Image Acquisition and Techniques to Perform Image Acquisition

Vikas Kumar Mishra[*1], Shobhit Kumar[2] and Neeraj Shukla[3]

1*. Asst. Prof. Dept. of Computer Engineering, UIET, BBA Central University, Lucknow, (U.P.), India. e-mail : mail2vym@gmail.com
2. Asst. Prof. Dept. of Information Technology, Rajkiya Engineering College, Ambedkar Nagar, (U.P.), India.
e-mail : shobhit5786@gmail.com
3. Asst. Prof. Dept of Computer Science, School of Management Sciences, Lucknow, (U.P.), India. e-mail : neer1980@gmail.com

Publication Info

Article history :
Received : 25th Oct. 2016
Accepted : 02nd Feb. 2017
DOI : 10.18090/samriddhi.v9i01.8333

Keywords :
Digital Image, Spectrum, Quantum detectors, Image Acquisition.

***Corresponding author :**
Vikas Kumar Mishra
e-mail : mail2vym@gmail.com

Abstract

In the present scenario images have become the most suitable way to keep our past alive. Nowadays people are very busy in earning their livelihood and day to day life, even though they want to keep their golden moment alive for the rest of life. Images have touched almost all the fields like medical, sports, social networking and many more. It is the need of time to know how the images are being captured and stored into memory.

To deal with images and before analyzing them the most important thing is to capture the image. This is called as Image Acquisition. Image Acquisition is achieved by suitable camera. We use different cameras for different application. If we need an X-Ray image, we use a camera (film) which is sensitive to X-Rays. If we want Infra Red image, we use cameras which are sensitive to Infra Red radiations. For normal images (family pictures etc.) we use cameras which are sensitive to visual spectrum.

1. INTRODUCTION

An image can be defined as a 2-D function f(x,y) where (x, y) is co-ordinate in two dimensional space and f is the intensity of that co-ordinate[1]. Each co-ordinate position is called as pixel. Pixel is the smallest unit of the image it is also called as picture element or pel. So digital images are composed of pixels, each pixel represents the color (gray level for black and white images) at a single point in the image. Pixel is like tiny dot of particular color. A digital image is a rectangular array of pixels also called as Bitmap. From the point of view of photography the digital images are of two types [2][3]

- Black and white Images
- Color Images

1.1 Black and White Images

Black and white images are made of different shades of gray. These different shades lies between 0 to 255, where 0 refers to black, 255 refers to white and intermediate values refer to different shades of black and white. Grayscale refers to the range of neutral tonal values (shades) from black to white.

1.2 Color Image

Color images are made up of colored pixels. Color can capture a much broader range of values than grayscale. “The spectrum – the band of colors produced when sunlight passes through a prism – includes billions of colors, of which the human eye can perceive seven to ten million”. The electronic capture and display of color is complicated. RGB (Red, Green, and Blue) is the most commonly adopted color system.

Example: A one-bit image can assign only one of two values to a single pixel: 1 or 0 (black or white). An 8-bit (28) grayscale image can assign one of 256 colors to a single pixel. A 24-bit (2(3x8)) RGB image (8-bits each for red, green and blue color channels) can assign one of 16.8 million colors to a single pixel.

Table-1: Shades/Colors Depends on the Bits Required to Represent the Digital Image

Bits/Digital Image type	Shades/colors
8 bits black and white image	256 shades
24 bits colored	16.8 million color
10 bits black and white image	1024 shades
30 bits colored	1 billion color
12 bits black and white image	4096 shades
36 bits colored image	68.7 billion colors

2. IMAGE ACQUISITION

The general aim of Image Acquisition is to transform an optical image (Real World Data) into an array of numerical data which could be later manipulated on a computer, before any video or image processing can commence an image must be captured by camera and converted into a manageable entity [4]. The Image Acquisition process consists of three steps:-

1. Optical system which focuses the energy
2. Energy reflected from the object of interest
3. A sensor which measure the amount of energy.

Image Acquisition is achieved by suitable camera. We use different cameras for different application. If we need an x-ray image, we use a camera (film) that is sensitive to x-ray. If we want infra red image, we use camera which are sensitive to infrared radiation. For normal images (family pictures etc) we use cameras which are sensitive to visual spectrum. Image Acquisition is the first step in any image processing system.

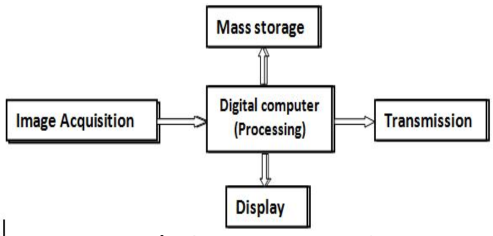

Fig.1: Image Processing

3. IMAGE ACQUISITION CONCEPT

In order to capture an image a camera requires some sort of measurable energy. The energy of interest in this context is light or more generally electromagnetic waves. An EM waves can be described as mass less entity, a photon, whose electric and magnetic field varies sinusoidaly, hence the name waves. A photon can be described in three different ways:-

1. A photon can be described By its energy E (measured in eV)
2. A photon can be described by its frequency f (H_2)
3. A photon can be described by its wave length λ(m)

$$E = (hc)/\lambda$$

$$E = hf$$

4. QUANTUM DETECTORS

Quantum Detector is the most important mechanism of image sensing and acquisition it relies upon the energy of absorbed photon being used to promote electrons from their stable state to a higher state above an energy threshold. Whenever this occurs, the properties of that material get altered in some measurable way.

Planck/Einstein came up with a relationship between λ of the incident photon and the E that it carries:-

$$E = (hc)/\lambda \qquad (1)$$

S-JPSET : Vol. 9, Issue 1, ISSN : 2229-7111 (Print) & ISSN : 2454-5767 (Online)

On collision the photon transfer all or none of this quantum of energy to the electron.

5. IMAGE ACQUISITION MODEL

The images are generated by combination of an illumination source and the reflection or absorption of the energy by the elements of scene being imaged. Illumination may be originated by radar, infrared energy source, computer generated energy pattern, ultrasound energy source, X-ray energy source etc.

To sense the image, we use sensor according to the nature of illumination. The process of image sense is called image acquisition.

By the sensor, basically illumination energy is transformed into digital image. The idea is that incoming illumination energy is transformed into voltage by the combination of input electrical energy and sensor material that is responsive to the particular energy that is being detected. The output waveform is response of sensor and this response is digitalized to obtain digital image.

Image is represented by 2-D function f(x, y). Practically an image must be non-zero and finite quantity that is [1]:

$$0< f(x, y) <``\infty \qquad (2)$$

- It is also discussed that for an image f (x, y), we have two factors:
- The amount of source illumination incident on the scene being imaged. Let us represent it by :

$$i(x, y)$$

The amount of illumination reflected or absorbed by the object in the scene. Let us represent it by:

$$r(x, y)$$

Then f(x, y) can be represented by :

$$f(x, y) = i(x, y).r(x, y) \qquad (3)$$

Where $0< i(x, y)<``$

It means illumination will be a non-zero and finite quantity and its quantity depends on illumination source.

and $0< r(x, y)<1$

Here 0 indicates no reflection or total absorption and 1 means no absorption or total reflection.

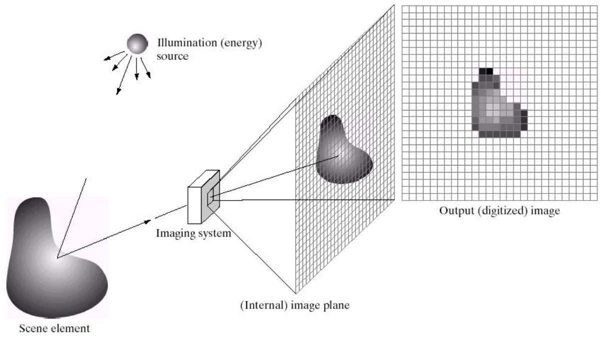

Fig.2: Image Acquisition Model

6. TECHNIQUES TO PERFORM IMAGE ACQUISITION

Image Acquisition process totally depends on the hardware system which may have a sensor that is again a hardware device. A sensor converts light into electrical charges. The sensor inside a camera measures the reflected energy by the scene being imaged. The image sensor employed by most digital cameras is a charge coupled device (CCD) [5]. Some cameras use complementary metal oxide semiconductor (CMOS) technology instead [5].

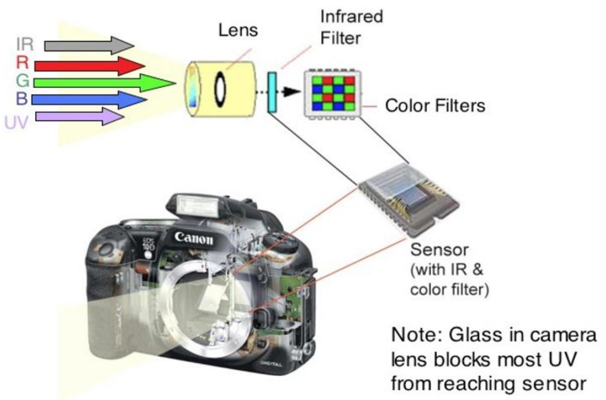

Fig.3: Inside a Digital Camera

Both CCD and CMOS image sensors convert light into electrons. A simplified way to think about these sensors is to think of a 2-D array of thousands or millions of tiny solar cells. (in this case the sensors are called photosites). Once the sensor converts the light into electrons, it reads the value (accumulated charge) of each cell in the image. A CCD transports the charge across the chip and reads it at one corner of the array. An analog-to-digital converter (ADC) then turns each pixel's value into a digital value by measuring the amount of charge at each photosite and converting that measurement to binary form. CMOS devices use several transistors at each pixel to amplify and move the charge using more traditional wires. CCD sensors create high-quality, low-noise images. CMOS sensors are generally more susceptible to noise.

CMOS sensors traditionally consume little power. CCDs, on the other hand, use a process that consumes lots of power. CCDs consume as much as 100 times more power than an equivalent CMOS sensor. CCD sensors have been mass produced for a longer period of time, so they are more mature. They tend to have higher quality pixels, and more of them.

7. CONCLUSION

The Image Acquisition is purely Hardware Dependent Process, in which reflected light energy from the object being imaged is converted into electrons and spread over the internal sensor chip which is like a 2-D array of cells is cell is called photosite and contain amount of charges which is further converted to digital form using Analog to Digital Converter.

Now this digital image can be used for enhancement, restoration, segmentation and other manipulations.

REFERENCES

[1] A. yadav, P. Yadav, "Digital Image Processing", University Science Press, 2009.

[2] Jonathan Sachs, "Digital Image Basics", Digital Light and Color, 1996-1999.

[3] Melanie Cofield, "Digital Imaging Basics", Information Technology Lab School of Information The University of Texas at Austin, Summer 2005.

[4] D. Sugimura, T. Mikami, H. Yamashita, and T. Hamamoto, "Enhancing Color Images of Extremely Low Light Scenes Based on RGB/NIR Images Acquisition With Different Exposure Times", IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 24, NO. 11, NOVEMBER 2015.

[5] A. W. Mahastma, "Image Acquisition", Computer Vision