

# Image Compression System using H.264 Encoding

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## Abstract

The proposed method for image compression using reference images stored in the disk. For each newly uploaded picture which is in the raw data format, the system does compression by utilizing the massive images already existing in the disk. Weber Local Descriptor (WLD) is employed for feature extraction. The images in the disk will also be represented in the form of these features. The features of current image are compared with the image features in the disk to retrieve similar images. A reference image is selected among the retrieved images. Finally, the current image is treated as a frame in a video sequence by referencing the image retrieved from disk. This frame is encoded using standard video coding technique which largely compresses the image.

**Keywords:** Image compression, Current image, Reference image

## I. INTRODUCTION

Nowadays the evolution and requirement of multimedia outcome is growing fast, which is added to storage of memory device and insufficient bandwidth of network. To reduce data redundancy the theory of data compression has become more and more significant, which in term saves transmission bandwidth and save space. The process of encoding information using lesser bits is called as data compression in computer science. Hard disk space or transmission bandwidth is considered as expensive resources that can be reduced using data compression.

The usage of digital cameras and mobile phones are more in demand nowadays. Since more number of images is obtained by using mobile phones and these images require more space to store. As a result, there is more demand for storage devices to store images. So to deal with this insufficient of storage devices some of the companies are emerged such as Google drive, drop box etc. but using this storage space shifts the storage pressure from an individual to a company.

Data compression is one of the technology in multimedia transformation without data compression it could not be possible to provide communication with clarity by cellular phones. Therefore data compression is a technique where the information is represented in compact form. Image compression can be one of the important solutions available for file sizes that can be created with manageable dimensions. In the selection of compression or decompression technique platform portability is important.

To overcome less storage space for images the image compression method is used which minimize the size of the image in bytes without losing the quality of the image. Compressing the images reduce the cost of taking picture, people tend to take more images in the same place or of the same objects and these images have different orientations and illumination etc., if these pictures are uploaded to disk or space the correlations between them can be exploited for compression.

### A. Types of image compression

#### 1) Lossy image compression:

Lossy compression decreases a file by forever taking out certain data, particularly repetitive data, and particularly repetitive data like duplicated pixels. Lossy compression is by and large utilized, where a specific measure of data loss will not be distinguished by users. The JPEG picture file, regularly utilized for photos and other complex still pictures on the web, these pictures that has lossy compression the creator can choose how much loss to represent and make an exchange off between document size and picture quality.

Applications that do not need high reliability in picture and video quality are normally achieved using lossy compression methods. The worthy loss in quality is determined by the utilization case. Typical example of lossy compression identifies with pictures and recordings caught by advanced cameras or portable telephones, in which information from the picture sensor is handled to a compacted configuration of either GIF on the other hand JPEG of wanted quality. Lossy pressure can decrease the digital content size from 5% to very nearly 95% depending on business necessity. So it is called lossy compression.

#### 2) Lossless compression:

With lossless compression, each and every piece of information that was initially in the file stays after the file is decompressed. The majority of the data is totally restored. This is generally the technique decision for content or spreadsheet. Applications that order zero misfortune in the nature of pictures examples by using this technique in medical services commercial ventures which manage radiographic pictures and assembling commercial enterprises which utilize machine drawings pictures and whose complex points of interest are noteworthy. Also, pictures of circuit charts and so on are another case that request zero loss in quality and henceforth utilize lossless.

## II. BACKGROUND AND RELATED WORK

Jorn ostermann, jan Bormans [1], describes about the H.264/AVC, which existed as collaborative task between the ISO/IEC moving pictures experts group and ITU-T video coding experts group is the current standard for the video coding. The goal of this collaborative effort was to increase the compression efficiency. A video representation which is network friendly for interactive application, this increases the efficiency of compression upto 50%. When compared to other standards decoder complexity has increased by four times that of MPEG-2 and two times that of MPEG-4. He provided an overview of tools features and also explained the complexity of H.264/AVC.

Wei-Yi Wei [2], describes about the evolution and requirement of multimedia applications growing faster. The data compression is becoming more important for lowering the excess data to save more memory space and network bandwidth. Information theory and computer science describes about the data compression. Compressing the data is very essential because it helps to reduce utilization of expensive resources like transmission of network bandwidth or disk space. He briefly explains about image compression fundamentals of typical standards like JPEG and JPEG 2000.

Chen Zhao at [3], the author defined the image compression system which is used to encode every image by referencing its counterpart images in database to obtain similar images in the database. The prediction accuracy for more images is obtained by preprocessing on the retrieved image by using illumination compensation and projective transformation. The current image is encoded by using prediction coding methods and by influencing the redundancy between the current image and reference images.

Bharathi S.H., K.Nagabushana Raju [4], the author describes algorithm of H.264 to improve the image compression by exploiting spatial redundancy. The results show the achievement of better compression rate in horizontal, vertical modes of pictures that have been encoded with compression technique. The compression is achieved without sacrificing the quality of preprocessed pictures by using these modes. The compression improves by using the intra prediction in pictures.

Manjinder Kar, Ganganpreet Kaur [5], the author describes about the methods of image compression. By using the compression methods we can reduce the image storage spaces, videos which it helps for transmission process's performance and increasing the storage capacity. In this image compression method not only concentrating on reducing size of image but also concentrating on the quality of image without losing and information of image. Image compressions are of two types lossy and lossless. In the lossless method of compression the original image is reconstructed from the compressed data. Lossy it allows constructing an original data which approximate to better compression rates.

Robert S. Gray at [6], the author describes about the image search in database it conveys the desired information; the user should be capable to search collection of published work for images that are suitable to the need of user. If the user wants to search image by using image retrieval system which are associated with keywords or text. These text based retrieval systems have several drawbacks like associated keywords or text is most tedious task. Some of the features cannot be described with text. So to overcome problems and improve the performance of retrieval system researchers have concentrated on more content based retrieval of image. This retrieval system carry out the comparison of image features directly rather than using text. Image features like color, edge and shape are regularly used in content based retrieval of image system. The system performance is evaluated and different extensions to the proposed techniques.

Herique S. Malvar Felolow [7] the author presents the designs of quantization and transformation in H.264 unlike the previous standards DCT of size 8 x 8, the H.264 uses the size of 4 x 4 transforms can be computed in integer arithmetic, this avoids the mismatch problems in inverse transform. Some new transforms are also computed without using multiplications, only using shifts and additions. This minimizes the complexity of computations, mainly for low-end processors. Transform is proposed and adapted in H.264; it has additional advantage by removing the multiplications. To improve the efficiency of compression, H.264 uses the transform the co-efficient of neighboring 4 x 4 block size are grouped in 4 x 4 blocks.

## III. PROPOSED WORK

Image compression is one of the important aspects of the multimedia communication. Image compression is necessary to make optimal use of available bandwidth and other network resources efficiently. The proposed mechanism here extracts the similar images from the repository by comparing the features of the images. Most matching image is taken to be reference image. Further an image H.264 encoding mechanism is applied in order to obtain the compressed image.

Objectives of the proposed methodology are as follows:

- 1) Efficiently perform the feature extraction and store features into repository.
- 2) Efficiently perform the comparison of the features to identify reference image.
- 3) Efficiently perform the H.264 encoding operations on reference image.

The overall system architecture can be divided in to two major activities. They are

- 1) Content based image retrieval
- 2) H.264 Encoding

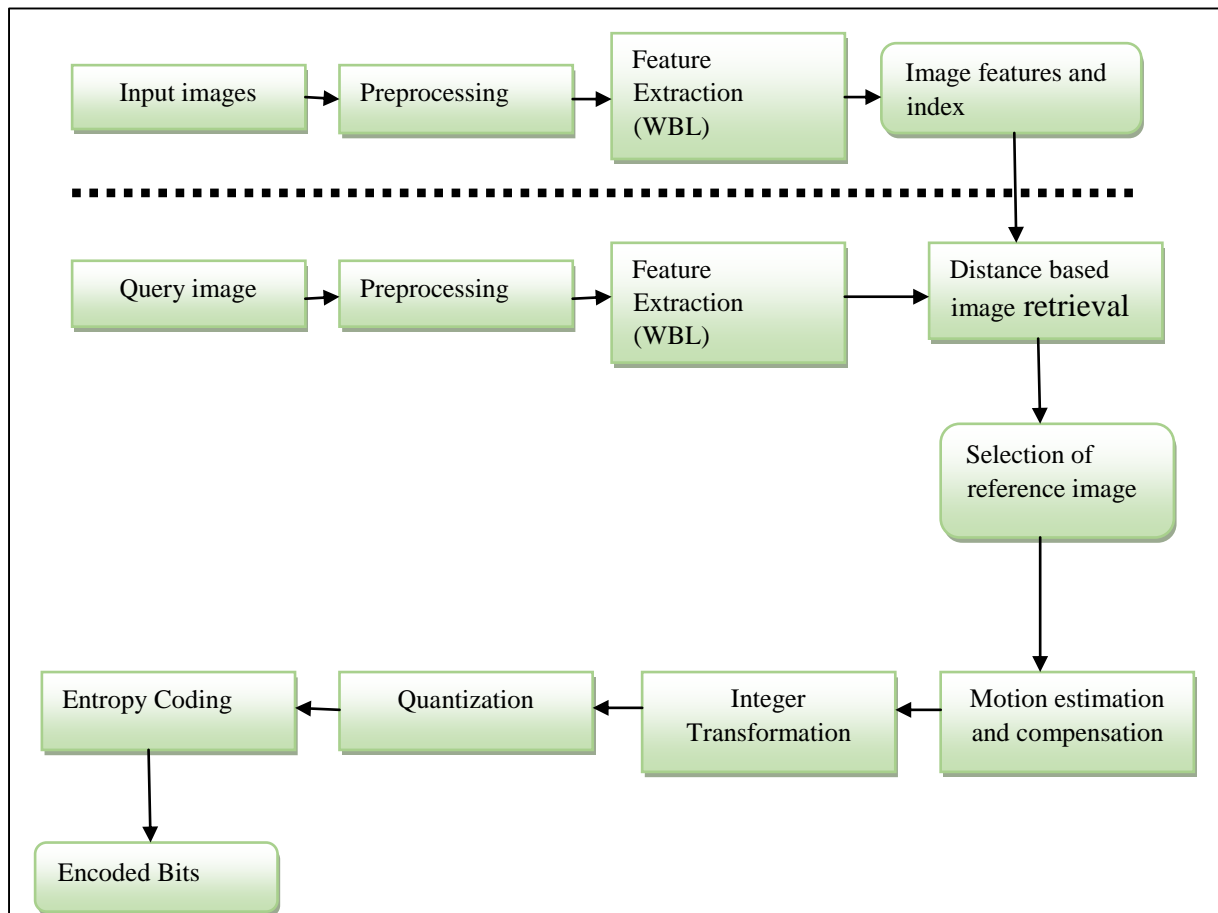


Fig. 1: Architecture of compression image system

### A. Content based image retrieval:

Image Retrieval Based on Content (CBIR) mechanism describes images as sequence of data elements. Visual features of images have several dimensions like their texture patterns or color. Image retrieval mechanism based on querying a group of images by using a sample image, and it gives the result of the images based on the similarity of visual features with the sample image. When we compared Image Retrieval Based on Content with text-based retrieval mechanism which searches images based on visual similarity of images. For example, group of images are different to each other it gives result by comparing all images with query image

CBIR is the process of retrieving similar images from huge collection of images in database based on similar features of images, so images can be automatically retrieved. The final aim of CBIR system avoids the usage of textual descriptors, this text-based retrieval have two problems one is automated annotation inconsistency, incorrectness and manual annotation.

The CBIR contains similarities of image features like colors, textures and shape etc. these features are considered as low-level image features. These approaches of image retrieval depend on the computation of similarity matches between the images queried by the user and images stored in database.

Feature extraction of image based on average RGB, color moments, local color histogram, Co-occurrence used to test image. Matching of features means comparison between the features extracted from query image and database images.

#### 1) Preprocessing:

After the process of storing input images in the database the next step is preprocessing. In order to compare these input images with the query image with various size of images and the speed of computer is considered and the size of every images are within 256\*256 pixels limited. Mainly in preprocessing it is very efficient to select proper color space to represent a color trademark image HSV color space, which contains Hue, Saturation and value, these values are closer human vision. Chroma is the combination of Hue and Saturation. RGB color space is periodically converted to HSV space, because the HSV space is accepted easily.

#### 2) Weber Local Descriptor:

It is a law states that the changes in the stimulus are a just original stimulus constant ratio. If there is change in the stimulus is smaller when compared to original stimulus constant ratio. It would be recognized by the human being as a background noise. The Weber local descriptor component is differential excitation proposed for pixel given. This differential excitation is between two terms: first is the current pixel intensity and second is relative intensity difference between current pixel and its neighbor

pixel (eg 3 x 3) square regions by using the component of differential excitation for a input image local salient patterns are extracted and gradient orientation of a current pixel is also calculated. Here we calculate two components of WLD; they are gradient orientation and differential excitation for every pixel in the given image.

### 3) Euclidean distance algorithm:

For the query image feature vector is calculated. The Euclidean distance method used to compare two vector features and it is the default method of implementation. After the feature vector comparison the difference is obtained if it is small then it is considered as similar image found in the database. The searching is usually based on the similarity between images not exactly matching of images.

## B. H.264 Encoding

Basics steps in image compression algorithm are listed below.

- 1) Motion estimation
- 2) Motion Compensation and Image subtraction
- 3) Integer Transformation
- 4) Quantization
- 5) Entropy coding

Every block in the execution step applies a discrete calculation that is dependent on the application, approach and the level of compression. Any computerized picture is just a two-dimensional matrix. The compression calculation changes the picture, or edge, to an alternate measurement and area, in which image individual parts can be analyzed.

Post analysis, redundant picture parts are quantized and the picture matrix is encoded by utilizing lossless or lossy compression systems. The encoded picture stream is changed into compressed computerized bit streams, which are utilized for transmission or storage capacity. If the framework handles a sequence of pictures or video streams, estimation of motion and motion compensation calculations are the important factor. These segments analyze the present frame by using the previous frame present in the memory and calculate redundant components that are wrong for further preparing.

### 1) Motion estimation:

Motion estimation is the procedure of calculating motion vectors by finding coordinating or matching blocks in the current frame to the future frame. The temporal redundancy can be easily recognized using motion estimation. In estimation of motion process number of algorithms are used. The basic assumption is essential, because these algorithms of transnational motion can be satisfied for rational motion but by using algorithms of block based search zooming cannot be estimated. In video compression algorithm it is the most computational and crucial process. Between any object of two successive frames there is frame rate ranges from 15 to 30 frames per second, therefore there is no large motion. Hence matching block in most of the search algorithms searches in the current block of the neighborhood of next frame. The region of the matched block is search region it is show in fig.

The quality of the match between two blocks of sizes 8 x 8 or 16 x 16 depends upon the result of MAE (Mean Absolute Error). Mean absolute error is the average result of pixel-wise difference in matching two blocks. If the result of MAE is small is better in block match. The minimum value with the displacement of the block is taken as the motion vector.

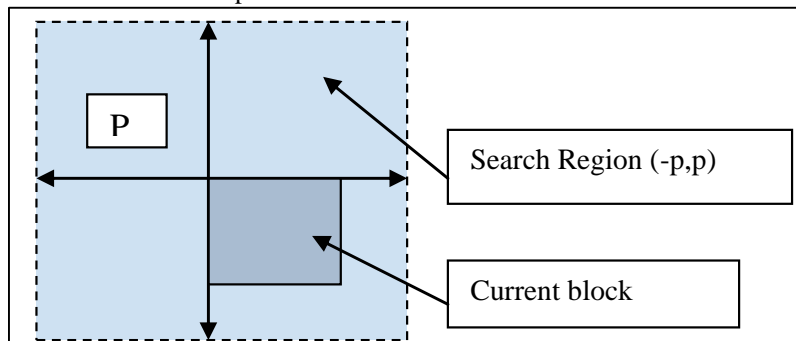


Fig. 2: Search region (-p, p)

### 2) Motion Compensation:

The main aim of motion compensation is to minimize the required bandwidth for the image sending. The motion estimation produces motion vectors, these vectors are used in the process of motion compensation in order to produce the image predicted in the encoder. The motion compensated frame and current frame are subtracted and the result is sent at the receiver.

In this process blocks are predicted from the previously transmitted reference images signal. For this reason, every macro blocks are partitioned into smaller blocks with the size of 16 x 8, 8 x 16, 16 x 16 and 8 x 8. Consider in the case of an 8 x 8 sub macro blocks are divided with size of 8 x 4, 4 x 8, or 4 x 4. In past standards of MPEG-4 or H.263 only few blocks of sizes are supported like 16 x 16 and 8 x 8. A movement of vector transmitted for every block refers to the previously transmitted reference picture of identical position to its image signal. The most prior image in past MPEG standards is the reference image. H.264 it is

feasible refer more number of prior images. Because of this reason the additional parameter of reference image has to be passed together by using motion vector. This is the motion compensation prediction technique with number of frames.

### 3) Integer Transformation:

Former standards MPEG-1 and MPEG-2 standards used to code prediction signal error by applying two dimensional DCT (Discrete Cosine Transform) of size 8 x 8. But in H.264/AC instead of DCT different integer transform are applied. The size of integer transforms 4 x 4, 2 x 2 in special case. Block size of 4 x 4 is smaller used instead of using large block 8 x 8, which allows the encoder for better prediction error coding of moving objects boundaries, to match the size of motion compensation smallest block with the size of transform block and for local prediction error signal transformation is adopted.

There are three different types of transforms used. The first type of transform coding is applied to error prediction blocks of all samples. This contains y luminance component irrespective of intra prediction or motion compensated was used.

The second transform is hadamard transform of size 4 x 4 with the matrix H2; it is applied in addition to first transform. It transforms all blocks transformed from the luminance signal with 16DC co-efficient.

The third transform also same as second transform it is hadamard transform used, But with variation in size 2 x 2. IT transforms all blocks of chrominance component signal with 4DC co-efficient.

When compared to DCT, in the transform matrix integer numbers ranges from -2 to 2 when applied the integer transforms. So this allows the inverse transforms and computing the transform, using 16-bit arithmetic of low shift, subtract and add operations. But in the case of handamard transform, only subtract and add operations used. Further there is more usage of integer operations mismatches with the inverse transform are fully avoided but this is not in the case of previous standards and problems are caused.

In integer pixel redundancy the neighboring pixel is used to obtain the information about the given image pixel can be easily predicted. This predicted pixel is relatively small. Here the redundancy of pixels is removed in order to achieve compression by reducing inter pixel redundancies in 2-D pixel array are normally used for interpretation and viewing, it must be transformed into 'non visual' format. Consider an example the difference between neighboring pixels of image can be represented as a image. So this type of transformation is called as mappings. This process is reversible if the elements of original image can be reconstructed from the data set transformed.

### 4) Quantization:

The principle behind the quantization is removing the spatial redundancies does not lead to any visible loss in quality of image and the human eyes are not more sensitive to the frequency in the image. The content of spatial frequency of the image is received by operation of integer transformation; it is followed by the content of frequency removed from image in the quantization process. The standard of JPEG recommends quantization tables values, these values are used to in the DCT image to deemphasize more frequencies.

### 5) Context based adaptive variable length coding (Entropy coding):

CAVLC encoding mechanism is applied residual data of 4 x 4 sub-blocks. Residual data in lossy coding exposes several advantages such as 1) once the transformation and quantization is complete, sub-block mostly contains zeros, specifically in high frequency regions 2) there will be very few highest non zero co efficient.

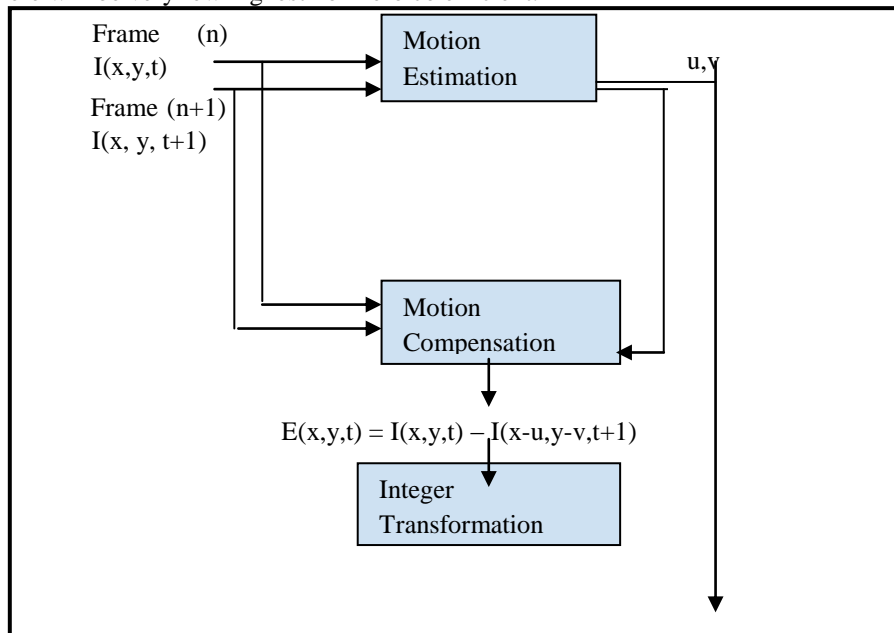


Fig. 3: Block Diagram of Encoding

#### IV. EXPERIMENTAL RESULTS

The system is proposed for image compression to minimize the size of image. This chapter deals with the results obtained in the previous methods used. The disk consists of uncompressed images like bmp format. Content based image retrieval is used to retrieve similar image and this image is compressed using motion estimation, motion compensation, integer transformation, and quantization and CAVLC algorithm. The results are obtained are compared with other image values. This compression system takes better advantage of H.264 Encoding method. Figure (a) is input image (b) is gray scale converted image (c) Similar image retrieved (d) is the final encoded results using H.264 Encoding method and performance analysis.

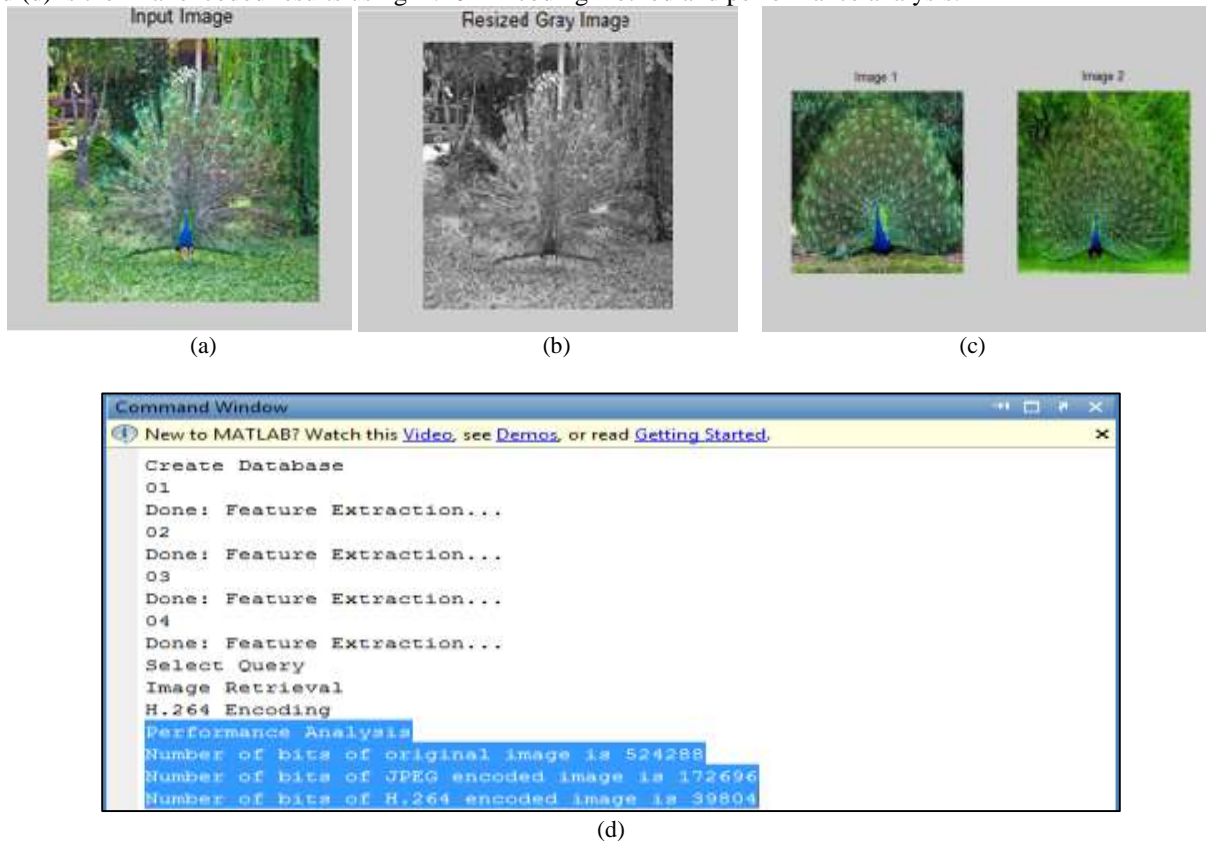


Fig. 4: (a) (b) (c) (d) Experimental results

#### V. CONCLUSION

The proposed methodology provided the optimal feature extraction and comparison technique based on image retrieval. Based on the comparison techniques reference image and current image is considered for the encoding. Based on the extracted features, an efficient encoding mechanism is formed. The experimental results showed the great performance by using H.264 Encoding method is similar to other encoding mechanisms such as JPEG.

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