Final Year Design Project Showcase
Batch-2022
Year 2026

	Department: Electronics Engineering Programme: Electronics Engineering
1	**Project Title** AI-Based Smart Sign Language Recognition Gloves for Real-Time Speech Conversion
2	**Project Idea** The project aims to bridge the communication gap between speech- & hearing-impaired individuals and the general public through an AI-powered smart glove. The glove uses flex sensors and an inertial measurement unit (IMU) to capture hand and finger movements. An embedded TinyML model deployed on an ESP32 microcontroller recognizes predefined sign language gestures in real time and converts them into natural speech through a speaker. The system is portable, low-cost, and works completely offline.
3	**Process** The proposed project involves the design and fabrication of a smart glove capable of translating sign language into speech in real time. The system integrates multiple hardware components, including flex sensors, an inertial measurement unit (IMU), an ESP32 microcontroller, a rechargeable battery, and a speaker, to capture and process hand gestures. A comprehensive dataset of sign language gestures is collected and accurately labeled to train a TinyML-based machine learning model. The trained model is then deployed on the ESP32, enabling on-device inference without requiring cloud connectivity. The system performs real-time gesture recognition and converts the identified gestures into audible speech, providing an efficient and portable communication solution for individuals with speech and hearing impairments.
4	**Outcome** The developed prototype successfully recognizes predefined sign language gestures with high accuracy and converts them into spoken words in real time. The system is lightweight, portable, and operates without requiring an internet connection, making it suitable for everyday communication.
5	**Evidence (Theoretical Basis)** The project is based on embedded artificial intelligence (TinyML), machine learning, sensor fusion, and wearable electronics. Flex sensors measure finger bending while the IMU captures hand orientation and motion. The collected sensor data is processed by a trained machine learning model running on the ESP32 microcontroller, which classifies gestures in real time. The predicted gesture is then converted into speech using an onboard audio module and speaker. This approach provides a practical, efficient, and privacy-preserving communication solution for deaf and mute individuals.
6	**Competitive Advantage or Unique Selling Proposition**

	(Cost Reduction, Process improvement, Attainment of any SDG (Sustainable Development Goal), increase of market share or capturing new market or having superior performance over a competitor. In summary, any striking aspect of the project that compels the industry to invest in FYP or purchase it. Some detailed description is required in terms of how, why when what. You can select one or more from the following dropdown and delete the rest of them). Please keep relevant options, delete the rest of them, and correct the sequence	
a	**Attainment of any SDG** The project supports SDG 3 (Good Health and Well-being) by improving communication accessibility and SDG 10 (Reduced Inequalities) by promoting social inclusion for speech- and hearing-impaired individuals.	
b	**Process Improvement which Leads to Superior Product or Cost Reduction, Efficiency Improvement of the Whole Process** Unlike camera-based sign language recognition systems, the proposed glove does not depend on lighting conditions, camera positioning, or internet connectivity. Real-time AI processing on the wearable device provides faster response, greater privacy, and improved portability.	
c	**Any Other Aspect** • Low-cost and affordable compared to existing commercial solutions. • Fully portable and battery-powered. • Offline operation ensures data privacy. • Easy to use in homes, schools, hospitals, and public places. • Scalable to support additional sign language gestures in future updates.	
7	**Target Market** The primary target users are speech- and hearing-impaired individuals. Other potential users include educational institutions, rehabilitation centers, hospitals, NGOs, government welfare organizations, special education schools, and families of deaf and mute individuals. The product can also be adopted by organizations working on accessibility and inclusive technology.	
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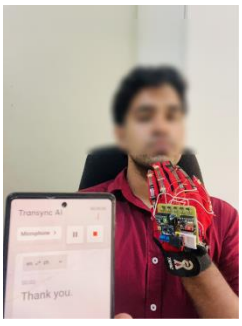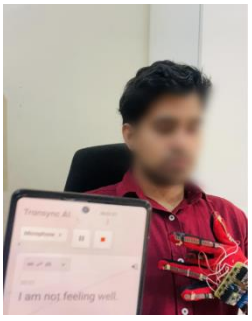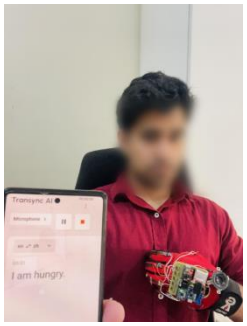
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