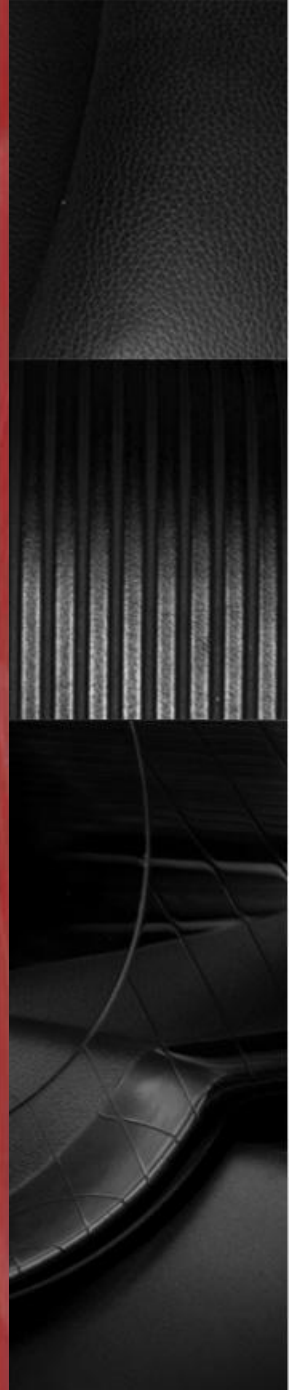


Mouse Sleep Deprivation Device

Group Members: Kyle Anderson, John Diaz de Leon III,
Peter Guerin, Rebecca Stoebe

Client: Dr. Rama Maganti & Eli Wallace

Advisor: Dr. Chris Brace



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 programming 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>

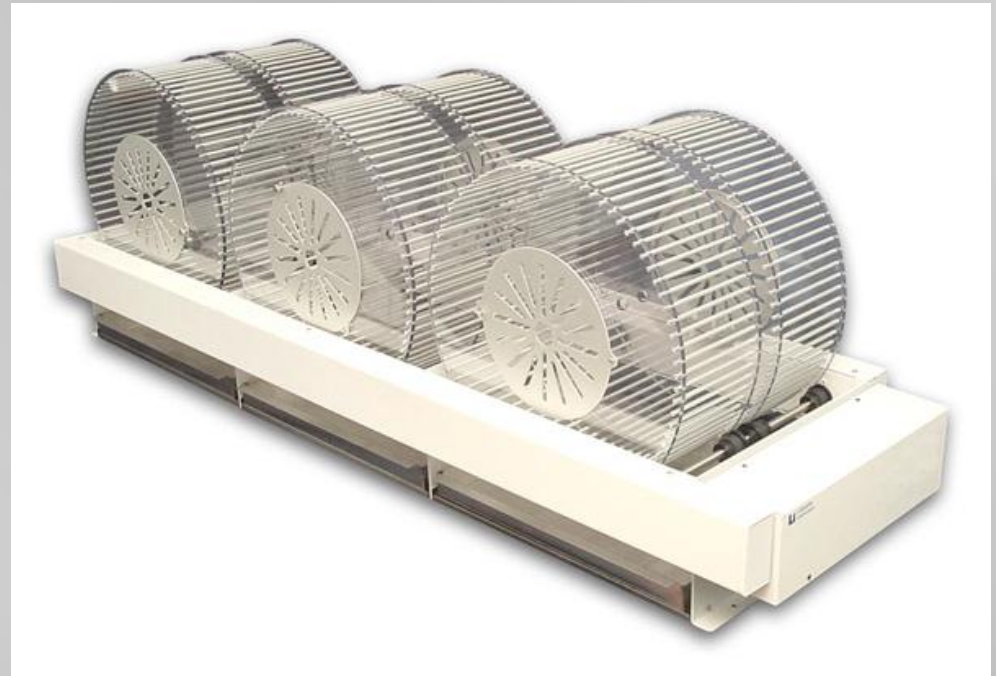
Existing Products-Forced Exercise/Walking Wheel

■ 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



https://www.lafayetteneuroscience.com/product_detail.asp?ItemID=976

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



https://www.lafayetteneuroscience.com/product_detail.asp?ItemID=1948

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



<http://en.wikipedia.org/wiki/File:Sleep-deprivation-flowerpot-technique-jepoirrier.jpg>

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.pinnacle.com/sleep-deprivation.html>

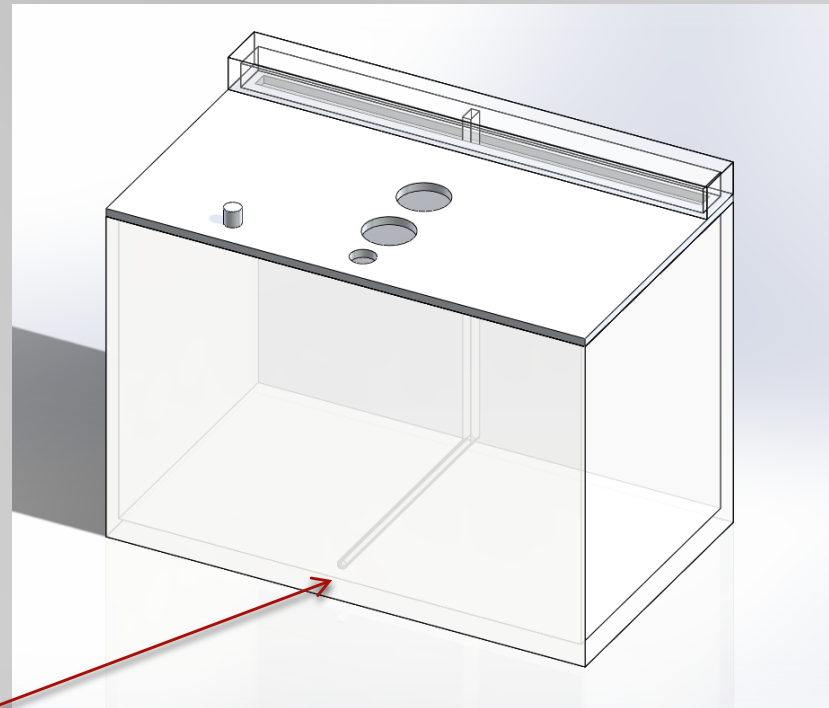


Objective Statement

- 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

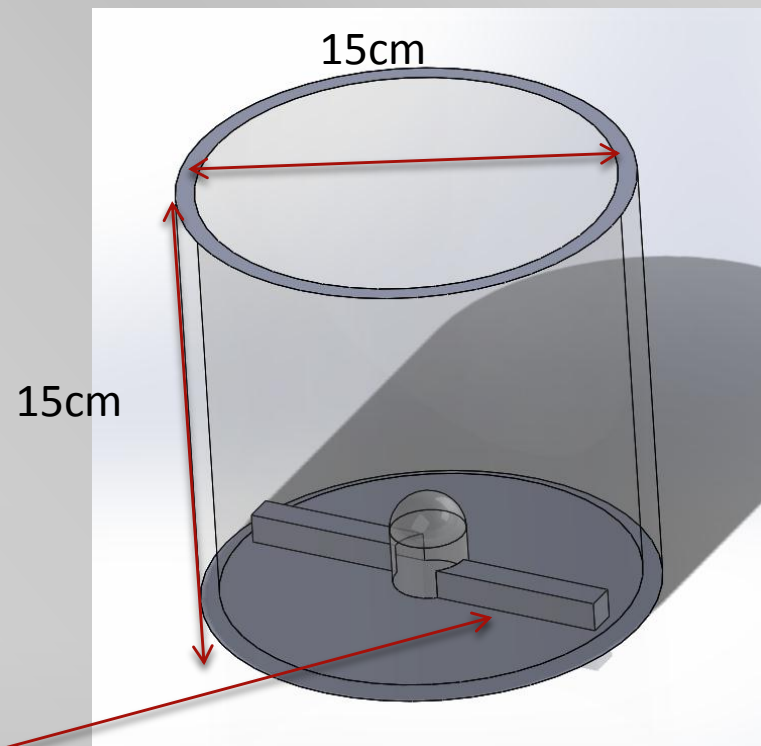
- Design Features
 - Sliding bar not flushed with bottom
 - Removable motor complex
 - Food and water delivered from top
- Pros
 - Sanitary
 - Proven effective
- Cons
 - Complex mechanics



Moving bar

Propeller Design Alternative

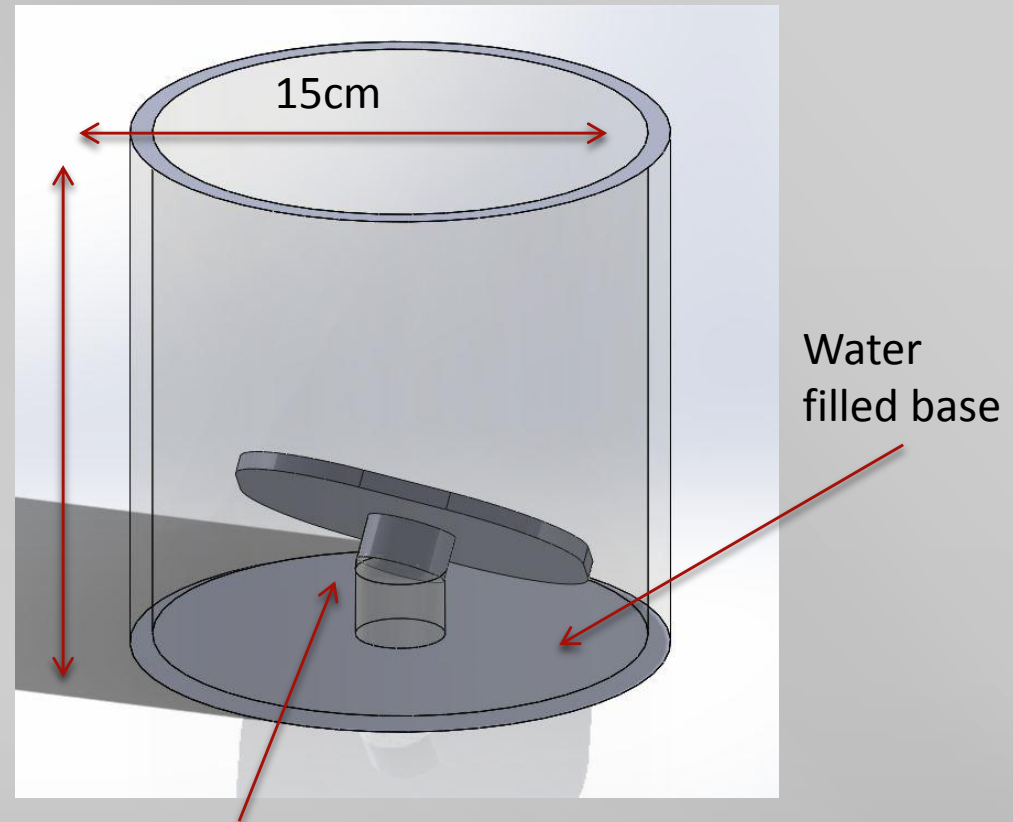
- Design Features
 - Circular cage
 - Insertable, removable motor
 - Flexible propeller spanning cage; not flush with bottom
- Pros
 - Mechanically simple
 - Non-problematic day-to-day operations
- Cons
 - Small cage
 - Not as effective



Rotating
flexible
propeller

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

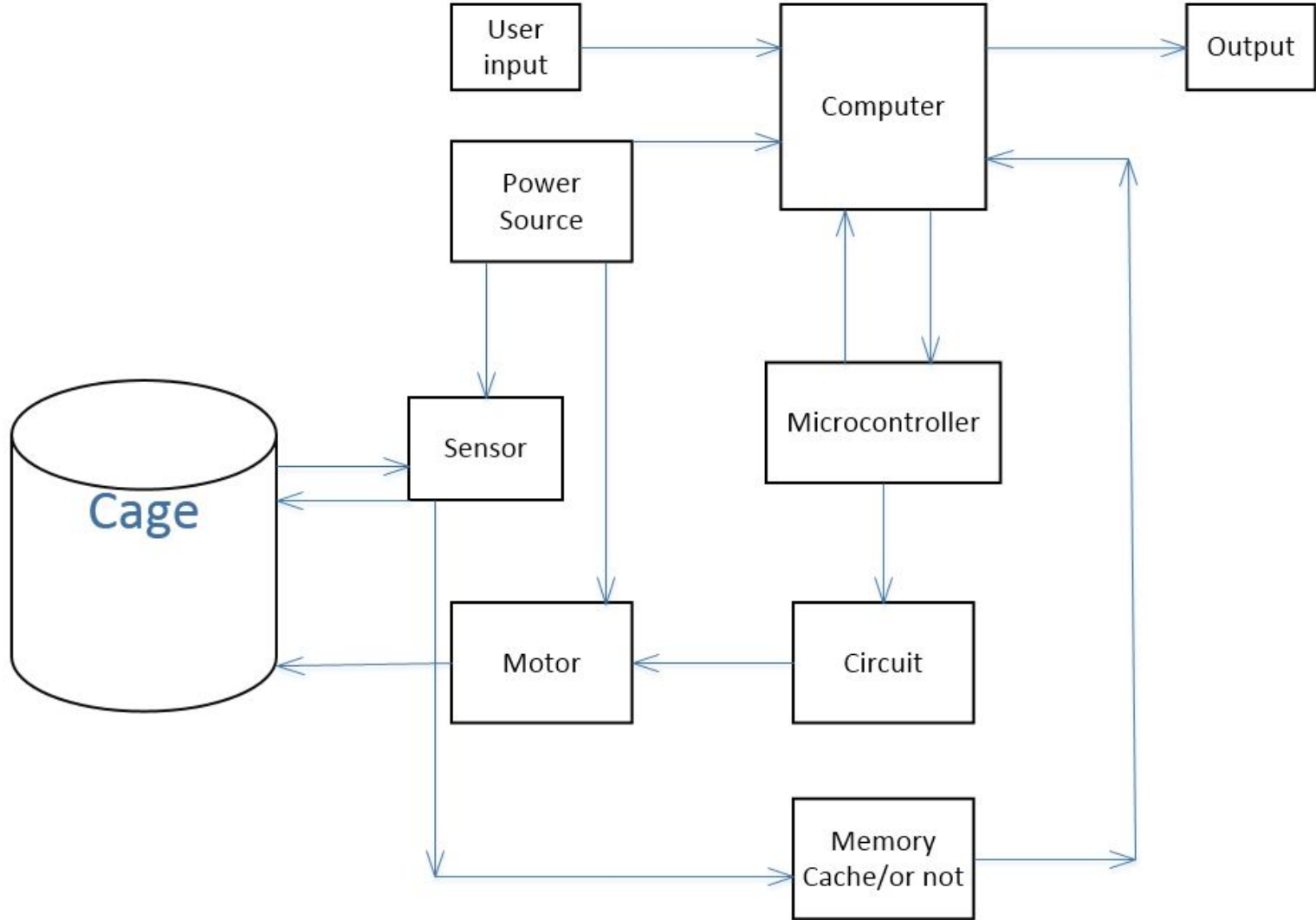


“Tipping”
Platform

Design Matrix

Design Criteria	Weight	Design Alternative		
		Slide Bar	Propeller	Platform
Ability to Wake Mouse	20	15	12	15
Ability to Implement Software	15	10	10	10
Ability to Implement Circuit	15	7	15	5
Ease of Operation	15	10	15	5
Ease of IACUC Approval	10	10	10	7
Feasibility	10	6	8	4
Ease of Sterilization	5	3	5	3
Ease of Producing >1	5	3	5	4
Cost	5	3	5	3
		Total		
	100	67	85	56

System Block Diagram





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

- Dr. Rama Maganti
- Eli Wallace
- Dr. Chris Brace
- Matt Bollom



Questions?