Electromechanical Whole-Body Rotator for Cats:
Project Design Specification (PDS)

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Client: Professor Tom C.T. Yin

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Function:

This project will design and implement an electromechanical device for a behavioral experiment with cats that are actively localizing sound sources. We need a control experiment in which the cat is passively rotated under computer control (rather than actively moving its head) to see if the same reflex is elicited by stimulation of the vestibular system.

Client Requirements:

The client requires the design to:

- Center of rotation must be about the center of the cat's head.
- Maximum 90 degrees rotation in the horizontal direction
- Minimize electromagnetic interference inside magnetic field
  - Metal use
  - Electricity
  - Competing magnetic fields
- Speed of rotation less than 3-4 hertz
- Minimize noise and vibrations
- Design must integrate two existing pegs as support
- Motor must be computer controlled (stepper motor)
- Allow integration into existing computer program
- Be able to move weight of cat (2-3kg)

1. Physical and Operational Characteristics

a. *Performance requirements*: The design must endure repeated use during the work day. Experiments include approximately 100 trials per day and possibly over several months. Loading on the design will vary with the weight of the cat; generally 2-3kg.

b. *Safety*: There should not be any exposed wires or sharp edges that may pose health risks to the cats. Also, amount of control and rotational speed of the motor should be adequate enough to prevent unnecessary distress to the subject.

c. *Accuracy and Reliability*: Position of the cats head can deviate ~ 20cm from the center of the magnetic field to ensure linearity in experiments. Rotation of the cat cannot exceed 45 degrees to the left or right of the initial (centered) position of the cat.

d. *Life in Service*: See performance requirements.

e. *Shelf Life*: Device should be operable over several years.

f. *Operating Environment*: Operation of the device may occur directly in a magnetic field. The design should be away from sensors and disrupt the magnetic field as little as possible

g. *Ergonomics:* Design should facilitate experiment preparation including cat placement and removal. The device should not cause any unnecessary discomfort to the cats including rotational speeds not exceeding 3-4 hertz.

h. *Size*: No definite size requirements exist for the motor setup; though it should not take up an excessive amount of space nor deviate the cats head more that 20cm from the center of the magnetic field. Cat box size requirements assuming current support peg height of 75cm are as follows:
    - 50.5 x 17.5 cm x 12.7cm
    - Base elevation $\leq$ 2.5cm
    - Empty rear space ~ 12.7cm
    - Velcro spaced 12.7cm from back and 12.4cm apart

i. *Weight:* Optimal weight should be less than the current weight of the box (approx. 15lbs.)

j. *Materials:* Non-metal or diamagnetic materials are preferred to minimize disruption inside the magnetic field. Outside the magnetic field may allow for more metal components.

k. *Aesthetics*, *Appearance, and Finish*: Secondary to safety and functionality.

2. Production Characteristics

a. *Quantity*: Only one unit is required for the experiments.

b. *Target Product Cost*: Funded by research grants, any reasonable cost is acceptable.

3. Miscellaneous

a. *Standards and Specifications:* This project must adhere to all relevant animal testing protocol as stated by the IRB and the IACUC.

b. *Customer*: The current weight of the cat box is a concern. It would be optimal to reduce the overall weight of the finished box.

c. *Patient-related concerns*: Components of the design in direct contact with the cats should allow of easy clean-up and maintenance.

d. C*ompetition*: U.S. patents for computerized rotational systems and similar products include patent numbers 6,976,821; 6,023,247; 5,671,648; and 4,920,350. The products previously mentioned do not directly compete with this project because the use of the rotational system differs and the integration of a containment box is not seen in any design.