

Project Description: Edge-Directed Error Diffusing Dithering

Course: COMP4431 Multimedia Computing

Team: Project Group 15

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1. Project Goals

1. Extend Error Diffusion to Color image Posterization:

- Implement error diffusion dithering (e.g., Floyd-Steinberg) for RGB image posterization.

2. Edge-Directed Improvement:

- Modify the error diffusion algorithm to prioritize edge preservation using edge detection (Sobel operator) on its luminance grayscale, ensuring sharper and more natural results. Keep using traditional error diffusion in smooth area.

2. Technical Approach

A. How to Calculate RGB Error

- Treat (R, G, B) as a vector, calculate vector difference, diffuse the vector difference as error.

B. Core Idea of "Edge-Directed"

- Standard error diffusion propagates errors in fixed weights, may blur edges.

Solution:

1. Detect edges using the Sobel operator. Using an “edge sensitivity” as threshold.

2. Adjust error diffusion weights dynamically:

- Strengthen error propagation across edges to retain sharpness.
- Maintain standard diffusion along edges or in smooth regions (edge strength < threshold)

C. Implementation Steps

1. Posterization with Error Diffusion:

- Quantize input images by bit mask or to a fixed color palette.
- Distribute quantization errors to neighboring pixels using Floyd-Steinberg weights.

2. Edge-Directed Adaptation:

- Compute an edge map of the image.
- Modify error diffusion weights based on edge strength and direction.

3. Implementation Plan (4 Weeks)

Week	Tasks
Week 1	Implement basic error diffusion for posterization (Floyd-Steinberg + palette reduction).
Week 2	Integrate Sobel edge detection and adjust error diffusion weights near edges.
Week 3	Optimize algorithm; test on sample images.
Week 4	Build a simple HTML/JS demo with side-by-side comparisons (original vs. edge-directed vs. standard dithering).

4. Final Deliverables

1. **Code:** JavaScript implementation of edge-directed error diffusion for posterization.

2. Demo Webpage:

- Upload an image and adjust parameters (bit mask size / diffusion matrix type / edge sensitivity).
- Display results: Original, standard dithering, and edge-directed dithering.

3. 2-Minute Video Demo:

- Demonstrate workflow and highlight edge-preservation improvements.

5. **Evaluation** - Qualitative: Visual comparison.

6. Significance

- Extends course concepts (error diffusion for thresholding) to RGB image posterization.
- Enhances visual quality by integrating luminance edge-awareness.

7. **Limitation:** - edge detection on luminance grayscale may not work well for color-based edges.