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## A MODERN ERA IN IMAGE PROCESSING

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### **Abstract**

The main objective of the Image Process is to extract important information from photographs, images in any format. Machines can generate view descriptions, interpretations, and understandings based on this extracted data. The main purpose of image editing is to transform your photos, images in a desired way. This expertise allows the user to capture the text of the image processing and save the data to disk in various formats. In other words, image processing is the process of neutralizing and analyzing the graphic information in a photograph. In day-today life, we see many types of images. The clearest example of image processing in our lives is how the brain perceives images. When our eyes perceive an image, the process is relatively short.

**Keyword:** Image processing, image acquisition, image segmentation, resizing of image, image visualization.

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### **Introduction**

#### **WHAT IS IMAGE PROCESSING?**

Digital image processing is a set of methods for manipulating digital images using computer algorithms. This is an essential preprocessing step in many applications such as: Face recognition, object recognition, and image compression.

Image processing is performed to enhance existing images or extract important information from them. This is important in several deep learning-based computer vision applications where such preprocessing can significantly improve model performance. Manipulating images, such as adding or removing objects from images, is another application, especially in the entertainment industry.

Image processing is a method of performing some operation on an image to obtain an enhanced image or extract useful information from it. It is a type of signal processing where the input is an image and the output is an image or properties/features associated with that image.

#### **HOW MACHINES “SEE” IMAGES?**

A digital image is interpreted by a computer as a 2D or 3D matrix, with each value or pixel in the matrix representing an amplitude known as the pixel's "intensity". We are usually used to working with 8-bit images with amplitude values between 0 and 255. Here's how a computer "sees" a digital image as a function.  $I(x,y)$  or  $I(x,y,z)$ . "I" is the pixel intensity and  $(x,y)$  or  $(x,y,z)$  are the coordinates (for binary/grayscale or RGB images).



Fig 1: What we See?



Fig 2: What Computer See's

## TYPES OF IMAGES

Computers deal with different "types" of images based on functional representations. Let's examine them next.

### 1. Binary Image

Binary images are made up of pixels that can be exactly one of two colors usually black and white - 0 (representing black) and 1 (representing white) are called binary images. Such images are generally used to highlight a discriminating portion of a colored image.

### 2. Grayscale Image

A grayscale image is a simple image with only shades of gray in color. The reason such images are distinguished from other types of color images is that they provide less information for each pixel. A grayscale (8-bit) image consists of 256 different colors, with a pixel intensity of 0 representing black and a pixel intensity of 255 representing white. All the other 254 values in between are various shades of gray.

### 3. RGB Color Image

The images we are familiar with in the modern world are RGB or color images, which are 16-bit matrices for computers. This means that each pixel can have 65,536 different colors. "RGB" stands for the red, green, and blue "channels" of an image.

So far, we've had images with only one channel. That is, two coordinates can define the position of any value in the matrix. Currently, we have three equal-sized matrices (called channels) stacked

on top of each other, each with values between 0 and 255, so we need three unique coordinates to specify the values of the matrix elements.

Therefore, a pixel in an RGB image is black if the pixel value is (0, 0, 0) and white if it is (255, 255, 255). Combinations of numbers in between result in all the different colors found in nature. For example, (255, 0, 0) is red (because only the red channel is enabled for this pixel). Similarly, (0, 255, 0) is green and (0, 0, 255) is blue.

#### PHASES OF IMAGE PROCESSING

The fundamental steps in any typical Digital Image Processing pipeline are as follows:

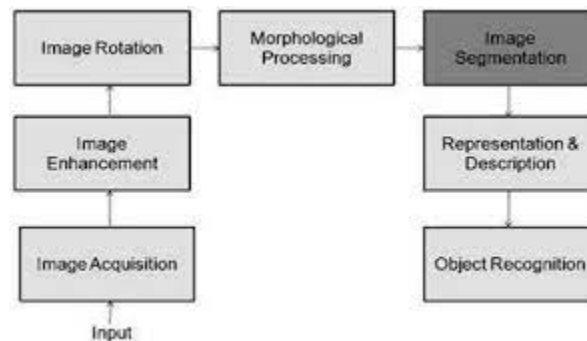


Fig 3: Image Processing Phases

#### 1. Image Acquisition

Image acquisition is the first step in image processing. This step is also known as image preprocessing. This involves getting the image from a source, usually a hardware-based source. Images are captured by a camera and digitized using an analog-to-digital converter for further processing by a computer (if the camera output is not automatically digitized).

#### 2. Image Enhancement

In this step, we manipulate the captured images to meet the requirements of the specific task in which they are used. Such techniques are primarily aimed at bringing out hidden or important details in images such as contrast and brightness adjustments. Image enhancement, by its very nature, is highly subjective.

#### 3. Image Restoration

Image restoration is the process of taking a corrupted/noisy image and estimating a clean original image. Corruption can come in many forms, including: Camera motion blur, noise, and defocus. This step deals with improving the appearance of the image and is an objective operation as image degradation can be attributed to mathematical or probabilistic models. For example, remove noise or blur from an image.

#### 4. Color Image Processing

This step is intended to handle processing of color images (16-bit RGB), such as performing image color correction or color modeling.

#### 5. Image Compression

To transfer images to other devices or due to storage limitations, images must be compressed and cannot be saved in their original size. This is also important when displaying images over the Internet. For example, on Google, small image thumbnails are heavily compressed versions of the original image. Only when you click on the image will it appear in its original resolution. This process saves server bandwidth.

### **7. Morphological Processing**

Image components that help represent and describe shapes should be extracted for further processing or downstream tasks. Morphological processing provides tools (essentially mathematical operations) to achieve this. For example, the Erosion and Stretching operations are used to sharpen and blur the edges of objects in the image, respectively.

### **8. Image Segmentation**

This step divides the image into different main parts in order to simplify the representation of the image or change it into something more meaningful and easier to analyze. Image segmentation allows computers to focus their attention on the more important parts of an image and discard the rest, improving the performance of automated systems.

### **9. Representation and Description**

This step is usually followed by an image segmentation method. In this method, the display's task is to decide whether to display the segmented region as a boundary or as a complete region. This discussion deals with the extraction of attributes that lead to quantitative information of interest or are fundamental to distinguishing objects of one class from another.

### **10. Object Detection and Recognition**

After the objects have been segmented from the image and the rendering and description phases have completed, the automated system should assign labels to the objects. This allows human users to know which objects have been recognized (such as "vehicle" or "person").

## **IMAGE PROCESSING TECHNIQUES**

Image processing can be used to improve image quality, remove unwanted objects from an image, or even create a new image from scratch. For example, image processing can be used to remove the background from an image of a person, leaving only the foreground subject.

Image processing is a vast and complex field with many different algorithms and techniques that can be used to achieve different results. This section focuses on the most common image processing tasks and how to perform them.

There are 6 different techniques used in image processing explain as below:

#### **1. Image Generation Technique (GAN)**

Generative Adversarial Networks (GANs) can be used to train deep learning models on images to generate images of the same type.

GAN consists of two different models generator Discriminator

The generator's job is to generate fake images, and the discriminator tries to classify fake and real images. During training, the generator tries to outsmart the discriminator by producing better fake images, and the discriminator tries to improve itself to distinguish between real and fake images.

#### **2. Template matching**

Template matching is a method of searching and locating templates within a large image. You can think of this as a very simplistic approach to object detection. Template matching slides the template image over the larger image to find matches, similar to the convolution process.

#### **3. Pixelation**

Pixelation occurs when an image is increased in size so that individual pixels are visible, or when pixels are stretched beyond their original size.

In computer graphics, pixelation occurs by displaying a bitmap or portion of a bitmap at a size such that the individual pixels, the small solid-color square display elements that make up the bitmap, are visible. Such images are called pixelated.

#### 4. Independent Component Analysis

Independent Component Analysis (ICA for short) is a technique for separating a multivariate signal into its underlying components. ICA helps extract a desired component from a mixture of multiple components or signals.

#### 5. Linear filtering

Linear filtering is a process in which the value of an output pixel is a linear combination of adjacent input pixels. This process is done by a technique called convolution.

Convolution is the process of adding each element of an image to its local neighborhood, weighted by a kernel.

#### 6. Image restoration

Photos degrade for a variety of reasons. For example, old photos of grandparents taken with his old high-tech camera can be blurry or lose their original shape.

This can happen if the image has been subjected to physical stress or, if in digital format, can be corrupted by motion blur or added noise.

#### Applications

Image Processing is used in various applications such as:

- Remote Sensing
- Medical Imaging
- Non-destructive Evaluation
- Forensic Studies
- Textiles
- Material Science.
- Military
- Film industry
- Document Processing
- Graphic Arts
- Printing Industry

#### Conclusion

Digital image processing is used not only in computer science, but also in other areas of computer science, engineering and technology. This article provides a comprehensive overview of various types image, phases of image processing and different image processing techniques and its diverse applications.

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