WAVELET COMPRESSION TECHNIQUES AS A TOOL FOR THE PRESENTATION OF PRINTED DOCUMENTES ON THE WWW

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The Internet has become so popular and is expanding in a such an explosive way, because it is the greatest source of all kind of information. It is often said that almost everything can be found somwhere on the WEB. However, there are great problems in providing information which has been released before the Information Age. We mean here magazines and newspapers, old books, documents of historical and artistic value, technical drawings and so on.

Of course, using a sophisticated OCR software it could be possible to obtain the text together with pictures from an old document. However, in most cases the user is interested in a copy of the original and not in a processed version of it.

The only reasonable way to provide copies of older printed documents to the intersted audience is their scanning or making digital photos of good enough quality. At this point however great problems arise, because of the huge data amount and the need for using an appropriate compression technique.

JPEG, which is the most popular compression tool, can not be used for processing of files representing document text, as it causes blocking artefacts at the edges of the letters and in this way the decompressed image would be of very poor quality.

In the last few years, there has been a rapid development of compression techniques based on the wavelet transformation. On of the most efficient and flexible format is the DjVu, developed byAT&T Laboratories. This technology is just intended for the compression of scanned documents containing both text and pictures. Our tests performed on different types of printed documents, show that the the information regarding the efficiency of this technique provided by its developer is not exaggerated. Indeed, a scanned document of let say 10 MB can be compressed do 300 KB or less without much quality loss.

In our opinion the common usage of such kind of compression will be a breaking point in the history of the Internet, as all the information which is stored now on paper could be made avaulable in an electronic way through the WWW.

Wavelets are a highly efficient tool for image compression because they organize image data in a way that closely resembles the human visual system. By using a multiscale decomposition rather than the blocking approach of JPEG, wavelets provide a superior representation for localized image features, such as edges. The wavelet advantage achieves 2 to 3 times better compression efficiency than JPEG for high compression ratios. Wavelet transform-based image compression involves the use of a relatively new field of applied mathematics often called "wavelet theory" or simply "wavelets".

The method is well suited to "lossy" image and video compression. Lossy compression involves the slight loss of data during the compression process, so that the decompressed image is not bit for bit identical to the original.

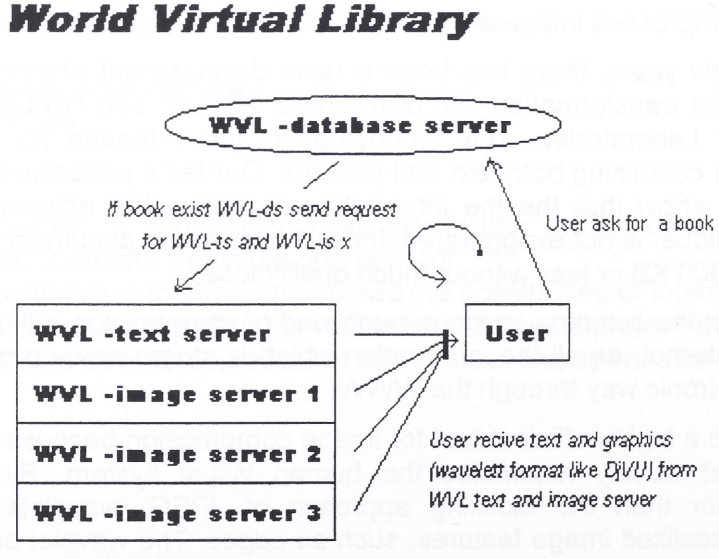
Wavelet compression is a method of mathematical modeling of images, which breaks the image down into small waves that represent the frequency analysis of a function. The shapes and patterns in an image are identified, and then described using mathematical functions. The function that models or describes the image is contained within the compression and decompression software. The image file contains only the coefficients or numbers used by the function and compression is achieved by averaging the values of these coefficients, so that an image is represented by fewer numbers.

Wavelet compression is very efficient, with ratios up to 200:1 and more. The efficiency of the compression and the quality of the image are very dependent on the structure of the images being compressed; typical wavelet compression ratios range between 15:1 and 100:1. As a comparison, typical compression ratios for JPEG are usually between 10:1 and 20:1 and for LZW around 2:1. Wavelet compression can take a longer time to compress images due to the complex mathematics involved. However, the time required to decompress a wavelet or fractally-encoded image is usually comparable to decompressing of a JPEG image.

An advantage of wavelet compression is that image processing can be incorporated into the wavelet transformation, including sharpening, contrast enhancement, and noise reduction.Images can be also enlarged or reduced via embedded interpolation, using common interpolation algorithms, such as bicubic, bilinear, or nearest neighbor, as found in Adobe Photoshop and in other pixel-based image editing software. Generally the quality of this type of interpolation will not be as good as fractal interpolation.

Wavelet compression is used in many varied digital applications: photographic imagery, audio and video recordings, 2D and 3D rendering, multimedia, fingerprints imaging (used by the FBI), medical imaging (radiography, MRI, etc.), satellite and remote sensing imaging, geographic information systems (GIS), and document imaging.

Our new project called WVL (World Virtual Library) is using a wavelet compression format for fast transfering (via Internet) of pictures and text as usually found in books and magazines.



The pictorial data can be viewed by a user who has a typical internet browser (like Netscape or Explorer) or using a simple program taken free of charge from the main WVL serwer.

It is worth mentioning, that the WVL viewing program is much easier in using than the internet browsers, especially for the beginners or people not using computers in their work.