

1. Desired Needs Driving Final Design Objectives
 - Provide a safe, low-cost, portable, battery-powered, ECG device for classroom and outreach demonstrations where clinical ECGs are impractical.
 - Enable students to visualize real-time cardiac electrical activity to improve understanding of electrophysiology.
2. Major Constraints on the Design
 - Full electrical isolation from wall power; battery-only operation.
 - Leakage current kept below 10 μA ; adherence to principles of IEC 60601-1.
 - Safe electrode placement and lead-off detection to prevent misuse.
 - Noise contamination from movement and 60 Hz interference.
 - Potential device malfunction during outreach sessions.
 - Expands access to hands-on physiology education in low-resource schools.
 - Demonstrates scalable, low-cost biomedical instrumentation for global STEM programs.
 - Uses commercial off-the-shelf components (AD8232, Arduino).
 - Self-test mode ensures reliability before demonstrations.
 - Color-coded electrode mapping improves usability for first-time users.
3. Major Engineering Standards Relevant to the Project
 - IEC 60601-1: Medical electrical equipment safety (electrical isolation, leakage current).
 - IEC 60601-2-47: Performance standards for ambulatory ECG systems.
 - IEEE signal processing standards for filtering and digital acquisition.
 - Potential future standardization for educational biomedical demonstration devices.
4. Ethical, Environmental, and Societal Concerns
 - Ensuring participant safety when connecting electrodes to the body.
 - Protecting student privacy when collecting physiological data.
5. Teamwork and Leadership
 - Collaborative decision-making with diverse technical roles (hardware, software, filtering, enclosure).
 - Sub-team leadership for analog front-end, firmware, MATLAB/Python pipelines, and outreach design.
 - Weekly milestones ensured progress toward winter-quarter deadlines.
 - Constructive peer feedback during design reviews and testing sessions.
6. Motivating Factors for Learning and Persistence
 - Need to understand ECG physiology, analog filtering, and microcontroller data acquisition.
 - Desire to create a device that would be used by real students in outreach programs.
 - Overcoming noise, filtering, and hardware integration challenges encouraged self-initiated research.
 - Iterative testing and failures motivated refinement of filters, enclosure, and firmware.
7. Most Innovative / Entrepreneurial Ideas
 - A portable, self-contained 6-lead educational ECG using only two AD8232 modules and derived-lead computation.
 - Integration of Kalman and Butterworth filtering for real-time clarity in noisy environments.
 - A battery-powered, isolated design safe for public demonstrations.
 - Future scalability toward a custom PCB, wireless connectivity, and 12-lead expansion.