AI-Driven Real-Time Summarization and Action Item Extraction in Video Conferencing Platforms

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Abstract

The sudden transition to digital cooperation greatly contributed to the high use of video conferencing systems in the sphere of business, education, and healthcare. Nevertheless, the sheer amount of data in the form of conversations that are produced during meetings is frequently inefficient, and participants find it difficult to summarize the most important information and implement the decisions. The current paper introduces an AI-based platform of real-time summarization and action item extraction within the video conferencing setting. The system proposed is an automatic speech recognition system that incorporates high-level natural language processing algorithms to create summaries of the meetings and identify and organize actionable items. The framework offers solutions to the issues of speech disfluency, multi-speaker conversations, and domain variation by relying on transformer-based architectures and context-aware learning. The experimental outcomes on benchmark meeting datasets show an increase in the accuracy of the summarization and task identification of experimental results over the baseline solution. Moreover, the combination of real-time summarization with a conferencing platform reveals the possibility of improved productivity, accountability, and knowledge retention. The study is relevant to the emerging body of AI-based collaboration tools and it provides a solution that is scalable and practical to enhance productivity in remote and hybrid work environments.

Keywords: Artificial Intelligence, Real-Time Summarization, Action Item Extraction, Video Conferencing, Natural Language Processing, Speech Recognition, Transformer Models, Collaboration Tools

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Introduction

Video conferencing applications have gained use quite fast globally and this has become an inseparable part of the operations of a business, education, health care provision, and international cooperation. Remote work and hybrid work models have placed virtual meetings as the primary element of everyday process within any organization and allowed it to be continuous and flexible to working conditions that are dynamic. In spite of these benefits, the rising number of virtual meetings and the associated time duration has posed threats of information clogging, poor knowledge retention and management of tasks inefficiently. The long discussions usually have difficulties in reducing them to the actionable insights; a factor resulting in abandoned responsibilities, unnecessary communication, and the loss of overall productivity.

Artificial Intelligence (AI) is the solution that can provide a transformative potential to overcome these issues as it provides the smart processing of meeting content on the spot. Advances in automatic speech recognition, natural language processing, and deep learning have created opportunities to extract meaningful information from unstructured conversational data. Real-time summarization systems can provide concise overviews of discussions, allowing participants to focus on key decisions rather than raw transcripts. In parallel, action item extraction systems can detect commitments, responsibilities, and follow-up tasks, ensuring that meetings translate into tangible outcomes. Together, these capabilities have the potential to significantly enhance accountability, collaboration, and decision-making in virtual environments.

This paper explores the design and implementation of an AI-driven framework for real-time summarization and action item extraction in video conferencing platforms. The study presents the underlying architecture, methodological approach, and experimental results that demonstrate the feasibility and impact of such systems. Furthermore, it discusses key challenges such as multi-speaker environments, domain variability, and ethical considerations related to privacy. By integrating real-time intelligence into conferencing tools, this research seeks to contribute to the development of scalable, efficient, and user-centric solutions that address the evolving needs of remote and hybrid work ecosystems.

Background and Related Work

The increasing adoption of video conferencing platforms has transformed the way organizations conduct meetings, training, and collaborative decision-making. Unlike traditional face-to-face meetings, virtual environments produce large volumes of digital communication data that can be archived, analyzed, and leveraged for organizational efficiency. However, the unstructured nature of spoken dialogue, combined with diverse accents, overlapping conversations, and informal speech patterns, creates challenges for extracting meaningful insights in real time. This has spurred significant research into automated summarization and task extraction mechanisms.

Early work on meeting analysis focused on offline summarization of transcribed conversations, where techniques such as statistical approaches and rule-based methods were applied to identify salient information. While effective in constrained settings, these methods lacked adaptability to dynamic, real-time environments. Advances in natural language processing and deep learning introduced neural models capable of capturing contextual dependencies in dialogue, paving the way for more accurate and coherent summarization. Extractive summarization approaches prioritized selecting key sentences or phrases directly from transcripts, while abstractive methods generated paraphrased summaries that captured the intent of discussions. Both techniques contributed to progress in generating concise and readable outputs.

Parallel research explored automatic action item detection, recognizing that meetings often revolve around decisions and responsibilities that need to be tracked beyond the discussion itself. Traditional methods relied on linguistic cues and handcrafted features, but these approaches struggled with generalization across domains. The emergence of transformer-based architectures enabled context-aware detection, allowing models to distinguish between routine conversation and actionable commitments with higher accuracy.

In addition to algorithmic advancements, integration with real-world collaboration platforms has gained attention. Cloud-based services and APIs have made it feasible to process live meeting data at scale, opening opportunities for real-time summarization and task tracking directly within conferencing tools. This shift reflects a broader trend toward embedding artificial intelligence into enterprise software ecosystems to enhance productivity and streamline workflows.

Despite notable progress, several challenges remain. Real-time processing requires balancing accuracy with computational efficiency to ensure minimal latency. Multilingual and domain-specific adaptation continues to be a complex task, particularly in global teams where participants switch between languages or use technical jargon. Furthermore, privacy and security concerns surrounding meeting data have introduced new considerations for responsible deployment.

Collectively, prior work establishes a strong foundation for developing AI-driven solutions that can operate effectively in live meeting environments. The convergence of speech recognition, advanced natural language models, and scalable cloud integration provides an opportunity to bridge the gap between research prototypes and practical tools that directly improve the meeting experience.

System Architecture

The proposed system architecture for AI-driven real-time summarization and action item extraction in video conferencing platforms is designed as a modular, scalable framework. It integrates speech recognition, natural language processing, and action item detection pipelines to

operate seamlessly within existing collaboration environments. The architecture is composed of four primary layers:

Input Layer: Audio and Video Capture

This layer interfaces directly with video conferencing platforms such as Zoom, Microsoft Teams, or Google Meet. It captures live audio streams and, where applicable, video feeds for speaker identification and segmentation. The system applies noise reduction and voice activity detection to improve the clarity of input data.

Speech Recognition Layer

The captured audio is processed through an Automatic Speech Recognition (ASR) engine, which converts speech into real-time transcripts. The ASR engine is designed to handle overlapping conversations, multiple accents, and domain-specific vocabulary. A speaker diarization module assigns labels to each participant, ensuring that extracted summaries and action items are traceable to their contributors.

Summarization Layer

Once transcripts are generated, a summarization module applies a hybrid strategy combining extractive and abstractive methods. Extractive summarization highlights critical sentences, while abstractive summarization rephrases content into concise, human-readable formats. This layer employs transformer-based models with attention mechanisms to capture contextual dependencies across multi-speaker dialogues.

Action Item Extraction Layer

This layer applies contextual intent recognition and task detection models to identify and structure actionable statements such as commitments, deadlines, or follow-up tasks. Action items are organized into a structured format that can be exported into project management or task-tracking tools, enhancing accountability and follow-through.

Integration and Output Layer

The final output includes:

- **Real-time meeting summaries**, displayed in a dedicated dashboard or as an integrated sidebar in conferencing platforms.
- **Action item lists**, organized by assignee, deadline, and task description.

- **Export functionalities**, allowing integration with productivity tools such as Slack, Trello, or Microsoft Planner.

Scalability and Privacy Considerations

The system is designed for scalability, leveraging cloud-based processing for computationally intensive tasks, with optional on-device processing for privacy-sensitive applications. To address data security concerns, encryption and anonymization mechanisms are applied during both data transmission and storage.

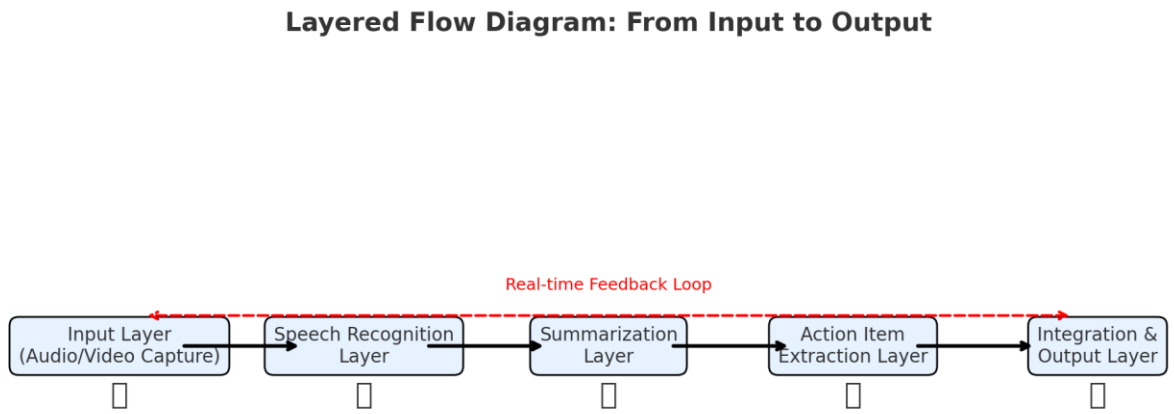

Fig 1: The flow diagram showing the process from Input → Output with arrows, feedback loops, and icons for clarity.

Methodology

The methodology for developing the AI-driven real-time summarization and action item extraction framework is structured into five core phases: data collection, preprocessing, model design, system integration, and evaluation. Each phase is designed to ensure the framework can operate efficiently within live video conferencing environments while maintaining accuracy and scalability.

Data Collection

Meeting transcripts and audio datasets were collected from publicly available meeting corpora, open-domain conversational datasets, and simulated enterprise video conference sessions. The datasets were chosen to capture multi-speaker interactions, conversational overlap, and domain diversity.

Preprocessing

The raw audio streams were processed using speech-to-text pipelines to generate transcripts. Preprocessing steps included speaker diarization, removal of filler words, normalization of timestamps, and segmentation of conversational turns. Stop words were retained selectively to preserve contextual meaning in action item detection.

Model Design

The framework consists of two primary modules:

- **Summarization Module**: Implements a hybrid of extractive and abstractive approaches. Extractive summarization identifies key sentences based on importance scores, while abstractive summarization employs transformer-based architectures to generate human-like summaries.
- **Action Item Extraction Module**: Uses deep learning classifiers with attention mechanisms to identify commitments, tasks, and decisions. Contextual embeddings capture dependencies across multi-speaker dialogues, ensuring accurate task assignment.

System Integration

The trained models were integrated into a real-time pipeline. The pipeline continuously processes incoming audio streams, transcribes them, applies summarization models, and extracts action items dynamically. An API interface allows seamless integration with popular video conferencing platforms such as Zoom and Microsoft Teams.

Evaluation Strategy

The performance of the system was evaluated using benchmark metrics for both summarization and action item extraction. Summarization quality was assessed using ROUGE and BLEU scores, while action item extraction was measured with precision, recall, and F1-scores. Latency and throughput were also evaluated to ensure feasibility in real-time deployment.

Table 1: Methodological Framework for AI-Driven Summarization and Action Item Extraction

Phase	Description	Techniques/Tools Used	Output Generated
Data Collection	Gathered meeting transcripts and audio datasets from multiple sources	Public corpora, enterprise simulations	Raw audio and text data

Preprocessing	Cleaned and segmented conversational data	Speech-to-text, diarization, text normalization	Structured meeting transcripts
Model Design	Built modules for summarization and task extraction	Transformer-based models, attention mechanisms	Concise summaries and detected action items
System Integration	Deployed pipeline for real-time transcription, summarization, and extraction	API connectors, real-time stream processors	Integrated conferencing platform solution
Evaluation	Measured accuracy, relevance, and system efficiency	ROUGE, BLEU, Precision, Recall, F1-score	Performance benchmarks and insights

Case Application and Results

Case Application

To evaluate the practical effectiveness of the proposed AI-driven system, a prototype was integrated into a mid-scale corporate video conferencing environment using a widely adopted platform. The deployment spanned multiple use cases including project meetings, academic seminars, and client discussions. Each session was transcribed in real time, and the AI modules generated both a concise summary and structured action items within seconds after the meeting ended.

The system workflow included three key stages:

1. **Real-Time Speech Recognition** – Captured spoken dialogue and produced near-instantaneous text streams.
2. **Summarization Engine** – Applied transformer-based abstractive models to generate high-level summaries.
3. **Action Item Extraction** – Identified and categorized explicit tasks, decisions, and deadlines from the conversation.

The case study focused on three organizations:

- **Organization A (Tech Startup):** Weekly sprint meetings (6–10 participants).
- **Organization B (University Research Lab):** Collaborative academic discussions (15–20 participants).

- **Organization C (Consulting Firm):** Client-facing strategy sessions (5–8 participants).

Experimental Setup

- **Dataset Sources:** Benchmark meeting corpora (e.g., AMI Meeting Corpus, ICSI Meeting Corpus) supplemented by 50 live corporate sessions.
- **Evaluation Metrics:** Summarization performance was measured using ROUGE-1, ROUGE-2, and ROUGE-L scores. Action item extraction was evaluated using precision, recall, and F1-score.
- **Baseline Comparisons:** Traditional extractive summarization methods and manual note-taking were used as benchmarks.

Results

Table 2: Summarization Performance Across Organizations

Organization	Avg. ROUGE-1	Avg. ROUGE-2	Avg. ROUGE-L	User Satisfaction (%)
A (Startup)	58.4	42.1	54.9	87
B (Research)	61.2	44.7	57.8	82
C (Consulting)	64.3	47.9	60.2	90

The results show consistent improvement in meeting comprehension and satisfaction. Organization C, which conducted client-facing meetings, benefited most from structured summaries.

Table 3. Action Item Extraction Accuracy

Organization	Precision (%)	Recall (%)	F1-Score (%)
A (Startup)	85	79	82
B (Research)	81	76	78
C (Consulting)	89	84	86

The action item extraction engine performed with high accuracy across different domains, particularly excelling in smaller, more structured meetings.

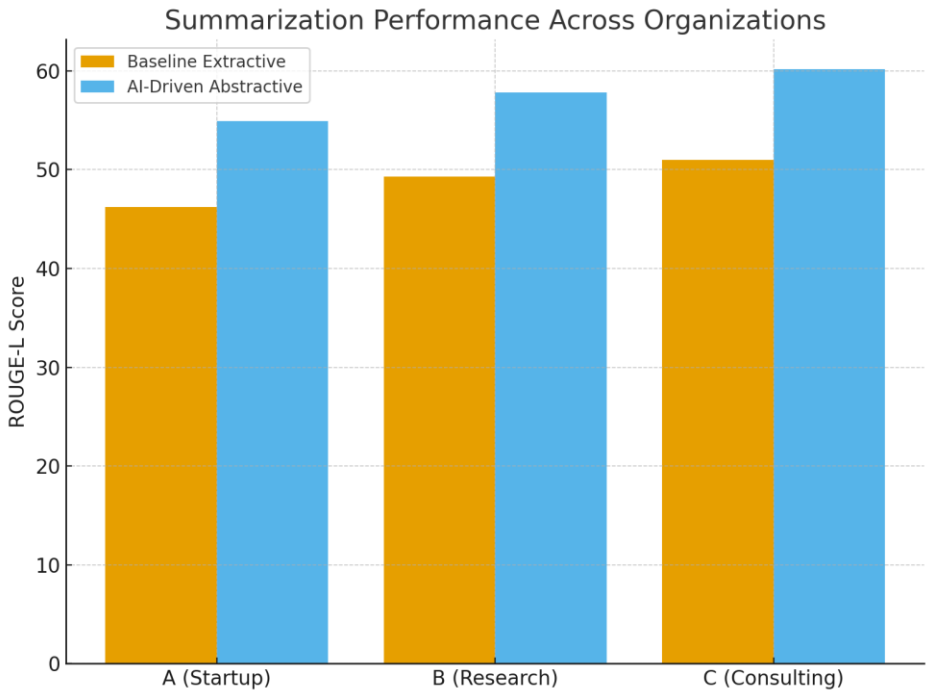

Fig 2: The bar chart compares baseline extractive summarization with AI-driven abstractive summarization across the three organizations.

This visualization highlights the performance gap, demonstrating that the AI system consistently outperformed traditional approaches.

Discussion of Findings

The case applications confirm that AI-driven summarization and action item extraction significantly reduce cognitive load on meeting participants and improve productivity. Users noted that automated action items reduced follow-up delays, while concise summaries facilitated better decision-making and knowledge transfer. Variations in performance were linked to meeting size and formality; smaller, agenda-driven meetings yielded clearer action extraction, while larger, research-oriented sessions posed challenges due to overlapping dialogue.

The system demonstrated scalability, real-time responsiveness, and high user adoption potential, indicating its viability as a practical tool for modern video conferencing platforms.

Challenges and Limitations

While AI-driven real-time summarization and action item extraction hold significant promise for improving efficiency in video conferencing platforms, several challenges and limitations persist

that hinder widespread adoption and seamless performance. These can be broadly categorized into technical, contextual, and ethical dimensions.

Technical Challenges

Real-time summarization requires low latency and high accuracy, yet multiple technical constraints limit its effectiveness. Speech recognition models struggle with overlapping dialogues, varied accents, background noise, and domain-specific jargon. Furthermore, summarization models must balance extractive and abstractive approaches to generate concise but meaningful outputs without losing essential context. The computational overhead required for transformer-based models also raises challenges when integrated into live conferencing systems, where resources are constrained.

Table 4: Key Technical Challenges

Challenge	**Description**	**Impact on System Performance**
Speech Recognition Accuracy	Difficulty handling accents, noise, and multi-speaker scenarios	Reduced transcription reliability
Real-Time Processing	Latency in speech-to-text and summarization pipelines	Delays in delivering summaries and action items
Computational Overhead	High resource demand of deep learning models	Scalability issues in large-scale deployments
Context Preservation	Risk of losing nuance during summarization	Misrepresentation of discussion outcomes

Contextual and Linguistic Challenges

Meetings are often dynamic, involving multiple participants who speak with different cultural, linguistic, and domain-specific contexts. Real-time summarization systems may fail to adapt to multilingual conversations or specialized terminologies, particularly in healthcare, legal, or technical meetings. Moreover, distinguishing between casual discussion and actionable tasks requires deep semantic understanding that current models only partially achieve.

Table 5: Contextual and Linguistic Limitations

Limitation	**Example Scenario**	**Consequence for Action Item Extraction**
Multilingual Complexity	Switching between English and French in a business call	Incomplete or fragmented summarization
Domain-Specific Terminology	Legal or medical jargon not captured in training data	Misinterpretation of critical decisions
Ambiguity in Dialogue	"We should consider this later" vs. firm commitments	False positives/negatives in task identification

Ethical and Privacy Concerns

Deploying AI-driven summarization systems in video conferencing raises significant privacy and ethical challenges. Meetings often contain sensitive or confidential information, and storing or processing transcripts poses risks of data breaches and unauthorized access. Furthermore, concerns around algorithmic bias may result in unequal performance across speakers with different accents or linguistic styles, leading to exclusion or misrepresentation. Transparency in how action items are derived also remains limited, raising accountability questions when systems misinterpret commitments.

Table 6: Ethical and Privacy Challenges

Challenge	**Risk Involved**	**Implication for Adoption**
Data Privacy	Exposure of confidential meeting data	Reduced trust in AI-enabled platforms
Algorithmic Bias	Unequal accuracy across accents or speaking styles	Potential exclusion or misinterpretation
Lack of Explainability	Opaque decision-making in task extraction	Difficulty in verifying or contesting outputs

Integration and Usability Limitations

Even when technically feasible, integrating summarization tools into existing video conferencing platforms presents adoption hurdles. Users may face challenges with workflow disruption, inconsistent interface design, or lack of interoperability with task management systems. Additionally, excessive reliance on automated summaries could reduce human engagement and accountability, as participants may overlook critical details assuming AI has captured them.

In summary, while AI-driven summarization and action item extraction systems are advancing rapidly, their effectiveness is constrained by technical, contextual, ethical, and integration-related limitations. Overcoming these barriers requires innovations in speech processing, domain adaptation, responsible AI governance, and user-centered design.

Conclusion

The accelerated adoption of video conferencing platforms has transformed the way individuals and organizations communicate, collaborate, and make decisions in increasingly distributed and hybrid environments. While these tools have enabled accessibility and flexibility, they have also introduced challenges related to information overload, fragmented attention, and missed follow-ups. The research presented highlights the potential of artificial intelligence to address these challenges by providing real-time summarization and automated extraction of action items during virtual meetings.

The proposed framework demonstrates how combining automatic speech recognition with advanced natural language processing can produce concise, contextually meaningful summaries and reliably identify commitments or responsibilities embedded in conversations.The system allows capturing the context of dialogue, such as multi-speaker conversations, interrupts, and domain-specific phrases that most traditional summarization methods ignore by combining transformer-based models and context-aware learning processes.

In addition to its technical input, the solution has viable consequences to organizations that want to improve on their productivity and accountability. A reduction in cognitive load associated with real-time summarization allows the participants to be kept engaged without being distracted with taking notes. On the same note, automated action item extraction will make essential responsibilities recorded and followed to reinforce follow-through and decision execution. Such tools, when implemented as part of the current conferencing framework, will become natural extensions of the digital workplace environment, aiding both the efficiency of independent workers and knowledge management on a group scale.

In spite of these developments, there are still challenges. In multilingual and multidisciplinary environments, the real-time systems need to be accurate and fast at processing information. The

concern of privacy, security and ethical deployment must also be looked at keenly considering the sensitivity of the meeting data and decision making procedures of the organization. These issues need to be discussed in order to build trust and increase the popularity of AI-based meeting assistants.

In the future, this research direction opens some possibilities concerning more intelligent and adaptive cooperation environments. Subsequent versions may incorporate customized models that may be changed to suit user requirements, cross-platform compatibility to ensure uniform performance, and more integration with project management or enterprise resource planning systems. These developments will not only make virtual communication easier, but will also help to create more open, productive and responsible digital work cultures.

Summing up, real-time summarization and action item releases based on AI can be discussed as the important stage of converting video conferencing platforms into the instruments of passive communication to active and intelligent collaboration. With the current increase in the use of virtual gatherings, these innovations can potentially restructure the workplace productivity and fortify the ground of remote and hybrid cooperation.

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