

Sign & Spell VR

Irish Sign Language Learning in Virtual Reality



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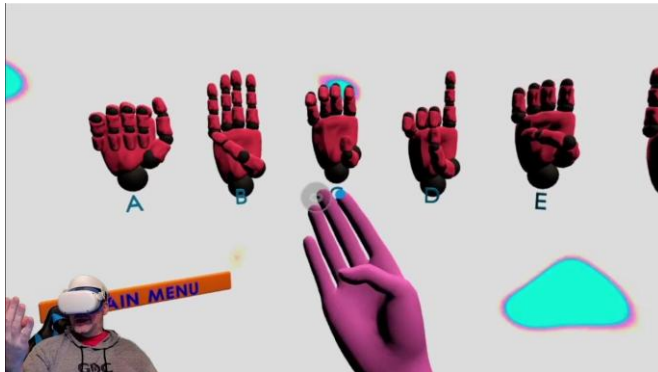
Supervisor: Colette Kirwan

Project

- VR app using hand tracking.
- Teaches Irish Sign Language alphabet, words, maybe even sentences.
- Meta Quest 3/3S with real-time feedback.
- Local Progress Tracking.

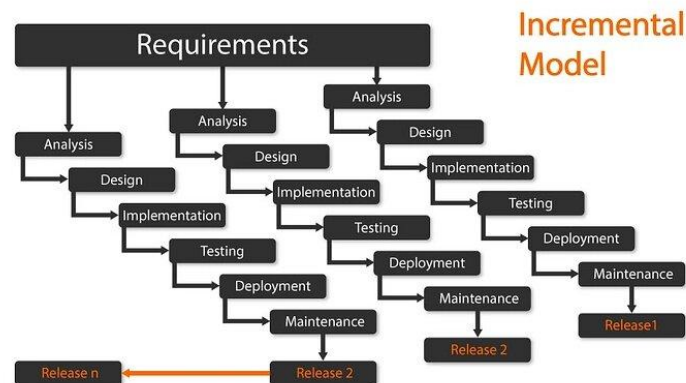
Background

- Existing Solutions: ASL FingerSpeller, Silent Classroom VR
- **Why Different:**
 - **ISL Focus**
 - **Common Words, in the future, sentence making**
 - **VR Immersion**
- Less Common than ASL – Fills a Gap
- Ethical Approach: Designed with Deaf community input, respects ISL cultural significance & accuracy (vs avatars as substitute)



Methodology

- Incremental Model
 - Core Features:
 - **Increment 1:** Real-Time Hand Tracking, recognition of basic ISL Letters, Real-Time Feedback
 - **Increment 2:** Common Words, Common Sentences, Improve UI
 - **Increment 3:** Data Saving



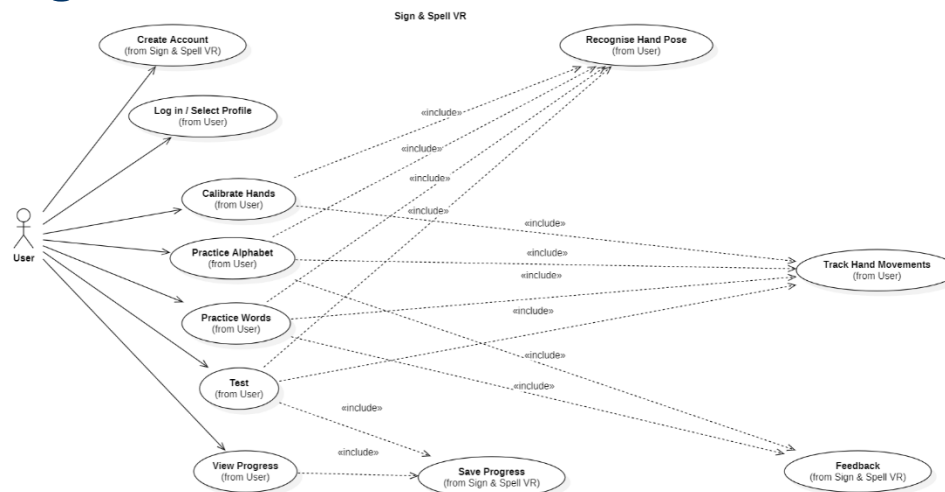
Technologies

- **Operating Systems(s):** Meta Quest 3/3S (VR headset OS)
- **Programming Language(s):** GDScript
- **XR Framework:** OpenXR
- **Data Storage:** JSON (local)
- **Game Engine:** Godot 4



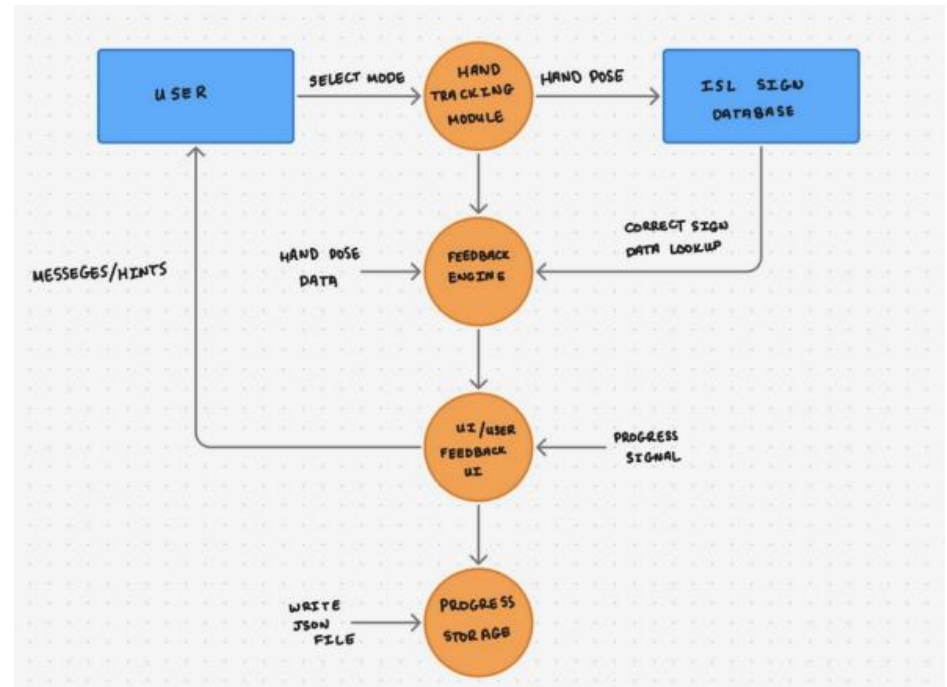
System Requirements

- **Requirements**
 - **Stakeholder Interviews:** Learners, Deaf Community, Teachers
- **Functional**
 - Hand Tracking, Sign Recognition, Feedback, Progress Storage
- **Non-Functional**
 - Low Latency, accessible UI, intuitive design
- **Use Case Diagram**



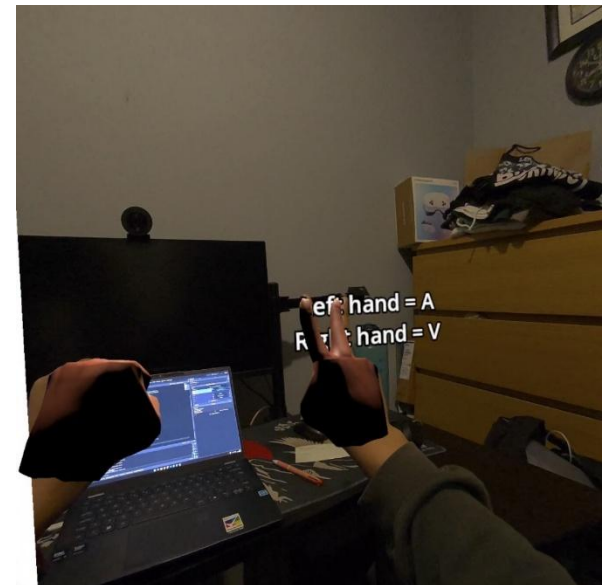
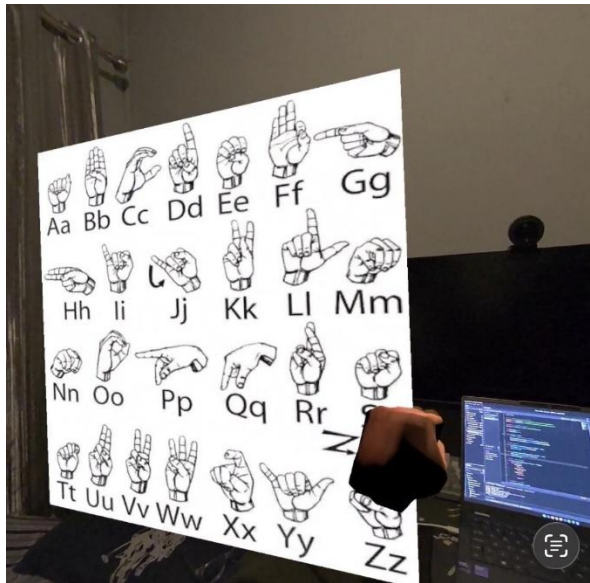
Technical Architecture

- Standalone VR application on Meta Quest 3/3S
- Hand tracking → Recognition → Feedback → Storage
- Data Flow Diagram



Front End Design

- Simple VR room with floating ISL alphabet reference board.
- Passthrough view shows user's real room plus virtual ISL hands.
- Live virtual hands mirror the user's hands for practice and feedback.
- On-screen text shows detected letters for each hand in real time (e.g. "Left hand = A, Right hand = V").



Middle Tier Design

- **Hand Pose Detection:** OpenXR sensors detect finger positions in real-time
- **Gesture Matching:** Compare user hand pose to stored ISL sign database
- **Confidence Validation:** Check if pose matches threshold for correct/incorrect
- **Real-time Feedback:** Generate visual feedback (correct/try again) instantly
- **Rule-based recognition:** simpler, faster setup

Back End Design

- Local JSON files store user calibration, progress, and settings on the Quest headset.
- One JSON structure per learner: user info, hand-pose calibration, learned alphabet letters, and simple stats.
- Accessed through Godot 4's FileAccess API in the user data path (no external DB).
- Designed so the same JSON can later be sent to a cloud service for sync without changing the data model.

DEMO HERE

- DEMO HERE

Evaluation Criteria

- “A”, “V”, and “D” is readable from hand-tracking on both hands.
- Feedback works when user signs “A”, “V”, and “D”, shows Left Hand = “A”/”V”/”D” and Right Hand = “A”/”V”/”D”
- User can complete a short practice session (A, V, D) without confusion or crashes.

Future Work

- Increment 2 (Immediate):
 - Complete remaining alphabet letters A-Z
 - Better Visualisation of the UI Environment
- Increment 2 (Christmas):
 - Implementing User Account Creation and Hand Calibration
 - Implementing Common Words
- Increment 3 (Post-exams: Late Jan–Late Feb):
 - Local Data Saving
 - Test Page
 - User testing & refinement

Thank you!

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Questions

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