

1. Desired Needs

- Need for a readable, clean ECG waveform, with clear QRS complexes and a stable baseline, so that students are able to connect physiology concepts to live signals.
- Needs to be a safe, portable, and reliable ECG demonstration that can be used in classroom/outreach settings without needing an outlet source or exposed conductors

2. Major Constraints of the Project

-Safety/Regulatory Affairs: The device must be battery-powered, with enclosed electronics and a clear electrode-handling procedure.

Risks

-Unstable/noisy acquisition from electrode contact variability, motion artifacts, or unwanted electrical interference.

-User Error: Loose electrodes or incorrect lead placement can reduce signal quality during demonstrations.

-Global Impact: Understandable and accessible to a variety of students, regardless of their prior technical background.

-Manufacturability: Reusable, low-cost design that supports broader educational access.

-Quality Control/Marketability: Waveform legibility: It has consistent QRS visibility and minimal baseline drift under typical demo conditions, and is reliable and affordable.

3. Major Engineering Standards

-IEC 60601-1 (Medical electrical equipment, basic safety & essential performance): informed our emphasis on isolation, enclosure protection, and conservative human-connected design practices.

-IEC 60601-1-2 (Electromagnetic disturbances/EMC): guided attention to noise sources, grounding strategy, shielding/lead management, and filtering to reduce mains/EMI effects.

-AAMI/IEC 60601-2-25 (ECG-specific performance concepts) (used as a reference point):

4. Ethical, Environmental, or Societal concerns

-Safety during public demos: minimize risk by using battery power, using an enclosure, providing clear instructions, and training volunteers on electrode placement and hygiene.

5. Active Teamwork and Leadership

- Each member contributed their own opinion by researching and developing a subproject.

-Each member worked on their own subproject and provided ideas for filtering, our first circuit design, our final design module, educational outreach, and coding.

-Establishing goals/deadlines: Weekly meetings discussing what will be accomplished by that week and what needs to be done by a certain date.

-Constructive feedback: Received constructive criticism and feedback from the mentor during meetings and design reviews.

6. Significant motivating factors

-Acquire new knowledge: The subprojects allowed each member to contribute different knowledge pertaining to the project.

-No prior research for this project or from the mentor allowed for freedom to initiate new ideas for the circuit, filter, and educational outreach.

-Needed a reliable final module for outreach, and setbacks from the first design pushed us to figure out the bottlenecks and tune the final module design

7. Innovative ideas

- Battery-powered and isolated portable ECG that is safe to use for outreach.

-Utilizing the AD8232 module and finding Butterworth filtering works best for the live signal