INTRODUCTION

Millions of people are visually impaired, with the number of people with disabling visual problems increasing with the growing aging population. A Louis Harris survey found that vision impairment affects 17% of Americans 45 and older, and 26% of those 75 and older [1]. A visual image is rich in information. Confucius said, “A picture is worth a thousand words.” [2] Medical imaging uses IE techniques for reducing noise [3] and sharpening details to improve the visual representation of the image [4]. Visually impaired people have difficulties reading small print, watching television, recognizing faces, etc. While much research and rehabilitation effort has been aimed at improving the reading ability of low-vision patients [5, 6]. Image enhancement to improve video images for the visually impaired was first proposed by Peli and Peli [7] applying an adaptive enhancement algorithm, and Peli, Arend, and Timberlake [8] investigated the use of a number of common image enhancement algorithms. Similar techniques were applied to the enhancement of text by Lawton [9] and by Fine and Peli [10]. While image enhancement was shown to modestly improve reading rate and may improve mobility.

Images provide visual representation of the content that is to be examined and allow the users to reflect on them later. They are a powerful data collection medium [11], [12] that is stored easily and used indefinitely. With the advent of digital imaging, a whole new set of possibilities have opened up for professional and amateur users. The amateur users can now easily snap, store, edit and share images [13], while researchers and professional users rely on them to identify areas of interest and present their findings effectively.

Image Enhancement (IE) transforms images to provide better representation of the subtle details. For example forensic images/videos employ techniques that resolve the problem of low resolution and motion blur while medical imaging benefits more from increased contrast and sharpness. To cater for such an ever increasing demand of digital imaging, software companies have released commercial softwares [14], [15] for users who want to edit and visually enhance the images. Low vision can be caused by an accident, a disease, a condition existing from birth (or early childhood) or due to aging. The most common causes of low vision are macular degeneration, cataracts, glaucoma, retinal detachment, diabetic retinopathy or retinitis pigmentosa [16]. Students with visual impairments encounter many difficulties in exploring interesting articles and attending seminars and, thus, may miss opportunities to learn. The result can be a far less effective learning experience and thus a hindrance to their education. Hence there arises a need for a low cost, portable system which assists to read not only the close up materials but also far away objects in a classroom environment. This system also needs facility to combine different techniques depending on their personal needs.

There are mainly three methods for image-enhancement:

- Spatial Domain
- Frequency Domain
- Histogram Equalization

2. SPATIAL DOMAIN

The principal objective of image enhancement is to modify attributes of an image to make it more suitable for a given task and a specific observer [17]. Spatial domain methods which are operate directly on pixels. Spatial domain methods pixel values may be modified according to rules that depend on the original pixel value (local or point processes). Alternatively, pixel values may be combined with or compared to others in their immediate
neighborhood in a variety of ways [18]. Consider the input image \( f(x,y) \) and processed image \( g(x,y) \) then the transformation \( g(x,y)=T[f(x,y)] \), Where \( T \) is an operator on \( f \) defined over some neighbourhood of \( (x,y) \). The operator \( T \) is applied at each location \((x,y)\) to yield output \( g \) at that location. The process uses pixels in the area of image spanned by neighbourhood \([19]\). Example: Thresholding.

Advantages:
- Direct manipulation of pixels.
- Very good method for contrast enhancement.
- It is also a good method for image sharpening.
- Conceptually simple to understand and the complexity of these techniques is low which favours real time implementations.
- It removes impulsive noise and preserves edges.

Disadvantages:
- Sometimes it shifts image boundaries during sharpening.
- It has only manipulates the pixel.
- Their specification requires considerably more user input 24.
- Having poor performance with Gaussian noise.

2.1 Literature review of spatial domain

SnehalO.Mundhada et.al [20] proposed image enhancement is to improve the image quality so the resultant image is better than the original image. Many images suffer from poor contrast, therefore it is necessary to enhance the contrast. The purpose of image enhancement method is to increase image visibility and details. However, this technique bring about tonal changes in the images and can also generate unwanted artifacts in many cases, as it is not possible to enhance all parts of the image in balanced manner. Spatial domain technique is useful for altering the gray level values of individual pixels and hence the overall contrast of the entire image. But it usually enhance the whole image in a uniform manner which in many cases produces undesirable results and highly balanced and visually appealing results for a diversity of images with different qualities of contrast and edge information and it will produce satisfactory result.

RakhiChanaa et.al [21] presented paper in which Digital images are captured from different imaging media elements like cameras, scanned electron microscopes etc. While going through the imaging process, Images get distorted in various forms resulting in extreme dark or light areas. All these things lead to the loss of information. The goal in each case is to extract useful information so implementation of various enhancement methods for Scanned Electron Microscope (SEM) images and their experimental results. SEM images lead to very dark and light areas in an image. While imaging the information in the front scene is not only the source of information but some scenes on the dark side can also have the useful information. It helps in enhancing details over small areas in an image. The image has been enhanced through this method in a most satisfactory way as far as bringing out the desired detail is concerned.

3. Frequency Domain

Frequency domain techniques are based on the manipulation of the orthogonal transform of the image rather than the image itself. Frequency domain techniques are suited for processing the image according to the frequency content. The principle behind the frequency domain methods of image enhancement consists of computing a 2-D discrete unitary transform of the image, for instance the 2-D DFT, manipulating the transform coefficients by an operator \( M \), and then performing the inverse transform. The orthogonal transform of the image has two components magnitude and phase. The magnitude consists of the frequency content of the image. The phase is used to restore the image back to the spatial domain. The usual orthogonal transforms are discrete cosine transform, discrete Fourier transform, Hartley Transform etc[22].

Advantages:
- Manipulation of frequency.
- Best method for periodic noise reduction.
- Best method for image sharpening.
- It includes low complexity of computations, ease of viewing and manipulating the frequency composition of the image.
- This method is simple, fast and we get acceptable results for many applications.

Disadvantages:
- Not a good method for contrast enhancement.
- It has only manipulates the frequency.
- It cannot simultaneously enhance all parts of image very well and it is also difficult to automate the image enhancement procedure.
- It may increase the contrast of background noise, while it decreases the usable signal.

3.1 Literature review of frequency domain

Asst. Lect. Musa HadiWali [23] presented the image enhancement method using contrast measure in DCT domain has been implemented. The proposed algorithm is easy for application since its required no parameter to be varied and selected by the user which is reduce the time of processing since the original image is required to be repeated many times to select a proper contrast enhancement factor. Also this algorithm provides good performance especially for darkened images, and the Enhancement factor is computed according a proposed function depends on the mean of the image (8X8) blocks.

Zaid Albataineh et.al[24] presented the RobustICA-based algorithm to solve the frequency-domain BSS problem for convolutive acoustic mixtures in several adverse conditions. Through the real-world experiments, we show the superiority of the presented algorithm among other popular algorithms in the literature in terms of the performance and complexity computation. Moreover, they compared several permutation solvers in terms of
computation complexity and performance to provide the RobustICA-based algorithm with an efficient frequency-dependent permutation scheme. Finally, they studied the effect of several parameters on the separation performance of the presented algorithm. Accordingly, the presented algorithm is optimized to be suitable for the real-time operation. As a result, it is suitable for a large number of applications to ensure the real-time implementation.

4. HISTOGRAM EQUALIZATION

[25] Histogram equalization is the technique by which the dynamic range of the histogram of an image is increased. It assigns the intensity values of pixels in the input image such that the output image contains a uniform distribution of intensities. It improves contrast and the goal of histogram equalization is to obtain a uniform histogram [26]. This technique can be used on a whole image or just on a part of an image. It is well known that the appearances of the resulting image from the equalization process are not visually pleasing for most of the cases [27].

Image enhancement refers to the process of performing a set of operations on an image so that to improve its visual appeal. This involves an increase of the contrast range or an improvement of the perceptibility of the various details present in an image. The modification of the image histogram to improve the dynamic pixel range - called as “Histogram Equalization”. On many images, histogram equalization provides satisfactory to good results, but there are a number of images where it fails to properly enhance an image [28]. It is believed that the information that a certain image tends to convey, is dependent upon the probability of occurrence of pixels of the different gray levels. By re-distributing this probability in a uniform manner, the perceptibility of the image details improves [29].

![Figure 1.3: Histograms of an image before and after equalization][30].

**Advantages:**
- The method is simple and efficient in terms of implementation.
- The image with a very poor dynamic range can be enhanced.
- HE includes uniform distribution of intensity values, optimal contrast enhancement and fast processing.

**Disadvantages:**
- It is not a suitable property in some applications such as consumer electronic products, where brightness preservation is necessary to avoid annoying artifacts.
- Visual artefacts can be introduced resulting in graininess and patchiness.
- Brightness is not preserved.

4.1 Literature review of histogram equalization

Jia-Bin Huang et.al [31] proposed a fast and effective re-coloring algorithm for people with color vision impairment. They propose to enhance the contrast in the hue channel only, which is the major factor resulting in confusion in visual communication. They employ the generalized histogram technique to encode local information in the original color image. They also provide a control parameter for users to specify the degree of enhancement. Their algorithm can run at real-time, and thus can be easily extended to video processing applications. Computational simulation results have demonstrated the effectiveness and efficiency of the proposed algorithm.

Rajesh Garg et.al. [32] described a frame work for image enhancement based on prior knowledge on the Histogram Equalization has been presented. Many image enhancement schemes like Contrast limited Adaptive Histogram Equalization (CLAHE), Equal area dualistic sub-image histogram equalization (DSIH), Dynamic Histogram equalization (DHE) Algorithm has been implemented and compared. The Performance of all these Methods has been analyzed and a number of Practical experiments of real time images have been presented. From the experimental results, it is found that all the three techniques yields Different aspects for different parameters. In future, for the enhancement purpose more images can be taken from the different application fields so that it becomes clearer that for which application which particular technique is better both for Gray Scale Images and colour Images. Particularly, for colour images there are not many performances measurement parameter considered. So, new parameters can be considered for the evaluation of enhancement techniques. New colour models can also be chosen for better comparison purpose. Optimization of various enhancement techniques can be done to reduce computational complexity as much as possible.

5. CONCLUSION

Image enhancement methods improve the image quality so that the resultant image is better than the original image for a specific application or set of objectives. The aim of image enhancement is to improve the visual appearance of an image. In this paper different image enhancement schemes have been suggested for students with visual impairments. The improvement in image enhancement is particularly effective in the case of very low contrast images. Spatial domain is good method for contrast enhancement however frequency domain is less effective method and histogram equalization is simple and efficient in terms of implementation.
REFERENCES


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