

BRIDGING COMMUNICATION BARRIER WITH AI (AI4KSL)

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Background

1. Introduction

Kenyan Sign Language (KSL) is the primary language for Kenya's deaf community, serving as the medium of instruction from pre-primary to university and for daily social interaction. It is a natural language with distinct grammatical structures, unique handshapes, movements, and facial expressions, regulated by the Kenya Institute of Curriculum Development (KICD) to ensure consistency.

Current Work

1. Objectives

- Curation of English-KSL Gloss dataset
- Building spoken English and video-recorded KSL dataset
- Developing an assistive AI technology that converts spoken and written English into real-time KSL using virtual signing characters

2. Methodology

- Sequential explanatory mixed methods research design
- Approximately 15,000 English-KSL sentences were curated
- Videos of KSL signs were recorded using a front-facing camera
- Video annotation and segmentation
- 3D landmark extraction and Modelling
- Glossing Model and Signing Avatar
- System Evaluation: Experimental and Empirical Analysis

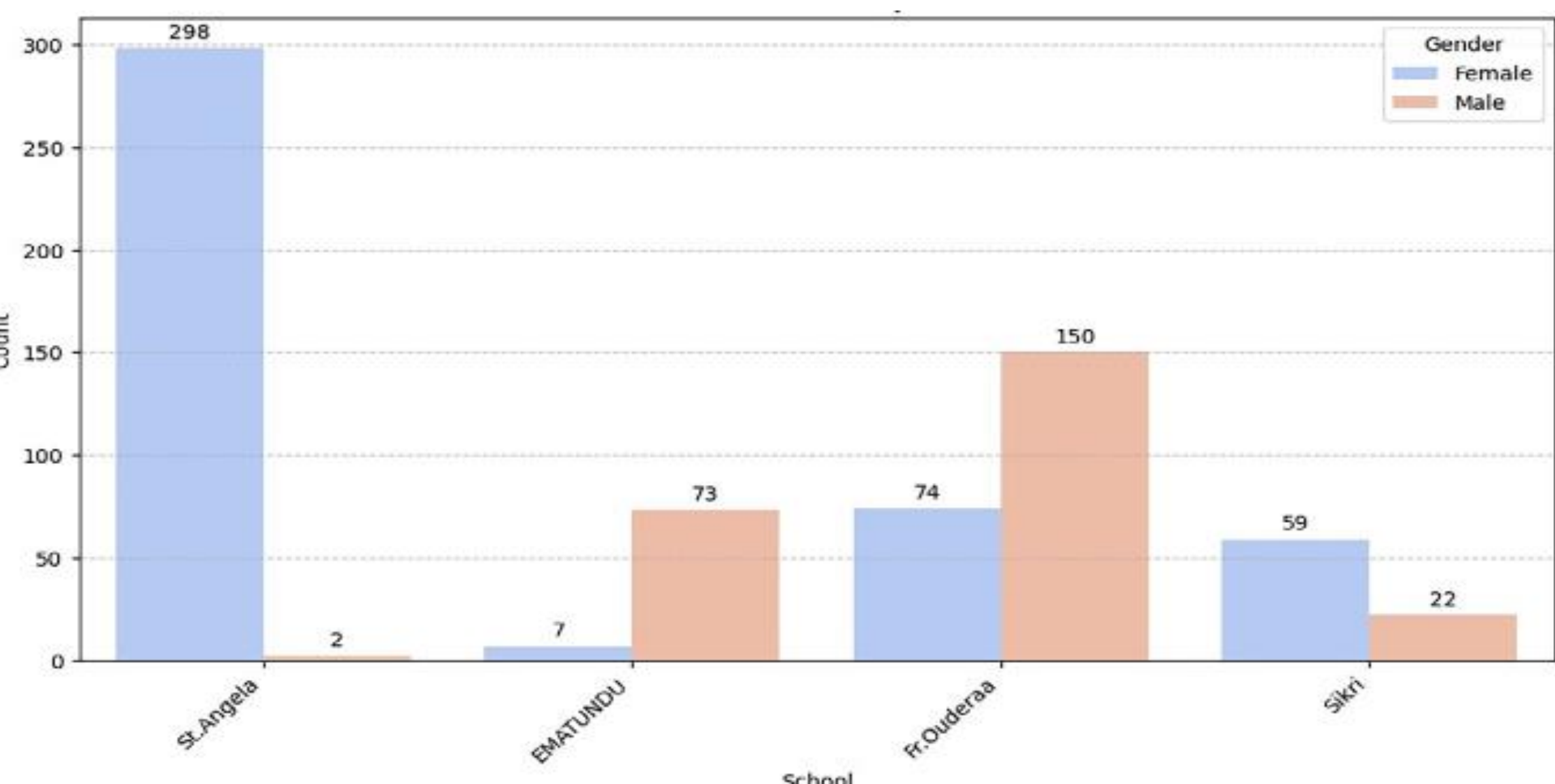


Fig. 1 Demographics

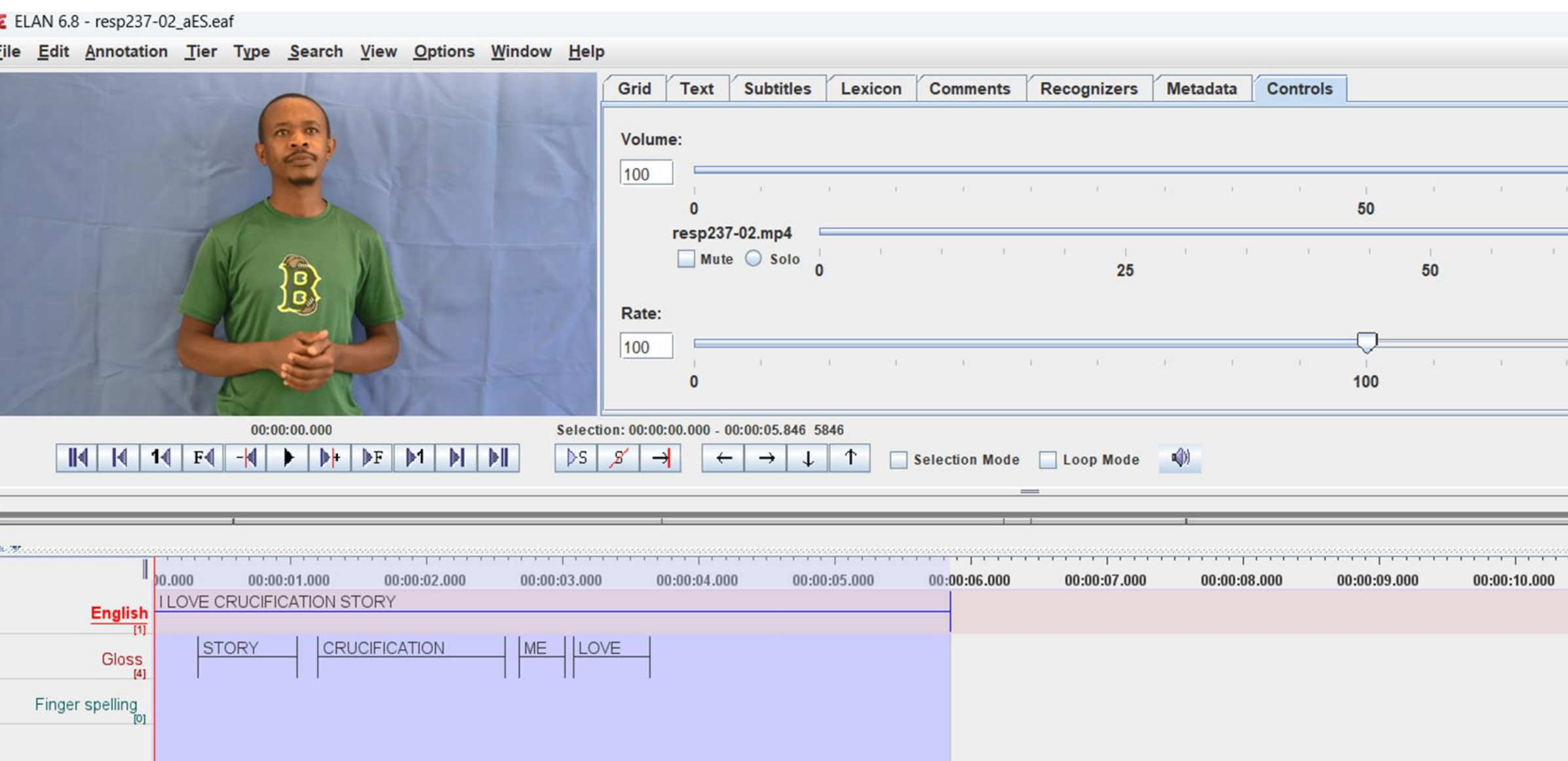


Fig. 2 Video Segmentation ELAN



Fig. 3. Landmark Extraction and Modelling

2. Problem statement

1. **Communication Barrier:** Deaf and Hard Hearing individuals struggle to communicate with non-signers due to limited public understanding of sign language.
2. **Dataset Need:** Assistive tools require visual sign language datasets, but sharing them risks exposing signer identities.

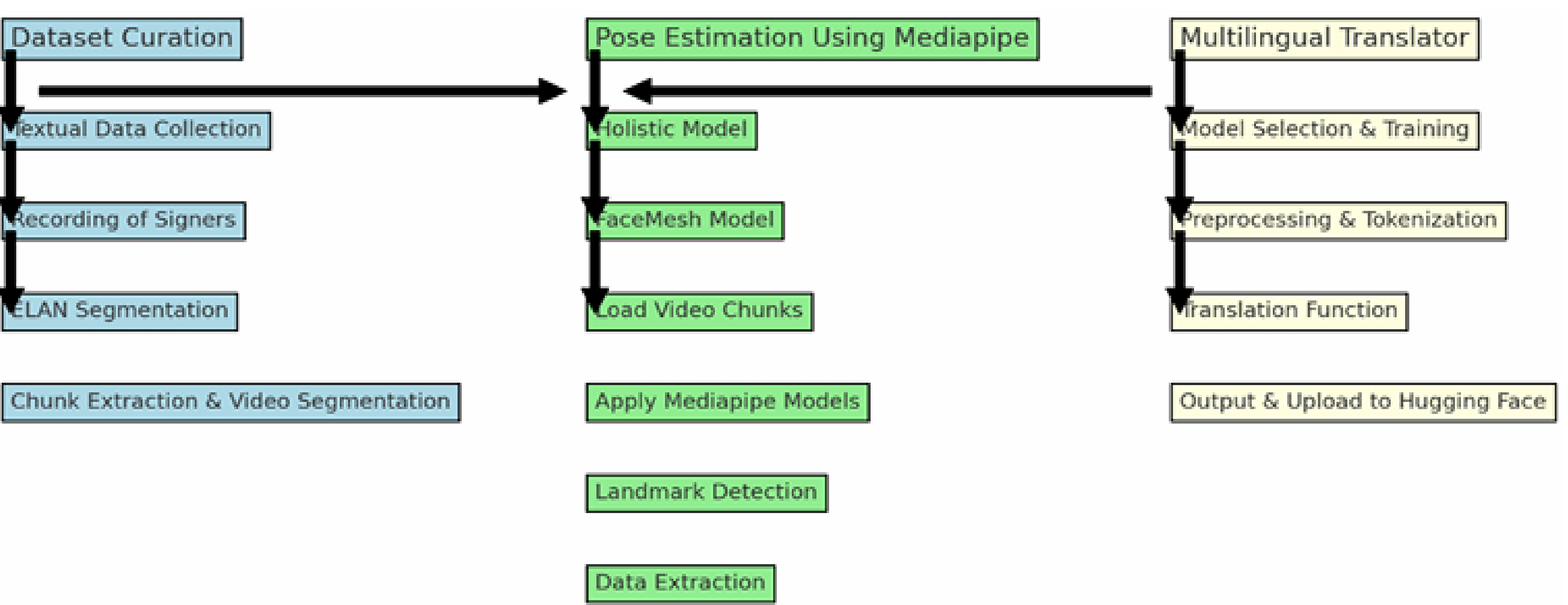


Fig. 4 AI4KSL Methodology

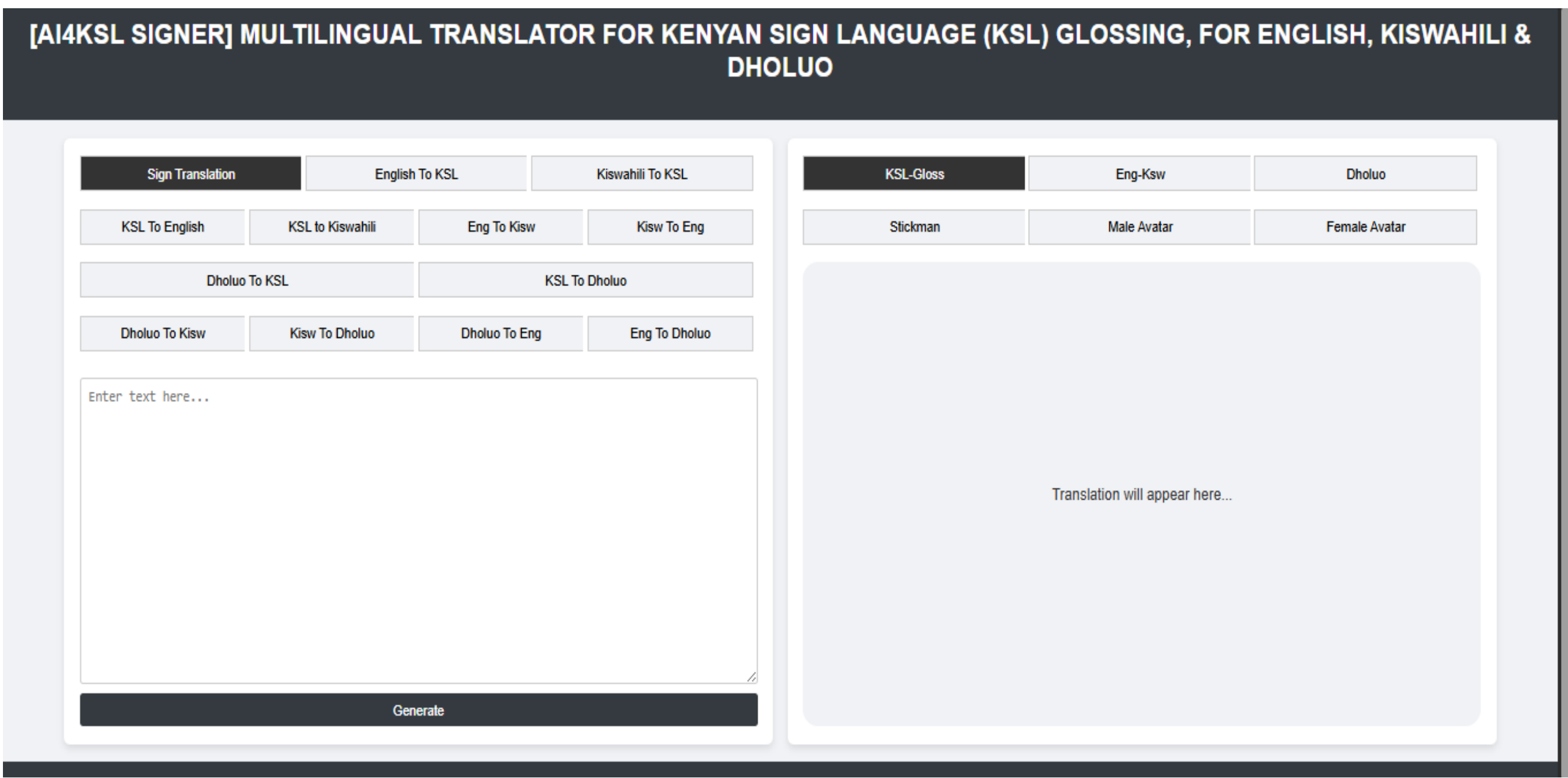


Fig. 4 AI4KSL Interface

3. Results

Experimental testing: Pose Evaluation-Figure
BLUE score analysis: 0.8813, 0.6220, 0.75, 0.89 and 0.81
Empirical Analysis: Users rated anonymization effectiveness highly ($M = 4.28$), alongside naturalness ($M = 4.07$) and gender representation ($M = 4.46$). Respondents particularly commended the avatar's gesture clarity, realism, and ability to conceal identity. While analysis showed statistically significant variation across age groups ($p < 0.001$), no significant differences were observed by gender ($p > 0.5$), indicating the system's broad inclusivity and effectiveness across diverse user demographics.

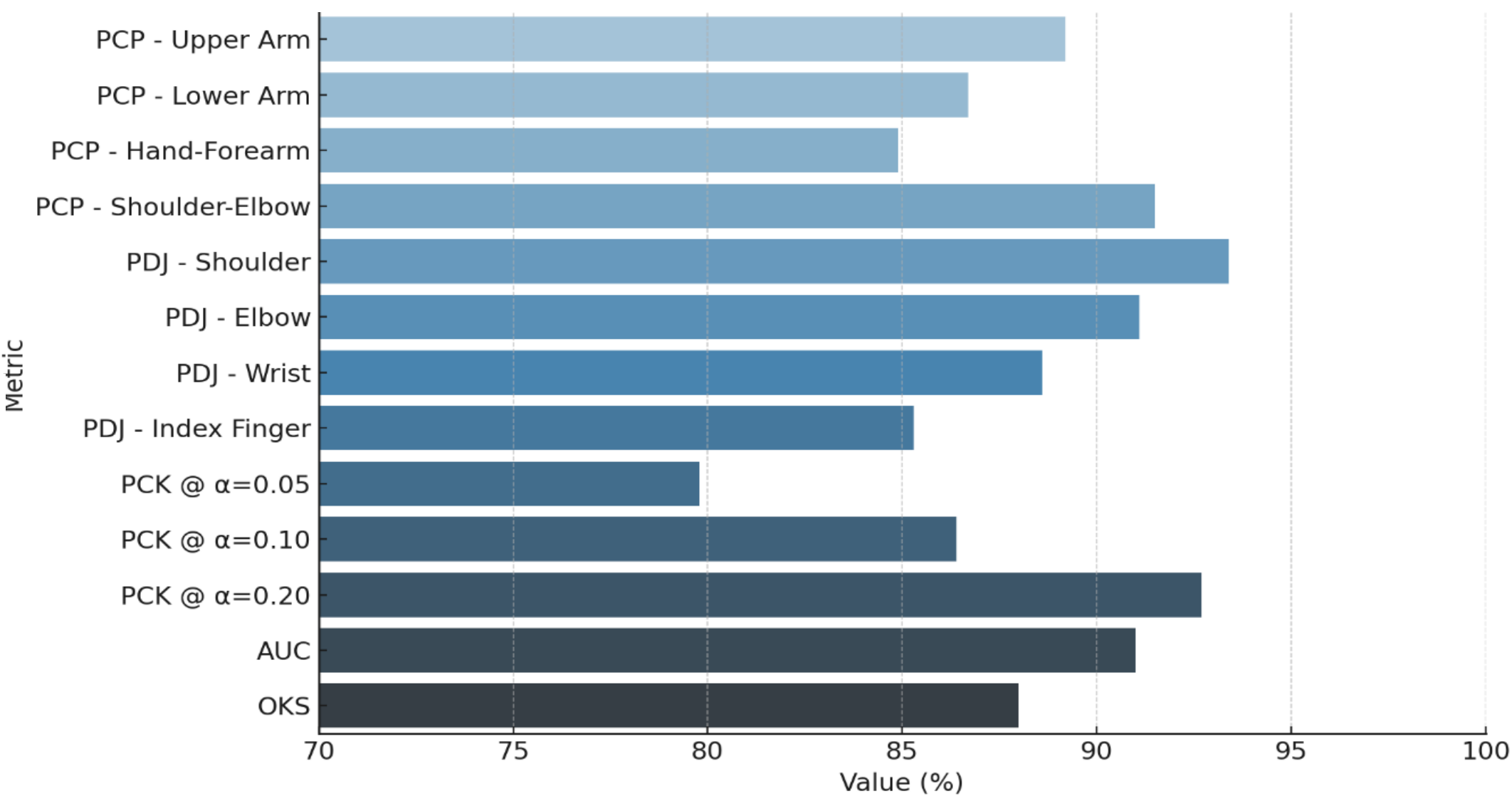


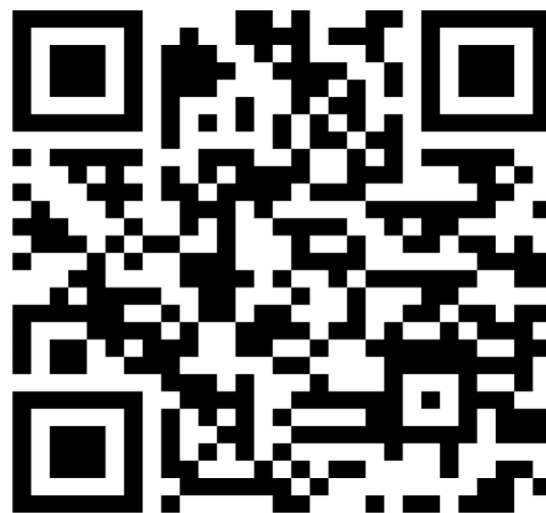
Fig. 5. Pose Evaluation

Conclusion & Recommendations

The AI4KSL project marks a foundational step in developing assistive AI technology for KSL, aiming to break communication barriers, increase learning outcomes, and improve bilingual proficiency for deaf learners. The curated datasets are vital resources for advancing sign language research and AI applications in special education for individuals with special needs, particularly in Africa.

Model and Dataset Improvement: Refine dataset quality by integrating linguistic rules, spatial features and facial expressions; enhance human-in-the-loop evaluation; and expand language support to Kenyan languages and other African languages.

Real-world Deployment: Conduct classroom testing/deployment with deaf learners for feedback and scale the solution for global impact in deaf education.



Acknowledgment

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