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A Technical Seminar Report On

"Image Compression Techniques"

Submitted by

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Under the Guidance of

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

UNIVERSITY B.D.T. COLLEGE OF ENGINEERING

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CERTIFICATE

This is to certify that the "**Technical Seminar report**" submitted by **Gagan A (4UB19CS021)** the bonafide student of "UNIVERSITY B.D.T. COLLEGE OF ENGINEERING, DAVANGERE", in partial fulfillment for the award of Bachelor of Engineering in "COMPUTER SCIENCE & ENGINEERING", of Visvesvaraya Technological university, Belagavi, during the year 2022-23. It is certified that all corrections and suggestions indicated for internal assessment have been incorporated in the report. The technical seminar report has been approved as it satisfies the academic requirements in a respect to technical seminar work prescribed by said degree.

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- **GAGAN A (4UB19CS021)**

TABLE OF CONTENTS

ABSTRACT

Image compression techniques refer to the methods used to reduce the file size of digital images while maintaining an acceptable level of image quality. The primary goal of image compression is to decrease the amount of storage space required for an image, making it easier to store, transfer, and share.

There are two main types of image compression techniques: lossless and lossy. Lossless compression algorithms compress image data without sacrificing any image quality, whereas lossy compression techniques aim to reduce file size by removing some of the less important image details.

Some common lossless compression techniques include run-length encoding (RLE), Huffman coding, and Lempel-Ziv-Welch (LZW) compression. These algorithms are effective for images with large areas of uniform color or patterns.

On the other hand, lossy compression techniques involve discarding some of the image information that is deemed less important by the algorithm. This can result in a noticeable loss of quality, especially if the compression level is high. Some common lossy compression techniques include discrete cosine transform (DCT) and wavelet compression.

CHAPTER 1: INTRODUCTION

Image compression is a critical technique for reducing the size of digital images, while still maintaining an acceptable level of image quality. With the proliferation of digital images in our daily lives, from social media to online shopping, image compression has become an essential tool for saving storage space and reducing transfer times.

The main goal of image compression techniques is to compress the image file size without sacrificing the quality of the image to an unacceptable degree. This is especially important when dealing with large images or when transferring images over networks with limited bandwidth.

There are two main categories of image compression techniques: lossless and lossy compression. Lossless compression techniques preserve all of the image data, while lossy compression techniques selectively discard some data to achieve a smaller file size.

Lossless compression algorithms are effective for images with large areas of uniform color or patterns, but may not be as effective for images with many details. In contrast, lossy compression techniques are more effective for complex images with many details, but can result in a noticeable loss of quality when the compression level is high.

Modern image compression standards, such as JPEG, JPEG 2000, and WebP, combine both lossless and lossy techniques to achieve the best balance between image quality and file size. These standards use advanced algorithms that analyze the image and apply different compression techniques to different parts of the image, depending on the level of detail and importance.

Overall, image compression techniques are essential for storing, sharing, and transmitting digital images efficiently, while still maintaining the desired level of image quality.

CHAPTER 2: NEED OF IMAGE COMPRESSION

Image compression is necessary for several reasons:

- Reducing file size: Images captured by modern digital cameras or created by graphic designers can have very large file sizes. Compressing these images can significantly reduce their file size, making it easier to store, transfer, and share them. This is particularly important in situations where storage space is limited, such as on mobile devices or when uploading images to websites.
- Improving transmission speeds: Large image files can take a long time to upload or download, especially over slow internet connections. Compressed images can be transmitted more quickly, making them more practical for online sharing and communication.
- Saving bandwidth: Image compression can reduce the amount of data needed to transmit an image, which can be particularly important in situations where bandwidth is limited or expensive, such as in developing countries or on mobile networks.
- Improving user experience: Websites and mobile apps that use compressed images can load faster and provide a smoother user experience. This is especially important for online retailers, where slow load times can lead to lost sales.
- Enhancing storage capacity: Compressed images take up less storage space than uncompressed images, allowing more images to be stored on a given device or server. This can be particularly important in situations where large numbers of images need to be stored, such as in digital archives or on e-commerce websites.

CHAPTER 3: DIFFERENT IMAGE COMPRESSION TECHNIQUES

There are several different image compression techniques, which can be broadly categorized into two main types: lossless and lossy compression.

Lossless compression techniques:

- Run-length encoding (RLE): This method replaces consecutive identical pixels with a count and a value, reducing the size of the data without losing any information.
- Huffman coding: This is a variable-length coding technique that assigns shorter codes to frequently occurring pixels and longer codes to less common ones.
- Lempel-Ziv-Welch (LZW) compression: This method replaces frequently occurring sequences of pixels with a single code, reducing the size of the data without losing any information.

Lossy compression techniques:

- Discrete Cosine Transform (DCT): This method transforms the image into a set of frequency coefficients and then discards the high-frequency components, which contain fine details that may not be noticeable to the human eye.
- Wavelet compression: This method decomposes the image into a set of wavelets of different frequencies and scales and discards the high-frequency wavelets, again, these details may not be noticeable to the human eye.
- Fractal compression: This method uses a fractal image compression algorithm to generate a mathematical description of an image and store it as a set of coefficients. The compression ratio can be very high, but the encoding and decoding process can be computationally expensive.

In addition to these techniques, many modern image compression standards use a combination of lossless and lossy compression techniques to achieve the best balance between image quality and file size. Some examples include JPEG, JPEG 2000, and WebP.

CHAPTER 4: SOME MODELS OF IMAGE COMPRESSION

1.Transform coding

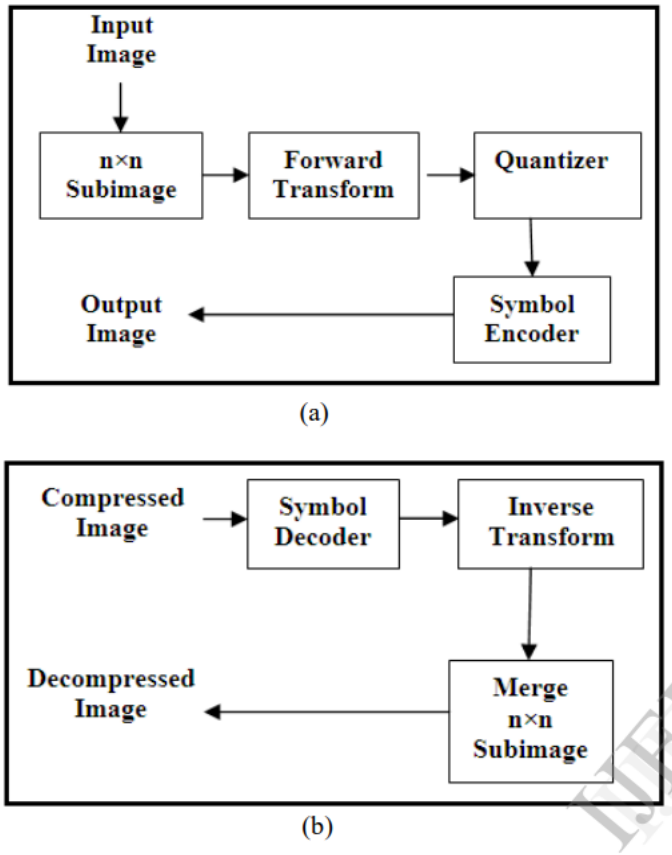

Fig.(a)encoding (b)decoding

Transform coding is most well known form of lossy compression where in original form of the image is subdivided into smaller sub images. For each sub image obtained transform coefficients is calculated which converts the original array of sub image in array of coefficients. The arrays of coefficients are then quantized and obtained output is further treated by image encoding technique which provides the final output representing the encoded image. In decoding process reverse process is applied i.e. the decoded output obtained is dequantized. Decoding process does not provide exactly the same image as original; in other words, information lost during encoding process cannot be recovered. DCT, DFT, WHT etc… are frequently used transforms.

2.Wavelet coding:

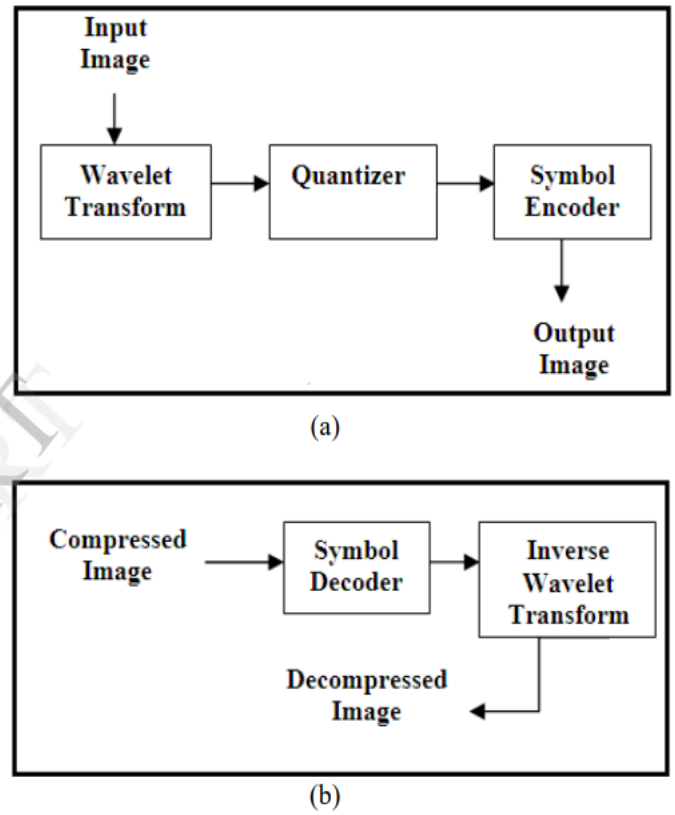

Fig.(a)encoding (b)decoding

Wavelet coding is general used to represent high frequency components in two-dimensional images, like images of star or satellite images by means of smaller amount of information[11].Wavelet Coding is implemented in JPEG 2000.The main purpose of wavelet coding is to store an image of higher dimension in space as small as possible. In encoding process, initially wavelet transform is applied as a result of which, coefficients are obtained where in number of coefficients obtained are equal to number of pixels in the image. After that coefficients are quantized and quantized output pass through encoder that provides final output. In decoding process, Compressed is decoded by decoder followed by inverse wavelet transfer.

CHAPTER 5: IMPLEMENTATION

Source code:

```
import os
import sys
from PIL import Image

def compressMe(file, verbose=False):
    filepath = os.path.join(os.getcwd(),
                            file)
    picture = Image.open(filepath)

    picture.save("Compressed_" + file,
                 "JPEG",
                 optimize=True,
                 quality=5)
    return

def main():
    verbose = False
    if (len(sys.argv) > 1):
        if (sys.argv[1].lower() == "-v"):
            verbose = True
    cwd = os.getcwd()
    formats = ('.jpg', '.jpeg')
    for file in os.listdir(cwd):
        if os.path.splitext(file)[1].lower() in formats:
            print('compressing', file)
            compressMe(file, verbose)
    print("Done")
if __name__ == "__main__":
    main()
```

Explanation of the above code:

This Python code is used to compress JPG or JPEG images in a directory. The compressMe function takes a file name and an optional verbose argument, which is False by default. It opens the image using the Pillow library and saves it with optimized compression and quality set to 5, with a file name prefixed with "Compressed_".

The main function checks for a command-line argument -v to enable verbose output, and then iterates through all the files in the current working directory, and for each file that has a JPG or JPEG extension, it calls the compressMe function to compress it.

Finally, the program prints "Done" to indicate that the compression is complete.

Overall, this code provides a simple way to compress JPG or JPEG images in a directory. However, it could be improved by adding error handling for cases where the input file is not a valid image or when the output file cannot be written.

CHAPTER 6 : RESULTS

Image before compression:

Image after running the above code :

CHAPTER 7 : BENEFITS

There are several benefits of image compression, including:

Reduced file size: Image compression reduces the file size of digital images, making them easier to store, transfer, and share. This is especially important when dealing with large image files such as high-resolution photographs or graphics.

Faster loading times: Smaller image file sizes also mean faster loading times for web pages and other digital media. This is particularly important for websites, where slow loading times can lead to user frustration and abandonment.

Lower storage costs: By reducing the file size of digital images, image compression can help lower storage costs for individuals and organizations. This is especially important for businesses that deal with large volumes of images, such as those in the e-commerce or media industries.

Increased accessibility: Smaller image files are easier to share and access on a variety of devices and networks. This can help improve accessibility to digital media for people with limited internet bandwidth or storage capacity.

Improved user experience: By reducing loading times and increasing accessibility, image compression can help improve the overall user experience for people viewing digital media. This can lead to increased engagement and customer satisfaction for businesses and organizations.

Environmental benefits: By reducing the file size of digital images, image compression can help reduce the amount of energy required to store and transfer data, leading to a more environmentally friendly approach to digital media.

CHAPTER 8 : LIMITATIONS

While image compression techniques offer numerous benefits, they also have some limitations that can impact the quality of the compressed images. Some of the main limitations include:

- Loss of quality: Depending on the compression algorithm and the level of compression applied, image compression can result in a loss of quality, which can be noticeable in some cases. Lossy compression, in particular, can introduce artifacts or distortions in the image.

- Complexity: Modern image compression algorithms are complex and require a lot of computational resources to compress and decompress images. This can limit their use in some applications that require fast processing times, such as real-time video streaming.

- Compatibility: Not all image compression standards are compatible with all devices and software. For example, older devices may not be able to display images compressed using newer standards, and some software may not support certain compression formats.

- Copyright issues: Image compression can make it easier to share and distribute images, which can be a concern for copyright holders who want to control the use of their images.

- Compression ratio limitations: The compression ratio of an image is the ratio of the uncompressed image size to the compressed image size. While modern compression techniques can achieve high compression ratios, there are limits to how much an image can be compressed without a significant loss of quality.

Overall, image compression techniques have limitations that must be considered when deciding whether to use them and which technique to use. It is important to balance the benefits of compression with the potential drawbacks to ensure that the compressed images meet the needs of the intended application.

CHAPTER 9 : CONCLUSION

In conclusion, image compression techniques play a crucial role in reducing the file size of digital images while maintaining an acceptable level of image quality. There are two primary types of compression techniques: lossless and lossy. Lossless compression algorithms compress image data without sacrificing any image quality, whereas lossy compression techniques aim to reduce file size by removing some of the less important image details.

Both types of compression techniques have their advantages and disadvantages, and the choice of compression technique depends on the specific requirements of the application. Modern image compression standards such as JPEG, JPEG 2000, and WebP use a combination of lossy and lossless techniques to achieve the best balance between image quality and file size.

Overall, image compression techniques have enabled the storage, transmission, and sharing of high-quality digital images, which has significantly impacted various fields such as photography, medicine, and entertainment. As technology continues to evolve, it is expected that new and more advanced compression techniques will be developed to meet the growing demand for high-quality images in various applications.

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