

Product Design Specifications
Rat Quad Vitals Monitor
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Team:

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Function: A device that is capable of recording and displaying SpO₂ levels, heart rate, rectal temperature, and breathing rate of four rats simultaneously. The purpose of this is to help maintain appropriate anesthesia dosage on the four rats.

Client requirements: Accurately record and display SpO₂ levels, heart rates, breathing rates, and body (rectal) temperatures of four rats under anesthesia simultaneously.

Design requirements: Build a device that measures and displays the vital readings of four rats under anesthesia. The device must be able to accurately detect heart rates of up to 500 bpm and blood oxygen saturation levels to an accuracy of $\pm 2\%$ so that the anesthesiologist is able to determine the adequate dosage of isoflurane to keep the rats anesthetized. Device will also be designed to monitor respiratory rate (around 20 breaths/min) and rectal temperature (93-100° F).

Physical and Operational Characteristics

1. *Performance requirements:* The device, at minimum, should be able to take the heart rates, breathing rates, and temperatures of four rats simultaneously and display them onscreen. It should also have running graphs showing the vitals of each rat for the duration of the experiment or for a user specified time. It should also display live traces of respiration and heart rate. The software should also record the average values of the vitals to hard disc every fifteen seconds.
2. *Safety:* The device should be safe for animal use and be consistent with the safety standards of the current rat platform.
3. *Accuracy and Reliability:* The device must be able to accurately detect heart rates of up to 500 bpm, blood oxygen saturations level accuracy of $\pm 2\%$, respiratory rates of at least 30 breaths/min, and rectal temperatures of 93-100° F.
4. *Life in Service:* The device must be functional for at least 5 years, with calibration as needed. The device will be used twice a month to once a week.
5. *Shelf Life:* The device should be able to go without use for a semester and be put back into use with normal functionality.
6. *Operating Environment:* Will be used in a laboratory environment.
7. *Ergonomics:* The pulse oximeter probe should comfortably fit onto the hind paw of each rat. The probes should not be influenced by the inclusion of bubble wrap

during tests. The graphical user interface must be optimized to minimize user interaction. All external probes must be user replaceable with minimal effort.

8. *Size*: Clips must be small enough so that it will not interfere with surrounding sensor and/or devices. No sensors should interfere with the PET imaging, keeping any large components inferior to the base of the heart.
 9. *Weight*: The sensor system must not have a mass greater than 1 kilogram.
 10. *Materials*: Derived oximeter sensors, converted human oral thermometers, and force sensing resistors. All other materials will not be in contact with the rats.
 11. *Aesthetics, Appearance, and Finish*: There must be no exposed circuit components.
- **Production Characteristics**
 1. *Quantity*: One.
 2. *Target Product Cost*: under \$4,000
 - **Miscellaneous**
 1. *Standards and specifications*: N/A
 2. *Customer*: Research organizations working with rats.
 3. *Patient-related concerns*: Currently no patient-related concerns.
 4. *Competition*: MouseOx produced by Life Starr