ISSN:0975-9646

Study and Analysis of Digital Image Enhancement

Sanjib Das[#1], Niranjan Cannon[*2]

[#1]*Assistant Professor*
Department of IT & Mathematics
ICFAI University Nagaland
Sovima, 6th Mile, Dimapur - 797112

[*2]*Department of IT & Mathematics*
ICFAI University Nagaland
Sovima, 6th Mile, Dimapur - 797112

Abstract— **Digital image processing is the process of enhancing samples of image which may or may not degraded by noise and other distortion. Image Processing takes a big role to *amplify* and *rectify* of an image, video clips, medical films, designing, animations, machineries, Computer Graphics, etc. *Amplify* is the process of magnification with or without noise presents applying the techniques and re-checking respect to the result and *Rectify* is the process of analyzing ROI(Region of Interest) from a sample, with the techniques to recover or to enhance. For the above processes, selecting of techniques and maintaining of samples are difficult because any techniques may hinder the samples and cannot be usable for further. The ideas need to know and going to find out is all about Image Processing and their techniques. The conversion of an image into digital image to perform analyzing, modifying, amplifying of detail of objects or globally is implies to Image Processing. IP's applications are applied in many fields like Science and Researches, Graphical Designing in Automobile Industries, Law and Enforcement, etc. IP helps in to analyze, enhance, restore, to get more visual perception of image. Types and techniques of IP are explained in the following chapters. But we are confined only to the main basic concepts and techniques due to complexity of techniques and unqualified of the respective fields.**

Keywords—Image, Digital image, Image preprocessing, Image Enhancement, Spatial domain techniques, Frequency domain techniques.

I. INTRODUCTION

Image processing comprises image restoration, image enhancement and image extraction respectively. The different categories have their own different methods and techniques. The volume of Image processing topic is enormously vast. After studying some theories, notes and existing applications software. The applied techniques in the application are complex and difficulties in understanding altogether. The main problem is lack of clarity, contrast, brightness and noise. None are far from errors and disadvantages. User's knowledge and the defects in an image are compulsory for choosing of techniques. The problems find in image are varies say, unrelated pixels, noise, low contrast, opacity, natural phenomena, etc, can be improvise and overcome depending on the different techniques, because the defects may or may not overcome easily due to the availability of techniques and hardware. Currently, impairments are overcome and applied in industries, animations and satellite imaging.

We have explained the basic about images, properties, features of image that will be needed for image enhancement and also basic knowledge about image processing

II. BACKGROUND

1. Image:

Image is a graphical representation of snapshots or scene that is captured or displayed either in analog or digital form. Analog image is a continuous signal of different variations of image-tone that are developed by photosensitive chemicals in a photographic film, example Hard copies of photographic films. Digital image can be defined in 2D space that has discrete values of intensity having row and column that are made up by picture elements called Pixels. There are two types of images viz. Vector images and Raster image. Vector images comprise a geometric shapes, lines, points or dots and also text that have both direction and length. There are two common format for vector images i.e. postscript and PDF (portable document format). Postscript is a programming language developed by Adobe Company in 1976 by John Warnock. A system language interpreter to process graphics for uses as page description language and other desktop publishing (DTP) areas to run postscript. Primitive postscript comprise of lines and curves joined to form a complex images, fonts for further uses. Whenever postscripts are printed the interpreter converts into the actual raster graphic component. Demerits of postscript are, it need other external data like font libraries enough memory space and high power capability system. The extension of postscript is ".eps" or ".ps".

PDF is also developed by Adobe system in 1993. Officially it was released as opened standard on July 1, 2008 through ISO standard. In PDF, the necessary information, text, images are contained so they need minimum requirements, memory and easy to use. They are compact not as Postscript but the particular contained are same page, text, geometrical shapes and images and also possible to store digital images. PDF is considered exchangeable document format as cross platform. ".pdf" is the extension of PDF files.

Raster images are the digital graphical images that have different intensity of pure colors in picture element. Pure colors can be considered as red, green and blue. Their types of images are sub-categorized as follows:

a. **Binary Images:** Binary image are the image that pixel posses having only two values i.e. 0 and 1. It is obtained by shades of grey i.e.1 is set for black color and 0 as White for the background. They are used in some Medical Treatment Images such as X-Ray, CT scan, Black and White images, Printer, Fax Machine, Barcode Reader, Interpretation text.
b. **Grayscale Images:** Grayscale image contains only shades of Gray, Black and White. The objects in the images are created by different shades of gray color. The darkest color is black and brightest part is white and other possible Grays in the visible wavelength. Level of gray scale is 2^**t** (where **t** is bits), depends on the file format like 8 bits, 16 bits. Grayscale have advantages in PC Monitor B/W because it can display range gray scale color from 0 to 1.Conversion of B/W, RGB images to grayscale are fast and easy to process.
c. **RGB Images:** RGB (red green blue) images is comprise of red, green and blue color stored in each of the pixels that are displayed in an electronic devices. It is device dependent because RGB color images need device that are capable of displaying it. RGB image extension is "*.rgb", used in Photography, Printer, Digital Cameras, Scanners and other multimedia purposes.
d. **Indexed Images:** Indexed images have specific 256 colors and it ranges scale up to 0 to 255. It is a technique to manage digital image size and memory allocation in order to save RAM and buffering and also to speed up the transmission time. This kind of image has typical separate data that stores the information of color of the image called palette. . Disadvantage of indexed images is that it has limited set of simultaneous colors in the images so, developing of real-images are quite difficult but for the basic geometric shapes and icons it is simple and effective.

An image comprise of different characteristics. An image is made up of picture elements i.e. pixels. Comprise varies of colors viz. primary color i.e. RGB and secondary color i.e. CYM (Cyan, Magenta, Yellow) and B/W (Black and White). Pixels have different value of colors i.e. intensity of colors. In an image 70-72 (approx) pixels are present in inch. Megapixels are also pixels; they are represented as circle in an image whereas pixels are rectangle or square shaped in dimension. So, coordinates can be represent as *x* and *y* that indicates x as rows and y as column. Altogether these pixels made a distinguishable image. The total pixels present in an image are known as Resolution that is present by its height and width. E.g. 240 X 320, 1024 X 720, etc. In context size of an image, they are dependent on types of compression, resolution, information contained in the image. In digital file format there are two types of compression techniques i.e. lossy and lossless compression. Lossy compression is a kind of data encoding techniques that are used to compress data partially with excluding some unnecessary content to reduced size and other common pixels for transmitting to different platforms with minimum space and time. Lossless compression is totally opposite of lossy compression. One advantages of lossless compression, preserved the quality, information content of image with/without depending on size. There are different techniques of lossy and lossless techniques that compress without hampering the quality of image. The main purpose for compressing image is to store, execute image with lesser amount of time and memory. Some techniques are mentioned below:

I. Lossy compression:

Lossy compression techniques is the techniques of data encoding that are recreate the files by reducing redundancy of data of the files. It's an effective method that transformed the files into lesser memory size and reduces transmission and retrieving of files. Wherever, it reduce the quality of image with less noticeable by users, present color space.

II. Lossless compression:

Lossless compression techniques is also a kind of data encoding that recreates the files exactly without losing any elements present in the data. These techniques are mainly used in the fields of researches that required maximum quality of data. So, it gives the best quality of files and big memory size.

2. Digital image:

Digital image file format are means of storing images in different standardized format. It stores information about resolution, types of compression, color formats. There are many image formats for digital images. Some are explained below:

a. **BMP format:** BMP (bitmap) format is an uncompressed image format developed by Microsoft. It has disadvantages of large size of memory space.

b. **JPEG format:** JPEG (Joint Photographic Expert Group) is most common images format used in web and other publishing uses. It was developed by JPEG in 1992. It has two types of standard viz. JPG/Exif used for digital image sensor and JPG/JFIF for web purposes. JPEG 200 support both *lossy and lossless* compression which maintains both quality and size. It supports 16 millions colors. The format are not suitable for primitive graphical representations like lines, shapes and icons but have good quality in photographs and scene of smooth color tones. The concepts of this file format techniques is, compress to store and uncompressed while in execution. So, automatically it reduces the quality of an image if we use again and again. File extension of JPEG file format are ".jpg, .jpeg, .jif, .jfi, .jpe ", universally as ".jpg".
c. **PNG format:** PNG (Portable Network Graphics), most popular and portable image format used in web. Developed as free source by PNG development group in 1996. This format is developed especially for web purposes. There are some types of PNG format that supports palette based images i.e. In 8-bit PNG format, it supports

RGB palette, 24-bit supporting RGBA palette. The prior version PNG 1.O (released in 199) does not have properties for animating of images. Since, PNG is developed to replace GIF format, PNG 1.2 have extra features than GIF that are able to execute animation far better than GIF and also able to display multiple images. GIF supports 256 colors through palette but PNG support 256 colors and also 16 million colors as JPG, TIFF and other format suitable for photographic images.

d. TIFF format: TIFF format are flexible file format that can be read and write above different platforms. It can store multiple images in single image files. TIFF format gives advantages of editing of image, manipulating several time with less degradation because it used lossless file compression techniques. Its extension is ".tiff"

e. RAW: Raw image format are the format that are captured or scanned by image sensor or scanner exactly without losing any data in it. There are many file formats of raw images. Taking an example of an image sensor say Digital camera captured the image in there company's own format, different companies have their own file formats.

3. Image preprocessing:

Image Processing is fields that analyze, recover or restore, enhance even extraction to get the original image or nearly original image for different applications. It is a problem oriented field because different techniques have their own merits and demerits. Contrast stretching techniques may or may not help in noisy images. Before going too further in image processing, an *image pre-processing* are the techniques to perform before image processing to get overall information about the image like height, width, present noise, distortion, and other relevant techniques needed for processing but it does not increase the information of an image. Some common Image pre-processing methods are explained below:

a. Cropping of images: It focus on ROI, cropping tool helps to extract and identify the part of an image. It selects only the ROI to process for further problems of image. It is the most common method used by DTPs works, journalism and other image related practices. Uncrop of image also can be done if undo or reset exists in the image processing system.

b. Magnification and Minimization: Magnification of image is the enlarging of image without the physical size, in simple words "zooming in". Its help us to observe the fine details of an image but if we maximize the image enough we will get the shapes of pixels. Minimization is opposite of magnification that it reduces the size of image i.e. zooming out. It makes the image smaller and smaller in appearance.

c. Rotation: An image can be view in different angles by geometrical transforming the physical form. The rotation of image is described in degree of angles i.e. 90^{O}, 180^{O}, 270^{O}, 360^{O}, etc or as clockwise and anti-clockwise. The geometric transformation does not harm the physical data of an image; it changes only in the appearance. It can be applied in all the file format of images.

d. Mosaic: Mosaic is an art of combining and creating images, sculpture and other painting of image by assembling stones, glass, other materials used by Greek, Romans and others well-developed civilized countries started around 4 AD. Currently, in digital image it gives the idea to develop an image by analyzing and combining many relevant small images. It used for animating pictures, creating abstract images, etc.

The process of converting an image into digital image to perform analyzing, modifying, amplifying of detail of objects or whole as an image is implied to Image Processing. There are required components in IP system viz. Image Sensor, Digitizer, Processor and Display unit. The required common steps for image processing are given below:

- **Digitalization:**

Digitalization is the first step for Image Processing. All the images from any sources like Cameras, CCTV video images and other analog images(that are hardcopies) like Photograph, X-ray images, etc are needed to convert into Digital form in order to process in the Computer System. The process of changing an image to digital form is known as *Digitalization*. It is performed by the software with the help of Digitizer like Image scanners, Digital Cameras, etc.

- **Image Acquisition**:

Collecting images from different sources and stored temporarily that are ready to start enhancing in a system. Problem definition of an image is the task to enhanced or problem present in the image.

- **Image Enhancement:**

Selecting of techniques is the first task for an user. Because depending on the problems of an image and techniques which is available should be in one way. Else, different techniques are useless. So, "specific" is must for processing image.

- **Output:**

With all the available techniques, Images are analyzed, enhanced with/without noise present. The Enhanced Images are stored in the user Computer system after File compression with a specific file extension that are readable and executable.

Image Processing are applied for the designing and reviewing in the following fields:

- Animation

  In animation movies Industries used Image processing for the characters, background with the real-time, Artistic effects are used in Movies to make more realistic.
- Medicals Research

Image processing is widely used in analyzing of X-ray, MRI (Magnetic Resource Imaging), Computerized Tomography images (CT), Radiography images. Especially, ROI(Region of Interest) from any source are taken out and analyzed by experts to get their respective results.

- GIS(Geographic Information System):
  Satellite images of weather, climate, stars and planets present illusion or abstract images because of technical difficulties. Because of this, Image Processing is required to manipulate and remove noise.
- Scientific Applications and Researches
- Law and Enforcement
  Evidence found from crime scenes sometimes contains noises. To rectify the ROI (Region of Interest) Image Extraction techniques are used to remove background or to take sample of objects, Magnifying of Image, Biometric data and CCTV images Enhancement.

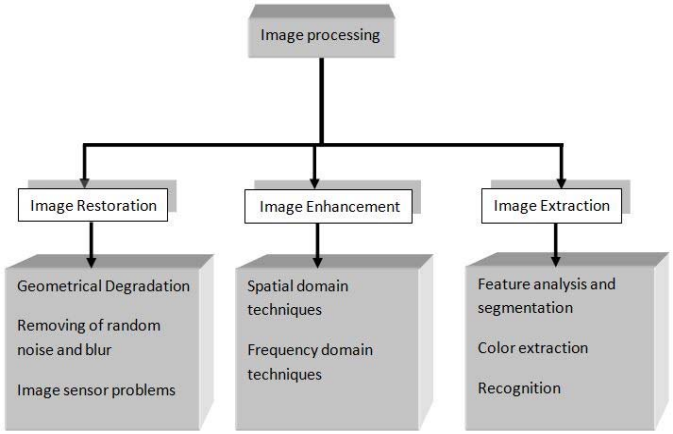


Fig. Image Processing types and their techniques.

3.1. Image Restoration:

Digital images have many problems many problems that degraded images resulting bad images. It caused because of noise, blur, less quality, rigidness, wrong focus, natural and atmospheric defects, etc. Image restoration helps in recovering the degraded image to approximate original images with the help of prior or estimate knowledge. There are two common methods of image restoration: Deterministic and stochastic method. These techniques are used convolution techniques that applied globally. This method is used to apply only when there are prior knowledge and information about the degraded images. Advantages of Deterministic method is that it can give better result of images but at all the time of processing there is always lack of knowledge about the image. So, Stochastic method are applied when there is lack of information of images exist. Some techniques of image restoration are:

- Filtering techniques.
- Blind deconvolution techniques.
- Geometric degradation restoration.

3.2. Image Enhancement:

Image enhancement is the process of improving the visual perceptibility with different techniques. It makes the image clearer; minimize errors, quality and information present in the image. Image enhancement and image restoration is almost same techniques but how the problems are approached is different. Image enhancement has different techniques to be applied on different problem. Wrong selection of techniques may leads to error. They are effective to give good results but application and problem dependent. It needs problems of images and techniques to apply on it. We need to have idea of problems and techniques to apply on it because without any knowledge it gives different undesired result. Tools of image enhancement that is effective and essential to applied in upcoming enhancement techniques are explained below:

- **Convolution**
  Convolution tools defined that through a function of selected region we can apply the method to enhance an image.Mathematically.it express below
- **o(x,y) = F(x,y) * i(x,y)**
  Where o(x,y) as output images, F(x,y) as the function in the specific position of image i(x,y).
- **Fourier transformation**
  Fourier transformation is taken from convolution tool. It's can be express as
  O(x,y) = F(x,y) * I(x,y), where O(x,y) as output images, F(x,y) as the function in the specific position of image I(x,y).

Image techniques are divided into two domain techniques as explained below:

3.2.1. Spatial domain techniques:

Spatial domain techniques are the process that manipulates image pixels directly. Mathematically, spatial domain techniques can be express as:
o(x,y) = S(i(x,y))
Where o(x,y) as output image, S as spatial function to be apply on input image i(x,y).
Spatial techniques are effective and easy to compute also less complexity nut they enhance the whole image so they provide low-details of image, inadequate and less robustness.

3.2.1.1. Point operations

Point operation is the technique using gray levels from the image to enhance. Point operation is also known as intensity transformation operation applied directly on each pixels of image. Intensity is the amount of visual perception from pixels. Intensity domain techniques are carried on to enhanced luminance related features in an image Brightness is the amount of lightness or darkness of pixels. It minimizes the intensity related problems. Some techniques of point operations techniques are given below:

3.2.1.1.1. Contrast Stretching:

Contrast is the amount of intensity between objects and background of image. It is the most common features of images. Contrast stretching is enhancement technique of adjusting contrast in image because of poor contrast, lack of image

sensor, miss focus and dark environment, etc. The objective of this technique is to adjust contrast in image. Application of contrast enhancement is applied in remote-sensing satellite images and GIS, etc. There are two types of contrast stretching techniques i.e. linear and non-linear contrast enhancement techniques. In linear contrast stretching techniques used histogram of image that help to adjustment of contrast of image. In this method, it expands the value of original contrast value. Mathematically, this algorithm used minimum and maximum intensity value i.e.

$o(x,y) = ((i(x,y)- min)/(max-min))* I$

Where o(x,y) is the result image, i(x,y) is the original image, min and max are intensity value present in the image, I as total intensity of the image.

There are other techniques of linear contrast enhancement viz. *Percentage* linear contrast enhancement that used specific minimum and maximum value that comes under certain percentage and *Piecewise* linear contrast enhancement that perform enhancement parts by part or ROI wise. Linear contrast enhancement is simple and effective to apply the algorithm but in some cases it gives undesired result due to simplicity of the algorithm.

In non-linear techniques used histogram equalization to get a proper overview of the original contrast image. Histogram is a kind of graph that gives an occurrence of events.

3.2.1.1.2. Digital Negative image:

Digital images can be in different colors formats. Negative image is a kind of grayscale image. It is suitable for enhancing poor grey levels; maximize the details in an image. Negative images are the simple and small in size. They can be developing by inverse the level of intensity from the pixels. Its method is explained below:

$$o(x,y)= | i(x,y)- 255 |$$

Where o(x,y) as output images, 255 is total level of intensity and i(x,y) as input image. Every pixels of input image is subtraction by 255 as result, it gives digital negative image. They applicable in medical and research films e.g. X-ray.

3.2.1.1.3. Conversion of color image to grey level image:

From a true color image for further enhancement, a grayscale image can be developed. It is useful for contrast enhancement and other intensities related degradations in image. The steps for conversion of color image to gray scale images are given below:

- Normalizing the intensities

  In every image pixels have their amount of luminance of the different colors. In normalizing of intensities, all the colors value is reduced to some range of intensities. It helps to enhance an image easily and comfortably. The normalization can be performing as:

  $$i(x,y) = | x- a/ b- a |$$

  Where i(x,y) is input image x is image pixels value, a is minimum intensity and b as maximum intensity.
- Extracting of color from images

  Color represents different pixels value of images. Extracting of colors are need to calculate the value of image. The formula is given below:

  Say, I(x,y) is an image. $I(x,y) = (r_{x,y}, g_{x,y}, b_{x,y})_{x,y=1}$ where $r_{x,y}$ represent as red color, $g_{x,y}$ as green color and b_{xy} as blue colors present in the image.
- Applying the algorithm

  The algorithm change all the red, green and blue color present in image into one gray level value *G* . By getting the maximum intensity of the primary color, red, green and blue i.e. $G = \max (r_{x,y}, g_{x,y}, b_{x,y})$ or another way is by adding all the primary color present and taking average of the result image i.e. i(x,y) = (r+g+b) then G= i/ max(I) where i(x,y) is the color image and *G* is the result gray scale image.

3.2.1.2. Masking or Filtering techniques:

Masking used two dimensional matrix of an image. It applied filtering techniques with matrix e.g. 1 X 1, 3 X 3, 5 X 5 11 X 11 with the matrix it changes pixels by pixels. The matrix should take as odd number only. Masking concepts is also known as spatial filtering. Spatial filtering minimizes the degradation factors like noise, blur and roughness of pixels. To reduce this kind of degradation, *Mean filters, Gaussian filters* are used. For sharpening of image, edge detection are the main to applied at the first steps and later different kind of edge detection methods like Laplacian operator, Prewitt operator, etc are apply.

3.2.2. Frequency domain techniques:

Frequency domain techniques used Fourier Transformation to apply their method to enhance an image. The techniques can be applying both globally and spatially too. Theoretically these techniques, takes the input images and converts into frequency distribution and apply their techniques to enhance. After the image is enhanced, inverse transformation are perform to give output image. There are different types of transformation function viz. Fourier series and Fourier transformation, Laplace transform, Wavelet transformation, etc. There is relation between spatial domain and frequency domain techniques because spatial domain techniques used convolution techniques and the frequency techniques domain used transformation that are based and extract form convolution techniques. Its relation is express below:

In spatial domain techniques, i(x,y)* f(x,y) <=> F(x,y) i(x,y), where i(x,y) is the input images and f(x,y) function or method to be apply on the image to get enhanced images.

In Frequency domain techniques, i(x,y)f(x,y) <=> F(x,y)*o(x,y), where F(x,y) Frequency transformation function and o(x,y) as output image. The Frequency domain techniques transformation function from spatial domain, apply the techniques. Then, the images which are enhanced are converting through inverse transformation and it gives the results.

Some common techniques of Frequency domain techniques are explained with different types of filter used to remove noise and increase smoothness and sharpness. The techniques are Low-pass and high-pass frequency filters.

Low-pass filters are used to reduce noise and increased smoothness by creating a smooth image and clear images. Noise is any unwanted pixels present in an image that are occurring may be during acquisition of image, digitization or transmission period. This algorithm can apply with 3X3, 5X5, 11X11, depending on the algorithm that is going too applied. The algorithm to use for smoothing is given below:

$$o(x,y) = (i(x,y) + i(x-1,y) + i(x,y-1) + i(x-1,y-1) + i(x+1, y) + i(x,y+1) + i(x+1,y+1) + i(x+1,y+1) + i(x-1, y+1) \ldots\ldots\ldots i(x-n,y+n))/ k.$$

Where o(x,y) as output image, k as total pixels present in matrix.

High-pass filters are types of filtering that keep limit of low frequency and increased more of high frequencies. These filtering techniques sharpened the images by recreating low frequencies into high frequencies. Sharpness is the concept of maximizing details in the image. Sharpness can be recreated by inversing the low-pass filtering technique.

Mathematically,

$F_H = 1- F_l$ where, F_H as high-pass frequency, F_l as low-pass frequency.

Through this relation, high-pass frequency can be developed easily from low-pass frequency. The disadvantages of using low-pass and high-pass filtering techniques are less reduction of noise and hampered details of the image.

3.3. Image Extraction:

Image extraction is the process of recognize and analyze the ROI details with the help of decision-making capability computer to get the desired results. It is the advanced-level task among all the image processing techniques. From the given image it takes some part of it then identifies, analyze and rectify the problems.

- Color extraction
- Image segmentation
- Features analysis
- Recognition of image and object.
- Image Enhancement of ROI

III. DESIGN

In this paper "Study and Analysis of Digital image enhancement" is carried with a target to fulfill these mentioned objectives is our goal. The main objectives are listed below:

a) To improve quality of image i.e. sharpness, clarity, contrast, brightness, details of objects in image.
b) To remove noise.
c) Ease of use.
d) Adjustment of an Image resolution.
e) The processed image should be more suitable to understand than original image.

Proposed Flowchart:

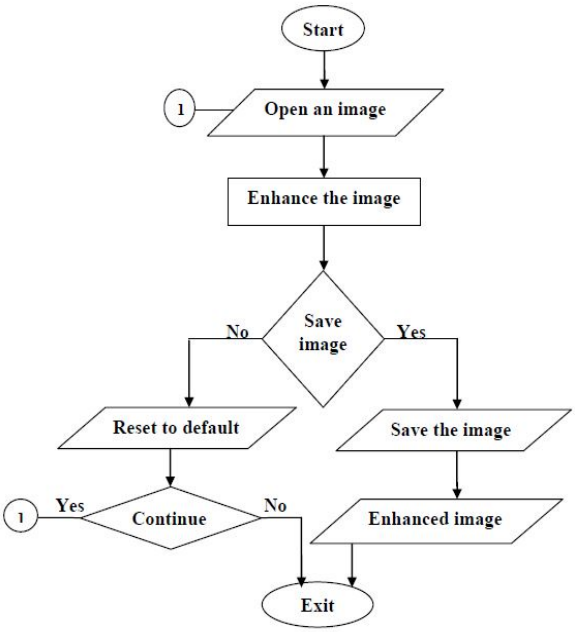
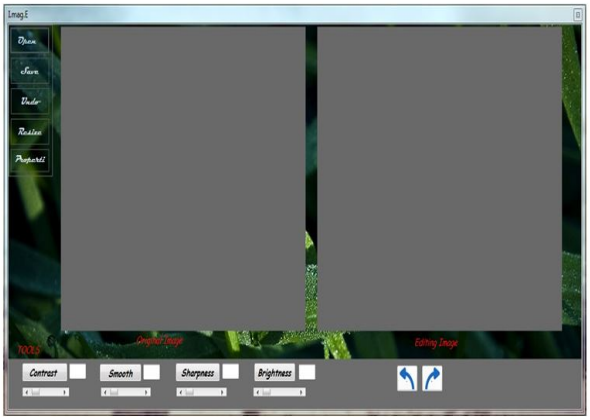


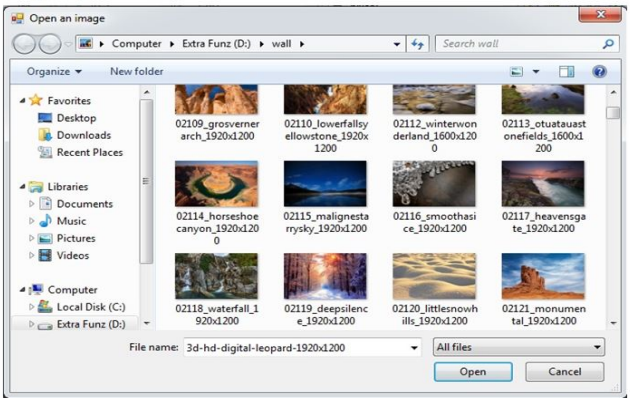
Fig: Flow Chart of Proposed Digital Image Enhancement

System design is the process of modeling different elements, module used in development of a project. It gives the graphical design of tasks need to be perform. Image processing as mentioned before there are various steps to do. The steps are image acquisition, analyzing, availability of techniques, applying the techniques and get the output. So, few snapshots are given below:

- Application Graphical Design



- **Image Acquisition Design**



- **Enhancing of images.**

IV. IMPLEMENTATION

The paper "Study and Analysis of Image Enhancement" is done with study and analysis of Image processing types with their different techniques. We have come up with basic image enhancement application software ***"I.mag.E"***, show how an image enhancer works and rectifying basic degradation in image to output an image with properties like clear, good contrast levels, brightness and sharpness. This application software is developing with some distinct features viz. as follows:

- **Contrast features:**

The contrast is the common and most important property of image. If the image is having low contrast then objects and background are less clarity, less perceptibility. So, adjustment of contrast gives advantage to overcome it easily through the techniques of **Contrast stretching**. This method of contrast enhancing is applied with **linear contrast stretching** technique (as mentioned earlier).

- **Smoothing features:**

Low-pass filtering method is used for smoothing of image. Smoothing makes the image less of rigidness and reduced noise. One disadvantages is when smoothing of image is done it produce new pixels as dotted noise.

- **Sharpness:**

Sharpness is the property that able to view the image's fine details. For sharpening of image, **High-pass filtering** method is applied. It gives output as better sharp and clear of image.

- **Converting a color image into negative image:**

Conversion can be done in different form of image like grayscale, hue, saturated, sepia, etc. We select to conversion into negative image only this is because negative image is give more contrast effect of color. The contrast property that are not able give can be overcome after conversion to negative image i.e. it gives more fine details of object and background. The method to convert a color image to negative image is apply by normalizing the intensity, taking an average of different color and subtracts every pixel by 255 each.

- **Rotation of image**

Rotation of image is image preprocessing technique that able to rotate the image in four angles i.e. 90^{o}, 180^{o}, 270^{o}, and 360^{o}. It is simple tool to rotate image. Rotating of image does not change the physical property of the image; actually it changes only in appearance.

V. CONCLUSION

This paper "Study and Analysis of Digital Image Enhancement" is selected because to understand the various techniques, knowledge of image processing that are applied in different fields, around 120 days has been spend to get our goals. In image enhancement the techniques available are not able to enhanced an image in desired output because of different samples or degraded image have various unexpected problems and also specific techniques to be apply in specific degraded functions. Since, the project touches only basics and low-level enhancing techniques able to give only few problems in image.

We conclude that, this project give us a chance to go through the world of Image processing. In future we look forward to do this kind of project. It's been a great pleasure to do such a project.

ACKNOWLEDGMENT FROM 2ND AUTHOR

I would like to thank **Dr.C.P.Alexander, Pro-Vice Chancellor, ICFAI University Nagaland**, for providing me with all the facilities needed for this project.

I would also like to give my heartfelt gratitude to my Internal Guide **Mr. Sanjib Das, Asst. Professor, Deptt. Of IT & Mathematics, ICFAI University Nagaland** for guiding while doing this project.

I would also like to acknowledge **Mr. Rupanka Bhuyan, Asst. Professor & HoD, Department of IT & Mathematics**, **ICFAI University Nagaland** for ideas and useful instructions needed for my project. Also, I would like to thank Sir **Kamal Hussain** for providing motivation and innovative tips and ideas.

REFERENCES

[1] An Introduction to computer Graphics, Sweta Verma
[2] Computer Graphics, 2nd Edition by Donald Hearn and M. Pauline Baker.
[3] Digital Image Processing, An Algorithmic Approach , by Madhuri A.Joshi
[4] Digital Image processing and Amalysis, By B.Chanda and D.Dutta Majumder
[5] www.georeference.org/doc/image_types.htm
[6] www.exelisvis.com/docs/Image_Types.html
[7] homepages.inf.ed.ac.uk/rbf/HIPR2/gryimage.htm
[8] rosettacode.org/wiki/Grayscale_image
[9] www.tannerhelland.com/3643/grayscale-image-algorithm-vb6/

[10] m.wisegeek.com/what-are-the-different-types-of-digital-image-processing-techniques.htm
[11] in.mathworks.com/help/matlab/creating_plots/image-types.html
[12] www.uio.no/studier/emner/matnat/math/MAT-INF1100/h08/kompendiet/images.pndf
[13] www.webopedia.com/TERM/R/resolution.html
[14] www.princeton.edu/~achaney/tmve/wiki100k/docs/RGB_color_model.html
[15] www.investintech.com/resources/articles/whatcompression/ cern_doc
[16] faraday.ee.emu.edu.tr/ee583/Lectures/EE%20583-Lecture01.pdf
[17] www.thefreedictionary.com/picture
[18] m.wisegeek.org/what-is-a-raster-image.htm
[19] www.cs.bham.ac.uk/~slb/courses/ kGraphics/g12.html
[20] en.m.wikipedia.org/wiki/Graphical_Kernel_System
[21] baikalweb.jinr.ru/doc//asdoc/gks_html3/node6.html
[22] www.ijrat.org/downloads/march-2014/paper%2520id-212014147.pdf
[23] en.m.wikipedia.org/wiki/Lossy_compression
[24] www.gifted.uconn.edu/siegle/HonorsSeminar/filetype.html
[25] en.m.wikipedia.org/wiki/Portable_Network_Graphics
[26] elib.mi.sanu.ac.rs/files/journals/kjm/32/kjom3209.pdf
[27] en.m.wikipedia.org/wiki/Mosaic
[28] in.mathworks.com/help/images/what-is-image-filtering-in-the-spatial-domain.html
[29] baikalweb.jinr.ru/doc/cern_doc/asdoc/gks_html3/node6.html
[30] www.scantips.com/basics1b.html
[31] www.owlnet.rice.edu/~elec539/Projects99/BACH/proj2/intro.html
[32] www.ssp.ece.upatras.gr/galatsanos/IMAGE%20RESTORATION.htm
[33] shonen.naun.org/multimedia/NAUN/bio/bio-2.pdf
[34] www.ijarcsse.com/docs/papers/April2012/Volume_2_issue_4/V2I4i0095.pdf
[35] www.tutorialspoi nt.com/dip/Histograms_Introduction.htm
[36] www.workwithcolor.com/color-properties-definitions-0101.htm
[37] www.mobileburn.com/definition.jsp?term=color+saturation
[38] paper.ijcsns.org/07_book/201002/20100222.pdf
[39] shonen.naun.org/multimedia/NAUN/bio/bio-2.pdf
[40] sse.tongji.edu.cn/linzhang/DIP13/slides/Lecture%252001-Introduction.pdf
[41] cmm.ensmp.fr/~hanbury/intro_ip/
[42] www.cse.unr.edu/~bebis/CS474/Lectures/IntensityTransformations.ppt
[43] www.utsa.edu/lrsg/Teaching/GEO5053_4093/L5_image%2520processing.ppt
[44] paper.ijcsns.org/07_book/201002/20100222.pdf
[45] nptel.ac.in/courses/117104069/chapter_9/9_1.html
[46] www.go4expert.com/articles/graphics-visual-basic-6-t30202/
[47] eeweb.poly.edu/~yao/EL5123/lecture3_contrast_enhancement.pdf
[48] www.philadelphia.edu.jo/academics/inaji/uploads/DIP8%2520-%2520Image%2520Enhancement%2520in%2520the%2520Spatial%2520Domain.ppt
[49] www.maerivoet.org/website/traffic/publications/resources/aitieitsd.pdf