SDSU | San Diego State University

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HW 1 - BASIC IMAGE PROCESSING

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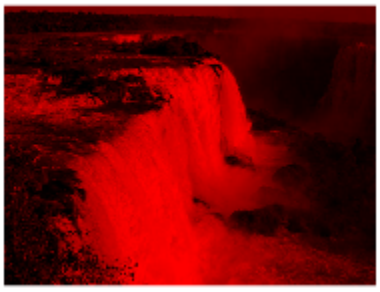
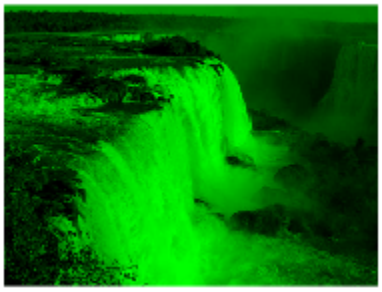
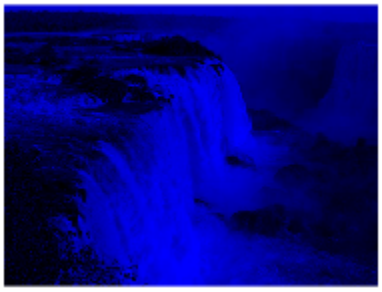
red band



green band

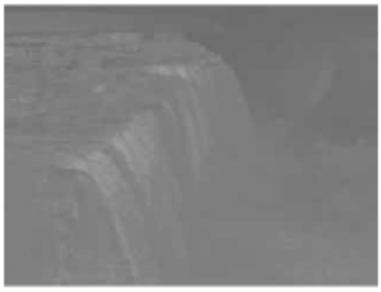


blue band



Cb band

Cr band



Y band

subsampled Cb band

subsampled Cr band

upsampled Cb band

upsampled Cr band

original RGB image

reconstructed RGB image

Report

Introduction

Image and video coding are essential for efficient storage and bandwidth utilization. In this report, we explore various aspects of image processing, addressing the need for these techniques in the digital era. As the demand for multimedia content grows, optimizing image storage and transmission becomes paramount.

Our work focuses on image manipulation in the broader context of digital media. Efficient coding not only conserves storage space but also ensures high-quality image delivery even in bandwidth-constrained scenarios. Related items seen in the references guide our understanding of image coding's significance.

Procedural Section

Our experiment involved a comprehensive exploration of image processing using MATLAB. We began by reading and displaying an original image, followed by the separation of color bands into red, green, and blue components. Converting the image to YCbCr color space allowed us to work with luminance (Y) and chrominance (Cb and Cr) components. We displayed these components individually to understand their characteristics.

We then examined the 4:2:0 subsampling technique for Cb and Cr components, considering the balance between data compression and image quality. Subsequent upsampling through replication revealed the impact on image fidelity. Converting the image back to RGB format facilitated a comparison between the original and reconstructed versions.

Results

Our results offered valuable insights into image manipulation. Visual representations in figures, tables, and graphs succinctly summarized key findings. Separating color bands showcased their distinct contributions to the overall image.

The conversion to YCbCr color space exposed the roles of luminance and chrominance components. Subsampling Cb and Cr using the 4:2:0 approach demonstrated the trade-off between compression and image quality. Upsampling showed the potential for detailed restoration but with some introduced artifacts.

The conversion back to RGB format emphasized the significance of color space transformations. These findings highlight the balance between data compression and image fidelity, critical in practical applications.

Mean Squared Error (MSE): The MSE measures image reconstruction quality by calculating the average squared difference between original and reconstructed pixel values. A lower MSE indicates a closer match between the two images, signifying higher quality. It's a valuable tool for comparing image processing methods.

Compression Ratio: The compression ratio gauges how much an image has been reduced in size compared to the original. In this code, it's calculated by comparing the pixel count of the original Cb and Cr components to their subsampled versions. A higher ratio signifies more aggressive data reduction, often used in image and video compression to save storage or bandwidth.

The following table displays the MSE and Compression results:

MSE and Compression Results	
Mean Squared Error (MSE)	Compression Ratio (4:2:0)
0.3912	4

Conclusion

In conclusion, our image processing experiment contributes insights into color space conversion, subsampling, and upsampling techniques. These operations play a vital role in multimedia processing. The report underscores the impact of data reduction on image quality, emphasizing the need for careful consideration in practical applications.

This work lays the foundation for further exploration in image processing and coding. Future research can delve deeper into advanced techniques to optimize data utilization while preserving high-quality image reproduction. As images continue to be integral to communication and information sharing, efficient handling remains a pivotal endeavor.

In summary, this report illuminates the intricacies of image manipulation and underscores the importance of efficient coding techniques in the digital landscape.

References

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