**Description of Key Algorithms**

The framework consists of a **two-step process** for image enhancement:

**Step 1: White Balance Adjustment**

* Underwater images often have a **color cast** due to light absorption in water.
* The algorithm adjusts the **red and blue channels** to compensate for the loss of red wavelengths.
* **Implementation:** A white balance correction factor is applied to the red and blue channels.

**Step 2: Contrast Enhancement and Sharpening**

* **Contrast Adjustment:** Converts the image to **LAB color space** and applies **adaptive histogram equalization** to the luminance channel.
* **Sharpening:** Uses an **unsharp mask filter** by subtracting a blurred version from the original image.

**Implementation Details**

The MATLAB-based **Graphical User Interface (GUI)** allows users to:

* **Load an Image** from local storage.
* **Adjust enhancement settings** using sliders for **White Balance, Contrast, and Sharpness**.
* **Preview real-time changes** before saving the final output.
* **Save the Enhanced Image** back to storage.

**Enhancement Functions Used:**

* **White Balance:** Adjusts the **R-G-B** channel intensity.
* **Contrast Adjustment:** Uses **LAB color space transformation + Adaptive Histogram Equalization**.
* **Sharpening:** Applies a **Gaussian blur-based unsharp mask** to enhance image details.

**Instructions for Implementation**

**Step 1: Install MATLAB and Required Toolboxes**

Ensure MATLAB and the **Image Processing Toolbox** are installed.

**Step 2: Load and Run the Script**

Run the MATLAB script that contains:

1. GUI controls (buttons, sliders)
2. Image enhancement functions
3. Display and save functionality

**Step 3: Adjust Enhancement Parameters**

Use the GUI to fine-tune the **white balance, contrast, and sharpness** to achieve the best visual quality.

**Step 4: Save the Enhanced Image**

Once satisfied with the enhancement, save the improved image to your system.

**Additional Features & Future Enhancements**

* **Batch Processing:** Automate enhancement for multiple images.
* **Deep Learning Integration:** Utilize pre-trained models for enhancement.
* **Real-Time Processing:** Enhance live video feed instead of static images.