International Journal of Technology Research and Management
ISSN (Online): 2348-9006
Vol 9 Issue 5 May 2022

Towards End-to-End Image Compression and Analysis Model with Transformation Techniques

Atul Kumar Yadav[1], Prof. Jitendra Mishra[2]
M. Tech. Scholar, Department of EC, PCST, Bhopal (India)[1]
Head & Professor, Department of EC, PCST, Bhopal (India)[2]

Abstract: *More and more fields of human's life are becoming computerized nowadays. This determines generation of huge, and further increasing, amount of information stored in digital form. All this is possible thanks to technological progress in registration of different kinds of data. This progress is also being observed in wide field of digital images, which covers scanned documents, drawings, images from digital or video cameras, satellite images, medical images, works of computer graphics and many more. In this paper we presents the comparative performance evaluation model for the image compression with the previous and proposed techniques, here we draw the proposed model with previous and new approach and getting the results for each methods for the all input images like cameraman images, Barbara image tec. . Our proposed approach shows the better results than the previous approach.*

Keywords: *Image processing, Computer vision, Neural network, Convolution neural network.*

1. INTRODUCTION

Data compression domain is still an interesting topic also because of the number of files/data keep growing exponentially. There are many examples of fast growing digital data. The first example is in radiography and medical imaging. Hospitals and clinical environments are rapidly moving toward computerization that means digitization, processing, storage, and transmission of medical image. And there are two reason why these data keep growing exponentially. Firstly, because of the growth of the patients that need to be scanned. Secondly, is the conversion of archived film medical images. The second example of the growing digital data is in the oil and gas industry that has been developing what's known as the "digital oilfield", where sensors monitoring activity at the point of exploration and the wellhead connect to information system at headquarters and drive operation and exploration decisions in real time, that means more data produce each day. And there are more applications that produce data exponentially such as broadcast, media, entertainment, etc. Those digitized data have heightened the challenge for ways to manage and organize the data (compression, storage, and transmission). This purpose is emphasized, for example, by non compression of raw image with size of 512 × 512 pixels, each pixel is represented by 8 bits, contains 262 KB of data. Moreover, image size will be tripled if the image is represented in color. Furthermore, if the image is composed for a video that needs generally 25 frames per second for just a one second of color film, requires approximately 19 megabytes of memory. So, a memory with 540 MB can store only about 30 seconds of film. Thus, data compression process is really obvious to represent data into small size possible, therefore less storage capacity will be needed and data transmission will be faster than uncompressed data. Modern data compression began in the late 1940s with the development of information theory. Compression efficiency is the principal parameter of a compression technique, but it is not sufficient by itself. It is simple to design a compression algorithm that achieves a low bit rate, but the challenge is how to preserve the quality of the reconstructed information at the same time. The two main criteria of measuring the performance of data compression algorithm are compression efficiency and distortion caused by the compression algorithm. The standard way to measure them is to fix a certain bit rate and then compare the distortion caused by different methods. A digital image is two-dimensional functional in space where amplitudes at each location are called pixels. There are different types of images depending upon the different number of data bits per pixel for their representation. Quality of an image can be assessed either visually or by mathematical formulation. The former is called subjective quality assessment and the later objective quality assessment. A common objective quality assessment metric for images obtained after decompression is PSNR (peak signal-tonoise ratio). Transform based lossy image compression is flexible as it can compress images at different qualities depending upon the application of the image. JPEG uses 8x8 block-wise 2-D DCT as the transform. DCT has very high energy compaction and its performance is almost similar to optimal Karhunen-Lo'eve transform (KLT) with the advantage of constant kernel and less computational complexity. Still, for the hardware implementation, similar kind of transform which will have less computational complexity and hence less hardware requirement with performance almost similar to DCT can be a preferred choice.

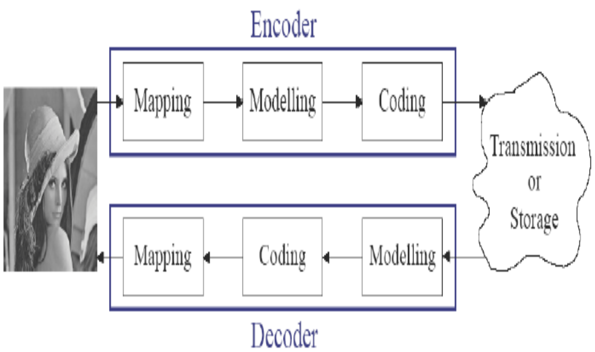

Figure 1: The above figure show the image transmission stage.

An image in its original representation carries huge amount of data. Thus, it requires large amount of memory for storage. Image compression is an important area in image processing which efficiently removes the visually insignificant data. Compressed images are sent over limited bandwidth channel with some additional processing for robust (error free) transmission. Transform based image compression algorithm is a most preferred choice which consists of image transform (in non-overlapping blocks), quantization of transformed coefficients and entropy coding. Joint photographic expert group (JPEG) is a committee that standardizes the image compression algorithm. The 8x8 block-wise two-dimensional discrete cosine transform (2-D DCT) is used as orthogonal transform in JPEG image compression. Images compressed by this standard are used globally. This algorithm provides the user to choose between amount of compression and quality as per the requirement of the image in different applications. The variable amount of compression makes this algorithm very much suitable for the transmission purpose as user can adjust the bit rate of the transmission according to channel capacity. JPEG is fixed algorithm and it has some flexibility that can be incorporated easily without any major changes in the basic structural feature. JPEG system can be implemented in software as well as in hardware. Software solution is not promising for the applications requiring high speed. Therefore, real-time processing is done through the dedicated hardware. In custom hardware implementation, architecture plays a vital role in deciding area, power and throughput of the design. Architecture optimizations lead to lower computational units (adders, multipliers), reduced memory size for storage of temporary variables and smaller interconnects. Architecture explorations to minimize the area and power consumption is a issue for portable devices running on battery. Low silicon area reduces the cost of the appliance and low power consumption increases the battery lifetime (time between recharges for chargeable battery) which in turn reduces the weight of the battery and overall size. 2-D DCT is a complex algorithm and requires high computations. Further, subsequent stages in transform based image compression require high memory storage along with arithmetic circuits. For portable devices, having image compression system (like JPEG compression in digital camera), low-cost design, that can be achieved by reducing silicon area is highly required. By efficiently designing the hardware architecture, image compression can be performed with low-cost and low power budget. Image data representation has redundancy (also called pixel correlation, interpixel redundancy or spatial redundancy), in the sense, a pixel value can be predicted by its neighborhood pixels. Decorrelation process removes the spatial redundancy and hence, facilitates compression. Some of the techniques used for this process are predictive coding, transform coding and subband coding. Apart from the interpixel redundancy, there is statistical redundancy present in the data after de-correlation (not only image but any data possess statistical redundancy). This is removed by entropy encoding process where more probable symbol is assigned less number of bits and vice-versa (also called variable length encoding). Huffman coding and arithmetic coding are two important techniques used for entropy encoding of data.

2. IMAGE PROCESSING COMPONENTS

Image Sensors: With reference to sensing, two elements are required to acquire digital image. The first is a physical device that is sensitive to the energy radiated by the object we wish to image and second is specialized image processing hardware. Specialize image processing hardware: It consists of the digitizer just mentioned, plus hardware that performs other primitive operations such as an arithmetic logic unit, which performs arithmetic such addition and subtraction and logical operations in parallel on images. Computer: It is a general purpose computer and can range from a PC to a supercomputer depending on the application. In dedicated applications, sometimes specially designed computer are used to achieve a required level of performance Software: It consists of specialized modules that perform specific tasks a well designed package also includes capability for the user to write code, as a minimum, utilizes the specialized module. More sophisticated software packages allow the integration of these modules. Mass storage: This capability is a must in image processing applications. An image of size 1024 x1024 pixels, in which the intensity of each pixel is an 8- bit quantity requires one Megabytes of storage space if the image is not compressed .Image processing applications falls into three principal categories of storage:-

i) Short term storage for use during processing
ii) On line storage for relatively fast retrieval
iii) Archival storage such as magnetic tapes and disks

Image display: Image displays in use today are mainly color TV monitors. These monitors are driven by the outputs of image and graphics displays cards that are an integral part of computer system. Hardcopy devices: The devices for recording image includes laser printers, film cameras, heat sensitive devices inkjet units and digital units such as optical and CD ROM disk. Films provide the highest possible resolution, but paper is the obvious medium of choice for written applications. Networking: It is almost a default function in any computer system in use today because of the large amount of data inherent in image processing applications. The key consideration in image transmission bandwidth.

3. PRESENT WORK

DCT is an orthogonal transform. Karhunen-Lo'eve transform (KLT) is optimal in class of orthogonal transforms like Fourier transform, Walsh-Hadamard transform and Haar transform and has the best energy compaction. However, KLT is not ideal for practical image compression as its basis vectors has to be calculated according to the pixel values of the image (i.e., KLT is a data dependent). For each image, there will be separate basis vectors that also need to be included in the compressed image for the decompression process. It was found that DCT performs close to KLT and their performances are also close with respect to rate-distortion criterion (quality at different compression). In addition, there are several fast and hardware efficient algorithms available for the computation of DCT. Therefore, DCT became the widely used transform for lossy image encoding/compression and also in the several other signal processing applications.

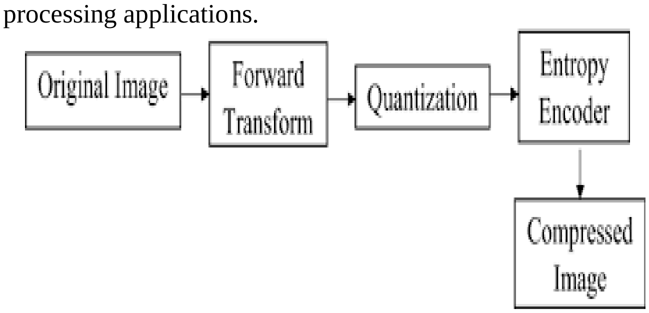

Figure 2: Proposed model block diagram for image compression.

DCT is one of the most efficient transform coding schemes. It was introduced by Ahmed to produce good performance and solve the problem of discontinuity at the ends of the data blocks inherit with the DFT. This transformation is an orthogonal, separable, and real transform which translates the image information from spatial domain to frequency domain to be represented in a more compact form. It is closely related to DFT. DCT is the basis of many image compression methods. For example, the standard JPEG (Joint Photographers Expert Group), for which DCT is carried out in 8×8 image blocks existed as the main image compression standard. DCT has an excellent energy compaction property for highly correlated data. These properties make the DCT a popular transform for image coding.

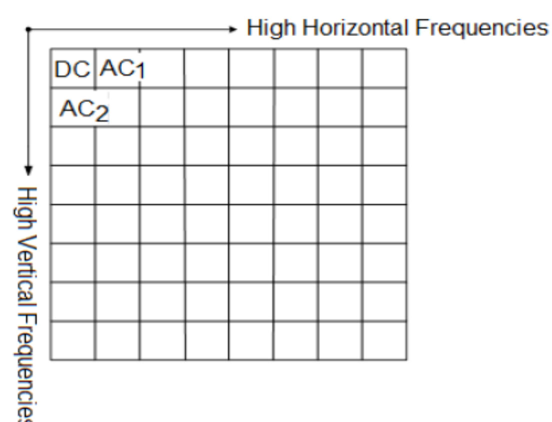

Figure 3: DCT block structure.

4. EXPERIMENTAL RESULT

In this section the experimental process of image compression is performed with Existing and present work. This process of image compression is done by using two methods that are with integer wavelet transformation and present works. This all methods implemented in MATLAB 7.14.0.

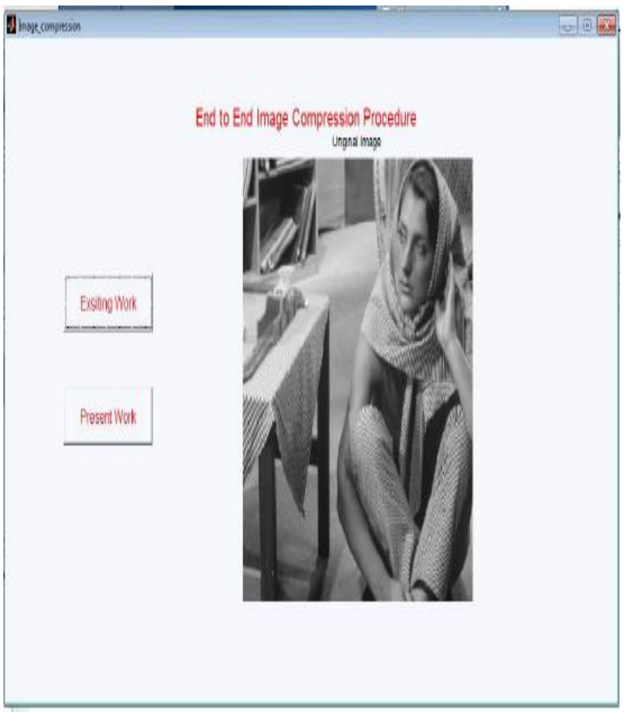

Figure 4: The above figure shows the input image barbara2 for the simulation process using existing work.

Figure 5: The above figure shows the transform function result barbara2 image for the simulation process using existing work.

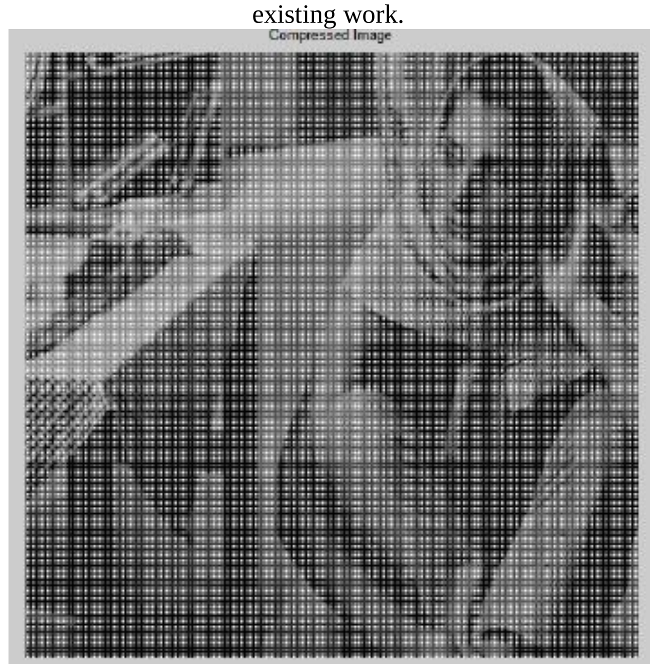

Figure 6: The above figure shows the compressed image result barbara2 image for the simulation process using existing work.

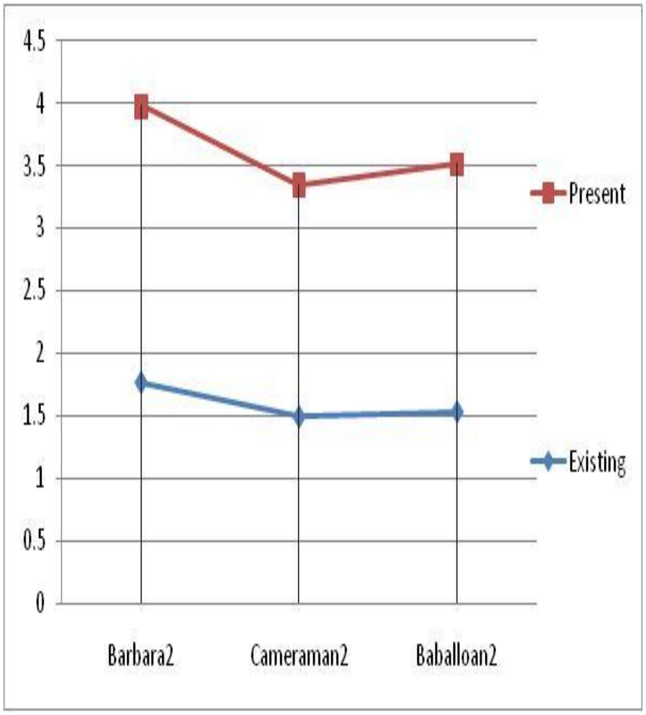

Figure 7: The above figure shows the comparative experimental analysis for the compression ratio parameters for the Existing and present work with using cameramn2 image, babara2 image and baballon2 image.

5. CONCLUSION

In recent years, the development and demand of multimedia product grows increasingly fast, contributing to insufficient bandwidth of network and storage of memory device. Therefore, the theory of data compression becomes more and more significant for reducing the data redundancy to save more hardware space and transmission bandwidth. In computer science and information theory, data compression or source coding is the process of encoding information using fewer bits or other information-bearing units than an un-encoded representation. Compression is useful because it helps reduce the consumption of expensive resources such as hard disk space or transmission bandwidth. In this paper we present the comparative experimental study for the image compression and assess the image quality on various parameters such as the peak signal noise ration, compression ratio etc, Our proposed work simulated with the input image on matlab and gives better results than the previous work.

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