

# A Platform-Independent System for Fast and Interactive Access to Losslessly Compressed Visible Human Color Images over the Internet

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This paper describes our continuing progress in investigating techniques to transmit losslessly compressed Visible Human (VH) color images over the Internet. In our current implementation, the use of Java as the sole programming language allows the system to easily integrate networking capabilities and be platform-independent. This represents a sensible upgrade over our previous implementation [1].

The complete system consists of three main parts: Image processing, graphical user interface (GUI), and networking. The image processing module segments and compresses the images. In the case of VH images, lossless compression is required to reduce the amount of data to be transmitted and stored while keeping the anatomical information conveyed by the images. Without compression, theoretical computations yield transmission times of about 3.3 days over a traffic-free T1 line for the Male and Female datasets [2]. Prior to compression, an ad-hoc segmentation algorithm eliminates the blue background on the images (Figure 1). Such segmentation is based on a color space transformation from RGB to HSI that facilitates the separation of the anatomical structures from the background [3][4]. Lossless compression is achieved by an Adaptive Arithmetic Coding (AAC) model [5][6] that exploits the low frequency characteristics of VH images. This two step processing method yields compression ratios (CR) of 8:1 on average and as high as 16:1 for specific images (Figure 2). Decoding of the images is carried out by the inverse AAC algorithm.

In choosing the programming language for the coding-decoding modules, we have considered performance and inter-platform operation. In our previous implementation, C was the choice due to its unmatched performance. However, C programs suffer from their platform dependency and would have to be changed and recompiled to run on different platforms. Java, on the other hand, provides the flexibility best suited to our purpose of making

VH images accessible to the public. Using the latest Java release, performance has been found to be comparable to C code for the present application.

The GUI module allows a user to browse the Male and Female datasets, select one or more images and retrieve them from the storage site at the Lister Hill Center. The GUI is implemented as a Java applet that the user activates through his Web browser when directed at the storage site. Selection of the images is an interactive process in which the user uses a sizeable selection box on a full-body image of the Male and the Female datasets. Two preview images are displayed to show the images corresponding to the top and bottom of the selection box (Figure 3.)

The networking module controls the communication between the storage site and the user's computer and is completely implemented in Java. This module transmits the compressed images, selected by the user using the GUI, and stores them at the user's computer.

CR for the Male and Female datasets is 8:1 on average but can be as high as 16:1 for selected images. Experimental transmission times between NLM and TTU show that time savings of up to 52 times can be achieved depending on the image and the time of day.

The system described here presents a solution for storage, management and distribution of a unique large image dataset, namely VH color images, by efficient two step image processing, interactive image selection and retrieval, and platform-independent networking. In applications where slight image degradation might be acceptable, other high fidelity lossy compression methods can be used instead, such as vector quantization [7][8] [11], modified EZW [9] and SPIHT [10]. Our system, as described here, provides a complete and integrated concept that can be easily customized for other large databases.

## References

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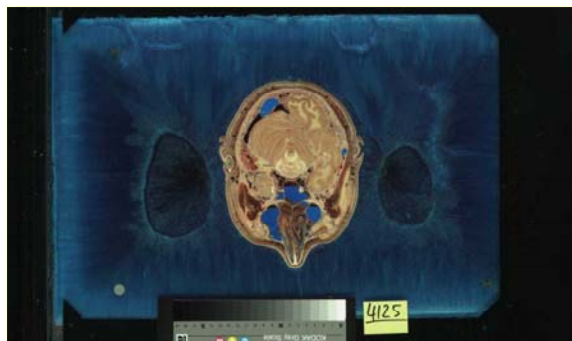


Figure 1. Original VH image (CR=2.07:1 when losslessly compressed)



Figure 2. Segmented VH image (CR=13.34:1 when losslessly compressed)

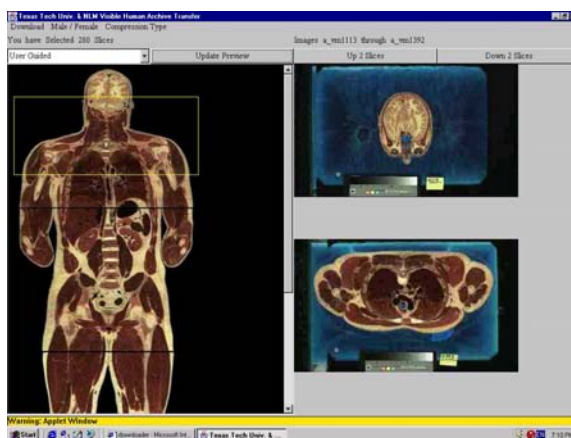


Figure 3. Applet snapshot