Open access Journal International Journal of Emerging Trends in Science and Technology

DOI: http://dx.doi.org/10.18535/ijetst/v2i10.08

JPEG Encoder Using Digital Image Processing

Author
M. Divya
M.Tech (ECE) / JNTU Ananthapur/Andhra Pradesh

ABSTRACT
This article deals with study techniques for reducing the storage required for saving an image, or the bandwidth required for transmitting it. Image compression addresses the problem of reducing the amount of data required to represent a digital image. The underlying basis of the reduction process is the removal of redundant data. From a mathematical viewpoint, this amounts to transforming a 2-D pixel array into a statistically uncorrelated data set. The transformation is applied prior to storage or transmission of the image. In this paper implementation of basic jpeg compression using only basic matlab functions is pursued. This includes going from a basic grayscale bitmap image all the way to a fully encoded jpeg file. Image compression is reducing the amount of data required o represent a digital image. The principle objective of his project was to present the theoretic foundation of digital image compression and to implement JPEG image compression. HAAR transform is the technique used for compression of image in this JPEG encoder.

INTRODUCTION

An image is an 2D array of information bearing function. This basic element of an image is called as pixel or picture element. Digital image processing deals with the formation of image, enhancement of image. Digital image processing is a subpart of digital signal processing. The light energy that has been reflected from the object will be collected by sensor mounted on the electronic device either by photo chemical recording or photo electronic recording.

Digital image processing system includes:

i. Image formation and recording
ii. Image compression
iii. Image restoration
iv. Image enhancement

Image formation includes receiving of radiant energy from the object. Image recording can be based on either photo chemical or photo electronic recording. Image acquition is done by sensor capable of converting light energy into respective voltage.

Image compression techniques can be classified into following categories:

- Lossless compression technique
- Lossy compression technique

In lossless compression, image will be the exact replica of the object and noise will be almost zero. The ratio will be approximately 3:1. The details of the image are not lost. This technique requires more space for storing images.

In lossy compression, the compression ratio is quite appreciable when compared with lossless compression technique. Compression ratio will be 10:1. By this technique some information may be lost from the original object due to excessive compression. Images formed with this technique requires less storage space.

Once original image is digitaly sampled and reconstructed, the digital image includes noise. Image enhancement deals with visually upgrading the obtained image for better visual appearance. Presence of unnecessary noise degrades the

quality of image. These noises can be filered out with the help of adaptive filters.

One of the most popular and comprehensive continuous tone,still frame compression standards is a JPEG standards in the baseline system, often called the sequential baseline system. Here the input and output data precision data is limited to 8bits, where as the quantized DCT values are restricted to 11bits. The compression itself is performed in three sequential steps:

- DCT computation
- Quantization
- Variable length code assignment

IMAGE FORMATS

The most common image file formats, that are important for printing, scanning and internet use are TIF, JPG, GIF and PNG. TIF cannot be used in internet browsers. All editor programs like Adobe photoshop or Adobe Elements support these file formats, which will generally support and store images in the following color modes:

Image format	Color data mode (bits per pixel)
TIF(Tag Image File)	RGB – 24 or 48 bits, GRAYSCALE – 8 or 16 bits, Indexed color – 1 or 8 bits, Line art(bilevel) – 1 bit. For TIF files, most programs allow either no compression or LZW compression. Adobe photoshop also provides JPG or ZIP compression too(but wbich reduces third party comparability of TIF files). "Document programs" allow ITCC G3 or G4 compression for 1 bit text, which I lossless and tremendously effective.
PNG(Portable Network Graphics)	RGB – 24 or 48 bits, Gray Scale – 8 or 16 bits, Indexed Color – 1 or 8 bits, Line Art(bilevel) – 1 bit. PNG uses ZIP compression which is lossless and slightly more effective than LZW(slightly smaller files). PNG is a never format, designed to be both versatile and royalty free, back when the LZW patent was disputed.
JPEG(Joint Photographic Expert Group)	RGB – 24 bits, Gray Scale – 8 bits JPEG always uses LOSSY JPG compression, but its degree is selectable, for higher quality and larger files, or lower quality and smaller files.
GIF(Graphic Interchange Format)	Indexed Color – 1 to 8 bits. GIF uses lossless LZW compression, effective on indexed color. GIF files contain no dpi information for printing purposes.

IMAGE ACQUISTION TECHNIQUES

Image acquisition technique is important to capture your images in a systematic manner so that the calculated results truly represent the size distribution of the material of interest.

To eliminate side-to-side distortion, all pictures should be taken perpendicular to the line of the toe of the slope. To eliminate vertical scaling error, the scaling balls need to be placed in a manner that the balls intersect the plane if the materials slope.

For muck piles, take images of different scale:

1) large scale (20 X 20 feet) including boulders and areas of fines, this scale range is to get resolution on material above 8-inches.

2) medium scale (10 X 10 feet) of typical region of 2 to 8 –inch material.
3) small scale (1.5 X 1.5 feet) are zoomed in images of representative samples of the finer material, typically 2-inch minus.

Take approximately equal number of images at each scale, or more images at the large and medium scales.

SIZE RANGE

The largest scale images really show the overall size range present. Include the patches of fines that are actually visible and not just the largest boulders or the results from the analysis may be biased towards the coarse end.

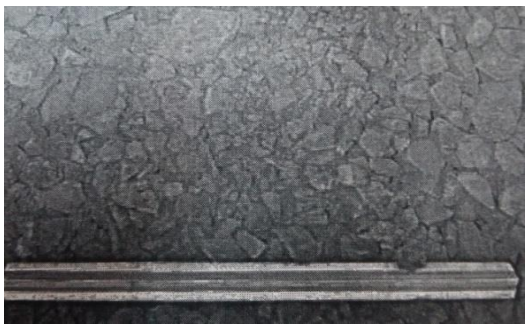
LIGHTING

Be conscious that shadows and light do not interface with the overall image appearance. Overcast days actually provide the best lighting due to fewer shadows. Make sure the images are in focus. You must get close enough so that the rock fragments are distinguishable in the image.

ZOOMING

While capturing three scales of images, you should zoom in or get closer to patches of fine material to help determine the size distribution of the finer material.

Far Range



Zoom

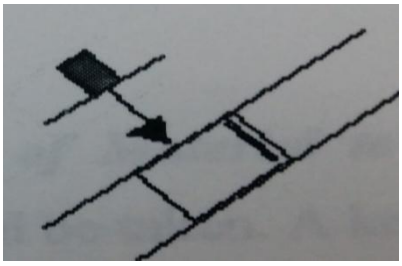
SCALING

An object or objects of known size must be in picture in order to set the scale for the entire image that is to be analyzed. The change in apparent size of objects due to the top of a pile being further away from the observer then the bottom is also corrected for using the scaling information.

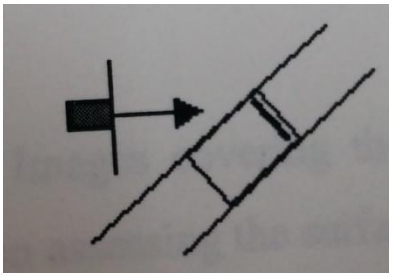
ONE-KNOWN OBJECT METHOD

For Zoomed-in images it may be necessary to use a ruler or scale as the known size in the image. In the case where only one known object is used and the distance and angle are not measured, it is important to take the image in the same plane as the slope of the material imaged. By imaging in the same plane, scaling differences and slope distortions are greatly reduced.

Correct Zooming:



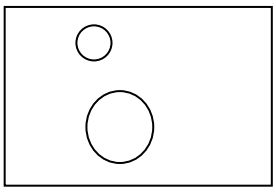
Incorrect Zooming:



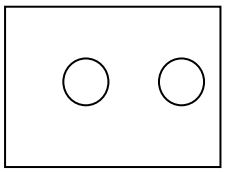
This method can also be used for images where the plane of the material is not perpendicular to the camera. In this case the distance to the bottom of the image must be known as well as the angle of the pile. It is also important that the scaling object is placed at the bottom of the image. Thie makes this method a little more difficult to implement in the field which means the two-object method is preferable to use to correct for slopes.

TWO-KNOWN OBJECT METHOD

Use two known objects to scale the image, preferably spheres of known diameter. Place the wo scaling objects on the pile so that boh are in the field of the view of the image that is to be taken. The objects should be at different vertical heights within the image to correct the effect of slope on the scale. The best scaling tools for this method are rubber balls with handels on them so tha a rope can be used to retrieve the balls. The scaling balls need to be placed so they intersect the plane of the slope of the material that is imaged.



correct Scaling



incorrect scaling:

Multiple Image Acquisition

The number of images required to calculate the size distribution of a given sample of material is not fixed and varies from situation to situation. The number of images to acquire depends on

1) The physical size of population of material in question
2) The rock size fraction that is of interest.

Taking these two key issues into consideration should lead to the correct number of images to acquire.

Physical Size Of Material To Be Measured

Images covering the entire surface area of the material should be taken. A key consideration is assessing the surface area is the homogeneity of the material on the surface. If the entire pile looks similar in size on each exposed face, then extra images of the "same" material will probably not result in better size information. If the surface area does expose varying size fractions, then images of the entire surface should be acquired. Again, when imaging muckpiles, it is recommended to acquire images after the shovel has advanced towards the middle of the pile as the surface of the blast is rarely representative of the contents inside the pile.

Size Fraction of Interest

Images should be acquired of the surface at different scales (large scale – far range, medium scale – medium range, small scale – zoom-in). This allows the software to focus and analyze particles at different scales that will eventually be merged together in one cumulative size distribution as a complete size sample.

JPEG (Joint Photographic Expert Group):

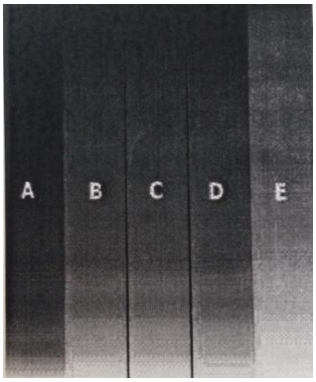
The aim of JPEG is o take *full-color (and gray scale) "real world" scenes and to reduce* the file size of images for storage and transmission. While capacity and bandwidth have improved dramatically over the last decade, the increased size of images make jpeg still relevant for digital camera users and websites.

The Jpeg organization is an umbrella body that coordinates formats for encoding and compression of images. Jpeg is commonly known as FIF (Jpeg File Interchange Format) implementation. This standard doesn't define exactly how to implement this process, but is sufficiently wide that the images from any program can be viewed. The most common version in use is that produced by independent jpeg group or IJG. Other implementations are the Pegasus Jpeg library, and the version used in photoshop. These differ only on the encoding side of the process.

Visual perception: Human visual perception comprises of the eye and retina, techniques used to create the feeling of accurate perception, but "optical illusion" dispel this myth. The human eye is more sensitive to moving objects and edges rather than gradual transition, and to red and green rather than blue light. It is also more sensitive to

changes in brightness than color. In the diagram shown right, various gray scales A to E represent gradual changes in brightness. These appear smooth and continuous to the eye, although each is made up of less than 256 steps (B and D are not as smooth as C). This perceptual bias is exploited in Jpeg. Similar perceptual biases are taken advantage of in television images and MP3 audio coding.

Compression (Encoding): Conventional methods of lossless compression such as zip reversibly reduce file sizes while preserving information by compacting regularities in the data. Jpeg compression goes one step further, by organizing regularities in the visual perception of an image and using lossy compression to reduce the file size of the image. This process involves a small but irreversible loss of quality.

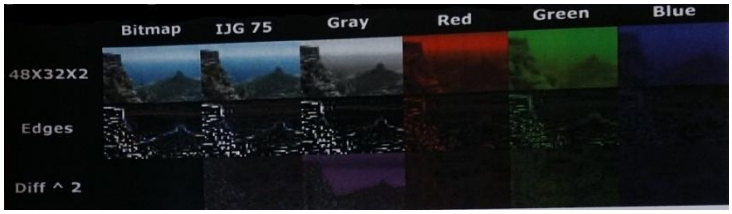


Edges in a typical image – zoomed in to see the pixels:

The actual method of Jpeg/JFIF compression is well described. The main steps are as follows:

- Standard color space is 256 levels of Red, Green, Blue (1.67 million RGB colors).
- Color space separation (YCbCr) from RGB.
- Example: Y (luminance) = 0.299 * R + 0.587 * G + 0.114 * B.
- Spatial separation in to 8X8 pixel blocks.
- Sub-sampling (if required) of chroma Cb and Cr (colors) in 16X16 pixel blocks.
- Discrete cosine function (DCF) of the spatial frequencies in each 8X8 blocks.
- Quantization of the spatial frequency matrix.
- Lossless compression of the resulting matrix.

Edges in a typical Jpeg image – split by red, green and blue channels



ADVANTAGES OF JPEG:

- It is the most common file format in use.
- Smaller file size.
- No editing is required to print.

In general, a Jpeg will compress a photographic image 2 – 3 times smaller than GIF. Jpeg is the best for scanned photographs, images using textures, images with gradient color transition or any images that require more than 256 colors. It is generally best to let JPEGs handle photographic material and to leave the graphics to GIF.

Jpegs are used to compress and take up much less room than a TIFF, BMP, or RAW. Most items that allow saving package for e-mail sending or just saving space.

CONCLUSION

This presents a brief study of the image compression from a grayscale bitmap image to a fully encoded jpeg image. The basic Jpeg compression was implemented by using matlab functions. The principle objective of this project was to present the theoretic foundation of image compression and to implement the Jpeg image compression. HAAR transform is the technique used for compression.

This work presents the compression of digital image using Matlab by creating pre defined functions. JPEG encoder fully implement all aspects of the standard and because of certain short coming of the standards such as Color space definition, Component sub-sampling registration, pixel aspect ratio definition.

REFERENCES

1. Digital Image Processing 2nd edition by GONZALEZ AND WOODS
2. Mathworks Documentation-V7 Matlab Function references
3. Introduction to Matlab by SIKANDER M.MIRZA
4. Jpeg Data Compression Standard 3rd edition by WILLIAM B.PENNABAKER and JOAN L.MITCHELL
5. "JPEG IMAGE COMPRESSION FAQ" by TOM LANE
6. M. StTIRNER AND G. SEELMANN. Improved Redundancy Reduction for JPEG files. Proc.of picture coding symposium, LIBSON

Websites:

1. WWW.MATHWORKS.COM
2. WWW.WIKIPEDIA.COM
3. WWW.SCIENCEBLOG.COM
4. WWW.JPEG.ORG
5. WWW.VISENGI.COM