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Image Compression Techniques and Image Types: Survey and Discussions

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ABSTRACT

Image compression is one of the most widespread techniques for applications that require storage of various types of images and transmission in database. Digital images are large in size and occupy large space. Image compression is the solution associate with transmission and storage of large amount of information for digital images. Image compression reduces the data from the image in either lossless or lossy way. In past years, a variety of compression techniques are reported by many researchers for the effective compression of general images and information. In this work, we presented a review of these compression techniques with the classification of these techniques, their performance parameters and their advantages in the field of the image compression.

Keywords:- Wireless sensor network, Deep learning, Internet of Things, Cognitive radio, Primary user, Secondary user.

INRODUCTION

The rapid growth of technology and various sciences revolutionize human knowledge. Computer networks are increasing day by day, and more and more people join the networks every day. Increasing the volume of communications will give rise the new risks and threats in communication networks and can lead to diminish in the networks' security level. The media such as images, videos and so on exchanges as main element in the context of communication networks.

The inherent property of media (such as image and video) is the ability of tampering them to alter their content by using various software processes that could threaten the ownership of the artistic or scientific works. These changes jeopardize the ownership of the sources that published the images or videos. The risk of changing, tampering, or foreclosure of the multimedia concepts for the transmission process are an easy task in communication networks [8].

Image compression can be additionally characterized or separated in two isolate sorts, for example, lossy compression and lossless compression. In the lossy compression as its name demonstrated that it brings about the loss of little data. In this procedure the packed image is same as to genuine/unique uncompressed image yet not correct to the past one as inside the compression procedure more diminutive data identified with the image has been lost. So they are regularly connected for the photos. The extremely regular case of the lossy compression is a JPEG. Where are in Lossless compression, it packs a image by encoding it's all data from the genuine record, so on the off chance that if the image is get decompressed once more, at that point it will be the precisely same as the genuine image. For cases of the lossless procedure of image compression are PNG and GIF [1].

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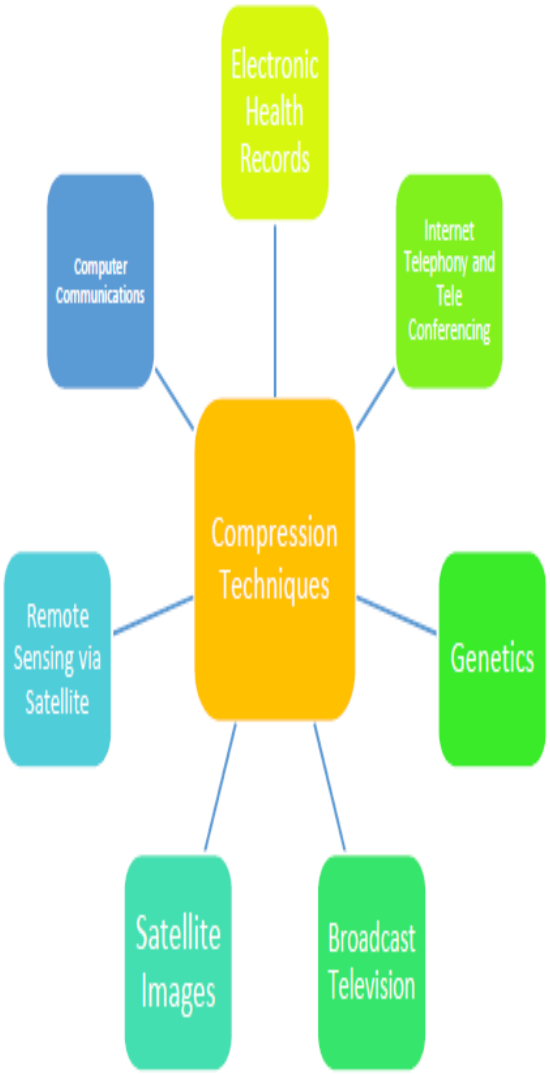

Fig 1: Various application areas of the compression techniques.

Image compression gives a compact representation of digital images by exploiting the redundancy in the original data. Mainly, it results in reduction of bit rate to represent an image. Most of the internet applications require high bandwidth for voluminous data transfer. So, image compression plays a vital role in effective image storage and transmission. The process of image compression is presented in below fig.

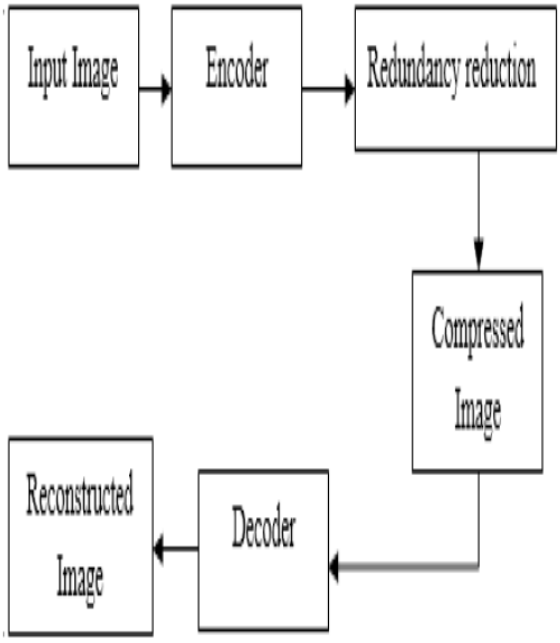

Fig 2: Process of Image Compression.

Though the recent developments in technology have resulted in reduction of data transmission and storage costs, massive data generation due to exponentially growing digital online applications still poses a challenge for their effective storage and transmission [1]. Image compression becomes a unique solution for many imaging applications such as, document imaging management systems, facsimile transmission, image archiving, remote sensing, medical imaging, entertainment, HDTV, broadcasting, education and video teleconferencing. Specifically, medical field has witnessed tremendous growth with state of the art imaging technologies for accurate diagnosis, which in turn demands efficient storage of medical images. Image compression technique is widely classified into two types such as, lossy and lossless compression. Various methods have been proposed for image compression based on Vector Quantization, Image Transforms and Evolutionary computation techniques for improving the quality of an image with a reduced storage space.

II Advantages of image compression

There are the following advantages of image compression [13]:

Size reduction: The size reduction is most significant benefit of the image compression. It takes up less space on the hard drive and retains the same physical size, unless edit the image's physical size in an image editor. The file size reduction with the help of internet, to create image rich sites without using much bandwidth or storage space.

Data Loss: Some common files like JPEG, which an image shrinks in the size of compression, will discard some of the photo's data permanently. So compress the images to ensure that decompressed back up before starting. Otherwise lose the high quality of the original decompressed image permanently.

Slow Devices: Various electronics devices may load large compressed image slowly. For example CD devices can only read data at a specific rate and cannot display large images in real time. Also doe some webhost that transfer data slowly compressed images remain necessary for a fully functional websites. Image compression allow for the faster loading of data on slower devices.

III Types of image

In a raw state, images can occupy a large amount of memory both in RAM and in storage. Image compression reduces the storage space required by an Image and the bandwidth needed when streaming that image across a network [14]. Generally images are classified as the following.

JPG: JPG is optimized for photographs and similar continuous tone images that contain many, numbers of colors. JPG works by analyzing images and discarding kinds of information that the eye is least likely to notice. It stores information as 24 bit color. The degree of compression of JPG is adjustable. At moderate compression levels of photographic images, it is very difficult for the eye to discern any difference from the original, even at extreme magnification. Compression factors of more than 20 are often acceptable.

TIFF: The TIFF (Tagged Image File Format) is a flexible format that can be lossless or lossy compression. It normally saves 8 bits or 16 bits per color (red, green, blue) for 24-bit and 48-bit totals, respectively. The details of the image storage algorithm are included as part of the file. In practice, TIFF is used almost exclusively as a lossless image storage format that uses no compression at all. TIFF files are not used in web images. They produce big files, and more importantly, most web browsers will not display TIFFs.

JPEG: Joint Photographic Expert Group (JPEG) is an excellent way to store 24-bit photographic images, such as those used for imaging and multimedia applications. JPEG 24- bit (16 million color) images are superior in appearance to 8-bit (256 color) images on a Video Graphics Array (VGA) display and are at their most spectacular, when using 24-bit display hardware (which is now quite inexpensive). JPEG was designed to compress, color or gray-scale continuous-tone images of real-world subjects, photographs, video stills, or any complex graphics, that resemble natural subjects. Animations, ray tracing, line art, black-and-white documents, and typical vector graphics don't compress very well under JPEG and shouldn't be expected to. And, although JPEG is now used to provide motion video compression, the standard makes no special provision for such an application.

GIF: Graphics Interchange Format (GIF) is useful for images that have less than 256-(2^8) colors, grayscale images and black and white text. The primary limitation of a GIF is that it only works on images with 8-bits per pixel or less, which means 256 or fewer colors. Most color images are 24 bits per pixel [14]. To store these in GIF format that must first convert the image from 24 bits to 8 bits. GIF is a lossless image file format. Thus, GIF is "lossless" only for images with 256 colors or less.

For a rich, true color image, GIF may "lose" 99.998% of the colors. It is not suitable for photographic images, since it can contain only 256 colors per image.

PNG: Portable Network Graphics (PNG) is a file format for lossless image compression. Typically, an image in a PNG file can be 10% to 30% more compressed than in a GIF format [4]. It allows making a trade-off between file size and image quality when the image is compressed. It produces smaller files and allows more colors. PNG also supports partial transparency. Partial transparency can be used for many useful purposes, such as fades and antialiasing for text.

BMP: The Bitmap (BMP) file format handles graphics files within the Microsoft Windows OS. Typically, BMP files are uncompressed, hence they are large; advantage is that their simplicity, wide acceptance, and use in Windows program.

IV RELATED WORK

[1] In this paper, they discussed about image compression and different image compression techniques without any data loss. Few of it are run length arithmetic encoding, Huffman coding and LZW. Finally, they presented the performance issues and pros of compression techniques. Another strategy for the image compression that uses the Wavelet-based Image-Coding in the mix with the Huffman encoder has been clarified here. This strategy utilizes the zero tree engineering of wavelet-coefficients at the decay level of eight with the Huffman encoder is a productively utilized that demonstrated in the higher proportion of compression and a superior PSNR. This paper likewise serves to the product designer to grow new packed programming for the compacting of any image as the lossless genuine image by the utilization of Huffman encoding calculation. [2] In this paper they present a learned image compression system based on GANs, operating at extremely low bitrates. Our proposed framework combines an encoder, decoder/generator and a multi-scale discriminator, which they train jointly for a generative learned compression objective. The model synthesizes details it cannot afford to store, obtaining visually pleasing results at bitrates where previous methods fail and show strong artifacts. Furthermore, if a semantic label map of the original image is available, our method can fully synthesize unimportant regions in the decoded image such as streets and trees from the label map, proportionally reducing the storage cost. [3] In this paper they develop a bit allocation and rate control method that improves object detection of a DNN-based state of the-art object detector called YOLO9000. They utilize the outputs of the initial convolutional layers of this detector to create the importance map, which is used to guide bit allocation towards regions that are important for object detection. The resulting strategy offers significant bit savings of 7% or more compared to the default HEVC at the equivalent object detection rate. For the same bit-rate, the proposed strategy offers more accurate object detection and classification compared to the default HEVC. [4] Their investigation in this paper is to make a real-time compression system able to capture an image, apply compression algorithm and save compression image on an SD card (for Arduino or Raspberry) or sent directly compressed image to cloud. Compression system with a Raspberry Pi basically used a webcam USB camera to capture the images, the compression function based on python language, and a function to store compressed image to an SD card or to Cloud. The compression system with Arduino used an SD card where the image to be compressed are stored, an external SRAM chip, and an Ethernet shield. The proposed hardware system can decompress the image. In opposition to the approach adopted in the literature, all the results presented within this work use the vector quantization. Eight images have been used to evaluate and compared the compression time for each board according to codebook size used during vector quantization step. Based on their results, they remark that compression and decompression time using Raspberry Pi is lower than compression and decompression time using Arduino. [5] In this paper they present a robust and secure watermarking approach using transform domain

techniques for tele-health applications. The patient report/identity is embedding into the host medical image for the purpose of authentication, annotation and identification. For better confidentiality, they apply the chaos based encryption algorithm on watermarked image in a less complex manner. Experimental results clearly indicated that the proposed technique is highly robust and sufficient secure for various forms of attacks without any significant distortions between watermarked and cover image. Further, the performance evaluation of our method is found better to existing state-of-the-art watermarking techniques under consideration. [7] In this paper author develops a novel method based on the binary particle swarm optimization (BPSO) with the variance accounted for (VAF) as fitness function to reduce the number of input variables while improves the accuracy in joint moment prediction. The proposed method is tested on the experimental data collected from ten healthy subjects who are running on a treadmill with four different speeds of 2, 3, 4 and 5m/s. The BPSO is used to select optimal inputs subset from ten electromyography (EMG) data and six joints angles, and then the selected optimal inputs subset be used to train and predict the joint moments via artificial neural network (ANN). Prediction accuracy is evaluated by the variance accounted for (VAF) test between the predicted joint moment and multi-body dynamics moment. Results show that the proposed method can reduce the number of input variables of five joint moments from 16 to less than 11. [8] This paper proposes a new blind and robust color image watermarking method based on a new three Dimension Henon chaotic map and uses Integer Wavelet Transform (IWT), Discrete Wavelet Transform (DWT) and Contourlet Transform (CT) in embedding and extracting processes. Color images are divided into 4X4 main non-overlapping blocks, and they are selected to apply one of the transform. Then the LL sub band is selected and proposed map is used to find the 2X2 sub- blocks, which used in embedding process. The watermark bits are embedded in all main blocks to increase the robustness of proposed watermark technique. This method uses a correction process to improve the quality of watermark in extracting process.

V CONCLUSION

Image compression is the application of data compression on digital images. The objective is to reduce redundancy of the image data in order to be able to store or transmit data in an efficient form. This paper represents the concept of image compression and application area with advantages of image compression. Mostly two types of image compression techniques lossless and lossy image compression, Lossless algorithms are used for the applications that require an exact reconstruction of original data while lossy compression is used when the user can tolerate some distortion.

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