



A COMPREHENSIVE REVIEW ON DIGITAL IMAGE PROCESSING

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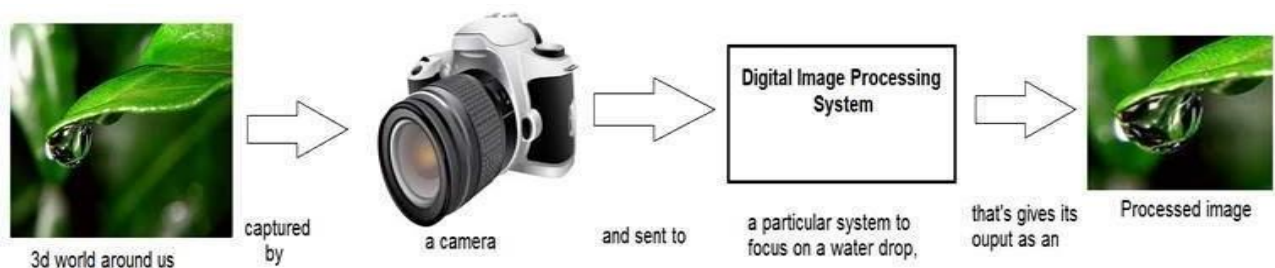
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Abstract: Digital Image Processing means processing digital image by means of a digital computer. We can also say that it is a use of computer algorithms, in order to get enhanced image either to extract some useful information. Digital image processing deals with manipulation of digital images through a digital computer. It is a subfield of signals and systems but focus particularly on images.

Keywords- Image Processing, Algorithms.

1. INTRODUCTION

Digital Image Processing means processing digital image by means of a digital computer. We can also say that it is a use of computer algorithms, in order to get enhanced image either to extract some useful information. Digital image processing deals with manipulation of digital images through a digital computer. It is a subfield of signals and systems but focus particularly on images. DIP focuses on developing a computer system that is able to perform processing on an image. The input of that system is a digital image and the system process that image using efficient algorithms, and gives an image as an output. The most common example is Adobe Photoshop. It is one of the widely used application for processing digital images.



In the above figure, an image has been captured by a camera and has been sent to a digital system to remove all the other details, and just focus on the water drop by zooming it in such a way that the quality of the image remains the same.

Image processing mainly include the following steps:

1. Importing the image via image acquisition tools;
2. Analyzing and manipulating the image;
3. Output in which result can be altered image or a report which is based on analyzing that image.

4. WHAT IS AN IMAGE?

An image is defined as a two-dimensional function, $F(x,y)$, where x and y are spatial coordinates, and the amplitude of F at any pair of coordinates (x,y) is called the **intensity** of that image at that point.

When x,y , and amplitude values of F are finite, we call it a **digital image**.

In other words, an image can be defined by a two-dimensional array specifically arranged in rows and columns.

$$f(x,y) = \begin{bmatrix} f(0,0) & f(0,1) & f(0,2) & \dots & f(0,N-1) \\ f(1,0) & f(1,1) & f(1,2) & \dots & f(1,N-1) \\ \cdot & \cdot & \cdot & \dots & \cdot \\ \cdot & \cdot & \cdot & \dots & \cdot \\ \cdot & \cdot & \cdot & \dots & \cdot \\ f(M-1,0) & f(M-1,1) & f(M-1,2) & \dots & f(M-1,N-1) \end{bmatrix}$$

Digital Image is composed of a finite number of elements, each of which elements have a particular value at a particular location. These elements are referred to as *picture elements*, *image elements*, and *pixels*. A *Pixel* is most widely used to denote the elements of a Digital Image.

1.1 TYPES OF AN IMAGE

- **BINARY IMAGE**– The binary image as its name suggests, contain only two pixel elements i.e 0 & 1, where 0 refers to black and 1 refers to white. This image is also known as Monochrome.
- **BLACK AND WHITE IMAGE**– The image which consist of only black and white color is called BLACK AND WHITE IMAGE.
- **8 bit COLOR FORMAT**– It is the most famous image format. It has 256 different shades of colors in it and commonly known as Grayscale Image. In this format, 0 stands for Black, and 255 stands for white, and 127 stands for gray.
- **16 bit COLOR FORMAT**– It is a color image format. It has 65,536 different colors in it. It is also known as High Color Format. In this format the distribution of color is not as same as Grayscale image.
- A 16 bit format is actually divided into three further formats which are Red, Green and Blue. That famous RGB format.
- *Image as a Matrix*
- As we know, images are represented in rows and columns we have the following syntax in which images are represented:

- The right side of this equation is digital image by definition. Every element of this matrix is called image element, picture element, or pixel.

THE ORIGIN OF DIP:

One of the first application of digital image was in the **newspaper industry**, when picture were first sent by submarine cable between London and New York. **Bartlane** cable picture transmission system (1920s) f

Transport a picture : a week < 3 hours



Digital image produced in 1921 from a coded tape by a telegraphprinter with special type faces

A Digital Picture Made in 1922



From a tape perforated at the telegraph Receiving terminal purchased after the Signals had cross the Atlantic twice.



The Improvements over previous pictures are Evident, both in tonal quality and resolution.

Unretouched cable picture of Generals Pershing and Foch, transmitted in 1929 From London to New York by 15 tone Equipment.

2. IMAGE PROCESSING APPLICATIONS

- The late 1960's and early 1970's
- Medical imaging
- Remote earth resources observation
- Astronomy
- Computerized Axial Tomography(CAT)

3. EXAMPLES OF FIELDS THAT USE DIP

- Electromagnetic Spectrum
- Acoustic
- Ultrasonic
- Electronics
- Gamma-Ray Imaging
- X-Ray Imaging
- Imaging in the Ultraviolet Band
- Imaging in the Visible and Infrared Bands
- Imaging in the Microwave Band
- Imaging in the Radio Band
- Examples in which other imaging modalities are used

4. DIGITAL REPRESENTATION

Definition. In computer science, the **representation** of an **image** can take many forms. Most of the time, it refers to the way that the conveyed information, such as color, is coded digitally and how the **image** is stored, i.e., how is structured an **image** file. After an **image** has been segmented into object and background regions, one intends to represent and **describe** them in characteristic features for computer processing during pattern recognition or in quantitative codes for efficient storage during **image** compression. A **digital image** is an **image** composed of **picture** elements, also known as pixels, each with finite, discrete quantities of numeric **representation** for its intensity or gray level that is an output from its two-dimensional functions fed as input by its spatial coordinates denoted with x, y on the x-axis and y-axis. To store an **image** on a computer, the **image** is broken down into tiny elements called pixels. A **pixel** (short for **picture** element) **represents** one colourIn order for the computer to store the **image**, each pixel is **represented** by a binary value. We call this representation of colours a “bit-plane”.

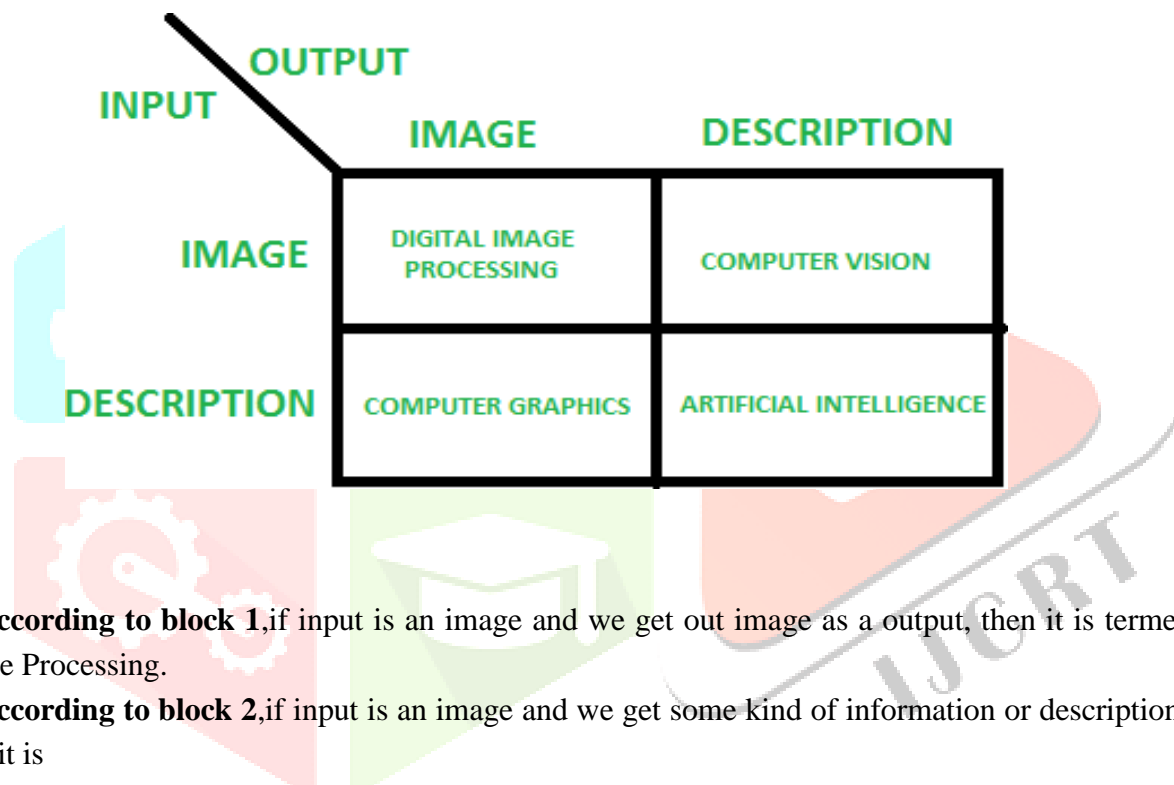
5. FUNDAMENTAL STEPS IN DIP OR PHASES OF IMAGE PROCESSING:

1. **ACQUISITION**– It could be as simple as being given an image which is in digital form. The mainwork involves:
 - a) Scaling
 - b) Color conversion(RGB to Gray or vice-versa)
2. **IMAGE ENHANCEMENT**– It is amongst the simplest and most appealing in areas of Image Processing it is also used to extract some hidden details from an image and is subjective.
3. **IMAGE RESTORATION**– It also deals with appealing of an image but it is objective(Restoration is based on mathematical or probabilistic model or image degradation).
4. **COLOR IMAGE PROCESSING**– It deals with pseudo color and full color image processing color models are applicable to digital image processing.
5. **WAVELETS AND MULTI-RESOLUTION PROCESSING**– It is foundation of representing images in various degrees.
6. **IMAGE COMPRESSION**-It involves in developing some functions to perform this operation. It

mainly deals with image size or resolution.

7. **MORPHOLOGICAL PROCESSING**-It deals with tools for extracting image components that are useful in the representation & description of shape.
8. **SEGMENTATION PROCEDURE**-It includes partitioning an image into its constituent parts or objects. Autonomous segmentation is the most difficult task in Image Processing.
9. **REPRESENTATION & DESCRIPTION**-It follows output of segmentation stage, choosing a representation is only the part of solution for transforming raw data into processed data.
10. **OBJECT DETECTION AND RECOGNITION**-It is a process that assigns a label to an object based on its descriptor.

7. OVERLAPPING FIELDS WITH IMAGE PROCESSING



According to block 1, if input is an image and we get out image as a output, then it is termed as Digital Image Processing.

According to block 2, if input is an image and we get some kind of information or description as a output, then it is termed as Computer Vision.

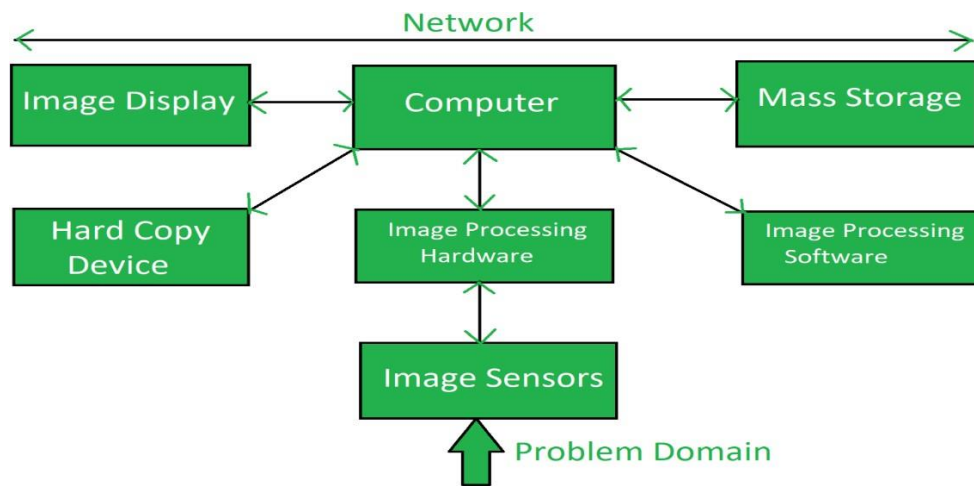
According to block 3, if input is some description or code and we get image as an output, then it is termed as Computer Graphics.

According to block 4, if input is description or some keywords or some code and we get description or some keywords as a output, then it is termed as Artificial Intelligence

8. COMPONENTS OF DIGITAL IMAGE PROCESSING

Image Processing System is the combination of the different elements involved in the digital image processing. Digital image processing is the processing of an image by means of a digital computer. Digital image processing uses different computer algorithms to perform image processing on the digital images.

It consists of following components:-



- **Image Sensors:**
Image sensors sense the intensity, amplitude, co-ordinates and other features of the images and pass the result to the image processing hardware. It includes the problem domain.
- **Image Processing Hardware:**
Image processing hardware is the dedicated hardware that is used to process the instructions obtained from the image sensors. It passes the result to the general purpose computer.
- **Computer:**
Computer used in the image processing system is the general purpose computer that is used by us in our daily life.
- **Image Processing Software:**
Image processing software is the software that includes all the mechanisms and algorithms that are used in the image processing system.
- **Mass Storage:**
Mass storage stores the pixels of the images during the processing.
- **Hard Copy Device:**
Once the image is processed, it is stored in the hard copy device. It can be a pen drive or any external ROM device.
- **Image Display:**
It includes the monitor or display screen that displays the processed images.
- **Network:**
Network is the connection of all the above elements of the image processing system.

9. CONCLUSION:

In this paper, we studied about digital image processing. What is an image. This paper can help you in understanding basic terms of image processing. Digital Image Processing means processing a digital image by means of a digital computer. We can also say that it is a use of computer algorithms, in order to get enhanced images either to extract some useful information. By using digital image processing, we can create digital images by using different techniques or software's. You can convert your image into grayscale or 16-bit image.

10. REFERENCES

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