UNDERWATER IMAGE QUALITY ENHANCEMENT BY USING CONVOLUTIONAL NEURAL NETWORK BASED ALGORITHM

SW40106 SCIENTIFIC PROJECT II

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ABSTRACT

This paper proposes a new deep learning-based underwater image quality enhancement by combining the image formation model and white balance model to improve the overall quality of underwater images in terms of haze removal, improve contrast and sharpness, and colour balance. Experimental results demonstrate the advantages of the proposed method in improving visual quality by eliminating the influence of underwater environmental factors, removed haze, increased contrast and sharpness, restore and balancing colours. These results are further supported by quantitative metric, indicating improvement of 2.80%, 4.67%, 5.22% and 2.69% in entropy, PCQI, UIQM and UCIQE respectively, as compared to image formation model.

INTRODUCTION

Digital image processing involves manipulating images using computers, with applications spanning from gamma to radio waves. Underwater surveillance faces challenges like low illumination and limited visibility due to light attenuation, absorption, and scattering. Traditional methods struggle to adapt to diverse underwater scenes. This paper proposes a dual Convolutional Neural Network (CNN)-based approach to comprehensively enhance underwater images, aiming to overcome traditional limitations for improved surveillance and exploration.

METHODOLOGY

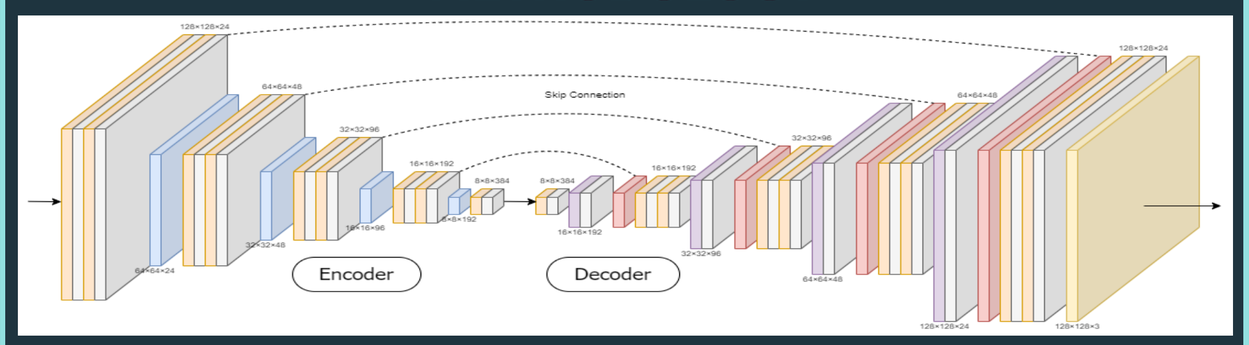

Figure 1. Framework of white balance model

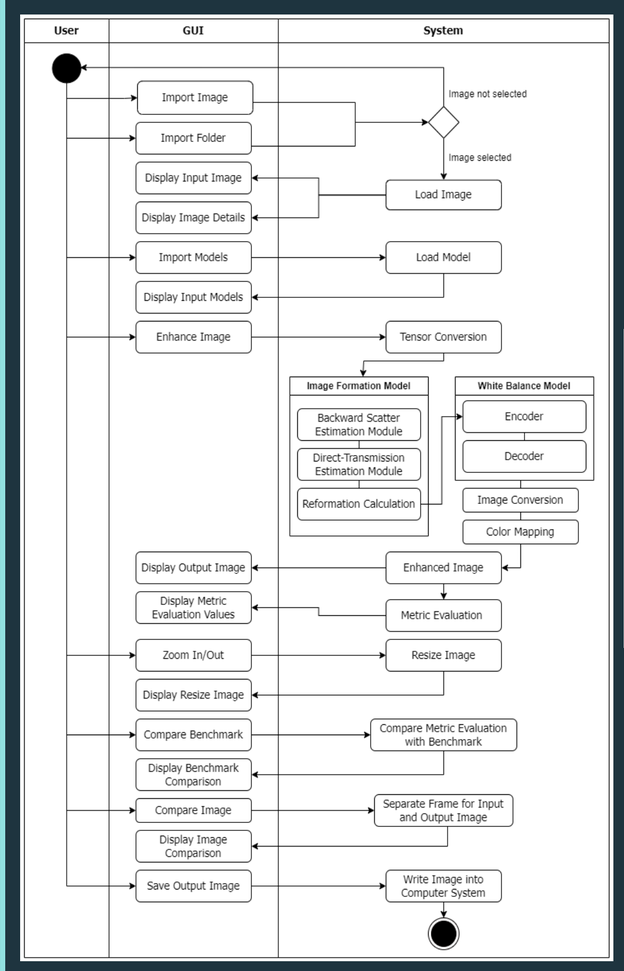

Figure 3. Activity diagram of proposed system.

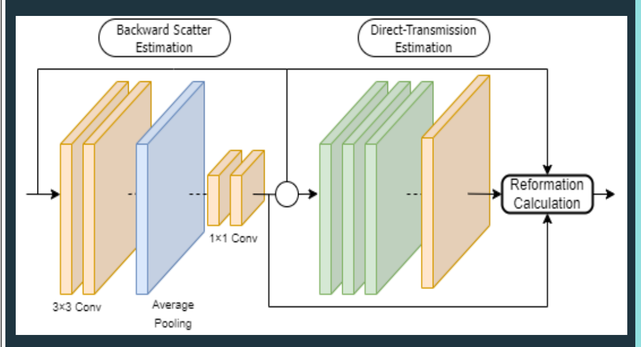

Figure 2. Framework of image formation model

OBJECTIVES

- To implement underwater image formation model by removing haze-like effect in the underwater images.
- To develop a fusion of white balance model and underwater image formation model to increase sharpness, contrast and colour balance in the degraded underwater colour images.

RESULT & DISCUSSION

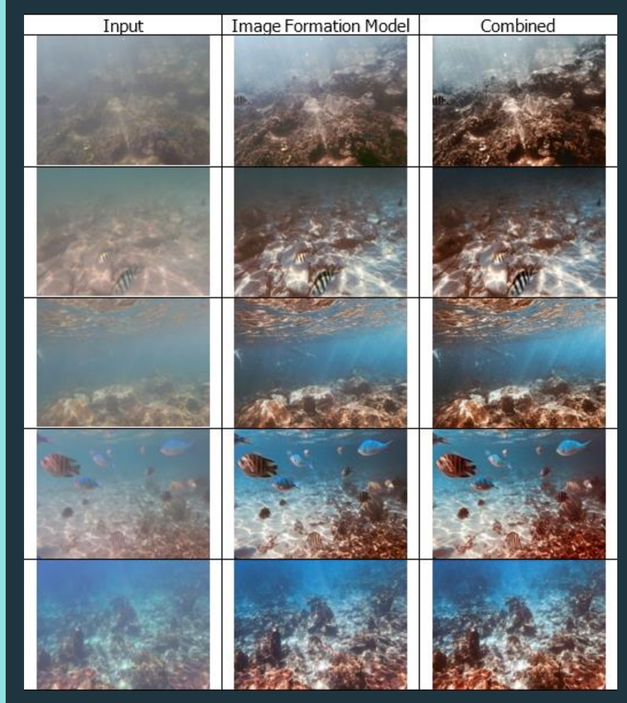

Table 1. Visual Quality Results of Proposed System for Hazy Images

Metrics	SSIM	Entropy
Input	1.0000	6.3342
IF	0.7408	7.3498
Proposed	**0.6268**	**7.5553**

Table 2. Summary of SSIM and Entropy of Proposed System for Hazy Images

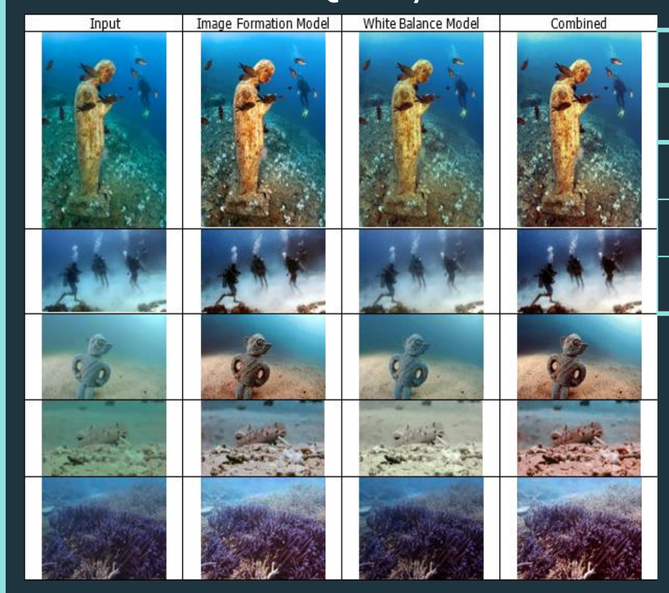

Table 3. Visual Quality Results of Proposed System for Low Contrast and Sharpness Images

Metrics	PCQI	UIQM
Input	1.0543	0.6810
IF	1.3092	1.1306
WB	1.1858	0.9283
Proposed	**1.3703**	**1.1896**

Table 4. Summary of PCQI and UIQM of Proposed System for Low Contrast and Sharpness Images

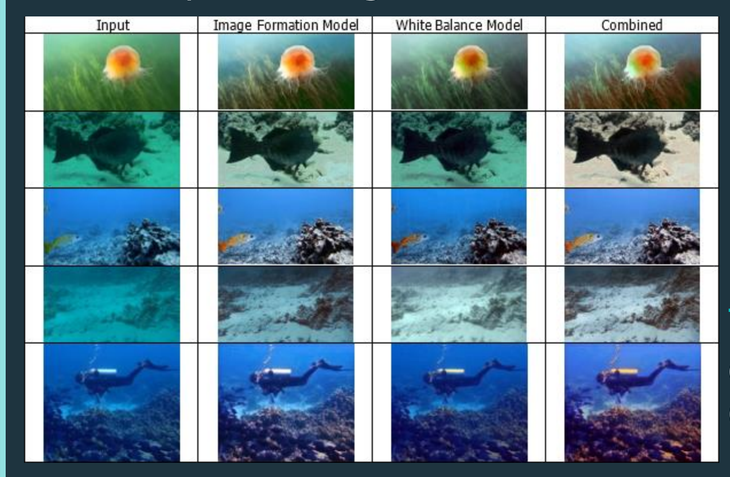

Table 5. Visual Quality Results of Proposed System for Greenish and Bluish Images

Metrics	UCIQE
Input	54.6248
IF	77.2292
WB	73.0024
Proposed	**79.3077**

Table 6. Summary of UCIQE of Proposed System for Greenish and Bluish Images

CONCLUSION

- The evaluation result shown that both objectives of this project were achieved by using deep learning-based algorithm.
- The underwater image formation model was implemented to remove haze-like effect in the underwater image.
- The fusion of white balance model and underwater image formation model was developed to further improve the image quality.

REFERENCES

- Afifi, M., & Brown, M. S. (2020). Deep White-balance editing. 2020 IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR).
- Chen, X., Zhang, P., Quan, L., Yi, C., & Lu, C. (2021, January 7). Underwater Image Enhancement based on Deep Learning and Image Formation model. arXiv.org.

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