المحور الأول

1. Introduction to Multimedia

1.1 Introduction

Multimedia has become an inevitable part of any presentation. It has found a variety of applications right from entertainment to education. The evolution of internet has also increased the demand for multimedia content.

Definition

Multimedia is the media that uses multiple forms of information content and information processing (e.g. text, audio, graphics, animation, video, interactivity) to inform or entertain the user. Multimedia also refers to the use of electronic media to store and experience multimedia content. Multimedia is similar to traditional mixed media in fine art, but with a broader scope. The term "rich media" is synonymous for interactive multimedia.

1.2 Elements of Multimedia System

Multimedia means that computer information can be represented through audio, graphics, image, video and animation in addition to traditional media (text and graphics). Hypermedia can be considered as one type of particular multimedia application.

A Multimedia System is a system capable of processing multimedia data and applications.

A Multimedia System is characterized by the processing, storage, generation, manipulation and rendition of Multimedia information.

A Multimedia system has four basic characteristics:

- Multimedia systems must be computer controlled.
- Multimedia systems are integrated.
- The information they handle must be represented digitally.
- The interface to the final presentation of media is usually interactive.

1.3 Categories of Multimedia

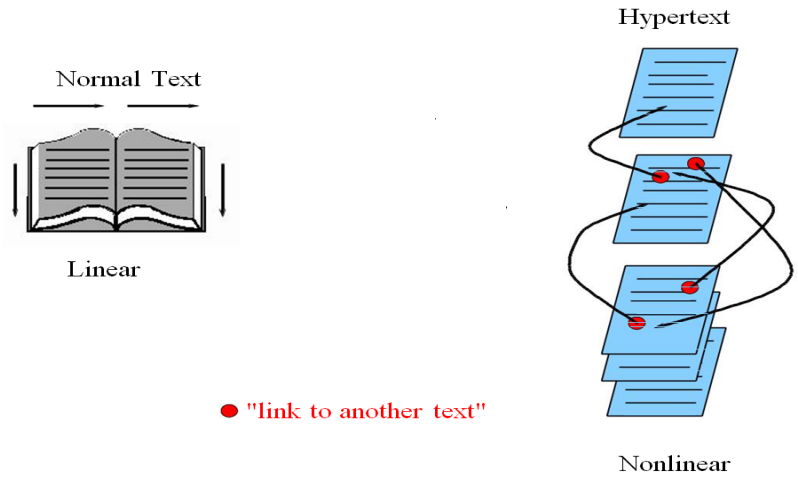
Multimedia may be broadly divided into linear and non-linear categories. Linear active content progresses without any navigation control for the viewer such as a cinema presentation. Non-linear content offers user interactivity to control progress as used with a computer game or used in self-paced computer based training. Non-linear content is also known as hypermedia content.

Multimedia presentations can be live or recorded. A recorded presentation may allow interactivity via a navigation system. A live multimedia presentation may allow interactivity via interaction with the presenter or performer.

2. "HyperText" and "HyperMedia"

Hypertext is a text which contains links to other texts

Hypertext System: meant to be read nonlinearly, by following links that point to other parts of the document, or to other documents



The World Wide Web (WWW) is the best example of a hypermedia application.

Multimedia means that computer information can be represented through audio, graphics, images, video, and animation in addition to traditional media.

HyperMedia: not constrained to be text-based, can include other media, e.g., graphics, images, and especially the continuous media — sound and video.

Example Hypermedia Applications:

- The World Wide Web (WWW) is a clear example of the hypermedia application.
- PowerPoint.
- Adobe Acrobat (or other PDF software).
- Adobe Flash

3. Components of Multimedia

Now let us consider the Components (Hardware and Software) required for a multimedia system:

1) ***Capture devices***: Video Camera, Video Recorder, Audio Microphone, Keyboards, mice, graphics tablets, 3D input devices, tactile sensors, VR devices. Digitizing Hardware.
2) ***Storage Devices***: Hard disks, CD-ROMs, DVD-ROM, etc.
3) ***Communication Networks***: Local Networks, Intranets, Internet, Multimedia or other special high speed networks.
4) ***Computer Systems***: Multimedia Desktop machines, Workstations, MPEG/VIDEO/DSP Hardware.
5) ***Display Devices***: CD-quality speakers, HDTV, SVGA, Hi-Res monitors, Color printers etc

Multimedia involves multiple modalities of text, audio, images, drawings, animation, and video. Examples of how these modalities are put to use:

1. Video teleconferencing.
2. Distributed lectures for higher education.
3. Tele-medicine.
4. Co-operative work environments.
5. Searching in (very) large video and image databases for target visual objects.
6. “Augmented” reality: placing real-appearing computer graphics and video objects into scenes.
7. Using voice-recognition to build an interactive environment, say a web browser

4. Multimedia Research Topics and Projects

To the computer science researcher, multimedia consists of a wide variety of **topics**:

1. ***Multimedia processing and coding:*** This includes multimedia content analysis, content-based multimedia retrieval, multimedia security, audio/image/video processing, compression, etc.
2. ***Multimedia system support and networking:*** network protocols, Internet, operating systems, servers and clients, quality of service (QoS), and databases.
3. ***Multimedia tools, end-systems and applications:*** These include hypermedia systems, user interfaces, authoring systems, multimodal interaction, and integration, web-everywhere devices, multimedia education, including computer supported collaborative learning and design, and applications of virtual environments.

The concerns of multimedia researchers also impact researchers in almost every other branch. For example, data mining is an important current research area, and a large database of multimedia data objects is a good example of just what we may be interested in mining.

4. ***Multi-modal interaction and integration:*** "ubiquity" web-everywhere devices, multimedia education including Computer Supported Collaborative Learning, and de-sign and applications of virtual environments.

Multimedia Projects

Many exciting research projects are currently underway in multimedia, and we'd like to introduce a few of them here:

- For example, researchers are interested in camera-based object tracking technology. One aim is to develop control systems for industrial control, gaming, and so on that rely on moving scale models (toys) around a real environment (a board game, say). Tracking the control objects (toys) provides user control of the process.
- 3D motion capture can also be used for multiple actor capture, so that multiple real actors in a virtual studio can be used to automatically produce realistic animated models with natural movement.
- Multiple views from several cameras or from a single camera under differing lighting can accurately acquire data that gives both the shape and surface properties of materials, thus automatically generating synthetic graphics models. This allows photo-realistic synthesis of virtual actors.
- 3D capture technology is next to fast enough now to allow acquiring dynamic characteristics of human facial expression during speech, to synthesize highly realistic facial animation from speech.
- Multimedia applications aimed at handicapped persons, particularly those with poor vision and the elderly, are a rich field of endeavor in current research.
- Digital fashion aims to develop smart clothing that can communicate with other such enhanced clothing using wireless communication, so as to artificially enhance human interaction in a social setting. The vision here is to use technology to allow individuals to allow certain thoughts and feelings to be broadcast automatically, for exchange with others equipped with similar technology.
- Georgia Tech's Electronic Housecall system, an initiative for providing interactive health monitoring services to patients in their homes, relies on networks for delivery, challenging current capabilities.

5. Applications of Multimedia

Multimedia finds its application in various areas including, but not limited to, advertisements, art, education, entertainment, engineering, medicine, mathematics, business, scientific research and spatial, temporal applications. multimedia such as virtual reality, or VR. Goggles, helmets, special gloves.

A few application areas of multimedia are listed below:

Creative industries: Creative industries use multimedia for a variety of purposes ranging from fine arts, to entertainment, to commercial art, to journalism, to media and software services provided for any of the industries listed below. An individual multimedia designer may cover the spectrum throughout their career. Request for their skills, range from technical to analytical and to creative.

Commercial: Much of the electronic old and new media utilized by commercial artists is multimedia. Exciting presentations are used to grab and keep attention in advertising. Industrial, business to business, and interoffice communications are often developed by creative services firms for advanced multimedia presentations beyond simple slide shows to sell ideas or liven-up training. Commercial multimedia developers may be hired to design for governmental services and non-profit services applications as well.

Entertainment and Fine Arts: In addition, multimedia is heavily used in the entertainment industry, especially to develop special effects in movies and animations. Multimedia games are a popular pastime and are software programs available either as CD-ROMs or online. Some video games also use multimedia features. Multimedia applications that allow users to actively participate instead of just sitting by as passive recipients of information are called Interactive Multimedia.

Education: In Education, multimedia is used to produce computer-based training courses (popularly called CBTs) and reference books like encyclopaedia and

almanacs. A CBT lets the user go through a series of presentations, text about a particular topic, and associated illustrations in various information formats. Edutainment is an informal term used to describe combining education with entertainment, especially multimedia entertainment.

Engineering: Software engineers may use multimedia in Computer Simulations for anything from entertainment to training such as military or industrial training. Multimedia for software interfaces are often done as collaboration between creative professionals and software engineers.

Industry: In the Industrial sector, multimedia is used as a way to help present information to shareholders, superiors and coworkers. Multimedia is also helpful for providing employee training, advertising and selling products all over the world via virtually unlimited web-based technologies.

Medicine: In Medicine, doctors can get trained by looking at a virtual surgery or they can simulate how the human body is affected by diseases spread by viruses and bacteria and then develop techniques to prevent it.

Multimedia in Public Places: In hotels, railway stations, shopping malls, museums, and grocery stores, multimedia will become available at stand-alone terminals or kiosks to provide information and help. Such installation reduce demand on traditional information booths and personnel, add value, and they can work around the clock, even in the middle of the night, when live help is off duty. A menu screen from a supermarket kiosk that provide services ranging from meal planning to coupons. Hotel kiosk list nearby restaurant, maps of the city, airline schedules, and provide guest services such as automated checkout. Printers are often attached so users can walk away with a printed copy of the information. Museum kiosk are not only used to guide patrons through the exhibits, but when installed at each exhibit, provide great added depth, allowing visitors to browser though richly detailed information specific to that display.

Example Multimedia Applications

- ✓ World Wide Web
- ✓ Multimedia Authoring, e.g. Adobe/Macromedia Director
- ✓ Hypermedia courseware
- ✓ Video-on-demand
- ✓ Interactive TV
- ✓ Computer Games
- ✓ Virtual reality
- ✓ Digital video editing and production systems
- ✓ Multimedia Database systems

6. Multimedia on the Web

The World Wide Web is the largest and most commonly used hypermedia application. Its popularity is due to:

- the amount of information available from web servers,
- the capacity to post such information,
- and the ease of navigating such information with a web browser.

WWW technology is maintained and developed by the World Wide Web Consortium (W3C). The W3C has listed the following three goals for the WWW: universal access of web resources (by everyone everywhere), effectiveness of navigating available information, and responsible of posted material.

HyperText Transfer Protocol (HTTP)

HTTP is a protocol that was originally designed for transmitting hypermedia, but it also supports transmission of any file type. HTTP is a "stateless" request/response protocol, in the sense that a client typically opens a connection to the HTTP server, requests information, the server responds, and the connection is terminated - no information is carried over for the next request.The Uniform Resource Identifier (URI) identifies the resource accessed, such as the host name,

always preceded by the token "http://". A URI could be a Uniform Resource Locator (URL).

HyperText Markup Language (HTML)

HTML is a language for publishing hypermedia on the World Wide Web. It is defined using SGML and derives elements that describe generic document structure and formatting. Since it uses ASCII, it is portable to all different (even binary-incompatible) computer hardware, which allows for global exchange of information.

Extensible Markup Language (XML)

There is a need for a markup language for the WWW that has modularity of data, structure, and view. That is, we would like a user or an application to be able to define the tags (structure) allowed in a document and their relationship to each other, in one place, then define data using these tags in another place (the XML file) and, finally, define in yet another document how to render the tags.

7. Multimedia Data Basics

Multimedia systems/applications have to deal with the

- Generation of data
- Manipulation of data
- Storage of data
- Presentation of data
- Communication of information/data

Static or Discrete Media: Some media is time independent: Normal data, text, single images and graphics are examples.
Continuous Media: Time dependent Media: Video, animation and audio are examples.

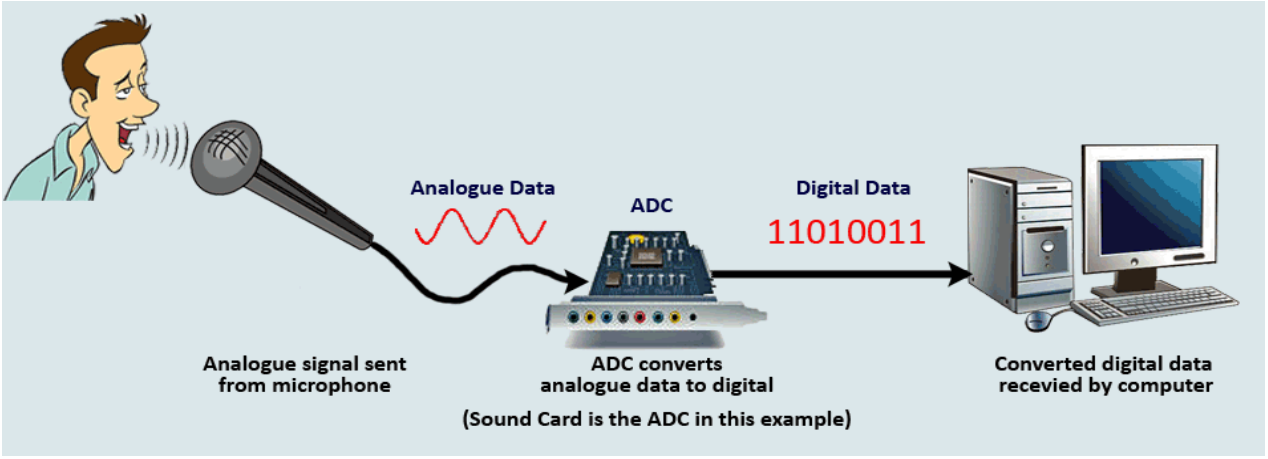
Analog and Digital Signal Conversion

The world we sense is full of analog signals: Electrical sensors convert the medium they sense into electrical signals

- E.g. transducers, thermocouples: temperature sensor, microphones: acoustic sensor
- Cameras (Video): light sensor. (usually) continuous Analog signals (e.g. Sound and Light)

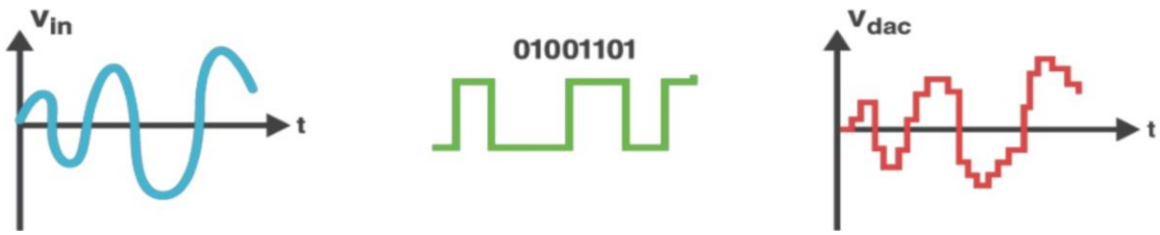
Analog: continuous signals must be converted or digitised for computer processing.

Digital: discrete digital signals that computer can readily deal with. Special hardware devices: Analog-to-Digital Playback {a converse operation to Analog-to-Digital converters. E.g. Audio: Take analog signals from analog sensor (e.g. microphone)



Analog-to-Digital-to-Analog Pipeline

• Begins at the conversion from the analog input and ends at the conversion from the output of the processing system to the analog output as shown:



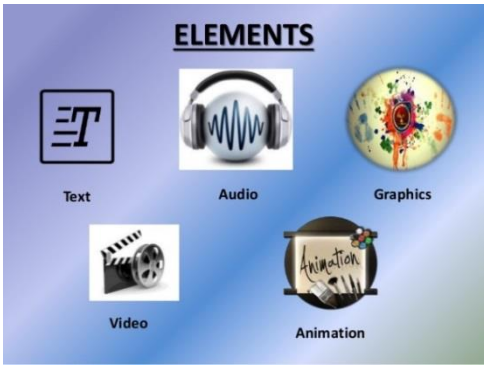
Multimedia Data: Input and Format

How to capture and store each Media format?

- Note that text and graphics (and some images) are mainly generated directly by computer/device (e.g. drawing/painting programs) and do not require digitising: They are generated directly in some (usually binary) format.
- Printed text and some handwritten text can be scanned via Optical Character Recognition.
- Handwritten text could also be digitised by electronic pen sensing.
- Printed imagery/graphics can be scanned directly to image formats.

Multimedia data may be in a **variety of formats**:

1- **Text**
2- **Graphics**
3- **Images**
4- **Audio**
5- **Video**



1) Text and Static Data

- Source: keyboard, speech input, optical character recognition, data stored on disk.
- Stored and input character by character:
- Storage: 1 byte per character (text or format character), e.g. ASCII; more bytes for Unicode. For other forms of data (e.g. Spread sheet les). May store as text (with formatting, e.g. CSV {Comma-Separated Values) or may use binary encoding.
- Formatted Text: Raw text or formatted text e.g HTML, Rich Text Format (RTF), Word or a program language source (Java, Python, MATLAB etc.)
- Data Not temporal | BUT may have natural implied sequence e.g. HTML format sequence, Sequence of Java program statements.

- Compression: convenient to bundle les for archiving and transmission of larger les. E.g. Zip, RAR, 7-zip.

2) Graphics

- Format: constructed by the composition of primitive objects such as lines, polygons, circles, curves and arcs.
- Input: Graphics are usually generated by a graphics editor program (e.g. illustrator, Freehand) or automatically by a program (e.g. Postscript).
- Graphics input devices: keyboard (for text and cursor control), mouse, trackball or graphics tablet.
- Graphics are usually selectable and editable or revisable (unlike images).
- Graphics les usually store the primitive assembly.
- Do not take up a very high storage overhead.
- Graphics standards: Open Graphics Library, a standard specification defining a cross-language, cross-platform API for writing applications that produce 2D/3D graphics.
- Animation: can be generated via a sequence of slightly changed graphics.
- 2D animation: e.g. Flash | Key frame interpolation: tweening: motion & shape.

  3D animation: e.g. Maya.
- Change of shape/texture/position, lighting, camera Graphics animation is compact
- Suitable for network transmission (e.g. Flash).

3) Images

- Still pictures which (uncompressed) are represented as a bitmap (a grid of pixels).
- Input: scanned for photographs or pictures using a digital scanner or from a digital camera.
- Input: May also be generated by programs similar to graphics or animation programs.
- Analog sources will require digitising.
- Compression is commonly applied.

- Can usually only edit individual or groups of pixels in an image editing application, e.g. photoshop.

4) Audio

- Audio signals are continuous analog signals.
- Input: microphones and then digitised and stored.
- CD Quality Audio requires 16-bit sampling at 44.1 KHz.
- Usually compressed (E.g. MP3, AAC, Flac, Ogg Vorbis).

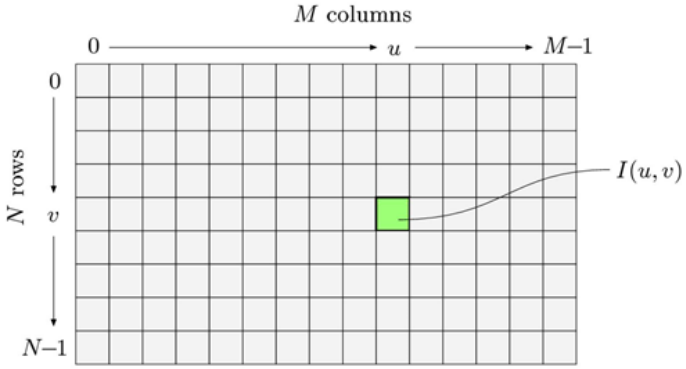
5) Video

- Input: Analog Video is usually captured by a video camera and then digitised, although digital video cameras now essentially perform both tasks.
- There are a variety of video (analog and digital) formats.
- Raw video can be regarded as being a series of single images. There are typically 25, 30 or 50 frames per second.

المحور الثاني

8 & 9 : Graphics and Image Data Representation

The image data structure is a 2D array of pixel values as shown in Figure below.



Digital Images

An image must be converted to numerical form before processing. This conversion process is called digitization, and a common form is illustrated in Figure (1). The image is divided into small regions called ***picture elements***, or ***pixel*** for short. The most common subdivision scheme is the rectangular sampling grid shown in Figure (1). The image is divided into horizontal lines made up of adjacent pixels.

At each pixel location, the image brightness are sampled and quantized. This