An Improved Image Compression Algorithm Based on Daubechies- Wavelets with Arithmetic Coding

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Abstract
In this paper, we present image compression techniques to utilizing the visual redundancy and investigated. To effectively define and utilize image compression context for natural image is difficult problem. Inspired by recent research in the advancements of image compression techniques, we propose Daubechies-Wavelet with arithmetic coding towards the improvement over visual quality rather than spatial wise fidelity. Image compression using Daubechies-Wavelet with arithmetic coding is quite simple and good technique of compression to produce better compression results. In this image compression technique we first apply Daubechies-Wavelet transform then 2D Walsh-Wavelet transform on each kxk where (k=2^n) block of the low frequency sub band. Split all values from each transformed block kxk followed by applying arithmetic coding for image compress.
Index Terms-Image Compression, Daubechies-Wavelet, Arithmetic coding

I. Introduction:

Over the last few years, great improvements have been made in image and video compression techniques driven by a growing demand for storage and transmission of visual information. Once personal computers gained the capacity to display sophisticated pictures as digital image people started to find for efficient representation of these digital images in order to simplify their transmission and low disk storages. The field of image compression has a wide spectrum ranging from classical lossless techniques and popular transform approaches to the more recent segmentation based coding methods. Basically, image compression techniques can be broadly classified into categories (i) lossless and (ii) lossy techniques [1]. The lossless techniques allow compressing an image without losing any information while the images reproduced by the lossy techniques are allow compressing an image with losing some information.

However, there are two mainstream signal-processing-based compression schemes share a common architecture, namely transform followed by entropy coding, where only the statistical redundancy among pixels is considered. Although two decades of development, it has been becoming difficult to continuously improve coding performance under such architecture. Specifically, to achieve high compression performance, more and more modes are introduced to deal with regions of different properties in image coding. JPEG2000 and MPEG-4 AVC/H.264 are two examples that significantly outperform their previous rivals in terms of coding efficiency [2, 3].

Like statistical redundancy visual redundancy in images is also an important to consider by several researchers. In the past few decades, the discrete cosine transform (DCT) has been the most popular for compression because it provides optimal performance and can be implemented at a reasonable cost. Several compression algorithms, such as the JPEG [2] for still images and the MPEG [3] for images are based on DCT [4]. Thus, the human vision system has been incorporated into compression schemes in [4] and [5], trying to remove some visual redundancy and to improve coding efficiency as well as visual quality. Moreover, attempts have been made to develop compression techniques by identifying and utilizing features within images to achieve high coding efficiency.

In the framework of image compression, the main stages in the image compression is transform and quantization, modeling and ordering, and the third stage is entropy coding and post processing. Previous works show that the method of modeling and ordering is very important to design a successful algorithm of image compression. We are going to propose a new algorithm based on a novel scheme of modeling and ordering in wavelet domain pixel classification and sorting [6].

DWT has the ability to solve the blocking effect introduced by DCT, it also reduces the correlation between the neighboring pixels and gives multi scale sparse representation of the image. In spite of providing excellent results in terms of rate-distortion compression, the transform-based coding methods do not take an advantage of the underlying geometry of the edge singularities in an image.

There have been many attempts to design next generation image coding techniques that exploit the geometry of the edge singularities of an image. Recently, many image compression algorithms such as the Bandelets [7], the

Prune tree [8], and the GW image coding method [9] based on the sparse geometric representation have been introduced. Rest of the papers is organized as follows: section 2 we discussed about some related terms to compression whereas in section 3 we present our proposed method of Daubechies-Wavelet based image compression with arithmetic coding. We deals results and comparison of proposed method in section 4 and section 5 contains conclusion and future work.

II. Some Related Terminology:

The discussion of Wavelet based image compression will be based on Daubechies-Wavelet and uniform scalar quantization. Daubechies-Wavelet provides us Wavelet based representation of an natural image, which is also the structure used in the EZW [10] and SPIHT [11] algorithms finally we will compare results obtained by proposed method and results of EZW [10] and SPIHT [11] algorithms. The linear correlation in wavelet domain is assumed negligible. However, nonlinear correlation, such as magnitude and sign redundancy [12], is still possible. To exploit the visual redundancy, the method of modeling and ordering in wavelet domain is very important.

In the image compression significance coding, unknown pixels will be classified and coded based on the information provided by the known pixels and the linear or non-linear correlation within the unknown pixels. This is the concept of pixel classification or removal of redundant data in significance coding of image compression [13]. There are two kinds of pixel classifications in significance coding, either explicitly or implicitly, to exploit the intraband and interband correlation in Wavelet domain.

III. Proposed Method:

Major steps of our proposed method for image compression summarizing following steps:

1. Select the input image.
2. Choose the Daubechies-Wavelet which is used for compression e.g. dbN.
3. Set both quantization factor parameters, which is denoted by qf_1 and qf_2 from standard parameter set.
4. Set the compression ratio factor (CRF) from range 1-10.
5. Apply Walsh Wavelet transform for transform, and then using arithmetic coding for compress an image.

Step 5 consists of the following:

   5.1. Two Levels Discrete Wavelet Transform.
   5.2. Apply 2D Walsh-Wavelet Transform on each *k*x*k* block of the low frequency subband.
   5.3. Split all values form each transformed block *k*x*k*.
   5.4. Compress each sub-band by using Arithmetic coding, the first part of Walsh Wavelet compression steps for high frequency, domains, and then second part of Walsh Wavelet compression steps for low frequency.

6. Output image obtained by the compression.

Flow chart of our proposed method is given below:

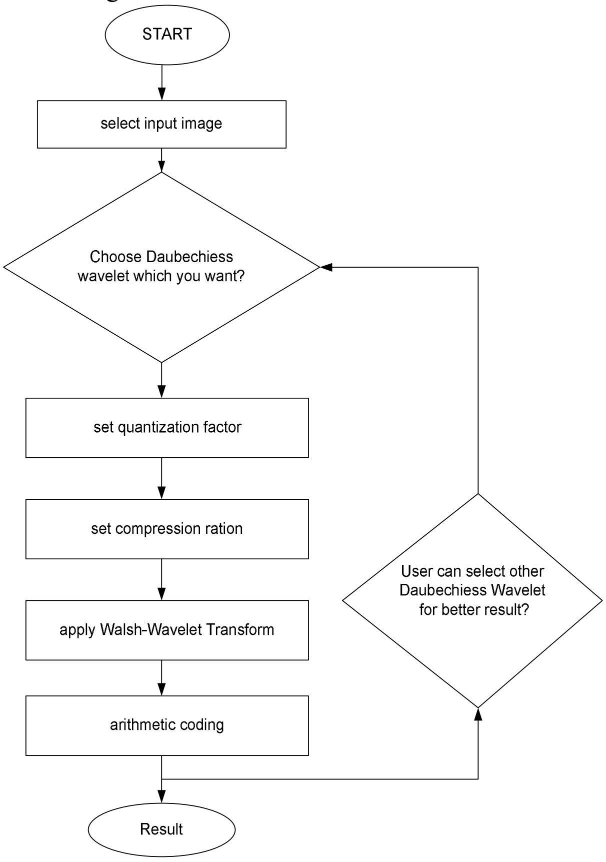

Figure 6.1: Flow chart of proposed method

IV. Results and Analysis:

Results using proposed method (with some Daubechies-Wavelets) for image compression are given below:

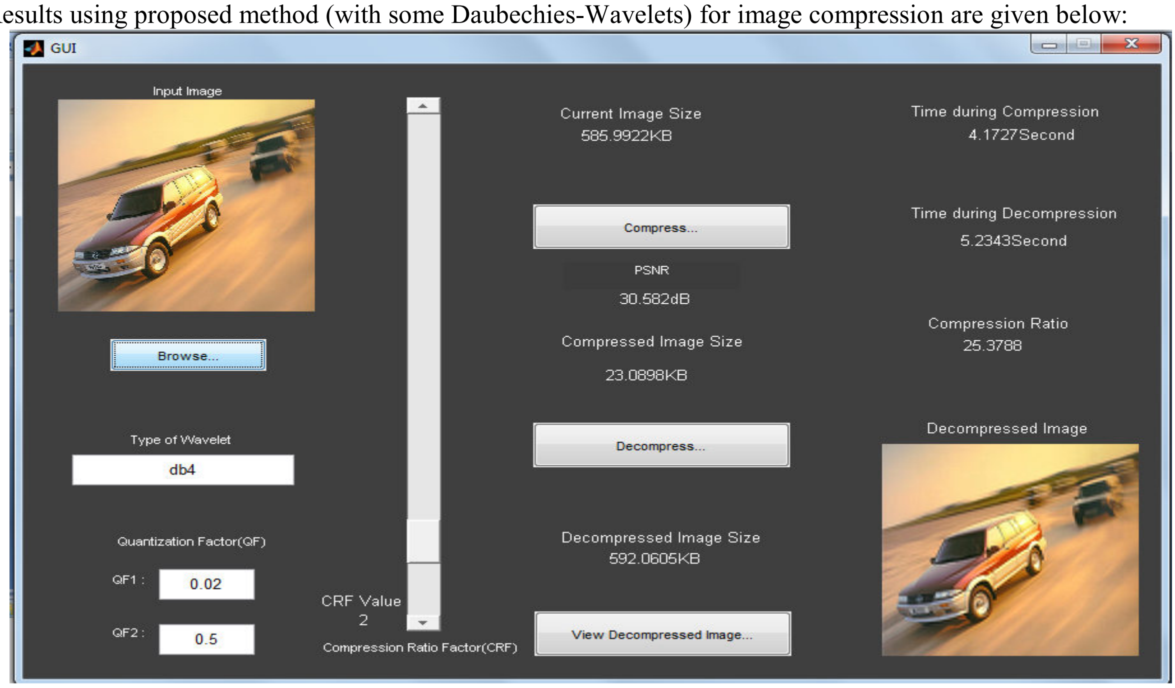

Figure 6.2: Image compression using db1 wavelet PSNR=31.1935dB,Compression Ratio=25.9903

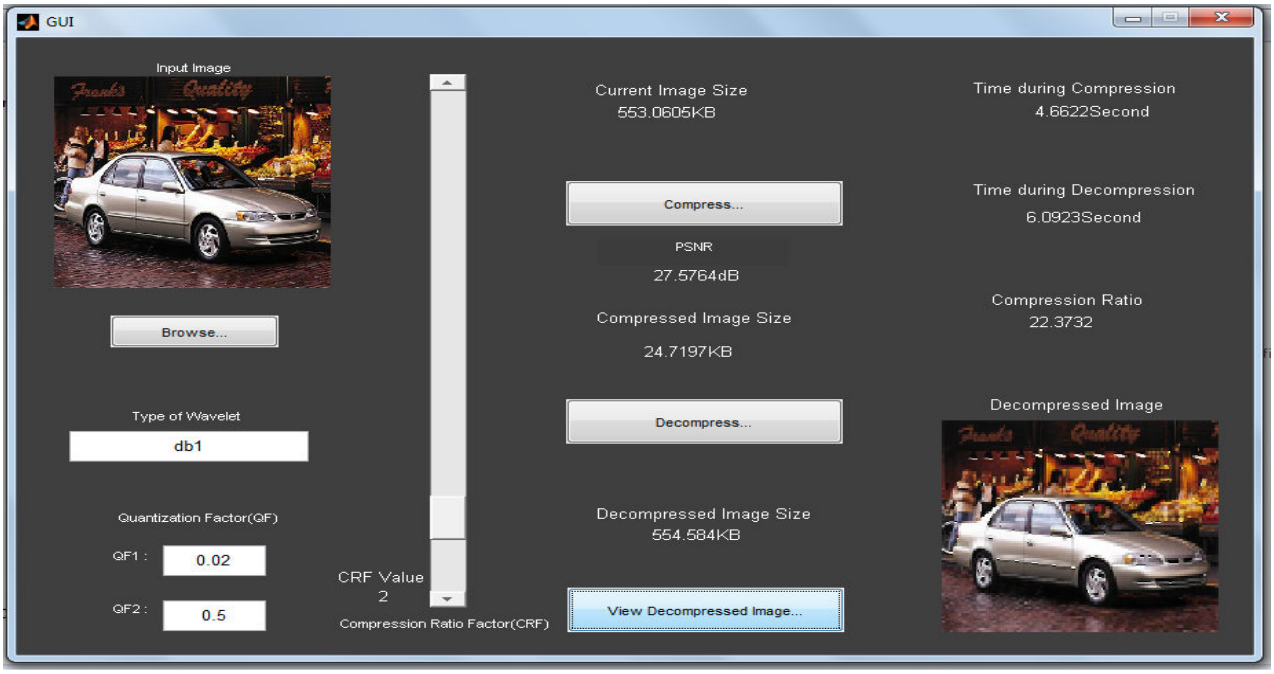

Figure 6.2: Image compression using db3 wavelet PSNR=27.5764db, Compression Ratio=22.3732

Table 1: Comparison of PSNR results for car 1240 x 1200 images

Methods	**Compression Ratio**		
	256:1	128:1	64:1
EZW [10]	25.38	27.54	30.23
SPHIT [11]	26.10	28.30	31.10
GW [12]	26.64	28.72	31.22
Proposed Method	27.57	28.82	30.88

V. Conclusion and Future Work:

In this paper, we present an image compression framework that adopts Daubechies-Wavelets with arithmetic coding techniques to remove redundancy from images. Wavelet decomposes a signal into a set of basis functions these basis of function are called wavelets. In this correspondence, we have proposed an improved image compression algorithm. Due to the delivered assistant information, our presented framework is able to remove enough regions so that the compression ratio can be greatly increased. Our presented Daubechies-Wavelets with arithmetic coding method is capable in effectively restoring the removed regions for good visual quality, as well. For a kxk transform matrix T, element of each row of T is repeated k times to generate k- Mother waves. In future we can extend this method for image compressing from input image by using interactive compression techniques and different transform apply on these techniques as well as using different discrete wavelet like produce better results with minimizing noise to improve the compression. Furthermore, image compression is still a challenging problem when some kinds of assistant information are provided, into which we need to put more effort in the future.

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