Sign Language Translation Using Image Processing

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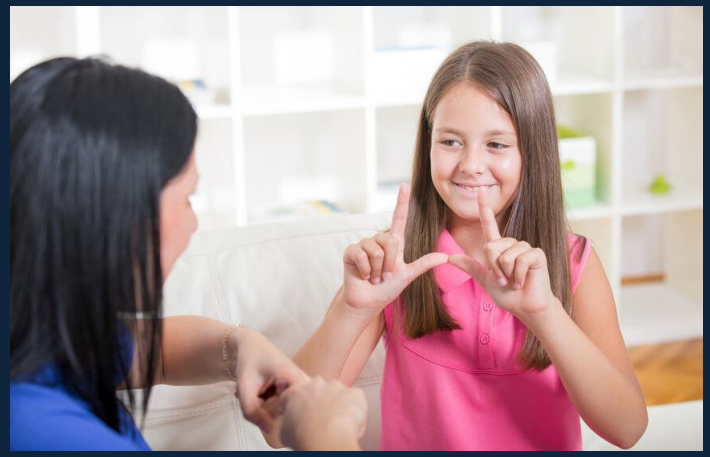
Problem

Communicating with a speech-impaired person using sign language

Communicating with a speech impaired person using sign language

- Deaf / mute people communicate using sign language
- But the general population lacks sign language communication skills
- A translator is needed when a normal person and a person with speech disabilities communicates
- This translation should happen in real time



Proposed Solutions

1. Sign Language Translator Glove (Initial Solution)
2. Sign Language Translator App

Proposed Solutions

Initial Solution - Sign Language Translator Glove

A wearable glove embedded with flex sensors to detect the finger positions from which the hand sign will be identified.

Sign Language Translator App

Real time sign language translation using image processing.

A camera will capture the hand signs and translate them through an application.

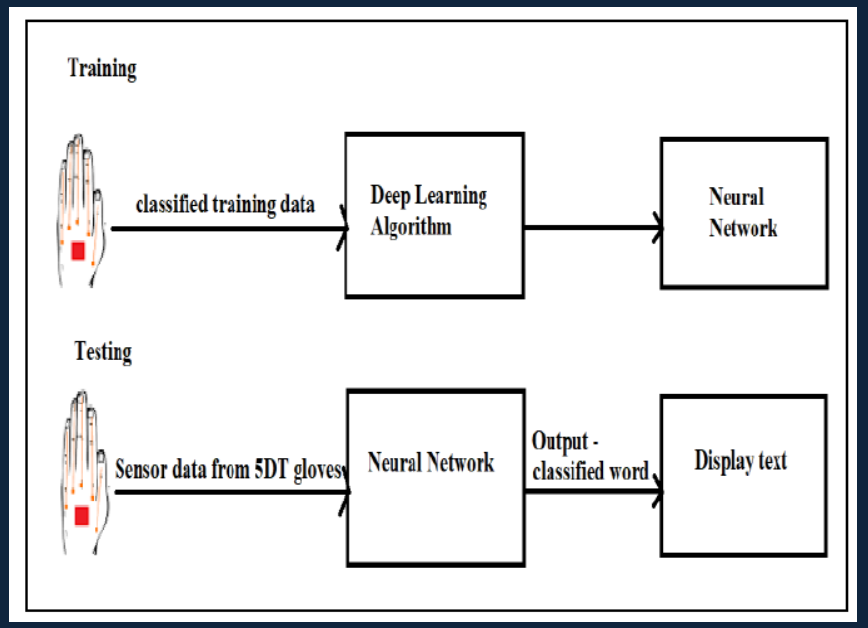
Sign Language Translator Glove

- The initial proposal was to develop a glove which has flex sensors for each finger and determine the hand sign by measuring the bend and the pressure applied in those sensors.
- The sensor data will be sent to a desktop application / app via a Bluetooth module / wifi module, and those data will be fed to an ML model which will classify them into a corresponding hand sign.
- There are some practical issues with the development of this design – cost, high complexity, unavailability of components

How It Works

User + glove

Hand Signs



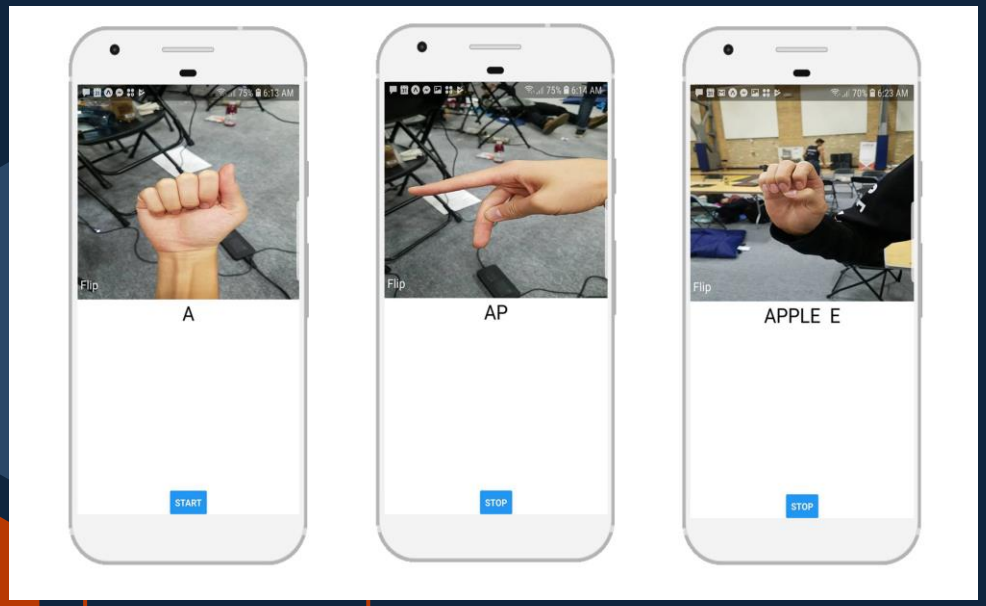
Display output

Challenges

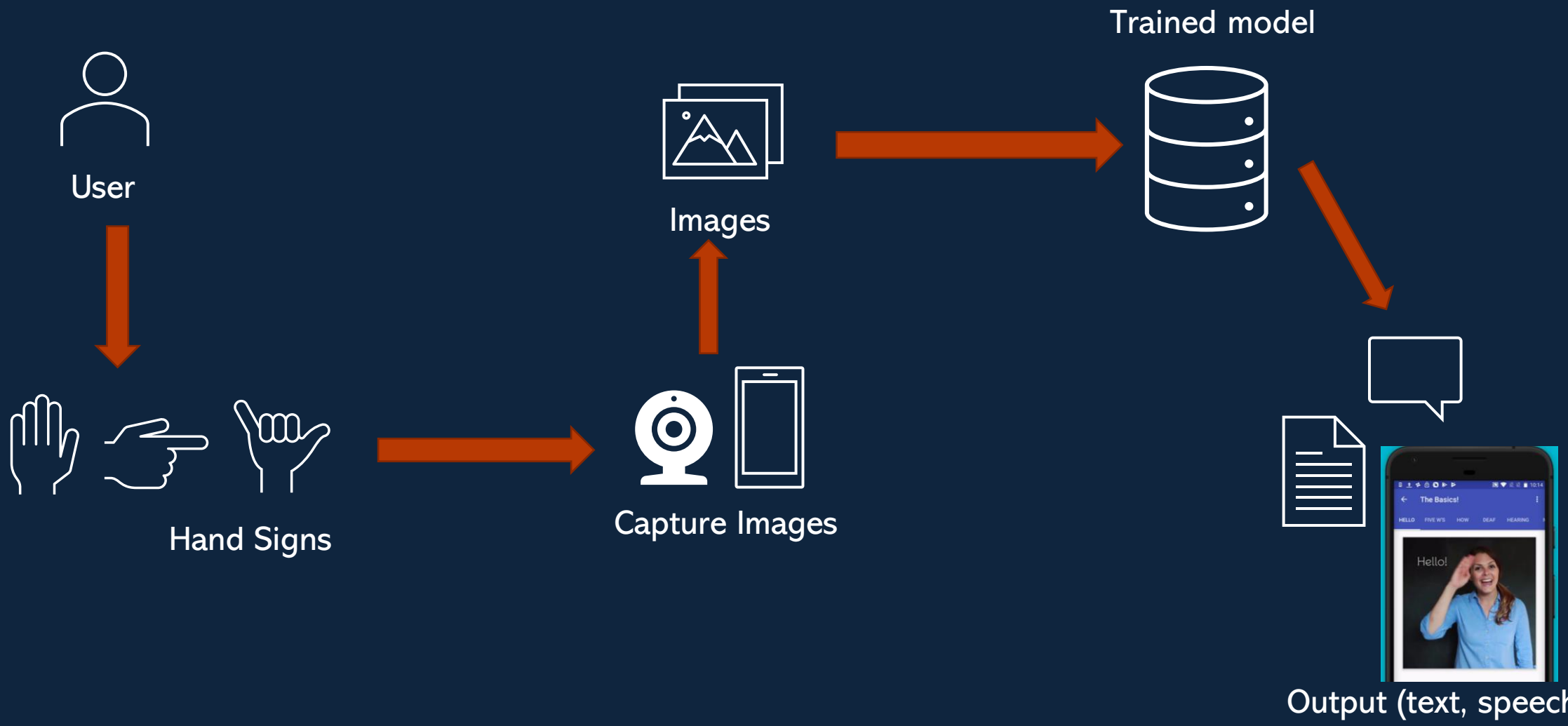
- High cost of the sensors
- To lower the cost, the sensors can be built by using copper foil tape and velostat sheets – however these components are not locally available
- Calibration issues with the handmade sensors – accuracy and speed may be affected
- Need to create new dataset with sensor values for training the ML model

Real-time Sign Language Translator App

- This is another solution for the given problem, and this uses image processing.
- A camera will capture images of the hand signs and they will be input to an ML model which identifies the respective letter / word.
- Since this is developed as an app, the smartphone camera itself can be used for image capturing.



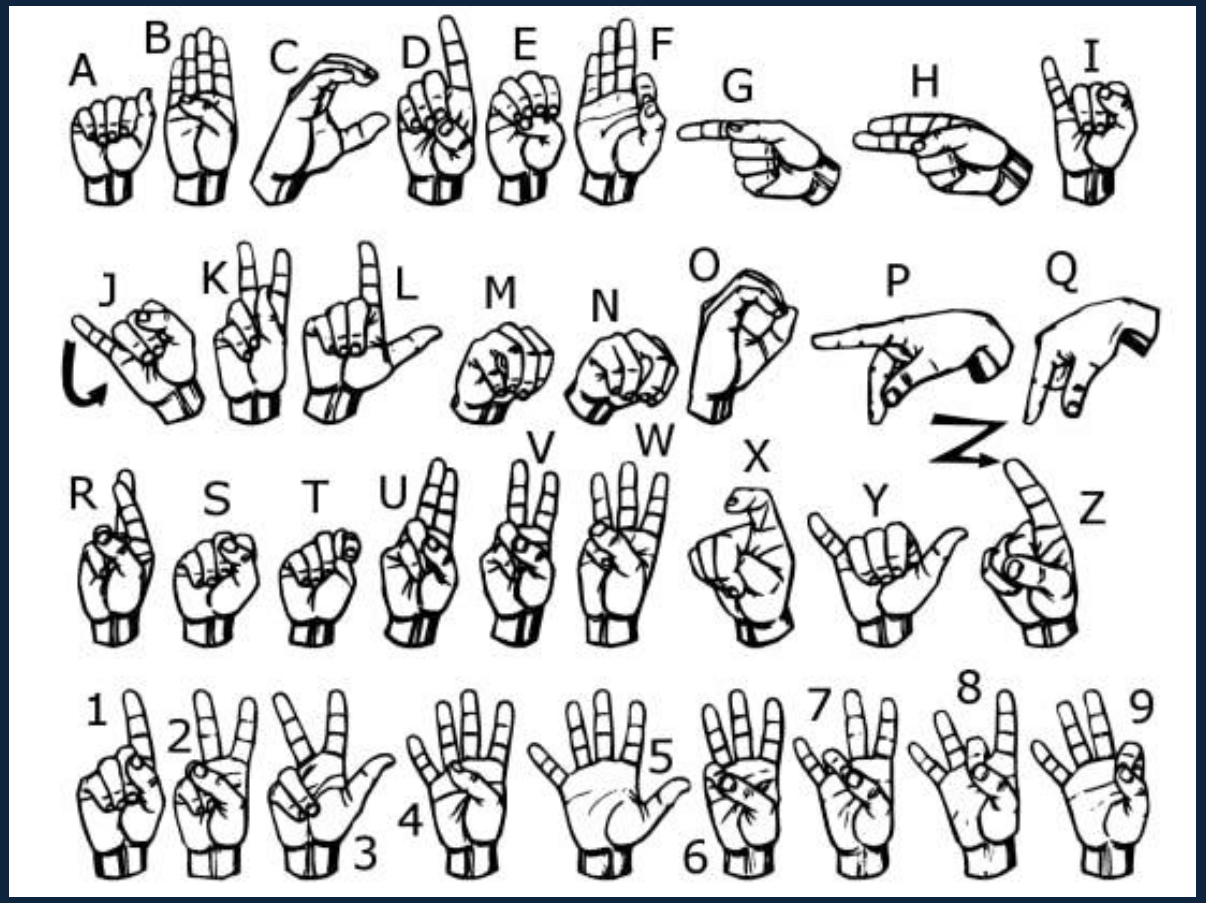
How it works


Trained model
User
Images
Hand Signs
Capture Images
The Basics!
Hello!
Output (text, speech)

Challenges

- The translation needs to be real time thus the camera should have a high fps rate to capture many frames as possible.
- The placement of camera, lighting and angle may affect the identification process of the hand sign.
- The ML algorithm should be able to output fast responses.

Scope



- American Sign Language (ASL)
- Alphabet and 9 digits' signs are targeted for development
- Many datasets are available

Subproblems

- The video captured by the camera should be separated into a stream of images and those images should clearly capture the gestures.
- Should find the most efficient algorithm for real time translation.

Previous Work

1. DeepASL
2. ARSL App

DeepASL

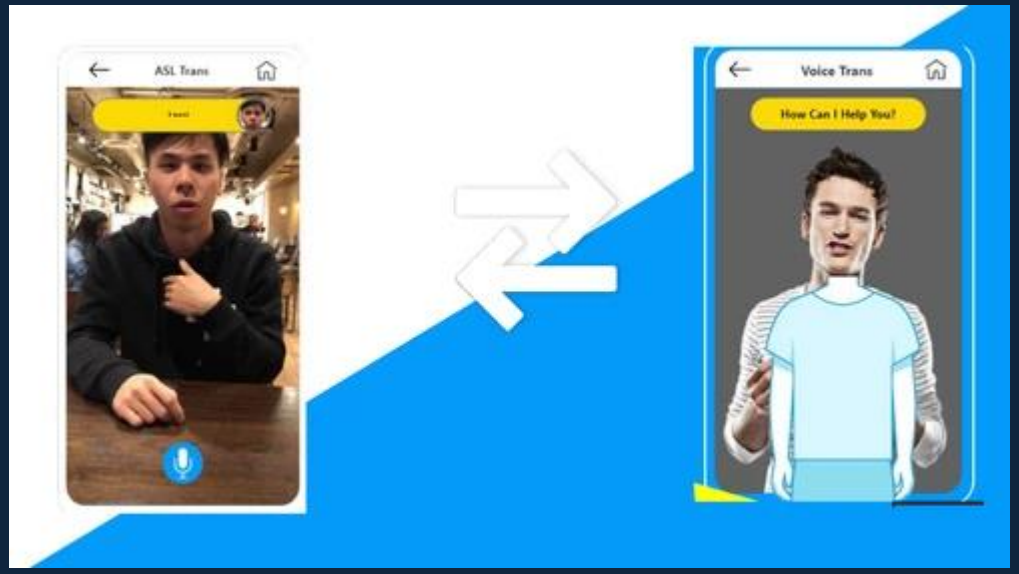
- A small tool, with a motion capture system, that translates ASL into English

- Developed by researchers at Michigan State University.
- This uses a camera device to capture hand motions, then feeds the data through a deep learning algorithm, which matches it to signs of ASL.
- DeepASL can translate whole sentences rather than single words, and doesn't require users to pause between signs

- Biyi Fang, Jillian Co, and Mi Zhang. 2017. DeepASL: Enabling Ubiquitous and Non-Intrusive Word and Sentence-Level Sign Language Translation. In Proceedings of the 15th ACM Conference on Embedded Network Sensor Systems (SenSys '17). Association for Computing Machinery, New York, NY, USA, Article 5, 1–13. https://doi.org/10.1145/3131672.3131693

ARSL app

- “Augmented Reality Sign Language”
- Can translate both ways.
- The app combines computer vision with AR to capture specific sign language hand gestures
- It is a prototype developed by NYU Tandon School of Engineering graduate students



- https://vrscout.com/projects/prototype-ar-app-translates-sign-language/

Other work

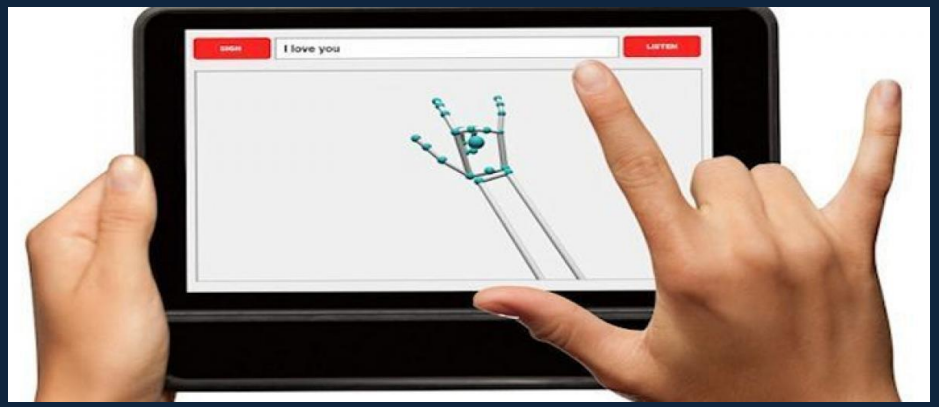
- Companies / groups working on sign language translation :
  - SignAll
    - Automatic sign language translation by using AI and Computer Vision
  - Easier
    - A project that aims to design and develop a complete multilingual machine translation system
    - Uses sign language recognition, machine translation, data processing etc.

- Many research work on sign language interpretation using machine learning methods

Demonstration

The final output will be a smartphone app that can translate ASL real time into text or speech.

Live demonstration of the app's functionalities.



Thank you