Sign Language Translator

CS 4391.001 - Group 3
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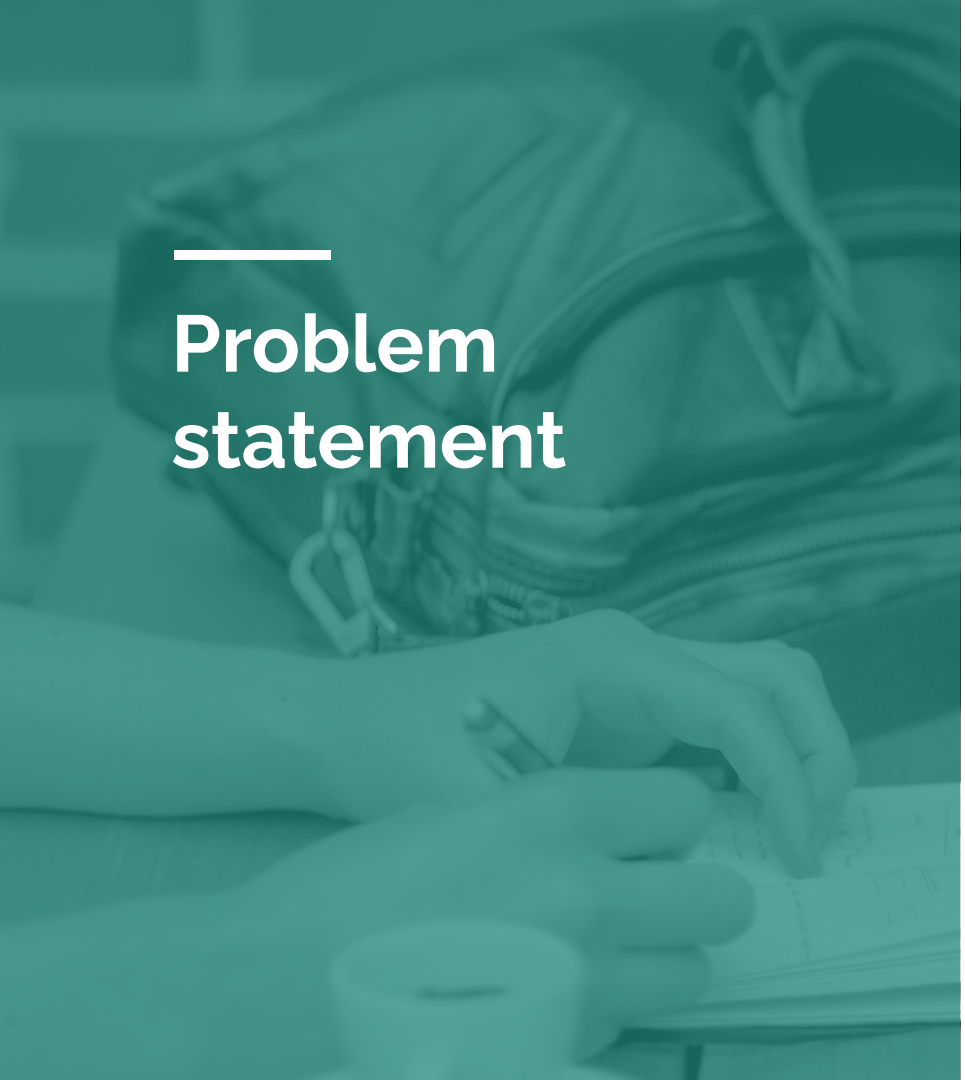
Outline

The Problem



Problem statement

Millions of people worldwide use Sign Language as their primary means of communication.

However, communication barriers persist between sign language users and non-signers, limiting accessibility in everyday interactions. A real-time, accurate translation system is needed to bridge this gap and promote inclusive communication.

Our Method

Technical Stack & Architecture

- PyTorch - Deep Learning Framework
  - CNN Neural Network Implementation
  - Model Training & Inference
  - CUDA GPU Acceleration
- OpenCV (cv2)
  - Real-time Video Capture
  - Image Preprocessing
  - Frame Analysis
- Pillow (PIL)
  - Image Processing
  - Data Augmentation
  - Format Conversion

Implementation Details

- Data Pipeline:
  - Kaggle ASL Dataset - 87,000 images for training
  - 26 classes (A-Z)
  - Real-time webcam input processing
- Processing Steps
  - OpenCV: Capture & frame extraction
  - PIL: Image resizing & normalization
  - PyTorch: Model inference
- Model Architecture:
  - CNN-based classification
  - Cross-entropy loss function
  - Adam optimizer
  - Batch normalization

Our Results

A	B	C	D	E	F	G	H	I	J	K	L	M
0	1	2	3	4	5	6	7	8	9	10	11	12

N	O	P	Q	R	S	T	U	V	W	X	Y	Z
13	14	15	16	17	18	19	20	21	22	23	24	25

Experimental Results

- Model Performance:
  - Training Accuracy: 97% on Kaggle ASL dataset
  - Validation Accuracy: 98% on test set
- Key Metrics:
  - Letter Recognition Accuracy:
    - A-Z Individual Letters: 83% Overall
    - Most Accurate: Letters: A, L, Y (96%)
    - Most Challenging: Letters E, M, N (65%) and Z (No Gestures)
  - System Performance:
    - Average Latency: 40 ms
    - Memory Usage: 1.5 GB
    - GPU Utilization: 60%

Current Limitations & Future Work

- Technical Constraints:
  - Single-hand signing only
  - Limited to ASL alphabet (A-Z)
    - However, Z does not work because it needs a gesture
  - Lighting sensitivity
  - Fixed camera angle requirements
- Next Development Steps:
  - Expand to multi-hand tracking
  - Add support for common ASL phrases
  - Improve low-light performance
  - Expand vocabulary beyond alphabet

Questions?

References

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