WEARABLE MOTION/POSITIONING MONITOR

December 8, 2025

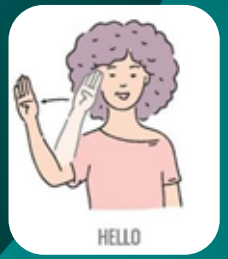
Adwoa Asare, Tianyi He, Shao-Ju Wang

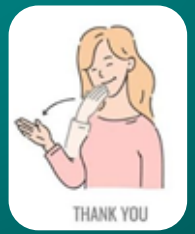
FINAL DEMO

ABSTRACT: Sign Language Interpretation

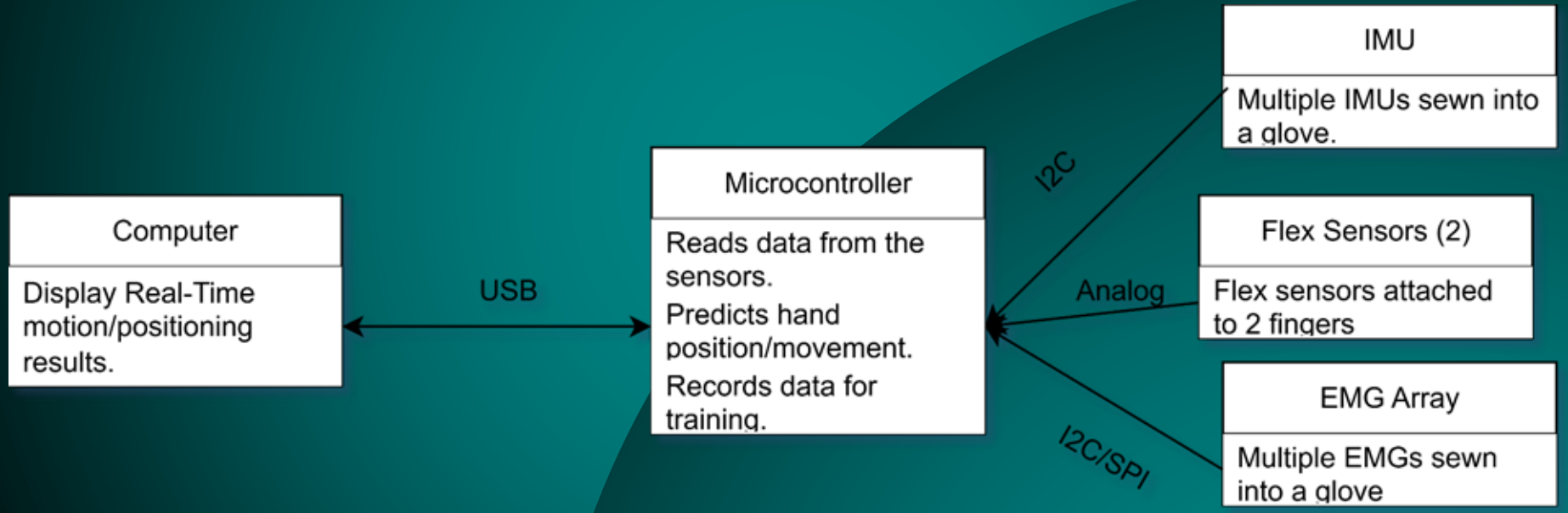
- Hand position/movement classification glove with applications in **human-computer interaction**
- Useful for cases where hands need to be tracked **without the use of a camera**
- Edge processing maintains user bio-data **privacy** and **real-time** responsiveness
- **Multi-sensor fusion** improves resolution and classification accuracy

The glove classifies sign language gestures and allows the user to interact with a virtual agent through sign language. Real-world applications would allow the glove to **translate American Sign Language (ASL) to English** or other spoken languages.





SYSTEM DESIGN: SENSOR FUSION



EDGE IMPULSE IMPLEMENTATION

1 Data Collection

We attached the sensors to a physical glove and recorded >= 50 samples of each gesture and cropped them to 1 second windows.

2 Spectral Analysis

Instead of analyzing the raw data, we do spectral analysis on all channels to convert to the frequency domain.

3 Classification

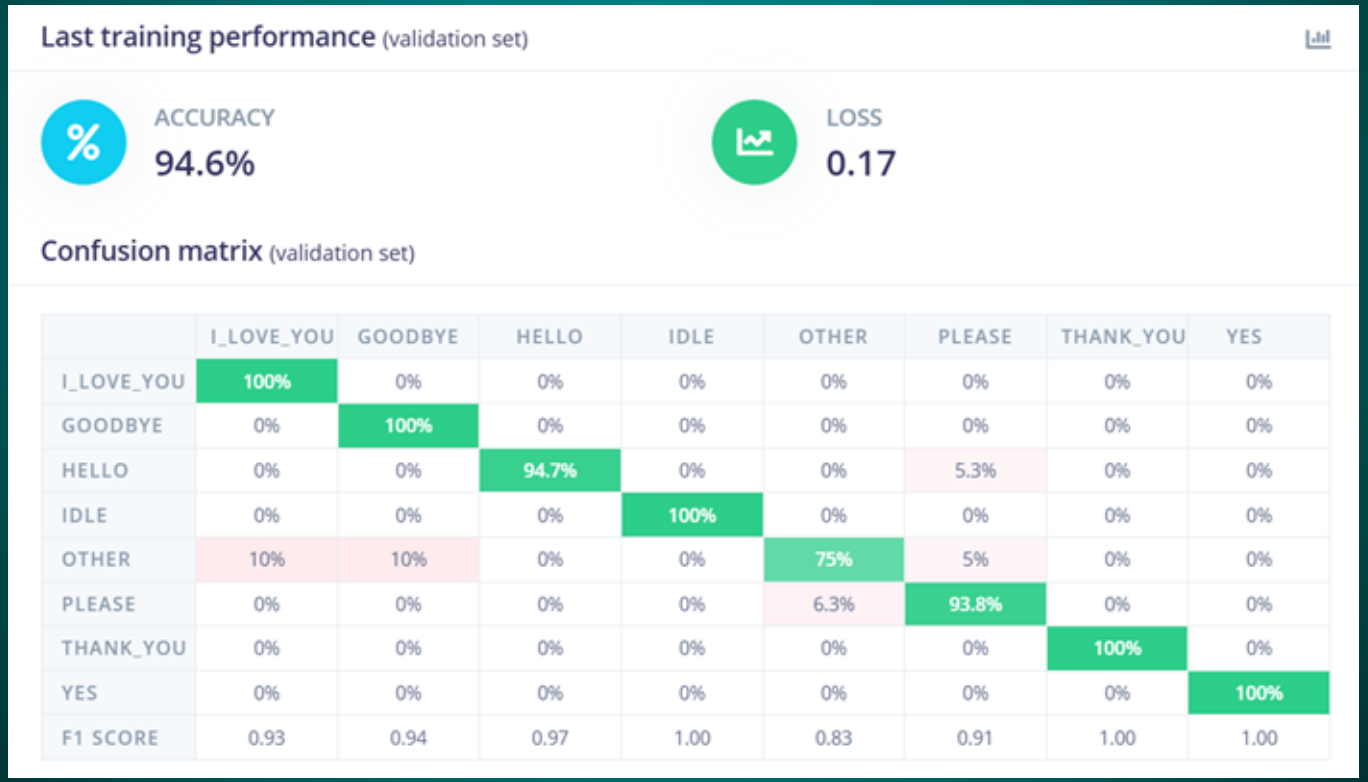
The EI Classifier block analyzes the spectral features and assigns a label out of: I_love_you, goodbye, hello, idle, other, please, thank_you, yes

4 LLM Integration

We used Ollama to run a local LLM that asks the user questions and responds to their sign language interactions.

1

Training Accuracy



	I_LOVE_YOU	GOODBYE	HELLO	IDLE	OTHER	PLEASE	THANK_YOU	YES
I_LOVE_YOU	100%	0%	0%	0%	0%	0%	0%	0%
GOODBYE	0%	100%	0%	0%	0%	0%	0%	0%
HELLO	0%	0%	94.7%	0%	0%	5.3%	0%	0%
IDLE	0%	0%	0%	100%	0%	0%	0%	0%
OTHER	10%	10%	0%	0%	75%	5%	0%	0%
PLEASE	0%	0%	0%	0%	6.3%	93.8%	0%	0%
THANK_YOU	0%	0%	0%	0%	0%	0%	100%	0%
YES	0%	0%	0%	0%	0%	0%	0%	100%
F1 SCORE	0.93	0.94	0.97	1.00	0.83	0.91	1.00	1.00

2

Testing Accuracy

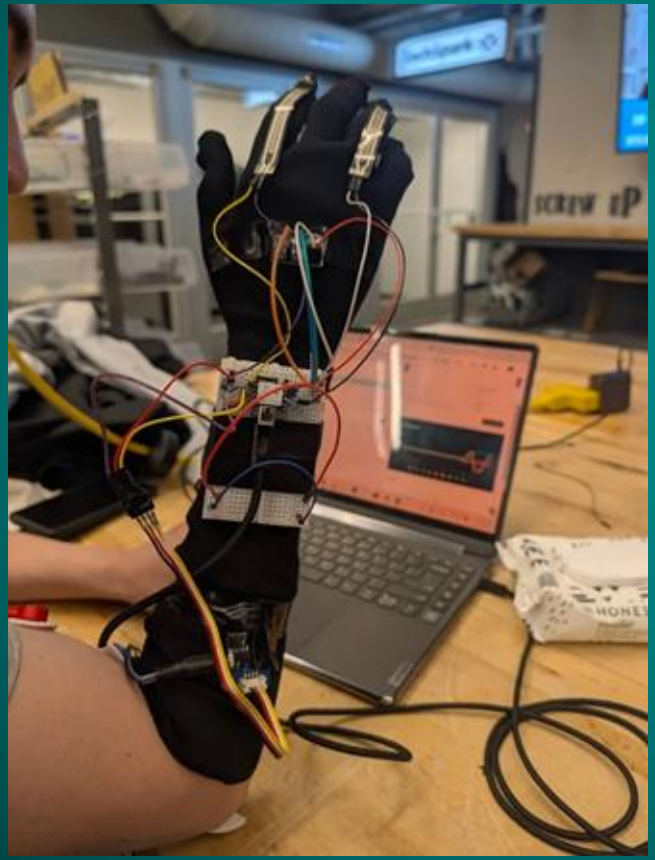
ACCURACY
93.06%

Confusion matrix

	I_LOVE_YOU	GOODBYE	HELLO	IDLE	OTHER	PLEASE	THANK_YOU	YES	UNCERTAIN
I_LOVE_YO	100%	0%	0%	0%	0%	0%	0%	0%	0%
GOODBYE	0%	89.5%	0%	0%	5.3%	0%	0%	0%	5.3%
HELLO	0%	0%	100%	0%	0%	0%	0%	0%	0%
IDLE	0%	0%	0%	95.2%	0%	0%	0%	0%	4.8%
OTHER	0%	12%	0%	0%	76%	4%	4%	0%	4%
PLEASE	0%	0%	0%	0%	0%	88%	0%	0%	12%
THANK_YO	0%	0%	0%	0%	0%	0%	100%	0%	0%
YES	0%	0%	0%	0%	0%	0%	0%	100%	0%
F1 SCORE	1.00	0.87	1.00	0.98	0.84	0.92	0.98	1.00	

2

Deployment



CHALLENGES FROM THE SEMESTER

1 Sensor Failure

Our original EMG sensors had a lot of issues and were not producing good readings. Many of our sensors did not arrive and needed to be reordered.

2 Difficult to Distinguish Gestures

Some gestures were difficult to distinguish from each other so we had to carefully select our gesture set after trial and error in the data collection phase.

3 LLM Integration

We got creative with hoe the LLM responded and guided the conversation to adapt to the limited gesture set.

4 Glove Construction

We sewed multiple glove prototypes to get it right as we iterated with our sensor designs.

GESTURES