing non-standard learning styles.
CogniTrack	AI-powered learning analytics platform for tracking and analyzing students' learning patterns.	Challenges in accurately predicting rapidly changing learning preferences; potential need for continuous updates based on evolving educational methodologies.
MindSync	Utilizes AI for collaborative learning experiences, facilitating group projects and personalized feedback.	Challenges in balancing collaborative learning with individualized learning needs; potential need for continuous updates based on evolving educational methodologies.

Gaps Identified:

1. While numerous AI-driven educational platforms exist, a gap is observed in the seamless integration of local educational resources and institutions. Integrating local learning materials and institutions can enhance the platform's ability to provide contextually relevant content.

2. Some existing projects may lack a cohesive and user-friendly interface, potentially leading to a fragmented user experience. Streamlining the platform's design and ensuring user-centric navigation can contribute to a more accessible and enjoyable learning environment.

3. Shortcomings in adaptability and personalization are identified in certain applications, limiting the platform's effectiveness in catering to diverse learning styles. Enhancing adaptability and tailoring content to individual preferences can contribute to a more personalized learning journey.

4. While many AI-powered educational platforms focus on global perspectives, there is a gap in actively empowering local educational initiatives. Integrating and promoting local educational content and institutions can foster community engagement and support local educational ecosystems.

5. Some existing projects may not provide real-time feedback or adaptive learning paths, potentially hindering the immediate identification and addressing of students' learning needs. Implementing real-time feedback mechanisms and adaptive learning features can enhance the platform's effectiveness.

6. Privacy concerns related to the collection and utilization of student data may not be explicitly addressed by certain projects. Ensuring robust data protection measures and transparent privacy policies is crucial to build and maintain user trust.

Chapter 3

Literature Survey

Section 3.1 to 3.4 briefs about the different literature available related to the area. Arrange them in chronological order with respect to year. The titles need not be exact copy of the paper, they can be condensed and written. More than five papers are also encouraged in this section. Increment the subsections accordingly if you add more titles. Subsections can also be included if needed.

3.1 Unlocking the power of chatgpt: A framework for applying generative AI in education(2023)

ChatGPT, developed by OpenAI in 2019 and upgraded to GPT-4 in 2023, is a natural language processing model designed for conversational interactions. It can generate human-like responses and has been employed in various sectors, including library services, healthcare, and education.

In the educational context, ChatGPT is utilized for creating virtual tutors, answering student queries, and providing personalized learning experiences. The passage emphasizes its potential to enhance AI literacy among teachers and students, referring to the understanding, usage, and critical evaluation of AI technologies. AI literacy encompasses knowledge of AI concepts, techniques, algorithms, as well as the ability to analyze and evaluate AI systems and their ethical, legal, and social implications.

What is ChatGPT?

ChatGPT is a large language model, utilizing deep learning techniques to analyze and generate human-like text in natural language processing (NLP) tasks. Developed by OpenAI, it is designed to perform various language tasks, such as answering questions, writing stories, composing code, and generating essays. The model is built upon GPT-3, recently

upgraded to GPT-4. ChatGPT functions through a transformer algorithm, processing natural language inputs through preprocessing, encoding, decoding, and postprocessing stages.

When asked about its limitations, ChatGPT acknowledged several:

- Lack of Common Sense: It may generate technically correct but nonsensical responses.
- Limited Understanding of Context: Struggles with understanding broader meanings, nuances, or subtext in conversations.
- Biased Data: Reflects biases present in the training data.
- Inability to Perform Physical Tasks: Limited to language tasks and cannot perform physical actions.
- Lack of Emotional Intelligence: Appears to convey emotions in responses but does not experience them.
- Vulnerability to Adversarial Attacks: Susceptible to input designed to generate incorrect or harmful responses.

While powerful in generating human-like responses, ChatGPT's limitations must be considered when utilizing it.

The IDEE framework for using ChatGPT in education

The framework consists of four key steps:

1. Identify the Desired Outcomes: Before employing ChatGPT or similar AI in education, define the specific goals and objectives to ensure alignment with desired outcomes.
2. Determine the Appropriate Level of Automation: Depending on the educational objectives, decide whether full automation or a supplementary role for generative AI is appropriate.

An inspiring example of the use of ChatGPT in education is the development of virtual tutors for language learning. Using ChatGPT, a virtual tutor can provide personalized feedback and conversation practices for language learners. The virtual tutor can also adapt to the learners' level and pace, thereby providing a highly customized learning experience. This can be especially helpful for learners who do not have access to in-person language tutors or prefer to learn on their schedule.

In one of our current research projects, we are trying to use ChatGPT to help coaches provide responsive and timely feedback to early childhood teachers. Below, we detail how the framework can be applied to the example of using ChatGPT to facilitate coaches in providing responsive and fast feedback to early childhood teachers:

1. Identify the Desired Outcomes: The objective, in this case, is to provide early childhood teachers with targeted and timely feedback on their teaching practices to improve the quality of early childhood education.

2. Determine the Appropriate Level of Automation: ChatGPT can be used to automatically generate feedback based on observations made by the coach during classroom observations.This feedback can be customized to the specific needs and challenges of each teacher, providing a highly tailored and efficient coaching experience.

3. Ensure Ethical Considerations: It is important to ensure that the feedback generated by ChatGPT is free from bias and is based on objective observations. Additionally, the use of ChatGPT should not replace the important role of human coaches in providing support and guidance to early childhood teachers.

4. Evaluate the Effectiveness: The effectiveness of using ChatGPT to facilitate coaching can be evaluated by analyzing the impact of feedback on the teaching practices and outcomes of early childhood teachers. This can be achieved through teacher evaluations, feedback surveys, and other assessment tools.

To facilitate the coaching of early childhood teachers, ChatGPT can be applied in the development of a virtual coach that can provide immediate feedback to teachers during classroom observations. For example, if a virtual coach observes that a teacher does not

use enough open-ended questions to promote critical thinking, it can provide feedback on the importance of using open-ended questions and suggest specific examples that the teacher can use in future lessons. This can help early childhood teachers improve their teaching practices and ultimately enhance the learning outcomes of young children.

Key issues of using ChatGPT in education

In this section, we highlight several potential benefits, limitations, challenges, future research directions, and suggestions associated with the use of ChatGPT in education, which can be generalized to other educative AI.

Potential Benefits

- Personalized Learning Experience: ChatGPT can offer a more personalized learning experience by creating virtual tutors and personalized recommendations. This tailors instruction to individual student needs, providing detailed assistance on specific topics.

- Efficient Question Answering: ChatGPT can assist teachers in answering students' questions, saving time and energy. It can generate detailed responses, addressing queries about educational concepts and promoting efficiency in teacher-student interactions.

- Engaging Learning Experience: By creating virtual tutors and personalized recommendations, ChatGPT contributes to a more engaging learning experience for students. It enhances teaching models, assessment systems, and education ecology, fostering interactive and enjoyable learning.

- Useful Suggestions for Teachers: ChatGPT can provide valuable suggestions for teachers, aiding in the transformation of AI's role in education. It can offer guidance on teaching young children about AI, emphasizing basic concepts, age-appropriate language, demonstrations, ethical considerations, and encouragement of curiosity.

- Assistance in Essay Writing: ChatGPT assists students in essay writing by recommending topics, outlining structures, providing ideas, and improving academic writing. For example, it can suggest statements and potential topics for body paragraphs, requiring students' critical thinking to ensure writing accuracy.

Potential limitations

- Effectiveness Not Fully Tested: ChatGPT is still an emerging technology, and its effectiveness in education has not been fully tested. While initial studies suggest its usefulness, more research is required to determine its effectiveness in different educational contexts.

- Dependency on Data Quality: The effectiveness of ChatGPT is contingent on the quality of the data used to train the model. If the training data is of low quality, the model's responses may be inaccurate or unreliable. This limitation underscores the importance of high-quality data to ensure ChatGPT's efficacy in educational applications.

- Limitation in Handling Complex Tasks: ChatGPT may face limitations when dealing with complex tasks. While it can generate human-like responses to simple queries, it may struggle with more intricate or sophisticated tasks. This suggests that the model's capabilities may be constrained in handling tasks beyond a certain level of complexity.

3.2 Generative AI and ChatGPT in School Children's Education: Evidence from a School Lesson(2023)

In 2023, there was a significant global upsurge in the utilization of generative AI, with a particular focus on the advancements represented by ChatGPT-3.5 and -4. This surge prompted extensive discussions on the sustainable integration of generative AI across diverse domains, ranging from primary schools to universities.

The study conducted with 110 pupils aged 8–14 years old, spanning the 4th–6th grades across four classes in two schools, laid a robust foundation for the findings presented in this report. The research revealed promising outcomes, showcasing the ability of generative AI, particularly ChatGPT-3.5 and -4, to personalize learning material effectively. This personalization aimed to cater to the diverse knowledge bases and learning skills among pupils at different proficiency levels.

Materials and Methods

This article presents the outcomes of a comprehensive test lesson that delved into the application of generative AI within the Social Sciences curriculum, with a specific focus on History, catering to 4th, 5th, and 6th-grade students in Uruguay. The research, conducted in adherence to both national and university guidelines on research integrity and ethics, sought to investigate the impact and efficacy of incorporating generative AI in the educational context. Data was meticulously collected from a diverse group of 110 pupils, ranging in age from 8 to 14, during the course of the test lesson. The research took place in Uruguay, encompassing four classes distributed across two schools in Montevideo, with Spanish being the designated language of instruction.

In this study, access to the test platform was facilitated through the use of laptops, with 60 pupils utilizing the national Ceibal program operating system, and an additional 50 pupils employing Chromebook devices. The utilization of distinct operating systems allows for a nuanced exploration of how generative AI performs across different technological infrastructures. This research, situated within a broader project on the integration of generative AI in education, meticulously adhered to a comprehensive research code of conduct and established ethical procedures, ensuring the ethical integrity of the study. Spanish, the mother tongue and language of instruction in the educational context, was deliberately chosen as the language for the test, aligning with its significant presence on the web and catering to the linguistic background of the participants.

Results

Conducting the Introductory Part of the Test Lesson

The commencement of the test marked an initial phase dedicated to the meticulous collection of information about the respondents, emphasizing a comprehensive understanding of the student population involved. Pupils, upon accessing their designated test devices, were prompted to furnish key demographic features and details regarding their academic performance in four core subjects: Social Sciences, Mathematics, Spanish, and English. Additionally, students were asked to indicate their favorite subject among these four, providing insights into individual preferences and inclinations. This deliberate approach not only laid the groundwork for personalized grouping in subsequent phases

but also allowed for a nuanced exploration of potential correlations between academic performance and subject preferences.

Conducting the Content Part of the Test Lesson

The dataset employed for analysis in this study represents a robust combination of quantitative and qualitative data, providing a multifaceted perspective on pupils' engagement, attention, and proficiency in comprehending the educational material enriched with generative AI. The evaluation criteria extended beyond traditional assessments, incorporating measures of interaction and attention alongside proficiency metrics.

For the 4th grade, the adapted texts differed in length based on knowledge levels, with basic having 137 words, intermediate having 123 words, and advanced having 125 words. In the 5th grade, both basic and intermediate texts had 119 words each, while the advanced text had 144 words. For the 6th grade, the length discrepancies continued, with basic comprising 220 words, intermediate containing 195 words, and advanced consisting of 164 words. This detailed exploration of text lengths not only quantifies the variations introduced by generative AI but also underscores the intricate adjustments made to accommodate different knowledge levels. The dynamic nature of text modification, as revealed by the varying lengths across grade levels and knowledge categories, underscores the adaptability and nuanced tailoring capabilities of generative AI, providing a deeper understanding of its impact on the complexity of educational content.

Conducting the Self-Evaluation Part of the Test Lesson

The assessment of pupils' perceptions regarding the supportive role of figures in their learning revealed a diverse range of responses. Among all the pupils, a majority found the figures beneficial, with 26.4% acknowledging them as very helpful and an additional 30.0% considering them quite helpful. However, a notable 27.3% expressed uncertainty about the figures' utility, while 10.0% found them not really helpful, and 6.4% deemed them not at all helpful. The breakdown by grade indicated varying trends, with the 4th grade having shares of 18.0%, 34.0%, 38.0%, 6.0%, and 4.0%, the 5th grade exhibiting 46.9%, 28.1%, 9.4%, 12.5%, and 3.1%, and the 6th grade displaying 17.9%, 25.0%, 28.6%, 14.3%, and 14.3%.

3.3 Using artificial intelligence in craft education:crafting with text-to-image generative models (2023)

Methodology The study extends our prior research and design-based investigations into incorporating AI topics in school education (Vartiainen et al. 2021, 2022). Employing an exploratory case study methodology, we applied a research-creation approach tailored for comprehending imaginaries related to emerging technologies like AI and automation (Lupton and Watson 2022). This approach involves participants in the creative production of artifacts, aiming to stimulate discussions and provide a tangible understanding of the intricate relationships with emerging digital technology (Lupton and Watson 2022).

Text to image generative models

In recent times, advancements in generative AI, particularly exemplified by models like Dall-E and Midjourney, have brought significant attention to the creation of visual content based on textual prompts. These models stand out not only for their sophisticated capabilities but also for their accessibility, allowing individuals with minimal technical expertise to engage in creative endeavors. The democratization of the creative process is underscored by user-friendly interfaces, exemplified by tools like Midjourney, which significantly lower the entry barrier, making these technologies widely applicable.

The training of generative models relies on massive image-text datasets like LAION-400M and LAION-5B, comprising millions and billions of image-text pairs, respectively. This extensive data enables neural networks to learn and generate diverse images, with state-of-the-art models employing diffusion models to achieve a remarkable level of photo-realistic quality. What sets text-to-image generative art apart is not just the end product but the dynamic interaction between users and AI throughout the creative process.

However, the rapid evolution of this technology has sparked various discussions and raised important concerns. Issues such as its potential impact on traditional creative fields, disruptions in job markets, and ethical considerations surrounding copyright violations and biases have come to the forefront. In the realm of education, while these generative models present opportunities for fostering innovation, creativity, and increased participation, there remains a significant gap in research addressing how this technology might influence the dynamics of learning, particularly in domains like craft, design, and technology education. Understanding these implications is crucial for educators and

researchers as they navigate the integration of these cutting-edge technologies into educational settings.

Concerns and tradeoffs

Biases in AI-generated Designs The study identified concerns regarding biases present in AI-generated designs. Issues of misrepresentation, underrepresentation, and overrepresentation in the output raised questions about the fairness and inclusivity of AI models.

Behavior Engineering and Manipulation Participants expressed apprehensions about the potential misuse of AI-generated images for behavior engineering, particularly in marketing. The concern was that personalized styles could be leveraged to manipulate individuals' preferences and perceptions.

Copyright and Plagiarism Discussion on the use of existing artworks in training data led to concerns about copyright violations. Participants questioned whether AI, by using a broad range of internet images, might inadvertently engage in a form of plagiarism, raising ethical and legal considerations.

Opaque Decision-making (Black-Boxing) The opacity of AI decision-making processes emerged as a significant concern. Participants grappled with the challenge of understanding how AI combines input to create designs, highlighting the need for transparency and interpretability.

Design Constraints and Feasibility Teachers and educators raised practical concerns about the feasibility of implementing AI-generated ideas within the constraints of traditional craft making. The study highlighted potential challenges in translating digital visualizations into tangible, real-world projects.

Findings The study's findings reveal a significant focus on concerns related to biases present in generative AI, particularly the potential distortions stemming from misrepresentation, under representation, and over representation. These concerns indicate a heightened awareness among participants regarding the impact of AI-generated content on the diversity and authenticity of perspectives.

Another noteworthy finding is the apprehension expressed by participants concerning behavior engineering based on aesthetic styles. This suggests a recognition of the potential manipulation or influence that AI-generated designs might exert on aesthetic preferences and cultural memory.

The findings, rooted in the experiences and perspectives of teachers engaging with generative AI, are deemed crucial for advancing research in the realm of craft education, providing valuable insights into the complexities and considerations surrounding the integration of AI technologies in educational settings.

3.4 Application of NLP:Design of Chatbot for New Research Scholars(2021)

Methodology Model Building Process

Building Vocabulary

Intent patterns are processed to build a vocabulary using the Python WordNetLemmatizer. Distinct word forms are collapsed, and the data is translated into a bag of words.

Model Specification

The Keras deep learning library is utilized to build a classification model. A Keras sequential model is constructed, consisting of three layers: input, hidden, and output. The ReLU activation is used for the input and hidden layers, while the output layer employs the softmax activation function. The problem involves intent classification, resulting in a multiclass array that identifies the encoded intent. Adagrad optimizer with a learning rate of 0.05 is selected after experimentation with other optimizers. The categorical_crossentropy function is employed to measure the loss, and the model is evaluated using the Accuracy metric.

Experiment with Different Optimizers at Different Learning Rates

Optimizer and learning rate are considered as hyperparameters of the sequential model. The choice of optimizer and learning rate significantly influences the model's performance. In this work, five optimizers—Stochastic Gradient Descent (SGD), Adagrad, Adadelta, Adam, and RMSprop—are experimented with at different learning rates to optimize the accuracy of the model. The model is implemented with these five optimizers, and accuracy is measured at five learning rate values: 0.001, 0.005, 0.01, 0.05, and 1.

Chatbot Framework

Chatbot Modules

Chatbot GUI Module In this module, a simple GUI is created for user interaction with the bot. The user can input queries in the query box. Spell check feature is

implemented using the Python enchant library to autocorrect spelling mistakes in user input. This enhances the responsiveness of the bot. The user query and the bot response are displayed in the chat window, significantly improving bot performance.

clean_up Module Data cleaning is the first step in data preprocessing. The clean_up module processes user input, identifies tokens, and lemmatizes them to find the root words considering context.

bag_of_words Module Algorithms cannot process data in text form directly. The text is broken down into a numerical form using the bag_of_words module. This module translates sentence words into a vector representation (0/1 array) based on their presence or absence in the chatbot vocabulary. The bag of words is then fed to the classify module for further processing.

Classify Module The classify module takes the bag of words and calculates its probability of belonging to each intent. It returns the list of intents satisfying a predefined error threshold to the response module.

Response Module The response module performs two important tasks:

1. **Context Maintaining:** Maintains the context of conversation by storing the state of the context using a dictionary data structure. Context flow is defined in the intents, and the state is maintained for multiple users simultaneously.

2. **Tag Matching:** Checks for matching tags in the intents database. Once a matching tag is found, it selects a response randomly from the list of available responses and returns it to the bot. If no matching tag is found, an empty response is returned.

Findings

- Accuracy of Adam and RMSpropoptimizers is inversely proportional to the learning rate.

- Accuracy of Adadelta is directly proportional to the learning rate.

- SGD and Adagrad optimizers have higher accuracy at medium values of learning rate. From the graph it is seen that, Adagrad optimizer has the highest accuracy amongst all at the learning rate 0.05. Hence, the Adagrad optimizer is used in final model building.

Chapter 4

System Architecture

4.1 System Overview

The system overview of Interlearn.AI introduces a groundbreaking educational platform that integrates cutting-edge technologies to revolutionize the traditional learning experience. At its core, Interlearn.AI is designed to address challenges prevalent in conventional education models by leveraging the power of Artificial Intelligence (AI) and Natural Language Processing (NLP). The system architecture, depicted in the accompanying figure, provides a visual representation of how the various components seamlessly interact to create an innovative learning ecosystem. The architecture encompasses NLP-driven topic modeling, a sophisticated GPT-3.5-powered chatbot, and video-based explanations, all intricately integrated to offer personalized and interactive learning experiences.

The system's architecture begins with a comprehensive data collection process, gathering educational content from diverse sources. This content undergoes preprocessing, ensuring that it is optimized for subsequent analysis. The heart of the system lies in the Generative Pre-trained Transformer (GPT-3.5) model, a state-of-the-art language model that powers the chatbot, enabling it to generate auto-questions and provide detailed explanations. This AI-driven methodology is augmented by NLP-driven topic modeling, which enhances content extraction and insight generation. The system ensures user-centricity, allowing students to learn at their own pace, ask questions intuitively, and engage with the material in a manner that suits their individual preferences.

The system architecture envisions a dynamic learning environment where the fusion of AI, NLP, and interactive features converges to redefine the boundaries of education accessibility and engagement. This innovative approach not only caters to the diverse learning needs of students but also sets the stage for a future where education becomes a personalized, adaptive, and enriching experience for learners worldwide. The depicted ar-

chitecture is a testament to the platform's commitment to inclusivity, customization, and the seamless integration of advanced technologies to transform the educational landscape.

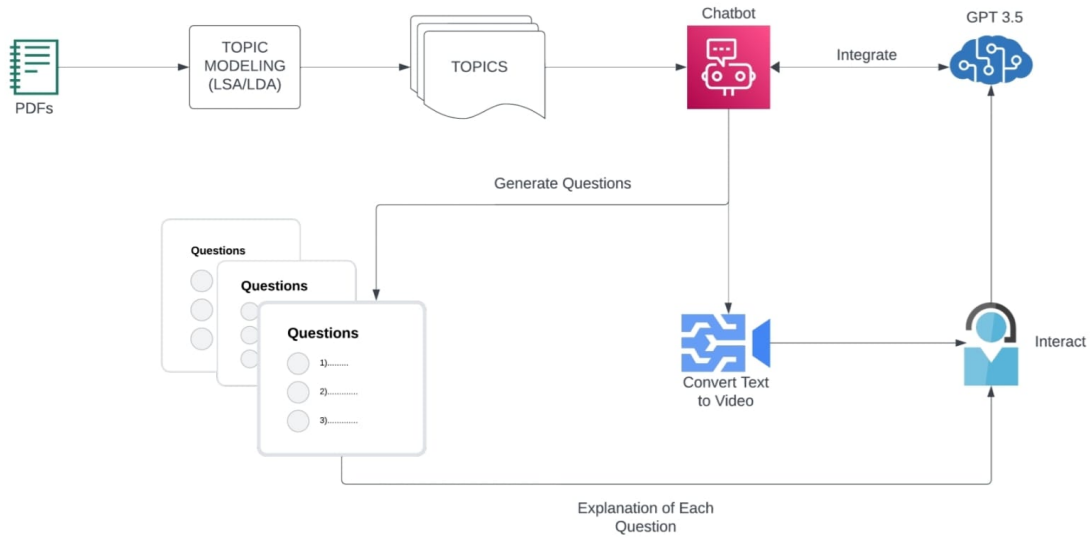

Figure 4.1: System Architecture

1. Data Collection: Gather PDFs of chapters for each class in ICSE and CBSE curricula. Extract text content from PDFs for further analysis.

2. Data Preprocessing: Identify and remove non-topical words, tokenize, and clean the text for analysis.

3. Topic Modeling with Supervised LDA: Extract bold and larger-sized text, use as seed words for supervised LDA. Train the model to categorize and extract relevant information from the text.

4. Auto-Question Generation: Use identified topics to generate auto-questions for different difficulty levels.

5. Develop an algorithm to check user-generated answers against correct answers.

6. Fail and Learn Method: Present auto-generated questions, provide immediate feedback and explanations with video explanations from the text.

7. Video Chatbot Interaction: Implement a video chatbot for text-to-speech explanations. Enable microphone access for student questions during the video.

8. Train the chatbot model to handle diverse queries and provide relevant explanations.

4.2 Architectural Design

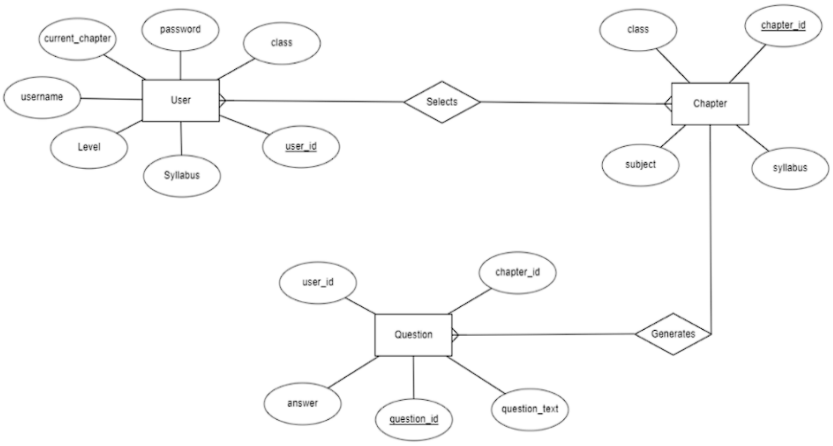

Figure 4.2: ER Diagram

1. ER diagram with three main entities: User, Chapter, and Question.

2. The User entity has attributes like username, password, class, current_chapter, and Level.

3. There is a "Selects" relationship between User and Chapter indicating that users can select chapters.

4. The Chapter entity has attributes like class, chapter_id, subject, and syllabus.

5. Questions are linked to Chapters through a "Generates" relationship indicating that each chapter generates questions.

6. The Question entity has attributes like question_id and question_text. It's also linked to the user through user_id attribute indicating which user is associated with which question.

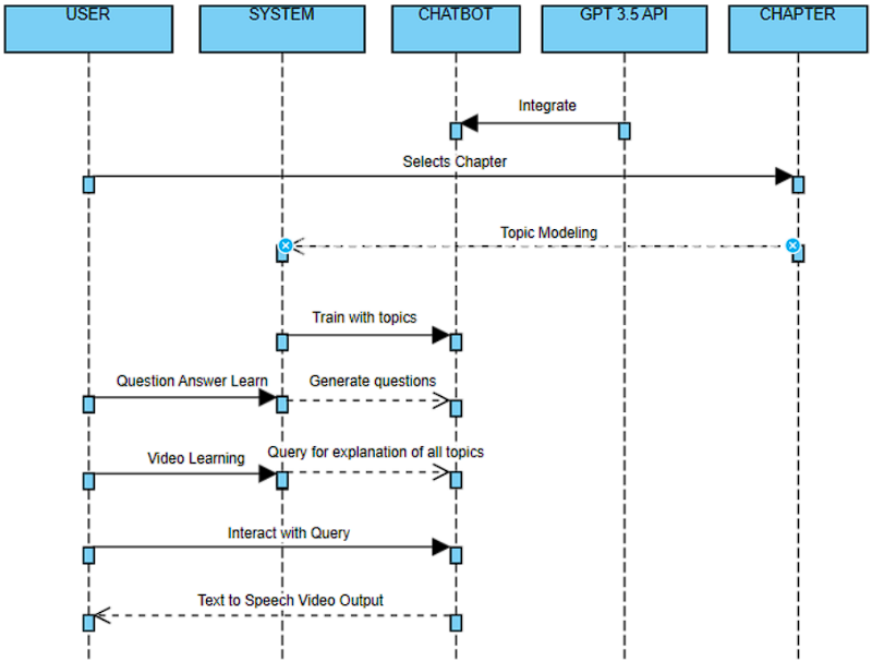

Figure 4.3: Sequence Diagram

This sequence diagram illustrates the interaction flow among a user, system, chatbot, GPT-3.5 API, and chapter in the context of a Generative AI NLP chatbot. The user selects a chapter which triggers the system to integrate and perform topic modeling. The chatbot is then trained with topics and generates questions while also querying for explanations of all topics. It interacts with queries and produces a text to speech video output as a response.

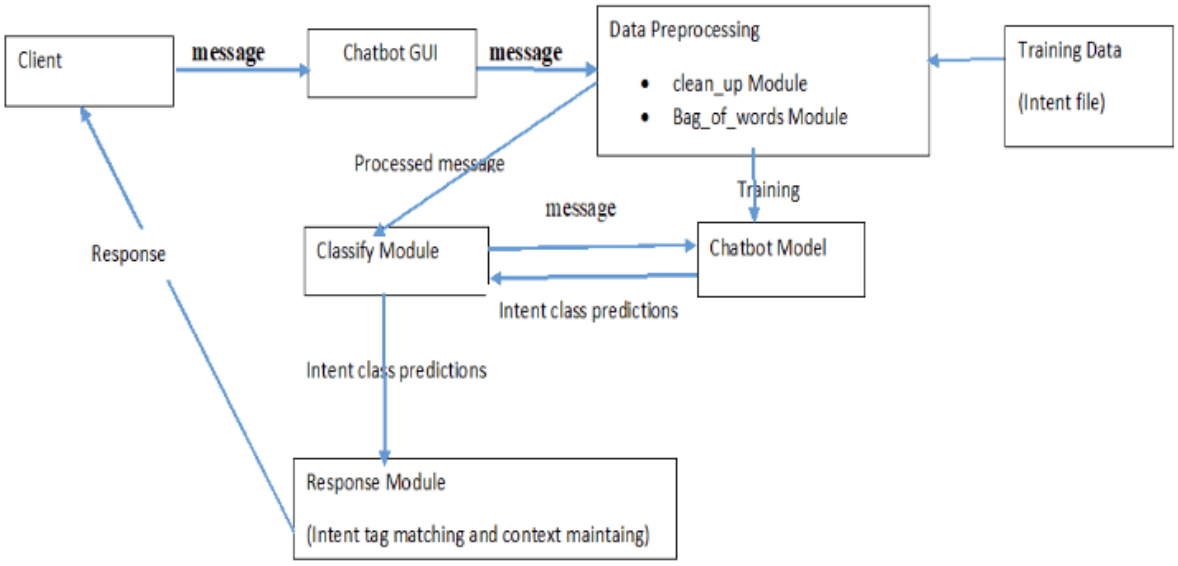

Figure 4.4: Chatbot Framework

Chapter 5

System Design

5.1 Datasets Identified

The datasets identified for Interlearn.AI project are as follows:

- Educational Content Dataset - Contains text, images, and formats of educational content from various sources. This includes PDFs of chapters for each class in ICSE and CBSE curricula. The dataset is collected for further analysis and question generation.
- Bold and Larger Text Dataset - This dataset consists of bold and larger-sized text extracted from the educational content. It is used for seed words in supervised LDA for topic modeling.

5.2 Proposed Methodology/Algorithms

5.2.1 Supervised Latent Dirichlet Allocation (sLDA) for Educational Content Analysis

Supervised Latent Dirichlet Allocation (sLDA) is an extension of the traditional Latent Dirichlet Allocation (LDA) topic modeling algorithm that incorporates supervised information. LDA is a generative probabilistic model that assumes documents are mixtures of topics, and each topic is a distribution over words.

In sLDA, the addition of supervision involves associating each document with a response variable (label) from a predefined set of classes. This allows the algorithm to learn topics in a supervised manner, taking into account both the document's content and its associated labels.

Generative Process:

Like LDA, sLDA assumes a generative process for each document. For each document:

- Choose a distribution over topics from a Dirichlet prior.
- For each word in the document:
- Choose a topic from the distribution over topics.
- Choose a word from the distribution over words for the selected topic.

Supervised Information: Each document is associated with a response variable (label) from a set of predefined classes.This response variable is used to guide the learning process and improve the quality of topic assignments.

Incorporating Labels: The sLDA model extends LDA by incorporating the supervised information. A logistic regression model is typically used to relate the document's topic distribution to the document's label.The logistic regression model considers the topic proportions as features to predict the document's label.

Objective Function: The sLDA model aims to maximize the joint likelihood of the observed words and the labels given the model parameters.This involves maximizing the product of the likelihood of word assignments and the likelihood of label assignments.

Inference: Inference in sLDA involves estimating the posterior distribution of latent variables given the observed data. This typically involves using techniques like variational inference or Gibbs sampling.

Parameter Estimation: Model parameters, including topic-word distributions and regression coefficients, are estimated from the training data. This is often done through optimization methods like stochastic gradient descent.

Prediction: Once the model is trained, it can be used to predict labels for new, unseen documents based on their topic distributions.

Evaluation: The performance of the sLDA model is evaluated based on its ability to accurately predict document labels and generate coherent topics.

5.2.2 Text To Speech Algorithm

Text Analysis: The input text is analyzed to identify linguistic features, including words, punctuation, and sentence structure.Special attention is given to elements such

as capitalization, punctuation marks, and abbreviations to ensure natural and expressive speech.

Text Normalization: The text is normalized to ensure proper pronunciation. This involves expanding abbreviations, converting numbers to words, and handling other linguistic variations.

Text-to-Phoneme Conversion: The process of converting text to phonemes involves mapping each word or segment of text to its corresponding phonetic representation. A phoneme is the smallest unit of sound in a language. Text-to-phoneme conversion helps in determining how each word should be pronounced.

Prosody Modeling: Prosody refers to the rhythm, intonation, and stress patterns of speech. Generating natural-sounding speech requires modeling prosodic features. Prosody modeling involves determining pitch, duration, and intensity variations to mimic the nuances of human speech.

Voice Synthesis: A voice synthesis model or a pre-recorded voice database is used to generate the actual speech waveform. Concatenative synthesis involves piecing together pre-recorded segments of human speech to form new utterances, while parametric synthesis involves generating speech from a set of predefined parameters.

Signal Processing: The synthesized speech signal undergoes signal processing to enhance its quality and ensure a smooth, natural flow. Techniques such as filtering, pitch modification, and dynamic range compression may be applied to improve the overall sound.

Output Generation: The final step involves generating the output, which could be in the form of an audio file or real-time speech output. The output may be delivered through various means, such as speakers, headphones, or an integrated voice interface.

Integration with Chatbot: In the context of a chatbot, the TTS system is integrated into the overall chatbot architecture. The chatbot converts text responses into speech using the TTS algorithm, allowing users to receive information through spoken words.

Step 1: Data Collection and Preprocessing

1. Collect a dataset of educational content, including PDFs of chapters for each class in ICSE and CBSE curricula.

2. Extract text content from PDFs and preprocess the data. Remove non-topical words, tokenize, and clean the text for better analysis.

Step 2: Topic Modeling with sLDA

1. Identify and remove non-topical words that might be bold or have larger font size using pre-processing techniques.
2. Tokenize and clean the text for better analysis.
3. Extract bold and larger-sized text from the document using text formatting attributes.
4. Use these identified words as seed words for supervised LDA.
5. Train a supervised LDA model using the identified bold words as seed words for topics.
6. Use these topics to categorize and extract relevant information from the text.

Step 3: Auto-Question Generation

1. The process of generating auto-questions involves using the identified topics (extracted from the educational content) to create prompts that form the basis of questions. The difficulty levels of the questions can be varied, ranging from easy to hard, based on factors such as the complexity of the underlying topic and the depth of understanding required. The following steps provide more clarity:

    - **Topic-Based Prompts:** Utilize the identified topics to create prompts that guide the formulation of questions. For example, if the topic is "Newton's Laws of Motion," prompts could include "Explain Newton's First Law" or "Provide an example illustrating Newton's Third Law."
    - **Difficulty Level Variation:** Adjust the complexity of the prompts to cater to different difficulty levels. For easy questions, the prompts may be straightforward, while hard questions may involve more intricate concepts or application scenarios.
    - **Diversity in Question Types:** Generate a variety of question types, such as multiple-choice questions, short-answer questions, and descriptive questions, to assess different cognitive skills and levels of comprehension.

2. Algorithm for Checking User-Generated Answers: Once the auto-questions are presented to the user, an algorithm is employed to assess the correctness of the user's answers. The algorithm should be designed to handle various types of responses and provide meaningful feedback.

    - **Answer Matching:** The algorithm compares the user's answer with predefined correct answers. This involves text matching and may consider variations in spelling, synonyms, or paraphrasing to account for diverse responses.
    - **Scoring System:** Implement a scoring system that assigns points based on the accuracy of the user's response. Different question types may have distinct scoring criteria.
    - **Feedback Generation:** Provide immediate feedback to the user. Explain why their answer is correct or incorrect and offer guidance for improvement. This feedback is crucial for the "Fail and Learn" approach, reinforcing learning through explanations.
    - **Adaptive Learning:** Optionally, incorporate adaptive learning mechanisms. If a user consistently struggles with certain types of questions, the system can dynamically adjust the difficulty level or provide additional resources to address the identified challenges.

Step 4: Fail and Learn Method

1. Present auto-generated questions to the user.
2. Provide immediate feedback and explanations for correct and incorrect answers.
3. Provide video explanations extracted from the text to reinforce learning.

Step 5: Video Chatbot Interaction

1. Implement a video chatbot that converts text to speech for explanations.
2. Enable microphone access for students to ask additional questions during the video.
3. Train the chatbot model to handle diverse queries and provide relevant explanations.

Step 6: Evaluation and Refinement

1. Collect user feedback on the effectiveness of auto-generated questions and video explanations.

2. Fine-tune the sLDA model and question generation algorithm based on user feedback.

Step 7: Deployment

1. Deploy the sLDA model and integrated modules for interactive learning experiences.

5.3 User Interface Design

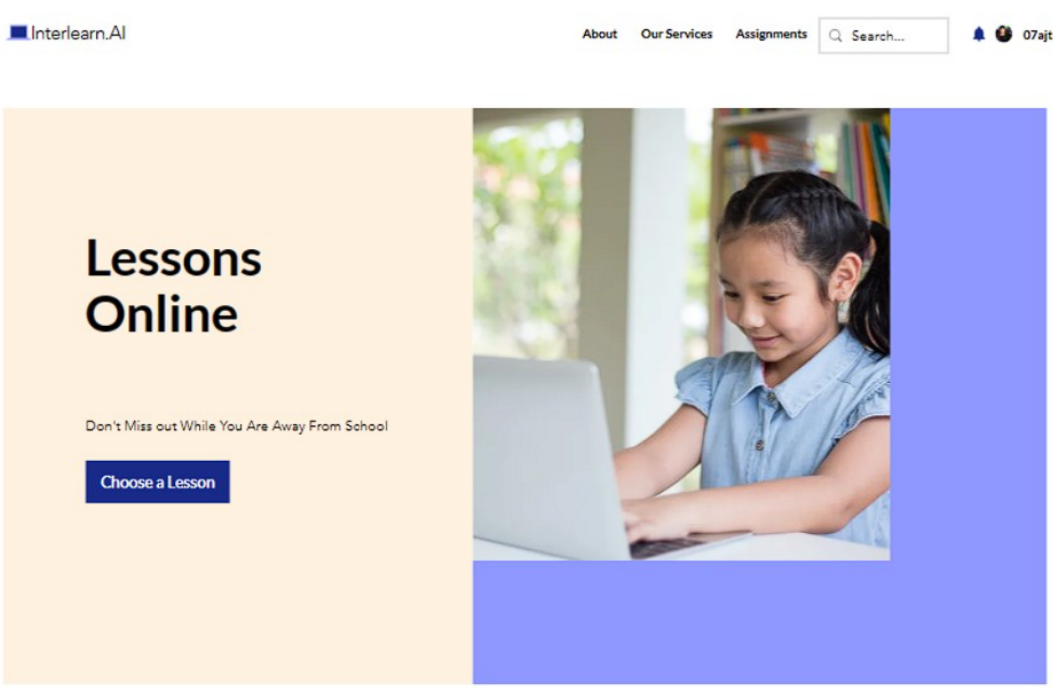

Figure 5.1: Homepage Design

5.4 Database Design

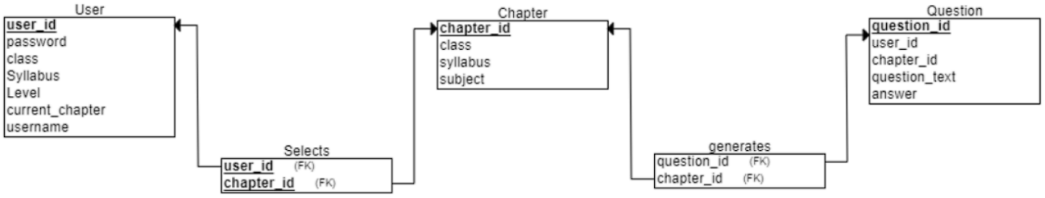

Figure 5.2: Database Design

- User Table: Contains information about the users including their ID, password, class, syllabus, level, current chapter, and username.
- Chapter Table: Contains information about different chapters including chapter ID, class associated with it, syllabus and subject.
- Question Table: Contains question ID, user ID (foreign key), chapter ID (foreign key), question text and answer.
- Selects Table: A junction table that connects User and Chapter tables with user_id (FK) and chapter_id (FK).
- Generates Table: Another junction table that connects Chapter and Question tables with question_id (FK) and chapter_id (FK).

Chapter 6

Requirements

6.1 Hardware and Software Requirements

6.1.1 Hardware Requirements

1. **Development Machines**
    - Processor: Multi-core processors (i5 or above) for efficient development processes.
    - RAM: 16GB or more to handle complex AI processing and multitasking during development.
    - Storage: SSD for faster data access and improved system responsiveness.
2. **AI Model Training Hardware**
    - High-Performance GPUs: Dedicated GPUs for accelerating AI model training processes.
    - CUDA Support: Ensure CUDA support for optimized GPU-accelerated deep learning tasks.
3. **Networking**
    - Stable Internet Connection: Required for accessing cloud services, AI model updates, and collaborative tools.
4. **External Hardware for Testing**
    - Devices with Different Resolutions: Test on various screen sizes and resolutions to ensure responsive design.
5. **System Security Measures**

- Security Software: Install reliable antivirus and anti-malware software to protect development machines.
- Regular Updates: Keep operating systems and development tools up to date with the latest security patches.

6. **Testing Devices**

   - Various Devices for Cross-Platform Testing: Test on different platforms and browsers to ensure compatibility.

6.1.2 Software Requirements

1. **Front-end Development**

   - Framework: React or Angular for building an interactive user interface.
   - Programming Languages: HTML, CSS, JavaScript for front-end development.
   - IDE (Integrated Development Environment): Visual Studio Code for code editing and debugging.

2. **Back-end Development**

   - Framework: Node.js for server-side logic and API development.
   - Database: MongoDB for efficient data storage and retrieval.
   - API Integration: Tools for seamless integration with external APIs.

3. **Machine Learning and AI**

   - Libraries: TensorFlow or PyTorch for developing and training machine learning models.
   - Programming Languages: Python for AI model development.

4. **Database Management**

   - Database Management System (DBMS): MongoDB Compass for effective database management.

5. **Text Editors**

   - Visual Studio Code: Text editor for code development and collaboration.

6.2 Functional Requirements

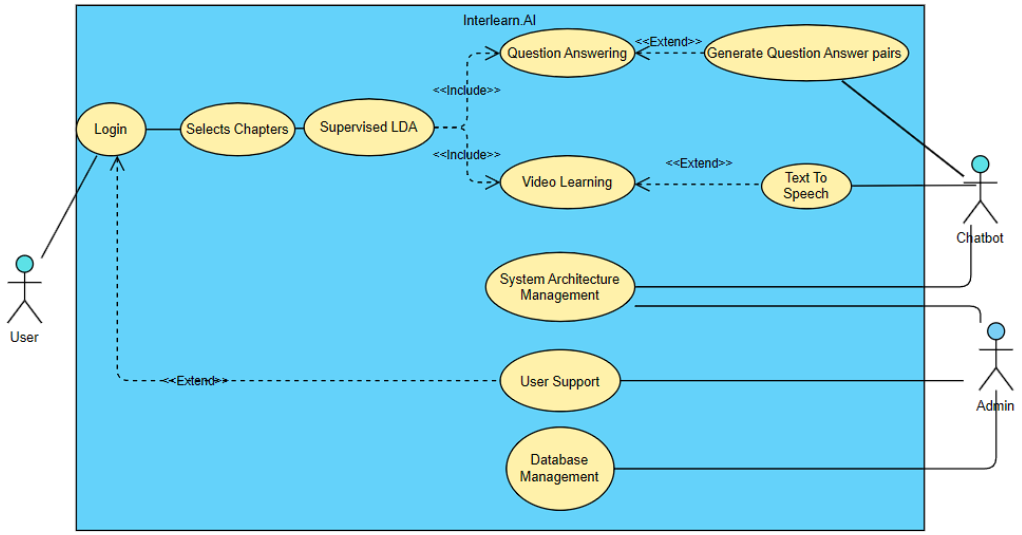

Figure 6.1: Use Case Diagram

1. User Information: The user logs in to access the system.

2. Homepage: After login, the user selects chapters or topics they want to learn about.

3. Learning Material Details and Preferences: The user interacts with Interlearn.AI, which includes Question Answering and Video Learning modules.

4. Learning Generation: These modules process users' selected chapters and preferences to generate question-answer pairs and provide video learning materials.

5. Real-Time Assistance: The Text To Speech module can be used for real-time assistance in understanding the learning materials. User Support is also available for additional help.

Chapter 7

Test plan and Implementation Plan

7.1 Module Division

Modules	**Description**	**Assigned To**
Data Collection	Collect information about educational content, including text, images, and formats from various sources.	Allain, Ansel
Data Preprocessing	Clean and preprocess collected data for further analysis, including text extraction and formatting.	Allain, Ansel
Topic Modeling with Supervised LDA	Train a model using supervised LDA to categorize and extract relevant information from the educational content.	Batton
Auto-Question Generation	Generate auto-questions based on identified topics for different difficulty levels. Develop an algorithm for checking user-generated answers.	Batton
Fail and Learn Method	Present auto-generated questions, provide immediate feedback and explanations with video explanations from the content.	Joswin
Video Chatbot Interaction	Implement a video chatbot for text-to-speech explanations. Enable microphone access for student questions during the video.	Joswin

Table 7.1: Module Division for Interlearn.AI

7.2 Implementation Plan

Sl. No.	Date	Task	Remarks
1.	Feb 1-7	Research and Dataset Acquisition	In-depth research to understand available educational datasets.
2.	Feb 8-14	Dataset Analysis and Preprocessing Plan	Define strategies for preprocessing educational text and content.
3.	Feb 15-21	Data Preprocessing Implementation	Implement preprocessing steps to organize and clean the dataset.
4.	Feb 21-28	Continuation of Data Preprocessing	Ensure the dataset is well-prepared, addressing any anomalies.
5.	Mar 1-7	NLP Model Development	Initiate the development of NLP models for topic modeling.
6.	Mar 8-14	NLP Model Refinement	Fine-tune NLP models for improved accuracy and efficiency.
7.	Mar 15-21	Chatbot Integration	Integrate GPT-3.5 for chatbot functionality.
8.	Mar 22-28	Fail-and-Learn Implementation	Develop the fail-and-learn mode with auto-generated questions.
9.	Apr 1-7	Video Explanation Integration	Implement text-to-speech for video content.
10.	Apr 8-14	User Interaction Enhancement	Refine user interaction options and continuous questioning features.

Table 7.2: Implementation Schedule

7.3 Gantt Chart

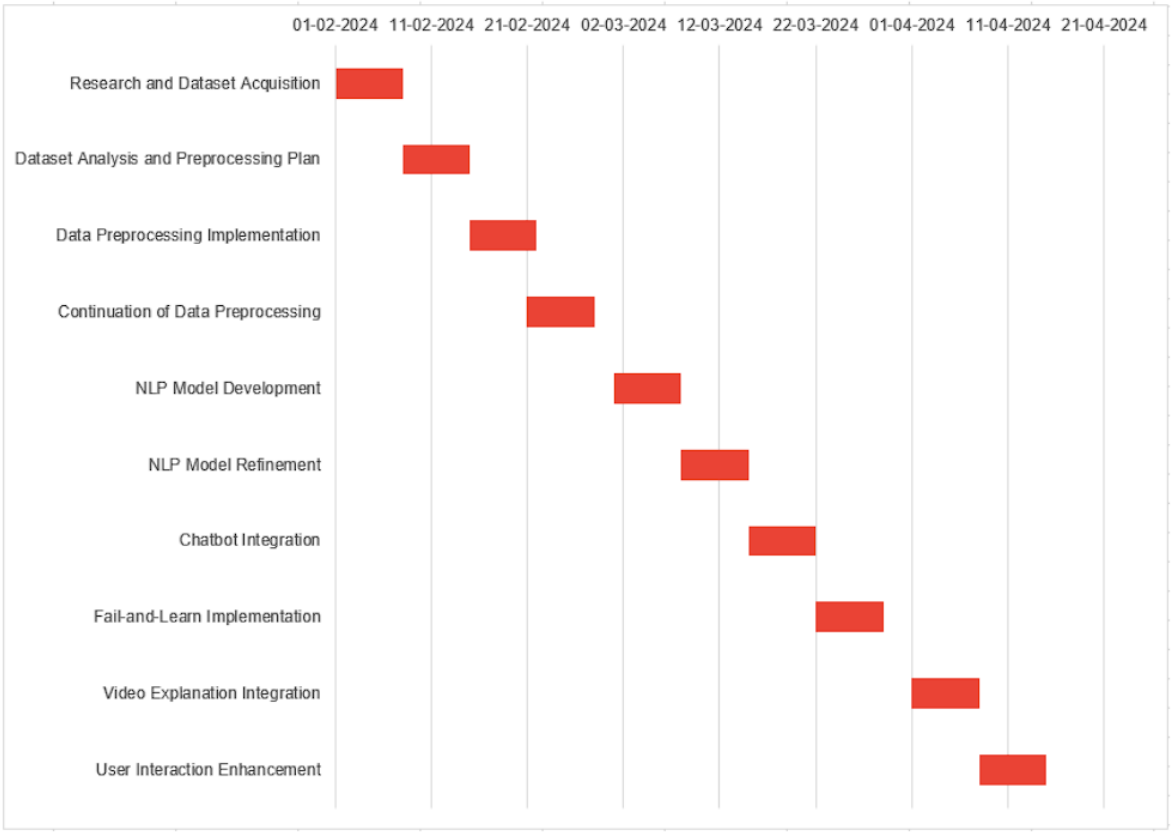

Figure 7.1: Gantt Chart

7.4 Test Plan

Sl No.	Module	Test Case/Functionality	Inputs	Expected Output
1.	User	Check if bold highlights already exist	Text with bold highlights	Identify and highlight existing bold text
2.	PDF Processing	Extract text from PDFs of class chapters	Sample PDFs of ICSE and CBSE classes	Successfully extract text from PDFs
3.	NLP Topic Modeling	Identify bold and large-sized text	Text data from PDFs	Identify and use bold, large-sized text for modeling
4.	Chatbot Integration	Fail-and-Learn Mode	Auto-generated questions and answers	Display questions, check answers, provide feedback
5.	Video Explanations	Convert text to speech for video content	Text content for video explanations	Successfully convert text to speech for videos
6.	User Interaction	Interact during video playback	Microphone access during video playback	Allow users to ask questions during video playback
7.	User Interaction	Ask additional questions during video	Microphone access during video playback	Provide responses to additional user questions
8.	User Interaction	Continuous questioning	Chatbot interaction during learning	Allow users to continuously ask questions
9.	System Integration	GPT-3.5 Integration	Chatbot and video components	Integrated system without compatibility issues

Sl No.	Module	Test Case/Functionality	Inputs	Expected Output
10.	System Integration	PDF Processing Integration	NLP and Chatbot integration	Ensure seamless operation between integrated modules
11.	Scalability Testing	Handle increasing user interactions	Simulate increased user interactions	Stable performance and response times
12.	Error Handling	Simulate incorrect user inputs	Incorrect queries and inputs	Graceful error handling and informative messages
13.	Performance Testing	Assess overall system performance	Normal and peak load conditions	Optimal performance within acceptable parameters
14.	Usability Testing	Gather feedback from users	User interactions and feedback	Positive user experience and ease of use
15.	Documentation	Verify completeness of system documents	System documentation	Accurate and complete documentation

Table 7.3: Test Plan

Chapter 8

Conclusion

In conclusion, the "AI for Education" project envisions a transformative initiative that holds the potential to reshape the landscape of education by integrating cutting-edge technologies such as Artificial Intelligence (AI) and advanced Natural Language Processing (NLP). This project addresses longstanding challenges in the education sector, providing a platform for adaptive and personalized learning experiences tailored to the individual needs and preferences of students.

The primary objective of the project is to elevate the educational journey by offering customized content, interactive learning modules, and real-time feedback. Through the implementation of AI, particularly supervised Latent Dirichlet Allocation (sLDA) and sophisticated question generation algorithms, the application excels in content analysis, generating questions of varying difficulty levels, and facilitating explanations through a dynamic video chatbot. This approach fosters a dynamic and engaging learning environment that caters to diverse learning styles.

The proposed methodology, involving supervised LDA for content analysis, auto-question generation, and interactive video chatbot interactions, reflects a commitment to delivering a comprehensive and immersive educational experience. By deploying the sLDA model and integrated modules, the project aims to make learning more accessible, personalized, and effective for students.

Chapter 9

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Appendix A: Presentation

INTERLEARN.AI

Transforming Education with Generative AI

TABLE OF CONTENTS

INTRODUCTION

INTERACT.AI is a revolutionary platform transforming education through Generative AI. By employing advanced Natural Language Processing techniques, the platform redefines the educational landscape. Generative AI empowers machines to generate human-like text, while NLP enables them to understand and interact with human language. This integration creates a dynamic and personalized learning experience, departing from traditional approaches and ushering in a new era of interactive education.

PROBLEM DEFINITION

Traditional learning lacks interactivity, leading to passive experiences. Additional tuition is often required, creating financial burdens and educational disparities. Limited accessibility to quality education persists globally. InterLearn.AI aims to address these challenges by using Generative AI to provide interactive, 24/7 accessible learning experiences, eliminating the need for extra tuition, and making quality education universally available.

AIM & OBJECTIVES

AIM: To provide interactive learning experiences using Generative AI.

Objectives:

1. We address the challenges of traditional learning by introducing interactive learning.
2. We eliminate the need for extra tuition and provide 24/7 accessibility.
3. Our mission is to make quality education available to anyone, anywhere.

PROJECT SCOPE

INTERLEARN.AI is designed to:

1. Accept chapter data from PDFs of ICSE and CBSE curricula.
2. Utilize NLP-powered chatbots for personalized learning.
3. Provide real-time interaction with a microphone access feature.

LITERATURE SURVEY

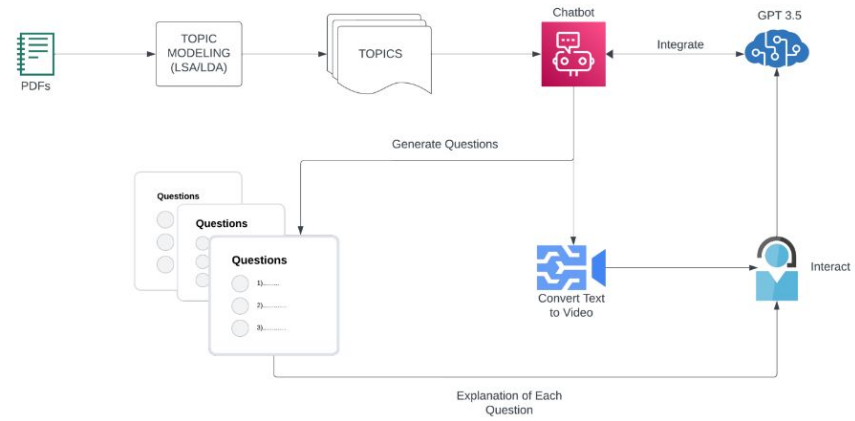
TITLE	LIMITATIONS	METHODOLOGY
Unlocking the Power of ChatGPT: A Framework for Applying Generative AI in Education. Author - Jiahong Su	• **Lack of Common Sense**: ChatGPT may generate responses that are technically correct, but do not make sense in the real world. • **Limited Understanding of Context**: ChatGPT may struggle to understand the broader meaning of conversations and fail to pick up on nuances or subtext. • **Biased Data**: ChatGPT may replicate the biases or inaccuracies of the data it is trained on. • **Inability to Perform Physical Tasks**: ChatGPT cannot perform physical tasks, such as cooking or cleaning. • **Lack of Emotional Intelligence**: ChatGPT does not experience emotions and may struggle to understand or respond appropriately to emotionally charged conversations. • **Vulnerability to Adversarial Attacks**: ChatGPT can be vulnerable to adversarial attacks, where the input data is designed to cause it to generate incorrect or harmful responses.	• **The IDEE framework**: A theoretical framework for guiding the use of ChatGPT and other generative AI in education, which includes identifying the desired outcomes, determining the appropriate level of automation, ensuring ethical considerations, and evaluating effectiveness. • **Preprocessing**: A step that converts the input text into a numerical representation called a token, which captures the meaning of each word. • **Encoding**: A step that uses attention mechanisms to help the model focus on the most relevant parts of the input text. • **Decoding**: A step that generates a response by decoding the encoded text into natural language, using a similar set of attention mechanisms as in the encoding step. • **Postprocessing**: A step that removes any unnecessary tokens and formatting, and presents the natural language response to the user.

TITLE	LIMITATIONS	METHODOLOGY
Using artificial intelligence in craft education: crafting with text-to-image generative models.	• **Lack of diversity in the data sets**: The authors note that the data sets used to train the text-to-image generative models are mostly based on English text and Western images, which may limit the applicability and generalizability of the models to other languages and cultures. • **Lack of control over the image quality and style**: The authors point out that the quality and style of the generated images depend largely on the choice of words and the complexity of the prompts. They argue that the users may not have enough control over the desired outcome, and that the models may produce unrealistic or inappropriate images that do not match the users' expectations or intentions. • **Lack of ethical and pedagogical guidelines**: The authors acknowledge that the use of text-to-image generative models in craft education poses ethical and pedagogical challenges, such as the ownership and originality of the generated images, the impact of AI on human creativity and agency, and the potential risks of misinformation and manipulation.	• **Research-creation approach**: The authors used creative making of artefacts with generative AI to stimulate discourses and capture insights into the everyday realities, hopes, concerns and future imaginaries of craft teachers. • **Workshop design and implementation**: The authors designed and ran a 3-hour workshop for 15 participants, including 5 teacher educators and 10 pre-service teachers, in a Finnish university programme on craft teacher education. • **Data collection**: The authors collected audio and video data from the group discussions and joint reflections, as well as the digital artefacts produced by the participants using Mid journey. • **Data analysis**: The authors used thematic analysis to identify the main themes and sub-themes that emerged from the participants' insights and experiences with generative AI. The analysis was supported by Atlas.ti software and discussed between the two researchers.

TITLE	LIMITATIONS	METHODOLOGY
Generative AI and ChatGPT in School Children's Education: Evidence from a School Lesson	1. **Lack of diversity in the data sets:** The authors highlight that the data sets used to train text-to-image generative models are predominantly based on English text and Western images. This limitation restricts the applicability and generalizability of the models to other languages and cultures. 2. **Limited control over image quality and style:** Users may find it challenging to precisely control the quality and artistic style of the generated images. The outcome depends heavily on the choice of words and the complexity of prompts. As a result, the models may produce unrealistic or inappropriate images that do not align with users' expectations. **Ethical and pedagogical considerations:** The use of text-to-image generative models in craft education raises ethical and pedagogical questions. These include issues related to image ownership, originality, the impact of AI on human creativity, and the risks of misinformation and manipulation.	• The authors designed a school lesson using generative AI, specifically ChatGPT-3.5 and 4, to create and modify text, figures, and exercises for pupils with different levels of knowledge and interest in a Social Sciences (History) topic. • The authors tested the lesson with 110 pupils from 4th to 6th grade in two schools in Montevideo, Uruguay, using laptops to access the learning material through the Digileac platform. • The authors collected and analyzed both quantitative and qualitative data on the pupils' interaction with the learning material, their test performance, and their feedback on the lesson. • The authors used descriptive statistics and cross-tabulation techniques to examine the relationships between the pupils' background variables, time usage, accuracy of answers, and perceptions of learning and enjoyment. • The authors also validated and fine-tuned the generative AI outputs using human intervention and feedback, following the principles of reinforced learning from human feedback (RLHF).

TITLE	LIMITATIONS	METHODOLOGY
Application of NLP:Design of Chatbot for New Research Scholars.	• **Lack of domain knowledge**: Chatbots may not have sufficient or accurate knowledge about specific domains or topics, especially if they are trained on general or noisy datasets. This may lead to irrelevant or misleading responses from chatbots. • **Lack of computational power**: Chatbots may not be able to perform complex calculations or simulations that are required for some scientific research tasks. Chatbots may also have limited memory and processing speed, which may affect their performance and scalability. • **Lack of inferential ability**: Chatbots may not be able to reason or draw conclusions from the given data or information. Chatbots may also struggle with handling ambiguity, uncertainty, or contradictions in the user input or the chatbot output.	• **Understanding User Input**: This involves parsing the input to understand the structure of the sentence and the meaning of the words. • **Generating Relevant Output**:This involves selecting an appropriate response from a predefined set of responses or generating a new response using ML algorithms. • **Tracking Human-Chatbot Interactions**: Novel methods are proposed for tracking human-chatbot interactions and measuring chatbot performance. These methods take into consideration ethical concerns, particularly trust. • **Linking Neuroscientific Methods, Text Mining, and Machine Learning**: This allows for a more comprehensive understanding of how users interact with chatbots and how chatbots can be improved. • **Addressing Challenges and Limitations**: Despite the advances in chatbot technology, there are many challenges and limitations in their application. These include the lack of domain knowledge, computational power, and inferential ability.

SYSTEM ARCHITECTURE



METHODOLOGY

Data Collection:

- Gather PDFs of chapters for each class in ICSE and CBSE curriculum.
- Extract text content from PDFs to be used for further analysis.

Data Preprocessing:

- Identify and remove non-topical words that might be bold or have larger font size (e.g.,headers, footers, page numbers) using pre-processing techniques.
- Tokenize and clean the text for better analysis.

Topic Modeling with Supervised LDA:

- Extract bold and larger-sized text from the document using text formatting attributes.
- Use these identified words as seed words for supervised LDA.
- Train a supervised LDA model using the identified bold words as seed words for topics.
- Use these topics to categorize and extract relevant information

from the text.

TECHNOLOGY STACK

- PDF Parsing: Use a PDF parsing library, such as PyPDF2 or pdfminer, to extract text from PDF documents containing the chapters of ICSE and CBSE classes.

- NLP (Natural Language Processing): Use NLP techniques for text analysis

- Supervised LDA (Latent Dirichlet Allocation): Train supervised LDA model to identify topics in the text.For the bold and larger-sized text, you might need to preprocess the text to identify formatting information, possibly using a librarylike PyMuPDF or pdfminer.

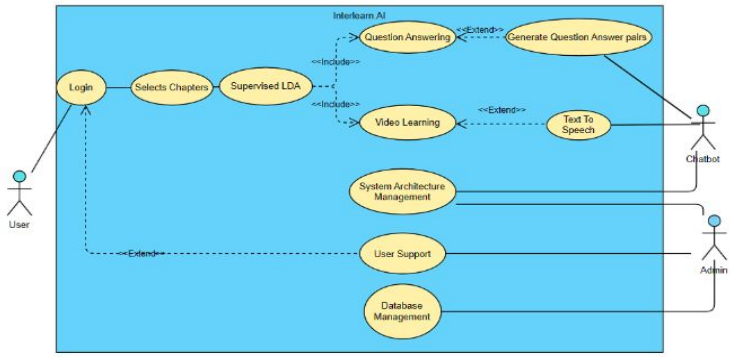
- GPT-3.5 Integration: Integrate the GPT-3.5 model to generate responses for the chatbot.

- Text-to-Speech (TTS):Convert text explanations to speech using TTS technology.

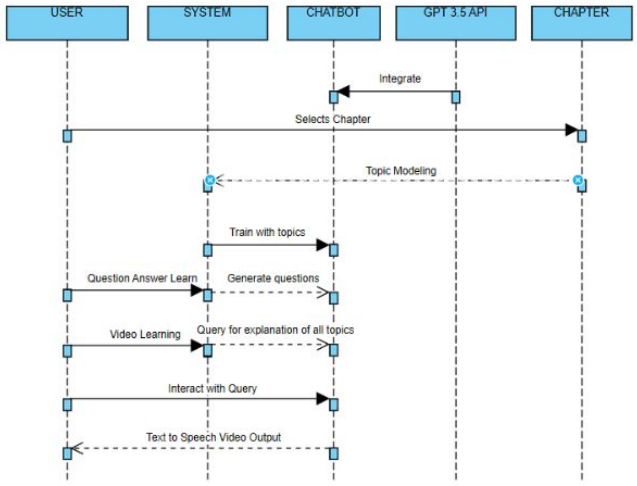
- Interactive Video Chatbot: Implement a video chatbot that explains topics visually. Use libraries like OpenCV for video processing and streaming.

- Real-time Interaction:Implement real-time interaction.features during video explanations and teaching sessions.

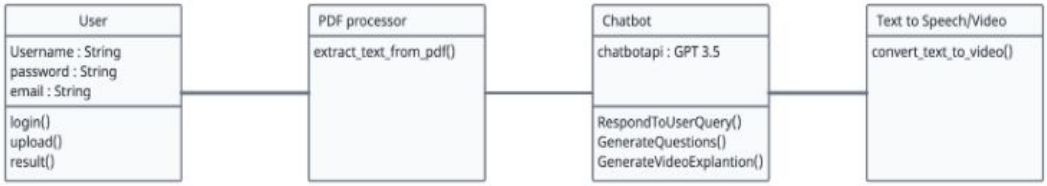
USE CASE DIAGRAM



SEQUENCE DIAGRAM

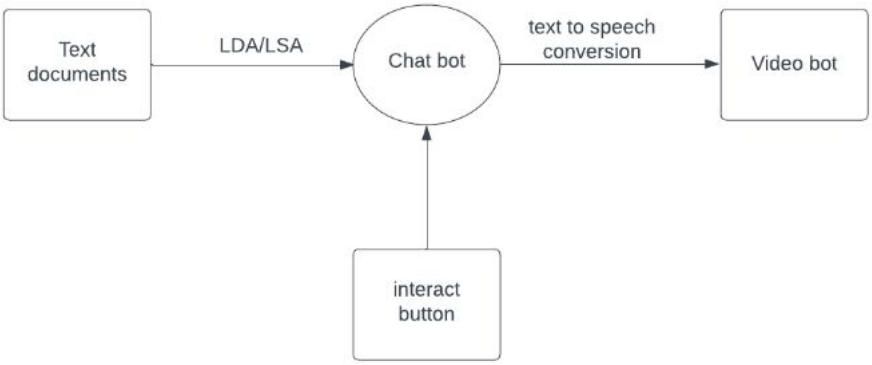


CLASS DIAGRAM

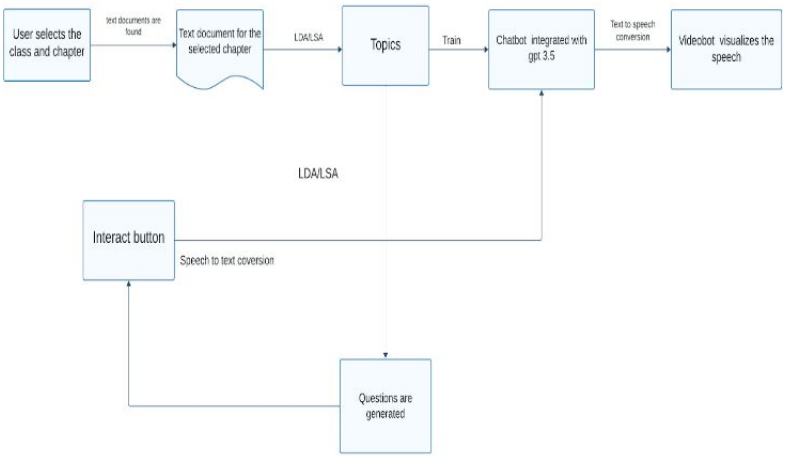


DATA FLOW DIAGRAM

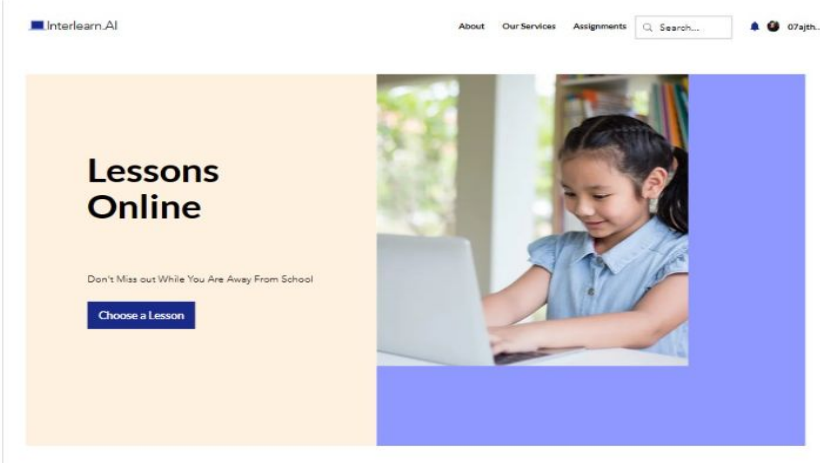
LEVEL 0



LEVEL 1



FRONT END DESIGN



IMPLEMENTATION REQUIREMENTS

Software Development:
- Python for AI tasks, and JavaScript for web development.
- Frameworks like TensorFlow, PyTorch, Flask, or Django.

Generative AI Model:
- Curate diverse training data for Generative AI.
- Fine-tune pre-trained models for educational content.

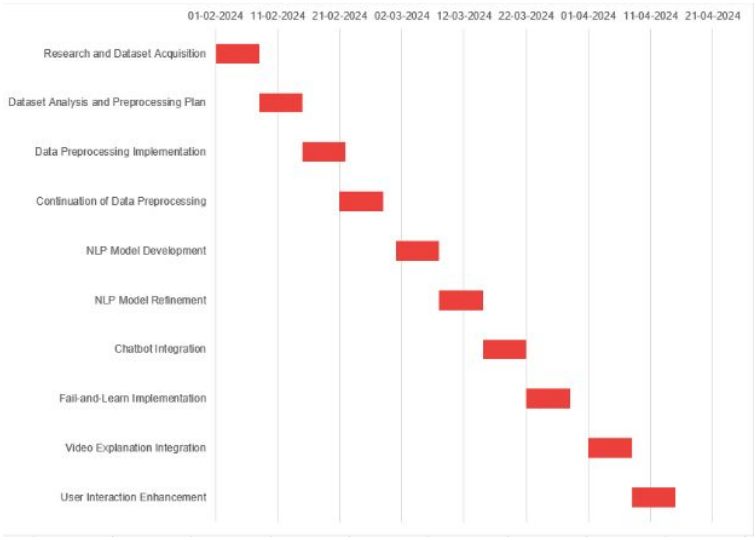
Natural Language Processing (NLP):
- Implement NLP using libraries like NLTK or spaCy.
- Use word embeddings (Word2Vec, GloVe) for semantic understanding.

GPT Integration:
- Integration of GPT 3.5 to the chatbot using api

User Interface (UI) and User Experience (UX):
- Develop an intuitive and responsive web interface through react.js

Security and Privacy:
- Implement data encryption (HTTPS) for secure transmission.
- Ensure secure user authentication mechanisms.

IMPLEMENTATION PLAN



TEST PLAN

Sl No.	Module/Process	Test Case/ Functionality	Inputs	Expected Output
1.	User	Check if bold highlights already exist	Text with bold highlights	Identify and highlight existing bold text
2.	PDF Processing	Extract text from PDFs of class chapters	Sample PDFs of ICSE and CBSE classes	Successfully extract text from PDFs
3.	NLP Topic Modeling	Identify bold and large-sized text	Text data from PDFs	Identify and use bold, large-sized text for modeling
4.	Chatbot Integration	Fail-and-Learn Mode	Auto-generated questions and answers	Display questions, check answers, provide feedback
5.	Video Explanations	Convert text to speech for video content	Text content for video explanations	Successfully convert text to speech for videos
6.	User Interaction	Interact during video playback	Microphone access during video playback	Allow users to ask questions during video playback
7.	User Interaction	Ask additional questions during video	Microphone access during video playback	Provide responses to additional user questions
8.	User Interaction	Continuous questioning	Chatbot interaction during learning	Allow users to continuously ask questions
9.	System Integration	GPT-3.5 Integration	Chatbot and video components	Integrated system without compatibility issues

10.	System Integration	PDF Processing Integration	NLP and Chatbot integration	Ensure seamless operation between integrated modules
11.	Scalability Testing	Handle increasing user interactions	Simulate increased user interactions	Stable performance and response times
12.	Error Handling	Simulate incorrect user inputs	Incorrect queries and inputs	Graceful error handling and informative messages
13.	Performance Testing	Assess overall system performance	Normal and peak load conditions	Optimal performance within acceptable parameters
14.	Usability Testing	Gather feedback from users	User interactions and feedback	Positive user experience and ease of use
15.	Documentation	Verify completeness of system documents	System documentation	Accurate and complete documentation

RISK AND CHALLENGES

- Handling sensitive student information poses privacy and security concerns. Breaches could lead to legal consequences and damage the platform's reputation.
- Developing and maintaining advanced AI models like Generative AI and NLP can be technically challenging.
- The AI model may struggle to adapt to diverse learning styles and preferences.
- Education technology platforms are subject to various regulations, and non-compliance can result in legal issues.
- Users might not fully engage with the AI-driven learning platform, leading to underutilization.

CONCLUSION

INTERACT.AI pioneers the use of Generative AI in education, ensuring 24/7 accessibility to quality learning. Our goal is to eliminate the need for extra tuition, making high-quality education universally available. By leveraging Generative AI, we create personalized, engaging, and interactive learning experiences for everyone, revolutionizing education for a diverse global audience.

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THANK YOU

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.

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

CO - PO Mapping

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	1		1
2	1		1
3	1		1
4	1		1
5	1		1