UMBC

American Sign Language (ASL-2)

Project Presentation

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Project Objective

- **Develop an American Sign Language (ASL) interpretation device**
- **Convert ASL gestures into text and sound**
- **Motivation:**
  - **Facilitate communication between deaf and non-sign language users**

Agenda

- Review first semester demo progress
- Inspect Design (Hardware & Software components)
- Demonstrate all signs w/speaker functionality
- Verify design meets requirements
- Discuss any challenges or future improvements

Last Demo

- No gestures implemented
- Sign accuracy -> 77%
- Timing was met at 2-5ms per translation
- No Housing
- No GUI
- No Text-to-Speech implemented
- Letters/numbers with the same hand sign were not handled in software

Final Build: Top and Front

Final Build: Left and Right

Port Cover

Audio Ctrl.

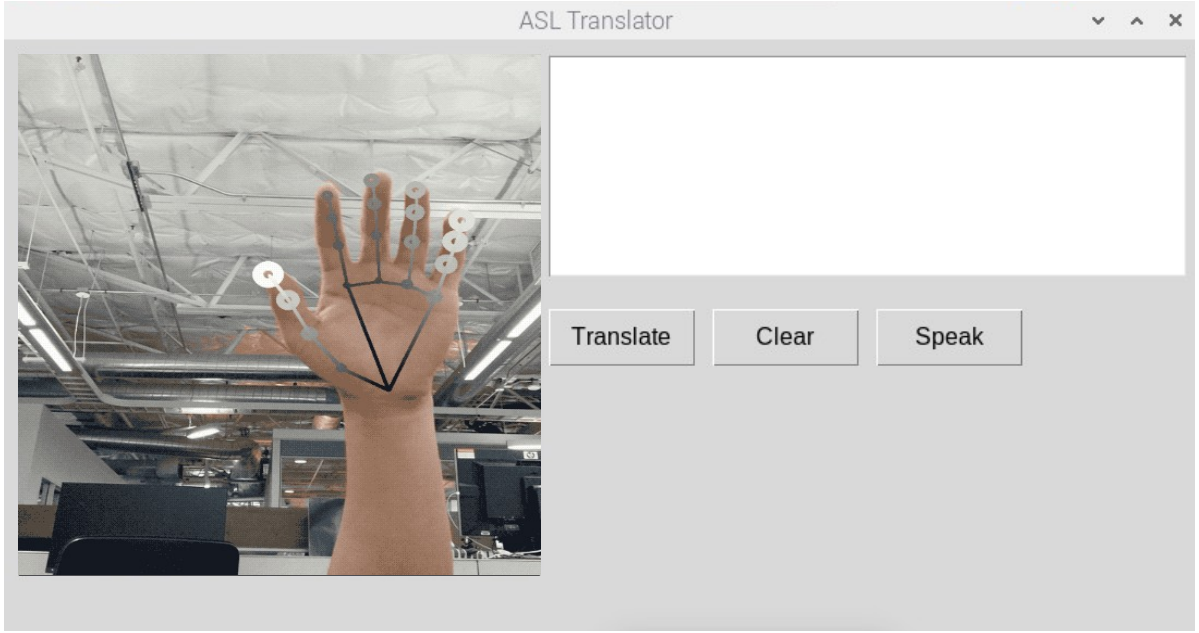
Final Build: Back

Speaker

Audio Ctrl.

Port Cover

Frontend



Functional Demo

FUNC1: Translate to English

2: Standalone Device

3: Translate to text and sound

4: Translate in various lighting conditions

5: Recognize diverse hands

6,7,8: Embedded Processor, Screen, Speaker Usage

PERF1: (A-Z, 0-9) and at least 10 basic signs

2: Translation delay under 5 seconds

3: Minimum 80% translation accuracy

4: Recognition within a 3-feet range

Functional Requirements

- ☑ 1: Translate to English
- ☑ 2: Standalone Device
- ☑ 3: Translate to text and sound
- ☑ 4: Translate in various lighting conditions
- ☑ 5: Recognize diverse hands
- ☑ 6,7,8: Embedded Processor, Screen, Speaker Usage

Performance Requirements 1

- ☑ **1: (A-Z, 0-9) and at least 10 basic signs**

```
hello, please, thanks, receipt, more,
price, order, wait, bag, water,
0, 1, 2, 3, 4, 5, (6W), 7, 8, (9F),
a, b, c, d, e, g, h, i, j, k, l, m,
n, o, p, q, r, s, t, u, v, x, y, z
```

- ☑ **4: Recognition within a 3-feet range**
  - **All tests performed in the 3-feet operating region**

Performance Requirements 2

- ☑ **2: Translation delay under 5 seconds**
  - **Average of 4.84 seconds per translation**

- ☑ **3: Minimum 80% translation accuracy**
  - **95% for low brightness testing**
  - **99% for normal/high brightness testing**
  - **Inconsistency with some signs**

Test Results

- Testing done in a high brightness ->
- Time: Average of 4.84 seconds per translation
- Distance: within 3 ft. of the camera
- Inconsistency:
  - ‘M’, ‘R’, ‘S’, ‘U’, ‘V’

Value	Left Hand	Right Hand
HELLO	✓	✓
PLEASE	✓	✓
THANKS	✓	✓
RECEIPT	✓	✓
MORE	✓	✓
PRICE	✓	✓
ORDER	✓	✓
WAIT	✓	✓
BAG	✓	✓
WATER	✓	✓
0	✓	✓
1	✓	✓
2	✓	✓
3	✓	✓
4	✓	✓
5	✓	✓
6W	✓	✓
7	✓	✓
8	✓	✓
F9	✓	✓
A	✓	✓
B	✓	✓
C	✓	✓
D	✓	✓
E	✓	✓
G	✓	✓
H	✓	✓
I	✓	✓
J	✓	✓
K	✓	✓
L	✓	✓
M	✗	✓
N	✓	✓
O	✓	✓
P	✓	✓
Q	✓	✓
R	✓	✓
S	✓	✓
T	✓	✓
U	✓	✓
V	✓	✓
X	✓	✓
Y	✓	✓
Z	✓	✓

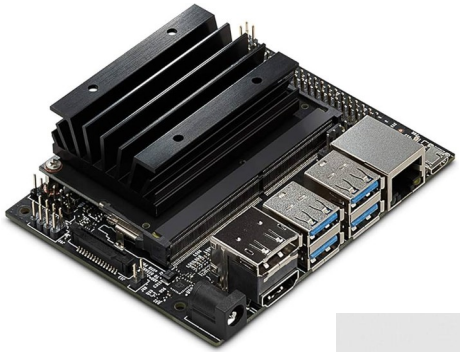
Value	Seconds
HELLO	2.96
PLEASE	4.21
THANKS	3.95
RECEIPT	3.08
MORE	2.63
PRICE	3.36
ORDER	3.21
WAIT	1.94
BAG	2.21
WATER	9.63
0	3.97
1	3.21
2	7.22
3	3.57
4	7.58
5	4.28
6W	4.37
7	3.75
8	3.5
F9	4.07
A	3.31
B	6
C	5.94
D	3.57
E	3.33
G	4.18
H	2.84
I	3.21
J	4.64
K	8.65
L	3.46
M	4.25
N	3.44
O	3.25
P	2.08
Q	3.3
R	20
S	4.29
T	3.54
U	20
V	5.9
X	3.54
Y	3.42
Z	4.26

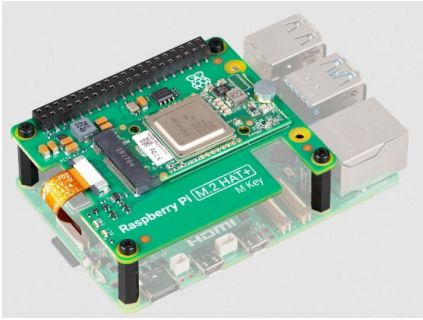
Challenges Faced

- **Discernment of similar signs (‘6’ and ‘W’ & ‘9’ and ‘F’)**
  - **Solution: Gesture is labeled as ‘(6W)’ or ‘(9F)’ and an additional software layer to find the most contextually appropriate character**
- **General Housing**
  - **Pre-Built housing + 3D printing additions**

Remaining Issues + Future Implementations

- GUI is aesthetic redesign of GUI
- Spell-Checking
- Optimizations to lower translation time
- Upgrade in computational power for ML and further translation capabilities





Conclusion

- **The ASL device exceeded initial goals in both accuracy and speed**
- **Met all functional and performance requirements**
- **Expanded translatable vocabulary for more complex conversations**
- **Demonstrated a functional model of the device live**

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Thank you!