STUDY MATERIAL

VIVEKANANDA COLLEGE THAKURPUKUR

NAAC Accredited Grade—A

COMPUTER SCIENCE
(HONOURS & GENERAL)

Computer Graphics Fundamentals

Bodhisattwa Das

Computer Graphics Fundamentals

Bodhisattwa Das

June 2018

1 What is Computer Graphics ?

Computer graphics is an art of drawing pictures, lines, charts, etc using computers with the help of programming. Computer graphics is made up of number of pixels. Pixel is the smallest graphical picture or unit represented on the computer screen. Basically there are two types of computer graphics namely.

2 Types of Computer Graphics

There are two types of Computer Graphics :

1. **Interactive Computer Graphics :** Interactive Computer Graphics involves a two way communication between computer and user. Here the observer is given some control over the image by providing him with an input device for example the video game controller of the ping pong game. This helps him to signal his request to the computer.

2. **Non Interactive Computer Graphics :** In Non Interactive Computer Graphics otherwise known as passive computer graphics. it is the computer graphics in which user does not have any kind of control over the image. Image is merely the product of static stored program and will work according to the instructions given in the program linearly.

3 Frame buffer

The portion of memory reserved for holding the complete bit-mapped image that is sent to the monitor. Typically the frame buffer is stored in the memory chips on the video adapter. In some instances, however, the video chipset is integrated into the motherboard design, and the frame buffer is stored in general main memory.

3.1 N-bit colour Frame buffer

Color or gray scales are incorporated into a frame buffer rater graphics device by using additional bit planes. The intensity of each pixel on the CRT is controlled by a corresponding pixel location in each of the N bit planes. The binary value from each of the N bit planes is loaded into corresponding positions in a register. The resulting binary number is interpreted as an intensity level between 0 (dark) and $2^n - 1$ (full intensity).

This is converted into an analog voltage between 0 and the maximum voltage of the electron gun by the DAC. A total of 2^N intensity levels are possible. Figure given below illustrates a system with 3 bit planes for a total of 8 (2^3) intensity levels. Each bit plane requires the full complement of memory for a given raster resolution; e.g., a 3-bit plane frame buffer for a 1024 X1024 raster requires 3,145,728 (3 X 1024 X1024) memory bits.

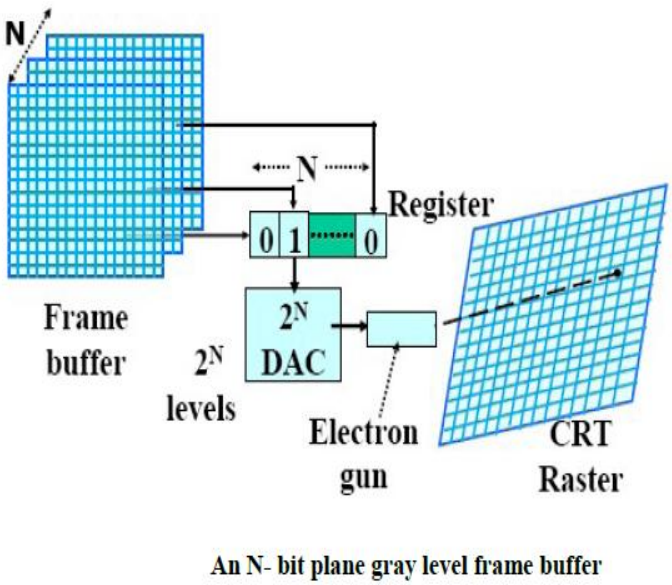

Figure 1: N Bit frame buffer

4 Pixel

A pixel (short for picture element, using the common abbreviation "pix" for "picture") is one of the many tiny dots that make up the representation of a picture in a computer's memory. Each such information element is not really a dot, nor a square, but an abstract sample.

With care, pixels in an image can be reproduced at any size without the appearance of visible dots or squares; but in many contexts, they are reproduced as dots or squares and can be visibly distinct when not fine enough. The intensity of each pixel is variable; in color systems, each pixel has typically three or four dimensions of variability such as red, green and blue, or cyan, magenta, yellow and black.

5 Bitmap

A bitmap (or raster graphic) is a digital image composed of a matrix of dots. When viewed at 100 %, each dot corresponds to an individual pixel on a display. In a standard bitmap image, each dot can be assigned a different color. Together, these dots can be used to represent any type of rectangular picture.

There are several different bitmap file formats. The standard, uncompressed bitmap format is also known as the "BMP" format or the device independent bitmap (DIB) format. It includes a header, which defines the size of the image and the number of colors the image may contain, and a list of pixels with their corresponding colors. This simple, universal image format can be recognized on nearly all platforms, but is not very efficient, especially for large images.

Other bitmap image formats, such as JPEG, GIF, and PNG, incorporate compression algorithms to reduce file size. Each format uses a different type of compression, but they all represent an image as a grid of pixels. Compressed bitmaps are significantly smaller than uncompressed BMP files and can be downloaded more quickly. Therefore, most images you see on the web are compressed bitmaps.

If we zoom into a bitmap image, regardless of the file format, it will look blocky because each dot will take up more than one pixel. Therefore, bitmap images will appear blurry if they are enlarged. Vector graphics, on the other hand, are composed of paths instead of dots, and can be scaled without reducing the quality of the image.

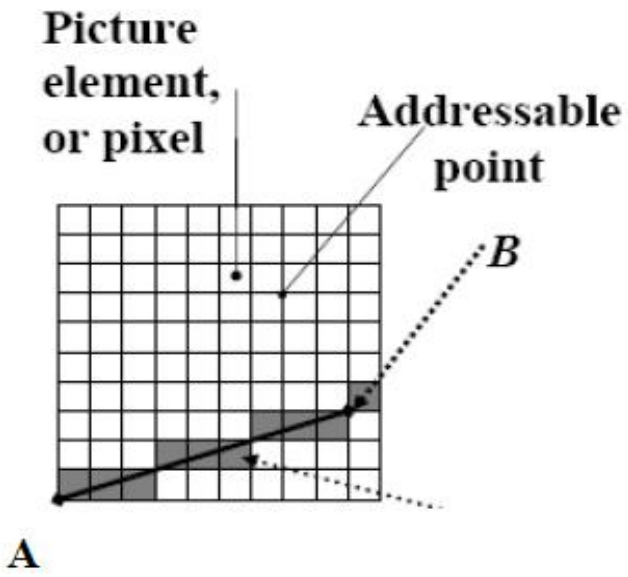

Figure 2: Pixel

6 Image resolution

Image resolution describes the detail an image holds. The term applies equally to digital images, film images, and other types of images. Higher resolution means more image detail. Image resolution can be measured in various ways. Basically, resolution quantifies how close lines can be to each other and still be visibly resolved.

7 Refresh rate

The refresh rate (most commonly the "vertical refresh rate", "vertical scan rate" for cathode ray tubes) is the number of times in a second that a display hardware updates its buffer. This is distinct from the measure of frame rate. The refresh rate includes the repeated drawing of identical frames, while frame rate measures how often a video source can feed an entire frame of new data to a display.

For example, most movie projectors advance from one frame to the next one 24 times each second. But each frame is illuminated two or three times before the next frame is projected using a shutter in front of its lamp. As a result, the movie projector runs at 24 frames per second, but has a 48 or 72 Hz refresh rate.

8 Graphics hardware

Graphics hardware is computer hardware that generates computer graphics and allows them to be shown on a display, usually using a graphics card (video card) in combination with a device driver to create the images on the screen.

Example : Graphics card

9 Applications of Computer Graphics

1. It provides tools for producing pictures not only of concrete real world objects but also of abstract, synthetic objects such as mathematical surface in 4D and of data that have no inherent geometry such as survey results.

2. It have ability to show moving pictures and thus it is possible to produce animations with computer graphics.

3. With computer graphics user can also control the animation speed, portion of the view, the geometric relationship the object in the scene to one another, the amount of detail shown and on.

4. The computer graphics provides tool called motion dynamics. with this tool user user can move and tumble objects with respect to a stationary observer, or he can make objects stationary and the viewer moving around them. A typical example is walk through made by builder show flat interior and building surroundings. In many case it is also possible to move both objects and viewer.

5. The computer graphics also provides facility called update dynamics. With update dynamics it is possible to change this shape, colour or other properties of the objects being viewed.

Further reading

1. Donald Hearn, M. Pauline Baker - 1997 *Computer Graphics, C Version* : Pearson Education Inc. and Dorling Kindersley Publishing Inc.

2. Terrence Masson - 1999 *CG 101: A Computer Graphics Industry Reference* : New Riders

3. Peter Comninos - 2010 *Mathematical and Computer Programming Techniques for Computer Graphics* : Springer Science & Business Media