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Global Histogram Stretching for Low Light Image Enhancement with Low Light Networks

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1. Abstract

Images captured under low- light conditions frequently suffer from poor visibility due to inadequate lighting. Low- light image improvement is a image processing fashion aimed at converting low- light images into visually natural, normal- light images. LLIE focuses on three primary tasks minimizing noise and vestiges, maintaining edges and textures, and restoring natural brilliance and colors. Lately, numerous studies have explored deep literacy approaches, which deliver emotional results. Still, a crucial challenge with these styles is their long conclusion time caused by complex network infrastructures. To address the trade- off of performance and processing speed, we do a simple yet effective design. Our approach incorporates Relative Global Histogram Stretching, a fashion that improves image discrepancy by conforming intensity values to span a target range. Results shown that the proposed system gets superior performance while immolation briskly conclusion compared to traditional LLIE (Low Light Image Enhancement) ways.

2. Introduction

Images acquired under shy lighting conditions negatively affect mortal visual perception and reduce the delicacy of computer vision tasks analogous as artical discovery(1), semantic segmentation(2), and facial recognition(3). Low- Light Image enhancement refers to process generating visually natural images from those captured in poor illumination. LLIE generally involves three major tasks suppression of noise and vestiges, preservation of edges and textures, and reduplication of realistic brilliance and color. Figure 1 demonstrates an illustration of the affair produced by the proposed LLIE approach.

1. The LLIE problem is largely challenging, as the histogram of a low- light image generally shifts toward the darker end. When analogous images are enhanced, critical information analogous as illumination, distinction, color, and structural features can be lost. Also, enhancement may amplify noise and haze.

The proposes a feathery, effective network balances enhancement of illumination, and noise reduction. The contributions of this work can be epitomized as follows. Unlike multitudinous CNN- predicated LLIE ways that employ complex architectures with multiple sub networks, the proposed approach introduces a simpler end- to- end network that reduces processing time. Drawing relief from conventional image processing, our model is designed on aU- Net back bone(29), which effectively captures original low-light inputs. Since images constantly warrant detailed textures and edges, performing in blurred labors, we string the raw image with an enhanced interpretation as input toU- Net. For edge enhancement, we employ an eight- neighbor Laplacian sludge. To help noise revision during this step, a blur sludge and a Gaussian sludge are first applied before Laplacian filtering. Experimental evidence confirms the effectiveness of this edge- enhancement preprocessing. Also, three knowledge modules are integrated to boost performance

3. Abbreviations and Acronyms

LLIE – Low Light Image Enhancement

RGHS – Relative Global Histogram Stretching

HE – Histogram Equalization

4. Objective

The main ambition of this project is to enhance images captured in low-light conditions using the Relative Global Histogram Stretching (RGHS) algorithm. This approach is designed to improve image contrast by broadening the dynamic range of pixel intensities, thereby making features more distinguishable. It focuses on enhancing visual clarity for use in low-light scenarios such as security surveillance, medical diagnostics, and night time photography. The algorithm is lightweight and computationally efficient, which makes it ideal for real-time processing. The ultimate objective is to generate improved images with higher clarity while minimizing unwanted distortions or artifacts.

5. Proposed Statement

Images captured in poorly lit conditions frequently exhibit low contrast and reduced visibility due to the limited spread of pixel intensity values. Traditional cameras and imaging devices often fail to capture finer details in such environments, which results in degraded image quality. Existing image enhancement techniques can sometimes create noise, artifacts, or excessive brightness in certain parts of the image. This decline in quality adversely affects domains like surveillance, self-driving systems, and remote sensing. Hence, there is a need for a reliable and efficient method that can enhance the contrast and clarity of low-light images without introducing undesirable distortions.

6. Tables and Charts

6.1 Unit Testing

Testing each module or component separately to ensure that it works as expected. Errors are easier to detect and fix at this stage since the testing happens during the development phase itself.

SI 1 Test case	UTCI
Test Name	Enhance Image
Test Objective	Verify if uploaded image is enhanced
Input Data	Low-light uploaded image
Expected Output	User can see the enhanced image and notice the improvement
Actual Output	User successfully logged into the application
Remarks	Pass

Figure 6.1 Test case 1

SI 1 Test case	UTC2
Test Name	Comparison with Other Techniques
Test Objective	Test the input image using other enhancement methods
Input Data	Low-light uploaded image
Expected Output	Image should be enhanced effectively
Actual Output	Enhancement is not as accurate as using the RGHS algorithm
Remarks	Pass

Figure 6.1 Test case 2

6.2 Integration test

Definition

testing phase **components are combined** and tested collectively. The goal of this stage is to uncover **errors in the interaction** among integrated units. To perform this, tools like **test stubs** and **test drivers** are often applied. It is carried out **after unit testing** is complete and before the system undergoes **validation testing**.

Purpose:

- To verify that modules, once integrated, function together correctly.
- To ensure proper **data transfer and communication** across interfaces.

SI 1 Test Case	STC 1
Name of Test	System testing in various versions of OS
Item being tesyed	OS Compatibility
Sample Input	Execute the program in windows XP/ Windows-7/8
Expected output	Performance is better in windows-7
Actual Output	Same as expected output, performance is better in windows-7
Remarks	Pass

Figure 6.2 Test case 1

SI 1 Test Case	ITC 2
Name of Test	Verify with other techniques
Item being tesyed	Input image to other techniques
Sample Input	Low light image
Expected output	Enhanced Image
Actual Output	Enhanced image not accurate as RGHS algorithm

Figure 6.2 Test case 2

7. SCREENS:

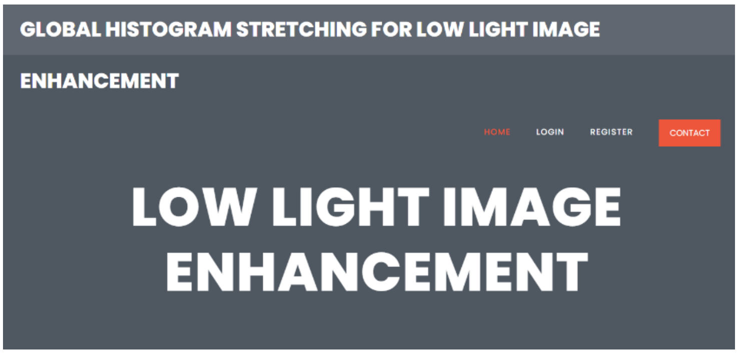
Start Anaconda/VS Code and open the project folder. Ensure your PPT's "Project Window" screenshot shows the code files (e.g., app.py, requirements.txt, or notebook).

```
(base) C:\Users\hp>conda activate tf

(tf) C:\Users\hp>cd C:\Users\hp\OneDrive\Desktop\low

(tf) C:\Users\hp\OneDrive\Desktop\low>python app.py
```

To start the project, double-click the "Run.bat" file and start the Python server to see the page below.

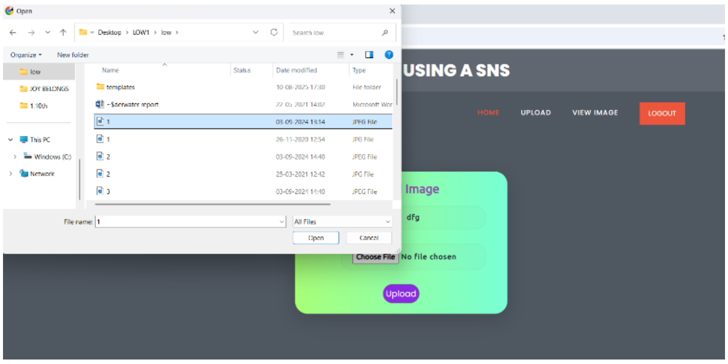
```
 * Serving Flask app 'app'
 * Debug mode: on
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server instead.
 * Running on http://127.0.0.1:5000
Press CTRL+C to quit
```

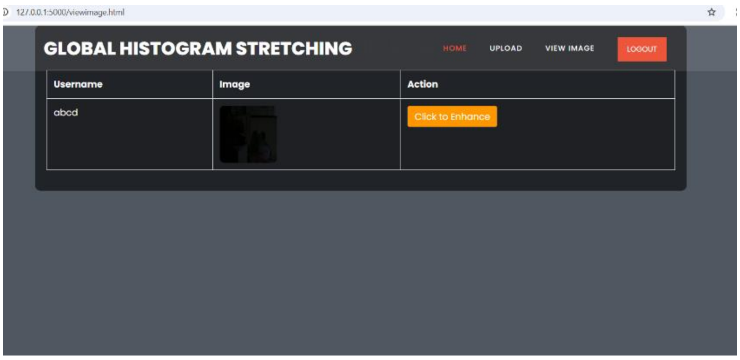
The Python server began in the picture above. Now open the browser, enter the URL and press Enter and see the page below.



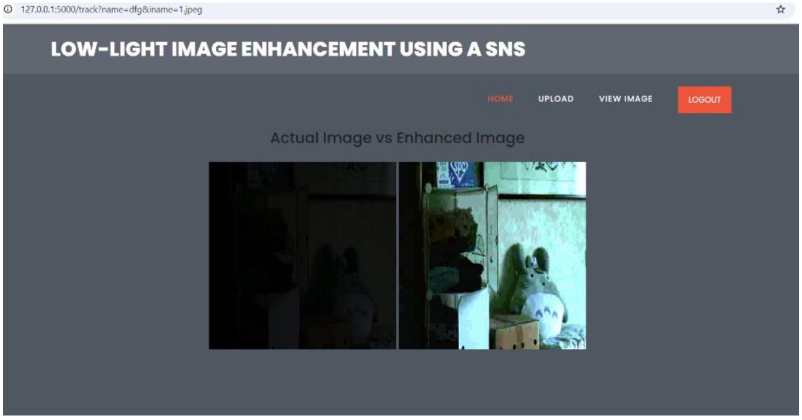
The user have to sign in and login to the website using a password. Fill the details in the placeholders as shown below

The user or the pupil fills in the login form on the screen above, uploads a image, and then click to get the page below.





Submit to begin noise handling/normalization followed by **Relative Global Histogram Stretching**. Add a progress/log or "Processing…" screenshot. The student enters the screen above. After uploading, they will see the page above.



The results page displays **Before vs After** with improved brightness/contrast. Insert a side-by-side screenshot highlighting the enhancement. As shown in the above image.

8. Conclusion

The Relative Global Histogram Stretching (RGHS) algorithm offers an efficient approach for enhancing images low-light conditions by significantly improving contrast and visibility. Unlike conventional enhancement techniques, it overcomes common drawbacks such as excessive noise amplification or detail loss, thereby ensuring that the images retain a **realistic** appearance. The proposed method is both computationally lightweight and adaptable, which makes it highly applicable in diverse fields such as security surveillance, medical imaging, and other real-world scenarios**.** By striking the right balance between contrast enhancement and image quality preservation**,** the RGHS algorithm demonstrates itself as a reliable solution for low-light image processing.

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Reference

1. R. Fattal, "Single image dehazing," ACM Transactions on Graphics, vol.27, no. 3, pp. 721-729, 2008.
2. L. Chao and M. Wang, "Removal of water scattering," in Proc. IEEE Int. Conf. Comput. Engin.and Tech. (ICCET), vol. 2, pp. 35-39, Apr. 2010.
3. N. Carlevaris-Bianco, A. Mohan, and R. M. Eustice, "Initial results in underwater single image dehazing," in Proc. IEEE Oceans, pp. 1-8, 2010.
4. H. Yang, P. Chen, C. Huang, Y. Zhuang and Y. Shiau, "Low complexity underwater image enhancement based on dark channel prior," Int. Conf. Innov. in Bio-inspired Comput. and App. (IBICA), pp. 17-20, Dec. 2011. 17-20, 2011.
5. J. Y. Chiang and Y.-C. Chen, "Underwater image enhancement by wavelength compensation and dehazing," IEEE Trans. Image Process., vol. 21, pp. 1756-1769, Apr. 2012..
6. Wang, Y. (2016). A survey on human activity recognition based on wearable sensors.