

# ASL Learning Platform

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# Creating an ASL Learning Platform

- Facilitate ASL remote learning
- Users able to learn signs and test their knowledge
  - Signing into a camera
  - Getting immediate feedback on sign correctness
  - Flexibility in learning pace and schedule



# Use-Case

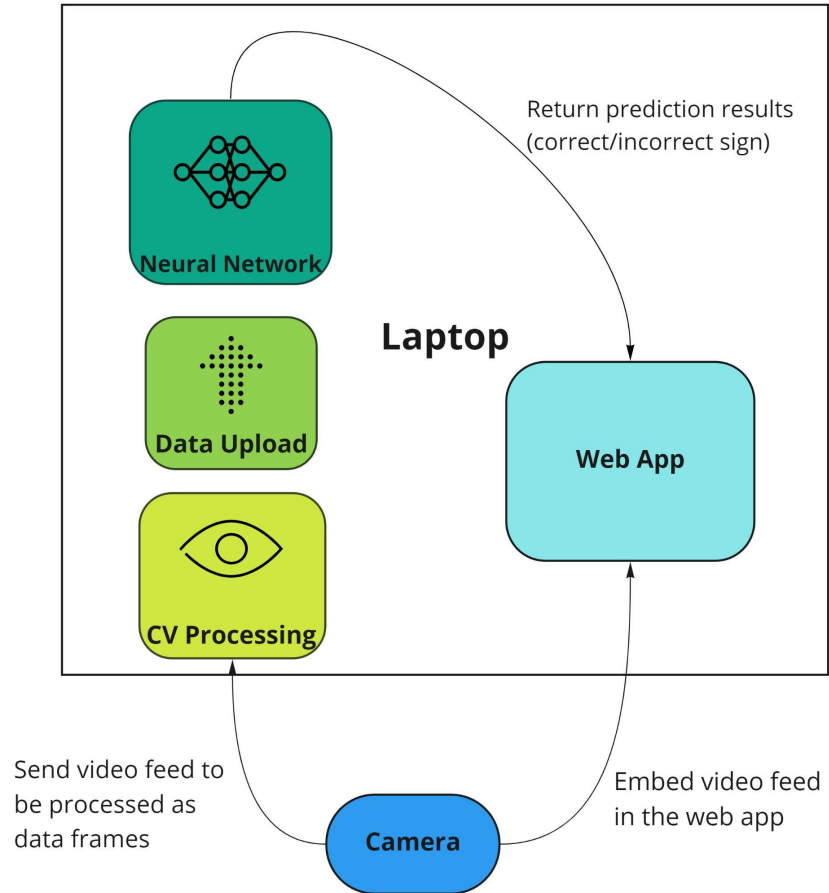
- **Existing solutions:** learning ASL websites and apps, in-person instructors
- **Our take:** giving live video feed and allowing user flexibility
- **ECE Areas:** Signals & Systems, Software Systems



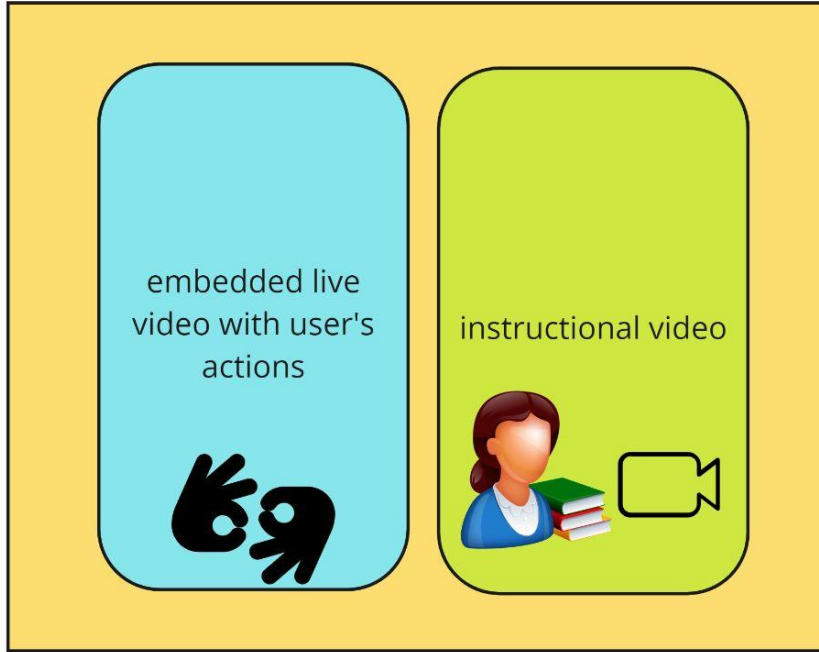
<b><u>Requirement</u></b>	<b><u>Metric</u></b>
Use computer vision to recognize when user is making ASL signs	<b>15</b> communicative signs + <b>26</b> alphabet letters + <b>10</b> numbers (0-9)
Model continues detecting user signs at a reasonable distance	Within <b>5 feet or less</b> when facing camera head on
Correct detections occur in a timely manner	Within <b>2 seconds</b> of visual input being received
Accurate feedback on correct vs incorrect signs	<b>90%</b> accuracy
Webapp displaying feedback to user	<b>80%</b> user satisfaction based on user testing

# Solution Approach

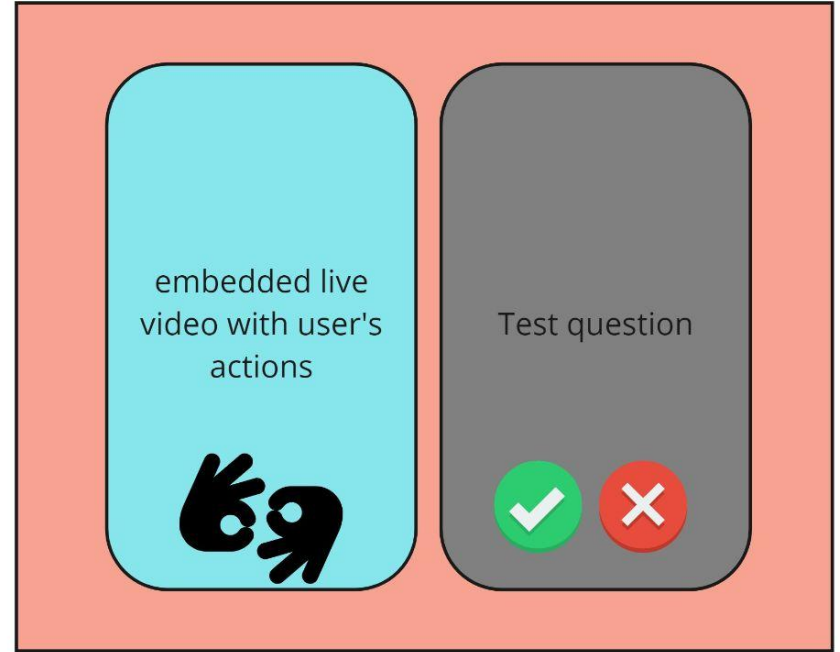
- Video Input
- Computer Vision
- Machine Learning/Neural Network
- Web Application



# Web App



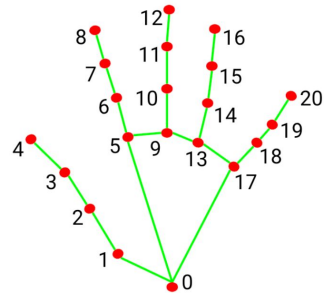
Learning mode



Testing mode

# Computer Vision

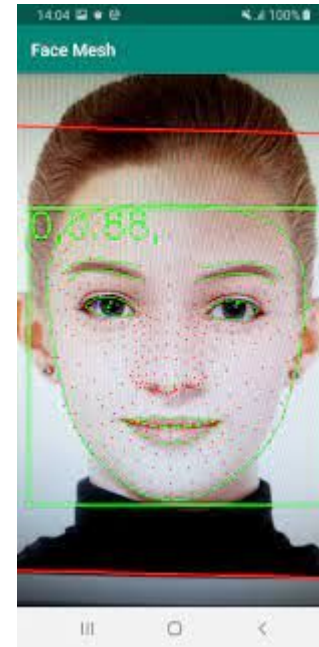
- Media Pipe
  - **Hands:** library to detect and label right and left hands
  - **Face Mesh:** library to detect and match up facial features



- |                       |                       |
|-----------------------|-----------------------|
| 0. WRIST              | 11. MIDDLE_FINGER_DIP |
| 1. THUMB_CMC          | 12. MIDDLE_FINGER_TIP |
| 2. THUMB_MCP          | 13. RING_FINGER_MCP   |
| 3. THUMB_IP           | 14. RING_FINGER_PIP   |
| 4. THUMB_TIP          | 15. RING_FINGER_DIP   |
| 5. INDEX_FINGER_MCP   | 16. RING_FINGER_TIP   |
| 6. INDEX_FINGER_PIP   | 17. PINKY_MCP         |
| 7. INDEX_FINGER_DIP   | 18. PINKY_PIP         |
| 8. INDEX_FINGER_TIP   | 19. PINKY_DIP         |
| 9. MIDDLE_FINGER_MCP  | 20. PINKY_TIP         |
| 10. MIDDLE_FINGER_PIP |                       |

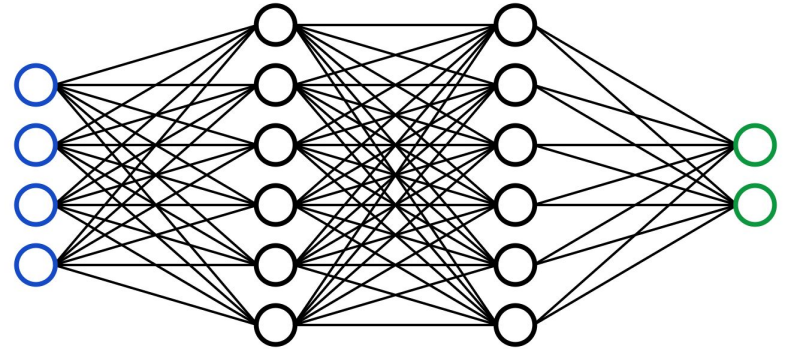


<https://google.github.io/mediapipe/solutions/hands.html>



# Machine Learning

- Find online sources of video/image data for signs, as well as create our own database of ASL data to use for model training and testing.
- Transfer learning: use an existing neural network. While keeping some of its structure/weights intact, we will tune the network with the new data that we found online and created.



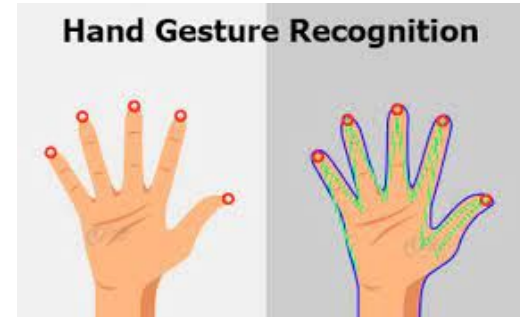


# Technical Challenges

<u>Challenge</u>	<u>Reason</u>
Training the models	Requires a large amount of data. Risk of overfitting or underfitting.
Handling video feed frames as inputs	Must decide on a particular sequence and number of frames
Determining sign correctness	Variation due to skin tone, left vs right hand, hand size, clothing/accessories, etc.

# Testing, Verification, and Metrics

- Distance of camera
- Latency and sign detection
  - How many gestures and how fast it will detect it?
- User interface for web application
- Skin tone, hand size, impediments (nail polish, bracelets, etc...)
- Lighting of environment
- Left/Right hand dominance



# Tasks and Division of Labor

- Train ML model
- Test ML model based on metrics
- For ASL alphabet: get existing ASL alphabet database and improve on it
- Record videos of us doing signs to show in training mode for web application



# Tasks & Division of Labor (continued....)

- Build web application with a learning and testing mode
- User testing for webapp & ML model
- Integration
- Customize webapp & improve usability





# Sources

- <https://google.github.io/mediapipe/solutions/hands.html>
- <https://github.com/google/mediapipe/issues/1535>
- <https://knowtechie.com/this-website-uses-ai-and-your-camera-to-teach-you-american-sign-language/>