Capstone 2 Proposal
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Identifying Humans in Drone Footage from Local Beaches

1. *Background*

Throughout the years, researchers have used a variety of different technologies to address the movement patterns and behavior of particular shark species. In more recent years, however, shark researchers have begun to use drones and helicopters to capture footage of shark species to answer questions like: *How do these animals interact with one another when they are not being actively tagged or followed?* Using drone data itself presents a lot of issues when it comes to data processing, such as having a suitable reference item to accurately predict the sizes of objects in the drone's field of view and figuring out the orientation of the drone in order to georeference the resulting footage. However, although drone footage is relatively new to the field of marine biology, data scientists have been analyzing video footage and images for quite a while.

2. *The Problem*

Shark attacks from a variety of species, including White Sharks (*Carcharodon carcharias*), Tiger Sharks (*Galeocerdo cuvier*), and Bull Sharks (*Carcharhinus leucas*) are heightened in the media and instill terror in much of the human population. Although shark researchers are aware that shark attacks do not happen as frequently as the media portrays, no research projects have addressed how frequently sharks and humans actually interact with each other, and how many times those interactions result in a shark bite. A graduate student at California State University, Long Beach is using video footage from drones and helicopters in order to answer this question, by identifying not only when White Sharks and humans are in the water at the same time, but also by categorizing how the sharks respond when approached by their human counterparts. However, gathering drone footage for such a project inevitably produces a lot of raw footage (several 10+ minute videos per day) that likely contains neither sharks nor humans. Going through each frame of a video one-by-one may take up a significant amount of one's time, leaving little time for true data analysis techniques. Therefore, this project's goal is to take stills from drone video footage and train a deep neural network to identify how many humans are present within each frame.

3. *Specific Clients*

This project is geared towards researchers who may be trying to answer similar research questions.

4. *Datasets and Approach*

Approximately 600 drone stills have been provided by the California State University, Long Beach Shark Lab. These images were taken at local beaches along the southern California coast and may include features such as: humans that are participating in a variety of

different activities (e.g. walking on the beach, wading in the shoreline, swimming, paddleboarding, or surfing), White Sharks swimming near the ocean's surface, or other forms of marine life (e.g. dolphins, stingrays, kelp).

I will begin by creating a method to manually label where humans are within each image that is provided by using OpenCV. The labeled images will have values of 0 where there are no humans and a value of 1 where humans have been located. These labeled images will be used to train and test a Convolutional Neural Network. Because there are only 600 images available, images will be rotated at 90 degree increments to create four images for each single image that was provided. This will help the model identify humans even when the orientation of the video changes.

Prior to building and training a neural network, I will research whether there is already a model that has been trained that identifies humans from an overhead point-of-view. If there is one available, I will use transfer learning in order to adapt the model and re-train some of the last layers of the model with my current dataset. If there are no models available, one will be made from scratch.

5. *Deliverables*

The code from this project will be made available on GitHub, and a thorough report will be written that addresses background, methodology, results, discussion points.