UNDERWATER IMAGE ENHANCEMENT

DIGITAL IMAGE PROCESSING

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Problem statement

The earth is aquatic, about 70% of its surface is covered by water. So, underwater images are essential for ocean exploration, deep-sea exploration, and underwater archaeological excavation.

However, researchers often suffer from a severe deterioration in quality due to several problems, such as refraction of light under the water.

In addition, this problem increases the difficulty of various tasks such as inspection of infrastructure and cables, ect.

so, Advanced image processing can bring sites to life.

In this project, we proposed image enhancement and restoration methods for these low-contrast ones that cause noise and limited range visibility.

PROJECT GOAL

The main objective of our project is to improve underwater images, by improving the pictorial information for human interpretation, improving image contrast, resolution, and quality, and restoring the original image such as documenting the health of coral reefs.

Processing identification

Image enhancement

highlighting certain information in an image as well as removing any unnecessary information. We will eliminate green bullish (eliminate the color cast brought on by underwater light scattering), reveal blurred details, and stretch the contract.
we focused in our project implementation on Spatial domain enhancement methods to perform operations on pixels directly.

Methodology

RED AND BLUE CORRECTION

extract individual RGB color channels to make them all have the same mean

WHITE BALANCE

eliminate the color cast brought on by underwater light scattering by measuring the intensity of the ambient light and adjusting the values giving a realistic appearance of the color white.

HISTOGRAM EQUALISATION

Underwater images contain low contrast, and histogram equalization useful in order to improve the contrast .

Methodology

GAMMA CORRECTION

Aims at correcting the global contrast, gamma correction should be used accompanied by some other kind of contrast correction technique, such as histogram equalization.

IMAGE SHARPENING

Underwater images often suffer from reduced visibility and details

FUSION ALGORITHM

combining relevant information from two or more images into a single image. The resulting image will be more informative than any of the input images. In our case, we combined (sharped image and Gamma corrected).

Code

```
%% Load the image and split channels.
Image=imread('7.jpg');
rgbImage=im2double(Image);
grayImage = rgb2gray(rgbImage);

%Display image
figure('Name','original image');
imshow(Image);
title('original image');

% Extract the individual red, green, and blue color channels.
redChannel = rgbImage(:, :, 1);
greenChannel = rgbImage(:, :, 2);
blueChannel = rgbImage(:, :, 3);

meanR = mean2(redChannel);
meanG = mean2(greenChannel);
meanB = mean2(blueChannel);
meanGray = mean2(grayImage);

% Make all channels have the same mean
redChannel = (double(redChannel) * meanGray / meanR);
greenChannel = (double(greenChannel) * meanGray / meanG);
blueChannel = (double(blueChannel) * meanGray / meanB);

%redChannel and blueChannel Correction
redChannel=redChannel-0.3*(meanG-meanR).*greenChannel.*(1-redChannel);
blueChannel=blueChannel+0.3*(meanG-meanB).*greenChannel.*(1-blueChannel);
```

Code

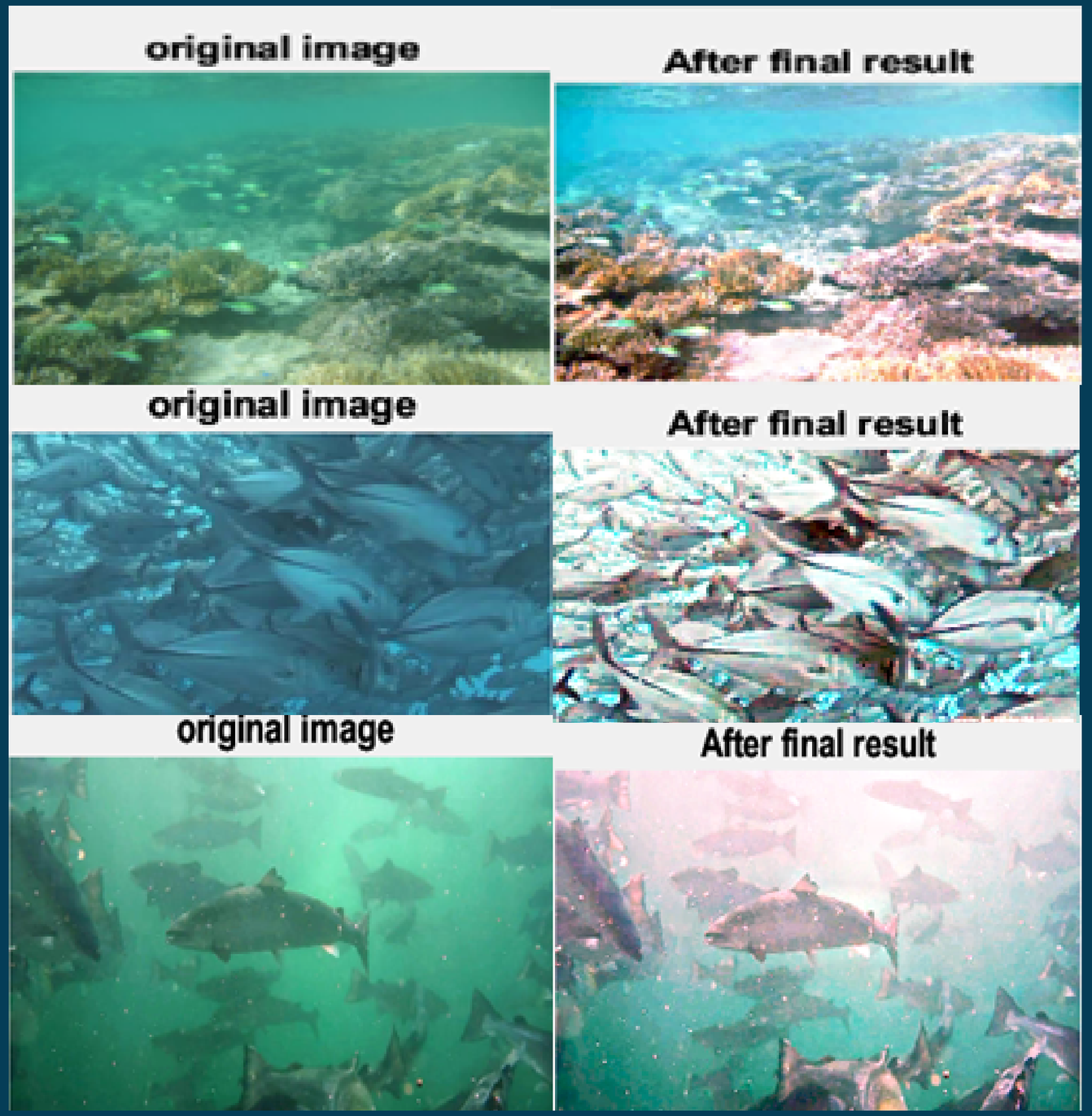
```
%% White Balancing

% Recombine separate color channels into a single, true color RGB image.
rgbImage_white_balance = cat(3, redChannel, greenChannel, blueChannel);

%Display image
figure('Name','White balance');
imshow(rgbImage_white_balance);
title('After White balance');
%% Histogram Equalization
Histogram_Equalization = histeq(rgbImage_white_balance);

%Display image
figure('Name','Histogram Equalization');
imshow(Histogram_Equalization );
title('After Histogram Equalization');
%% Gamma correction
%appliy contrast-adjusted image.
Gamma_correction = imadjust(Histogram_Equalization,[],[],0.5);

%Display image
figure('Name','Gamma correction');
imshow(Gamma_correction);
title('After Gamma correction');
```

Code

```
%% sharpening
%sharpening = imsharpen(Gamma_correction);
sharpening = imsharpen(Histogram_Equalization);
%Display image
figure('Name','sharpening');
imshow(sharpening);
title('After sharpening');


%% fusion

%Merge the two images by taking the maximum of the absolute value of the coefficients
for both approximations and details.
xfusmaxmax = wfusimg(Gamma_correction,sharpening,'sym4',5,'max','max');

%Display image
figure('Name','fusion');
imshow(xfusmaxmax);
title('After fusion');
```

Findings

As the example shows, there is a big difference between the original and final image, which is much clearer and more balanced.



CONCLUSION

WE IMPROVED THE CLARITY OF UNDERWATER IMAGES, GIVING US GREATER ACCESS TO THE UNDERWATER ENVIRONMENT AND ITS INHABITANTS, HELPING TO PROTECT AND PRESERVE THESE RESOURCES FOR FUTURE GENERATIONS.

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