

Energy Efficient, Real Time Electromyography Gesture Classification for Prosthetic Hands

Ekin Can Erkus | Ibrahim Ameen | Hachemi Cherrih | Shengyu Duan | Alex Chan | Alex Yakovlev | Rishad Shafik

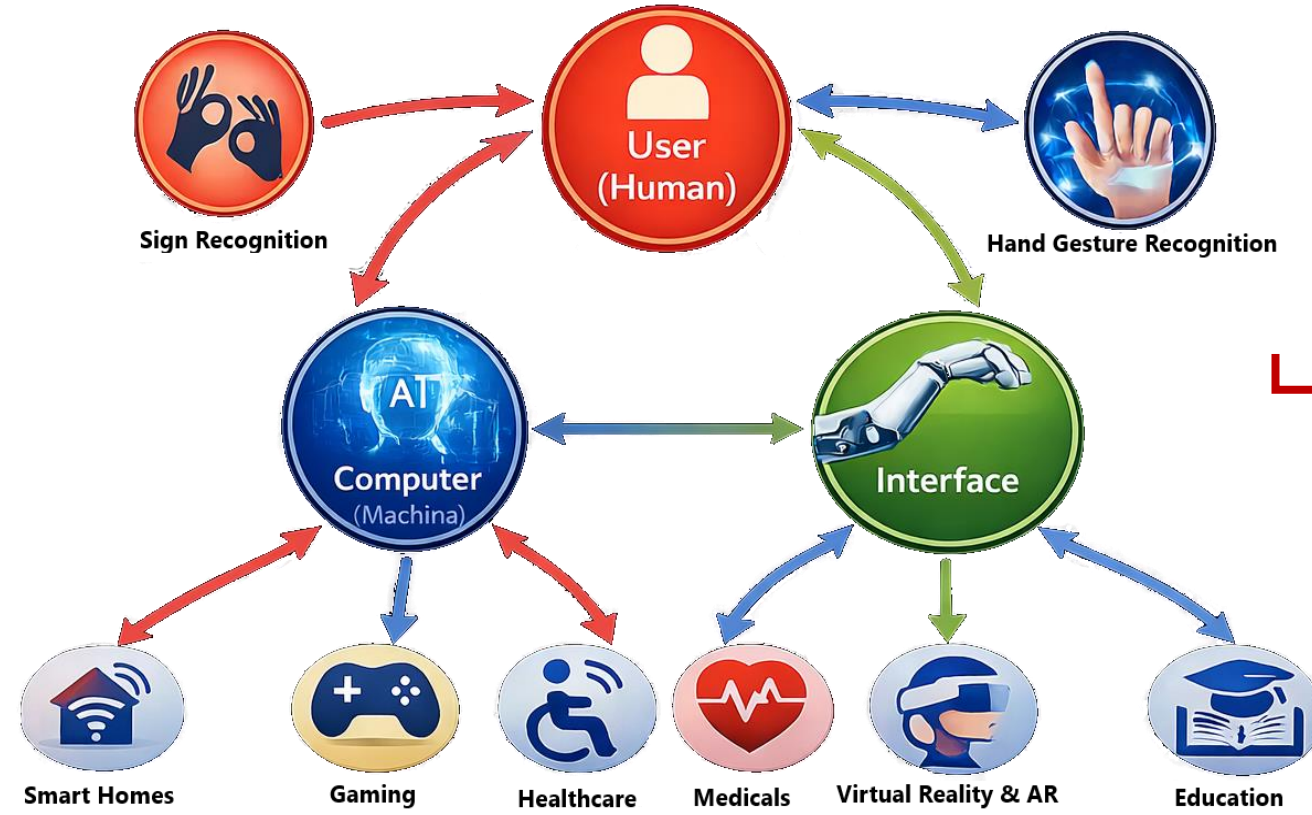
Problem

Statistics

- 160,000+ people in the UK use British Sign Language
- Global gesture recognition market: ~\$25.44B (2024)

Most Gesture Systems

- Slow on decisions
- 8-10 hours of battery life \Rightarrow Daily charging needed!
- Hard to implement in embedded systems



Other AI Models

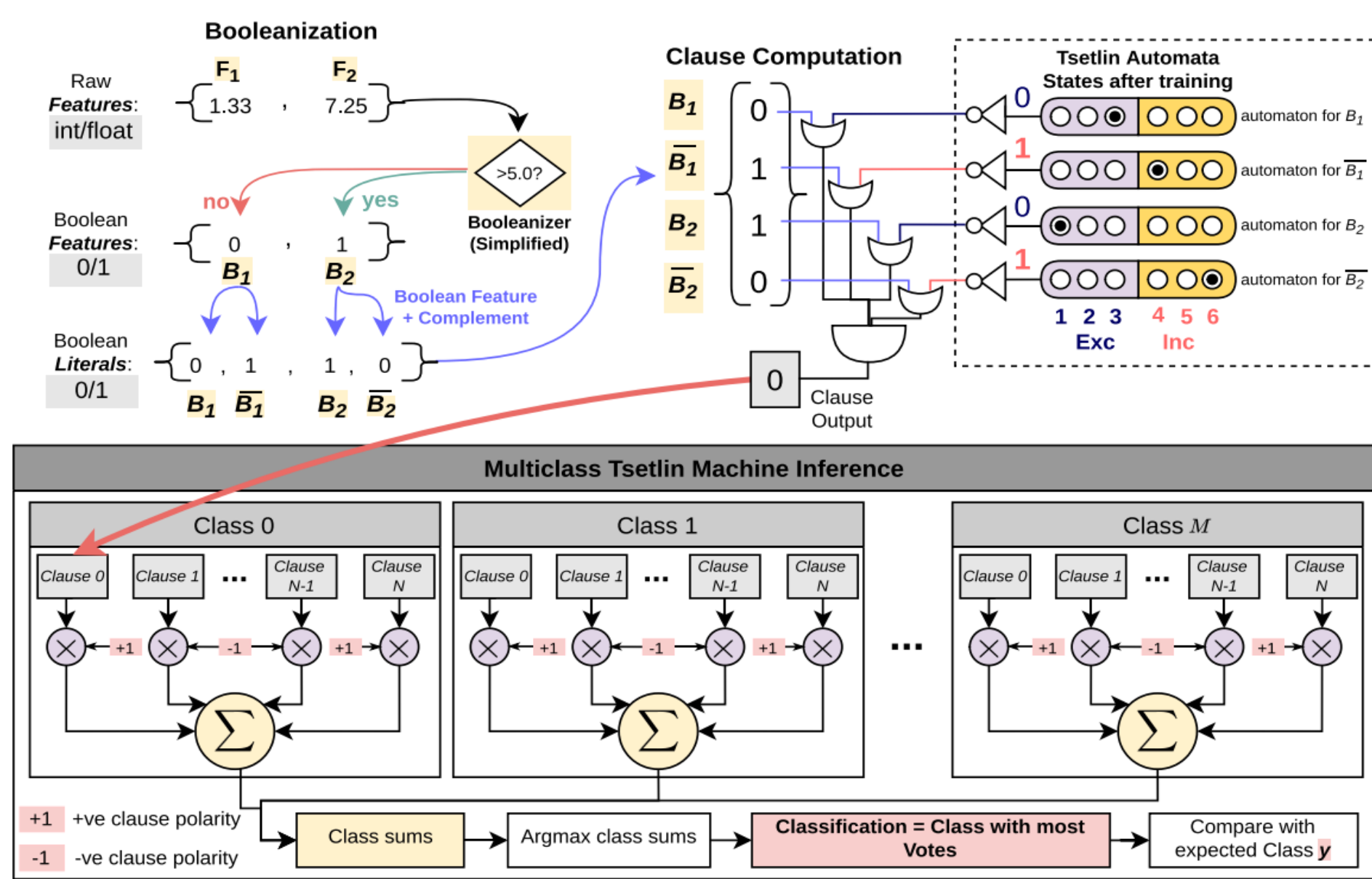
- Black-box AI models:
 - Hard to trust
 - Hard to tune
- Most AI-based models:
 - Slow
 - Energy draining

Why it matters?

- Less control
- Less confidence
- Less independency
- Higher cost

Our Solution: Low power, fast, explainable hand gesture classification

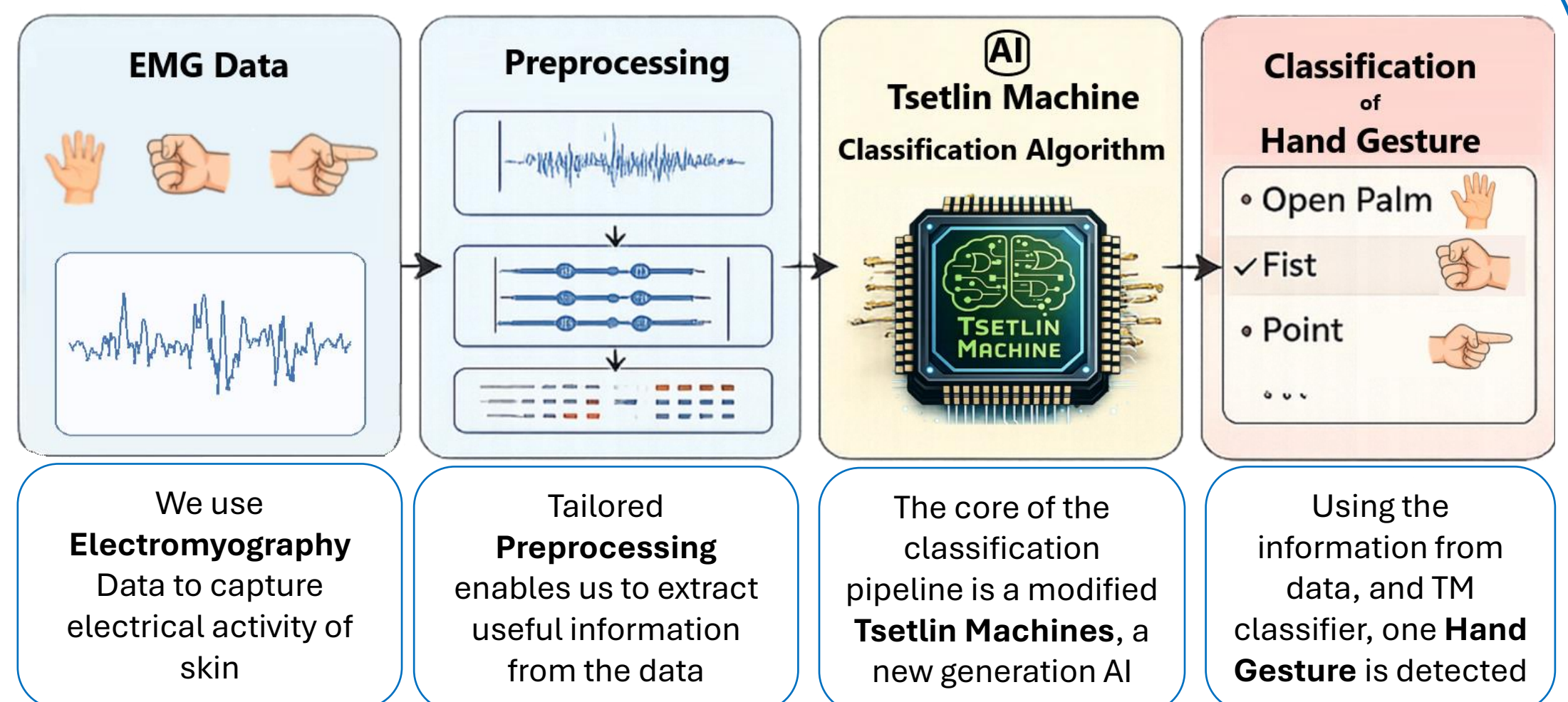
New Generation AI: Tsetlin Machines



- Tsetlin Machines use human-readable rules.
- Logic-based learning, not heavy computation.
- Built for tiny, battery-powered devices.
- Creates transparent decisions.
- Low energy proxy.



Our Approach



We use **Electromyography** Data to capture electrical activity of skin

Tailored **Preprocessing** enables us to extract useful information from the data

The core of the classification pipeline is a modified **Tsetlin Machines**, a new generation AI

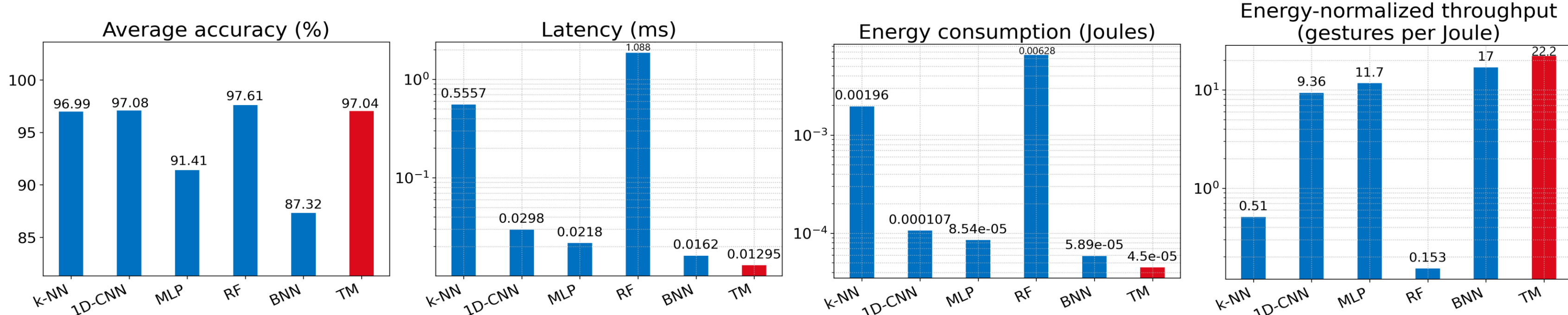
Using the information from data, and TM classifier, one **Hand Gesture** is detected

Real-time EMG \rightarrow Gesture classification pipeline.

Low energy consumption + High accuracy gesture classification.

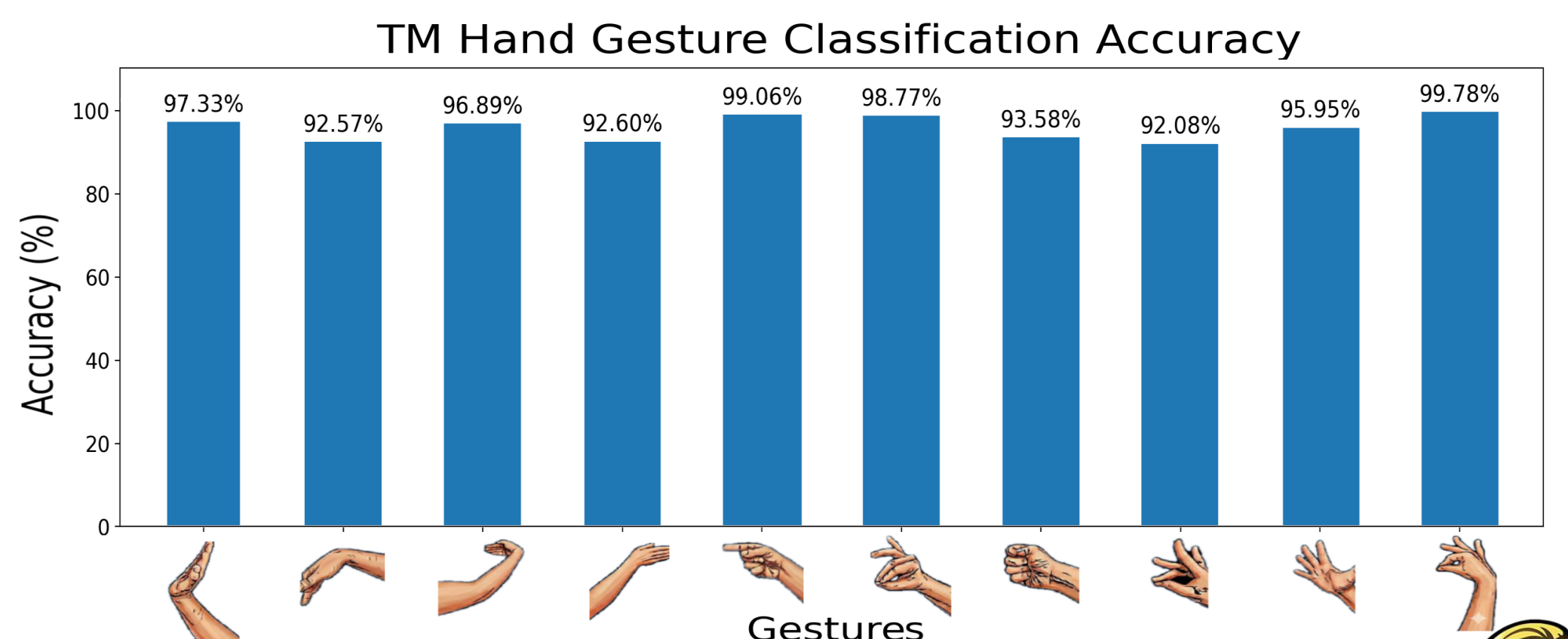
Explainable output: "Why" a gesture was chosen.

Comparison of Models on EMG Classification (Averaged for 3 Datasets)



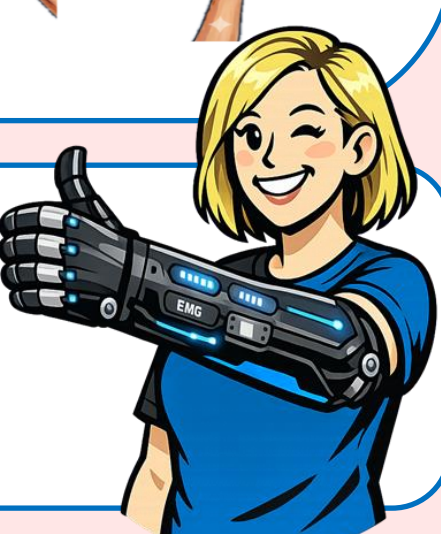
Key Achievements

- Real-time gesture detection \rightarrow Immediate Responses!
- Low-energy consumption \rightarrow Longer battery life!
- Explainable classification \rightarrow Easier to fix problems!
- Detection of multiple gestures \rightarrow Stable performance!
- Compact model for low-power chips \rightarrow Cheaper devices!



Impact

Low power, real time, explainable, on-device EMG gesture classification enables fast and private control that can improve prosthetic hand use, support NHS rehabilitation, safer robotics, and touchless digital interfaces.



Acknowledgements and References

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