

ECE 418 Final Project Proposal

Performance Analysis of Progressive and Hierarchical JPEG and JPEG2000

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1 Introduction

Image compression has become a very large topic with the emergence of the complex websites with numerous images littered throughout one web page. This has led to numerous different ways of displaying images on the web. The two that we will be focusing on in this project is Progressive and Hierarchical JPEG. Progressive JPEG is a process where a webpage will display a lower resolution image until the webpage can load in the entire high resolution image [1]. Hierarchical JPEG is a method where you store the same image with multiple resolutions to be used when the webpage is viewed at different magnifications [2]. In addition, we will also analyze the difference between JPEG and JPEG2000. We will look at the amount of compression that is done and the load times for both.

2 Applications

The findings from this lab could have multiple applications in various fields:

1. Web Performance Optimization
2. Network Bandwidth Management
3. Digital Archiving
4. Mobile Application Development
5. Image Processing Software Enhancement

More details on each of these applications in the final report.

3 Implemenation

We plan to use the website <https://www.webpagetest.org/> to analyse a series of different quantitative measurements regarding the differences between Baseline, Progressive, and Hierarchical formats for JPEG and JPEG2000. We will be making our own website to host an example of each of the 6 types of images, and run it though <https://www.webpagetest.org/>. These measurements include:

1. **Load Time:** Total time taken to fully load the page. This includes all content, such as images, scripts, and CSS.
2. **Time to First Byte (TTFB):** The time from the start of the initial request to the receipt of the first byte of data. This helps understand server response times.
3. **Start Render:** The time until the browser starts rendering anything on the screen. This is crucial for user perceived performance.
4. **Speed Index:** Measures how quickly the contents of a page are visibly populated. It is particularly useful for understanding user experience.
5. **Visual Progress:** Records the visual progress of the webpage's loading process, which can be used to compare the perceptual load speed of different image formats.
6. **First Contentful Paint (FCP):** The time at which the first text or image is painted.
7. **Cumulative Layout Shift (CLS):** Quantifies how much elements on the page shift during the loading phase. Lower scores are better as they indicate a more stable page.
8. **Total Page Size:** The total download size of the page, which includes all resources. It's useful for measuring the efficiency of content compression.
9. **Number of Requests:** The total number of HTTP requests made by the page. More requests can slow down the page load.
10. **Image Analysis:** Detailed breakdown of each image's encode quality, size, and compression technique impact on loading times.

References

- [1] J. Griffin. (2022) The ultimate guide to progressive jpeg images. [Online]. Available: <https://www.thewebmaster.com/progressive-jpegs/>
- [2] R. Yerraballi, "Hierarchical mode of the jpeg standard," PDF document, 2001, accessed: 2024-04-30. [Online]. Available: https://users.ece.utexas.edu/~ryerraballi/MSB/pdfs/M4L1_HJPEG.pdf