Underwater Image Enhancement / Augmentation

**Think Big**

**What is your innovative idea?**  
My idea is to make an image enhancement tool that can transform low-resolution underwater images into high-resolution images. This solution would be especially valuable for marine research, and underwater photography, where visibility is often compromised due to water conditions and low lighting.

**What problem, need, or goal does your idea address?**  
Underwater images are often blurry, low in resolution, and lack clarity due to poor lighting, and other challenges underwater. This makes it difficult for researchers and photographers to capture or analyze fine details in the images. My idea addresses the need for clearer, high-resolution images to improve the quality of underwater observations and analyses.

**Which (hypothetical or real) data will you need?**  
For this project, I will need a dataset of low-resolution and high-resolution underwater images to train and test the enhancement model. If possible, it would be ideal to obtain real images captured in various underwater conditions (e.g., different depths, lighting, and water types). I can also find high-resolution images and downscale these to have LR/HR pairs.

**Why is this interesting and innovative?**  
This idea is interesting because it offers a solution to a persistent issue in underwater imaging, with potential applications in multiple fields, including marine biology, archaeology, and even tourism. What makes it innovative is the focus on enhancing images in a specialized environment (underwater), which is more complex than typical image enhancement due to unique lighting and color challenges.

**Are there ethical aspects involved?**  
Yes, there are ethical aspects, particularly in making sure that enhanced images accurately represent underwater environments without exaggerating or misleading details. This is important for scientific research, where data integrity is important.

**The First Step**

**What is the realistic first step?**  
The first step is to collect or create a dataset of low and high-resolution underwater images for model training. Next, I will build a basic enhancement model to test the approach on this dataset, adjusting it based on initial results.

**Which real data will you use?**  
I will use the [**EUVP dataset**](https://irvlab.cs.umn.edu/resources/euvp-dataset) (Enhancing Underwater Visual Perception), which is a collection of underwater images designed for image enhancement projects. This dataset includes both low-quality and improved versions of underwater images, making it suitable for training and testing my model. The EUVP dataset has a range of underwater conditions and image types, which will help in developing a model that works well in real-world underwater environments.

**Which techniques and tools will you most probably use?**  
To enhance underwater images, I plan to develop a model trained specifically for underwater image resolution and clarity improvement. I will start by looking into applying deconvolution to handle blurriness typical in underwater images, aiming to reverse distortions caused by light scattering. Another interesting technique will be super-resolution to generate higher-resolution images, using layers that can progressively improve image details.

I’ll experiment with creating my own CNN to handle image features unique to underwater scenes, such as color distortions and low contrast. For model development, I’ll use TensorFlow or PyTorch for constructing and training this model, as well as OpenCV or Pillow for pre-processing steps like noise reduction, color balancing, and contrast adjustment.

To measure the effectiveness of the enhancements, I’ll apply image quality metrics such as Structural Similarity Index and Peak Signal-to-Noise Ratio, which will help me adjust the model based on visible and measurable improvements in the enhanced images.

**When is your first step successful?**  
The first step will be considered successful when the model can significantly improve the quality and resolution of underwater images in a way that makes key details clearer and more useful for end-users. A clear improvement in clarity and resolution, as verified by comparing pre- and post-enhanced images, would be the indicator of success.