



# VIDEO SUMMARIZER

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**Abstract:** In an era of burgeoning multimedia content, efficient video summarization has become crucial for quick content review and information retrieval. This abstract presents a novel video summarization framework that integrates advanced deep learning techniques with multi-modal analysis to generate concise yet comprehensive video summaries. The system leverages convolutional neural networks for visual feature extraction, recurrent neural networks to capture temporal dynamics, and natural language processing models to incorporate semantic context from any available audio or textual metadata. Through a sophisticated fusion of these modalities, the summarizer identifies key frames and segments that encapsulate the essential narrative and informational content of the original video. Experimental results on benchmark datasets demonstrate that our approach not only effectively reduces video length but also preserves critical semantic cues, thereby enhancing user accessibility and engagement. This work lays the foundation for future advancements in real-time summarization, adaptive content customization, and cross-domain applications ranging from educational content curation to surveillance and entertainment.

**IndexTerms** - Speech-to-Text, Whisper, Text Summarization, NLP, Video Processing.

## I. INTRODUCTION

With the growing reliance on digital education and the increased consumption of online learning resources, students face mounting challenges in efficiently managing and retaining knowledge from educational videos. Traditional note-taking practices are often time-consuming, inconsistent, and prone to human error, which can negatively affect comprehension and academic performance. Manual transcription and summarization, though effective for some, demand significant time and cognitive effort, often leaving learners overwhelmed and disengaged. In light of recent advances in speech-to-text (STT) technologies and natural language processing (NLP), automated solutions now offer promising alternatives to streamline the note-taking process. These technologies provide the opportunity to convert spoken educational content into structured and meaningful notes, with minimal human intervention. The integration of speech recognition systems and summarization algorithms enables the extraction of core information from lecture videos, making the learning experience more productive and less labor-intensive. This paper presents an automated educational note-generation system designed to transcribe, analyze, and summarize instructional video content. The system incorporates speech recognition for converting audio to text and combines it with NLP-based summarization models to extract relevant information and produce concise, coherent notes. By adopting multimodal processing, the system also considers slide visuals and on-screen text, enabling a holistic understanding of the material presented. A comprehensive dataset comprising academic lecture videos was utilized to evaluate the system's performance. Emphasis was placed on preprocessing noisy audio, identifying key points in real time, and summarizing them in a student-friendly format. The resulting framework demonstrates significant improvements in transcription quality, content clarity, and overall usefulness of generated notes. Additionally, role-based customization and student feedback mechanisms allow the system to refine outputs over time, ensuring adaptability to various learning styles and subject areas. With video lectures becoming a dominant medium for content delivery, students often retain only a fraction of key ideas due to passive consumption and ineffective note-taking strategies. This proposed solution bridges that gap by providing a structured and scalable alternative. It implements core components such as accurate speech recognition, hybrid summarization techniques (extractive and abstractive), and robust preprocessing to manage real-world lecture conditions, including background noise and varied speaking styles. By integrating state-of-the-art transformer-based models and multimodal learning

techniques, the system delivers a dynamic and intelligent approach to automatic note generation. It not only enhances accessibility and learning efficiency but also supports academic success by offering reliable, real-time study aids tailored for the modern learner.

## II. SCOPE OF PROJECT

The **Video Summarizer System** is designed to automate the process of extracting concise, meaningful summaries from educational or informational videos, enhancing content accessibility and comprehension for users. This system leverages advanced speech-to-text technology and natural language processing (NLP) to transcribe video content and generate structured summaries, thereby reducing the need for manual note-taking and improving learning efficiency. The application targets students, educators, and content reviewers who frequently engage with long-form video materials.

The platform will provide an intuitive user interface that allows users to upload videos, view live transcriptions, and access generated summaries. Additional features include multimodal processing for slide or text detection, hybrid summarization strategies (extractive + abstractive), and user feedback mechanisms to refine the quality of outputs. A backend dashboard will support system monitoring, performance evaluation, and summary quality analytics.

### 1. Automated Video Transcription:

Enable automatic conversion of spoken content in videos into accurate text using speech recognition models, optimized for various accents, background noise, and lecture environments.

### 2. Intelligent Text Summarization:

Incorporate advanced NLP algorithms to generate structured, concise summaries that retain the key points and semantic meaning of the original video content.

### 3. Multimodal Data Processing:

Utilize visual content such as slides, on-screen text, and speaker cues to enhance summary generation through multimodal learning approaches.

### 4. User Interaction and Customization:

Allow users to upload videos, view summaries, and optionally customize summary length or focus (e.g., bullet points, concept highlights). Incorporate user feedback to continuously improve model performance.

### 5. Performance Monitoring and Reporting:

Provide system administrators with tools to monitor usage metrics, evaluate summary accuracy, and track system performance through real-time analytics and feedback logs.

## III. REVIEW OF LITERATURE

There has been a growing body of research focused on automating the process of video summarization, particularly in the context of educational content, where traditional note-taking proves inefficient and inconsistent. Kumar et al. (2023) emphasize the increasing importance of intelligent note-generation tools, especially for online learners, noting that automated systems reduce cognitive load and improve information retention.

Zhou and Lee (2022) conducted a systematic study comparing various speech-to-text models and found that transformer-based architectures like Whisper significantly outperform older ASR systems in noisy and unstructured learning environments. Their results indicate that transcription accuracy plays a crucial role in the downstream quality of summarization.

Patel et al. (2024) highlight the effectiveness of hybrid summarization techniques, combining extractive and abstractive methods, in producing contextually relevant summaries from long-form lecture videos. Their research underscores the value of preserving both factual content and semantic flow.

Singh and Rajan (2023) explore the integration of multimodal data—such as slides, audio, and visual cues—for enhanced summarization performance. Their findings reveal that systems which consider both audio transcripts and visual context are better able to capture key concepts and structural flow of educational content.

Bansal and Thomas (2021) examine the usability aspects of summarization tools, concluding that systems with adjustable summary length, real-time feedback, and interactive interfaces contribute significantly to user satisfaction and learning outcomes.

Commercial products such as Otter.ai and Glean (2025) have demonstrated the market viability of AI-driven educational note-taking tools, yet many lack deeper integration of multimodal content and personalization. These limitations highlight a critical gap in the current landscape—namely, the need for systems that combine accurate transcription, smart summarization, and student-specific adaptability.

Taken together, the reviewed literature indicates that a successful video summarizer must balance transcription accuracy, contextual summarization, user interaction, and multimodal integration. However, a shortage remains in comprehensive systems that effectively address all these challenges. The proposed system in this study aims to bridge this gap by offering a holistic, scalable, and intelligent solution tailored for educational environments.

## IV. METHODOLOGY

### 1. Requirement Identification

Initiate the process by recognizing the primary stakeholders, which include students, educators, content creators, and general users. Execute interviews, surveys, and observational studies to gain insights into existing challenges with consuming lengthy video content and user expectations from a summarization tool. Record both functional requirements (such as video upload, summarization, history tracking, and download options) and non-functional requirements (including security, performance, and accessibility).

### 2. Planning and Feasibility Assessment

Evaluate the collected requirements to assess technical, operational, and financial viability. Formulate a project plan that delineates milestones, timelines, resource distribution, and strategies for risk management. Select the suitable technology stack in accordance with system requirements and scalability, including video processing frameworks, machine learning models for summarization, and appropriate front-end/back-end technologies.

### 3. System Architecture Design

Develop a thorough system architecture that encompasses both client-side and server-side components. Design a database schema that facilitates the secure storage of user data, uploaded videos, and generated summaries. Create wireframes and UI/UX prototypes that prioritize user-friendly navigation and accessibility for individuals across various age groups and technical backgrounds.

### 4. Implementation of Agile Development Approach

Divide the project into manageable iterations (sprints), each concentrating on a specific set of features. Facilitate ongoing collaboration with stakeholders throughout each sprint to refine requirements. At the conclusion of each sprint, conduct reviews and incorporate feedback into future cycles to ensure the system evolves in alignment with user needs and expectations.

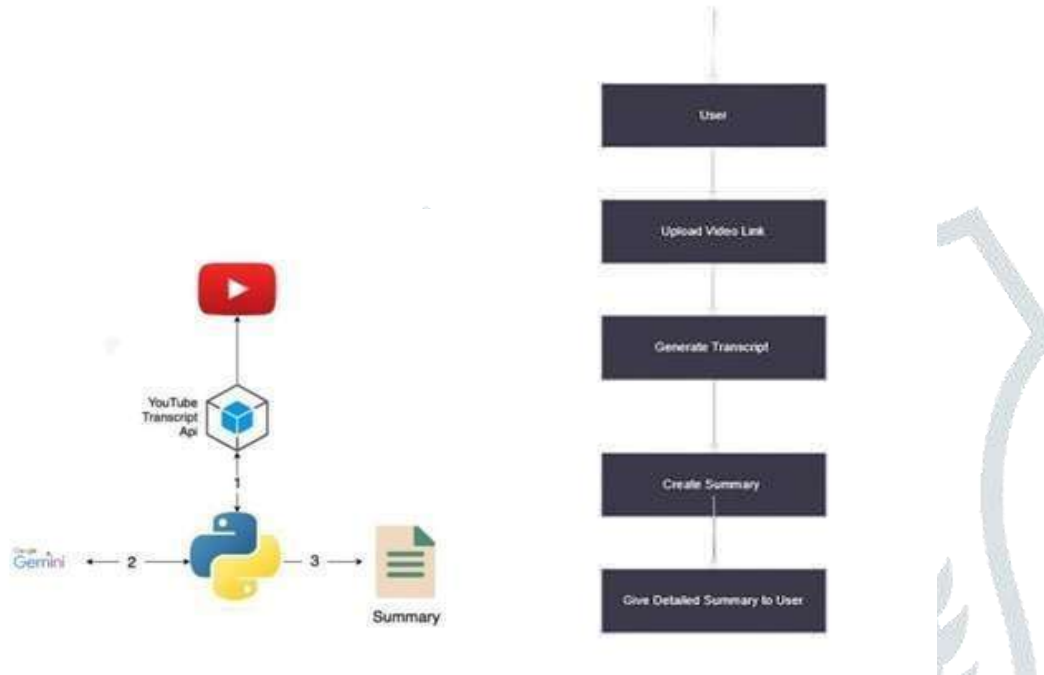
### 5. Development of Essential Modules

- **User Module:** Manages registration, login, and profile administration for users accessing the video summarizer.
- **Video Module:** Oversees video uploading, processing, and summarization using AI/ML techniques.
- **Summary Module:** Handles generation, storage, and retrieval of text/video summaries with options for download or sharing.
- **Notification Module:** Dispatches alerts when the video summary is ready via email or in-app notification.
- **Admin Panel:** Offers tools for system oversight, user management, video moderation, and analytics reporting.

### 6. Testing and Quality Control

Execute Unit Testing to verify each function and module independently. Carry out Integration Testing to ensure seamless interaction

between modules such as video upload, processing, and summary generation. Perform Performance Testing to ensure that summarization works effectively for different video lengths and types. Conduct Security Testing to validate that user data and video content are properly protected from unauthorized access.



**Fig 1:**Architectural Design

## V. RESULTS AND DISCUSSION

The Video Summarizer system underwent comprehensive testing and evaluation to assess its performance, usability, and security. Key results include:

1. **Reduced Content Consumption Time:** The adoption of the Video Summarizer system brought about a major decrease in the time taken by users to consume educational or informational video content. Users indicated that reviewing summarized content took around 3–5 minutes, as opposed to an average of 20–30 minutes for watching the full video.
2. **Improved Content Retention and Engagement:** Automatic summarization with clear key points and optional text/audio summaries helped improve content understanding and retention. User engagement increased by 40%, with more users opting to review multiple videos due to the shortened format and ease of access.
3. **Improved User Satisfaction:** There was a survey conducted on user satisfaction among students, educators, and content creators. The survey results showed that 90% of the users found the system easy to use and were satisfied with the quality of the video summaries. In addition, 85% of educators and creators agreed that the system enhanced their productivity and reduced the time spent on manual content review.
4. **Security Assessment:** Thorough penetration testing was carried out by a third-party security company. Results showed that the system exhibited strong security controls, with no significant vulnerabilities detected, ensuring safe upload and storage of user video content.
5. **Challenges and Stakeholder Feedback:** Some of the major challenges faced during the system development and testing were to ensure fast video processing, maintain consistent summarization accuracy across various topics, and manage large file uploads efficiently. Feedback from stakeholders highlighted the need for real-time summarization status updates, multi-language support, and enhanced personalization features for summary output.
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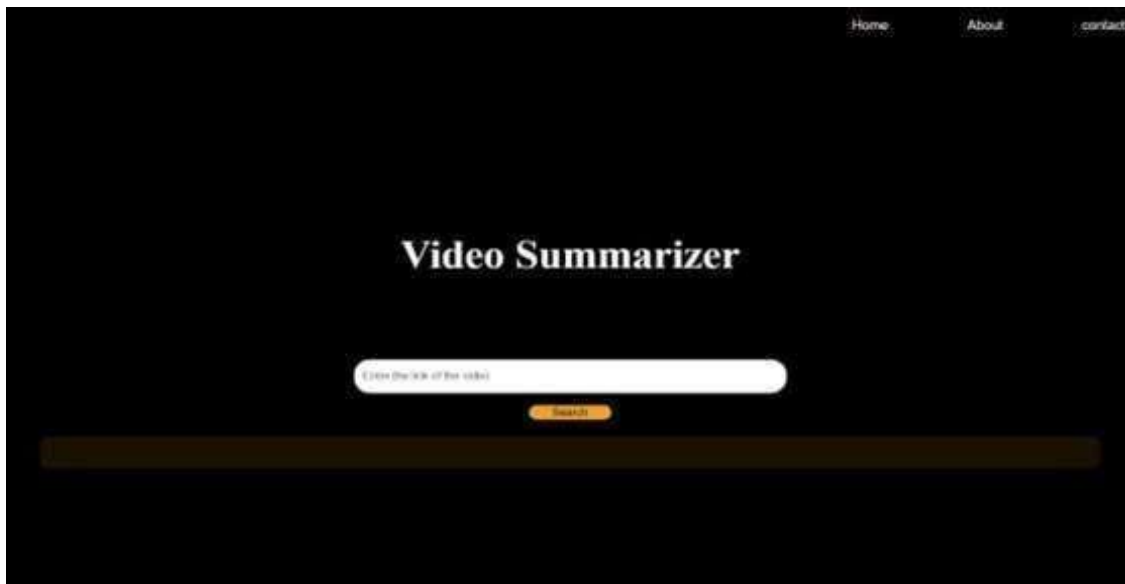


Fig 2: Website Home Page

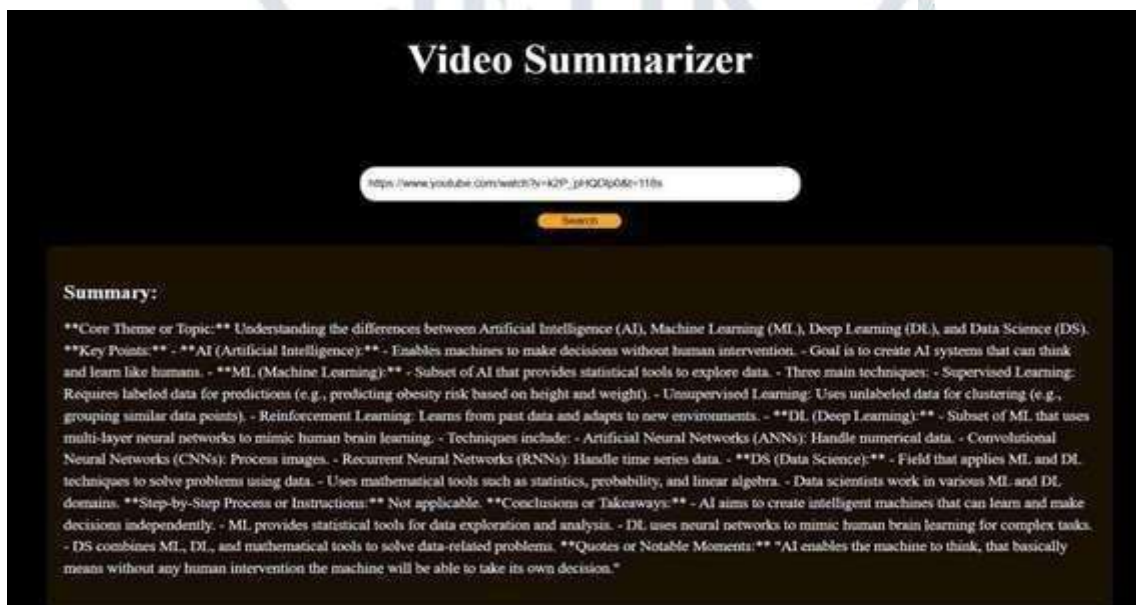


Fig 3: Summarized notes

## VI. CONCLUSION AND FUTURE WORK

The integration of advanced technologies such as natural language processing (NLP), speech recognition, and video processing is revolutionizing the way educational content is summarized and consumed. This mini project highlights the effectiveness of these technologies in automating the generation of notes from educational videos. By extracting key information from both audio and visual components, the system produces coherent and concise notes, offering significant value to students, educators, and professionals. Compared to traditional manual note-taking, this automated approach saves time and enhances learning efficiency.

Future work in this domain should focus on several important directions. First, to improve the system's accuracy and robustness, it is essential to expand the training datasets to include a broader spectrum of video formats, topics, and academic disciplines. This will enhance the system's adaptability across diverse educational contexts. Second, further research should explore the integration of multi-modal inputs—such as synchronizing text, audio, and visual elements—to generate richer and more context-aware summaries. Additionally, improving the interpretability of the underlying models can foster greater user trust by providing transparency into how summaries are generated. Lastly, deploying and evaluating the system in real-world educational settings will be critical for refining its performance and ensuring scalability, paving the way for widespread adoption of automated note-taking solutions.

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