**Prototype Activity:**

**PCB Design**

This report outlines the prototyping activities conducted to address two significant risks identified during the risk management meeting: PCB Design Complexity (Risk 5) and System Integration (Risk 6). The primary focus was on completing 20% of the PCB design process, including schematic creation, component placement, and routing in KiCad. The team conducted extensive Design Rule Checks (DRC) to identify and resolve errors early in the design phase, ensuring the designs are ready for fabrication and debugging. While physical testing is not yet possible, this phase lays a strong foundation for addressing these risks in future iterations.

**System Description**

The HANDS-EMG system relies on multiple subsystems to achieve functionality:

1. **Power Management**: The **LTC3556EUFD\_PBF** provides efficient battery charging and a stable **3.3V output**, powering all critical components.
2. **Signal Processing**: The **ADS1299** captures and processes surface electromyography (sEMG) signals, which are then transmitted via SPI to the control module.
3. **Control Module**: The **STM32L496ZGT6 microcontroller** processes incoming data and facilitates communication between the signal processing and the machine learning classifier.

Given the complexity of integrating these subsystems, the team adopted a modular approach. Three separate PCBs were designed for power management, signal processing, and control modules. These modular designs allow for isolated testing and debugging before integration into a single unified PCB.

**Initial Identification of Risks**

The risk management meeting identified the following significant risks for the project, with this activity addressing Risks 5 and 6:

Table X: Risk Summary

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Risk | Probability | Impact | Mitigation |
| 5 | PCB Design Complexity | 3 | 4 | Designed modular PCBs for debugging before integration. |
| 6 | System Integration | 3 | 5 | Tested modules individually with debugging tools before integration. |

1. PCB Design Complexity(Risk 5): Routing, signal integrity, and managing space for components like the LTC3556EUFD\_PBF, ADS1299, and STM32L496ZGT6 make PCB design challenging. Errors in design could delay the project or result in fabrication failures.
2. System Integration(Risk 6): The subsystems must communicate effectively through SPI and power lines. Inconsistencies or misalignments in protocols, signals, or power delivery could jeopardize the system’s functionality

**Prototype Activity**

This activity focused on the initial PCB design phase, addressing 20% of the overall design effort and emphasizing schematic creation, layout design, and error identification through DRC. Key steps included:

1. **Schematic Design**:

Created schematics for power management, signal processing, and control modules in **KiCad**, using recommended components from the manufacturer datasheets.

Included decoupling capacitors, inductors, and connectors to ensure proper functionality and ease of debugging.

**PCB Layout Design**:

**Power Management PCB**: Designed for the LTC3556EUFD\_PBF, focusing on stable 3.3V output and efficient battery charging with minimal ripple.

1. **Design Rule Checks (DRC)**:

Conducted DRC in KiCad to identify and resolve routing errors, ensuring proper trace clearances, via placements, and component footprints.

Resolved all detected issues, such as overlapping traces and incorrect pad connections, to ensure compliance with manufacturing standards.

1. **Debugging Preparation**:

Added test points and connectors to each PCB to facilitate real-time monitoring and troubleshooting during future testing.