AI-Powered Online Platform for Streamlined Meeting Management

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Abstract- The Meeting Manager Application is a web-based platform developed to streamline the planning, execution, and recording of meetings. It offers a full range of functionalities, including scheduling meetings, uploading related files, organizing discussion topics, creating agendas, transcribing meeting audio, and generating detailed summaries. Built with advanced technologies like Flask for the backend, SQLAlchemy for handling databases, ChromaDB for vector storage, and Google's Gemini Large Language Model (LLM) for natural language tasks, the system incorporates modern machine learning methods. It uses Sentence Transformers to create text embeddings, which are then stored and searched within ChromaDB for similarity matching. By automating critical parts of meeting management, the application enhances productivity and minimizes the need for manual intervention. This project highlights how AI-powered tools can optimize workflow in business environments. Planned future upgrades include enabling multi-user collaboration, scaling the system for larger operations, and offering real-time meeting insights to further enrich the user experience.

1. INTRODUCTION

In today's fast-paced corporate and academic environments, meetings play a vital role in fostering collaboration, guiding strategic initiatives, and facilitating decision-making. Yet, conventional methods of managing meetings—such as manually preparing agendas, documenting discussions, and tracking follow-ups—are often inefficient and prone to human error. These outdated approaches can lead to missed details, miscommunication, and delays. As organizations grow, these challenges only become more pronounced, creating roadblocks to effective teamwork and productivity.

The rise of artificial intelligence (AI) and natural language processing (NLP) has opened the door to smarter ways of handling meetings. With the emergence of powerful language models and vector-based data storage, it's now possible to automate core meeting tasks such as agenda generation, real-time transcription, and content summarization. AI-powered tools can quickly process and interpret large volumes of spoken and written information, allowing teams to capture and organize critical points effortlessly. These advancements significantly reduce the need for manual input, enhance documentation accuracy, and support more informed decision-making.

This paper introduces a robust web-based Meeting Management System that leverages the latest in AI technology to streamline the entire meeting lifecycle. By incorporating Google's Gemini language model for intelligent transcription and agenda formulation, and utilizing ChromaDB to store and retrieve meeting-related data through vector embeddings, the system delivers highly structured and accessible documentation. Its user-friendly interface enables users to set up meetings, upload supporting files, and access AI-generated summaries with ease. Altogether, this solution offers a scalable and intelligent alternative to traditional meeting practices, setting a new benchmark for organizational efficiency and collaboration.

2. RELATED WORK

A variety of recent studies have investigated ways to enhance meeting management through the integration of artificial intelligence (AI) and natural language processing (NLP). The growing reliance on virtual and automated systems has driven significant advancements in this domain, with researchers aiming to streamline tasks such as note-taking, transcription, agenda creation, and meeting summarization.

A foundational study [1] explores NLP-driven summarization methods that automatically extract key points and decisions from meeting discussions, reducing the need for manual note-taking. This approach leverages sentence embeddings and machine learning models to transform transcripts into concise,

relevant summaries. Such methods are foundational for AI-driven meeting management applications, as they ensure essential information is retained without overwhelming users with unnecessary details..

For effective information retrieval within meeting contexts, vector embeddings have proven especially valuable. Paper

[2] highlights the use of vector representations to improve semantic retrieval, crucial for systems that handle extensive or unstructured data, such as meeting recordings and documents. Techniques like Sentence Transformers enhance retrieval accuracy by creating meaningful vector embeddings, allowing for similarity-based searches. In meeting management, this enables users to easily find documents or previous discussion points related to current topics, enhancing both continuity and efficiency in recurring meetings..

The automation of agendas and action items has also been a significant focus in AI research for meeting management. In [3], researchers examine how AI-powered meeting assistants can automatically generate agendas based on user inputs or historical meeting data, with automated tracking of action items to ensure follow-through. By streamlining agenda creation and task management, these systems aim to alleviate administrative burdens and allow participants to focus on core discussions.

In addition to NLP models, vector storage databases like ChromaDB have gained attention for their ability to store and quickly retrieve large volumes of embedded data. Study

[4] demonstrates ChromaDB's utility in handling vector embeddings generated from meeting documents, enabling rapid and contextually accurate searches within the meeting management system. This technology supports NLP-based similarity searches, which are particularly beneficial in automating agenda creation by identifying recurring discussion topics or referencing relevant past documents.

Furthermore, the practical deployment of AI-based meeting management systems has raised concerns regarding scalability, security, and user experience. Research in [5] discusses scalable architectures for meeting systems capable of handling high data volumes and user traffic, emphasizing the importance of robust system design. Another study [6] highlights best practices for securing sensitive meeting data through encryption and access control, which are crucial for systems handling confidential or sensitive organizational information.

The automation of meeting management tools has been an area of significant research. In [7], the authors provide a comprehensive review of automated meeting management tools, highlighting the various software systems designed for scheduling, document management, and transcription. These tools, similar to the Meeting Manager Application, offer features such as agenda generation, note-taking, and follow-up actions. The paper also addresses challenges such as transcription accuracy, handling diverse accents, and real-time integration in collaborative environments, which are key areas for improvement in such systems.

The use of large language models (LLMs) for meeting transcription and summarization has also been explored. In [8], researchers discuss how LLMs like GPT-3 can be leveraged for automatic meeting transcription, summarization, and sentiment analysis. The study examines the benefits and limitations of using these models in real-time meeting contexts, noting how LLMs can reduce manual effort in transcription and improve document accessibility. This work is relevant as the Meeting Manager Application integrates Google's Gemini LLM for similar NLP tasks.

Furthermore, the application of vector databases and embedding-based information retrieval in NLP has been a topic of research. In [9], the authors investigate the use of ChromaDB for storing and querying embeddings in information retrieval systems. By representing text as vectors, these systems enable efficient similarity search, making them particularly useful for document retrieval and recommendation tasks. This is highly relevant to the Meeting Manager Application, which utilizes ChromaDB for storing and querying text embeddings to enhance meeting-related document management and search functionality.

3. PROPOSED SYSTEM

a. *System Overview Key Components of the System*

The Meeting Manager Application is an all-in-one, web-based platform built to automate every stage of the meeting process—from initial scheduling to post-meeting follow-ups. It brings together cutting-edge technologies, including modern web frameworks, machine learning, natural language processing, and

vector-based search, to provide users with a seamless and efficient meeting experience.

1. Web-Based Interface:
The front-end of the system is a user-friendly web interface that allows users to create meetings, upload documents, manage agendas, and track action items. Built using Flask, a lightweight web framework, the interface is accessible from any modern browser and can be accessed by multiple users for collaboration.

2. Meeting Creation and Document Management:
Users can schedule meetings by entering essential information like the meeting title, date, participant list, and agenda items. Additionally, they have the option to upload relevant materials—such as reports or presentations—which are securely stored on the backend and associated with the corresponding meeting entry for quick and convenient access.

3. Agenda Generation and Management:
The system leverages historical meeting data and user input to automatically generate meeting agendas. The agenda creation module analyzes previous meeting records to suggest relevant topics and discussion points, which can be customized by users. This reduces the time spent manually preparing meeting agendas and ensures a structured meeting flow.

4. Natural Language Processing (NLP) Integration:
At the heart of the system lies its capability to automatically transcribe and summarize meeting conversations using Google's Gemini Large Language Model. Whether through live audio capture or integrated transcription tools, the system processes discussions in real time, generating detailed transcripts. These transcripts are then analyzed to produce concise summaries and highlight key takeaways. Advanced NLP models extract essential insights—including decisions made, tasks assigned, and follow-up actions—offering participants a clear and organized overview of the meeting.

5. Action Item Tracking:
The system automatically extracts action items from meeting discussions, assigning them to relevant participants. The action items are stored in a task management system, and users receive notifications to ensure timely follow-up. This functionality promotes accountability and ensures that tasks are completed before the next meeting.

6. Similarity Search with ChromaDB:
To enhance the search functionality, the system uses ChromaDB, a vector database designed for storing and querying text embeddings. It utilizes Sentence Transformers to convert meeting notes, agendas, and documents into dense vector representations (embeddings), which are then stored in ChromaDB. This allows users to perform similarity searches to find relevant documents, meeting notes, or action items based on past content, significantly improving the search process.

7. Database Management:
SQLAlchemy, a powerful database toolkit for Python, is used for managing the backend database that stores meeting data, user information, documents, transcriptions, and action items. The relational database structure ensures that all meeting data is organized efficiently and can be queried quickly for future reference.

8. Multi-User Collaboration:
The application promotes collaboration by enabling multiple users to engage in meeting preparation, contribute to discussions, and access meeting records. Different user roles can be assigned to control access levels, ensuring that participants can only view or edit content relevant to their specific responsibilities within the meeting.
Additionally, the system enhances model performance by recognizing complex patterns through its dense layers. The final dense layer applies a softmax activation function, producing a probability distribution across two primary classes: random and non-random. To boost generalization and reliability, the system also emphasizes the importance of data replication during the training process.

b. *System Architecture*
Workflow of the Meeting Manager Application
1. Meeting Scheduling and Preparation:
The user creates a meeting by specifying the date, time, participants, and agenda. The system can automatically pull relevant documents and past

meeting data to help in the preparation.

2. During the Meeting:
The system records meeting discussions, transcribes audio in real time, and identifies key points, decisions, and action items using NLP models. The automatically generated agenda is followed, and discussion points are tracked.

3. Post-Meeting Follow-Up:
After the meeting concludes, the system automatically generates a meeting summary, including transcriptions, decisions, and action items. Action items are assigned to participants, and reminders are sent to ensure timely completion. The system also allows users to search for and retrieve previous meeting content using the similarity search feature.

4. Continuous Improvement:
The system's performance improves over time as it processes more meeting data. The NLP models refine their ability to summarize and identify action items accurately, while the system's document and meeting management capabilities evolve based on user feedback.

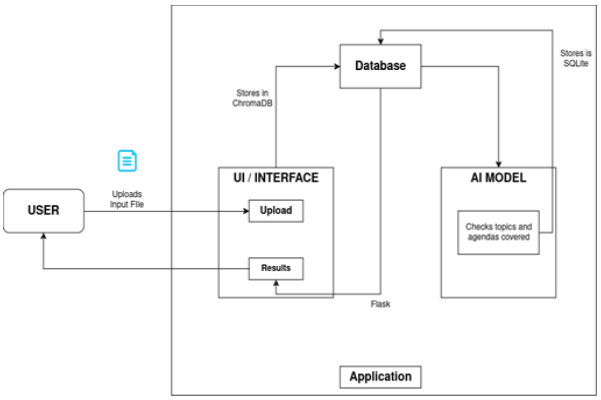

Figure 1.System Architecture

3.3 *Sequence Plan*
The Sequence Plan outlines the order in which different components and processes in the Meeting Manager Application are executed. It describes the interaction between the user, the system, and the various modules that make up the application, ensuring smooth functionality from meeting creation to post-meeting follow-up.
Meeting Creation and Preparation:

i. The user logs in and creates a meeting by entering details (title, date, participants) and uploading relevant documents. The system generates an agenda automatically based on user input or historical data.

Real-Time Meeting Management:

ii. During the meeting, the system transcribes discussions in real-time using NLP (Google's Gemini LLM), tagging key points, decisions, and action items. The agenda is tracked and updated dynamically.

Post-Meeting Summary and Action Item Tracking:

iii. After the meeting, the system generates a summary with key decisions and action items, which are assigned to participants. Notifications are sent for follow-up on action items, and their progress is tracked.

Document Retrieval and Search:

iv. Users can search past meeting content using ChromaDB for similarity-based document retrieval, making it easy to find relevant meeting notes, documents, or action items for future reference.

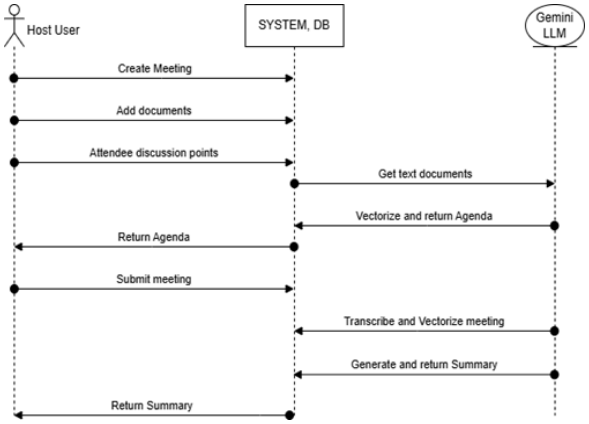

Figure 2 .Sequence Diagram

4. IMPLEMENTATION

4.1 Hardware Requirements

1. Processors: i3, i5, i7
2. RAM: 4GB, 6GB, 8GB, 16GB
3. Hard disk: 500 GB
4. Cameras for real-time processing

4.2 Software Requirements

1. Operating System: Windows 10 or Linux

2. Language: Python 8 or higher, NLP Libraries, Google Generative AI
3. IDE: VSCode
4. Database: SQlite, ChromaDB (Vector db)

4.3 Implementation Details

The Meeting Manager Application is implemented using a combination of web development technologies, machine learning techniques, natural language processing (NLP), and vector-based search systems to automate meeting management tasks. Below is a breakdown of the key components and technologies used in the implementation:

1.Web Framework and Front-End Development

- Flask: The application's backend is built using Flask, a lightweight Python web framework that facilitates the development of scalable web applications. Flask is used to handle HTTP requests, manage routes, and serve the web interface.
- HTML/CSS/JavaScript: The front-end is built using standard web technologies like HTML, CSS, and JavaScript, ensuring that the user interface (UI) is responsive and accessible. The UI includes pages for meeting creation, document uploads, agenda management, and viewing meeting summaries.

2.Database Management

- SQLAlchemy: For database management, SQLAlchemy is used as the ORM (Object-Relational Mapping) layer, which simplifies database interactions. It is used to manage meeting data, user accounts, documents, and action items. The database is structured to store:
  - Meeting details (title, date, participants)
  - Uploaded documents (linked to specific meetings)
  - Action items (tasks assigned to participants)
  - Transcriptions and summaries (generated after each meeting)

3. Natural Language Processing (NLP)

- Google's Gemini LLM: The core NLP functionality is powered by Google's Gemini Large Language Model (LLM). This model is used to automatically transcribe spoken content during meetings and summarize discussions. The LLM analyzes transcriptions to extract important points such as decisions, discussion summaries, and action items.
- Sentence Transformers: To generate text embeddings for document similarity, the system uses Sentence Transformers to convert text (e.g., meeting notes, action items, and documents) into high-dimensional vector representations. These embeddings are used to enable semantic search and similarity matching.

4.Vector Database and Similarity Search

- ChromaDB: The system utilizes ChromaDB, a vector database, to store and query the generated embeddings. ChromaDB allows the application to perform efficient similarity searches on meeting content, helping users quickly retrieve relevant documents, previous meeting summaries, or action items based on their query.
- Similarity Search: The embeddings of meeting notes and documents are stored in ChromaDB and can be queried to find semantically similar items. This functionality supports document retrieval and search across historical meeting data.

5.User Authentication and Access Control

- User Registration/Login: The application allows users to register and log in to access personalized meeting data. User credentials are securely stored using Flask-Login for session management and authentication. Role-based access control ensures that users have appropriate access rights to meeting information, documents, and action items.

6.Future Enhancements

- Real-Time Sentiment Analysis: Future versions of the application will incorporate real-time sentiment analysis to monitor participant engagement and mood during meetings. This can provide valuable insights for meeting effectiveness and improvement.
- Scalability: The system will be enhanced to support larger teams, more users, and a greater volume of meetings, with a focus on ensuring the application can scale to meet enterprise-level needs.

The Meeting Manager Application leverages modern

web technologies and AI tools to automate meeting management tasks. The application integrates Flask for the web interface, SQLAlchemy for database management, Google's Gemini LLM for transcription and summarization, and ChromaDB for similarity-based search. The system is designed to simplify meeting preparation, tracking, and follow-up, offering intelligent, automated insights through NLP and machine learning. Future enhancements will focus on improving scalability and adding advanced features like sentiment analysis

5. VLM PERFORMANCE

Multimodal Large Language Models (LLMs) are advancing rapidly, enabling the simultaneous processing of various data types such as text, images, and audio. These models are built to enhance performance across a wide range of tasks by interpreting and integrating multiple modalities, making them highly adaptable for real-world use cases.

To assess the effectiveness of multimodal LLMs, evaluations are typically based on several critical benchmarks, including:

- Accuracy: Measures how effectively the model handles traditional language tasks such as summarization, question answering, and sentiment detection.
- Inference Speed: Refers to the time required for the model to process input and produce results.
- Robustness: Assesses the model's resilience when working with noisy, incomplete, or conflicting data.
- Multimodal Integration: Evaluates the model's ability to synthesize and utilize information from multiple data types (e.g., text and visual content) to deliver coherent outputs.
- Scalability: Examines how well the model performs when managing large volumes of data or handling diverse inputs at scale.
- Task-Specific Performance: Focuses on specialized tasks such as cross-modal summarization, image-text retrieval, or video captioning to determine how effectively the model processes and fuses multimodal information.

Comprehensive Comparison

Feature	Claude 3	Gemini	GPT-4
Developer	Anthropic	Google	OpenAI
Model Sizes	Haiku, Sonnet, Opus	-	-
Training Data	Unknown	Unknown	Trained on online data up to Sept 2021
Benchmarks	Leads in MMLU, GPQA, GSM8K and others	Lags behind Claude 3	Trails Claude 3 Opus but GPT-4 Turbo leads
Coding	Excels with detailed explanations	Good	Good, but lacks details
Math Reasoning	Strongest with Opus model	Weaker than Claude 3	Weaker than Claude 3
Vision	On par, faster response times	Good, but ethical limits	On par with Claude 3
General Knowledge	Detailed scientific explanations	More general explanations	Detailed like Claude 3
Prompt Following	Opus leads, up to 10 logical outputs	Weaker than Claude 3	Up to 9 logical outputs
Multilingual	Unknown	Specialty, over 100 languages	Good, 25+ languages
Input Modalities	Text, images	Text, images, audio	Text, images, audio, video
Access	Free/paid tiers	Unknown	Paid OpenAI Plus subscription

Figure 3. Comparison of different LLMs

6. RESEARCH METHODOLOGY

The research methodology for developing the Meeting Manager Application involved a combination of software engineering practices, machine learning model integration, and user-centered design. The aim was to create a functional and scalable tool that automates various aspects of meeting management, such as transcription, summarization, agenda generation, and action item tracking. The methodology is divided into the following main stages:

1.Literature Review and Problem Identification

- Literature Review: A thorough review of existing meeting management tools, AI-powered meeting assistants, and multimodal language models (LLMs) was conducted to understand current capabilities and identify gaps. The literature review highlighted the need for more automated, integrated solutions that combine NLP, task management, and retrieval-based search.
- Problem Definition: From the literature review, the problem was identified as a lack of comprehensive meeting tools that can handle multiple meeting tasks autonomously. The objective was to design a system that reduces manual effort and improves meeting productivity through automation.

2.System Design and Architecture Development

- Requirement Gathering: Functional requirements (such as transcription, agenda generation, and action item tracking) were outlined based on

common needs in corporate and team-based meeting scenarios. Non-functional requirements, like scalability, robustness, and user accessibility, were also considered.

- Architecture Design: The system's architecture was developed to support integration between various components:
  - A Flask-based backend for handling data and serving the application.
  - SQLAlchemy for database management.
  - ChromaDB for storing embeddings and enabling similarity-based retrieval.
  - Google's Gemini LLM for transcription, summarization, and NLP-based task automation.
- User Interface Design: A user-centered design approach was adopted to ensure the application is easy to use, especially for scheduling, viewing, and managing meetings.

3.Implementation of Machine Learning and NLP Components

- Model Selection: The Gemini LLM was chosen for transcription, summarization, and action item extraction due to its high performance on multimodal tasks. Sentence Transformers were utilized for generating embeddings, which are essential for the similarity search functionality.
- Integration of NLP and Database Components: The NLP model was integrated with SQLAlchemy and ChromaDB to store and retrieve meeting notes, agendas, and action items based on semantic similarity.
- Real-Time Data Processing: Real-time transcription and action item extraction capabilities were developed to automate agenda tracking and follow-up actions during and after meetings.

The research methodology for the Meeting Manager Application combines the principles of software engineering, machine learning, and NLP with iterative testing and user-centered design. This approach ensures the final product is both technically robust and user-friendly, meeting the needs of modern, AI-powered meeting management.

7. CONCLUSION

The development of the Meeting Manager Application illustrates how AI-powered solutions can revolutionize traditional meeting management by automating and optimizing key tasks like transcription, agenda creation, and action item tracking. By leveraging cutting-edge technologies such as Google's Gemini Large Language Model for natural language processing, ChromaDB for efficient embedding storage and retrieval, and a robust Flask-based backend, the application dramatically reduces the manual workload typically involved in organizing and documenting meetings. It successfully achieves its primary objectives of boosting meeting productivity and minimizing administrative overhead by offering an end-to-end, integrated workflow platform.

The inclusion of multimodal LLM capabilities—specifically transcription and summarization—enables the application to deliver precise, context-rich meeting records, making it an invaluable resource for corporate teams and collaborative environments. Additionally, the use of similarity search via embeddings stored in ChromaDB allows users to efficiently retrieve relevant meeting materials and previously assigned action items, improving access to information across multiple sessions. This feature strengthens decision-making processes and ensures continuity in long-term projects, highlighting the real-world impact of AI-enhanced meeting solutions.

Looking ahead, the application is well-positioned for future growth. Planned enhancements include integrating real-time sentiment analysis to provide deeper insights into participant engagement, expanding multi-user collaboration features, and enabling more scalable deployment options. As advances in NLP and machine learning continue, the system is poised to support increasingly complex meeting dynamics and accommodate larger user groups, driving even greater improvements in efficiency and accuracy for modern meeting management.

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