

Smart Slip-Detection Glove for Prosthetic Hands

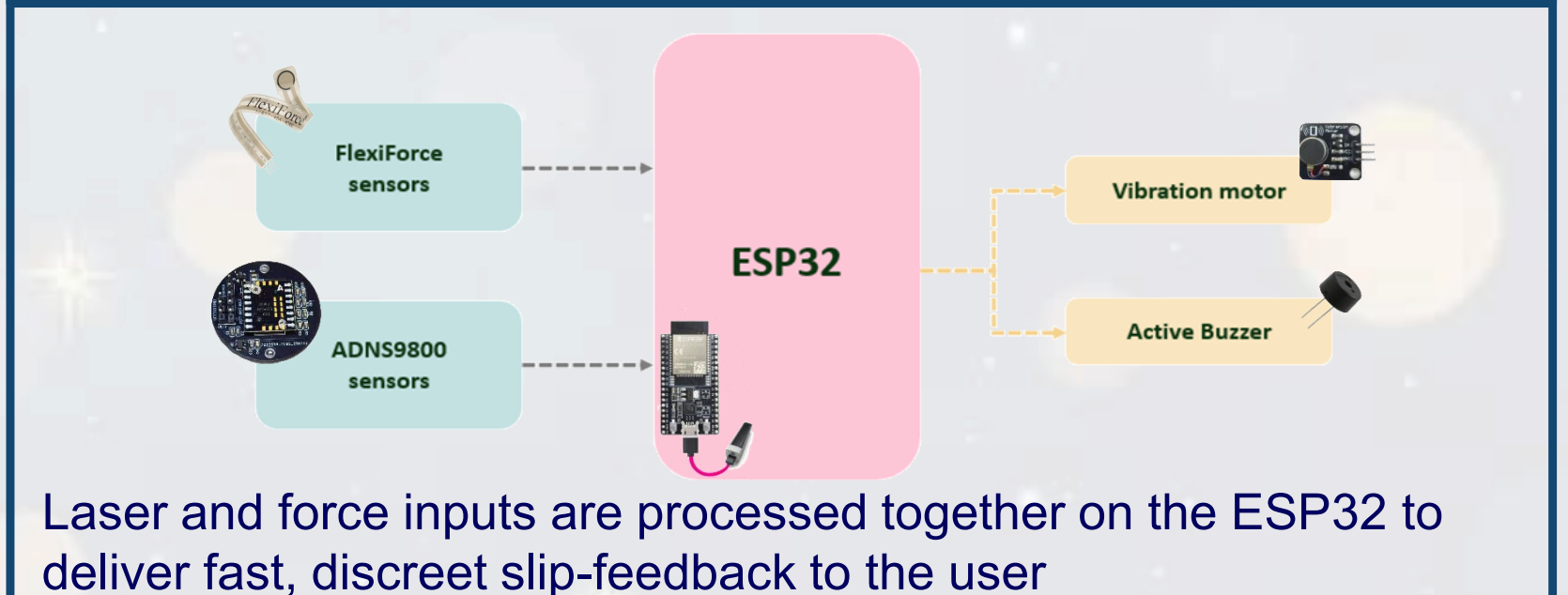
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Motivation

Problem: Prosthetic hands cannot reliably sense when an object starts to slip, leading to dropped items and reduced user confidence. Existing solutions are expensive and complex, leaving a need for a simple, low-cost real-time slip-detection method.

Solution: Create a low-cost system using laser sensors and force sensors to detect slip reliably.

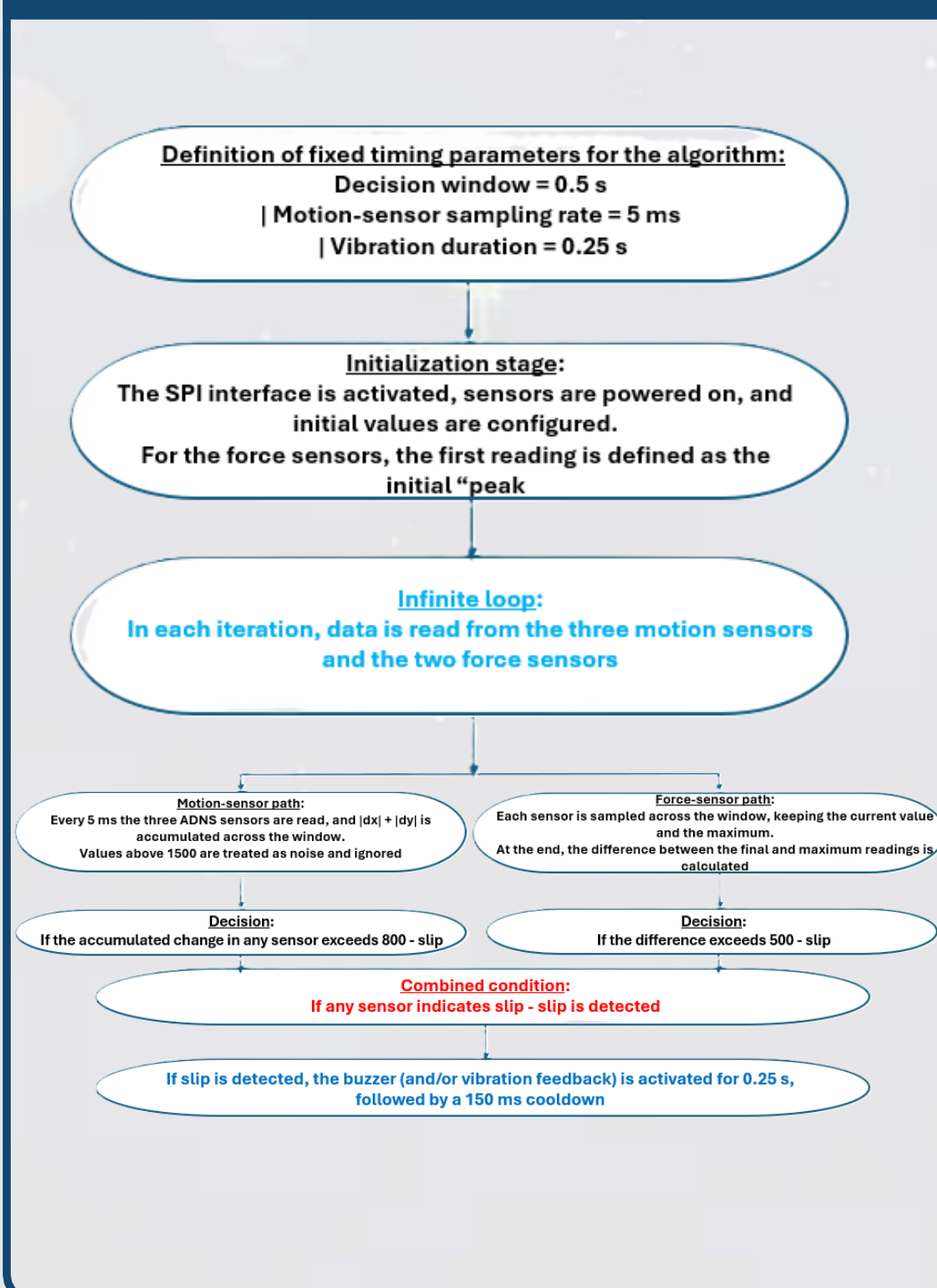
System Architecture



Requirements

Compact	Reliable
User Friendly Feedback	Cost Effective
Easy Integration	Fast Response Time

System Algorithm



System Components

ADNS-9800 Laser Sensors

(~20–30\$ each)

- Works on a wide variety of surfaces
- SPI interface
- Real-time slip-movement detection



FlexiForce Sensors

(~15–20\$ each)

- Thin and flexible pressure sensors
- Measures grip-force changes
- Fast response, easy to integrate



ESP32 Microcontroller

(~10–15\$)

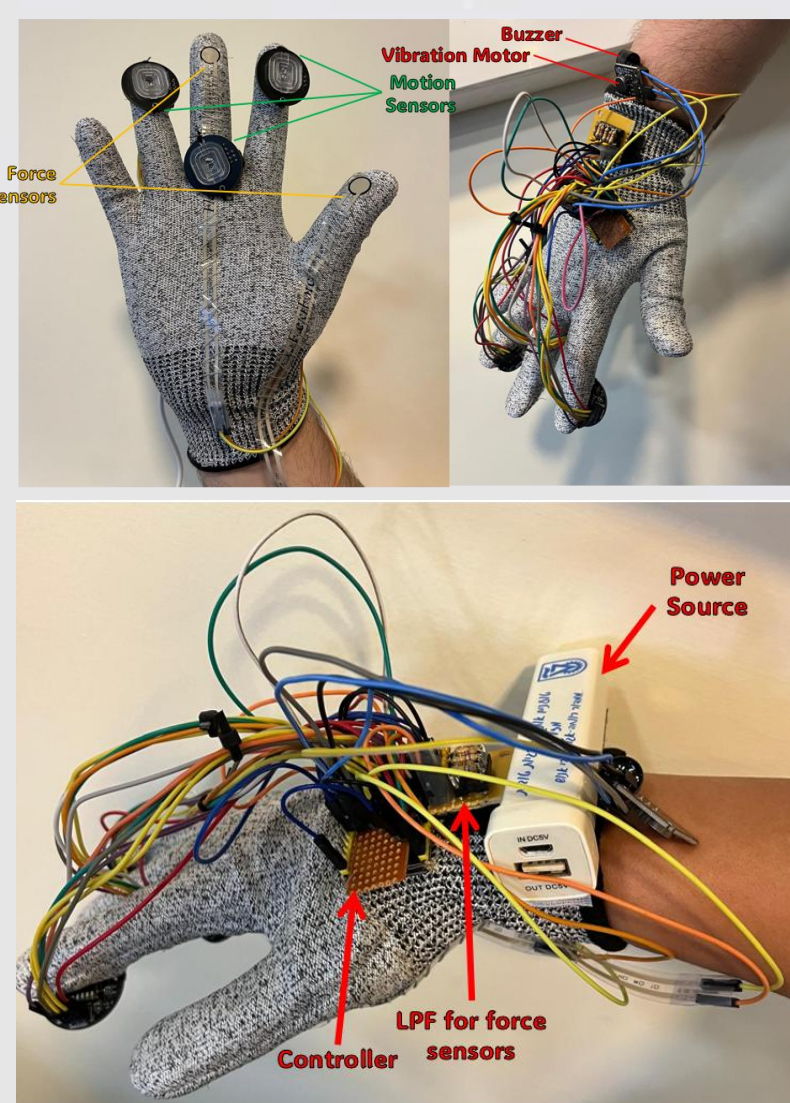
- SPI + ADC interfaces
- Handles real-time processing and feedback



Others - Wires, connectors, Vibration motor (~10–15\$)

Total System Cost: ~80–100\$

Results



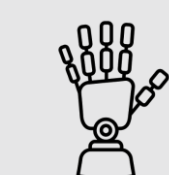
Results:

- Consistent slip detection across surfaces.
- Low false-positive rate.
- Fast and quiet vibration feedback.

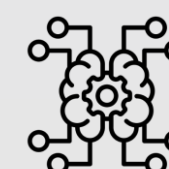
Challenges

- Integration complexity when using raw sensor modules
 - ✓ Switched to PCB-mounted versions for reliability
 - ✓ Reduced wiring, noise, and mechanical instability
- Noise and instability in FlexiForce signals
 - ✓ Added low-pass filtering (RC)
- Motion asymmetry and large spikes in ADNS output
 - ✓ Implemented spike filtering (>1500)
 - ✓ Accumulated movement over a sliding window

Future Work



Full integration into robotic prosthetic hand



Adaptive thresholds / machine learning



Mobile app for calibration



Additional sensors (temperature, tactile arrays)