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"ANALYSIS OF IMAGE COMPRESSION USING OPTIMIZATION TECHNIQUES"

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ABSTRACT

In this modern scenario, everyone requires products at cheap rate with miniaturization. Till now this is applicable only for electronic circuits. But with the growing needs of the users it is also applied to the digital images. We can easily transmit multimedia information through web network. Now a days, use of camera, transformation and manipulation of images is grown explosively. These digital picture files are huge in size and take large part of memory. While transmitting and receiving signal they waste enormous bandwidth which is a main constraint for us. Here we present comparative analysis of image compression techniques with different standard image like cartoon image, ship image and watch image, our proposed method gives better results than the previous technique and enhanced the quality of an image.

Key Words: *Image Processing, Image compression, JPEG, Optimization techniques, Artificial intelligence*

I. Introduction

Based on the simplification of light reflection, an observed image can be modeled as the product of the illumination and the reflectance [1]. Many methods that decompose an image into the illumination and the reflectance have been used in a series of applications, such as contrast enhancement, non-uniform illumination images enhancement tone mapping, remote sensing image correction, image segmentation and target selection and tracking etc. Image edge-preserving decomposition algorithms can be divided into two categories: local filter based and global optimization based Median filter [1].

A well-known de-noise filter, can be used as an edge-preserving decomposition filter. An iterative median filter was used as an edge-pre-serving decomposition tool in a generalized unsharp masking algorithm. The median filter, a well-known local image operator, is frequently adopted for image denoising or smoothing purposes. Median filtering has the reputation of good edge preserving ability, and does not introduce new pixel values to the processed image. However, median filtering also has the shortcoming to degrade the image quality, causing undesired image blurring. Besides, image anti-forensic researchers pointed out the destructive nature of median filtering to other image processing footprints, e.g., hiding traces of image resampling and disguising JPEG blocking artifacts. Therefore, the presence of median filtering traces, not only suggests the image has been previously median filtered, but also implies the possibility that other image processing operations may have been applied to the image.

The proposed optimization problem is constituted of a first term describing median filtering process based on image convolution, an additional image fidelity term with respect to the median filtered (MF) image, and at last an image prior term modeling the image derivatives using the generalized Gaussian distribution [4]. The achievement of the proposed

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method is two-fold: (i) improving the visual quality of MF images (with a certain parameter setting) as an image quality enhancement method, and (ii) fooling existing median filtering forensic detectors (with another parameter setting and an additional pixel value perturbation procedure) for anti-forensic purposes. Bilateral filtering (BF) combines a range filter with a domain filter to preserve edges. It is a simple and widely used local weighted average filter, but it may exhibit gradient reversal artifacts near some edges when used for detail enhancement. A guided image filter (GIF) derived from a local linear model can avoid the gradient reversal artifacts, thus it out-performs the BF. The computational cost of all the local filters is low. However they suffer from halos near some edges [5]. The total variation filter uses an norm based regularization term to remove noises in images, which is also considered as an edge-preserving decomposition algorithm. Weighted Least Squares (WLS) based multi-scale decomposition algorithm decomposes an image to two layers by solving a weighted least square optimization problem. To effectively decompose illumination and reflectance from one single observed image, most of the above methods use the logarithmic transformation for pre-processing not only to reduce the computational complexity but also to simulate human vision perception mechanism, such as Weber's law [3]. However, since the logarithmic transformation suppresses the variation of gradient magnitude in bright regions, solving the ill-posed problem in the logarithmic domain may lead to loss of finer structural details in these areas. Meanwhile, many existing methods solve the ill-posed problem using priors on either illumination or reflectance. In other words, different regularization terms of illumination and reflectance are not fully utilized to solve this problem. Histogram Equalization can be named as one of the popular contrast enhancement techniques available in literature [6].

Gray levels of the image, will be transformed based on the probability distribution of gray levels in the input image. Although it is a simple algorithm, it is highly effective. Global Histogram Equalization (GHE) is capable of remapping the dominating high frequency gray levels in a way that the stretching procedure will be restricted to those levels. Thus, significant contrast loss for the rest of the image will be occurred. Contrary to GHE, Local histogram equalization (LHE) tries to eliminate such problems. It uses a sliding mask through every pixel of the image. Thus, it makes use of the local information remarkably. However, LHE requires high computational cost and sometimes causes over-enhancement in some portions of the image. Not only it causes the over-enhancement in some parts, but also the noises along with the image can be enhanced. Although, LHE solve some of the GHEs issues with its local approaches, yet, these methods produce an undesirable checkerboard effects on enhanced images [4]. Local enhancement method applies transformation on a pixel considering intensity distribution among its adjacent neighboring pixels. Adaptive histogram equalization (AHE) is a local enhancement method which presents appropriate results on medical images. However, AHE is quite expensive [4]. Contrast enhancement is acquiring clear image through brightness intensity value redistribution. In other words, that is enhancing features as stretching interval between dark and brightness area. Enhanced image which was result of contrast enhancement processing in preprocessing stage will provide clear image to eyes or assist feature extraction processing in computer vision system. Contrast factor is one of the factors of low or good quality images. An image cannot be said to be of good quality when it has very low contrast or too high contrast. However, the quality of low contrast images can be improved by using global contrast enhancement or local contrast enhancement [5]. Low contrast image can be improved in its quality globally by using global contrast enhancement and the information is more defined globally as compared to the original image [5]. And the quality of low contrast image can be improved regionally by using local contrast enhancement and the local details are shown more distinctly as compared to the original image.

II. IMAGE COMPRESSION

In this Modern era, the population is increasing rapidly, due to which the consumption of the resources and the generation of digital data is growing day by day. In earlier days, the most of the medical imaging test is carried out over the radiological films, but now all of the tests are carried out digitally because of the evolution and the improvement in the medical technology which increases the quantity of digital medical data in last few decades. Nowadays, the electronic health record (EHR) systems are adopted by nearly 84 % of the hospitals as per the report of the office of the National Coordinator for Health Information Technology (ONC). EHR systems are able to store every possible digital information such as demographic information, diagnoses, laboratory tests, radiological images, and clinical notes, results and prescriptions of the patient related to its treatment. In medical field, the generation of the digital data in the form of Magnetic Resonance Imaging (MRI), Computed Tomography (CT), Ultrasound (US), Electrocardiography

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(ECG), Electroencephalograph (EEG), X-rays and Mammograms, etc. are increasing rapidly, so there is a need for the effective storage and the transmission of this digital data. So, most of the researchers are working in the domain of medical healthcare to provide effective and efficient compression techniques so the size of the digital data can be reduced without compromising its quality for the efficient storage and transmission.

The compression methods are able to process a large set of images or volumetric data for the fast interactivity, searching context dependent images and for quantitative analysis of the data. The performance of the compression approaches must a good so that, they are able to tackle the limitation of the bandwidth usage and storage. The researchers reported a great number of techniques for the compression of medical images and these techniques are mainly classified into three main categories: lossy, lossless and hybrid compression techniques. The lossy compression is the mechanism which compresses the image with loss of data whereas in lossless there is no loss of the data hence this mechanism used when the information is critical and no loss is acceptable i.e. it is widely used for the medical image compression. Hybrid compression techniques consist of two or more compression techniques to achieve the effective compression of the image. In lossless compression, the image we get after the compression is identical to the original image but in lossy compression, there is degradation of the quality of the image after compression. The major purpose for the designing of these compression techniques is to compress the images with best possible visual quality, reduced size and no or little loss of the information. The compression techniques have a wide range of applications because of the effective and efficient results, the compression techniques can be applied to the areas of the genetics, satellite imaging, medical imaging and many more.

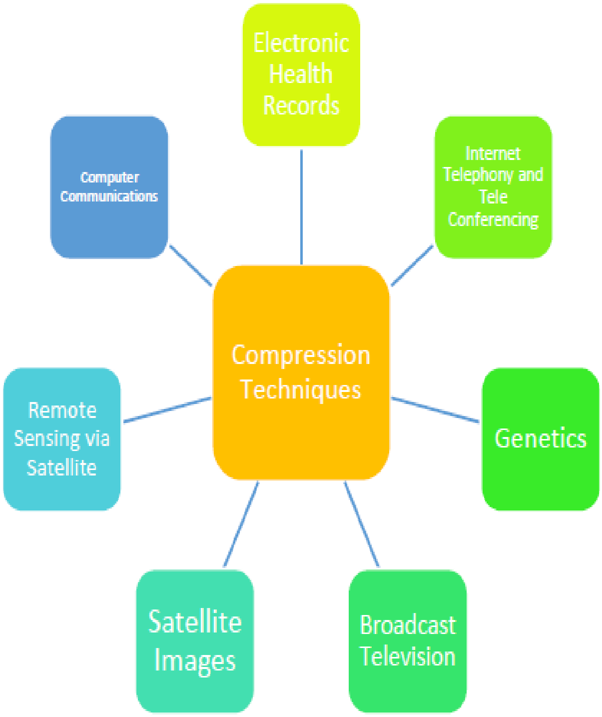

Fig 1: Various application areas of the compression techniques.

III. PROPOSED WORK

Large amounts of attentions have been paid to various techniques of Internet service and multimedia signal transmission for many years, which not only provide us a convenient manner of communication but also give us many choices for our life style. Meanwhile, the bandwidth of Internet has been accelerated and more stable transmission service is guaranteed by these developments. A unique property of document images is that they consist of regions with distinct characteristics, such as text, picture and background. Typically, text requires high spatial resolution for legibility, but does not require high color resolution. On the other hand, continuous-tone pictures need high color

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resolution, but can tolerate low spatial resolution. Therefore, a good document compression algorithm must be spatially adaptive, in order to meet different needs and exploit different types of redundancy among different image classes. Traditional compression algorithms, such as JPEG, are based on the assumption that the input image is spatially homogeneous, so they tend to perform poorly on document images.

Particle Swarm Optimization (PSO) is a popular swarm intelligence algorithm that is used to minimize a cost function (or maximize a fitness function) in a multidimensional space. PSO uses multiple particles, with the velocity of each particle updated based on costs evaluated and shared by the entire swarm. PSO has been used successfully in many different tasks, including artificial neural network training, scheduling problems, and calibration problems. Optimization commonly takes place in a synthetic environment, where virtual particles are allowed to roam without any physical constraints. The PSO algorithm itself has multiple parameters, and many studies have provided design guidelines for selecting these parameters to ensure both stability and rapid convergence [6–10]. These studies have made several assumptions. The non-stagnant distribution assumption model is so far the closest to completely describing PSO, and the study employing it was able to prove order-1 and order-2 stability of the algorithm. These orders of stability show that over time, both the expected position of a particle and its variance converge to a constant. All the existing analyses study the evolution of the swarm as a whole, and there are no studies of the short-term behavior of each particle.
Since the introduction of the PSO several variations have been presented. Here we will only explain in detail how the original one works and then summarize two variants. Remember that the main concept is that we have particles of a swarm moving in a problem space and evaluating their positions through a fitness function. Once a problem space is defined a set of particles is spawned in it and their positions and velocities are updated iteratively according to the specific PSO algorithm. Even though PSO has been proven to be an efficient algorithm with good results it is not by design one that guarantees that the best solution is found, since it relies on visiting and evaluating problem space positions. Even though many variations exist usually all have a fitness function. The specification of this function depends on the problem being optimized (especially in its dimensions) and as such we will simply refer to it as f(xi) being the short for f(xi,0, ..., f(xi,d). This function represents how good the i particle's position in the multidimensional space is relatively to the desired goal. With this it weights and binds the D dimensions to be optimized, given a problem modeled as an optimization one of d dimensions. By being a multi-dimensional algorithm, the positions and velocities of the particles we manipulated will then have d components, so we have positions as xi(xi,0, ..., xi,d) and velocities as vi(vi,0, ..., vi,d).

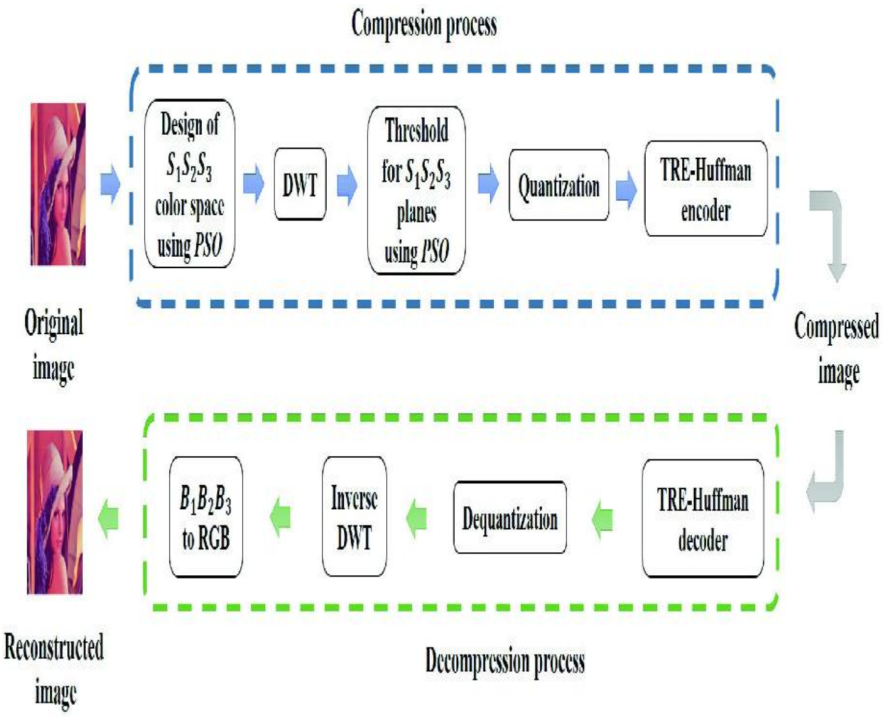

Fig 2: Proposed model block diagram using particle swarm optimization.

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IV. EXPERIMENTAL WORK

In this section the experimental process of image compression is performed with previous and proposed method. This process of image compression is done by using two methods that are with discrete wavelet transformation and proposed work using particle swarm optimization techniques.

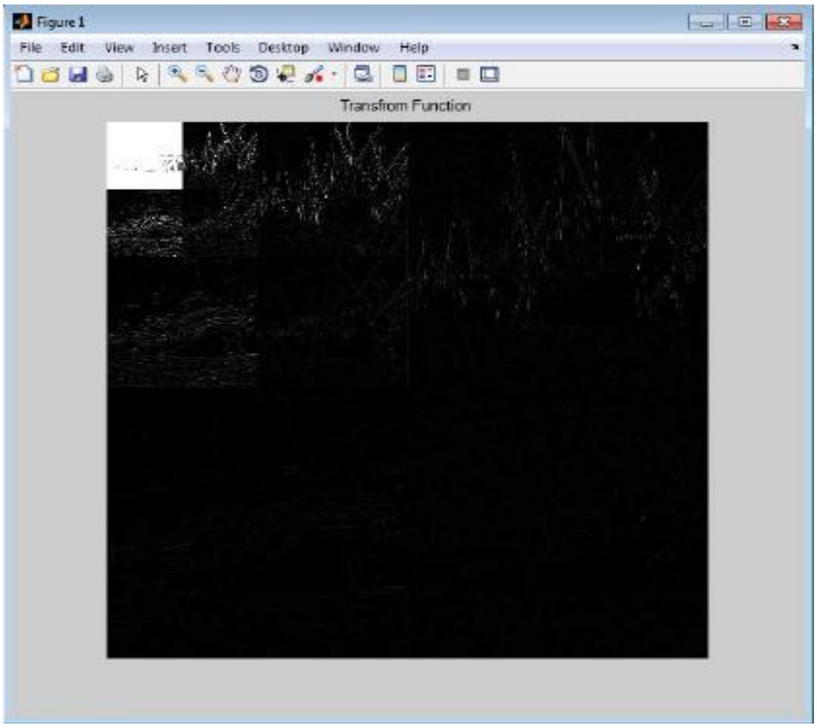

Fig 3: This picture presents the ship input image transform function for the experimental work.

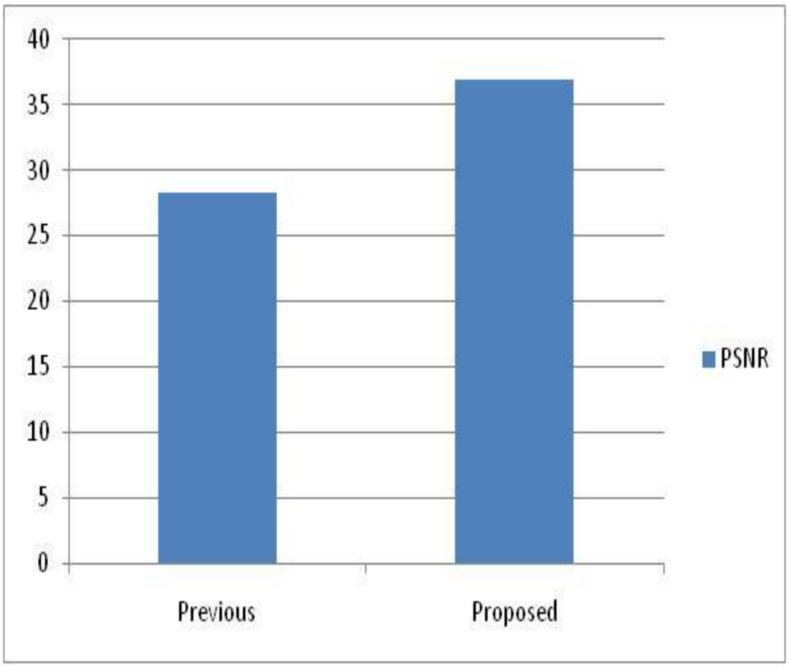

Fig 4: The above figure represents the PSNR value for the watch input image using previous and proposed method.

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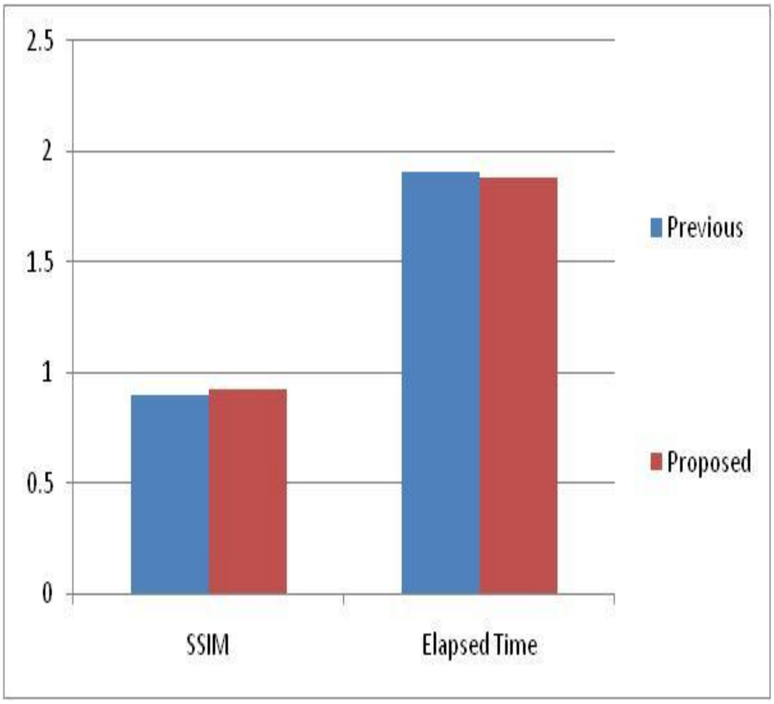

Fig 5: The above figure represents the SSIM and elapsed time value for the watch input image using previous and proposed method.

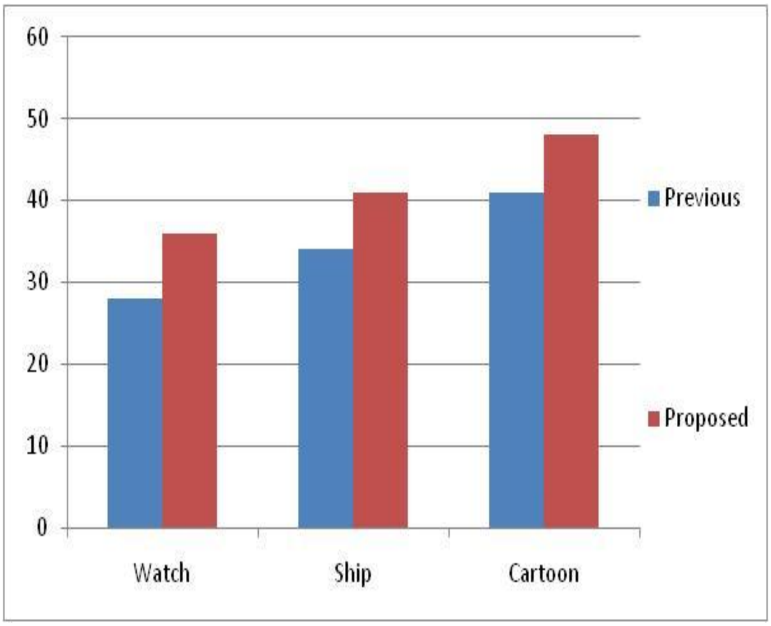

Fig 6: The above figure represents the PSNR value for the watch input image and, ship input image and, cartoon input image using previous and proposed method.

V. CONCLUSION

With the advent of modern publishing technologies, the layout of today's documents has never been more complex. Most of them contain not only text and background regions, but also graphics, tables and pictures. Therefore scanned documents must often be segmented before other document processing techniques, such as compression or rendering, can be applied. Nowadays, as a common and effective information carrier, a color image has penetrated into every corner of social life, which leads to our increasing demand for image processing, e.g., color image classification or

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color image forensics. Classification techniques enable computers to replace human beings to complete classification tasks. Forensics technology ensures the security of image information. In real life, most color images are stored in JPEG format. If an image is tampered with, it will undergo decompression, and then compressed to form a double JPEG compressed image. Therefore, double JPEG compression is an inevitable process in image tampering.

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