

Physical Function Testing Apparatus for Monkeys

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Outline

Background

Problem Statement

Project Design Specifications

Considered Designs

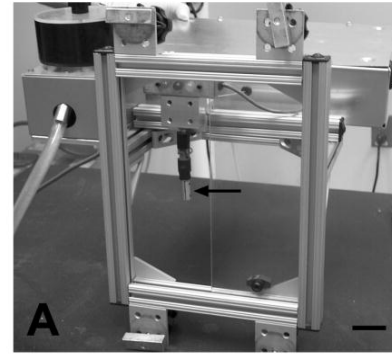
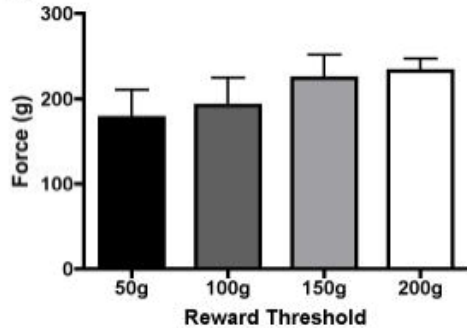
Design Matrix

Future Work

Acknowledgements

Competing Design - Grip Strength Device (Bury SD et al.)

- Measured grip force of squirrel monkeys through a small force transducer embedded in a bisected aluminum cylinder
- Reward was provided per grip; monkeys either gripped once for one reward or multiple times for multiple rewards



Competing Design - Pulling Strength Device (Bozek et al.)

- Measures pulling strength using a force gauge attached to a handle on one end and a sled with adjustable weight on the other
- Monkey pulls the handle with arms and legs, reeling in the weighted sled to obtain an attached reward
- Force gauge measures peak force, which is divided by the subject's weight for a normalized measurement
- With each successive pull, weight is increased on the shelf

Background Research - Monkey Physiology

- Similar to people in musculoskeletal anatomy and movements
- Hands and feet designed for grasping
- Untested strength comparable to that of humans
- Biopsy site – located on quadriceps (largest and most easily measured muscle group)

Problem Statement

Our goal is to design a device able to measure the maximum strength of a rhesus monkey while it is still in its cage. This apparatus should motivate the monkey to perform at its maximum ability while remaining safe and durable.

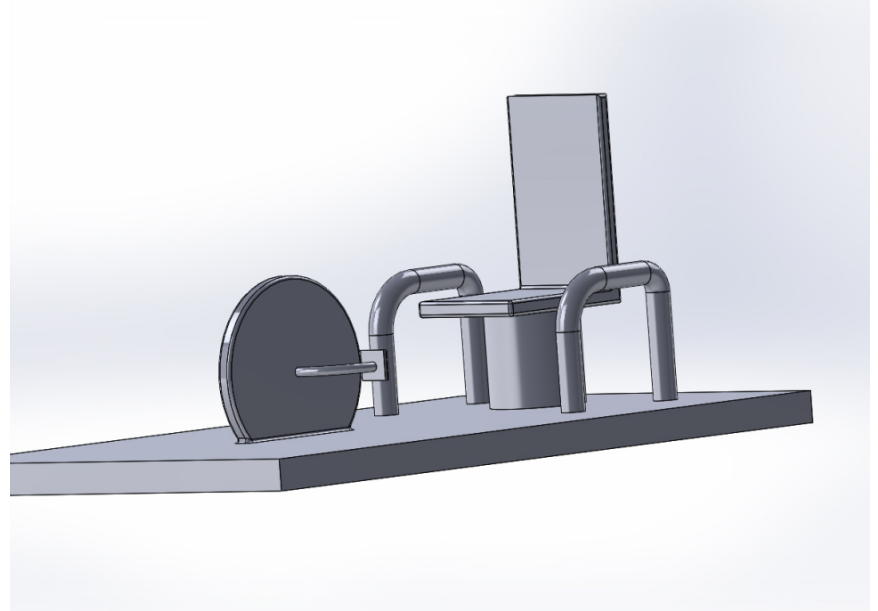
Product Design Specifications

- Device should focus on measuring leg strength
- Device must be safe, durable, and rust resistant
- Device must be easy to set up and compatible with multiple cages
- Monkey should be able to operate the device after training

Considered Designs

Bike

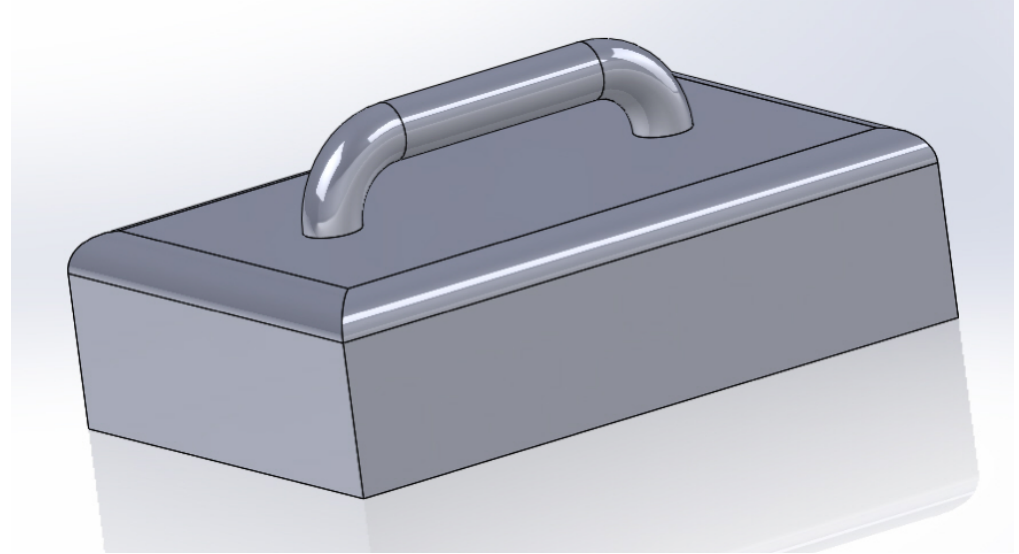
- Able to test legs independently from arms
- Monkey has to place hands on rails to activate device
- Resistance would increase over time, with continued food reward



Considered Designs

Deadlift

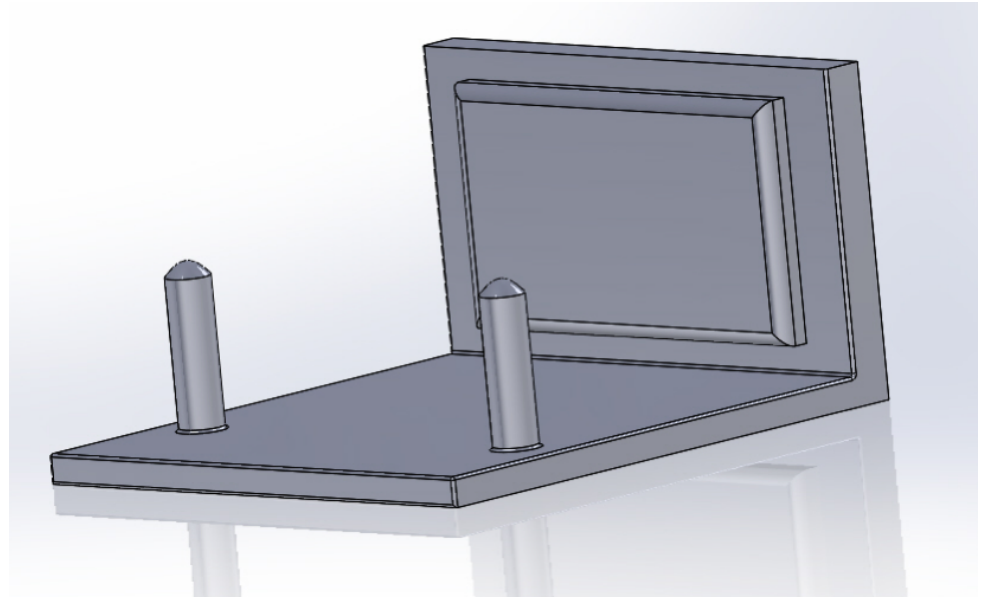
- Device is attached to the bottom of the cage
- Monkey lifts upwards on handle
- Incorporates both arms and legs



Considered Designs

Push Plate

- Monkey sits on ground, uses back plate of cage for leverage
- Places hands on handles, pushes on force plate for reward
- Tests only legs



	Push Plate		Stationary Deadlift		Bike	
Safety (25)	4	20	5	25	3	15
Durability (20)	5	20	4	16	2	8
Difficulty of Training (Subject) (15)	3	9	4	12	3	9
Ease of Fabrication (15)	5	15	5	15	3	9
Ease of Use (Researcher) (10)	4	8	3	6	3	6
Measurement Accuracy (10)	5	10	3	6	4	8
Cost (5)	3	3	4	4	5	5
Total (100)		85		84		60

Considered Designs

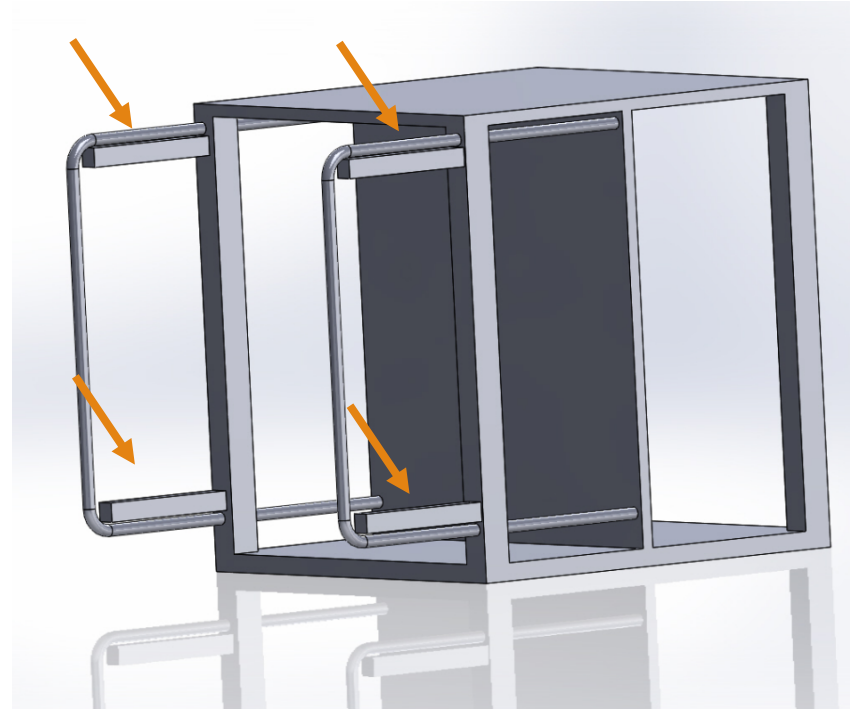
Sliding Cage

Pros

- No need to remove monkeys from cage
- Four force sensors instead of one
- Natural motion
- Simple

Cons

- Cannot Isolate the legs
- Must connect all sensors wirelessly



	Push Plate		Stationary Deadlift		Sliding Cage	
Safety (25)	4	20	4	20	5	25
Durability (20)	5	20	4	16	5	20
Difficulty of Training (Subject) (15)	3	9	4	12	5	15
Ease of Fabrication (15)	3	9	3	9	4	12
Ease of Use (Researcher) (10)	4	8	3	6	5	10
Measurement Accuracy (10)	5	10	3	6	4	8
Cost (5)	5	5	4	4	3	3
Total (100)		81		73		93

Future Work

- Find plausible force sensors
- Develop code that reads in data and runs further analysis
- Develop real-time feedback system for client
- Begin preliminary testing with and without monkeys
- Analyze testing and further improve device



<http://animals.nationalgeographic.com/animals/mammals/rhesus-monkey/>

Acknowledgements

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References

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