CADT
IDRI
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Research & Innovation

Khmer Sign Language Recognition System

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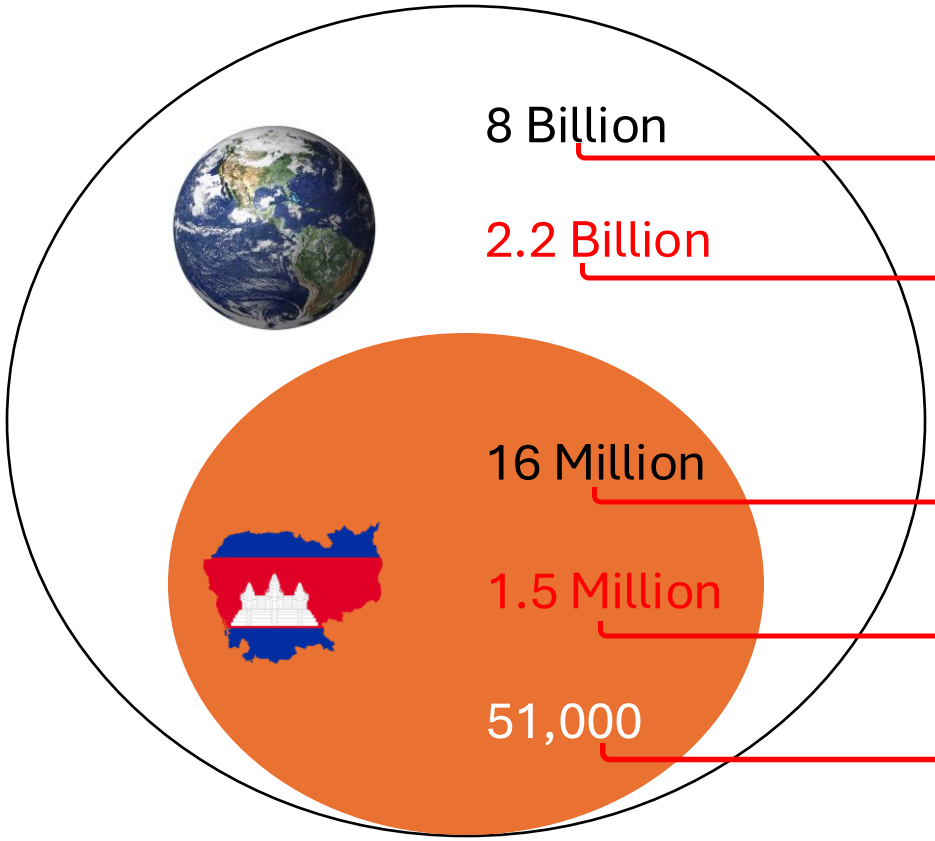
Overview



Global Population

Global Hearing Impaired
(**WHO,2023**)

Cambodian Population

Hearing Impaired in Cambodia
(DDP, 2022)

Profoundly Deaf in Cambodia

Problem Statement

- A significant communication gap exists between the hearing-impaired community and non-signers, leading to social isolation and difficulties in accessing education.
- Traditional communication methods are insufficient, and there is a need for technology that can bridge this gap in real-time.
- Sign language is not universal, and there is a need to develop a proper one for Khmer Language.

Khmer : ខ្ញុំ
English : I

Khmer : អ្នក
English : You

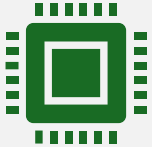
Objective

- Collect data for Khmer Sign Language.
- Identify the symbolic expression through images and videos so that the communication gap between a normal and hearing-impaired person can be easily connected.
- Create a prototype for predicting in real time.

Sample prototype

Methodology

Data Collection



Data Processing

Model Selection

Data Collection

- Video Collection
  - 100 words or classes will be collected.
  - Each class will contain around 10 to 15 videos by recording.
- Data Diversity
  - **Signers**: Include data from a diverse group of signers (different ages, genders, ethnicities).
  - **Variations**: Record variations in speed, signing style, and regional dialects.
  - **Environment**: Capture signs in different lighting conditions and backgrounds to improve model robustness.

Data Collection (cont.)

- Dataset overview

Number of Video	Participants	Location	Number of Word	Frame Rate	Resolution	Recording Device
2,645	8 signers	NISE	100	30 fps	1920x1080	Digital Cameras and Smartphone

Data Collection (cont.)

Khmer : កណ្តាល

Khmer : ខាងជើង

Khmer : ខាងត្បូង

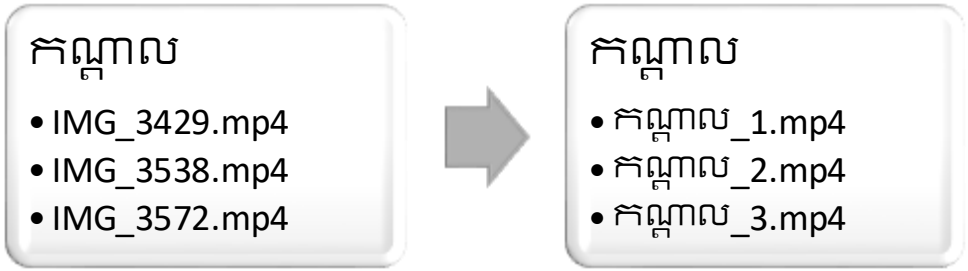
Khmer : ឈ្មោះ

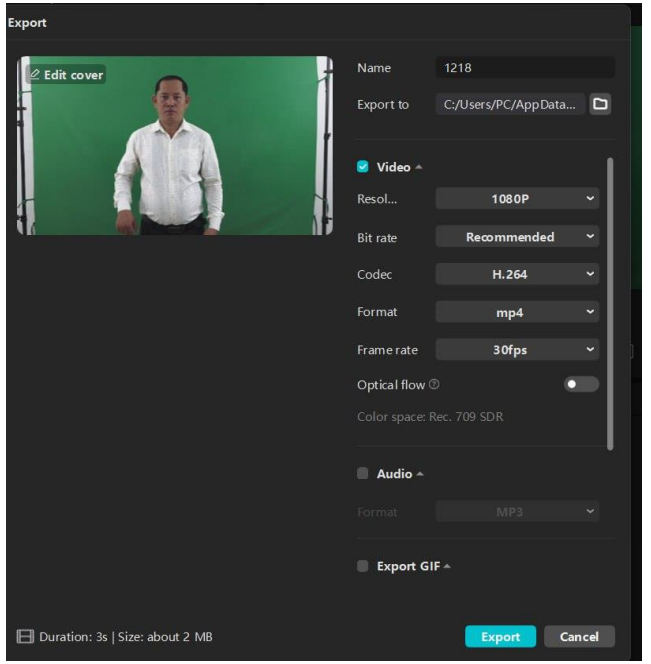
Khmer : គាត់

Khmer : នាយិកា

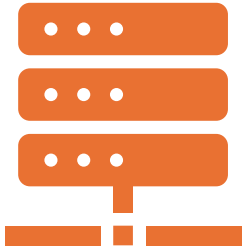
Data Processing

- Trimming the collected videos to keep the interval of action and cut out the unnecessary moment.
- Labeling the videos based on it correspond action.





Model Selection



Convolutional Neural Network based (CNN)

R(2+1)D

Channel-Separated Convolutional Network (CSN)

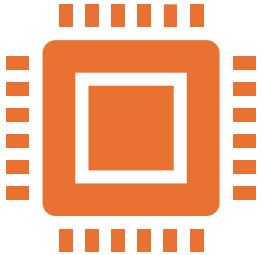
Transforms Architecture based

Video Vision Transformer (ViViT)

Experimental Setup

- We conducted this experiment with just 20 words.
- The total number of videos for this experiment: 580 videos

Experimental Setup



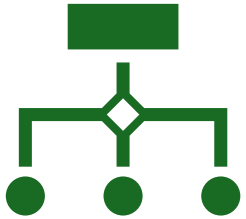
Data pre-processing & Augmentation

Resize video to (224,224) pixels

Apply frame skipping method and uniform sampling to 32 frames per video

Apply normalization

Apply center crop, random crop.



Hyper parameters

Learning rate: 1e-4

Epochs: 50

Optimizer: Adam

Loss function: Cross-Entropy Loss

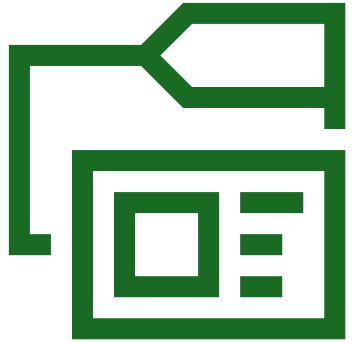
Data splitting: 70% for training, 30% for testing

Result & Discussion

Architecture	Precision	Recall	F1-Score	Accuracy
R(2+1)D	74.52%	71.27%	70.41%	71.27%
CSN	**86.00%**	**82.87%**	**81.20%**	**82.87%**
ViViT	82.68%	75.13%	75.31%	75.13%

Conclusion

The CSN model outperformed other networks for Khmer Sign Language Recognition.



This work addresses the gap in KSL recognition and contributes to improving accessibility for the deaf community in Cambodia.

Future Work

01

Expand number of videos of each class with more sign variations to enhance the robustness and accuracy of the model.

02

Conduct experiment with more classes.

03

Develop the real-time prototype.

Research Internship Opportunity

Objective	To improve Khmer Sign Language Recognition
Expected Outcome	- Expand the size of dataset - Refine the current model for KSL
Main Task	- Do literature review on state-of-the-art for sign language recognition - Pre-process the data for the model training - Train and test the model - Run various experiments
Tools/Technologies	- Language: Python, Shell command - Technologies: CNN, Transforms, Pytorch …
Recruitment	- Student: 1 - Department: Software Engineer/ Data Science
Benefits	- Get hands-on experience and understanding of building sign language recognition system
Focus Point	- **Mr. Veng Ponleur,** AI/DS researcher, CADT - Email: ponleur.veng@cadt.edu.kh
Duration	- 3 months

Thank You