Multimedia Applications S. D. G. P. Barkot

JPEG Compression, Zig Zag Coding, Multimedia Database, Content based retrieval for text and images.

Image Compression:

We are going to discuss JPEG compression which is lossy compression , as some data is loss in the end.

Let's discuss first what image compression is.

Image compression

Image compression is the method of data compression on digital images.

The main objective in the image compression is:

- Store data in an efficient form
- Transmit data in an efficient form

Image compression can be lossy or lossless.

JPEG compression

JPEG stands for Joint photographic experts group. It is the first interanational standard in image compression. It is widely used today. It could be lossy as well as lossless . But the technique we are going to discuss here today is lossy compression technique.

Following are the steps of JPEG Image Compression-

Step 1: The input image is divided into a small block which is having 8x8 dimensions. This dimension is sum up to 64 units. Each unit of the image is called pixel.

Step 2: JPEG uses [Y,Cb,Cr] model instead of using the [R,G,B] model. So in the 2^{nd} step, RGB is converted into YCbCr.

Step 3: After the conversion of colors, it is forwarded to DCT. DCT uses a cosine function and does not use complex numbers. It converts information?s which are in a block of pixels from the spatial domain to the frequency domain.

Step 4: Humans are unable to see important aspects of the image because they are having high frequencies. The matrix after DCT conversion can only preserve values at the lowest

frequency that to in certain point. Quantization is used to reduce the number of bits per sample.

There are two types of Quantization:

1. Uniform Quantization
2. Non-Uniform Quantization

Step 5: The zigzag scan is used to map the 8x8 matrix to a 1x64 vector. Zigzag scanning is used to group low-frequency coefficients to the top level of the vector and the high coefficient to the bottom. To remove the large number of zero in the quantized matrix, the zigzag matrix is used.

Step 6: Next step is vectoring, the different pulse code modulation (DPCM) is applied to the DC component. DC components are large and vary but they are usually close to the previous value. DPCM encodes the difference between the current block and the previous block.

Step 7: In this step, **Run Length Encoding (RLE)** is applied to AC components. This is done because AC components have a lot of zeros in it. It encodes in pair of (skip, value) in which skip is non zero value and value is the actual coded value of the non zero components.

Step 8: In this step, DC components are coded into Huffman.

Multimedia Database

Multimedia database is the collection of interrelated multimedia data that includes text, graphics (sketches, drawings), images, animations, video, audio etc and have vast amounts of multisource multimedia data. The framework that manages different types of multimedia data which can be stored, delivered and utilized in different ways is known as multimedia database management system. There are three classes of the multimedia database which includes static media, dynamic media and dimensional media.
Content of Multimedia Database management system :

1. **Media data –** The actual data representing an object.
2. **Media format data –** Information such as sampling rate, resolution, encoding scheme etc. about the format of the media data after it goes through the acquisition, processing and encoding phase.
3. **Media keyword data –** Keywords description relating to the generation of data. It is also known as content descriptive data. Example: date, time and place of recording.
4. **Media feature data –** Content dependent data such as the distribution of colors, kinds of texture and different shapes present in data.

There are still many challenges to multimedia databases, some of which are :

1. **Modelling –** Working in this area can improve database versus information retrieval techniques thus, documents constitute a specialized area and deserve special consideration.
2. **Design –** The conceptual, logical and physical design of multimedia databases has not yet been addressed fully as performance and tuning issues at each level are far more complex as they consist of a variety of formats like JPEG, GIF, PNG, MPEG which is not easy to convert from one form to another.
3. **Storage –** Storage of multimedia database on any standard disk presents the problem of representation, compression, mapping to device hierarchies, archiving and buffering during input-output operation. In DBMS, a "BLOB"(Binary Large Object) facility allows untyped bitmaps to be stored and retrieved.
4. **Performance –** For an application involving video playback or audio-video synchronization, physical limitations dominate. The use of parallel processing may alleviate some problems but such techniques are not yet fully developed. Apart from this multimedia database consume a lot of processing time as well as bandwidth.
5. **Queries and retrieval –**For multimedia data like images, video, audio accessing data through query opens up many issues like efficient query formulation, query execution and optimization which need to be worked upon.

Areas where multimedia database is applied are :

- **Documents and record management :** Industries and businesses that keep detailed records and variety of documents. Example: Insurance claim record.
- **Knowledge dissemination :** Multimedia database id a very effective tool for knowledge dissemination in terms of providing several resources. Example: Electronic books.
- **Education and training :** Computer-aided learning materials can be designed using multimedia sources which are nowadays very popular sources of learning. Example: Digital libraries.
- Marketing, advertising, retailing, entertainment and travel. Example: a virtual tour of cities.
- **Real-time control and monitoring :** Coupled with active database technology, multimedia presentation of information can be very effective means for monitoring and controlling complex tasks Example: Manufacturing operation control.

Content-based image retrieval

Content-based image retrieval, also known as query by image content (QBIC) and content-based visual information retrieval (CBVIR), is the application of computer vision techniques to the image retrieval problem, that is, the problem of searching for digital images in large databases for a recent scientific overview of the CBIR field). Content-based image retrieval is opposed to traditional concept-based approaches "Content-based" means that the search analyzes the contents of the image rather than the metadata such as keywords, tags, or descriptions associated with the image. The term "content" in this context might refer to colors, shapes, textures, or any other information that can be derived from the image itself. CBIR is desirable because searches that rely purely on metadata are dependent on annotation quality and completeness.

Having humans manually annotate images by entering keywords or metadata in a large database can be time consuming and may not capture the keywords desired to describe the image. The evaluation of the effectiveness of keyword image search is subjective and has not been well-defined. In the same regard, CBIR systems have similar challenges in defining success.

"Keywords also limit the scope of queries to the set of predetermined criteria." and, "having been set up" are less reliable than using the content itself.