SMART INDIA HACKATHON 2024

Sanchaar – Smart Intercom

- **Problem Statement ID – SIH1578**
- **Problem Statement Title-** Video call intercom based on Analog/IP system with Vibration Sensor.
- **Theme-** Miscellaneous
- **PS Category -** Hardware
- **Team ID- GLAUHT58**
- **Team Name (Registered on portal) – Tensor Minds**

TENSOR MINDS

Video call intercom based on Analog/IP system with Vibration Sensor

AI Powered Smart Intercom System - Your One Stop Solution.

Enhanced Communication and Extended Inclusivity To Everyone!

SMART INDIA HACKATHON 2024

GLA UNIVERSITY MATHURA

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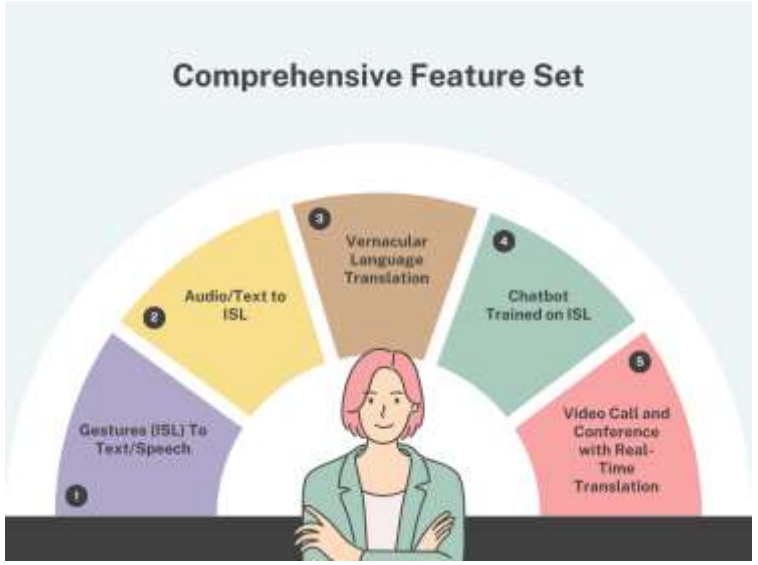
THE PROBLEM

Limited Accessibility in Traditional Intercoms

- **Lack of Visual Communication**, mostly supporting **Only Auditory** communication.
- **Inability in Inclusion of Deaf individuals** in **Real Time** Conversations, who rely on **Sign Language,** in environments like **Offices**, Homes or Public Places.
- **Lack of Effective ISL** (Indian Sign Language) and **Verbal Language Translation** and **Voice Generation.**

Emergency Response Challenges

Difficulty in **receiving and responding** to emergency alerts, leading to **delays in critical situations.**



OUR PROPOSED SOLUTION

We designed an Intercom System:

- Featuring **Video Call,** supporting **Multiple Users.**
- **Real Time ISL Translation** to **Text/Speech**, vice versa using Computer Vision, Open Source LLMs and customized dataset.
- **Multilingual Translation**
- **Vibration Sensor** triggering **Emergency** to pre-saved contacts.
- Cost-Effective **IP based** internal communication.
- **Offline, No Internet** required!
- **Portable,** Easy to use

TECHNICAL APPROACH

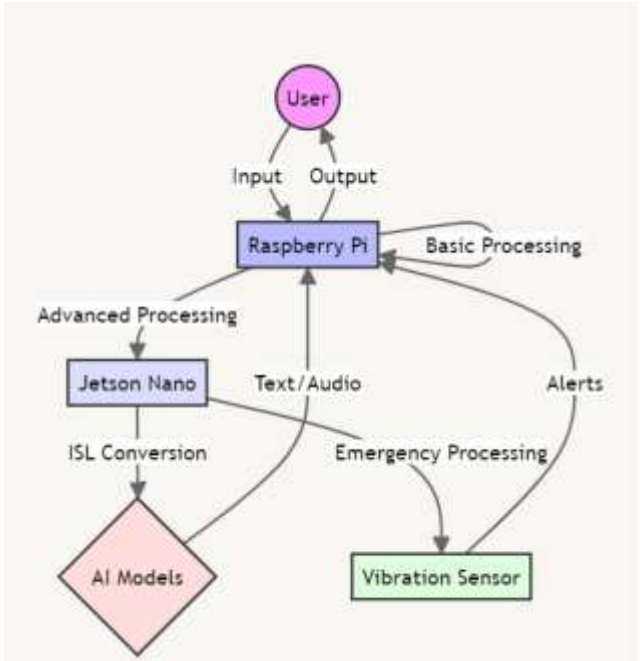
The Smart Video Call Intercom System enables seamless internal communication within buildings, especially for users with hearing impairments. Users at **Raspberry Pi client stations** can **initiate video calls or input Indian Sign Language (ISL) gestures**, which are **processed locally using WebRTC and sockets for real-time video communication**. Advanced tasks, **like ISL conversion** are sent to the **Jetson Nano server**, where **AI models convert ISL gestures into text or audio** and manage **vibration-based emergency notifications**. The **processed video, audio, or alerts are then transmitted back to the Raspberry Pi** for display or notification, with all communication occurring over a **secure local network**. **Emergency Notifications**: Alerts are communicated via buzzers and Flashing LEDs.

NVIDIA Jetson Nano
Server Station

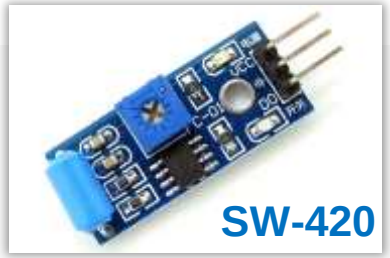
Central processing hub for **Offline AI**, **Gesture Recognition**, and **Translation**.

Raspberry Pi
Client Station

Hardware for the Video Call **Intercom System** with **Camera**, TFT Display, Microphone, Speaker, LEDs and **Vibration Sensor + Motors**.



Vibration Sensor



FEASIBILITY AND VIABILITY

Revenue Stream

Product Sales

- Intercom System Kits: Direct sales to residential and commercial customers

Subscription Services

- Software Updates & Support: Monthly or annual subscriptions

Customization Fees

- Tailored Design Solutions: Charging for unique UI designs, additional features, or specific hardware configurations

Enterprise Solutions

- Bulk Sales: Discounts for large enterprises, schools, hospitals, or housing complexes

Partnerships

- Collaboration with Smart Home Companies: Revenue from integration with existing smart home systems

- **Technical Feasibility** : Leverages mature technologies - Cost-effective hardware - Modular design ensures manageable integration complexity.
- **Operational Feasibility :** User-friendly - Accessible design for Deaf individuals - Low maintenance due to open-source tools and local processing.
- **Economic Feasibility** : Affordable development using open-source - Potential funding from accessibility-focused organizations.
- **Market Demand** : High demand for accessibility - Unique combination of features provides a competitive edge.
- **Social Impact** : Likely to drive widespread adoption due to practical benefits.

Potential Challenges and Risks

Limited Availability of Indian Sign Language **(ISL) Datasets**	**Integration** of Multiple Technologies with Differing **Compatibility**, High **Complexity** and **Synchronization** issues.	**Real-Time** Processing Performance and **Latency** challenges and Heavy Load due to **Multiple Simultaneous Users.**	**Vibration Sensor** Threshold setup to accurately assess desk taps
POSSIBLE SOLUTIONS			
We create our own **Customized Dataset** combining data from multiple sources.	We implement a **modular architecture** where different components are **loosely coupled**. This allows each module to function **independently.**	**Edge Computing** and **GPU Acceleration** on **Jetson Nano** as well as use of Optimized Algorithms and Load Balancing Techniques can handle load and improve latency.	**Calibration** and **Sensitivity Adjustment** , also allowing **User Customization.**

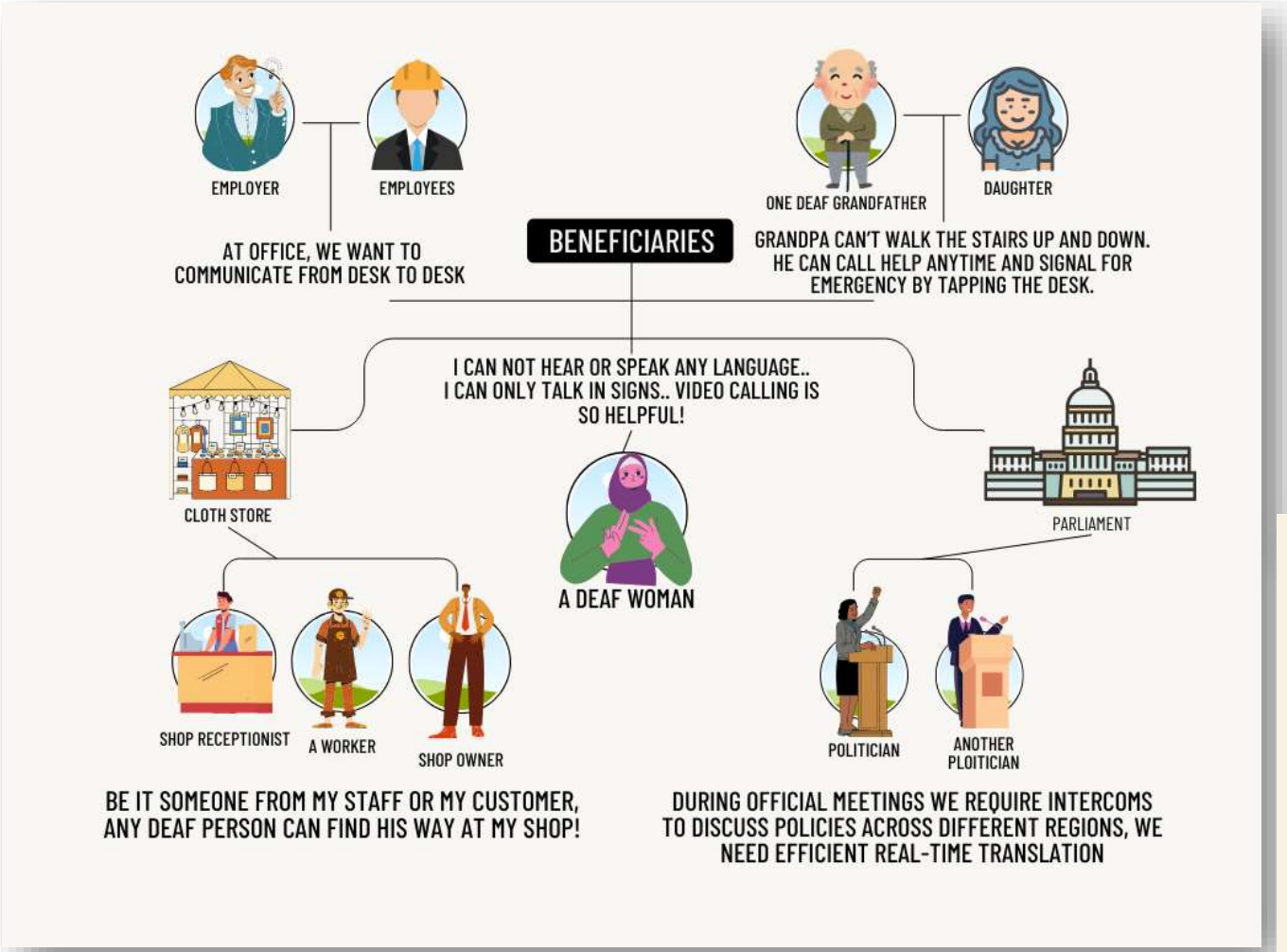
Show-Stopper

Real-Time Gesture Recognition and Translation: The most critical component of the project is the ability to accurately and efficiently recognize Indian Sign Language (ISL) gestures in real-time and translate them into text or speech. This feature is essential for the success of the intercom system, as it directly impacts the user experience and the system's effectiveness in facilitating communication for Deaf individuals.

Dependencies

1. **Reliable Hardware**: The performance of the Raspberry Pi or Jetson Nano, along with the camera and vibration sensors, is crucial for capturing and processing gestures accurately.
2. **Machine Learning Models**: The accuracy and efficiency of the AI models used for gesture recognition depend on high-quality datasets and robust algorithms.
3. **Network Connectivity**: Stable internet or network connections are necessary for real-time video calls and data transmission.
4. **Software Libraries**: Dependence on libraries such as TensorFlow, PyTorch, OpenCV, and WebRTC for AI processing, computer vision, and real-time communication.

IMPACT AND BENEFITS



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RESEARCH AND REFERENCES

Research Papers and Articles

- **A Review of AI Technologies for Sign Language Recognition"**
  -Link: IEEE Xplore
  Summary: Discusses various AI techniques for recognizing and translating sign languages, focusing on applications for the hearing-impaired community.
- **"IP-based Communication Systems for Smart Buildings"**
  Link: ResearchGate
  Summary: Provides an overview of integrating IP-based communication technologies in modern buildings, with a focus on efficiency and reliability.
- **"Vibration Sensors in Emergency Alert Systems: Applications and Innovations"**
  Link: Springer
  Summary: Explores the use of vibration sensors in emergency systems, emphasizing their role in alerting people with hearing impairments.

GitHub Repositiries

- **Indian Sign Language Recognition**. GitHub. https://github.com/shag527/Indian-Sign-Language-Recognition
- **Video Call System with WebRTC - :** A repository with sample code and documentation on building a video call **Link:** GitHub - WebRTC Video Call
- **Speech to ISL**. GitHub. https://github.com/prathyuma-08/Speech_to_ISL

Datasets

- **Data set** - Indian Sign Language Dictionary. (n.d.). Retrieved from https://www.data.gov.in/catalog/indian-sign-language-dictionary
- Indian Sign Language Research and Training Center (ISLRTC). (n.d.). Official Website. Retrieved from https://www.islrtc.nic.in

Additional Resources

- **Why Use Jetson Nano for AI Projects?** - Explains the benefits of Jetson Nano for AI applications, aligning with your hardware choice. NVIDIA Blog