301 – 27– Excellence – Monkey Strength– ExecutiveSummary

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Rhesus monkeys have long been used as models for scientific research due to their similar anatomy to humans. In studying the muscular effects of calorie-restricting diets and their impact on aging, Rhesus monkeys must be assessed for muscle strength. Current methods simply accurately measure muscle mass, which only loosely correlates with muscular function. Dr. Ricki Colman at the Wisconsin National Primate Research Center (WNPRC) requires an apparatus that intuitively allows moneys to complete a range of motion under resistance and delivers quantitative feedback on leg strength. The goal of this project is to develop a safe, durable, and easily sanitizable device that meets this goal.

There are several different products currently used to test monkey strength in the research setting. The most notable competing design is implemented by Bury SD et al. in a study to understand grip behavior by normal and neurologically-impaired squirrel monkeys. It consists of a small force transducer within a bisected aluminum cylinder used to measure grip strength. Monkeys are provided a reward upon each squeeze at a specified force. The reward system of the design is advantageous, but the product does not test leg strength as Dr. Colman desires. There are products in use with similar motivation to this design, but none would fulfill the WNPRC's specific experimentation needs.

After finishing the design process, it was decided that the best option was a three sided clamp that would be held in place using nuts and bolts, with friction created by a layer of foam film adhered to the inside walls of the devices. The prototype consists of four separate pieces which each hold a load cell against one corner of the monkey's cage as it pushes against the squeeze plate mechanism. The pieces are connected to one Arduino through a load combinator. The pieces are made from aluminum and are rounded to protect the animal subjects.

The devices will be tested in a step wise manner, having one device attached, followed by two, until all four are testing in unison. Each step of testing will test the load cells' accuracy with incrementing five pound forces until failure. The force will be applied by a human pushing a pressure scale against the back of the cage's squeeze plate. Each step will also be repeated until three sets of data are recorded. This data will be averaged and compared to other the other experimental steps. The final stage of testing will be to implement the devices directly with the monkeys to test whether we can obtain realistic force values over an extended time period.

The final prototype will accurately measure rhesus monkey strength in a way that is both safe for the monkeys and also convenient for the client. The device is attached to the cage externally so that the monkeys are not able to interact with it. This also increases the devices durability. In order to make the device convenient for the client, the final prototype integrates a new, simpler clamping method along with Bluetooth connection to minimize wiring. The prototype also contains four load cells, so that the force reading accuracy and range is drastically improved. This is the first device of its type, and it will be extremely beneficial for the client's research. She currently has no secondary measurement for the monkey's muscle function, and this prototype allows for her to correlate her muscle mass data with a muscle strength measurement.