Image segmentation and Compression Techniques –A study

V. Divya, S. Murali Mohan, P.P S Naik

Abstract— **Image segmentation is portioning into regions. This paper gives the overview of the invention of image compression. Also various methods of image compression, coding the image data into a compact form are discussed. An imaging apparatus receives a stream of image data compressed according to a token based compression algorithm. The token dictionary is decompressed and processed according to desired standards such as optimizing for a particular image output device. After revision, the revised tokens are stored in a revised dictionary which is accessed upon decompression of image content. When the image content is decompressed the locations in the compressed or coded input data stream refer to locations in the revised dictionary which are extracted and output either to hard copy or for further processing .This paper reports some pioneering work in this direction to show that compressed image processing could well become a new research area and challenge right through the next century**

Index Terms—**Image segmentation, compression Methods, Image Coding, JPEG**

I. INTRODUCTION

Image segmentation is an important step in image analysis and computer vision applications .There are four conventional types of segmentation techniques for grey scale images namely ,threshold techniques, boundary-based methods, region based methods and hybrid techniques. This paper discusses hybrid techniques which combine different edge criteria to improve region based image segmentation.

Region based methods provide unambiguous segmentation, but often divided regions that are not clearly separated by a strong boundary. The goal of the paper is to show how weighted combination of different edge criteria such as edge strength, edge smoothness, edge straightness and edge continuity produces better segmentation then that would have been obtained by any of these criteria alone.

There are few earlier papers that have described edge based techniques for improving image segmentation. Bajcy [16] showed that both edge detection and region growing processes could be unified by making the decision whether a point is on a boundary or on a homogenous surface. Anderson Bajcy [15] showed a combination of edge detection and region growing where they use edge detection to initialize a region a growing process based on a local similarity threshold which was used to check whether two points belonging to the same region. Montanari [17] considered smoothness and contrast and applied a measure to minimize the weighted some of smoothness and contrast the most recent paper that better segmentation is described in [14].

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V. Divya, PG Student M.Tech (CSE) CSE Department, Dr.SGIET, Markapur, India

S. Murali Mohan,

P.P S Naik,

II. IMAGE COMPRESSION

Image compression is minimizing the size in bytes of a graphics file without degrading the quality of the image to an unacceptable level. The reduction in file size allows more images to be stored in a given amount of disk or memory space. It also reduces the time required for images to be sent over the Internet or downloaded from Web pages. Image compression is important for web designers who want to create faster loading web pages which in turn will make your website more accessible to others. This image compression will also save you a lot of unnecessary bandwidth by providing high-quality image with fraction of file size. Image compression is also important for people who attach photos to emails which will send the email more quickly, save bandwidth costs and not make the recipient of the email angry. Sending large image attachments can be considered offensive. To address these needs and requirements in the specific area of still image compression, many efficient techniques with considerably different features have recently been developed for both lossy and lossless compression [1]-[5].

Furthermore image compression plays a major role in many important and diverse applications including televideo conferencing, remote sensing, document and medical imaging, hazardous waste management application and the like. Since the mid-80s, members from both the International Telecommunication Union (ITU) and the International Organization for Standardization (ISO) have been working together to establish an international standard for the compression of grayscale and colour still images. This effort has been known as JPEG, the Joint Photographic Experts Group. Officially, JPEG corresponds to the ISO/IEC international standard 10928-1, digital compression and coding of continuous-tone (multilevel) still images[6].

2.1 COMPRESSION TYPES

There are several different techniques in which image files can be compressed. A text file or program can be compressed without the introduction of errors, but only up to a certain extent. This is called *lossless compression*. Source encoder (linear transforms):- A variety of linear transforms have been developed which include Discrete Fourier Transforms (DFT), discrete cosine transforms (DCT), discrete wavelet transform (DWT) and many more each with its own advantages and disadvantages. Quantizer: - A quantizer simply reduces the number of bits needed to store the transformed coefficients by

reducing the precision of those values. Entropy encoder: - Entropy encoder further compresses the quantized values losslessly to give better overall compression.

In predictive coding, information already sent are available is used to predict future values, and the difference is coded. Differential Pulse Code Modulation (DPCM) is an example for predictive coding. *Image compression properties:* There are a few important properties of image compression schemes: Scalability generally refers to a quality reduction achieved by manipulation of the bit stream or file (without decompression and re-compression). There are several types of scalability: Quality progressive or layer progressive: The bit stream successively refines the reconstructed image. Resolution progressive: First encode a lower image resolution; then encode the difference to higher resolutions. Component progressive: First encode grey; then color

2.2 COMPRESSION TECHNIQUES

There are basically two types of compression methods: lossy and lossless. Lossy compression creates smaller files by discarding (losing) some information about the original image.

Graphic File Formats

The graphic file formats most browsers support are GIF, JPEG and, more recently, Progressive JPEG (p-JPEG). New formats are appearing as possible challengers, including PNG and those based on wavelet compression. Let's take a look at each of these in more detail.

GIF

The *Graphics Interchange Format* (GIF, pronounced *jiff*, though most people say *giff*) is the oldest graphic file format on the Web, and all browsers except Lynx support it. GIFs are 8-bit images, which limits them to a maximum of only 256 colors.GIFs use a lossless compression algorithm and support transparency, animation (display of multiple images within a single GIF file) as well as interlacing. When you save an image as an interlaced GIF (by checking the **Interlaced** option box in Photoshop) and display it inside a web page, visitors to your site will see a low-resolution image quickly, which gradually comes into focus. Non-interlaced GIFs, on the other hand, appear as an empty box with a red "X" until the image downloads fully to your web visitor's computer. The only drawback to interlacing is that it usually increases the file size slightly. The LZW compression algorithm used in the GIF format is owned by Unisys, and companies that *make* products that exploit the algorithm (including the GIF format) need to license its use from Unisys. As for *users* of GIF images, however, Unisys does not require a license, although their licensing statement indicates that it is a requirement. GIFs retain edge and sharpness information if there is no dithering. Humans are especially sensitive to edge sharpness, so GIFs generally appear sharper than JPEGs.

JPEG

JPEG (pronounced *jay-peg)*, is designed for compressing either full-color or gray-scale images of natural, real-world scenes. JPEG is a lossy compression algorithm. When you create a JPEG or convert an image from another format to a JPEG, you are asked to specify the quality of image you want. Since the highest quality results in the largest file, you can make a trade-off between image quality and file size. The lower the quality, the greater the compression, and the greater the degree of information loss. Much research has been undertaken on still image coding since JPEG standard was established. JPEG2000 is an attempt to focus these research efforts into a new standard for coding still images. The standardization process has already produced the Final Draft International Standard (FDIS) [7].JPEGs are best suited for continuous tone images like photographs or natural artwork; not so well on sharp-edged or flat-color art like lettering, simple cartoons, or line drawings. JPEGs support 24-bits of color depth or 16.7 million colors. JPEG is actually just a compression algorithm, not a file format. JPEG is designed to exploit certain properties of our eyes, namely, that we are more sensitive to slow changes of brightness and color than we are to rapid changes over a short distance. While JPEGs are usually the best choice for photographs, on 8-bit monitors they are force-dithered into an 8-bit palette. JPEG compression is treated as 24 bit data (8 bit for gray), regardless of the colors in the original image. Therefore, if you reduce an image from 24-bit to 8-bit prior to JPEG compression, the compression ratio will actually worsen as will the overall quality. JPEG compression introduces noise into solid-color areas, which can distort and even blur flat-color graphics. This is why JPEGs are not well suited to flat-color sharp-edged art or type. A JPEG can reduce a 900K 24-bit image to 45K (high quality) or 30K (medium quality), a factor of 20:1 to 30:1. With JPEGs, however, the more you compress the more edge definition and sharpness you lose. JPEGs do not support transparency, either. It is important to note that saving a graphic to JPEG format with compression should be a last step. Compression effects are cumulative. This means that every time you re-save a JPEG file, you are compressing it further, and thereby tossing away data (photographic detail) that you can't get back. the Joint Photographic Experts Group. Officially, JPEG corresponds to the ISO/IEC international standard 10928-1, digital compression and coding of continuous-tone (multilevel) still images [6].

Progressive JPEGs (p-JPEGs) are typically slightly smaller than baseline JPEGs, but their main advantage is that they appear in stages, giving the effect of the image fading in, similar to interlaced GIFs, as opposed to painting from the top down.

All Web browsers support GIFs, most support JPEGs, and a rapidly growing number support progressive JPEGs. All three formats are supported by the latest versions of Netscape and Internet Explorer.

PNG

The *Portable Network Graphic* (PNG), pronounced *ping*, format was designed to be a better, legally patent-free replacement for GIF. PNG is a lossless compression format for transmitting a single bitmap image over computer networks. PNG matches all of GIF's features except animation. PNG has better compression and interlacing than GIF and adds new features of its own, such as gamma storage, full alpha channel, true color support, and error detection. PNG supports two methods of transparency, one-color masking and the other alpha channel. PNG's full alpha channel makes it possible to create beautiful glows and drop shadows which layer over different-colored

backgrounds perfectly. Gamma is a measure display device brightness. The problem facing web designers is that gamma values for different platforms and different monitors vary. Macs have a gamma of about 1.8, and PCs a gamma of 2.2. Since there is no "gamma standard" on the Web, graphics that look great on a Macintosh may look dark on a PC. GIFs and JPEGs have no built-in gamma storage, so averaging these two gammas (setting gamma to 2.0) in Photoshop is one way of dealing with the problem. PNG avoids the problem by allowing designers to store the gamma of the creation device. When displayed, PNGs automatically adjust to the host monitor's gamma.

Not all browsers can display PNG's multilevel transparency. Support for PNG by older Web browsers is mainly through plug-ins.

Because PNG uses the same LZW compression method used in the popular *pkzip* file archiving utility, you can't zip PNG files because they are, in effect, already zipped.

In this paper we attempt to evaluate and compare image quality in two mentioned still image coding system: lossy baseline JPEG [8] and JPEG2000 image coding standard Part I [9]. JPEG and JPEG2000 use different compression techniques, which introduce different types of impairment in the reconstructed images. To describe image distortions of dissimilar nature, we used four test images with different spatial and frequency characteristics. Image quality is measured using peak signal-to-noise ratio (*PSNR*) [10] as most common objective measure, which does not correlate well with subjective quality measure, and picture quality scale (*PQS*) [11], which incorporates model of human visual system (HVS) and leads to better correlation with the response of the human observers.

III. TEST IMAGES

The fundamental difficulty in testing image compression system is how to decide which test images to use for the evaluations. The image content being viewed influences the perception of quality irrespective of technical parameters of the system [13]. Normally, a series of pictures, which are average in terms of how difficult they are for system being evaluated, has been selected. We used four types of test images (512×512, 8 bits/pixel) with different spatial and frequency characteristics: Baboon, Fingerprint, Goldhill and Lena, Fig. 1. Characteristics of test images are evaluated in spatial domain using spatial frequency measure (SFM) [10] and in frequency domain using spectral activity measure (SAM) [12]. SFM is defined as follows:

$$SFM = \sqrt{R^2 + C^2},\ R = \sqrt{\frac{1}{MN}\sum_{j=1}^{M}\sum_{k=2}^{N}\left(x_{j,k} - x_{j,k-1}\right)^2},\ C = \sqrt{\frac{1}{MN}\sum_{k=1}^{N}\sum_{j=2}^{M}\left(x_{j,k} - x_{j-1,k}\right)^2}, \quad (1)$$

where R is row frequency, C is column frequency, xj,k denotes the samples of image, M and N are numbers of pixels in horizontal and vertical directions respectively. *SAM* is a measure of image predictability. It is defined as the ratio of the arithmetic and the geometric mean of the Discrete Fourier Transform (DFT) coefficients:

$$SAM = \frac{\frac{1}{M \cdot N}\sum_{j=0}^{M-1}\sum_{k=0}^{N-1}\left|F(j,k)\right|^2}{\left[\prod_{j=0}^{M-1}\prod_{k=0}^{N-1}\left|F(j,k)\right|^2\right]^{\frac{1}{M \cdot N}}}, \quad (2)$$

where $F(j,k)$ is (j,k)-th DFT coefficient of image. *SAM* has a dynamic range of $[1, \infty)$. Higher values of *SAM* imply higher predictability. Active images (*SAM* close to 1) are in general difficult to code. These images usually contain large number of small details and low spatial redundancy.

a) Baboon — *SFM*=36.515, *SAM*=24.93
b) Fingerprint — *SFM*=24.925, *SAM*=352.65
c) Goldhill — *SFM*=16.167, *SAM*=126.77
d) Lena — *SFM*=14.019, *SAM*=227.43

Fig. 1. Test images

Test image Baboon has a lot of details and consequently large *SFM* and small *SAM*.Large value of *SFM* means that image contains components in high frequency area and small value of *SAM* means low predictability. It returns that Baboon presents low redundant image, which is difficult for Compression. Test image Fingerprint is not typical natural image because this image has relatively large *SFM* but also large *SAM*. For typical natural image largest value of *SFM* implies smaller value of *SAM*. Image Fingerprint is easier for coder to handle than Baboon. Images Goldhill and Lena are images with less detail (smaller *SFM*) than Baboon. Image Goldhill has higher *SFM* and lower *SAM* than Lena. It indicates that image Lena has higher predictability than Goldhill.

CONCLUSION

In this paper show brief discussion image segmentation and compression techniques. compare image quality in two mentioned still image coding system: lossy baseline JPEG and JPEG2000 image coding standard Part I JPEG and JPEG2000 use different compression techniques, which introduce different types of impairment in the reconstructed images. To describe image distortions of dissimilar nature, we used four test images with different spatial and frequency characteristics. Comparison of JPEG and JPEG2000 using *PSNR* as image quality measure shows that JPEG2000 achieves higher picture quality than JPEG for all bitrates and test images. But visual image quality quantified by *PQS* shows different results. JPEG offers better compression performance in the mid- and high bitrates (above 1 bpp) than JPEG2000. We propose the application of JPEG for moderate bitrates because of good image quality and lower computational complexity in comparison with JPEG2000

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