

# ABSTRACTIVE SUMMARIZATION & AUTOMATED **MINUTES OF MEETING** FOR VIRTUAL MEETINGS



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# INTRODUCTION



For professional meetings, it is common practice to produce minutes of meeting which get distributed to the participants containing information on meeting agenda, attendee list and action item list with task owner names and deadlines



The aim is to automate the process of producing minutes of meeting and summary (gist) with the help of AI and Deep Learning.



The audio from meeting recording will be converted to text using a unique approach consisting of Speech Accent detection model, which will detect accent of speaker and transcribe their audio accordingly improving the Speech to Text model's accuracy



The transcript summarization task will be done by BART pre-trained model for abstractive summarization, fine-tuned using meeting summary datasets like AMI and ICSI corpus.



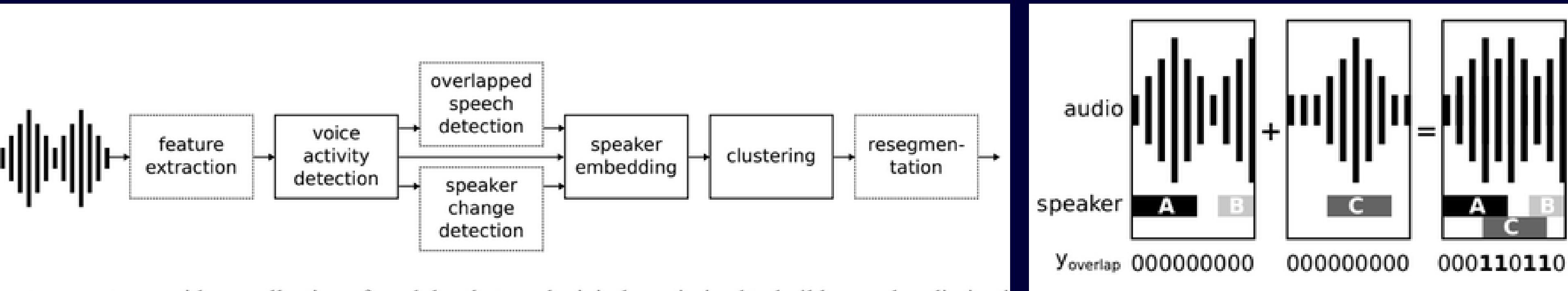
The action items will be extracted from transcripts and minutes of meetings will be complied in an automated manner.

## Research Gap

- Poor performance of summarization models for long input and transcripts
- Lack of annotated datasets for action items
- Proprietary architecture of meeting bots
- Only English language support
- High computational processing requirements

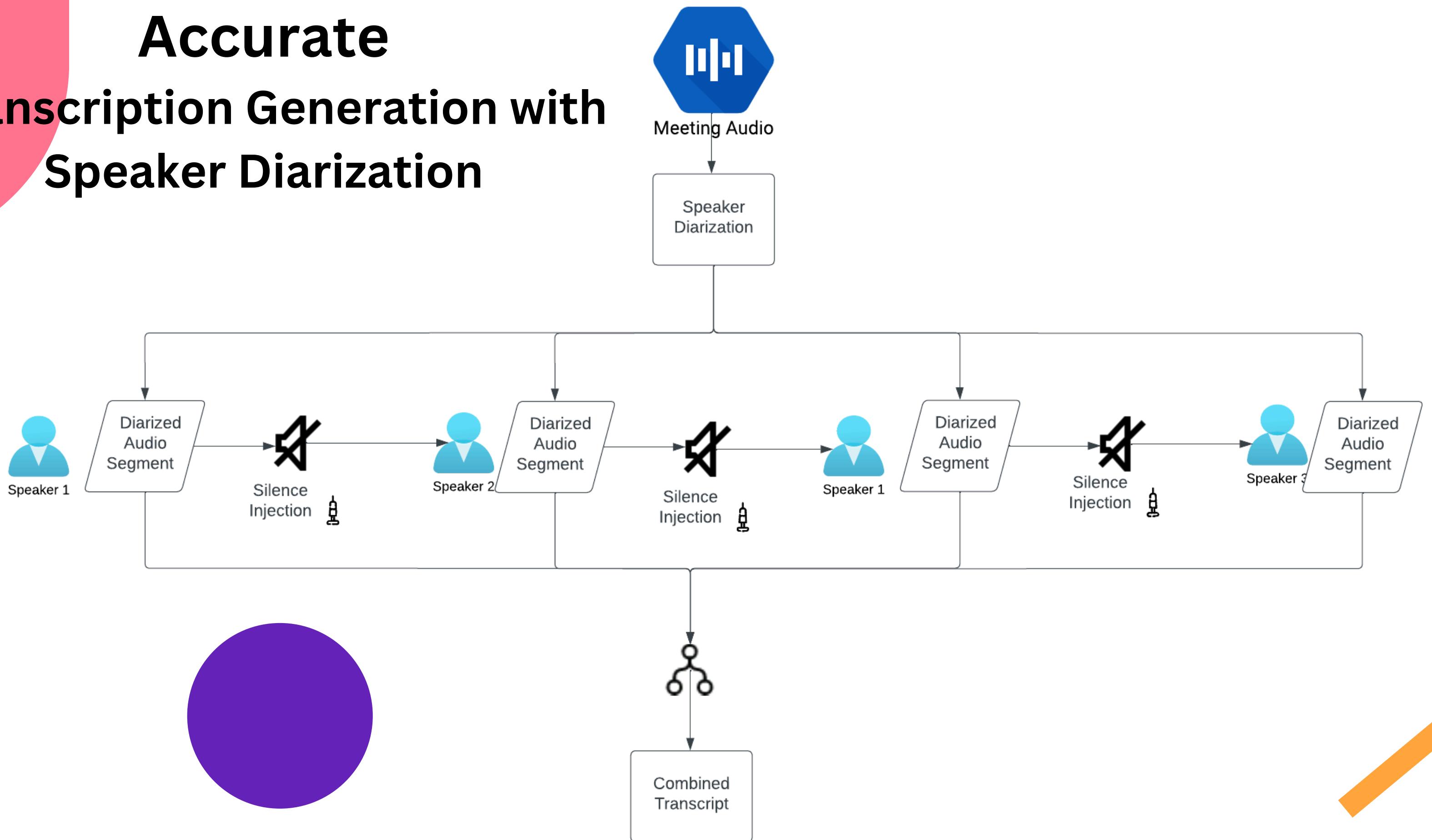
# Existing Architecture

## Speech to Text & Speaker Diarization



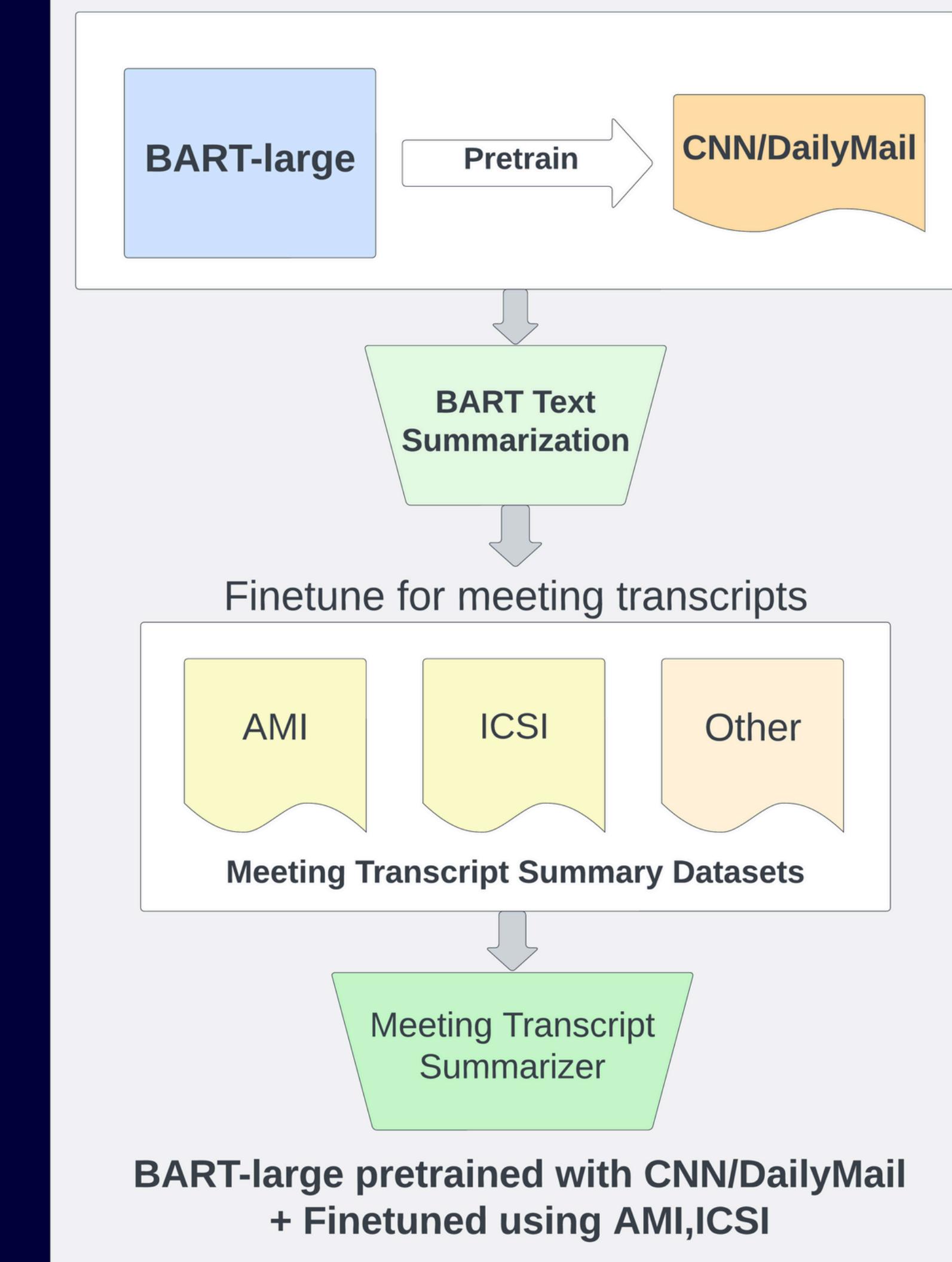
[16] H. Bredin et al., “pyannote.audio: neural building blocks for speaker diarization,” arXiv:1911.01255 [cs, eess], Nov. 2019, Accessed: Mar. 22, 2023. [Online]. Available: <https://arxiv.org/abs/1911.01255>

# Accurate Transcription Generation with Speaker Diarization

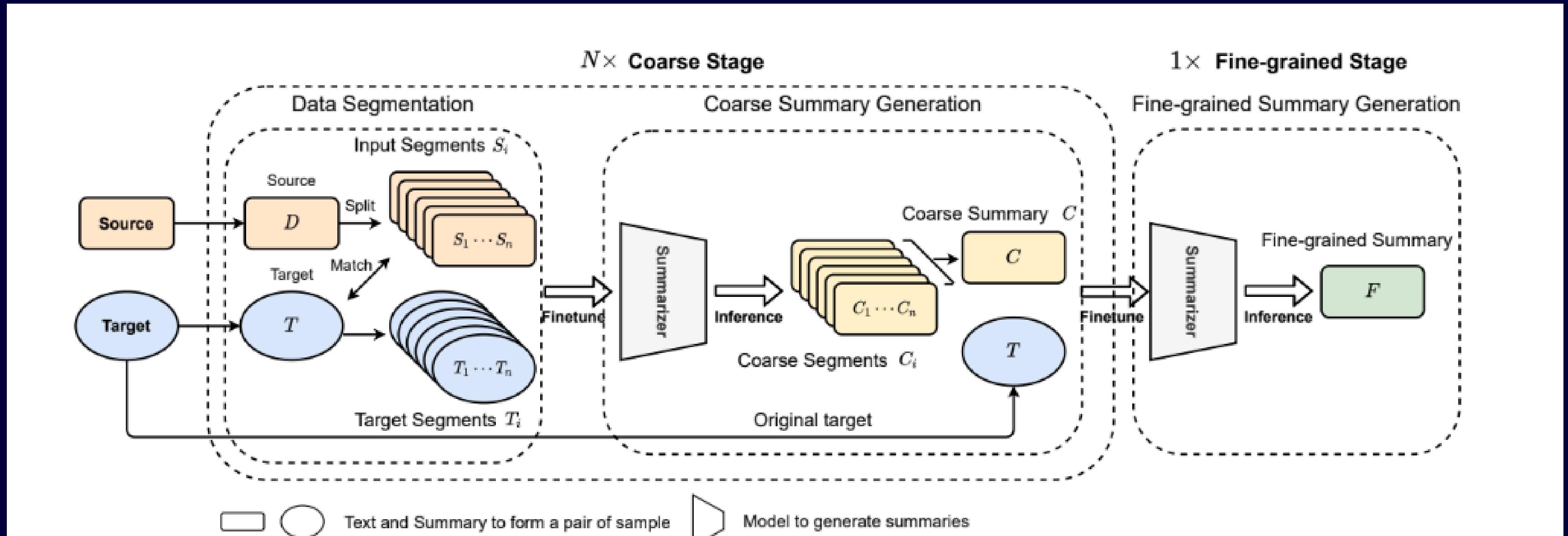


# Existing Architecture

Presently used  
architecture for  
**meeting transcript**  
summarization

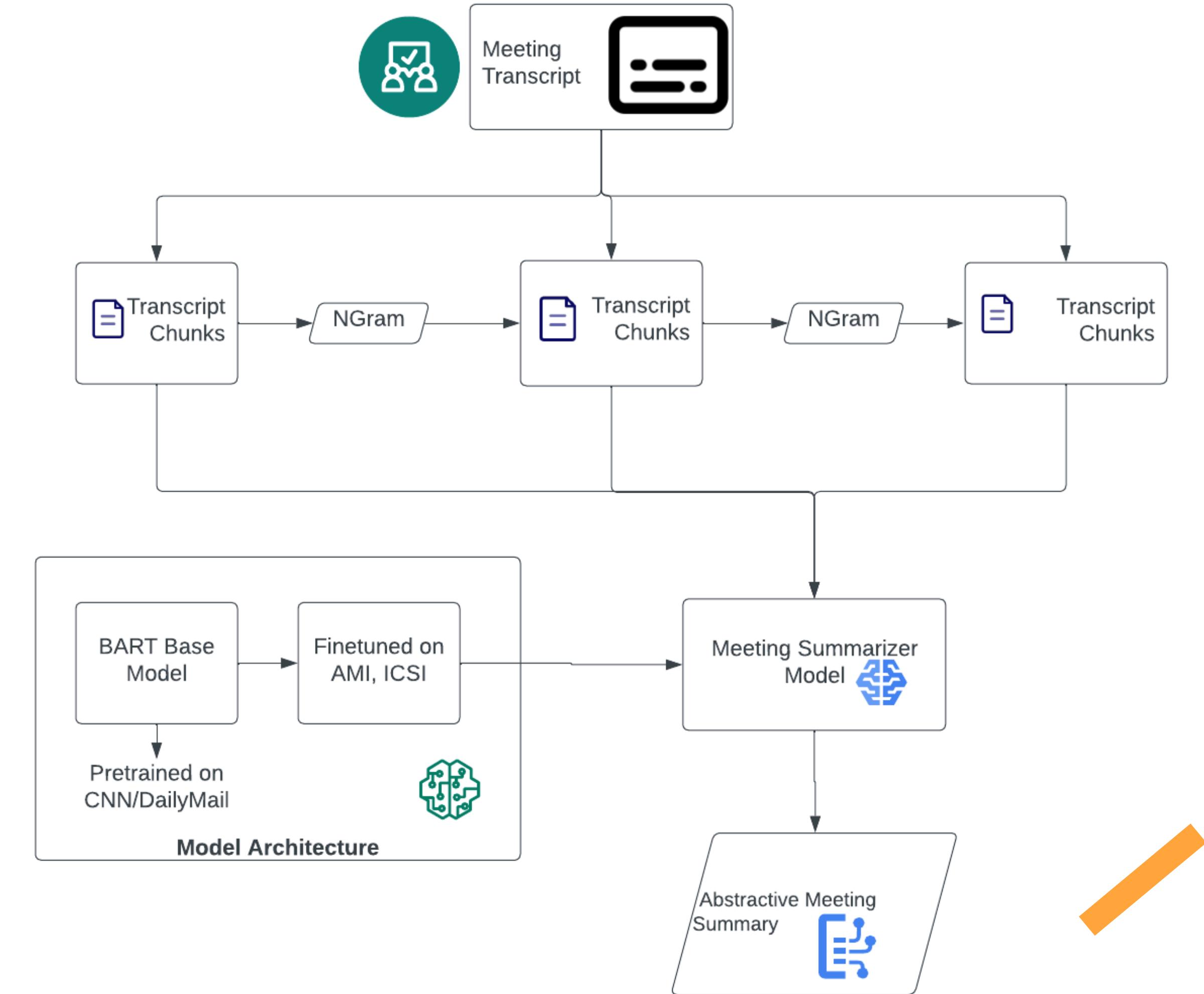


# Proposed System For Long Input Summarization



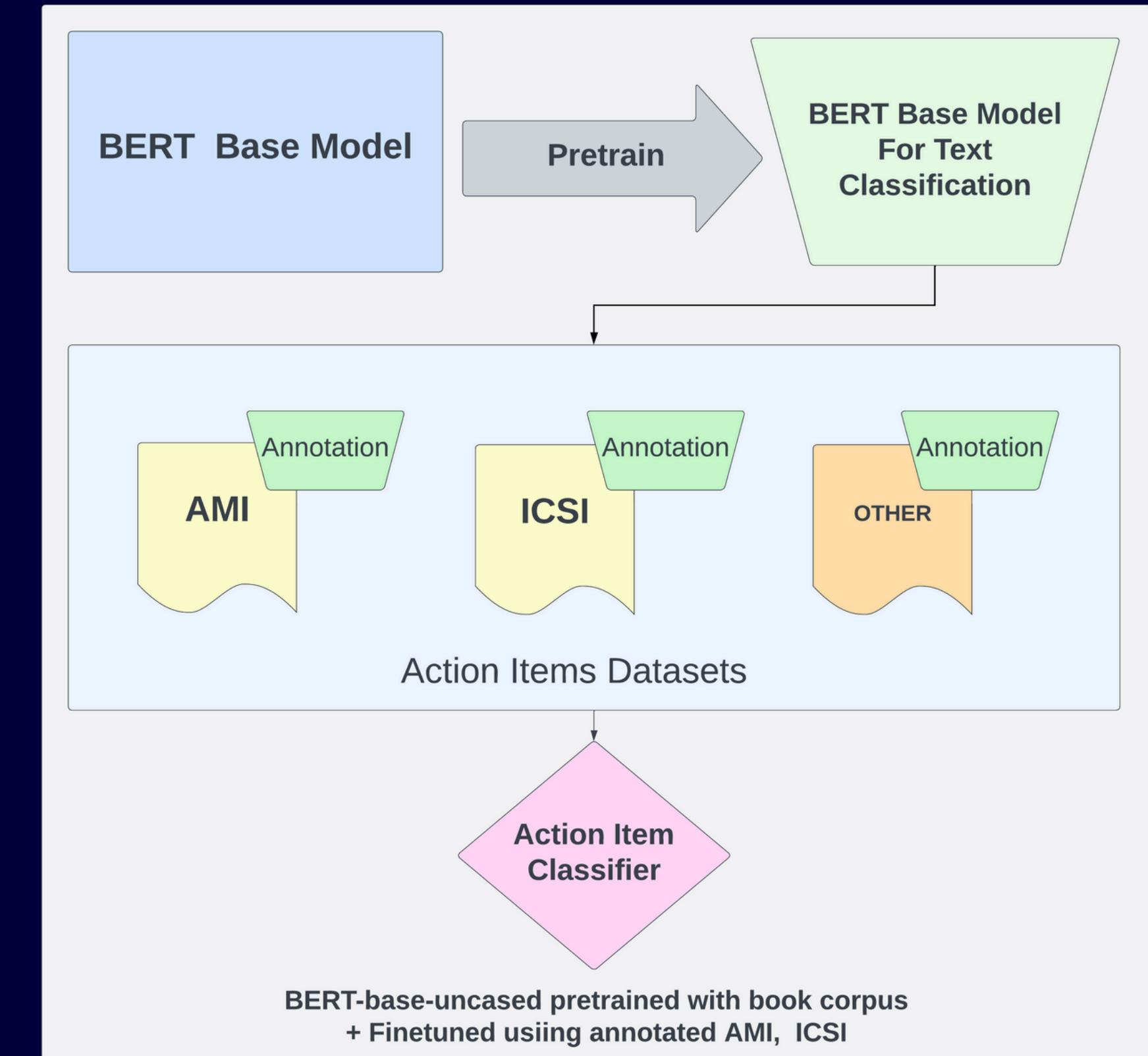
[4] Y. Zhang et al., "Summ^N: A Multi-Stage Summarization Framework for Long Input Dialogues and Documents," arXiv:2110.10150 [cs], Apr. 2022, Accessed: Mar. 22, 2023. [Online]. Available: <https://arxiv.org/abs/2110.10150> paragraph text

# Summarization

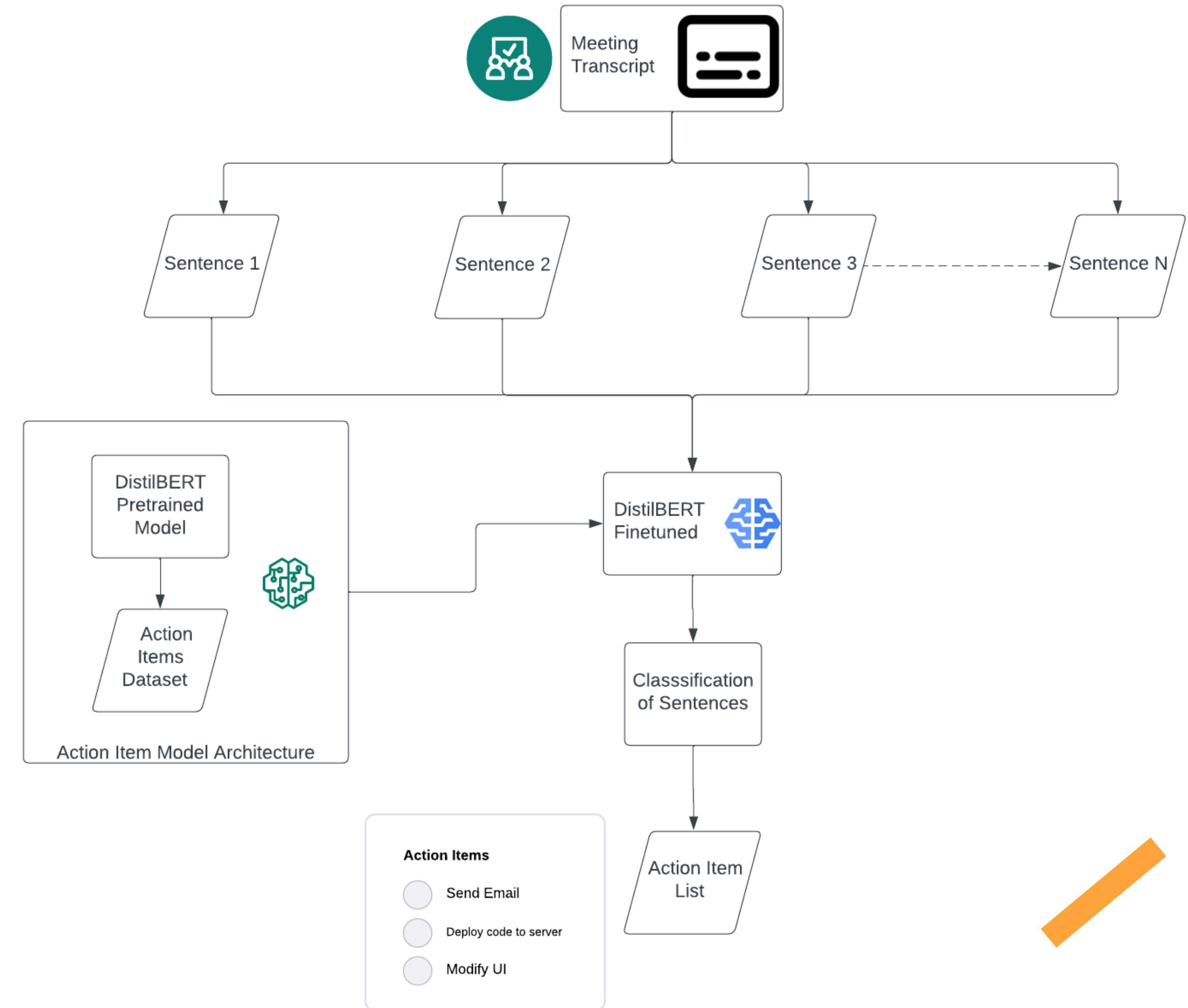


# Existing Architecture

## Action Items Extraction from Text

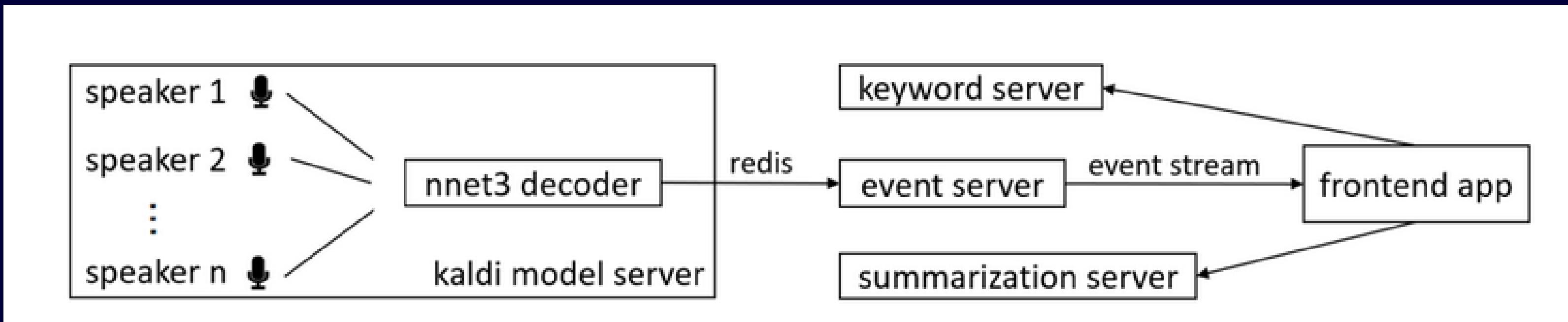


# Precise Action Items



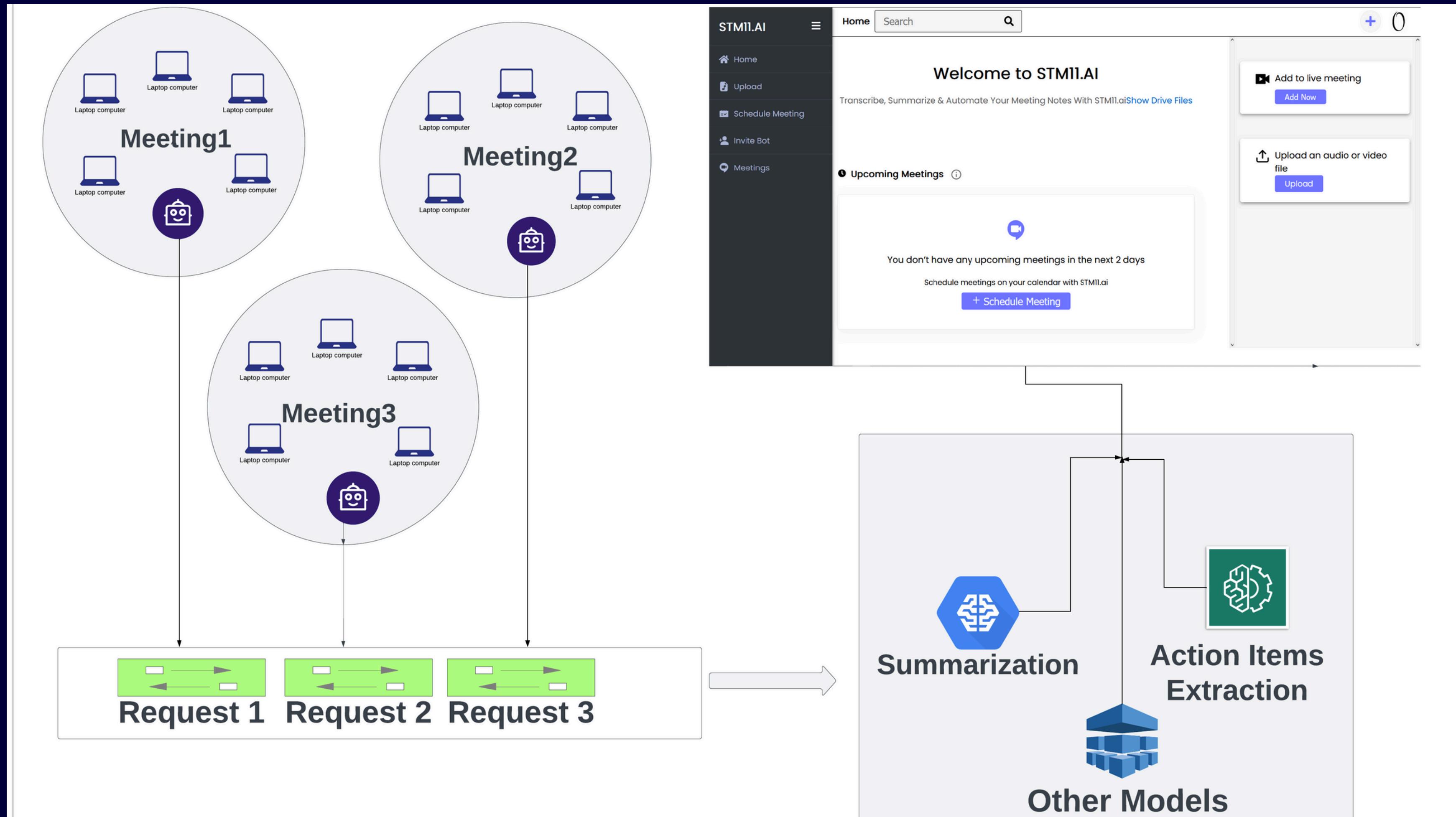
# Existing Architecture

## Minutes of Meeting Bot



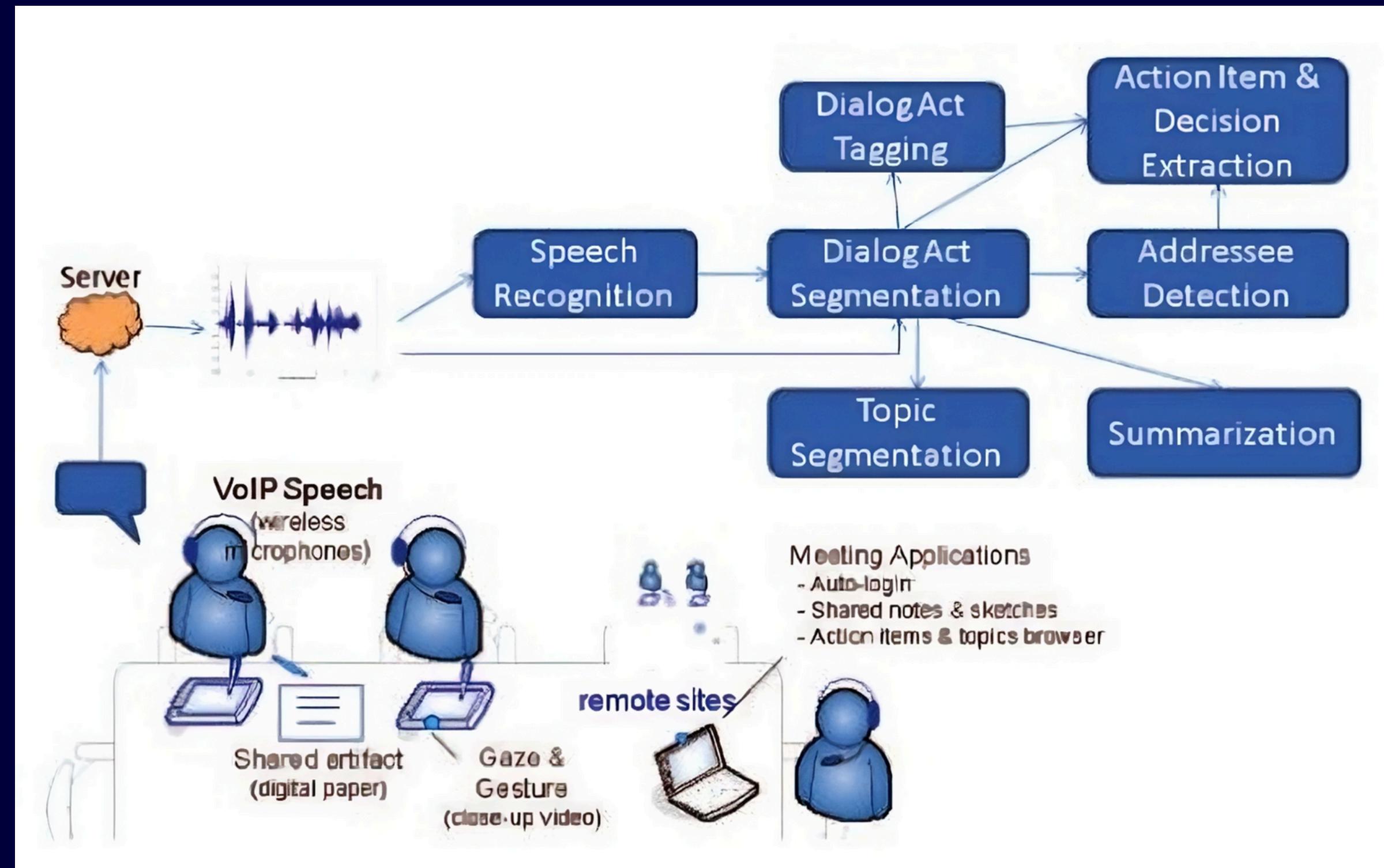
Benjamin Milde, Tim Fischer, Steffen Remus and Chris Biemann , "MoM: Minutes of Meeting Bot", 2021, Available:  
<https://www.inf.uni-hamburg.de/en/inst/ab/lt/publications/2021-mildeetal-interspeech-mombot.pdf>

# Meeting Bot

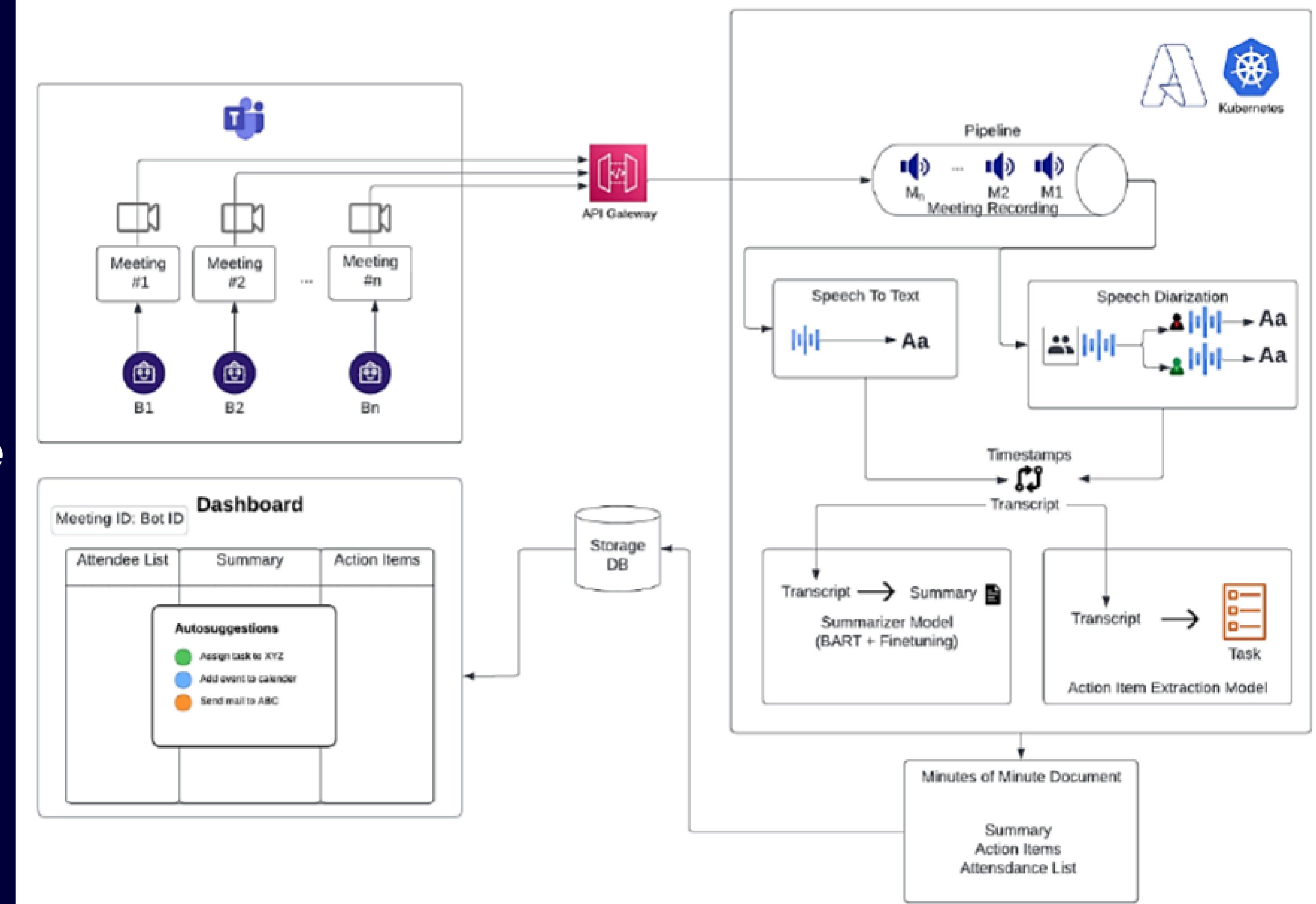


## Tasks involved in minutes of meeting generation

- Automatic speech recognition
- Speaker diarization (“who spoke when?”)
- Addressee detection (“who spoke to whom?”)
- Sentence segmentation and disfluency cleanup
- Dialog act tagging
- Named entity extraction
- Extracting distinguishing keyphrases
- Topic segmentation
- Topic identification (optionally with agenda)
- Keyword spotting
- Speaker role detection
- Agreement/disagreement detection
- Extraction of action items and decisions
- Meeting summarization



# SARANSH.AI Architecture



# Implementation Details

## Software Requirements:

### Platforms:

- Azure or AWS (API Gateway)
- Kubernetes
- Bot SDKs

### Languages:

- Python
- JavaScript

### Database:

- Mongodb
- S3 Buckets

### Frameworks:

- PyTorch, Tensorflow
- React, Node JS, Flask

## Hardware Requirements:

### Operating System:

- Any Operating System

RAM: Minimum 4 GB

# Time Spent In Meetings – Statistics



Meetings constitute a huge part of work where many employees view it as a necessary task that keeps the company's processes intact, and the team members engaged. But they fail to realize the amount of time spent on such meetings and their effect on its employees.

The staggering statistics surrounding the time spent on such meetings show a scary picture. Let's find out the ugly truth about how meetings are a waste of time.



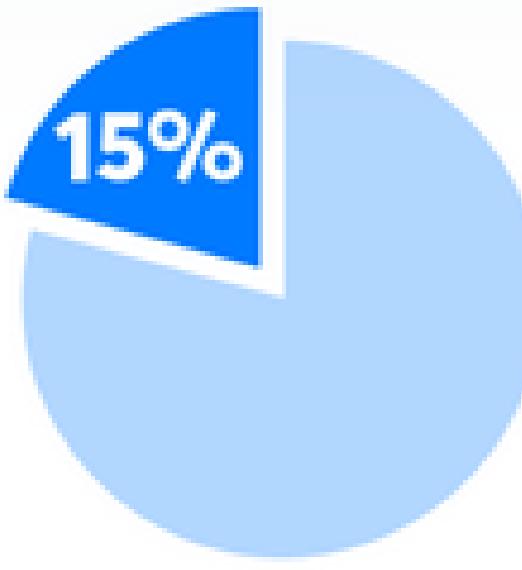
meetings are  
held each day



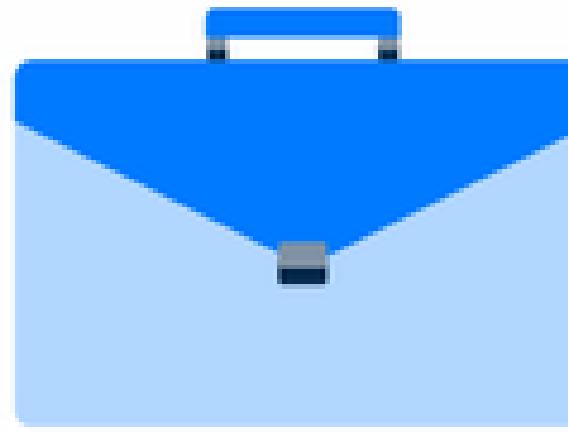
meetings are  
held per week



meetings are  
held per year



of an organization's time is spent in meetings, which has increased every year since 2008.



It has been observed that middle managers spend  
**35%**  
of their time in meetings.



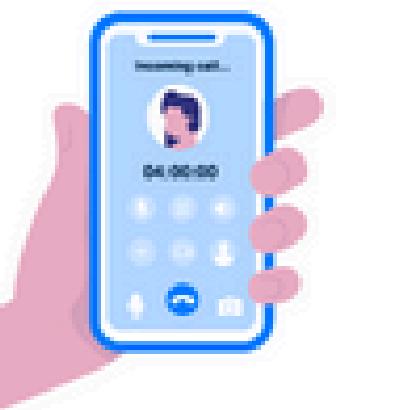
The employees in upper management spend  
**50%** of their time in meetings.



Research suggests that employees spend  
**4 hours per week**, preparing for status update  
meetings.



A recent survey found that **67%** of employees complain  
that spending too much time in meetings hinders them  
from being productive at work.



More than **35%** of employees found that they waste 2 to  
5 hours per day on meetings and calls, but they achieve  
nothing to show.

# Other Areas Of Impact

Automation

Sustainability

Enhanced Remote Work

Efficient decision-making

Productivity

Accessibility



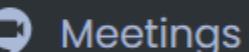
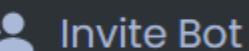
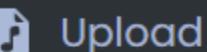
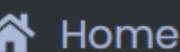
## Quarterly Business Review and Strategy Meeting

📅 4-11-2023 ⏰ 14:48:10

SHARE

MOM

Search across the transcript



TRANSCRIPT

ANALYTICS

AI Summary

Action Items



John Smith (CEO) : 9:00:00

Good morning, everyone. Thank you for joining this meeting. Let's dive straight in. Emily, could you give us an update on the production schedule?



Emily Davis (COO) : 9:02:15

Certainly, John. We're on track to meet our production targets for Q4. The new manufacturing process has improved efficiency by 15%. We're also working on implementing a quality control system to further streamline operations.



John Smith (CEO) : 9:05:45

That's excellent news, Emily. Efficiency gains like this will significantly impact our bottom line.



Michael Johnson (CFO) : 9:07:55

Speaking of the bottom line, I've prepared a financial report for Q3. Revenue increased by 10% compared to the previous quarter, and our expenses were well within budget. We're in a strong financial position moving into Q4.



John Smith (CEO) : 9:10:25

## Keywords

open agrees bug clarifying confirms  
contribution engineer pm

In the Quarterly Business Review and Strategy Meeting led by CEO John Smith, key department heads provided updates on their respective areas of responsibility. Emily Davis, the COO, reported that production targets for Q4 are on track, attributing a 15% efficiency boost to a new manufacturing process. Michael Johnson, the CFO, delivered positive news with a 10% increase in Q3 revenue, coupled with expenses well within budget. Sarah Lee, Head of Marketing, shared an impressive 20% surge in pre-orders for a new product, thanks to targeted ad campaigns and influencer collaborations. James Anderson, Head of Sales, reported a remarkable 30% conversion rate and promising discussions with a potential key account. Emphasizing proactive supply chain management, Emily secured alternative suppliers for critical components, mitigating potential delays.





## Quarterly Business Review and Strategy Meeting

4-11-2023 14:48:10

SHAREMOMSearch across the transcriptTRANSCRIPTANALYTICSAI SummaryAction Items

3

Questions were asked

4

Dates &amp; Times were discussed

9

People spoke during the meet

▼ Questions

- Could you give us an update on the production schedule?
- How's the marketing campaign for the new product launch coming along?
- How are we doing with the sales pipeline?

➤ Dates & Times

- Ensure Q4 production targets are met
- Monitor implementation of quality control system
- Provide detailed revenue and expense breakdown for Q3
- Maintain momentum in marketing campaign
- Continue collaboration with marketing for lead conversion
- Pursue discussions with potential key accounts
- Ensure alternative suppliers are secured for critical components
- Inform production team about increased demand projections
- Schedule dedicated session for R&D budget allocation discussion
- Coordinate closely with production team to address potential shortages
- Organize session with finance and operations teams for brainstorming

## Quarterly Business Review and Strategy Meeting

Online Meeting Platform:	Google Meet
Date:	17 <sup>th</sup> December 2023
Time:	9:15 am
Attendees:	John Smith, Emily Devis, Michael Johnson, Sarah Lee, James Anderson

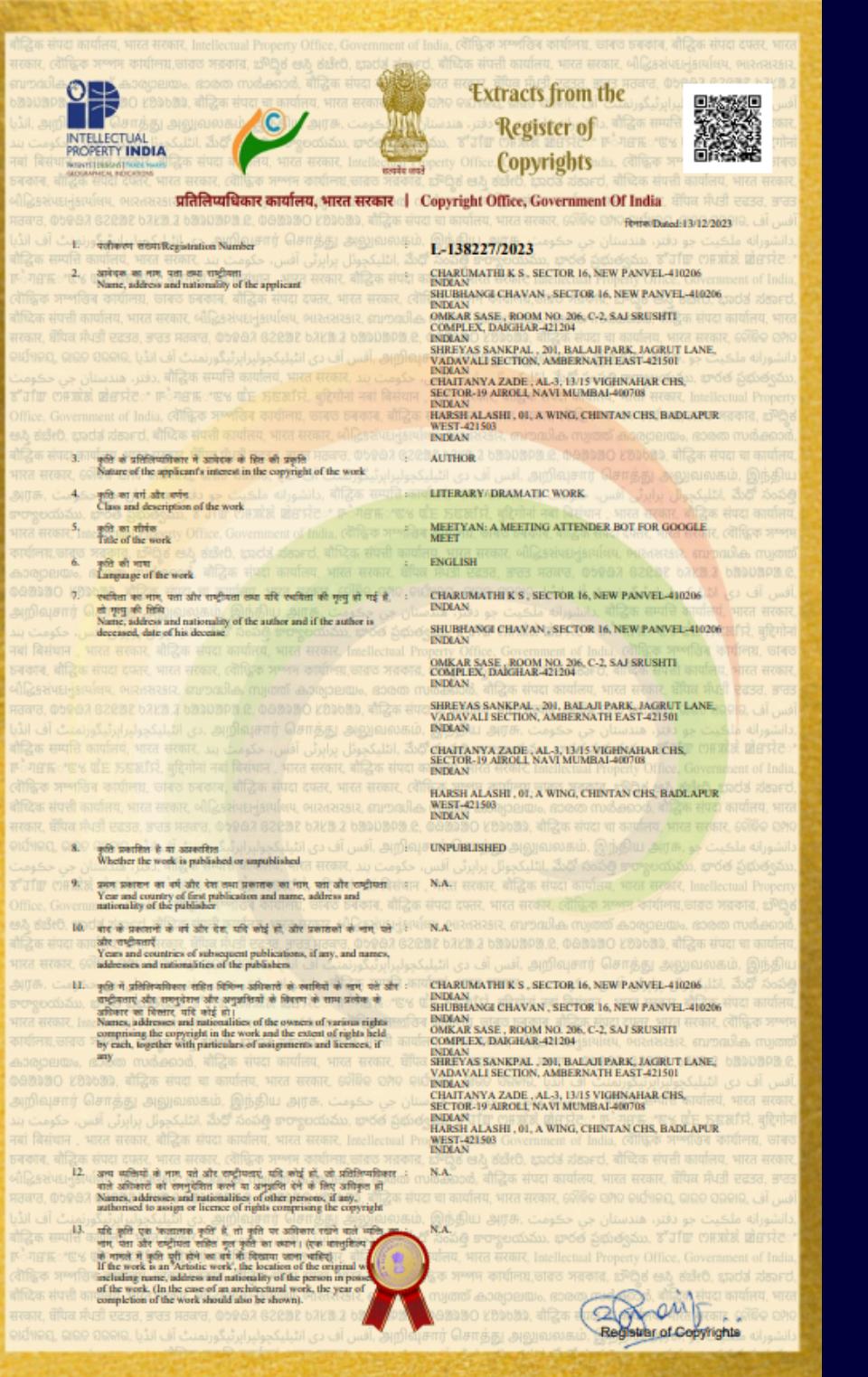
### Agenda items:

Action items	Owner(s)	Deadline	Status
Ensure Q4 production targets are met	John Smith - CEO	-	-
Monitor implementation of quality control system	Emily Devis- COO	20 <sup>th</sup> December 2023	Completed
Provide detailed revenue and expense breakdown for Q3	Michael Johnson- CFO	24 <sup>th</sup> December 2023	Not Started
Maintain momentum in marketing campaign	Sarah Lee- Head of Marketing	24 <sup>th</sup> December 2023	On Hold
Continue collaboration with marketing for lead conversion	James Anderson – Head of Sales	31 <sup>st</sup> December 2023	In Progress

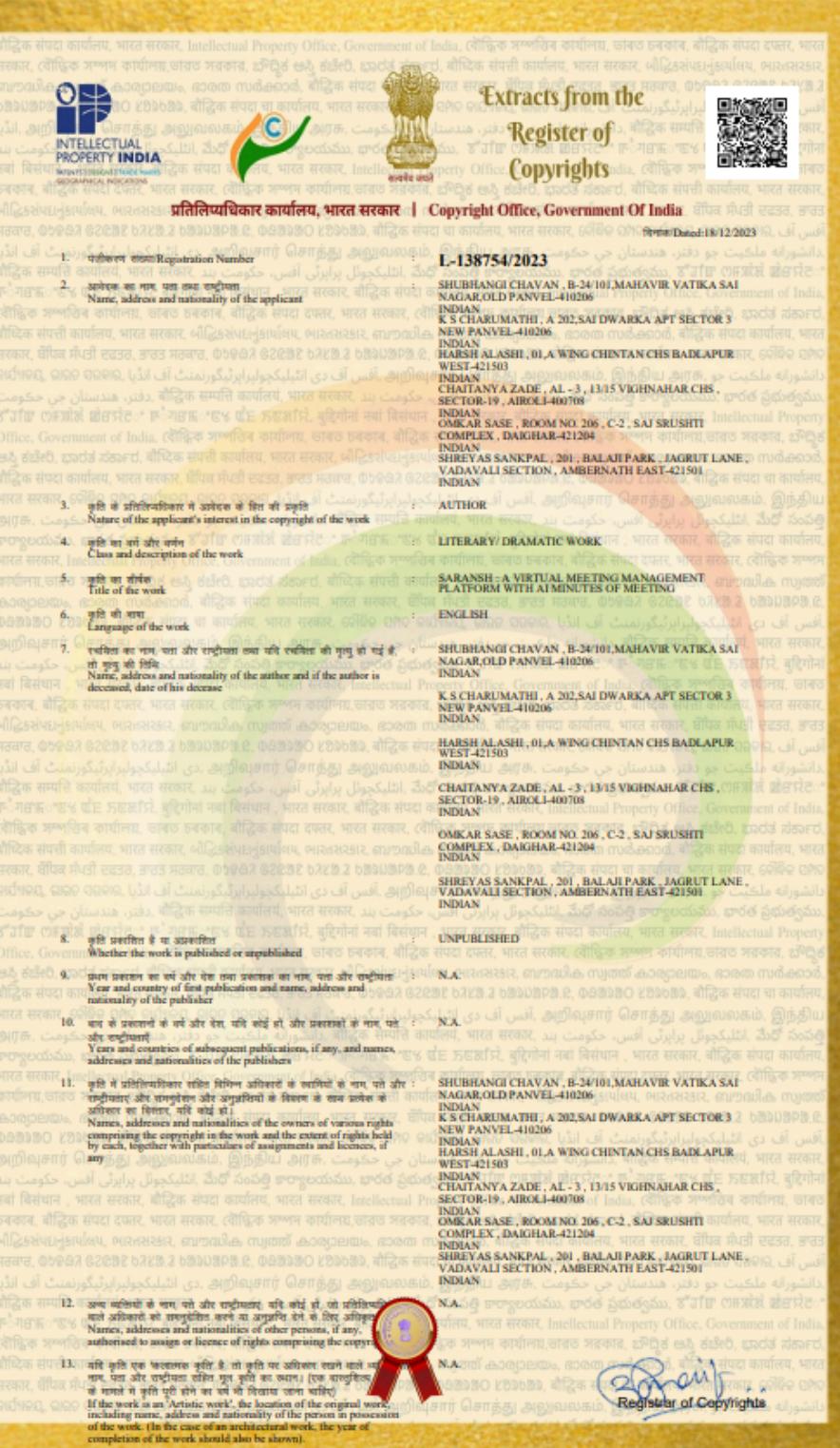
### Meeting Summary:

In the Quarterly Business Review and Strategy Meeting led by CEO John Smith, key department heads provided updates on their respective areas of responsibility. Emily Davis, the COO, reported that production targets for Q4 are on track, attributing a 15% efficiency boost to a new manufacturing process. Michael Johnson, the CFO, delivered positive news with a 10% increase in Q3 revenue, coupled with expenses well within budget. Sarah Lee, Head of Marketing, shared an impressive 20% surge in pre-orders for a new product, thanks to targeted ad campaigns and influencer collaborations. James Anderson, Head of Sales, reported a remarkable 30% conversion rate and promising discussions with a potential key account. Emphasizing proactive supply chain management, Emily secured alternative suppliers for critical components, mitigating potential delays. Michael proposed a budget allocation for R&D, highlighting the significance of innovation in sustaining long-term growth. CEO John Smith praised the team's dedication and encouraged open feedback. Sarah raised concerns about inventory management, prompting Emily to pledge close coordination with the production team. The meeting concluded with a review of upcoming events. Action items included a follow-up meeting on the R&D proposal and ongoing coordination with the production team to ensure seamless operations.

# MEETYAAN: A Google Meet Bot



# SARANSH: A Virtual Meetings Management Platform with AI Minutes of Meeting



# Aavishkar Inter-College Research Convention (Final Round)



**Merit Rank 4 in Mumbai University**

# Summary

- The objective of easing and automating the management of virtual meetings will be achieved with this project and better decisions can be made in organizations that rely on virtual meetings
- By automating the meeting recording summarization and action item extraction process using NLP, virtual meetings can become more efficient, productive, and streamlined.
- Participants can focus on the discussion and collaboration during the meeting, rather than worrying about taking detailed notes or remembering action items.

# Avishkar Research Convention: 2023-2024

## Abstractive Summarization & Automated Minutes of Meeting for Virtual Meetings

**Category: 5**

**Slot No.:**

**Level: UG**

**Introduction**

- For professional meetings, it is common practice to produce a minutes of meeting document which gets distributed to the participants and summarizes the meeting.
- A minutes of meeting document contains meeting agenda, attendee list and a list of action items with task owner names and deadlines or a list of decisions and votes.
- The aim is to automate this process of producing minutes of meeting document for online and offline meeting with the help of AI and Deep Learning.

**Objectives**

- Allow meeting participants to focus on the discussion and collaboration during the meeting rather than taking notes or remembering tasks.
- Ease and automate the process of virtual meetings for professionals and organizations by streamlining the experience and boosting efficiency and productivity.
- Leverage Natural Language Processing and Deep Learning techniques to summarize meetings, generate transcripts, track attendees, etc.

**Architecture**

The architecture diagram illustrates the system flow. It starts with multiple meetings (Meeting #1, #2, ..., #n) connected to an API Gateway. The API Gateway leads to a Pipeline (Kubernetes) which handles Meeting Recording (M1, M2, M3). The Pipeline feeds into Speech To Text and Speech Diarization modules. These modules output Transcripts and Timestamps. The Transcripts are then processed by a Summarizer Model (BART + Finetuning) to generate a Summary and Action Items. The Action Items are processed by an Action Item Extraction Model to extract specific tasks. Finally, the Summary, Action Items, and Attendance List are aggregated into Minutes of Meeting Document. A Storage DB is used for data persistence. A Dashboard provides real-time monitoring of attendees, summaries, and action items.

**Algorithms**

The algorithms diagram shows the detailed flow of the summarization process. It begins with a Meeting Transcript, which is divided into Transcript Chunks. These chunks are processed through NGram and then passed to a Meeting Summarizer. The Meeting Summarizer uses a BART Base Model that has been pretrained on CNDIAL-MT and finetuned on AMI, ICSI. The output is an Abstractive Meeting Summary. Below this, a Bert Base Model is shown being pretrained, followed by a BERT Based Model For Text Classification. This classification model uses Action Items Datasets (AMI, ICSI, OTHER) and an Action Item Classifier to identify specific action items.

**Sample Output**

**Quarterly Business Review and Strategy Meeting**

Online Meeting Platform:	Google Meet
Date:	17th December 2023
Time:	9:15 am
Attendees:	John Smith, Emily Devis, Michael Johnson, Sarah Lee, James Anderson

**Agenda items:**

Action items	Owner(s)	Deadline	Status
Ensure Q4 production targets are met	John Smith - CEO	-	-
Monitor implementation of quality control system	Emily Devis - COO	20th December 2023	Completed
Provide detailed revenue and expense breakdown for Q3	Michael Johnson - CFO	24th December 2023	Not Started
Maintain momentum in marketing campaign	Sarah Lee - Head of Marketing	24th December 2023	On Hold
Continue collaboration with marketing for lead conversion	James Anderson - Head of Sales	31st December 2023	In Progress

**Meeting Summary:**

In the Quarterly Business Review and Strategy Meeting led by CEO John Smith, key department heads provided updates on their respective areas of responsibility. Emily Davis, the COO, reported that production targets for Q4 are on track, attributing a 15% efficiency boost to a new manufacturing process. Michael Johnson, the CFO, delivered positive news with a 10% increase in Q3 revenues, coupled with expenses well within budget. Sarah Lee, Head of Marketing, shared an update on the 2024 strategy, focusing on new product launches to target global campaigns and influencer collaborations. James Anderson, Head of Sales, reported a remarkable 30% conversion rate and promising discussions with a potential key account. Emphasizing proactive supply chain management, Emily secured alternative suppliers for critical components, mitigating potential delays. Michael proposed a budget allocation for R&D, highlighting the significance of innovation in sustaining long-term growth. CEO John Smith praised the team's dedication and encouraged open feedback. Sarah raised concerns about inventory management, prompting Emily to pledge close coordination with the production team. The meeting concluded with a review of upcoming events. Action items included a follow-up meeting on the R&D proposal and ongoing coordination with the production team to ensure seamless operations.

**Research Gaps vs Innovation**

Poor performance of summarization models for long input and transcripts	Divided transcript into meaningful chunks and used ngrams to maintain context
Lack of annotated datasets for action items	Manually annotated + AI generated records
Proprietary architecture of meeting bots	Created new modular bot architecture
Limited to English language support	Used whisper open-source multi-language Speech to Text API
High computational processing requirements	Implementation in microservices architecture

**Applications**

- Board meetings
- Business conferences
- Academic conferences
- Classroom lectures

**Online Meetings:**

- Meeting is over? Upload the recording
- Meeting is live? Invite the bot
- Meeting scheduled? Bot will join automatically

**Offline Meetings:**

- Record live and stream to server

**Impact**

- 11 million meetings are held each day.
- 15% of an organization's time is spent in meetings.
- Managers spend 35% of their time in meetings.

Summarizing meetings and automating the task of producing minutes of meeting can ensure:

- Participants don't spend time taking notes
- Participants don't need to remember tasks
- Hosts can easily get an overview of any meeting and also view summaries of previous meetings.

**References**

[1] Y. Zhang et al., "Summ^N: A Multi-Stage Summarization Framework for Long Input Dialogues and Documents," arXiv:2110.10150 [cs], Apr. 2022, Accessed: Mar. 22, 2023. [Online]. Available: <https://arxiv.org/abs/2110.10150>

[2] K. Sachdeva, J. Maynez and O. Siohan, "Action Item Detection in Meetings Using Pretrained Transformers," 2021 IEEE Automatic Speech Recognition and Understanding Workshop (ASRU), Cartagena, Colombia, 2021, pp. 861-868, doi: 10.1109/ASRU51503.2021.9688167.

[3] M. Li, L. Zhang, H. Ji, and R. J. Radke, "Keep Meeting Summaries on Topic: Abstractive Multi-Modal Meeting Summarization," Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics, 2019, doi: <https://doi.org/10.18653/v1/p19-1210>.

# Thank You!

