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Digital Image Processing and its applications

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Abstract - In this paper, an application of digital image processing and analysis techniques has been discussed, which can be useful in many fields like signature recognition, face recognition, in automobile detection and in military applications. The importance of image processing and its applications to the field of computer vision is carried out in this paper. Each of these applications has its basic requirements, which may be unique from the others. An image is defined as an array, or a matrix, of square pixels arranged in rows and columns. Image processing is a procedure of converting an image into digital form and carry out some operation on it, in order to get an improved image and to retrieve some important information from the image.

Keywords: DIP, Signal, UV, Edges

I. INTRODUCTION

Signal processing is a discipline in electrical engineering and in mathematics that deals with analysis and processing of analog and digital signals, and deals with storing, filtering and other operations on signals. These signals include transmission signals, sound or voice signals, image signals, and other signals e.t.c. Out of all these signals, the field that deals with the type of signals for which the input is an image and the output is also an image is done in image processing. As its name suggests, it deals with the processing on images. It can be further divided into analog image processing and digital image processing.

Nowadays, image processing is among rapidly growing technologies. It forms core research area within engineering and computer science disciplines too. Image processing basically includes the following three steps: 1) Importing the image via image acquisition tools; 2) Analysing and manipulating the image; 3) Output in which result can be altered image or report that is based on image analysis.



This is the first digital photo

A. Analog image processing

Analog image processing is done on analog signals. It includes processing on two dimensional analog signals. In this type of processing, the images are manipulated by electrical means by varying the electrical signal. The common example include is the television image. Digital image processing has dominated over analog image processing with the passage of time due its wider range of applications.

B. Digital image processing

The digital image processing deals with developing a digital system that performs operations on an digital image.

C. What is an Image

An image is nothing more than a two dimensional signal. It is defined by the mathematical function $f(x,y)$ where x and y are the two co-ordinates horizontally and vertically. The value of $f(x,y)$ at any point is gives the pixel value at that point of an image.



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The above figure is an example of digital image that you are now viewing on your computer screen. But actually, this image is nothing but a two dimensional array of numbers ranging between 0 and 255.

D. Relationship between a digital image and a signal

If the image is a two dimensional array then what does it have to do with a signal? In order to understand that , We need to first understand what is a signal

E. Signal

In physical world, any quantity measurable through time over space or any higher dimension can be taken as a signal. A signal is a mathematical function, and it conveys some information. A signal can be one dimensional or two dimensional or higher dimensional signal. One dimensional signal is a signal that is measured over time. The common example is a voice signal. The two dimensional signals are those that are measured over some other physical quantities. The example of two dimensional signal is a digital image. We will look in more detail in the next tutorial of how a one dimensional or two dimensional single and higher signals are formed and interpreted.

F. Relationship

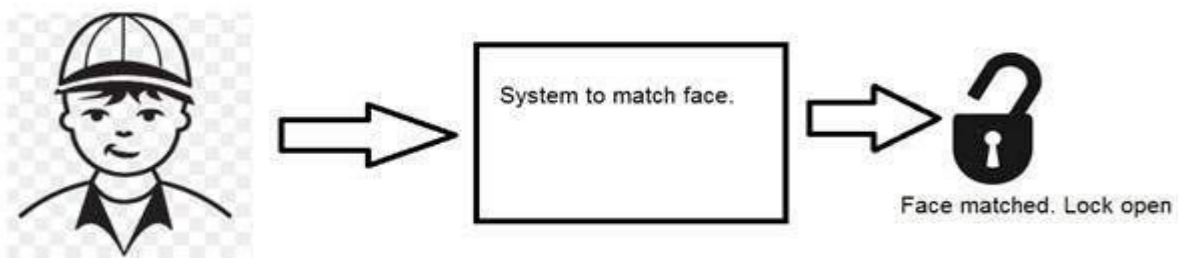
Since anything that conveys information or broadcast a message in physical world between two observers is a signal. That includes speech or (human voice) or an image as a signal. Since when we speak , our voice is converted to a sound wave/signal and transformed with respect to the time to person we are speaking to. Not only this , but the way a digital camera works, as while acquiring an image from a digital camera involves transfer of a signal from one part of the system to the other.

G. How a digital image is formed

Since capturing an image from a camera is a physical process. The sunlight is used as a source of energy. A sensor array is used for the acquisition of the image. So when the sunlight falls upon the object, then the amount of light reflected by that object is sensed by the sensors, and a continuous voltage signal is generated by the amount of sensed data. In order to create a digital image , we need to convert this data into a digital form. This involves sampling and quantization. (They are discussed later on). The result of sampling and quantization results in an two dimensional array or matrix of numbers which are nothing but a digital image.

H. Machine/Computer vision

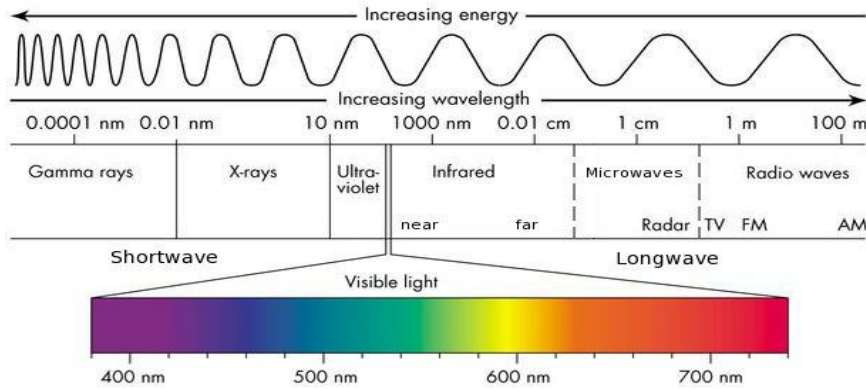
Machine vision or computer vision deals with developing a system in which the input is an image and the output is some information. For example: Developing a system that scans human face and opens any kind of lock. This system would look something like this.



I. Sources of Digital Images

Digital Image processing is not just limited to adjust the spatial resolution of the everyday images captured by the camera. It is not just limited to increase the brightness of the photo, e.t.c. Electromagnetic waves can be thought of as stream of particles, where each particle is moving with the speed of light. Each particle contains a bundle of energy. This bundle of energy is called a photon. The electromagnetic spectrum according to the energy of photon is shown below.

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In this electromagnetic spectrum, we are only able to see the visible spectrum. Visible spectrum mainly includes seven different colors that are commonly term as (VIBGOYR). VIBGOYR stands for violet , indigo , blue , green , orange , yellow and Red.

J. Applications of Digital Image Processing

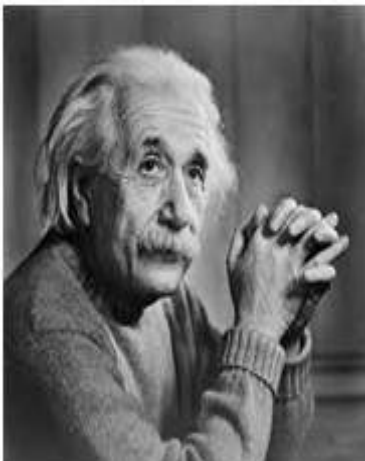
- 1) Image sharpening and restoration
- 2) UV Imaging
- 3) Medical field
- 4) Remote sensing
- 5) Transmission and encoding
- 6) Machine/Robot vision
- 7) Color processing
- 8) Pattern recognition
- 9) Video processing
- 10) Microscopic Imaging. Many applications have in DIP. But, here we taken only two applications

K. Image sharpening and restoration

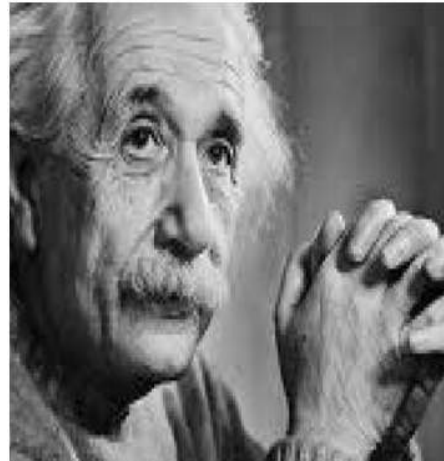
Image sharpening and restoration refers here to process images that have been captured from the modern camera to make them a better image or to manipulate those images in way to achieve desired result. It refers to do what Photoshop usually does.

This includes Zooming, blurring , sharpening , gray scale to color conversion, detecting edges and vice versa , Image retrieval and Image recognition. The common examples are:

The original image

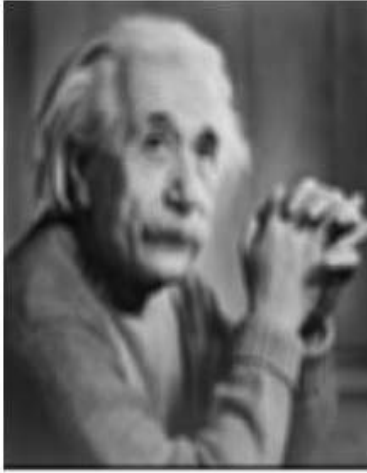


The Zoomed image

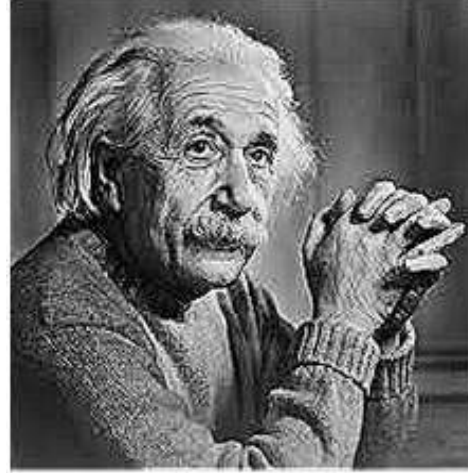


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Blur Image



Sharp Image



Edges



L. UV imaging

In the field of remote sensing, the area of the earth is scanned by a satellite or from a very high ground and then it is analyzed to obtain information about it. One particular application of digital image processing in the field of remote sensing is to detect infrastructure damages caused by an earthquake.

As it takes longer time to grasp damage, even if serious damages are focused on. Since the area effected by the earthquake is sometimes so wide, that it not possible to examine it with human eye in order to estimate damages. Even if it is, then it is very hectic and time consuming procedure. So a solution to this is found in digital image processing. An image of the effected area is captured from the above ground and then it is analyzed to detect the various types of damage done by the earthquake.

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The key steps include in the analysis are

- 1) The extraction of edges
- 2) Analysis and enhancement of various types of edges

II. CONCLUSION

In this paper, aspect of photography considering that technology keeps changing. There are a mass of digital image processing techniques that provides a wide application variety in feature extraction and classification. The systems have the capability to realize perfect results. A poorly selected set of features will realize poor partitioning rates by any neural network. The concept is one of the most important in the modern day photography and use of digital image processing.

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