A Study of AI based Technique in Image Processing

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ABSTRACT

Digital image processing is the process of manipulating digital image with the help of various algorithms which will result into the removal of any distortion of images while transfer or while storage. The image processing techniques will includes various methods like image enhancement, image restoration image segmentation ,image compression ,image manipulation ,image generation, image –to-image translation. This paper studies about different image processing task that can be performed on different types of images so as to enhance or restore the images.

Keywords: Image Processing, Image enhancement, Image Restoration ,Convolutional Neural Networks

1. Introduction

Image processing is defined as the process of doing some operations on images. An image is defined with a mathematical function $F(x,y)$,where x and y are the coordinated and the intensity F is defined at any pair of coordinates. Digital image is composition of elements known as pixels, which is known as elementary representation of the image. There are two types of image processing analog and digital .Analogue image processing deals with the hardcopy like printouts and photographs whereas the digital image processing deals with manipulating the images with the help of computers. Image processing will involve three steps, first is image acquisition, and second is analysis and manipulating the images and finally the output which includes altered image. Image processing is necessary to achieve a better quality image, to improve images for better human or computer interpretation. It also allows for easy electronic transfer of images. Also the digital image can be available in any format for interpretation. The different applications of image processing are in intelligent transport system, remote sensing, moving object detection, defense, and biomedical images. A wide research is being done in variety of fields in image processing like cancer imaging, brain imaging, development of automated software, development of instrumentation.

Image processing is divided into five major categories –retrieval of the image, restoration and sharpening, visualization, pattern recognition, and image recognition. The paper gives a literature review in section 2. Various tools and techniques are defined under section 3. Conclusion is given in section 4.

2. Literature Review

The use of artificial intelligence in medical fields is making new advancement. The use of deep learning in various fields of medical imaging provides with better results than any other technique. A convolutional neural network method was proposed to improve the image in term of enhancement was proposed in 2019 for unmanned air vehicles. Image quality is degraded in UAV images so use of CNN is suggested [1]. A CNN based model was proposed to improve low light enhancement, contrast adjustment, image de-noising or image super resolution. Convolutional neural network and deep learning methods are more effective because of the presence of neural processing unit. Combining

imaging sensors of high quality devices with the convolutional neural network will enhance the image [2]. In enhancing the images supervised as well as unsupervised learning models can be used. In case of unsupervised two phase multiple training technique like weight sharing has been used .In supervised case trained images are paired with target image and CNNs that learns from pre trained on the basis of parameters of transformation [3]. A deep learning based segmentation model was proposed for covid-19 CT images. The results have shown that the segmentation model improved the image quality by improving enhancement of image in terms of lesion pixel data [4]. A progressive stage-wise learning framework have been proposed to work under unsupervised method of learning. Here multilevel learning under multiple stages under deep learning was implemented. Three different task have been implemented jigsaw puzzle, image rotation and contrastive learning, for to improve learned feature representation [5]. Random spray retinex, an image enhancement algorithm have been implemented where RSR worked as preprocessing filter. The proposed system was high speed, area/energy efficient which worked on CMOS memrister. Also RSR was also used as preprocessing steps in artificial intelligence based computer systems [6].

3. Image Processing Techniques

Image processing plays an important role in image enhancement, analysis and manipulation. Adaptability, repetition and correctness in the original data preservation, are the principle advantages of digital image processing methods. The different image processing techniques are shown in the fig [1]. Some image processing techniques takes input and output images, while others take attributes of images in addition to the input images. The use of these technique is application specific.
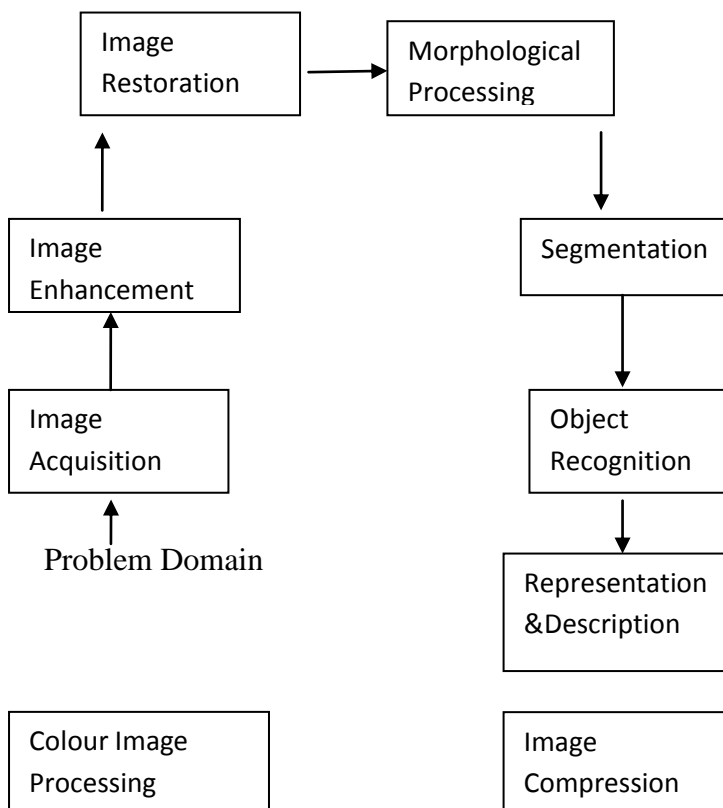
Fig1.Image processing Technique

a. Image Acquisition

An image is a two dimensional function f(u,v),with coordinates u and v are the plane coordinates with amplitude value f which is the intensity or the grey level. Acquiring the image plays a very important role because image processing techniques will not be effective is the images are not properly acquired.

b. Image Preprocessing

Image preprocessing is the process of enhancing few attributes of the images while suppressing some other attributes. Image preprocessing attributes includes the processes like reducing noise, Sharpening and smoothing, contrast enhancement and few advance like image segmentation.

c. Image Enhancement

The images captured from digital cameras or sensors or satellite lack in contrast and brightness. So image enhancement is to enhance the image quality in terms of contrast and brightness. It enhances few features that are concealed or to highlight some features of the image for better analysis. There are two types of image enhancement 1. Spatial domain method and the 2.Frequency domain method.

d. Image Restoration
The process of recovering the degraded or corrupted images by removing noise or blur so as to improve the appearance of image is known as image restoration. It can be done in two modes: spatial domain as well as frequency domain. In spatial domain action of filtering for restoring the images is obtained by operating directly on the pixels of the digital image and in frequency domain the mapping is done to obtain filtering. After the filtering, the image is remapped by inverse Fourier transform into spatial domain, to obtain the restored image. The use of any of the domains depends on the applications required.

e. Morphological Processing

Morphological is the process of applying a number of linear operations which extracts the image objects required for the representation and description of shapes. Some operations will check whether the pixel fits within the neighborhood while others check whether it hits or intersect the neighborhood. The morphological processes include the operations like erosion or dilation or a combination of both.

f. Image Segmentation

Image segmentation is the process of dividing an image into multiple segments to change the representation of the image which will be better in some form for analysis. Different image segmentation techniques are edge detection, region detection, thresholding and statistical classification. Image segmentation can ne combination of both region based as well as edge based.

g. Object Recognition

Object recognition is the process of classifying an object into its category based on its descriptors. It deals with training the computers to classify an image on the basis of various lighting conditions and various backgrounds. It has wide applications in surveillance, navigation and medical analysis.

h.   Image Data Compression

 Compression is the process of reducing the storage space of an image without degrading the quality of the image. It also reduces the time that is required to transmit the image over the internet or over the network. Compression can be both lossy as well as lossless compression techniques. Depending on the type of application any of the compression technique can be used.

4.   Convolutional Neural Network   in Image Processing

Image processing is manipulations of image in order to enhance it or extract information from it. The key phases of image processing are image acquisition, image enhancement, image restoration, image recognition and morphological processing. Artificial intelligence plays an important role in improving the quality of images using deep learning or neural networks .The different techniques which are now days being extensively used for mirror images are Convolutional neural network. CNNs are used for image classification and recognition because of their high accuracy. It is s hierarchical model that sets up the network in the form of funnel. It has three layers

1. Convolutional Layer

2. Pooling Layer

3. Fully Connected Layer

Convolutional layer is the initial layer and further pooling layers can be added to make more sophisticated and bigger network so as to grow the mesh network and provide more efficient result. CNN is a combination of neural networks which are basically the combination of individual units known as neurons. The neurons are combined in different layers.
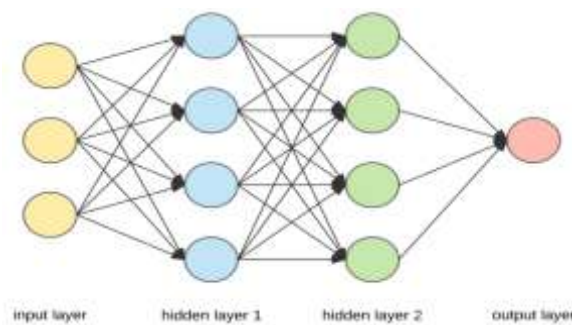

Fig2: Neurons Layer

The enhancement of images can be done by

1.   De noising Images

De noising where the use of any layer CNNs can be done. Multiple layers can increase the complexity and requires more computing power but the enhanced images are far better and accurate.

2. Low light Image Enhancement

It can be done using a number of methods where one is use of Retinex theory. IT removes the color distortions and grey zones.

3. Image Resolution

Further the use of generative adaptive network can be used for enhancing image by improving the resolution of the images.

A number of CNN architectures are available which are used a basic block of the algorithm. Some of them are LeNet, AlexNet, VGGNet, GoogLeNet and ResNet.
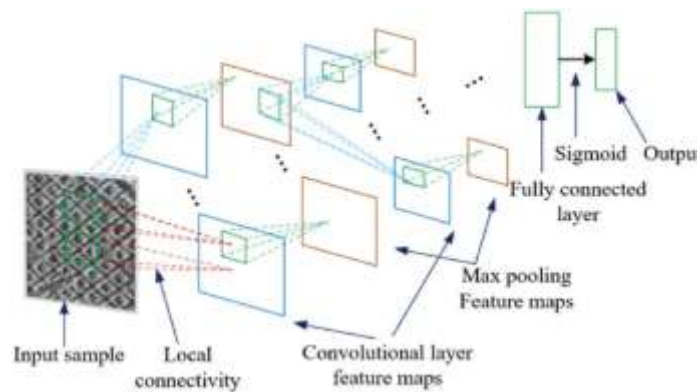

Fig3: Architecture of CNN

The working of a Convolutional neural network is as shown in fig.3 which has been given by Ning Li ,Heng Zhang, Zhen Zu, and Robert Wang [8].

5. Conclusion

As a number of AI based techniques are available to improve the quality of images, convolutional neural networks have been shown to give better and effective output quality images. Since these neural networks are pre-trained using deep learning techniques therefore they are more efficient and accurate in proposing the result output. Since the paper presented only simple image processing steps and the CNN technique ,these all can further be implemented on a different datasets with the help of different algorithms.

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