Computer Graphics

Unit 1 – Part1

-By Manjula. S

What is computer Graphics?

- **Computer graphics** is concerned with all aspects of producing pictures or images using a computer. In other words CG is an art of drawing pictures, lines, charts, animation on computer screen by using programming language.
- CG include creation, computation and manipulation of Data and representing data in pictorial form.
- The field began humbly 50 years ago, with the display of a few lines on a **cathode-ray tube (CRT)**; now, we can generate images by computer that are indistinguishable from photographs of real objects.

Graphics software – OpenGL

- **OpenGL**(Open Graphic Library), is a graphics software system which has become a widely accepted standard for developing graphics applications.
- Tool or a method used to develop graphics application.
- OpenGL is an application programming Interface(API) designed for rendering 2D and 3D graphics. This API is typically used to interact with a Graphics Processing Unit(GPU) , to achieve hardware accelerated rendering.
- OpenGL is easy to learn, and it possesses most of the characteristics of other popular graphics systems.
- Follows approach is top-down.

Applications of Computer Graphics

- Display of information
- Design
- Simulation and animation
- User interfaces

Display of information

- CG is a medium to convey information among people.
- More than 4000 yrs ago, Babylonians displayed floor plans of buildings on stones.
- More than 2000 yrs ago, Greeks conveyed their architectural ideas graphically.
- Cartographers have developed maps to display celestial and geographical information.
- Medical imaging poses interesting and important data-analysis problems. Modern imaging technologies—such as computed tomography (CT), magnetic resonance imaging (MRI), ultrasound, and positron-emission tomography (PET)—generate three-dimensional data.
- Today same information is generated by architects using computer-based drafting systems.
- Fluid flow, molecular biology and mathematics.

Design

- Interactive graphics tools are extensively used in the field of architecture, mechanical engineering.
- CG is used in the design of VLSI circuits, creation of characters for animations.
- In VLSI, the graphics package provides an interactive interface between the user and the design package.
- Tools to generate different images of same objects at different stages of design process.

Simulation and animation

- Once graphics system evolved to be capable of generating sophisticated images in real time, engineers and researchers began to use them as simulators.
- Training of pilots.
- Training expenses have been reduced with

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- Designing robots, planning its path, simulating its behavior in complex environments.
- Animation in television, motion pictures and advertising industries

User interfaces

- In the field of computers, user interaction system is dominated by windows, icons, menus and pointing devices like mouse.
- This style of interface makes wide use of CG.
- GUI is one of the most popular interfaces today.

A graphics system

- A graphics system is specialized for performing graphic based operations and image generations.
- Graphic system has all components of a general-purpose computer.
- 6 major elements are:
  1. Input devices
  2. Central Processor Unit
  3. Graphics Processing Unit
  4. Memory
  5. Frame buffer
  6. Output devices

Basic Graphics system

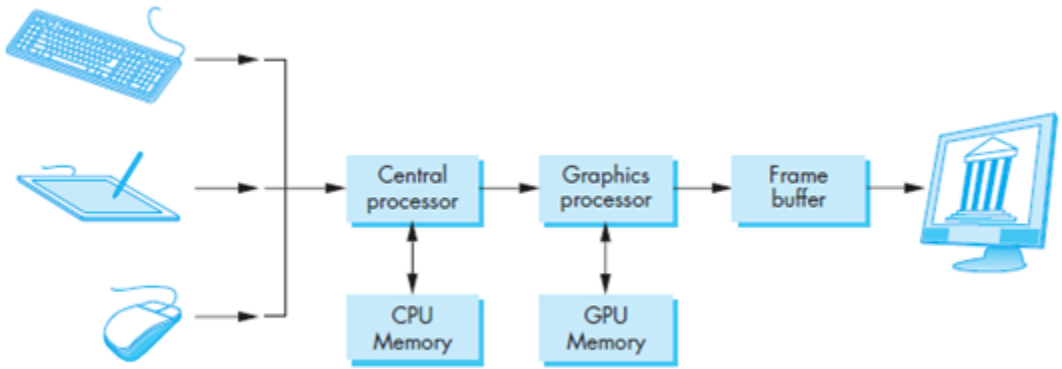

FIGURE 1.1 A graphics system.

Input Devices

- Keyboard + another input device
  - like mouse, joystick or data tablet – called as pointing devices.
  - Allow user to indicate a particular location on the display.
- Advanced Graphics systems allow 3D input devices
  - like Laser range finders (uses a laser beam to determine the distance to an object) and acoustic sensors (to measure sound levels).

Central Processing Unit

- In simple system, there is one processor, the **central processing unit**(**CPU**) of the system, which must do both the normal processing and the graphical processing.
- The main graphical function of the processor is to take specifications graphical primitives (such as lines, circles, and polygons) generated by application programs and to assign values to the pixels in the frame buffer that best represent these entities.
- Example : A triangle is specified by its 3 vertices, but to display its outline by 3 line segments connecting vertices, graphics system must generate a set of pixels that appear as line segments to the viewer.

Graphics Processing Units(GPUs)

- All graphic systems have a specialized graphics processor.
- It is designed to carryout special graphics functions such as rasterization.
- The process of converting primitives(images) into pixel representation (frame buffer representation) is known as rasterization or scan conversion.
- Now a days, special purpose graphics processing units(GPUs) are used.
- GPU can be on mother board or on a graphics card.

Memory

Graphics system has two types of memory.

- General Memory
- Frame Buffer

General Memory – used to store **non-graphics** based data.

Frame Buffer – used to store **graphics** data.

Frame Buffer

- It is a special type of memory present on graphics system.
- In CG, a picture or an image is produced as an **array of pixels(Raster).** These pixels are stored in the frame buffer.
- **Resolution of frame buffer**

  It is the no. of pixels in the frame buffer

Frame buffer

- Depth (precision) of frame buffer
  - No. of bits for each pixel is known as depth of frame buffer.
  - Determines properties like how many colors can be represented.

    Ex:

    1-bit-deep frame buffer – 2 colors

    8-bit frame buffer – 2 8 = 256 colors.

  If depth=24 bits per pixel or more, such systems are known as Full color OR True color OR RGB color systems.

- In full color systems, there are 24(or more) bits per pixel. Can display sufficient colors to represent most images realistically.

Output devices

- For many years, dominant type of display is CRT (Cathode Ray Tube).
- They are rapidly being replaced by flat screen technologies such as LEDs, LCDs, plasma etc.

Cathode Ray tube (CRT)

- The digital output produced by a processor is given to digital-to-analog converter.
- The analog voltages produced are applied across the x and y deflection plates.
- The direction of the beam can be controlled by these two deflection plates.
- When electrons strike the phosphor coating on the tube, light is emitted.

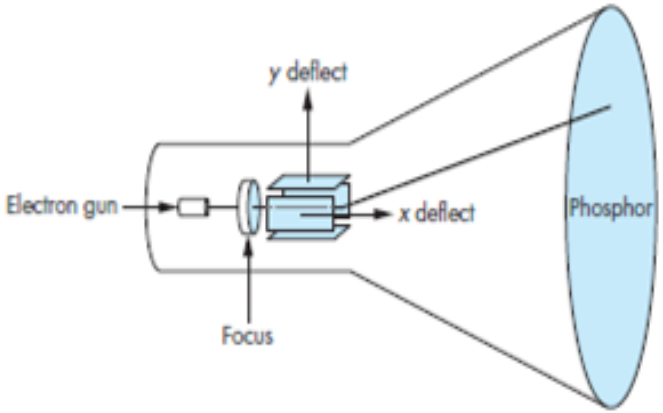

FIGURE 1.3 The cathode-ray tube (CRT).

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Working of Cathode Ray tube (CRT)

- Colored CRTs have 3 different colored phosphors (RED, GREEN, BLUE). They have 3 electron beams corresponding to 3 types of phosphors.
- A typical CRT will emit light only for a short duration when hit by an electron.
- This would produce flicker in the image.
- To produce a flicker-free image, the electron beam must be refreshed at a high rate called refresh rate.
- Modern displays have refresh rate of about 85 Hz

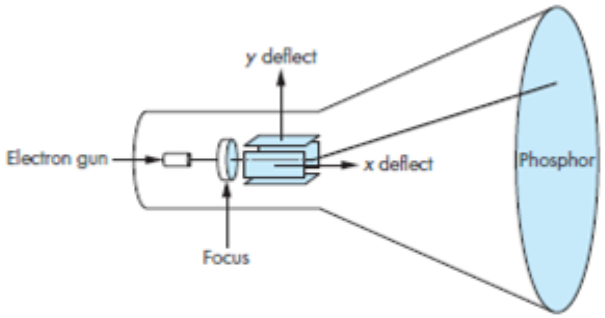

FIGURE 1.3 The cathode-ray tube (CRT).

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Shadow-mask CRT – colored CRT

- Most of the color CRTs have 3 electron beams corresponding to 3 types of phosphors.
- Shadow mask, a metal screen with small holes(shadow mask), to ensure that an electron beam excites only phosphors of the proper color

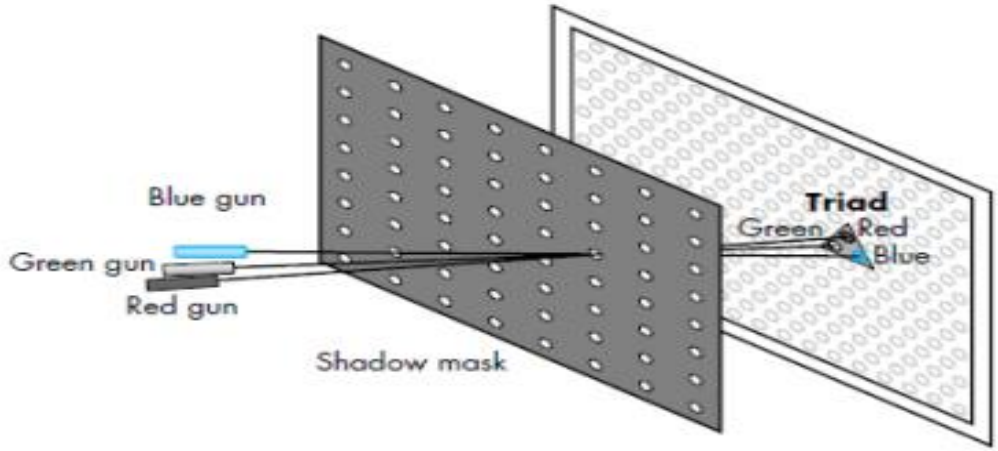

FIGURE 1.4 Shadow-mask CRT.

Thank You

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