Computer Graphics

Introduction

Computer graphics is a field related to the generation of graphics using computers. It includes the creation, storage and manipulation of images of objects. These objects come from diverse fields such as physical, mathematical engineering , architectural abstract structures and natural phenomenon. Computer graphics today is largely interactive; that is largely interactive; that is the user controls the contents structure and appearance of images of the objects by using input devices such as a keyboard, mouse, or touch sensitive panel on the screen

Until the early 1980's computer graphics was a small specialized field, largely because the hardware was expensive and graphics based application programs that were easy to use and cost effective were few. Then personal computers with built in raster graphics displays such as the Xerox Star Apple Macintosh and the IBM PC – popularized the use of bitmap graphics for user computer interaction. A bitmap is a ones and zeros representation of the rectangular array of points on the screen. Each point is called a pixel, short for "picture elements". Once the bitmap graphics became affordable an explosion of easy to use and inexpensive graphics based user interfaces allowed millions of new users to control simple low cost application programs such as word processors, spreadsheets and drawing programs

The concept of a "*desktop*" now became popular metaphor for organizing screen space. By means of a window manager the user could create position and resize rectangular screen areas called windows. This allowed user to switch among multiple activities just by pointing and clicking at the desired window , typically with a mouse. Besides windows, icons which represent data files , application program, file cabinets, mailboxes. Printers , recycle bin and so on, made the user computer interaction more effective . by pointing and clicking the icons, users could activate the corresponding programs or objects which replaced much of the typing of the commands used in earlier operating systems and computer applications . today almost all interactive application programs even those for manipulating text i.e. word processor) or numerical data (e.g. spreadsheet programs) use graphics extensively in the user interface and for visualizing and manipulating the application specific objects.

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Even people who do not use computers encounter computer graphics in TV commercials and as cinematic special effects. Thus computer graphics is an integral part of all computer user interfaces, and is indispensable for visualizing 2D, 3D objects in all most all areas such as education , science , engineering, medicine, commerce the military adversiting and entertainment. The theme is that learning how to program and use computers now includes learning how to use simple 2D graphics

Early history of computer graphics

We need to take a brief look at the historical development of computer graphics to place today's system in context. Crude plotting of hardcopy devices such as teletypes and line printers dates from the early days of computing. The whirlwind computer developed in 1950 at the Massachusetts Institute of Technology (MIT) had computer driven CRT displays for output. The SAGE air-defense system developed in the middle 1950s was the first to use command and control CRT display consoles on which operators identified targets with light pens (hand held pointing devices that sense light emitted by objects on the screen) Later on Sketchpad system by Ivan Sutherland came in light. That was the beginning of modern interactive graphics. In this system, keyboard and light pen were used for pointing, making choices and drawing.

At the same time, it was becoming clear to computer, automobile, and aerospace manufacturers that (CAD) and computer aided manufacturing (CAM) activities had enormous potential for automating drafting and other drawing intensive activities. The General Motors DAC system for automobile design and the Itek-Digitek system for lens design were pioneering efforts that showed the utility of graphical interaction in the iterative design cycles common in engineering. By the mid 60s, a number of commercial products using these systems had appeared
At that time only the most technology intensive organizations could use the interactive computer graphics where as others used punch cards, a non-interactive system .
Among the reasons for this were these:

- **The high cost of graphics hardware – at a time when automobiles cost a few thousand dollars, computers cost several millions of dollars, and the first commercial computer displays cost more than a hundred thousand dollars**

- **The need for large scale expensive computing resources to support massive design database**
- **The difficulty of writing large interactive programs using batch oriented FORTRAN programming**
- **One of a kind , non-portable software, typically written for a particular manufacturer's display devices. When software is non-portable, moving to new display devices necessitates expensive and time consuming rewriting of working programs**

Thus interactive computer graphics had a limited use when it started in the early sixties but it became very common once the Apple Macintosh and IBM PC appeared in the market with affordable cost.

Representative uses of computer graphics

Computer graphics is used today in many different areas of science, engineering , industry business, education, entertainment, medicine art and training

All of these are included in the following categories

1. User interfaces

most applications have user interfaces that rely on the desktop window systems to manage multiple simultaneous activities and on point and click facilities to allow users to select menu items, icons, and objects on the screen These activities fall under computer graphics. Typing is necessary only to input text to be stored and manipulated. For example, word processing spreadsheet and desktop publishing programs are the typical examples where user interface techniques are implemented

2. Plotting

plotting 2D and 3D graphs of mathematical physical and economic functions use computer graphics extensively The histograms, bar and pie charts, the task scheduling charts, are the most commonly used plotting . These are all used to present meaningfully and concisely the trends and patterns of complex data

3. Office automation and electronic publishing

computer graphics has facilitated the office automation and electronic publishing which is also popularly known as desktop publishing, giving more power to the organizations to print the meaningful materials in house. Office automation and electronic publishing can produce both traditional printed (hardcopy) documents and electronic (softcopy) documents that contain text tables, graphs and other forms of drawn or scanned in graphics

4. Computer aided drafting and design

one of the major uses of computer graphics is to design components and systems of mechanical , electrical , electrochemical and electronic devices , including structures such as buildings automobile bodies, airplane and ship hulls, very large scale integrated (VLSI) chips optical systems and telephone and computer networks . These designs are more frequently used to test structural , electrical and thermal properties of the systems

5. Scientific and business visualization

Generating computer graphics for scientific, engineering and medical data sets is termed as scientific visualization where as business visualization is related with the non scientific data sets such as those obtained in economics. Visualization makes easier to understand the trends and patterns inherent in huge amount of data sets. It would otherwise be almost impossible to analyze those data numerically

6. Simulation

Simulation is the imitation of the conditions like those, which is encountered in real life. Simulation thus helps to learn or to feel the conditions one might have to face in near future with out being in danger at the beginning of the course. For example, astronauts can exercise the feeling of weightlessness in a simulator, similarly a pilot training can be conducted in a flight simulator . The military tank simulator the naval simulator, driving simulator , air traffic control simulator, heavy duty vehicle simulator and so on are some of the mostly used simulator in practice. Simulators are also used to optimize the system

For example the vehicle, observing the reactions of the driver during the operation of the simulator

7. Entertainment

Disney movies such as Lion King and the beauty and the beast, and other scientific movies like star trek are the best examples of the application of computer graphics in the field of entertainment. Instead of drawing all the necessary frames with slightly changing scenes for the production of cartoon film only the key frames are sufficient for such cartoon film where the in between frames are interpolated by the graphics system dramatically decreasing the cost production while maintaining the quality. Computer and video games such as Fifa, Formula-1, Doom and Pools are few to name where computer graphics is used extensively

8. Art and commerce

Here computer graphics is used to produce pictures that expresses a message and attract attention such as a new model of a car moving along the ring of the Saturn. These pictures are frequently seen at transportation terminals, supermarkets, hotels etc. the slide production for commercial , scientific, or educational presentations is another cost effective use of computer graphics. One of such graphics packages is "PowerPoint".

9. Cartography

Cartography is a subject which deals with the making of maps and charts. Computer graphics is used to produce both accurate and schematic representations of geographical and other natural phenomena from measurement data. Examples include geographic maps, oceanographic charts, weather maps, contour maps and population density maps

Surfer is one of such graphics packages which is extensively used for cartography