Contrast Enhancement Algorithm for Colour Images

Rashmi Shukla[1] ,Prof. Lokesh Malviya[2]
[1]*M.tech. Research Scholar,* [2]*Research Guide*
SAM College Bhopal

Abstract- Digital image contrast enhancement methods that are based on histogram equalization (HE) technique are useful for the use in consumer electronic products due to their simple implementation. However, almost all the suggested enhancement methods are using global processing technique, which does not emphasize local contents. The focus of this research is on studying how well different contrast enhancement techniques developed for visible spectrum photographic images work on images; to determine which techniques might be best suited for incorporation into commercial imaging applications. Numerous contrast enhancement techniques found in literature were reviewed in this research, out of which one best representative technique has been selected.

Keywords- Contrast Enhancement, HE, Adaptive Histogram Equalization, Image Enhancement.

I. INTRODUCTION

Within seconds of entering the world, those who are blessed with the gift of sight start acquiring images. Human beings are primarily visual creatures who depend solely on sense of vision. So vision allows humans to perceive and understand the world surrounding them in a better manner. Hence, processing visual information by computer has been drawing a very significant attention of the researchers over the last few decades. The process of receiving and analyzing visual information by the human species is referred to as sight, perception or understanding. Similarly, the process of receiving and analyzing visual information by digital computer is called digital image processing [1].

Image Processing has been developed in response to solve three major problems concerned with pictures [2]:

- Picture digitization and coding to facilitate transmission, printing and storage of pictures.
- Picture enhancement and restoration in order for example, to interpret more easily pictures of the surface of other planets taken by various probes.
- Picture segmentation and description as an early stage in machine vision. An image may be described as a two-dimensional function I.

$$I = f(x, y) \dots\dots\dots\dots\dots (1)$$

Where x and y are spatial coordinates. Amplitude of f at any pair of coordinates (x, y) is called intensity I or gray value of the image. When spatial coordinates and amplitude values are all finite, discrete quantities, the image is called digital image.

The digital image I is represented by a single 2-dimensional integer array for a gray scale image and a series of three 2- dimensional arrays for each colour bands.

Digital image processing may be classified into various subbranches based on methods whose input and output are images and inputs may be images where as outputs are attributes extracted from those images.

Following is the list of different image processing functions based on the above two classes.

a) Image Acquisition
b) Image Enhancement
c) Image Restoration
d) Color Image Processing
e) Multi-resolution Processing
f) Compression
g) Morphological Processing
h) Segmentation
i) Representation and Description
j) Object Recognition.

For the first seven functions the inputs and outputs are images where as for the rest three the outputs are attributes from the input images. With the exception of image acquisition and display most image processing functions are implemented in software. Image processing is characterized by specific solutions; hence the technique that works well in one area can be inadequate in another.

Out of the ten sub-branches of digital image processing, cited above, deals with image restoration and one of its applications to enhancement. To be precise, the image restoration i.e. noise removal from images, stated in the Problem Definition. Further, image noise removal can be utilized for high quality image enhancement. Figure 1.1 depicts a pictorial representation of various image processing applications along with different image processing functions.

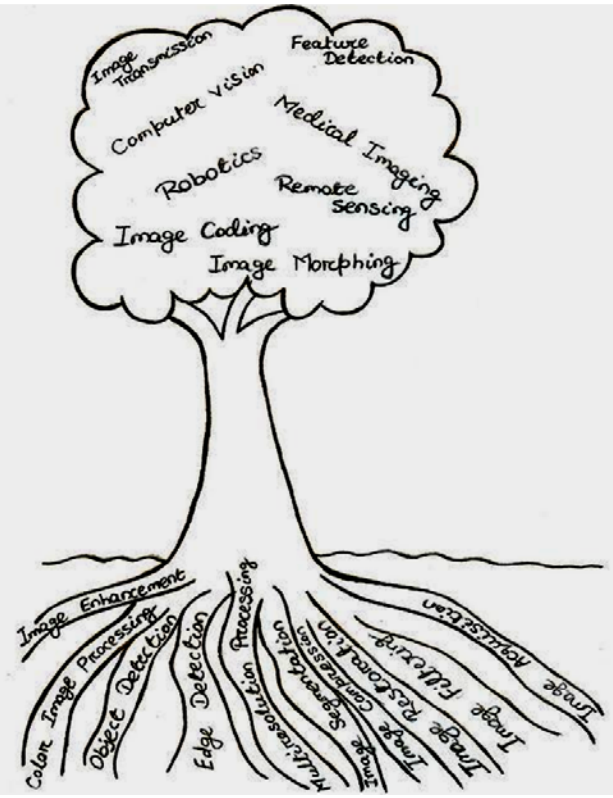

Figure 1.1: Image Processing Tree.

II. SYSTEM MODEL

Images are captured at low contrast in a number of different scenarios. The main reason for this problem is poor lighting conditions (e.g., pictures taken at night or against the sun rays). As a result, the image is too dark or too bright, and is inappropriate for visual inspection or simple observation. Image enhancement algorithms are used in a variety of image processing applications, primarily to improve or enhance the visual quality of an image by accentuating certain features.

Image processing modifies pictures to improve them (enhancement, restoration) to prepare suitable images for various applications from raw unprocessed images. Images can be processed by optical, photographic, and electronic means, but image processing using digital computers is the most common method because digital methods are fast, flexible, and precise. Image enhancement improves the quality (clarity) of images for human viewing. Increasing contrast, and revealing details are examples of enhancement operations where as removing blurring and noise comes under the category Image restoration.

Contrast Enhancement

Image enhancement usually employs various contrast enhancement schemes to increase the amount of visual perception. Different enhancement schemes emphasize different properties or components of images. Contrast enhancement techniques can be broadly classified into two categories. For the first category, the gray value of each pixel is modified based on the statistical information of the image. Power law transform, log transform, histogram equalization belong to this category. In the second category the contrast is enhanced by first separating the high and/or low frequency components of the image, manipulating them separately and then recombining them together with the different weights. Unsharp Masking (UM) which emphasizes high frequency components of an image belongs to this category. The pitfalls associated with unsharp masking is presented in problem definition. One possible solution for this problem is narrated in chapter 5. Some of the contrast enhancement methodologies are described below.

- *Image Negative*

The negative of an image with gray levels in the range [0, L-1] is obtained by using the negative transformation, which is given by the equation 2.

$$s = L - 1 - r \dots\dots\dots\dots (2)$$

Where r & s denote the values of pixels before and after the processing and L is the maximum Gray level intensity of the input image. Reversing the intensity level of an image in this manner produces the equivalent of a photographic negative.

- *Logarthimic law*

This is one of the simplest enhancement techniques. It uses a log transform to convert the input gray level to an output gray level to expand the values of dark pixels in an image while compressing higher level values. The general form of the log transformation can be represented using the relation

$$s = c.\log(1 + r) \dots\dots\dots\dots (3)$$

Where c is a constant and it is assumed that r < 0. Where r and s are input and output gray levels respectively.

- *Power Law*

Devices used for image capture, printing, and display respond according to a power law given as:

$$s = c.r^{Y} \dots\dots\dots\dots (4)$$

By convention, the exponent in the power law equation is referred to as gamma. The process used to correct this power law response is called gamma correction. Images not corrected properly can look bleached out or dark. So proper gamma adjustment must be done to produce the gray levels accurately and produce appropriate brightness.

- *Histogram Equalization*

The luminance histogram of a typical natural scene that has been linearly quantized is usually highly skewed toward the darker levels; a majority of the pixels possess a luminance less than the average. In such images, detail in the darker regions is often not perceptible. One means of enhancing these types of images is a technique called histogram modification, in which the original image is rescaled so that the histogram of the enhanced image follows some desired form.

- *Unsharp Masking*

Unsharp masking (UM) is an image manipulation technique which was first used in Germany in the 1930s as a way of increasing the acutance, or apparent sharpness, of photographic images. In Unsharp masking scheme, a high pass filtered scaled version of an image is added to the image itself. It is desired when a particular application requires the high frequency components of an image. One of its principal applications is dark room photography.

III. LITERATURE REVIEW

J. A. Ojo, I. D. Solomon and S. A. Adeniran,[1] Conventional contrast upgrade methods regularly neglect to create agreeable outcomes for low-contrast images, and can't be naturally connected to various images since preparing parameters must be determined physically to deliver tasteful outcomes for a given image. Author proposes a contrast improvement method to upgrade color images caught under poor light and changing atmospheric conditions. Images are changed over from RGB to HSV color space where upgrade is accomplished and reconverted to the RGB. Class Limited Adaptive Histogram Equalization (CLAHE) is utilized to upgrade the luminance component (V). Discrete Wavelet Transform is connected to the Saturation (S) components, and the decayed guess coefficients are adjusted by a mapping capacity got from scaling triangle transform. The improved S component is gotten through Inverse Wavelet transforms. The image is then changed over back to the RGB color space. Subjective (visual quality assessment) and target parameters (Peak-flag to-noise proportion (PSNR), Absolute Mean Brightness Error (AMBE) and Mean squared blunder (MSE)) were utilized for execution assessment. The calculation executed in MATLAB was tried images and contrasted and yields of HE and CLAHE improvement procedures. The outcome demonstrates that the new calculation gave the best execution of the three strategies.

S. S. Chong, K. S. Sim and M. E. Nia,[2] Magnetic resonance imaging (MRI) has higher affectability than mammography in breast cancer identification. Be that as it may, the low contrast images delivered frequently handle challenges in portioning the images into areas of intrigue. There is different contrast improvement systems proposed throughout the years. Despite the fact that these systems indicates obvious contrast improvement on general images, the vast majority of them are not reasonable to apply to bosom MRI images because of extensive segment of dim foundation and close gray levels between grandular tissues and greasy tissues. In this exploration, an adjusted form of hyperbolic logarithm contrast improvement system is presented. Correlations are made outwardly and measurably with a few existing contrast enhancement methods.

M. M. Ahmed, J. M. Zain and M. M. Ahmed, [3] the review reveals that histogram equalization (HE) - in a striking contrast to it's claim - is not identified with improvement of contrast. To comprehend this view, we begin with true images which have changing level of image quality that constantly oblige handling to enhance image contrast. For this reason, histogram adjustment including its variations is an often depended upon procedure. HE forms image by figuring pixel thickness of its constituent gray levels. This numerical model, depicted by HE, is neither connected to contrast nor is contrast straightforwardly incorporated into HE conditions. In this manner, the review means to discover the truthful way of transformation capacities utilized by HE. To comprehend these scientific estimations altogether, the exploration disassembles HE into it's building blocks. These blocks are, then, basically dissected to comprehend the genuine relationship between HE essentials and contrast. This present investigation's establishes that HE controls thickness - not contrast - which, thusly, accomplishes thickness changes yet no contrast improvement. Henceforth the review presumes that HE is not a legitimate contrast improvement procedure.

A. Das and M. Bhattacharya,[4] In the present review, author have connected the procedure of image improvement to mammographic images. This review has analyzed the issue of fuzziness/impreciseness of mammograms, for example, inhomogeneous foundation, low contrast, vague outskirts, little and badly characterized shapes, changing powers of the suspicious areas and low noticeability from their environment. In spite of the fact that fuzzy rationale based contrast improvement method can possibly handle the issue of inaccuracy in mammograms, more summed up and adaptable Vague Set hypothesis is suitable to catch the unclearness of mammograms.

R. Soleymani and M. G. Shayesteh,[5] author proposes the combination of histogram based strategies with a specific end goal to accomplish an enhanced contrast improvement procedure. In the proposed strategy, at first the histogram is adjusted in a way that arrangements with the histogram

spike with less computational intricacy. A technique is then used to safeguard the mean brilliance of image. Also, high contrast extending is connected to build nature of the subsequent image. A technique is additionally presented so that the extending parameters can be chosen relative to the force appropriation of every image. The proposed technique is powerful against noise and is completely mechanized and still easy to use. Exploratory outcomes demonstrate effectiveness of the new procedure from both of the goal and subjective perspectives.

S. K. Naik and C. A. Murthy,[6] The initial phase in numerous systems for preparing power and immersion in color images keeping tint unaltered is the transformation of the image data from RGB space to other color spaces, for example, LHS, HSI, YIQ, HSV, and so on. Transforming starting with one space then onto the next and handling in these spaces for the most part produce an array issue, i.e., the values of the factors may not be in their particular interims. We think about upgrade systems for color images hypothetically in a summed up setup. A guideline is recommended to make the transformations range issue free. Utilizing a similar guideline, a class of tone saving, contrast-improving transformations are proposed; they sum up existing gray scale contrast strengthening methods to color images. These transformations are additionally observed to sidestep the previously mentioned color organize transformations for image upgrade. The created standard is utilized to sum up the histogram leveling plan for gray scale images to color images.

B. A. Thomas, R. N. Strickland and J. J. Rodriguez,[7] One method for upgrading color image contrast is to input high-frequency spatial data from the immersion component into the luminance component. Another calculation, which utilizes a spatially variation measure of remarkable quality, is introduced. This strategy offers key changes to a past immersion criticism system. Trial comes about affirm that enhanced color image upgrade is accomplished.

IV. PROBLEM IDENTIFICATION

Different types of noise frequently contaminate images. Impulsive noise is one such noise, which may affect images at the time of acquisition due to noisy sensors or at the time of transmission due to channel errors or in storage media due to faulty hardware. One common drawback of typical image sharpening (enhancement) methods is that they tend to boost noise while amplifying the image details making the image noisier. This undesirable amplification limits the real time applications of sharpening algorithms. Typical solution to deal with noise amplification when performing enhancement is performs noise reduction prior to enhancement.

V. CONCLUSION

Image processing is a technique to improve the quality of pictorial information in raw images taken from cameras or sensors. Image processing systems are widely used in various applications due to easy access to powerful computers, large size memory devices and graphical software. Image Noise Suppression is a highly demanded approach in digital imaging systems design. Impulsive noise is one such noise, which is frequently encountered problem in acquistion, transmission and processing of images. Algorithm for colour image enhancement has been reviewed [1].

REFERENCES

[1] J. A. Ojo, I. D. Solomon and S. A. Adeniran, "Contrast enhancement algorithm for colour images," 2015 Science and Information Conference (SAI), London, 2015, pp. 555-559.

[2] S. S. Chong, K. S. Sim and M. E. Nia, "Modified HL contrast enhancement technique for breast MR images," 2013 IEEE International Conference on Signal and Image Processing Applications, Melaka, 2013, pp. 360-364.

[3] M. M. Ahmed, J. M. Zain and M. M. Ahmed, "A Study on the Validation of Histogram Equalization as a Contrast Enhancement Technique," 2012 International Conference on Advanced Computer Science Applications and Technologies (ACSAT), Kuala Lumpur, 2012, pp. 253-256.

[4] A. Das and M. Bhattacharya, "Development of advanced contrast enhancement technique for mammographie images," 2012 World Congress on Information and Communication Technologies, Trivandrum, 2012, pp. 185-190.

[5] R. Soleymani and M. G. Shayesteh, "An Automatic Contrast Enhancement Technique Using Combination of Histogram-Based Methods," 2011 7th Iranian Conference on Machine Vision and Image Processing, Tehran, 2011, pp. 1-5.

[6] S. K. Naik and C. A. Murthy, "Hue-preserving color image enhancement without gamut problem," in IEEE Transactions on Image Processing, vol. 12, no. 12, pp. 1591-1598, Dec. 2003.

[7] B. A. Thomas, R. N. Strickland and J. J. Rodriguez, "Color image enhancement using spatially adaptive saturation feedback," Proceedings of International Conference on Image Processing, Santa Barbara, CA, 1997, pp. 30-33 vol.3.

[8] NaglaeYehya H., and Norio A., (2006),“Contrast Enhancement Technique of Dark Blurred Image”, International Journal of Computer Science andNetworkSecurity,6(2A), 223-226.

[9] Pfizer S.M, (1987), “Adaptive Histogram Equalization and its Variations,” Computer Vision,Graphics and Image Processing, 39, 355¬368.

[10] Buzuloiu, V., Ciuc, M., Rangayyan, and Vertan, C., (2001),“Adaptive neighbourhood histogram equalization of color images”, International Journal of Electron Image, 10(2), 445-459.