ARM ProsthEEsis
(Actuation via Real-Time Myoelectric Signals)

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Introduction

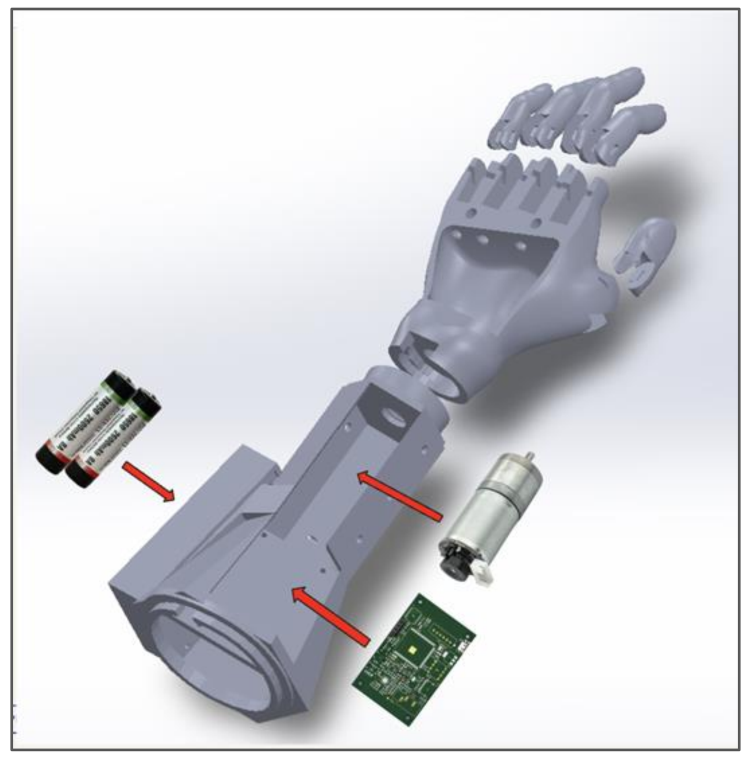
Problem

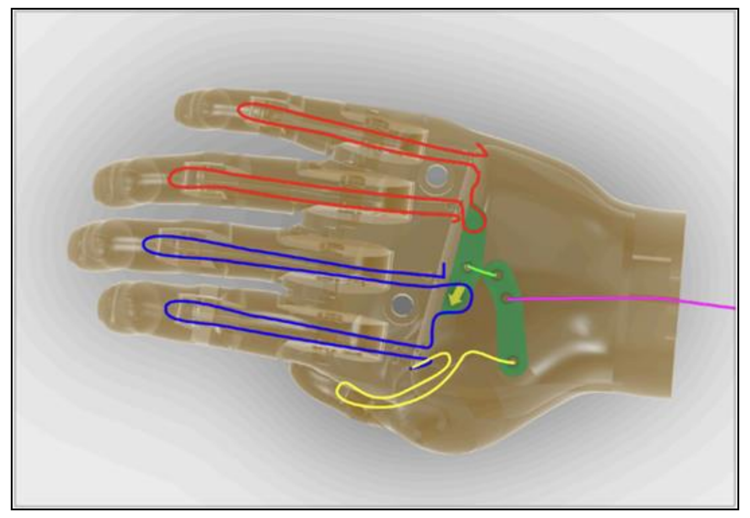
- Traditional prostheses are costly and require frequent replacement
- e-NABLE ND creates low-cost prostheses for local patients, but their mechanical designs greatly limit functionality and cause fatigue

Solution

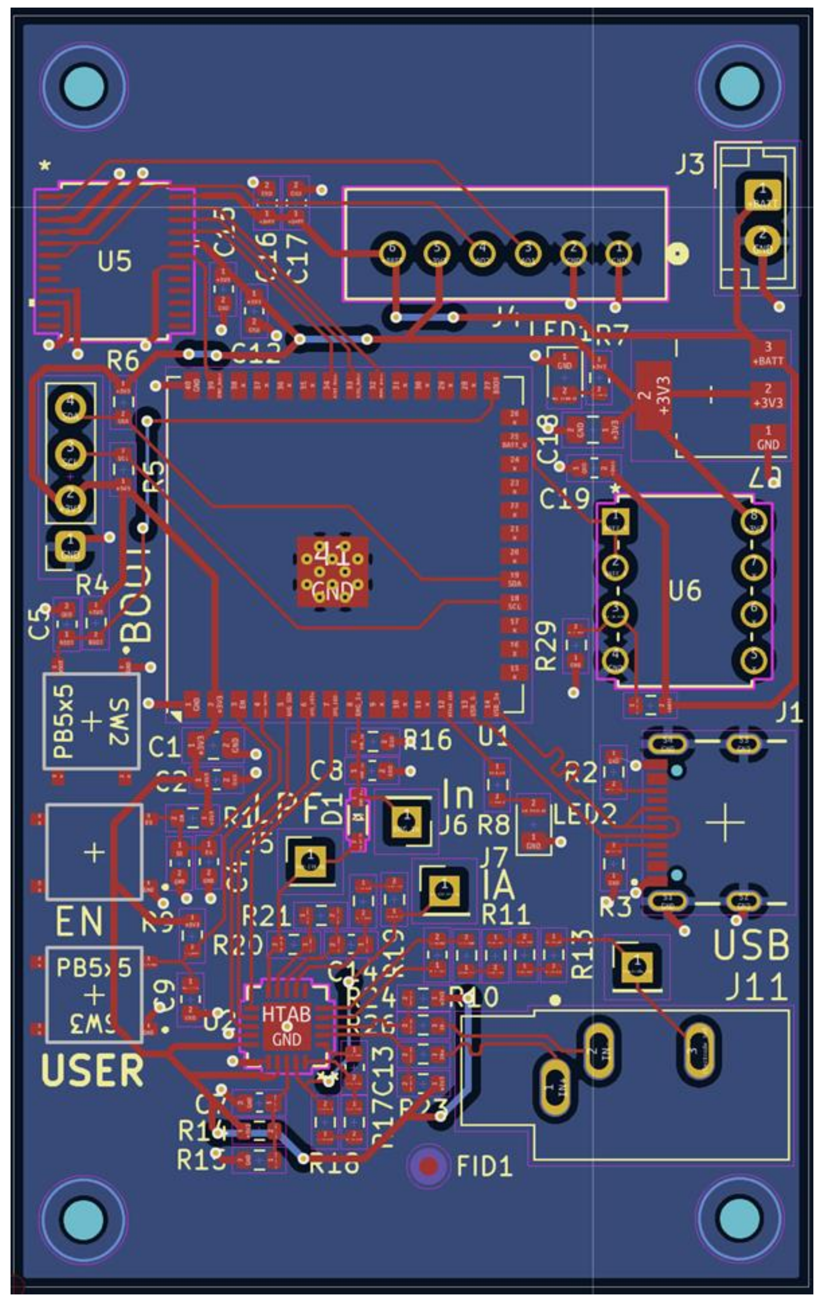
- Utilize electromyography (EMG) sensors to detect muscle signals, triggering hand actuation via muscle flexion
- Actuate the hand with a motor, reducing strain on the user
- Integrate the electronics and battery housing into a 3D printed arm

Hand & Socket Design





Board Design

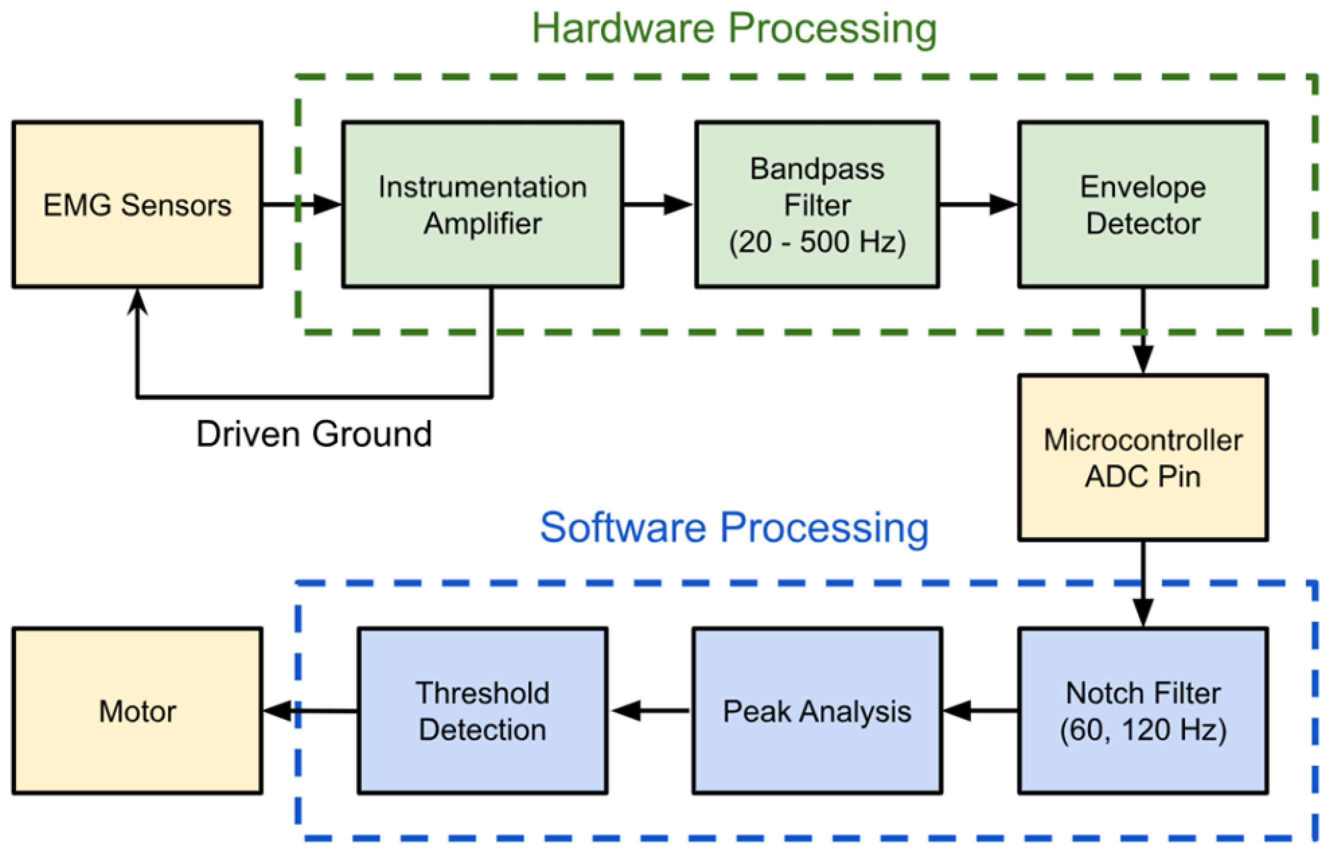


EMG Sensing

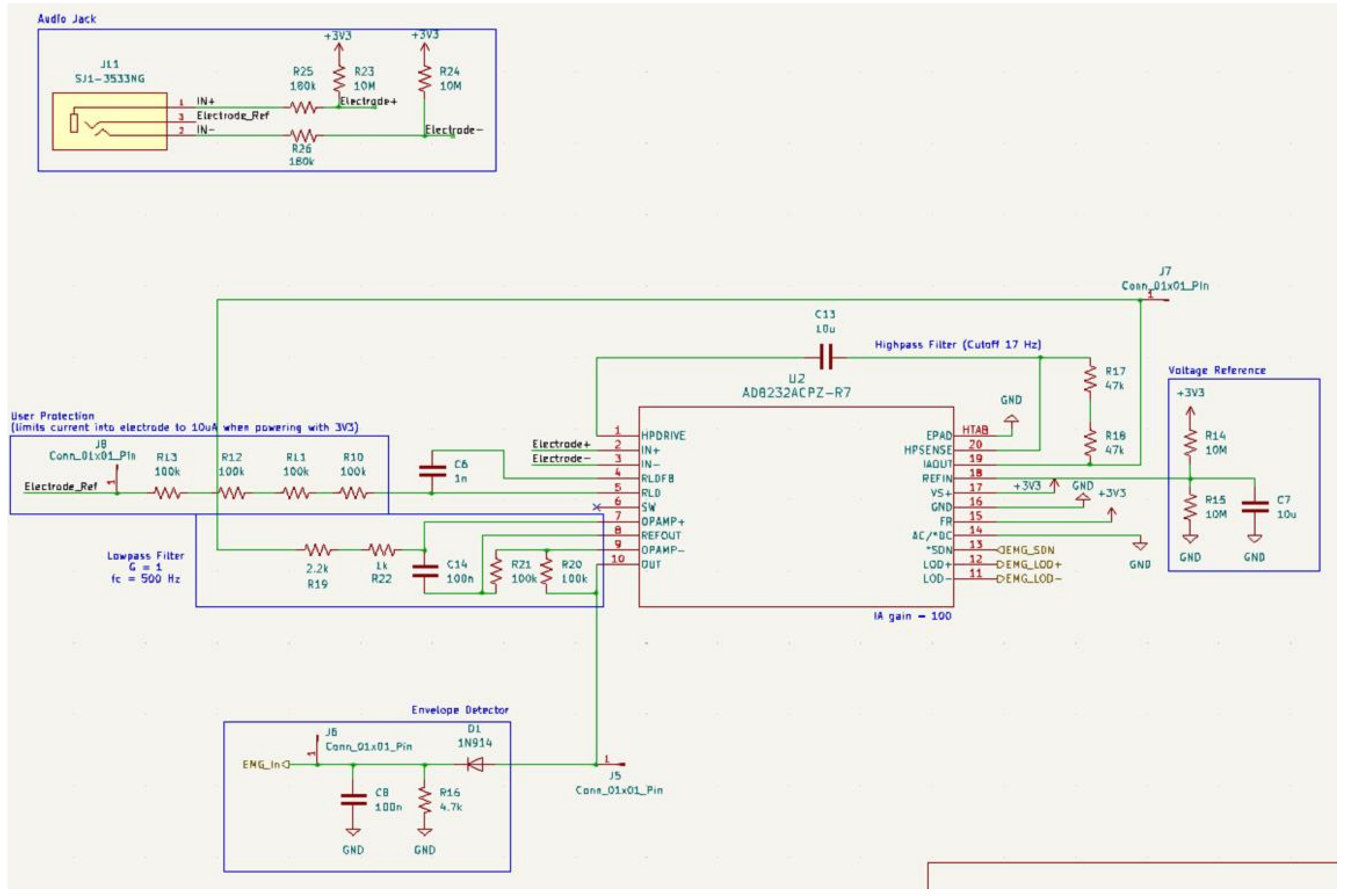
Key Design Considerations

- EMG is measured as a voltage difference between two points
- Usable EMG frequency range is 20-500 Hz
- User's body and circuitry act as an antenna for 60 Hz noise
- Maximum signal amplitude from the electrodes is 1 mV
- Protection circuit is required between the user and equipment

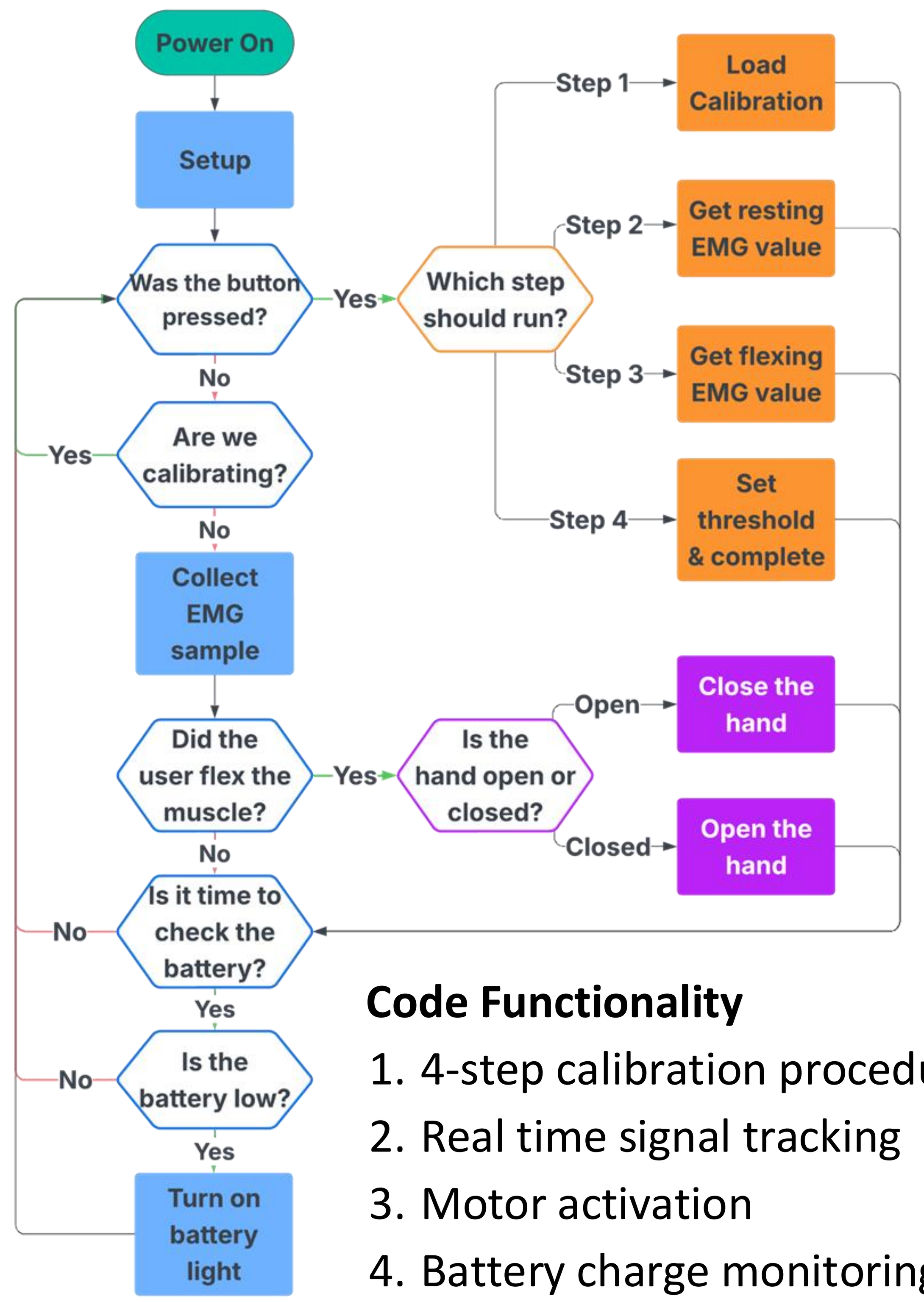
EMG Sensing Overview



EMG Sensing Schematic



Code Flow



Code Functionality

1. 4-step calibration procedure
2. Real time signal tracking
3. Motor activation
4. Battery charge monitoring

Subsystems

Power

- 3.3V for ESP32 and EMG hardware
- 7.4 V for motor
- 2 x protected 18650 batteries

Motor

- A compact metal DC geared motor with an encoder
- Motor driver allows for variable speeds and bi-directional rotation

User Interface

- User guide for electrode placement
- Calibration procedure using OLED display to tune to each user

Hand & Socket Design

- Built on existing eNABLE mechanical designs to house electronic components
- 'Tendon'-like stringing mechanism actuated by motors to close hand