Mouse Sleep Deprivation Device

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Outline

- Background
- Client Requirements
- Existing Products
- Objective Statement
- Design Alternatives
- Design Matrix
- Final Design
- Future Work

http://adasperdown.blogspot.com/2012/02/mouse-remorse.html
Background

- Relationship between sleep loss, epilepsy, and memory
- Depriving mice of sleep for six hours to two weeks
- Client uses Afasci products

Dr. Rama Maganti

Eli Wallace
Client Requirements

- Stable housing for mouse with access to food and water
- Fits within existing cage
- Stimulus that will awaken the mouse
- User interface for programing speed, frequency, and duration
- Continuous operation for up to two weeks
- Can be sterilized using autoclave between uses and cleaned daily

http://www.afasci.com/products
Existing Products - Forced Exercise/Walking Wheel

- **Good**
  - LCD interface with USB
  - Speed range: 1-28 m/min
  - Waste pans underneath

- **Bad**
  - Time: 0-24hrs
  - Cost of bed-$3,650.00
  - Cost of each wheel-$505.00
  - Forced exercise

Existing Products-Sleep Deprivation Chamber

- **Good**
  - Food and water support
  - Sweeping bar-tactile stimulus
  - Program controls speed, torque, and interval
  - Detects walls and relay engages it in other direction.

- **Bad**
  - Cost-~$1,650.00
  - Not working yet
  - Too noisy
  - Hard to clean and maintain

Existing Products-Flowerpot Technique

- Upside down flowerpot in a bucket of water
- Sleep results in the rodent falling off the platform and waking up

**Good**
- Allows NREM sleep where they retain muscle tone
- Does not allow REM
- Simple

**Bad**
- Connecting to computer for data collection
- Providing drinking water and food
- Not consistent

Existing Products - Propeller

- **Good**
  - Gentle tactile stimulation
  - Can link multiple cages together
  - Change of direction
  - Detects when mouse is asleep
  - LCD screen
  - Program scheduling
  - Accommodates water, food, bedding

- **Bad**
  - Cost $4,000-$7,500

http://www.pinnaclet.com/sleep-deprivation.html
Objective Statement

- To develop a device that can keep mice awake for 6 hours to 2 weeks at a time. This device must ensure that the mice do not fall asleep even for 30 seconds, should be able to be taken apart to be cleaned, should allow mouse access to food, and should not injure the mouse in any way. The device should respond to the mice trying to fall asleep, should be able to be programmable by the user for experiment customization and any programs created should be able to be run on multiple mouse cages at the same time.
Slide Bar Design Alternative

- Design Features
  - Sliding bar not flushed with bottom
  - Removable motor complex
  - Food and water delivered from top

- Pros
  - Sanitary
  - Proven effective

- Cons
  - Complex mechanics
Propeller Design Alternative

- Design Features
  - Circular cage
  - Insertable, removable motor
  - Flexible propeller spanning cage; not flush with bottom

- Pros
  - Mechanically simple
  - Non-problematic day-to-day operations

- Cons
  - Small cage
  - Not as effective

Rotating flexible propeller

15cm
Platform Design Alternative

- **Design Features**
  - Circular cage
  - Water filled base
  - Platform on dome that rotate and tilt

- **Pros**
  - Always wakes mouse
  - Most effective

- **Cons**
  - Difficult to sanitize
  - Water-proofing
  - Complex mechanics
## Design Matrix

<table>
<thead>
<tr>
<th>Design Criteria</th>
<th>Weight</th>
<th>Slide Bar</th>
<th>Propeller</th>
<th>Platform</th>
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<tbody>
<tr>
<td>Ability to Wake Mouse</td>
<td>20</td>
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<tr>
<td>Ability to Implement Software</td>
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<td>Ability to Implement Circuit</td>
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<td>Ease of Operation</td>
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<tr>
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<tr>
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System Block Diagram

- Cage
- User Input
- Power Source
- Sensor
- Motor
- Computer
- Microcontroller
- Circuit
- Memory Cache/or not
- Output
Future Work

- Refine final design
  - Material selection
  - Prototype construction
- Creation of software and circuitry
  - Labview program for user interface
  - Circuit design, parts search, construction
- Research mechanism to implement mouse monitoring
- Research manner to implement wireless memory and control
- Test prototype
  - Accuracy of program
  - Stamina of prototype including longer term testing of device
Acknowledgements

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- Eli Wallace
- Dr. Chris Brace
- Matt Bollom
Questions?