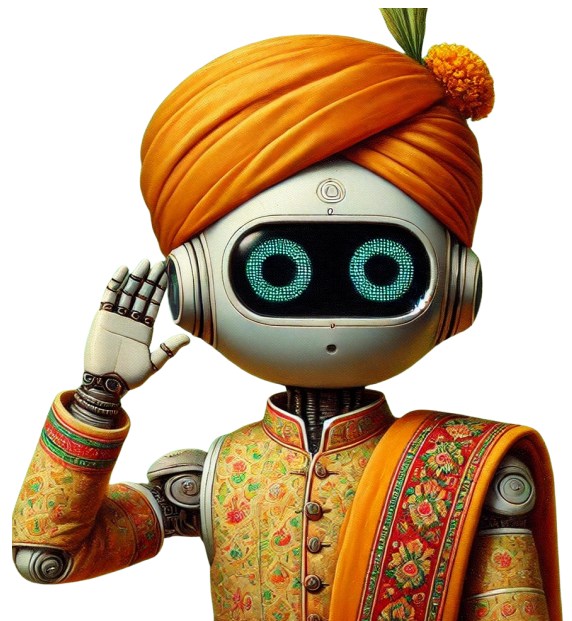




Sunva AI

An AI-Powered Accessibility Solution for India's Deaf Community

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About People+ai

People+ai is an EkStep Foundation initiative designed around the belief that technology, especially AI, has the potential to transform India through a people first approach. People+ai connects thinkers, do-ers, researchers, tinkerers and innovators by enabling voices and spaces for the ecosystem to focus on crafting use cases that make technology work better for the people.

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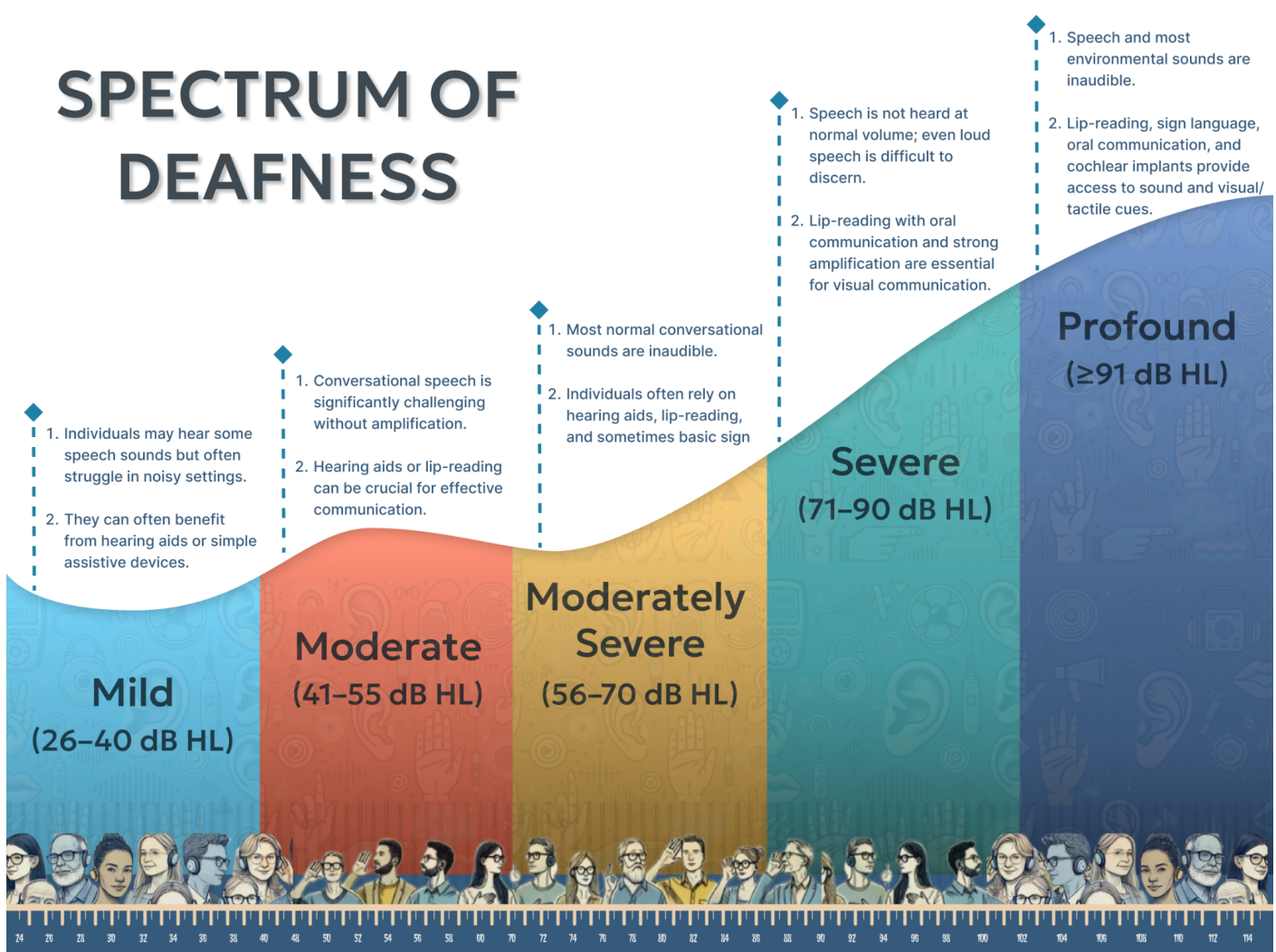
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Executive Summary

This paper presents Sunva AI, an AI-driven communication tool designed to enhance accessibility for the deaf community in India, particularly for those within the oral spectrum of deafness. Sunva addresses the challenges of communication faced by millions of deaf individuals who rely on oral communication and lip-reading, often struggling with current solutions like real-time transcriptions that can cause cognitive fatigue and impede natural conversation.

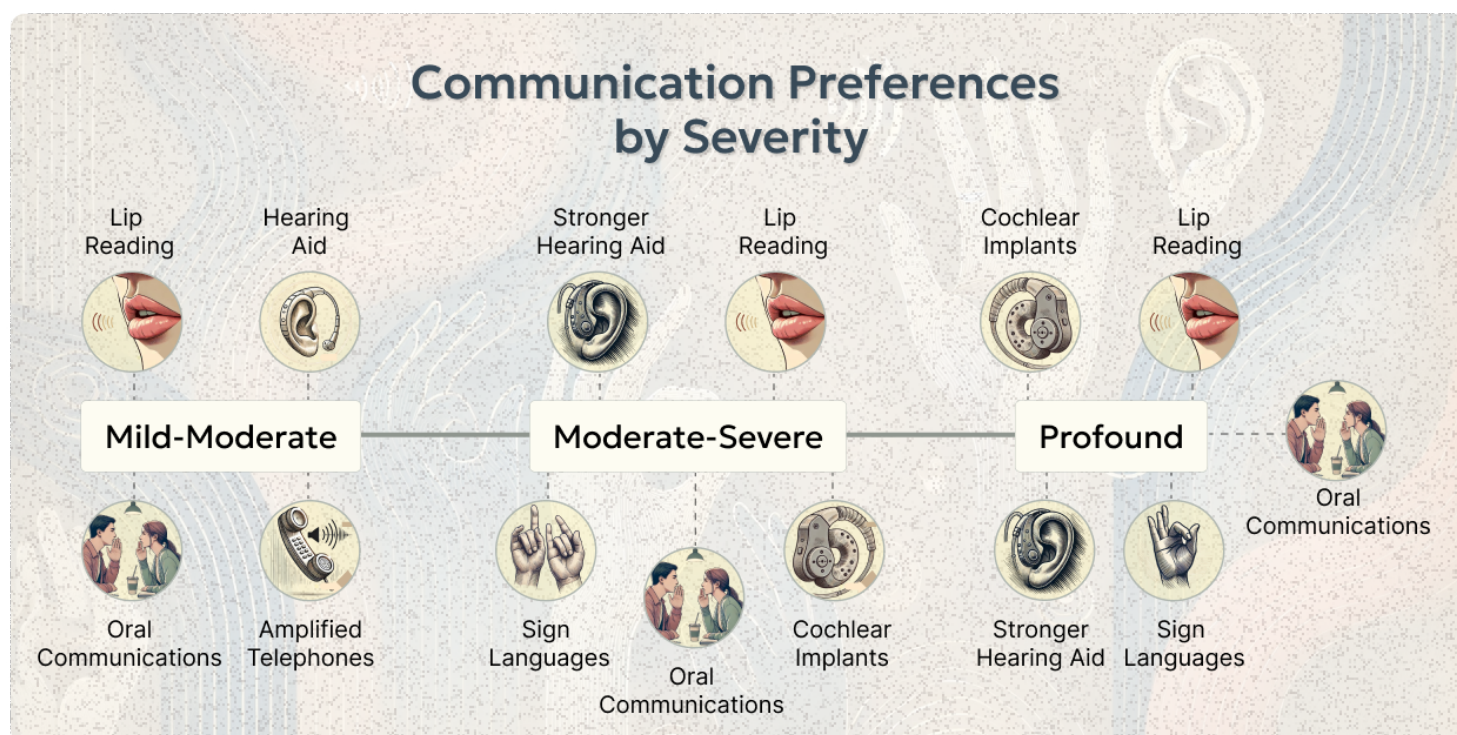
Sunva uses speech recognition, natural language processing, and text-to-speech technologies to provide intelligent live transcriptions, text simplification and text to speech capabilities, enabling deaf individuals to participate more fully in conversations, educational settings and professional environments. The paper details the problem, solution and technical architecture of Sunva AI, highlighting its potential impact on the lives of deaf individuals.

The Spectrum of Deafness Within India's Diverse Deaf Community



Communication is a fundamental aspect of human interaction, yet for millions of deaf individuals, especially in a diverse country like India, it presents significant barriers. According to the 2011 Census, over 5 million people in India have hearing impairments, though disability rights organizations estimate the actual number to be much higher, possibly exceeding 65 million.

India's deaf community comprises individuals with varying degrees of hearing loss, using oral communication, lip-reading, or sign language. The heterogeneity within the deaf community is often overlooked, leading to solutions that do not fully address their needs. Many deaf individuals, particularly those with partial hearing loss or who use hearing aids or cochlear implants, prefer oral communication combined with lip-reading.



The Communication Challenges of India's Oral Deaf Community

India's oral deaf community faces a major challenge: a lack of truly accessible communication tools. Many rely on lip-reading and spoken language, but most existing solutions don't support these needs well, making everyday conversations frustrating.

Current transcription tools force users to constantly switch between reading captions and following speakers, which leads to cognitive fatigue and social isolation. The problem is even bigger in India, where early intervention and speech therapy aren't always available, and assistive hearing devices don't work well for those with significant hearing loss. Many deaf individuals develop non-standard speech patterns, which makes communication even harder.

Because of this, many people in the oral deaf community end up relying on writing to communicate—a slow, limiting alternative. These barriers hold millions back from fully participating in education, work, and social life. There's a clear need for better tools that make communication smoother and more natural.

That need becomes even more obvious when talking to deaf individuals who experience these challenges firsthand—including project co-anchors, one of whom has non-standard speech. Their experiences reinforce just how urgent it is to build solutions that work for real people in real situations.

And in a country as linguistically diverse as India, those solutions need to be adaptable, culturally aware, and genuinely helpful for a wide range of communication needs.

Key issues include:

Through engagement with the oral deaf community and analysis of existing solutions, several insights emerged:

Cognitive Overload: Real-time transcription tools demand constant visual attention, making it nearly impossible to follow speakers, presentation materials, and captions simultaneously.

Cognitive Overload



Disrupted Conversational Flow: Typing responses and switching focus between inputs creates delays, preventing natural, fluid exchanges.

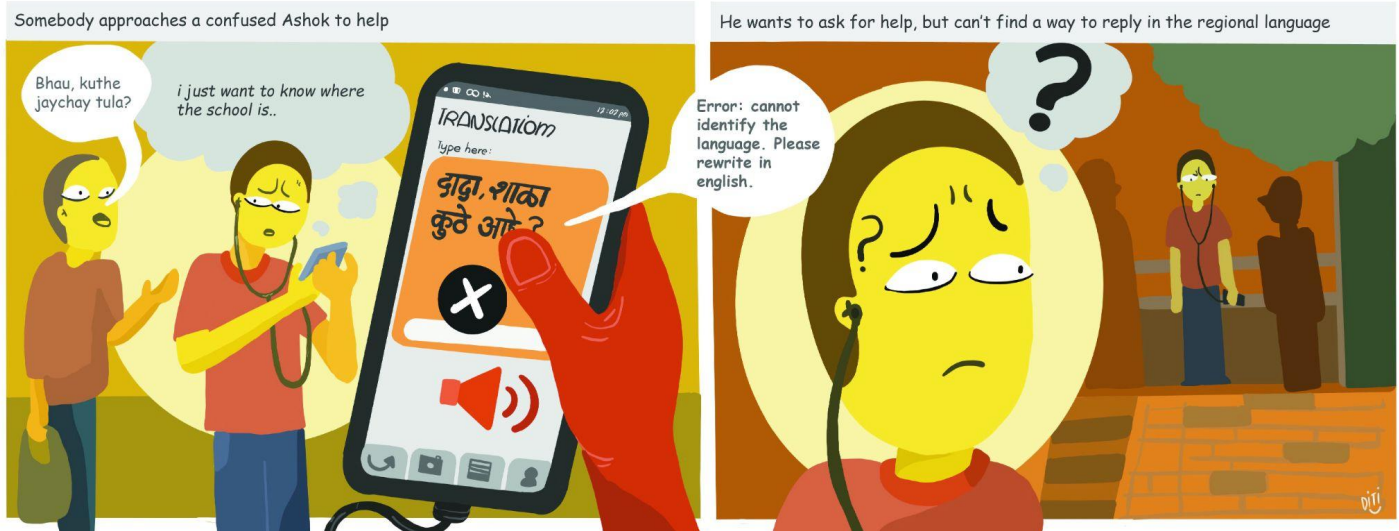
Inadequate Support for Non-Standard Speech: People with speech irregularities find their speech often misunderstood, excluding them from meaningful conversations.

Inadequate Support for non- standard speech - Difficulty in having group conversations



Multilingual Challenges: The Indian context requires consideration of multiple regional languages for effective communication.

Multilingual Challenges

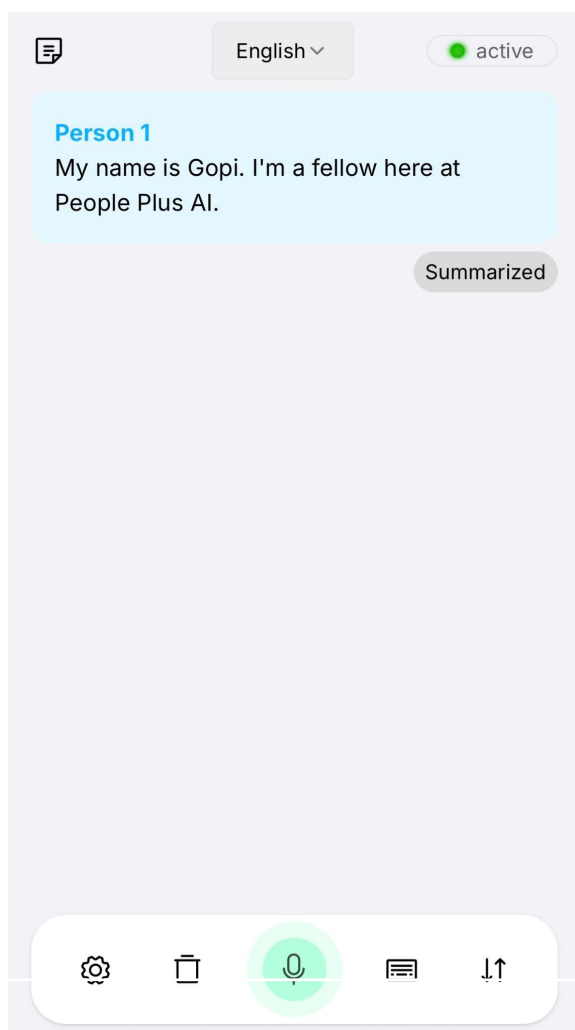


These issues are underpinned by a failure to recognise and understand in detail, the vast spectrums of deafness, with varying degrees of hearing loss, preferred modes of communication and language abilities, impacting educational and economic opportunities for deaf individuals in India. **This has far-reaching impacts, limiting social inclusion, workplace participation, and educational attainment for the deaf community.**

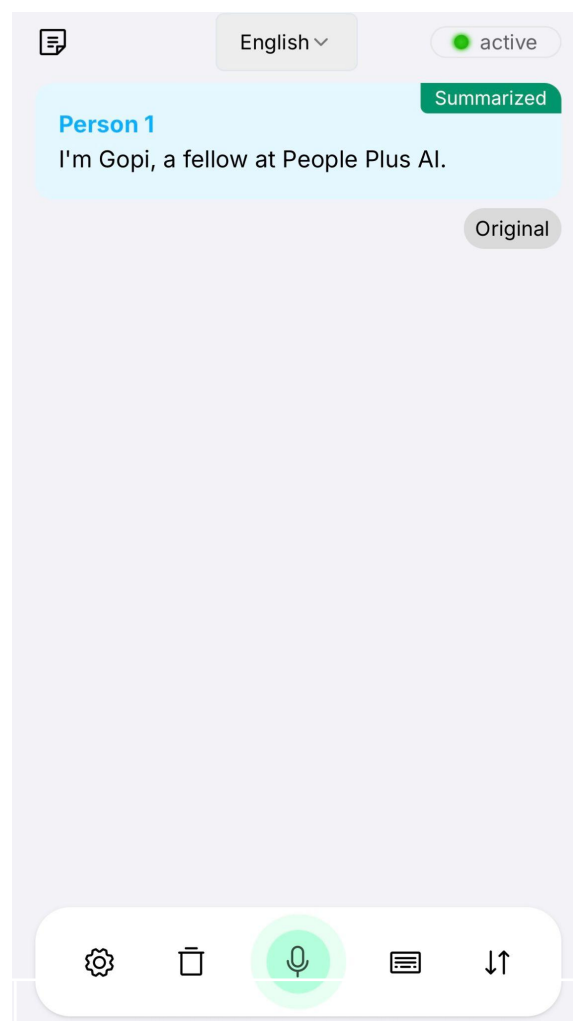
How Sunva AI Combines Live Transcription, Text-to-Speech, and Multilingual Support to tackle communication challenges

Imagine you're a deaf individual navigating daily conversations in a world designed primarily for those who can hear. Here's how Sunva AI transforms your experience:

Joining a Conversation Effortlessly:



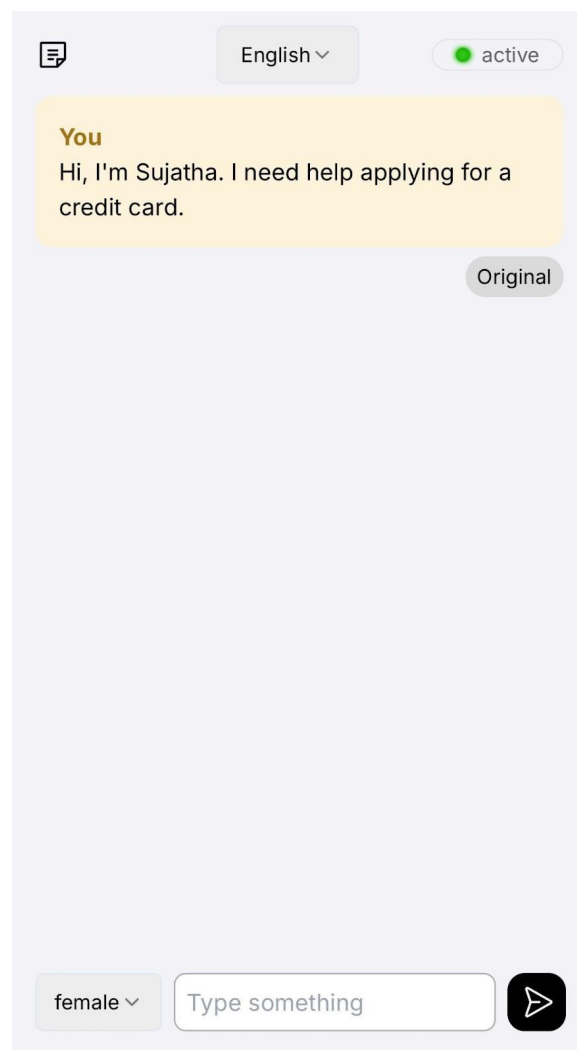
When someone speaks, Sunva's live transcription kicks in instantly. You see their words transcribed in real-time on your screen.



Critical points are highlighted, and long sentences are simplified, making it easier for you to follow along without feeling overwhelmed.

Responding to others:

1. If you are a deaf person with non standard speech you can type your response directly into the app.
2. If you make a typo or struggle with phrasing, Sunva's AI steps in to correct your text, polish the grammar, and even can auto-complete your thoughts.
3. With a single tap, this refined text is converted into clear, fluent speech, allowing you to express yourself effortlessly.



Breaking Language Barriers:

If you're more comfortable in an Indian regional language, Sunva supports multiple languages and seamlessly translates your input into English (or another language) for processing and translates it back for accurate, context-sensitive responses.

Adapting to Your Needs:

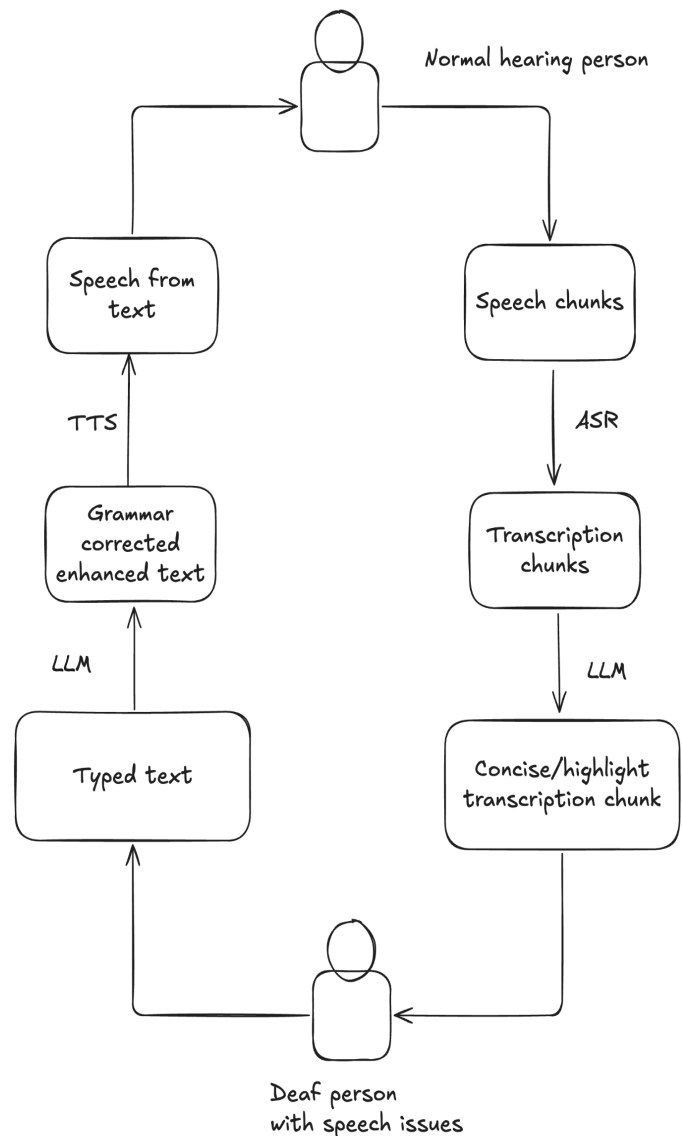
Conversations shift between casual and complex topics. Sunva's AI adapts dynamically, simplifying everyday chatter but retaining detailed nuances when needed, ensuring you're always in control without the hassle of manually switching modes.

User-Friendly Interface:

The intuitive design keeps everything you need on a single screen. You can simultaneously view live transcriptions and type your responses, ensuring the conversation flows naturally without interruptions.

Sunva AI workflow:

1. **Speech Input:** Spoken words from a hearing person are captured in chunks.
2. **ASR Processing:** Speech chunks are transcribed using ASR APIs.
3. **Text Processing with LLMs:**
 - a. Transcription chunks are simplified or highlighted based on context.
 - b. Important points are highlighted, while less critical details are concise.
4. **Transcription Display:**
 - a. Real-time transcriptions are displayed to the deaf user with options to toggle between concise and full modes.
5. **Typed Response:**
 - a. Deaf users can type responses, which are preprocessed by LLMs to correct errors, improve grammar, and complete partial sentences.
6. **TTS Conversion:**
 - a. Refined text is converted to speech using Ai4Bharat Indic TTS models for response delivery.



Technical Architecture:

- **Intelligent Live Transcription:** Sunva uses speech recognition to transcribe conversations, and it simplifies the transcripts by highlighting important information and summarizing less critical details to minimise cognitive load. The system also provides a full transcription mode, adjustable to the reasoning levels of the user based on their feedback. For this we use the following APIs
 - Groq Whisper API handles English transcriptions.
 - Bodhi Navana API processes Indic languages.
- **Natural Language Processing:** Sunva uses natural language processing to complete partial sentences, improve grammar, and auto-complete sentences. It assists users who have speech irregularities by correcting or expanding typed input into fluent, natural language.
 - Large Language Models (LLMs) such as OpenAI GPT-4o for English and Claude Sonnet for Hindi.
 - These LLMs are used for deciding text formatting, concising and highlighting text, expanding short sentences, and translating between languages.
- **Text-to-Speech (TTS):** Sunva allows users to respond to conversations through typed text, which is converted to speech to enable them to participate in conversations even if they have speech clarity issues. This functionality is also designed to grab the attention of hearing peers.
 - We use AI4Bharat Indic models which are fine tuned versions of coqui models on indic speech datasets
- **Multilingual Support:** Sunva is designed to support multiple Indian languages using translation capabilities. The system translates source language to English, does processing in English, and translates back to the source language.
- **Sunva Backend:** Sunva backend is a set of REST APIs and WebSocket APIs written in FastAPI.
- **Sunva Frontend:** The application is written in NextJS and interacts with the Sunva backend API to capture real time transcriptions, highlight or concise transcriptions, save transcriptions, and speak what the user typed using a text-to-speech model.

Over the past five years, these technologies have become more effective and affordable. By adopting a "+1 philosophy", Sunva takes the existing abundance of Automatic Speech Recognition (ASR), Large Language Models (LLMs), and TTS technologies and tweaks them to directly address challenges faced by the deaf community in India.

The problem statement was meticulously deconstructed into smaller components, allowing targeted solutions using these technologies.

Sunva AI use cases :



Deaf students struggle to follow lectures and take notes. Sunva's transcription helps them switch between teachers, live captions, and presentations seamlessly. Schools and colleges can leverage the intelligent live transcription capability of Sunva AI to help the deaf students to attend classes.

This way the deaf students can easily switch their attention from the teacher moving around the class to the live transcription and to the white board or presentation screen in the classroom.

Deaf students with non-standard speech can ask their doubts and answer teacher's questions using Sunva's AI voices. They can type what's in their mind and Sunva AI will speak it aloud for them.

For deaf people with non standard speech it is hard to raise their queries in public places like in a bank or in a railway station. Especially in the crowded spaces where other people are waiting in line for the service.

In such situations they can use Sunva AI's text to speech capabilities to type in their queries and the AI voice will ask the queries for them.

They don't have to worry about typing the full sentences. The predictive intelligence will complete their sentences and ask it aloud using TTS.





Our goal should be to provide equal opportunities to everyone. Due to the lack of proper systems in place a lot of deaf people are blocked from pursuing their dream jobs.

If deaf people can use Sunva AI during interviews they will be able to understand the questions asked by the interviewer and easily respond back using Sunva AI's voices.

A lot of deaf people have issues understanding language. But this doesn't mean they are skilled to do a job. They can demonstrate their domain knowledge and skillsets with the help of simplified live captions and text to speech interface of Sunva.

Sunva AI can be a valuable tool for communication with deaf individuals during disaster management by providing real-time transcription of spoken information from emergency responders, with the ability to highlight key details and summarise less important content.

This helps to ensure that the needs of deaf individuals are met during a disaster, while also reducing the cognitive load of managing information during high stress situations.

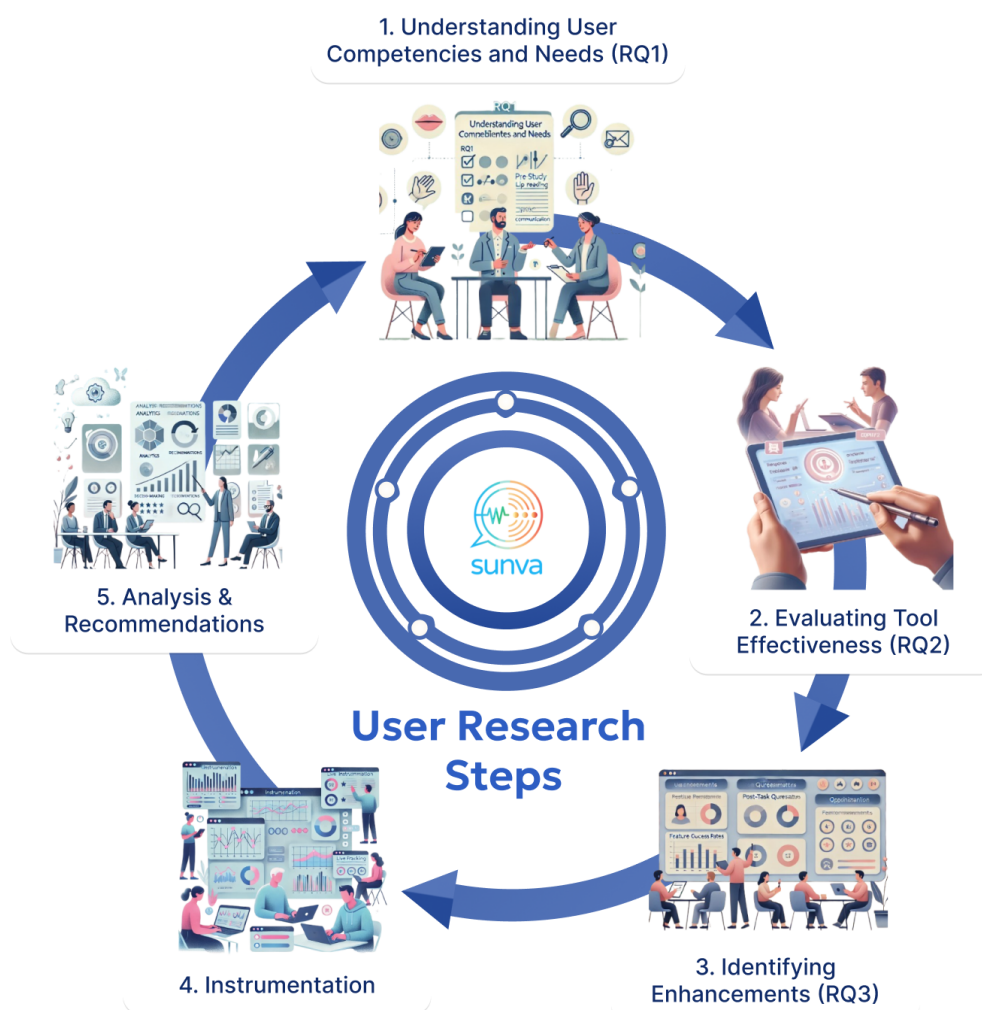
Sunva's adaptability and its potential for integration with other applications could improve communication and coordination in disaster relief efforts.



Our learnings from building the technology:

1. A lot of Speech to text APIs available for Indian languages don't support real-time speech recognition. So we implemented a pseudo real-time speech by chunking 3 seconds of audio and sending it to the APIs for processing. This creates small latency but for the user research purpose this is fine.
2. For real-time audio processing we need a proper engineering pipeline to process the audio and the text processing by LLMs in an asynchronous fashion. We couldn't find volunteers with expertise in those areas to work on this part of the project. And that was a big challenge.
3. Our text to speech interface using AI4Bharat TTS APIS works really well. But there are scopes of improvements in areas like adding emotions to the voice, better pause in the generated speech, passing the parts of completed texts to the speech pipeline to reduce latency between typing what's in the mind of the deaf person and generating the speech.
4. We decided to build the minimum viable version to showcase and take feedback and eventually bring in more developers as well as partners to build the real-time speech processing perfectly.

Sunva AI: Preparing for User Testing



The user testing phase for Sunva AI is currently in the planning and design stages, with a focus on rigorously evaluating the tool's effectiveness for oral deaf individuals. The primary objective of this testing is to understand user needs, assess the tool's performance in real-world scenarios, and gather actionable insights for refinement. The testing process is structured around three key dimensions: understanding user competencies, evaluating tool performance, and identifying opportunities for feature enhancements.

Designing a Comprehensive Testing Plan

To capture a holistic view of Sunva AI's utility, the testing plan encompasses a range of communication scenarios that oral deaf individuals encounter in their daily lives. These include tasks such as participating in group meetings, attending lectures, and engaging in casual one-on-one conversations. By simulating these diverse contexts, the study aims to evaluate how effectively Sunva's features—such as speech-to-text (STT), text summarization, text expansion, and text-to-speech (TTS)—address the specific challenges faced by users.

Participant Recruitment and Preparation

Participants for the study will be oral deaf individuals from varied professional and social backgrounds. Recruitment criteria include proficiency in English or regional languages, smartphone ownership, and diverse levels of communication competencies, such as lip reading and typing skills. The plan includes dividing participants into two groups:

- **Control Group:** Participants will rely on existing communication methods to complete assigned tasks.
- **Intervention Group:** Participants will use Sunva AI to perform the same tasks, allowing for a comparative analysis of tool effectiveness.

Inclusion and exclusion criteria are carefully outlined to ensure the study's focus remains on oral deaf users without confounding factors such as severe visual impairments.

Methodology for Data Collection

A mixed-methods approach will be employed to collect quantitative and qualitative data:

- **Quantitative Metrics:** Task success rates, time taken to complete tasks, and feature usage logs will be tracked.
- **Qualitative Insights:** Post-task surveys and semi-structured interviews will gather user feedback on ease of use, feature effectiveness, and suggestions for improvement.

For the intervention group, specific feedback will be sought on the usability of Sunva's key features, such as the clarity of transcriptions, the usefulness of summarization, and the naturalness of TTS outputs.

Anticipated Insights

The testing plan is designed to address key research questions, such as:

1. What are the communication competencies and challenges faced by oral deaf users?
2. How effective is Sunva AI in supporting diverse communication tasks?
3. What enhancements are needed to optimize the tool for real-world use?

Adoption Strategies for Sunva: Individuals, Organizations, and Developers

Sunva is designed to make communication easier and more natural for people with hearing and speech difficulties. It gives deaf individuals—especially those who rely on lip-reading and spoken language—more choice, agency, and flexibility in their interactions.

By using AI to adapt to different communication needs, Sunva helps reduce cognitive fatigue and makes conversations feel more natural. This means better participation in classrooms, workplaces, and public spaces, helping to bridge the gaps that often leave deaf individuals excluded.

Sunva isn't just a standalone tool—it's built to integrate with other platforms and devices, expanding its impact through partnerships with organizations that support accessibility. Over time, it can also help strengthen language literacy, giving users the confidence to communicate more effectively.

At its core, Sunva is about breaking down communication barriers. By making conversations smoother and more accessible, it empowers deaf individuals to fully participate in education, work, and everyday life—helping them contribute to India's growth and development.

1. **Open-Source:** Sunva AI is open-source under the MIT license, with comprehensive documentation to guide deployment and integration.
2. **Self-Deployment:**
 - a. Individuals or organizations can set up Sunva using API keys for ASR, LLMs, and TTS.
 - b. APIs are documented for customization or integration into other applications.
 - c. Support for local OSS models and APIs integrations can be added one by one.
3. **Integration:**
 - a. Businesses can integrate Sunva APIs to make their products accessible to the oral-deaf community.
4. **Collaborations:**
 - a. Partnerships with governments and NGOs can enable customized deployments in schools, banks, or public services to improve accessibility.

Next Steps

The finalized testing plan will be carried out in controlled settings to ensure accurate, reliable data collection. Insights from this phase will help refine Sunva AI, making sure its features align with user needs and can be easily adopted in classrooms, workplaces, and public spaces.

Beyond improving Sunva, the results will also guide the development of future accessibility tools—bringing us closer to a world where AI-driven communication solutions truly support the oral deaf community.

Call to action

Sunva AI is built to make communication more accessible for India's deaf community. By focusing on real-world needs and using AI to bridge gaps, it tackles the everyday challenges that make conversations difficult.

At its core, Sunva is about flexibility and personalization—giving people more control over how they communicate. Instead of rigid, one-size approaches, it adapts to different speech and hearing abilities, helping deaf individuals navigate conversations more easily.

This white paper is an invitation to test, refine, and improve Sunva AI through collaboration. With real-world feedback, we can continue shaping technology that truly supports diverse communication needs—so that no one is left out of the conversation.



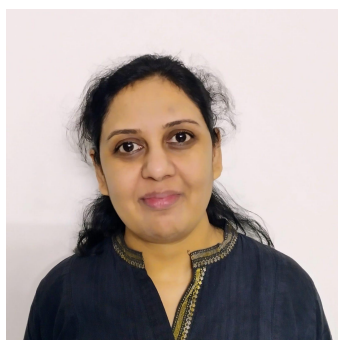
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Citations

1. The estimated number of deaf individuals in India is derived from the World Health Organization's webpage, last updated in 2023.
2. Definitions and decibel hearing level ranges for various terms are sourced from the British Society of Audiology.