Project Proposal

Project Title: Puppy Prosthetics: A Method for Mobility Rehabilitation Implementing 3D Design

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Project Definition:

The overall aim of this project is to improve the ease of movement for a dog who has lost a limb due to an amputation. This project is intended for a client, however, the findings and designs can be implemented in prosthetics for other dogs as well.
By designing the prosthetic to be primarily 3D printed, the functionality of this prosthetic will not be impacted, however, the cost will be lower in comparison to current prosthetics and braces available. This will make the prosthetic more accessible to the general population of amputee dogs. By having the majority of the prosthetic 3D printed, production time can also be reduced, allowing clients in need to obtain their assistive devices quicker.

Background:

Engineering Need: Many amputated dogs have limited mobility, and prosthetic limbs are expensive and not common for dogs.

Engineering Objective : The objective of this project is to improve the mobility of a dog that has an amputated front left limb. The cost of this prosthetic will be lower compared to currently available prosthetics since it will be manufacturing them out of a more cost-effective and accessible material. The prosthetic must be functional, lightweight, and have the ability to withstand daily activities.

After a body sustains a major injury, many times amputation of a limb is required to keep the patient alive. For humans, many prosthetic devices and braces are readily available. As time progresses, human prosthetics are becoming more advanced and better at emulating real limbs (Cherelle et al., 2017). Research and development on human prosthetics have a wide scope since a variety of body parts can be amputated off a person. Furthermore, testing is not very complicated since scientists can receive immediate feedback from their test subjects (Cutti et al., 2017).

Contrastingly, prosthetics for domestic animals have not been developed as extensively. Many animals, mostly dogs, have to receive amputations due to accidents, such as being hit by a car. Most are not able to get fitted for a prosthetic or brace due to the lack of accessible and affordable devices for dogs. This leads to many negative side effects, which include but are not limited to weight gain, restricted mobility, and premature euthanasia (Jarrell et al., 2018). However, like dentistry and acupuncture, many principles and concepts of human orthotics and prosthetics can be implemented in animal versions. Dogs who have prosthetics have increased mobility and less pain in comparison to amputee dogs who do not (Mich et al., 2014). Dogs are also very adaptive, which means that they can adjust to the addition of new limbs after losing their original ones (Drygas et al., 2008).

Experimental Design/Research Plan Goals:

IDV: 3D Printed Prosthetic
DV: Stability, Speed, Gait
Control Group: Dog without prosthetic
Experimental Group: Prototype of the modified prosthetic
Iterations: Multiple CADs, Multiple prototypes
Materials:

- Autodesk Fusion CAD Software
- 3D Printer
- Plastic
- Drill
- Screws
- Velco
- Adhesive
- Fabric
- Sewing Machine
- Polycarbonate Plastic
- Jigsaw
- Mechanical Lubricant
- Gyro Sensor
- Accelerometer
- Compass
- Arduino

Procedure:

Note: At any point, I may have to jump back to a previous step

1. Sketch possible modifications on paper
2. Measure client
3. Model the prosthetic with CAD software
4. Manufacture the modified component using 3D printing Test prototype with client
    a. Implement Arduinos on a treadmill to analyze pressure and cadence of the dog to measure gait
5. Reiterate design

Risk/Safety Concerns:

The prosthetic will be tested on a dog, but all precautions will be taken with respect towards the dog's safety. For example, the prosthetic will have padding to minimize friction The dog's owner or a veterinary professional will be present at all times. If the dog shows any signs of discomfort, such as whining or obvious physical discomfort towards the prosthetic (scratching, biting at it, etc.) the trial will be immediately terminated.

While working with electrical components or mechanical power tools, safety goggles will be worn at all times. Potential hazards such as long hair, loose clothing, and dangling jewelry will be eliminated in the building and testing environment.

Data Analysis:

The client will be put through a series of motions, once without the prosthetic, and then with the prosthetic on. The data from both trials will be graphed and compared to analyze the differences in the ability of motion. Additionally, difference bars will be implemented to represent the differences between the original and modified prosthetic.

Potential Roadblocks: (with action steps identified of how you might solve these):

The lack of a nub on my client may affect the ability of the prosthetic to be attached to them

- A larger prosthetic that includes a shoulder or back strap can be incorporated

Data may vary due to the fact that the test subject is living

- Multiple tests will be run to see overall impact on the client

References: (In APA Format with in-text citations):

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Sekine, M., Sugimori, K., Gonzalez, J., & Yu, W. (2013). Optimization-Based Design of a Small Pneumatic-Actuator-Driven Parallel Mechanism for a Shoulder Prosthetic Arm with Statics and Spatial Accessibility Evaluation. *International Journal of Advanced Robotic Systems, 10*(7), 286. doi:10.5772/56638

Timeline:

- August
  - Brainstorm
- September
  - Continue brainstorming
  - Begin background research
- October
  - Continue background research
  - Complete Project Proposal
  - Complete zFair paperwork
- November
  - Sketch design drafts
  - Purchase materials
  - Measure client
  - CAD 1-2 designs
  - Prototype one design
- December
  - Prepare materials for December Fair
  - Test prototype
  - Redesign and manufacture if needed
- January
  - Obtain final data
  - Create graphs
  - Prepare poster
  - Practice presentation
- February

- Practice presentation