Image enhancement is among the simplest and most appealing areas of digital image processing. Basically, the idea behind enhancement techniques is to bring out detail that is obscured, or simply to highlight certain features of interest in an image. The multi-spectral remote sensing images carry essential integrating spectral and spatial features of the objects [3]. In this paper, the multi-spectral three-band data of the Jabalpur region and seven-band data of the other region are used to calculate the percentage of vegetation present in the image using enhancement and without enhancement technique. Therefore the extracted feature can be available to the public for further analysis in order to avoid any sort of natural disasters like floods and earthquakes. Remote sensing is a technology used for obtaining information about a target through the analysis of data acquired from the target at a distance [5]. It is composed of three parts: (a) targets, objects or phenomena in an area; (b) data acquisition through certain instruments; and (c) data analysis by some devices. The derived data have been acquired by the use of electromagnetic radiation (EMR) in one or more regions of the electromagnetic spectrum. The multi-spectral remote sensing images carry essential integrating spectral and spatial features of the objects [3]. In this paper, the multi-spectral three-band data of the Jabalpur region and seven-band data of the other region are used to calculate the percentage of vegetation present in the image using enhancement and without enhancement technique. Therefore the extracted feature can be available to the public for further analysis in order to avoid any sort of natural disasters like floods and earthquakes. Remote sensing is a technology used for obtaining information about a target through the analysis of data acquired from the target at a distance [5]. It is composed of three parts: (a) targets, objects or phenomena in an area; (b) data acquisition through certain instruments; and (c) data analysis by some devices. The derived data have been acquired by the use of electromagnetic radiation (EMR) in one or more regions of the electromagnetic spectrum.
A familiar example of enhancement is shown in Fig. 1 in which when we increase the contrast of an image and filter it to remove the noise “it looks better.”

**B. Adaptive Histogram Equalization method**

This is an extension to traditional Histogram Equalization technique. It enhances the contrast of images by transforming the values in the intensity image $I$. Unlike HISTEQ, it operates on small data regions (tiles), rather than the entire image. Each tile's contrast is enhanced, so that the histogram of the output region approximately matches the specified histogram. The neighbouring tiles are then combined using bilinear interpolation in order to eliminate artificially induced boundaries. The contrast, especially in homogeneous areas, can be limited in order to avoid amplifying the noise which might be present in the image.

**C. Dualistic sub-image histogram equalization method**

The original image is decomposed into two equal area sub-images based on its gray level probability density function in this novel histogram equalization technique. Then the two sub-images are equalized respectively.

**D. Dynamic histogram equalization for image contrast enhancement**

It employs a partitioning operation over the input histogram to chop it into some sub histograms so that they have no dominating component in them. Then each sub-histogram goes through HE and is allowed to occupy a specified gray level range in the enhanced output image. Thus, a better overall contrast enhancement is gained by DHE with controlled dynamic range of gray levels and eliminating the possibility of the low histogram components being compressed that may cause some part of the image to have washed out appearance.

**II. Background**

One of the first applications of digital images was in the newspaper industry, when pictures were first sent by submarine cable between London and New York. Introduction of the Bartlane cable picture transmission system in the early 1920s reduced the time required to transport a picture across the Atlantic from more than a week to less than three hours.
Specialized printing equipment coded pictures for cable transmission and then reconstructed them at the receiving end. Some of the initial problems [9] in improving the visual quality of these early digital pictures were related to the selection of printing procedures and the distribution of intensity levels. Thus, the history of digital image processing is intimately tied to the development of the digital computer. In fact, digital images require so much storage and computational power that progress in the field of digital image processing has been dependent on the development of digital computers and of supporting technologies that include data storage, display, and transmission.

A. Linear Contrast Enhancement

This type referred to a contrast stretching, linearly expands the original digital values of the remotely sensed data into a new distribution. By expanding the original input values of the image, the total range of sensitivity of the display device can be utilized. Linear contrast enhancement also makes subtle variations within the data more obvious. These types of enhancements are best applied to remotely sensed images with Gaussian or near-Gaussian histograms, meaning, all the brightness values fall within a narrow range of the histogram and only one mode is apparent. There are three methods of linear contrast enhancement:

B. Min-Max Linear Contrast Stretch

When using the minimum-maximum linear contrast stretch, the original minimum and maximum values of the data are assigned to a newly specified set of values that utilize the full range of available brightness values. Consider an image with a minimum brightness value of 45 and a maximum value of 205. When such an image is viewed without enhancements, the values of 0 to 44 and 206 to 255 are not displayed. Important spectral differences can be detected by stretching the minimum value of 45 to 0 and the maximum value of 120. This method is applying with respect to image application type.

C. Percentage Linear Contrast Stretch

The percentage linear contrast stretch is similar to the minimum-maximum linear contrast stretch except this method uses specified minimum and maximum values that lie in a certain percentage of pixels from the mean of the histogram. A standard deviation from the mean is often used to push the tails of the histogram beyond the original minimum and maximum values.

D. Piecewise Linear Contrast Stretch

When the distribution of a histogram in an image is bi or trimodal, an analyst may stretch certain values of the histogram for increased enhancement in selected areas. This method of contrast enhancement is called a piecewise linear contrast stretch. A piecewise linear contrast enhancement involves the identification of a number of linear enhancement steps that expands the brightness ranges in the modes of the histogram.

II. OVERVIEW OF DCT

The term “transform” means to change form or appearance. In terms of signal processing, a transform is normally a tool that is used to convert the signals from time domain or spatial domain to the frequency domain.
There are various instances when it is pertinent to have the signal in the time domain and on the other instances it is important to have the signal in the frequency domain. For most of the image processing purposes it is better to have the signal in the frequency domain. In others words, a transformation can be described as the process of mapping the correlated data to no-correlated data. Each pixel in an image is correlated with its neighbour pixels.

DCT has been a very popular transform for many years. The fact that DCT is a near optimal transform is the main reason for its popularity. The optimal transform up to now is Karhunen Loeve Transform (KLT). Even though it is optimal, it’s not widely adopted due to the fact that it is very expensive and slow. There have been some new algorithms proposed to improve the KLT to make it less expensive[14][15], still the complexity in KLT is very high. DCT, the closest to KLT, is much faster to compute which has been the main driving force behind its popularity. DCT is also very closely related to the Discrete Fourier Transform (DFT).

Fig. 6. Taken from [16] shows a transformation system

It is actually possible to compute DCT using DFT [9]. The main difference between DCT and DFT is that DCT only has real values and it is comparatively easier to compute. Before formally describing the functioning to DCT, it will be beneficial to discuss the main parts of an image encoder and a decoder. Figure 6 shows the main parts of a transformation system.

As described in the introduction section, image compression is sometimes lossless and at other times lossy. In lossy compression some of the information is lost. The aim of any compression technique is to reduce the redundant amount of information from the signal during the compression process. There are mainly three kinds of redundancies in images that are exploited in the process of compressing images.

![Diagram of transformation system]

![Diagram of transformation system]

The DCT was for the first time used in 1974 [6]. The DCT coefficients can be quantised using visually weighted quantisation values. DCT is a fast algorithm similar to fast Fourier transform (FFT) [7]. The DCT is a technique for converting a signal into elementary frequency components. It is widely used for extracting the features [7].

\[
y(u, v) = \sqrt{\frac{2}{M}} \sum_{v=0}^{N-1} \alpha_v x(m, n) \cos \left(\frac{(2m + 1)u\pi}{2M}\right) \cos \left(\frac{(2n + 1)v\pi}{2N}\right)
\]

where

\[
\alpha_v = \begin{cases} 
\frac{1}{\sqrt{2}} & v = 0 \\
1 & v = 1, 2, ..., N - 1
\end{cases}
\]

\[
\alpha_u = \begin{cases} 
\frac{1}{\sqrt{2}} & u = 0 \\
1 & u = 1, 2, ..., N - 1
\end{cases}
\]

The image is reconstructed by applying inverse DCT operation according to the following equation.

\[
x(m, n) = \sqrt{\frac{2}{M}} \sum_{u=0}^{M-1} \sum_{v=0}^{N-1} \alpha_u \alpha_v y(u, v) \cos \left(\frac{(2m + 1)u\pi}{2M}\right) \cos \left(\frac{(2n + 1)v\pi}{2N}\right)
\]
Since the two-dimensional (2D)-DCT can be computed by applying 1D transforms separately to the rows and columns; it means that the 2D-DCT is separable in two dimensions [6][7].

III. LITERATURE REVIEW

In this section, we are presenting the research work of some expert authors in the same field and explaining a short description of various techniques used for image enhancement.

In 2011 [18] D.T.; Nguyen, T.Q., "Localized filtering for artifact removal in compressed images," proposed a novel method for coding artifact reduction in compressed images. For removing blocking artifacts, a localized DCT-based filter with condition on the similarity between surrounding blocks is considered. To reduce ringing, a localized fuzzy filter is utilized to avoid the blurry effect of linear filter and painting-like effect of conventional fuzzy filter. To enhance chroma components and reduce the colour bleeding, the localized filter for luma component are implemented for the chroma components. Simulations on a wide range of compressed images are performed to verify the effectiveness of the algorithm.

In 2011 [19] Fengjiao Jiang; Kun He, "Colour Image Enhancement Based on Sparse Representation," worked image enhancement is used to improve quality of images for further analysis. In this paper, we proposed a colour image enhancement method with the use of sparse representation of orthogonal transform based on the characteristics of discrete cosine transform (DCT) coefficients: fewer nonzero coefficients exist in smooth domains, the amplitudes of DCT change slightly in texture contents but significantly in edge. Nonlinearly reduces the impact of textures with the use of the threshold on DCT coefficients, and then enhances the texture and edge regions by applying the a-power computation on nonzero coefficients in medium and high frequency domains. To remove blocky effects, Kaiser window function is used on each processed image block. Compared with traditional method, this image enhancement algorithm achieves better visual effects, while the noise in texture region is restrained at the same time.

In 2011 [20] Junjun Xia; Panetta, K.; Agaian, S., "Colour image enhancement algorithms based on the DCT domain," presented a novel modified multi scale contrast enhancement (MMCE) technique for colour image enhancement based on manipulating the DCT coefficients. Modified multi contrast enhancement (MCE) is an improved version of multi contrast enhancement by redefining the frequency spectral bands and introducing more band enhancement techniques to achieve a better performance. This paper also uses an image contrast measure SDME to choose the optimal parameters and to demonstrate the effectiveness of the methods. Computer simulations and analysis are shown that the presented method outperforms the commonly used methods such as Retinex and the original MCE for most images.

In 2012 [21] Bhandari, A.K.; Kumar, A.; Singh, G.K., "SVD Based Poor Contrast Improvement of Blurred Multispectral Remote Sensing Satellite Images," analyzed the satellite images by using discrete cosine transform and singular value decomposition. The proposed technique presents an advance multiband satellite colour, contrast improvement technique of a poor-contrast satellite images. The input image is decomposed into the two frequency sub bands by using DCT and estimates the singular value matrix of the low "low sub band image and then it reconstructs the enhanced image by applying inverse DCT. This technique is useful for the betterment of the INSAT as well as LANDSAT satellite image for the feature extraction purpose. The singular value matrix represents the intensity information of the given image and any change on the singular values change the intensity of the input image. The proposed technique converts the image into the DCT-SVD domain and after normalizing the singular value matrix, the enhanced image is reconstructed by using IDCT. The visual and quantititative results suggest that the proposed DCT-SVD method clearly shows the increased efficiency and flexibility of the proposed method over the exiting methods such as the Decor relation Stretching, Linear Contrast Stretch, GHE and DWT-SVD based techniques. The experimental results show the superiority of the proposed method over conventional methods.
<table>
<thead>
<tr>
<th>Year</th>
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<td>D.T.; Nguyen, T.Q.</td>
<td>Localized filtering for artifact removal in compressed images</td>
<td>localized DCT-based filter, localized fuzzy filter</td>
<td>Enhanced chroma components and reduce the colour bleeding</td>
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<td>2011</td>
<td>Fengjiao Jiang; Kun He</td>
<td>Colour Image Enhancement Based on Sparse Representation</td>
<td>Sparse representation of orthogonal transform based on the characteristics of discrete cosine transform (DCT) coefficients</td>
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<td>2011</td>
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<td>2013</td>
<td>Sengar, P.S.; Rawat, T.K.; Parthasarathy, H.</td>
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<td>This colour enhancement technique that provides very good enhancement</td>
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In 2012 [22] Xiaoxiang Zou; Gaochao Li; Ming Chen; Shupeng Wang; Yongjian Wang; Guangjun Wu, "An improved method to image copy detection.\textdagger\textdagger, proposed a novel method to detect image copies based on DCT coefficients and ordinal measure. This method had a good ability to resist various signal and local geometric manipulations. However, Kim's method was based on block units, which would lead to an insufficient precision. In order to solve the problem, on the basis of Kim's method, we use an extended feature set which takes advantage of prior information to detect more attack types and the comparison of fine-grained edge information which can improve retrieval precision to further perfect Kim's method. Experimental results show the improved method not only detects all copies that Kim can detect, Such as histogram equalization, contrast enhancement, water colouring, motion blurring, mosaic tiling, Gaussian noising, resizing, rotate with 180\textdegree and so on, but also significantly improves retrieval precision.

In 2013 [23] Sengar, P.S.; Rawat, T.K.; Parthasarathy, H., "Colour image enhancement by scaling the discrete wavelet transform coefficients.\textdagger\textdagger, presented a performance based comparison of some of the major compressed domain colour image enhancement techniques with special emphasis on the Colour Enhancement By Scaling the DCT Coefficients technique [CES-DCT] and Colour Enhancement By Scaling the Wavelet Transform Coefficients technique [CES-DWT]. The CES technique is found to be simple but more effective than some of the existing enhancement techniques suggested earlier. The novelty of the CES technique is that it treats the chromatic components, while previous techniques treated only the luminance component. The CES-DWT utilizes the advantages of the wavelet transform and is found to be capable of improving both global and local contrast as well as preserving colour consistency.
The results of all previous compressed domain enhancement techniques along with that of the CES are compared with respect to those obtained by applying a spatial domain colour enhancement technique that provides very good enhancement. The CES-DWT technique is found to provide better enhancement compared to other compressed domain based approaches (even better than CES-DCT) and is computationally more efficient than the spatial domain based method.

IV. PROPOSED METHODOLOGY

In the previous sections, we have discussed some issues concerning image enhancement techniques. It has been highlighted that researchers within the field of image enhancement research in general and computer science in particular are facing problems regarding the quality of the images. The problems related the images come from the light absorption and scattering effects by the open environment. To eliminate this problem, researchers are using state-of-the-art technology such as, sensors and optical cameras, and well programmed DSPs. However, the technology has not yet reached to the appropriate level of success.

In order to overcome the limitations of technology, some researchers annotate images manually. However this process is labour intensive and it also requires significant agreement amongst the annotators. In order to address the issues discussed above, we propose an approach based on colour stretching in DCT domain. Firstly, we use contrast stretching of RGB algorithm to equalize the colour contrast in the images. Secondly, we apply the saturation and intensity stretching of HSI to increase the true colour and solve the problem of lighting and for this we use the unsharp masking filtering (USM). The performance of Unsharp Masking is significantly improve the colour quality of images distorted or affected by noises or by bad environment.

V. SIMULATION RESULTS

By implementing proposed methodology on MATLAB R2011a, v7.12, the results are displayed below:
The proposed algorithm implement a basic concept of DCT based image enhancement with USM Filtering to increase the colour contrast stretching and colour level enhancement. To enhance contrast, the proposed algorithm modified the DCT coefficients according to the new measure of spectral image content based on human visual perception. To improve the processing speed, the distributional characteristics of the DCT coefficients will exploit as well. In addition, a simple noise estimation and reduction scheme directly in the DCT domain can be introduced for a robust enhancement algorithm. The experimental results showed that the proposed algorithm improved the image colour levels and contrast effectively without causing block artefacts and boosting noisy information less.
The performance of the proposed algorithm may be affected by the quality of the compressed input image since the quality of the input image is mainly decided by a quantization table in encoding procedure, and the proposed scheme operates directly on the compressed domain. It works well with most of natural images. However, the image with very high frequency components may be blurred. Nevertheless, we believe that the proposed algorithm can be used as a significant tool to improve the dynamic range and colour contrast of an image in the compressed domain.

REFERENCES


AUTHOR'S PROFILE

Jyoti Patil is a research scholar at RKDF Institute of Science & Technology, Bhopal, pursuing her M. Tech. in Digital Communication. Her research area are Digital Image Processing and Digital Signal Processing.