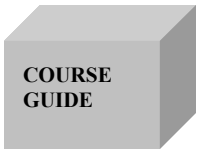
CIT 635: APPLICATION SOFTWARE DESIGN AND MULTIMEDIA



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CIT 635: APPLICATION SOFTWARE DESIGN AND MULTIMEDIA

Module 1: Basic Concepts in Multimedia

Unit 1: Introduction to Multimedia

Module 1: Basic Concepts in Multimedia

Unit 1: Introduction to Multimedia

1.0 Introduction

Multimedia simply means numerous or multiple medium. The term medium implies the existence of a channel through which messages or information pass through. Multimedia therefore refers to multiple channels through which we can send, receive, present, store or perceive message or information.

When a teacher uses some sets of instructional materials such as the chalkboard, flash card, textbook, flannel board, graph paper, audiocassettes and videocassettes etc. What he simply does is to ensure effective teaching and learning of the subject matter.

2.0 Objectives

At the end of the unit you will be able to:

- define the multimedia concept ;
- explain the benefits of multimedia applications;
- describe the various areas where multimedia systems can be applied;
- classify multimedia systems;
- outline the various multimedia data elements;
- carry out an exposition on the historical landmarks in relation to multimedia.

3.0 Definitions

Multimedia has been defined variously by different scholars based on the technology available as per time dictum. We will examine some of these definitions:

Multimedia is media that uses multiple forms of information content and information processing (for instance audio, graphics, and video) to inform, entertain *or educate* the user (Access Developer Network).

Multimedia is a combination of text, animated graphics, video, and sound delivered to an audience which can be learners, listeners or viewers through electronic means (Batch elder).

In the words of Xie (1997), multimedia involed the computer-controlled integration of text, graphics, still and moving images, animation, sounds and any other medium where every type of information can be represented, stored, transmitted, and processed digitally.

Mayer (2001) defined Multimedia as presenting words (such as printed text or spoken text) and pictures (such as illustrations, photos, animation, or video). Multimedia refers to the combination of multiple media to effectively convey a message (Dorin & McCormack, 2000).

According to Marshall (2001), multimedia is concerned with the computer-controlled integration of text, graphics, drawings, still and moving images (Video), animation, audio, and any other media where every type of information can be represented, stored, transmitted and processed digitally.

Ayo (2001) defined multimedia as the delivery of information in intuitive, multi-sensory ways, through integration of distinct media such as texts, graphics, computer animation, motion video, and sound in a single presentation which is computer controlled.

Multimedia is the combination of a variety of communication channels for presenting text, graphics, audio and video with links and tools that allow users to interact, create, navigate and communicate (Elsom-Cook, 2001)

Multimedia refers to computer-based materials designed to be used on a computer that can display and print text and high-quality graphics, play pre-recorded audio and video material, and create new audio and video recordings (ICT4LT).

The concept of multimedia as observed from the various definitions above connotes three facts, namely:

1. **Presence of a message or information (content)**. The information could be a learning material, news, business presentation, awareness creation on some health, political, social issues, or entertainment etc.;
2. **Source and destination**, speaker and listeners, teacher and students, government and her citizens, business and its customers etc.;
3. **Communication channels (media) through which the information is passed**. These channels could be traditional means such as symbol, text, scrolls, spoken words, graphics drawing, pictures, illustrations and images, or they could be in electronic forms such as audiocassettes and radio presentations (audio), videocassettes and television presentations (videos), slides, computer PowerPoint, YouTube, graphics animation.

Therefore, multimedia is a medium with multiple content forms (combination of different media) having multiple content forms (combination of different content forms). In contemporary terms, it refers to electronic (digital and computer) representations of information (text, voice, still images, pictures and illustrations) and their interactive electronic presentations (text, audio, video, animation, and interactive content forms).

3.1 Benefits of Multimedia

Multimedia is used based on the following reasons amongst others:

i. it enhances effective presentations;
ii. it is an effective and flexible communication tool;
iii. it is conducive to cooperative work environment;
iv. it facilitates high retention rate, hence high recall of knowledge content;
v. its supports large audience;
vi. it encourages participatory learning through interactivity;
vii. it stimulates audience or learners interest in the subject; and
viii. it is easy to use, learn and understand.

3.2 Applications of Multimedia

A multimedia application is an application which uses a collection of multiple media sources e.g. text, graphics, images, sound/audio, animation and/or video.

Applications and delivery platforms of multimedia are virtually limitless. Multimedia finds its application in various areas including, but not limited to, e-commerce (advertisements, home shopping), education (hypermedia courseware), art and entertainment (video-on-demand, interactive TV, games, digital video editing and production systems), engineering, medicine, mmultimedia database systems, mathematics, business, scientific research, spatial temporal applications (World Wide Web, Video conferencing, Groupware, Virtual reality). Several examples are as follows:

1. **Simulations**: computer-based models of real-life situations or environments;
2. **Business Presentations**: used to sell products or ideas, can also serve to illustrate data analysis or trends;
3. **Computer Based Training**: type of education in which students learn by using and completing exercises with instructional software (also called Computer Aided Instruction CAI). CBTsoftware are generally flexible, time-wise, location-wise and customized teaching programs with instant feedback. They are self-paced study and one-on-one instruction;
4. **Courseware**: the name given to interactive CBT software which can be used to teach new skills, teach quicker and at a lower cost, and train for situations;
5. **Web Based Training** (WBT)/Distance Learning: same basic principle as CBT but delivery is via the web;
6. Classroom and special education;
7. **Electronic Books**: a digital text that uses links to five the user access to information. E-book is a small book-sized computer that can hold up to 4,000 pages (10 books) worth of text and images. Electronic Reference (e-text) – a digital version of a reference book which uses multimedia to provide additional information;
8. **Multimedia Newspaper/ Electronic Magazine**: electronic version of a newspaper distributed via CD-ROM or the Web. E.g. The Punch etc;

9. **Virtual Reality (VR)**: the use of a computer to create an artificial environment that appears and feels like a real environment and allows you to explore a space and manipulate the environment;
10. **Kiosks**: a computerized information or reference center that allows you to select various options to browse through or find specific information (usually uses touch screen). E.g. Target's gift registry, Information centers at malls, hospitals, museums, airports etc.

3.2.1 Commerce

Electronic commerce which is the process of buying, selling products and services and information on computer networks dominate most commercial platforms today. Advertising has gone through some laudable changes with the influence of multimedia. Sales presentations are being conducting with catchy and stimulating PowerPoint presentations which combine different forms of media content. Creative and advanced multimedia presentations are being combined with a variety of online methods (matching services, web services and advertising services of exchange) to reach business customers in business to business (B2B) marketing.

3.2.2 Education

In Education, multimedia is used to produce computer-based training courses (popularly called CBTs) and reference books and websites like encyclopedia, wikipedia 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.

3.2.3 Arts and Entertainment

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*.

3.2.4 Engineering and Industry

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 a collaboration between creative professionals and software engineers.

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. Creative industries unse 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.

3.2.5 Mathematical and scientific research

In mathematical and scientific research, multimedia are mainly used for modelling and simulation. For example, a scientist can look at a molecular model of a particular substance and manipulate it to arrive at a new substance. Representative research can be found in journals such as the Journal of Multimedia.

3.2.6 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.

3.2.7 Document Imaging, Digital Publishing and Library

Document Imaging is a technique that takes hard copy of an image/document and converts it into a digital format

3.2.8 Spatial Temporal Applications

Video conferencing (web conferencing) is a virtual meeting in which participants in one location can see and interacts with participants at other locations separated by geographical distance but which is facilitated by digital technology capable of linking various types of computers across different networks.

Groupware are software products that support collaboration over networks among groups of people who share a common task or goal.

Virtual reality is a system that delivers interactive computer-generated 3D graphics to a user through a head-mounted display.

SELF-ASSESSMENT EXERCISE 1

1. Define the term “Multimedia”.
2. Explain how a particular human field of endeavour would benefits from the application of multimedia systems.

3.3 Classification 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. Hypermedia is an example of non-linear 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 an interaction with the presenter or performer.

Multimedia presentations can be in electronic forms and in printed form.

3.4 Multimedia Data Element

The followings multimedia data elements and their in various forms are describe below:

3.4.13 Text

This is any of the signs or symbols that are used in writing or printing and which represent a speech sound. Text mode refers to alphanumeric or character operation mode which computer uses in displaying letters, numbers and other text characters.

3.4.14 Facsimile (or Fax)

A letter or a message that is sent in electronic form down a telephone line and then printed using a special machine called Fax Machine.

3.4.15 Document Images

These are electronic versions of printed images which are captured and converted through electro photographic process.

3.4.16 Photographic Images

This refers to the production of permanent images by means of the action of light on sensitized surfaces.

3.4.17 Geographic Information Systems Maps

A geographical information system (GIS) is a computer system that synthesizes, analyses and displays many different types of geographical data in an easily understandable form. Geographical maps are now being made from computer databases. Such digital maps combine and clearly display different kinds of information (e.g. census, pollutions, minerals, political affinities, residential patterns etc) for a given geographical area.

3.4.18 Voice Commands and Synthesis

Voice is the sound (phonation) produced in the voice box (larynx) by the expiration of air through vibrating vocal cords. It is defined in terms of pitch, quality, and intensity or loudness. Voice command is the use of

words and syntax of spoken language to operate or control the computer. Voice synthesis refers to the ability of a computer to produce spoken words.

3.4.19 Audio Messages

These are sounds which are recorded and probably broadcasted. Sound is physical phenomenon that stimulates the sense of hearing and in human beings, hearing takes place whenever vibrations of frequencies between about 15 and 20,000 hertz reach the inner ear.

Electronic circuits provide different functions to process audio signals into from analogue to digital form and verse versa. Digital functions include the coding, storage an d transmission of information-bearing in binary form, and the logic operations and numerical processing performed in computers.

3.4.20 Music

This is the organized arrangement and movement of sounds made by instruments or voices through a continuum of time in a pleasant or exciting way.

3.4.21 Graphics

This describes the process of information (objects, images, people, data distributions, statistics etc) representations through drawing, pictorial illustrations, tables, charts. The computer screen is divided into pixels which made it possible for lines and characters to be drawn pixel by pixel on the computer screen. A pixel (picture element) is the smallest unit $(1/1000\,th)$ tiny spots of an image in a grid display on a computer screen.

Animated graphics produces the illusions of movement in graphic images using some. In a computer, it is the simulation of movement produced by displaying series of successive images on the screen.

3.4.22 Full-Motion and Video

This is the art of making motion-picture films (telling a story using sound and moving pictures) and projecting such films onto a screen for a large audience. Video is the process of recording and showing pictures along with sounds on television.

3.4.23 Holographic Images

These are 3D photographic images obtained using a lensless photography technique called Hologram. Holograms are made by exposing a piece of film to laser light, which is scattered by the object being holographed.

3.4.24 Fractals

These are geometric shapes that are complex and detailed in structure at any level of magnification.

3.5 Categorization of multimedia data

Multimedia data element can be categorized as presented in the table below

Category		Description
1.	Nature /Media	Captured from real world
		Synthesized by computers
2.	Spatial-temporal properties	Discrete: space-based only
		Continuous Space-based and time based E.g. animation, motion, video etc.

Source: Winter 1997

3.6 History of Multimedia

This section presents an overview of the pioneering works through to the contemporary contributions of people that have over many centuries labour to bridge the divide between the arts, science and technological disciplines. We shall study the work and ideas of artists who have explored new interactive and interdisciplinary forms, as well as engineers and mathematicians who have developed information technologies and influential scientific and philosophical ideologies that have influenced the arts.

This broad historical analysis will help illuminate an understanding of the emerging digital arts and its aesthetics, strategies, trends, and socio-cultural aspirations. Central to this analysis will be an understanding of key concepts for the interpretation of evolving multimedia forms: including integration, interactivity, hypermedia, immersion, and narratives.

Some of the important events in relation to Multimedia in Computing include:

Dates	Events
15,000 - 13,000BC	Prehistoric humans paint images on the walls of their caves
1895	Gugliemo Marconi sent his first wireless radio transmission at Pontecchio, Italy
1901	Gugliemo Marconi detected radio waves beamed across the Atlantic. Initially

	invented for telegraph, radio is now a major medium for audio broadcasting. Television was the new media for the 20th century. It brings the video and has since changed the world of mass communications.
1906	Color photography became practicable concept.
1914	Silent movies incorporated multiple media by using film and text captions together
1928	Walt Disney debuts the second short starring a mouse named Mickey, and the first cartoon to use synchronized sound.
1928 – 1931	Movies with sound replace silent movies
1930s	Technicolor is introduced in film and most movies are filmed in colour after
1937	Bell Laboratories had a breakthrough in creating dual sound tracks on film.
1940	Fantasia was the first commercial movie with a complete surround soundtrack in movies.
1945	Vannevar Bush wrote about Memex "As We May Think"
1960s	Ted Nelson, created Xanadu, "a universal instantaneous hypertext publishing network".
1967	Nicholas Negroponte formed MIT Architecture Machine Group (later in 1985 MIT Media Lab opens).
1969	Nelson & Van Dam hypertext editor at Brown. Birth of Arpanet (Internet) by US Military. DARPA
1971	The first E-mail was sent and received successfully,
1976	Negroponte's Architecture Machine Group proposed Multiple Media to DARPA.
1977	Apple starts to gain control of the PC market with its Macintosh Computers.
1980	Lippman & Mohl: Aspen Movie Map.
1981	IBM PC announced and captures market share in 18 months..
1983	Backer's Electronic Book was launched.
1985	Negroponte & Wiesner opened MIT Media Lab.
1987	RCA's David Sarnoff Labs' announce Digital Video Interactive.
1988	Apple "Knowledge Navigator" vision
1989	Tim Berners-Lee proposed the World Wide Web to CERN (European Council for Nuclear Research).
1990	K. Hooper Woolsey, Apple Multimedia Lab opened.
1991	Motion Picture Experts Group. World Wide Web debuts thanks to Tim Berners-Lee. Apple Multimedia Lab launched Visual Almanac, Classroom MM Kiosk.
1992	MS Windows 3.1 is released HTML debuts The first M-bone audio multicast on the Net also debuts.

1993	The first graphical browser called MOSAIC which allows us to view web pages containing IMAGES was launched by Marc Andreessen, Erin Brina &Tim Clark at University of Illinois National Center for Supercomputing Applications (NCSA).
1994	Jim Clark and Marc Andreesen launched Netscape Creation of World Wide Web Consortium (W3C) The Rolling Stones become the first major band to broadcast a live performance over the Internet.
1995	Disney releases Toy Story, the first feature length computer generated movie (77 minutes long, 4 years to make, 800,000 machine hours to render). JAVA for platform-independent application development launched.
1996	Portable Network Graphics (PNG) was launched. Microsoft, Internet Explorer was launched. Affordable digital cameras widely available.
1997	HTML 4.0
1998	XML 1.0 Google Search Engine operates by Larry Page & Sergey Brin was launched.
1999	XSLT 1.0 and Xpath 1.0 Napster debuts, allowing users to download and share MP3s.
2000s	Integration of computer, memory storage, digital datacamcorders, MP3 players, IPods, speakers, telephones, HD TV and other technologies explodes.
2001	MPEG-7, JPEG 2000, SVG.
2002	Intellectual property and JPEG 2000

The **multimedia computer (MPC)** was the next major landmark in the history of multimedia, appearing in the early 1990s. The MPC was a breakthrough in terms of its compactness, price and user-friendliness. Most PCs that are currently available can be classified as multimedia computers. These following components are essential features of an MPC:

- a soundcard
- twin loudspeakers or a set of headphones
- a microphone
- a CD-ROM drive - but modern MPCs are likely to be equipped with a combination CD-ROM / DVD drive as standard.

There were earlier computers that qualified as multimedia computers, e.g. the **Apple Mac** and the **Acorn Archimedes** in the UK, but the dominant multimedia computer is the MPC. Apple computers appear to have a commanding position in the print and graphic design industries, while Acorn computers only ever gained a foothold in the UK schools sector and finally lost their market share to the MPC.

Now we have **multimedia on the Web**. It's a growing area but has not yet completely supplanted CD-ROM or DVD technology. Web-based multimedia may offer more in terms of **presentation** rather than **interactivity**, and **broadband** access is essential in order to avoid hiccups in delivering sound and video.

3.7 Multimedia Societies

In Europe, the reference organization for Multimedia industry is the European Multimedia Associations Convention (EMMAC).

- ACM Multimedia;
- International Conference on Multimedia & Expo (IEEE ICME).

3.8 Multimedia as a Discipline

Multimedia is an inter-disciplinary subject because it involves a variety of different theories and skills:

- these include computer technology, hardware and software;
- arts and design, literature, presentation skills;
- application domain knowledge.

SELF-ASSESSMENT EXERCISE 2

1. Highlight the various multimedia elements.
2. Trace the historical development of multimedia systems.

4 Conclusion

Multimedia refers to the combination of multiple media to effectively convey a message or information.

5 Summary

In this unit, we have learnt that:

i. Multimedia is a combination of text, animated graphics, video, and sound delivered to an audience (learners, listeners or viewers) through electronic means.

ii. Multimedia finds its application in various areas including, but not limited to, e-commerce, education, art and entertainment, engineering, medicine, multimedia database systems, mathematics, business, scientific research, spatial temporal applications.
iii. Multimedia may be broadly divided into linear and non-linear categories.
iv. Multimedia data elements include text, facsimile, document images, photographic images, GIS maps, voice commands and synthesis, audio messages, music, graphics, full-motion or video, holographic images and fractals.
v. The work and ideas of artists who have explored new interactive and interdisciplinary forms, as well as engineers and mathematicians who have developed information technologies, and influential scientific and philosophical ideologies that have influenced the arts

6 Tutor Marked Assignments

1. Multimedia is a medium with multiple content forms having multiple content forms. Discuss fully.
2. Describe the various types of information that are represented in multimedia applications.

7 Further Readings and Other Resources

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Module 1: Basic Concepts in Multimedia

Unit 2: Hypermedia

Module 1: Basic Concepts in Multimedia

Unit 2: Hypermedia

1.0 Introduction

Multimedia components are used in combination with the interactive and hyperlink features.

2.0 Objectives

At the end of the unit you will be able to:

- define the hypermedia, hypertext and hyperlinks concepts;
- describe the available tools that can be used to develop hypermedia;
- explain what relationship exists between multimedia and hypermedia;
- distinguish between hypertext and hypermedia;
- describe how multimedia documents are organised;

3.0 Definitions

Hyperlinking is an index which allows for jumping around to different sections of electronic documents such as e-books, webpages, etc.

Hyper Text Mark-up Language (HTML) has features that allow a person to build hyperlinks to other webpages or location on the same page.

Hypertext is a text which contains links to other texts and is therefore usually non-linear. It is the general term applied to 'clickable' text. Once a user click on a word or words, he is then taken to a different document or another area of the current document.

3.1 Hypermedia

Hypermedia refers to multimedia systems that include nonlinear structure of information units, events, and discrete media. Hypermedia can be considered as one of the multimedia applications which combined materials in many media—text, graphic art, sound, video and animation; are delivered via digital computer or other electronic means, and provides a linked structure through which a user can navigate through elements.

Hypermedia is a general term applied to 'clickable' media. Once a user click on a particular word or graphic, he is then taken to other text, graphics, sound files, animation or moving video. The World Wide Web is a classic example of hypermedia, whereas a non-interactive cinema presentation is an example of standard multimedia due to the absence of hyperlinks.

Most modern hypermedia is delivered via electronic pages from a variety of systems including Media players, web browsers, and stand-alone applications. Audio hypermedia is emerging with voice command devices and voice browsing.

3.2 Hypermedia development tools

Hypermedia may be developed in a number of ways. Any programming tool can be used to write programs that link data from internal variables and nodes for external data files. Multimedia development software such as Adobe Flash, Adobe Director, Macromedia Authorware, and MatchWare Mediator may be used to create stand-alone hypermedia applications, with emphasis on entertainment content. Some database software such as Visual FoxPro and FileMaker Developer may be used to develop stand-alone hypermedia applications, with emphasis on educational and business content management.

Hypermedia applications may be developed on embedded devices for the mobile and the Digital signage industries using the Scalable Vector Graphics (SVG) specification from W3C (World Wide Web Consortium). Software applications such as Ikivio Animator and Inkscape simplify the development of Hypermedia content based on SVG. Embedded devices such as iPhone natively support SVG specifications and may be used to create mobile and distributed Hypermedia applications.

Hyperlinks may also be added to data files using most business software via the limited scripting and hyperlinking features built in. Documentation software such as the Microsoft Office Suite allows for hypertext links to other content within the same file, other external files, and URL links to files on external file servers. For more emphasis on graphics and page layout, hyperlinks may be added using most modern desktop publishing tools. This includes presentation programs, such as Microsoft Powerpoint, add-ons to print layout programs such as Quark Immedia, and tools to include hyperlinks in PDF documents such as Adobe InDesign for creating and Adobe Acrobat for editing. Hyper Publish is a tool specifically designed and optimized for hypermedia and hypertext management. Any HTML Editor may be used to build HTML files, accessible by any web browser. CD/DVD authoring tools such as DVD Studio Pro may be used to hyperlink the content of DVDs for DVD players or web links when the disc is played on a personal computer connected to the internet.

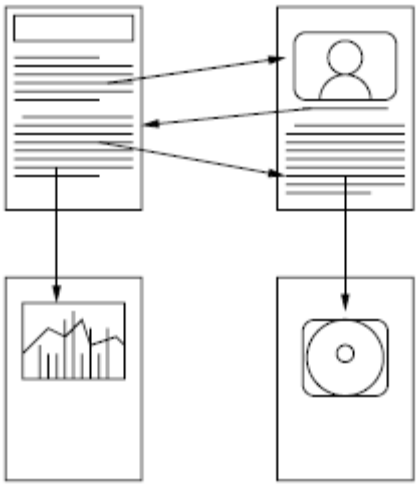
SELF-ASSESSMENT EXERCISE 1

1. What do you understand by the term “hypermedia”?
2. Itemize five environments that could serve as platform for hypermedia applications.

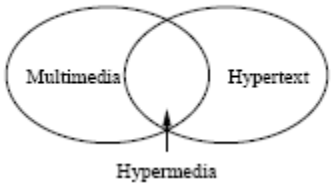
3.3 Hypertext

In contrast to traditional document, hypertext and hypermedia have as their major property, a *non-linear information link*. A hypertext structure is a *graph*, consisting of nodes and edges. The nodes are the actual *information units*. The edges provide *links* to other information units. One can *navigate* through a document by clicking the edges (arrows or links). The root of the arrows are known as *anchors*. The links serve as a

navigation aid allowing users to access information quickly and to navigate from one topic to another in a nonlinear manner.



Hypertext refers to a document containing purely text, or sometime some images but no continuous media, with non-linear links, while there have been a number of hypertext systems before the recent bloom of World Wide Web, e.g., Apple's Hypercard.



3.4 Document Structure

Document structure is the logical organization of the information, i.e., the *contents*. Traditional documents, such as a book, may contain only text and still images. They can be organized linearly. The logical structure will be, for example, chapters, sections, subsections, paragraphs. When documents are exchanged, everything about the document has to be transferred. These include the contents, the structure and the presentation. Therefore, it requires some way of describing the structure and the presentation of the document along with the contents.

3.5 Document Markups

When exchanging hypertext documents, we need to transfer the contents as well as the structure and the presentation of the documents. Document markups allow us to specify the document structure and how it is presented by inserting commands into the document. These are known as *markups*. There are in general two kinds of markups: a) *logical* and b) *visual*.

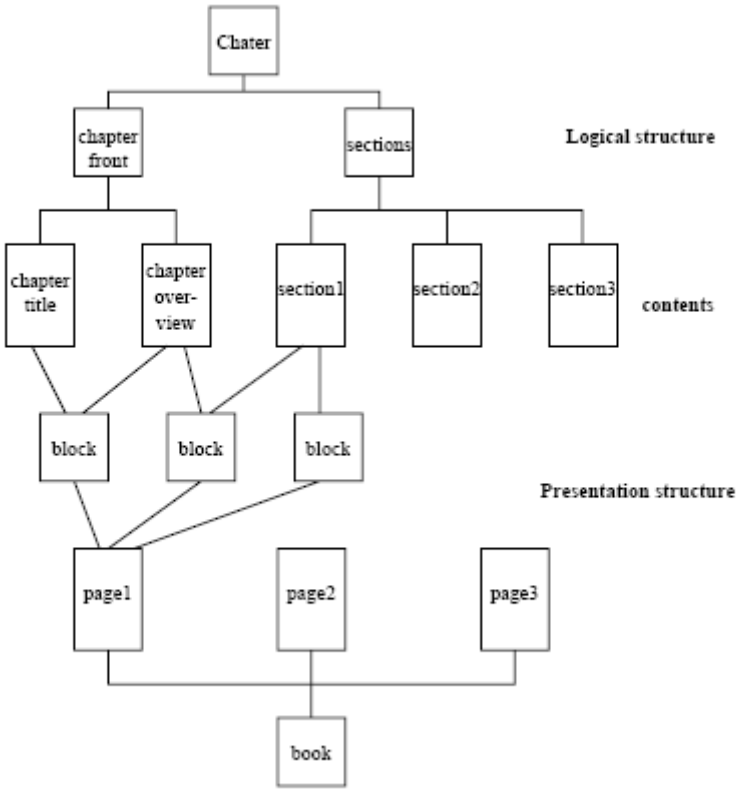
The logical markups marks the document elements according to their functions and relations with other elements, e.g., chapter, section, paragraph. It does not tell how the elements looks. The advantages of logical markups are:

- The document structure is explicit, thus the organisation of information is clear.
- It is easy to maintain the consistent look of the document.
- It requires a more powerful process to render the document.

The visual markups defines how the elements are rendered, for example, a chapter title is formatted in Helvetica Bold 24 point, while a section heading is formatted in Times Roman Bold 20 point. With visual markup, the logical structure is lost. The visual effects of the elements are explicit.

- It is easier to keep the fidelity.
- It is easier to render the document.
- It is hard to maintain the consistent look of the document.

A document can be viewed in these two aspects at the same time. In the diagram on the right, if we start from the top, we will see the logical structure of a document. If we start from the bottom, we will see the presentation aspect of the document.



SELF-ASSESSMENT EXERCISE 2

1. Explain the importance of document markups in hypermedia applications.

4.0 Conclusion

Hypermedia can be thought of as one of the multimedia applications which combined materials in different media—text, graphic art, sound, video and animation. Hypermedia applications are delivered via digital computer or other electronic means, and provides a linked structure through which a user can navigate through elements.

5.0 Summary

In this unit, we have learnt that:

i. Multimedia components involve interactivity and hyperlink features.
ii. Such components include hypermedia, hyperlink and hypertext.
iii. Hypermedia refers to multimedia systems that include nonlinear structure of information units, events, and discrete media.
iv. Hypermedia may be developed using programming tools, database software, multimedia development software, on embedded devices for the mobile, and Scalable Vector Graphics.
v. Document structure is the logical organisation of the information
vi. When exchanging hypermedia and multimedia documents, we need to transfer the contents as well as the structure and the presentation of the documents.

6.0 Tutor Marked Assignments

1. Why are hypermedia and hypertext documents refer to as non-liner information links.
2. Compare and Contrast between Document structure and Document markup.

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Module 1: Basic Concepts in Multimedia

Unit 3: Interactive Multimedia and Metamedia

Module 1: Basic Concepts in Multimedia

Unit 3: Interactive Multimedia and Metamedia

1.0 Introduction

Interactive multimedia implies allowing an end user some control over what elements to present and when. Thus, it allows user-response to *alter* the way the presentation proceeds. For someone to truly learn how to use a program or a product, it's essential that they actually use it. Interactivity allows each user to actively participate in the viewing process, instead of passively watching the material presented. The nature of your material determines the amount of interactivity you should use. The desktop computer is currently a popular vehicle for interactive multimedia presentation.

2.0 Objectives

At the end of the unit you will be able to:

- define interactive multimedia and metamedia;
- explain the benefits of interactivity to multimedia applications;
- describe the various components of interactive multimedia;

3.0 Definitions

Interactive Multimedia can be defined as an integration of relationship between multimedia and interaction. It is a multimedia system in which related items of information are connected and can be presented together. It involves combination of the followings:

- knowledge and information
- a collection of technologies
- a collection of multimedia components (modality, channels of communication, medium)
- a set of collaborative systems
- virtual environments

3.1 Interactive multimedia

Interactive multimedia is a type of collaborative media and refers to media that allows for active participation by the recipient, hence interactivity. Traditional information theory would describe interactive media as those media that establish two-way communication.

In media theory, interactive media are discussed along their cultural implications. The field of human–computer interaction deals with aspects of interactivity and design in digital media. Other areas that deal with interactive media are new media art, interactive advertising and video game production.

While much traditional analog electronic media and print media qualifies as interactive media, the term is sometimes misunderstood as exclusive to digital media. The significant increase in possibilities for interactivity (especially over vast distances) brought by the internet boosted the availability of digital interactive media. Still, e.g. language in face-to-face communication would formally belong to the category of interactive media.

Interactive media are often designed by information designers. As all media they rely on communication. In the case of e.g. computer games this is visual, acoustic, and haptic communication between the user (player) and the game. In mobile telephony, the communication happens between two people and is purely acoustic at the first glance. Yet, according to media theory the cultural implications of the medium have to be taken into account. Thus, aspects like constant availability, customization of the mobile phone and Short Message Service are also part of the interactive medium called mobile telephony. Media restrain from being translated to technological entities.

3.2 Components of Interactive Multimedia

The components of interactive multimedia include the followings:

- Asset – an object which encapsulates a single piece of 'media' (e.g. video, sound clip, graphic)
- Information – the collection of data by a particular encoding
- Knowledge – the interpretation and understanding of information

3.3 Metamedia

Metamedia refers to new relationships between form and content in the development of new technologies and new media. Metamedia utilizes new media and focuses on collaboration across traditional fields of study, melding everything from improvisational theatre and performance art, to agile, adaptive software development and smart mobs. Succinctly, it refers to the theoretical effects of mass media and focus on provision of flexible online environment for creating and sharing rich media documents for learning on core humanities subjects.

SELF-ASSESSMENT EXERCISE

1. What are the benefits of interactivity to multimedia applications?
2. Differentiate between metamedia and hypermedia.

4.0 Conclusion

Interactivity allows each user to actively participate in the viewing process, instead of passively watching the material presented.

5.0 Summary

In this unit, we have learnt that:

i. Interactive Multimedia refers to related items of information which are connected and presented together.
ii. Interactive media is a type of collaborative media and refers to media that allows for active participation by the recipient, hence interactivity.
iii. The components of interactive multimedia include asset, information and knowledge.
iv. Metamedia referred to new relationships between form and content in the development of new technologies and new media.

6.0 Tutor Marked Assignments

1. Describe the various components of interactive multimedia.
2. Discuss Metamedia as a subject discipline.

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Unit 4: Issues in Multimedia Systems

Unit 4: Issues in Multimedia Systems

1.0 Introduction

A *Multimedia System* is a system capable of processing multimedia data and applications. It is characterised by the processing, storage, generation, manipulation and rendition of Multimedia information.

2.0 Objectives

At the end of the unit you will be able to:

- state the basic characteristics of a multimedia system;
- describe the challenges confronting multimedia systems;
- highlight and describe the desirable features of multimedia systems;
- outline what hardware and software resources are required to develop multimedia systems;
- explain the current trends in multimedia applications;
- describe how multimedia contents can be accessed or delivered;

3.0 Characteristics of a Multimedia System

A Multimedia system has four basic characteristics:

- Multimedia systems must be *computer controlled*.
- Multimedia systems are *integrated*. Multimedia = multi X separate medium.
- The information they handle must be represented *digitally*. All information is ONLY in the images or video.
- The interface to the final presentation of media is usually *interactive*. Query by example is best access method. Editing of media is almost always off-line.

3.1 Challenges for Multimedia Systems

Supporting multimedia applications over a computer network renders the application *distributed*. This will involve many special computing techniques -- discussed later.

Multimedia systems may have to render a variety of media at the same instant -- a distinction from normal applications. There is a temporal relationship between many forms of media (*e.g.* Video and Audio. There 2 are forms of problems here

- Sequencing within the media -- *playing frames in correct order/time frame in video*
- *Synchronisation* -- inter-media scheduling (*e.g.* Video and Audio). Lip synchronisation is clearly important for humans to watch playback of video and

audio and even animation and audio. Ever tried watching an out of (lip) sync film for a long time?

The key issues multimedia systems need to deal with here are:

- How to represent and store temporal information.
- How to strictly maintain the temporal relationships on play back/retrieval
- What process are involved in the above.

Data has to represented *digitally* so many initial source of data needs to be *digitise* -- translated from analog source to digital representation. The will involve scanning (graphics, still images), sampling (audio/video) although digital cameras now exist for direct scene to digital capture of images and video.

The data is *large* several Mb easily for audio and video -- therefore storage, transfer (bandwidth) and processing overheads are high. Data compression techniques very common.

3.2 Challenges of Multimedia System Design

- Host computing power requirement
- Data Storage and Management requirements
- Human Interface Usability requirements
- Network latency and throughput requirements

3.3 Desirable Features for a Multimedia System

Given the above challenges the following features are desirable (if not a prerequisite) for a Multimedia System:

3.3.1 Very High Processing Power: needed to deal with large data processing and real time delivery of media.

3.3.2 Multimedia Capable File System: needed to deliver real-time media -- *e.g.* Video/Audio Streaming. Special Hardware/Software needed *e.g* RAID technology.

3.3.3 Data Representations/File Formats that support multimedia: Data representations/file formats should be easy to handle yet allow for compression/decompression in real-time.

3.3.4 Efficient and High I/O: input and output to the file subsystem needs to be efficient and fast. This needs to allow for real-time recording as well as playback of data. *e.g.* Direct to Disk recording systems.

3.3.5 Special Operating System: to allow access to file system and process data efficiently and quickly. This needs to support direct transfers to disk, real-time scheduling, fast interrupt processing, I/O streaming *etc.*

3.3.6 Storage and Memory: large storage units (of the order of 50 -100 Gb or more) and large memory (50 -100 Mb or more). Large Caches also required and frequently of Level 2 and 3 hierarchy for efficient management.

3.3.7 Network Support: Client-server systems common as distributed systems common.

3.3.8 Software Tools: user friendly tools needed to handle media, design and develop applications, deliver media.

SELF-ASSESSMENT EXERCISE 1

1. State four characteristics of multimedia systems.
2. Describe the desirable features of multimedia systems.

3.4 Components of a Multimedia System

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

3.4.1 Capture devices include Video Camera, Video Recorder, Audio Microphone, Keyboards, mice, graphics tablets, 3D input devices, tactile sensors, VR devices. Digitising/Sampling Hardware

3.4.2 Storage Devices include Hard disks, CD-ROMs, Jaz/Zip drives, DVD, *etc*

3.4.3 Communication Networks include Ethernet, Token Ring, FDDI, ATM, Intranets, Internets.

3.4.4 Computer Systems include Multimedia Desktop machines, Workstations, MPEG/VIDEO/DSP Hardware

3.4.5 Display Devices include CD-quality speakers, HDTV,SVGA, Hi-Res monitors, Colour printers *etc.*

3.5 Trends in Multimedia

Current big applications areas in Multimedia include:

3.5.1 World Wide Web: Hypermedia systems -- embrace nearly all multimedia technologies and application areas. Ever increasing popularity.

3.5.2 MBone: Multicast Backbone: Equivalent of conventional TV and Radio on the Internet.

3.5.3 Enabling Technologies: developing at a rapid rate to support ever increasing need for Multimedia. Carrier, Switching, Protocol, Application, Coding/Compression, Database, Processing, and System Integration Technologies at the forefront of this.

3.6 Multimedia Delivery

Multimedia contents can be accessed or delivered via videotape, hard-disk, CD-ROM or over a distributed network such as the World Wide Web. Also it can be non-interactive or interactive, or printed multimedia. Multimedia and the Internet require a completely new approach to writing. The style of writing that is appropriate for the 'on-line world' is highly optimized and designed to be able to be quickly scanned by readers.

A good site must be made with a specific purpose in mind and a site with good interactivity and new technology can also be useful for attracting visitors. The site must be attractive and innovative in its design, function in terms of its purpose, easy to navigate, frequently updated and fast to download. When users view a page, they can only view one page at a time. As a result, multimedia users must create a 'mental model of information structure'.

Patrick Lynch, author of the Yale University Web Style Manual, states that users need predictability and structure, with clear functional and graphical continuity between the various components and subsections of the multimedia production. In this way, the home page of any multimedia production should always be a landmark, able to be accessed from anywhere within a multimedia piece.

3.7 Delivery of Multimedia Applications

Multimedia applications can be delivered via the World Wide Web or on CD-ROMs/DVD.

	World Wide Web	**CD-ROM/DVD**
Access Time	Can experience slow connection speeds. Access time depends on internet bandwidth and available resources on the local computer.	Content are viewed immediately the CD/DVD is inserted into the CD-ROM/DVD drive
Ability to change content	It is easy to update material on web. New updates can be instantly accessed off the web	Content can not be changed but can be recreated and redistribute to audience.

Computer based delivery of delivery multimedia applications include Video Games, Interactive Web Applications, CD ROM discs and Informational kiosks. Computer-

based multimedia applications integrate the various media components and allow interactivity and hyperlinking.

Web-based multimedia applications are faced with two major challenges, namely link fossilization, and server and network overload. Link fossilization challenges include when the host server has changed, the applications is no longer residents at the host, or when a host contain only an outdated version of the applications. The challenges related to network and server overload include when large size of multimedia applications, users are not informed of their network capabilities in relation to application file sizes, when users and authors are not conscious of network implications, and sub-optimally designed servers and protocols (same applications being transferred many times between a server and a client size).

SELF-ASSESSMENT EXERCISE 2

1. State the hardware components required for a multimedia systems.
2. Compare and contrast two common multimedia delivery modes.

4.0 Conclusion

Effective applications of multimedia systems require that the issues and challenges confronting it be paid attention to.

5.0 Summary

In this unit, we have learnt that:

i. Multimedia systems must be *computer controlled*; are *integrated;* be represented *digitally;* and are usually *interactive*.
ii. The key issues multimedia systems that need to be deal with include how to represent and store temporal information; how to strictly maintain the temporal relationships on play back/retrieval; and what processes are involved in the above.
iii. Multimedia systems have desirable features which are necessary for their effective deployment and utilization.
iv. Multimedia applications can be accessed and deliver via CD/DVD and the Web.

6.0 Tutor Marked Assignments

1. Explain why multimedia systems need to be *computer controlled*.
2. Taken into account the trends of multimedia applications, discuss the future direction of multimedia applications.
3. Justify with sufficient reasons why multimedia applications must be attractive and innovative in its design, function in terms of its purpose, easy to navigate, frequently updated and fast to download.

7.0 Further Readings and Other Resources

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Unit 5: Multimedia Tools: Hardware

Unit 5: Multimedia Tools: Hardware

1.0 Introduction

This unit describes the various hardware equipment necessary to design, develop and deploy multimedia applications. Multimedia Personal Computer (MPC) is a working group that define the minimum hardware and software specifications for running multimedia software.

2.0 Objectives

At the end of the unit you will be able to:

- outline the minimum hardware required to run multimedia applications;
- describe fully each of these hardware devices.

3.0 Multimedia Hardware

Certain minimum hardware specifications are desirable for a use to run multimedia applications on a computer. Modern computers are normally equipped with all the essential components as standard, but the variety is huge and careful choices have to be made. These are typical minimum hardware specifications:

- A fast multimedia PC running at 500MHz or higher.
- At least 512MB of RAM (memory). The more RAM the better!
- Hard disk drive with at least 40GB storage capacity.
- Monitor. Buy the best-quality monitor you can afford.
- Soundcard (an expansion card that provides both input and output).
- Loudspeakers or headphones.
- Microphone.
- Video card / graphics card.
- CD-ROM drive.
- DVD drive.

3.1 Soundcard

An adequate soundcard is essential for multimedia. Modern multimedia computers are fitted with soundcards as standard, so the choice of soundcard may already have been made for you. A user should be familiar with soundcard controls under the *Windows* operating system in other to be able to adjust the output volume of the soundcard and the input sensitivity of the microphone.

3.2 Loudspeakers / Headphones

Speakers or headphones are essential for listening to sound recordings. When purchasing speakers it is worthwhile checking that they have their own inbuilt amplification system.

The sound level of all speakers or headphones can be controlled under the *Windows* operating system, but good speakers have a volume control knob that also enables the user to adjust the volume manually. Headphones can be integrated with a microphone - the so-called pilot's headset that is used in language laboratories. Stereo speakers or headphones are advisable for most multimedia applications.

3.3 Microphone

The importance of selecting the right kind of microphone is often not appreciated by ICT technicians. For good quality sound recordings the language teacher needs a high-quality microphone. A dynamic microphone (also known as a karaoke microphone) is satisfactory but provides a softer signal than a condenser microphone (also known as a powered microphone).

The level of the input signal to the microphone can be controlled under the *Windows* operating system. A common mistake made by newcomers to multimedia applications is a failure to set the input signal control properly so that very faint sound - or no sound at all - is emitted when playing back recordings made by the user. It is advisable to purchase a microphone that has its own on/off switch.

3.4 Video card / Graphics card

The terms video card and graphics card are used to mean much the same thing. The term card in this context is jargon for an electronic circuit board. You will not be able to see the video card from outside the computer. All that is visible is the rear of the card is the socket into which you plug the monitor. It is important to know what kind of video card your computer is equipped with, as this affects what the monitor can display. When you purchase software make sure that your computer has a video card that is compatible with the software you wish to use. Some software will only work on computers equipped with video cards with high specifications.

SELF-ASSESSMENT EXERCISE 1

1. List the minimum hardware specifications required to run multimedia applications.
2. Differentiate between sound card, video card and graphics card.
3. Why do multimedia specialists need the microphone?

3.5 CD-ROM drive

CD-ROM stands for **Compact Disc Read Only Memory**. A CD-ROM is an optical disk onto which data has been written via a laser - a process often referred to as "burning a CD". A CD-ROM looks much the same as an audio CD but can contain text, sound, pictures and motion video.

A CD-ROM drive - which is standard on modern multimedia computers - is essential for running multimedia applications. CD-ROMs are the commonest **storage media** for multimedia applications.

Modern computers are now usually equipped with a **combination drive** that enables both CD-ROMs and DVDs to be played and recorded - as well as playing and creating audio CDs and movies. A CD-ROM drive can also play standard audio CDs, so you can listen to your favourite music while you work or follow a language course supplied on audio CD - but most computer technicians keep quiet about this as they don't want their computer lab turning into a discotheque or language lab! It is possible to extract or copy tracks from an audio CD and save them to your computer's hard disk as audio files, which can then be played, edited, written back to another CD, or saved to an iPod or similar mobile player. This process is often referred to as **"ripping a CD".**

CD-ROM drives are available in a variety of different speeds, the speed being described thus: 12x (12-times), 24x (24-times), etc. This indicates the speed at which data can be pulled off the CD-ROM drive - the so-called **spin-rate** - 150 kilobytes per second being the notional original 1x spin-rate - long since superseded. A high spin-rate helps speed up data transfer, which is crucial when playing sound or video. A low spin-rate may cause hiccups when audio and video recordings are played. CD-ROMs work fine on stand-alone computers but networking CD-ROMs containing large amounts of sound and video can be problematic. Although it is technically possible for a limited number of network users to access data on the same CD-ROM, the success of this depends on a number of technical factors that are too complex to discuss here, and you are therefore advised to consult your network manager.

CD-ROMs can store at least 650 megabytes of data. Compared to other storage media, the CD-ROM's storage capacity is impressive. A single CD-ROM can comfortably accommodate 500 medium-length novels, a 12-volume encyclopaedia, the complete works of Shakespeare, or a whole year's edition of a newspaper. It is this enormous storage capacity that makes CD-ROMs attractive. When graphics and audio and video recordings are stored in computer-readable format they take up much more space than text, and they can only be made available to consumers in reasonable quantities if they are stored on CD-ROM or DVD.

Once written, the data on a CD-ROM can be fixed and rendered unalterable, hence the term **Read Only** - but modern computers are usually equipped with a **CD read/write drive** that enables new material to be stored on a special kind of CD-ROM: CD-R (recordable) or CD-RW (rewriteable). A CD-read/write drive is useful for making backups and storing your own multimedia materials. Blank CD-Rs or CD-RWs can be bought from computer media suppliers at a relatively low cost. You can store data on CD-Rs using a read/write drive, adding to it until it is full, and then you can format the CD-ROM so that it is fixed and can be read by a standard CD-ROM drive. You can also store data on CD-RWs in the same way, but these disks can only be read by a CD read/write drive. The advantage of CD-RWs is that they can be erased and used over and over again, but now that the cost of blank CD-Rs has fallen to such a low level it is questionable how useful CD-RWs are. It is also possible to create or copy audio CDs on a CD read/write drive.

Multimedia CD-ROMs are designed mainly for use on stand-alone computers. This is because the main target of CD-ROM manufacturers is the home user.

3.6 DVD drives

Most modern PCs come equipped with a **DVD drive**. **DVDs (Digital Video Discs)** - or, more accurately, **Digital Versatile Discs** - are relative newcomers to the multimedia scene. They look just the same as CD-ROMs and audio CDs, but they are much more versatile and can store much more data. They are already in widespread use to store movies that can be played back on domestic TV sets. DVDs can also be used to store computer data, which can be read by a computer equipped with a DVD drive.

Modern multimedia computers usually come equipped with a DVD read/write drive or a **combination drive** that can read and write to CD-ROMs too, as well as playing and creating audio CDs.

First, an important distinction:

i. A **DVD-player** is the name given to the device used in home entertainment systems to play back video and audio. A DVD-player can play:
   - DVD-Video discs - also referred to as **DVD-Movie discs**: e.g. containing, full-length feature films, videos of concert performances, etc;.
   - audio CDs.

ii. A **DVD drive**, as fitted in a multimedia computer, can play:
   - DVD-ROM discs, which consist of combinations of computer programs and high-quality motion video;
   - DVD-Video discs - also referred to as **DVD-Movie discs**: e.g. containing, full-length feature films, videos of concert performances, etc;
   - CD-ROMs ;
   - audio CDs.

A DVD-player cannot normally be used to play DVD-ROM discs - but bear in mind that this technology is in the process of coverging and moving towards fully integrated systems, including DVD read/write players that can be linked to TV sets.

The main advantage of all types of DVDs is that they offer very high quality video and sound. In this respect they have finally caught up with - and surpassed - the video quality offered by older 12-inch **laserdiscs**. Their capacity is impressive - up to 25 times the storage capacity of a CD-ROM, which means that a DVD can comfortably hold a full-length movie. Most modern computers can play DVD-Video discs and DVD-ROM discs.

1. DVD-Video discs

Standards for DVD-Video are still in the process of settling down. An annoying aspect of DVD-Video is that the world is carved up into six regions, also called **locales**, each of which has its own DVD standard. DVD-Video discs are regionally coded - look for a

small standardised globe icon on the packaging with the region number superimposed on it. If a disc plays in more than one region it will have more than one number on the globe. The current six regions are:

1. USA, Canada
2. Western Europe, Japan, South Africa
3. South East Asia
4. Australia, Spanish America
5. Russia, Eastern Europe, Africa
6. China

A DVD-Video disc coded for Region 1 (USA, Canada) will not play on a DVD player sold in Region 2 (Western Europe, Japan, South Africa). When you buy a computer equipped with a DVD drive, the region will have been pre-set, but you can change it via Windows. The problem is that you cannot keep doing this: you normally only have **five chances** (more on some systems) to change regions! There are various reasons for this non-standardisation, one of them being that movie producers release movies at different times in different regions and in different variations. There are various ways of getting round the problem of non-standardisation - but this is beyond the scope of this introduction and you are advised to consult someone who is technically competent in this area.

DVD-Video discs have impressive advantages. You can play back a full movie with 8-channel surround-sound cinema effects. You can easily jump to a particular sequence (a scene or chapter), and DVD-Video discs often offer alternative soundtracks in different languages, subtitles (i.e. subtitles in a language other than the one in which the film was recorded), closed captions (i.e. subtitles in the same language as the one in which the film was recorded), and information about the director and cast, as well as the possibility of previewing and playing your favourite scenes over and over again.

2. DVD-ROM discs

DVD-ROM discs are not subject to the same geographical restrictions as DVD-Video discs. They only run on computers equipped with a DVD drive and cannot be played on a domestic DVD player - but, having said that, DVD technology is in the process of settling down and moving towards fully integrated systems. DVD-ROM discs combine computer programs and movies and are becoming increasingly flexible as an instructional medium, especially for Modern Foreign Languages.

Each DVD is divided into six sections:

i. **Video & Script:** The whole movie can be viewed in full-screen mode without subtitles or in small-screen mode with subtitles and an optional rolling script. If the learner wishes to view a particular scene and play it over and over again, it can be selected from a menu.

ii. **Movie Quiz:** The learner takes part in a quiz on the movie, pitting his/her wits against a "virtual" competitor - a character who has already appeared in another EuroTalk series.
iii. **Record Yourself:** The learner can choose a character in a short clip from the movie and record his/her own voice, which is then substituted for the character's voice.
iv. **Dictionary:** The learner can look up a word, which is then spoken aloud and illustrated with a still picture from the movie.
v. **Word Search:** The learner can look for an example of a word in use. A short clip containing the word will then play.
vi. **Activities:** These consist of a four types of interactive exercises:

- **Vocabulary:** The learner attempts to match a spoken word with a still picture
- **Missing Word:** A gap-filling/multiple-choice drag-and-drop exercise in which the learner attempts to match a blanked-out word in the movie subtitle with a selection of possible words that appear below the subtitle.
- **Spelling:** An activity which is similar to **Missing Word,** except that the learner has to drag the word letter-by-letter into the gap in the subtitle.
- **What's the next line?** A multiple-choice exercise in which a short clip from the movie is played and the learner has to anticipate the next line.

3.7 Scanners

A **scanner** is a device that copies hard copy information (printed page, graphic image, photograph etc) into digital data, translating the information into a form a computer can store as a file. Thus it is possible to make a digitised copy of a printed page, graphic image or photograph. Simple graphic images are usually stored in a format known as **GIF**. Photographs are usually stored in a file format known as **JPEG** or **JPG** and they can then be printed on a colour printer, sent as an email attachment to a friend or colleague, or incorporated into a website.

Scanners do not distinguish text from graphic images and photographs, so you cannot use a word-processor to edit directly a printed page that has been scanned. To edit text read by an optical scanner, you need **optical character recognition (OCR)** software to translate the image into 'real text', i.e. a format that can be read by a word-processor. An OCR machine scans individual characters, isolates salient features, and then some decision is made as to what letter or other character lies below the reader. When the characters actually occur as part of natural-language text, it has long been recognized that contextual information can be used to assist the reader in resolving ambiguities. Most optical scanners today come bundled with OCR software.

The most popular type of scanner is known as a **flatbed scanner**. This looks a bit like a photocopier and works in a similar way. You lay the picture or page containing the text to be scanned on a glass plate, start the scanning software and watch the digitised image appear on screen. The image can then be saved as a file on your hard disk. Text saved as

an image can then be converted into "real text" with the aid of OCR software. OCR software does not work 100%, as broken characters and faded characters are liable to be misread, but surprisingly good results can be achieved - and it certainly beats typing!

Some scanners are small hand-held devices that you slide across the paper containing the text or image to be copied. Hand-held scanners are fine for small pictures and photos, but they are difficult to use if you need to scan an entire page of text or larger images.

3.8 Other Hardware Tools

These include the followings:

a. Audio digitizer – pair of A-D and D-A converters
b. Wavetable synthesis – has the capability of producing sound
c. Mixer – combines the above 2 signals with mixing audio from a CD-ROM or DVD-ROM
d. 3 jacks: - Microphone input, Line in from stereo, tv, radio, etc. and Speaker output
e. **PC Camera (Webcam)** – allows a user to see people at the same time they communicate on the Internet as well as edit videos from a video camera or a VCR, create a move from still photographs and videos, and take digital photographs automatically at preset times or when the camera detects motion. Typically a video in plug is present on the camera while some models will attach to USB ports.
   Digital Cameras – like a regular camera except images are stored to a floppy disk, PC Card or internal memory
f. **Display Device** – (monitor and video card) allow for the display of visual multimedia components
g. **Televisions** – must have an NTSC converter to change computer's digital output to the television's analog input. HDTV's don't require the converter.
h. **Multimedia (Data) Projector** – a device which connects directly to the computer with a cable and uses its own light source to display a multimedia app or presentation
i. **Video Capture Card** – enables you to connect a video camera or VCR to a computer and manipulate the video input.

SELF-ASSESSMENT EXERCISE 2

1. Explain the following terms:
   a. Burning a CD
   b. Ripping a CD
2. Differentiate between the following terms:
   a. Optical Character Reader b. Magnetic Ink Character Reader
   c. Optical Mark Reader
3. Itemize and describe the six sections of DVD-ROM discs.

4.0 Conclusion

The minimum hardware specifications desirable to run multimedia applications on a computer include a processor of. 500MHz or higher, at least 512MB of RAM, 40GB Hard disk drive, high resolution SVGA (Monitor), Soundcard, Loudspeakers or headphones, Microphone, Video card / graphics card, CD-ROM and DVD drives. Most modern computers come with all these essential components as standard, but the variety is huge and careful choices have to be made.

5.0 Summary

In this unit, we have learnt that:

i. the various hardware requirement for running multimedia systems include a processor of. 500MHz or higher, at least 512MB of RAM, 40GB Hard disk drive, high resolution SVGA (Monitor), Soundcard, Loudspeakers or headphones, Microphone, Video card / graphics card, CD-ROM and DVD drives
ii. a user should be familiar with soundcard controls under the *Windows* operating system.
iii. the sound level of all speakers or headphones can be controlled under the *Windows* operating system.
iv. selecting the right kind of microphone is important for good quality sound recordings.
v. a video card must be compatible with the software you wish to use. Some software will only work on computers equipped with video cards with high specifications.
vi. modern computers are now usually equipped with a **combination drive** that enables both CD-ROMs and DVDs to be played and recorded - as well as playing and creating audio CDs and movies.
vii. it is possible to make a digitized copy of a printed page, graphic image or photograph using a scanner.

6.0 Tutor Marked Assignments

1. State the reason why a multimedia users need to be familiar with the operating system on his computer.
2. Distinguish between a DVD player and a DVD drive.
3. What are the reasons for non-standardisation of DVD technology?
4. Describe three different kinds of scanner you are familiar with.

7.0 Further Readings and Other Resources

Godwin-Jones R. (1998) "New developments in digital video", *Language Learning and Technology* 2, 1: 11-13: Available at: http://llt.msu.edu/vol2num1/emerging/index.html

James Khazar (2009). Arts 21: Introduction to Computer for Arts.
Licensed under a Creative Commons Attribution-Noncommercial-No Derivative Works 3.0 Licences. http://www.khazar.com/academics/portal/ucsc/2008fall/art21/

Marshall, D. (2008), Multimedia. Module CM0340.
http://www.cs.cf.ac.uk/Dave/Multimedia/

Multimedia and Digital Commentary Online, a website maintained by Mike Bush at Brigham Young University: http://moliere.byu.edu/digital/ - contains lots of useful information and many links to other sources.

Text Recognition http://www.cim.mcgill.ca/~latorres/Viterbi/va_application

Unit 6: Multimedia Tools: Software

1.0 Introduction
2.0 Objectives
3.0 Media players

3.1 CODECs

3.2 Digital Language Labs

3.3 DVD media players

3.4 Multimedia Editing Software

3.5 Scanning and OCR software

3.6 Sound recording and editing software

3.7 Video editing software

3.8 Software Format

3.9 Plug-ins

3.10 Podcasting

3.11 Saving and converting streaming media for use offline

4.0 Conclusion
5.0 Summary
6.0 Tutor Marked Assignments
7.0 Further Readings and Other Resources

Unit 6: Multimedia Tools: Software

1.0 Introduction

This unit describes some of the software which is required for developing and deploying multimedia application. A basic knowledge of this software is required for a multimedia developer to create multimedia applications.

2.0 Objectives

At the end of the unit you will be able to:

- outline the various software required to run multimedia applications;
- describe fully each of these multimedia software applications.
- create, edit and play movie and sound plays using these multimedia software applications..

3.0 Media players

Software that you require for running multimedia applications will probably be supplied with your multimedia computer. A **media player** should automatically spring into action when your computer needs to play an audio or video clip. A media player is in effect a "virtual" playback machine, complete with Play, Stop, Pause, Fast Forward, Fast Reverse and Volume Control buttons. Media players installed on your computer can also act as a plug-in when an audio or video clip is accessed onthe Web.. Examples of media players include:

- **iTunes** is used for playing and organising multimedia files and transferring them to an **iPod** or similar mobile devices. **iTunes** also offers an extensive online library of music recordings and video recordings. The Open University in the UK has made some of its language-learning materials available via **iTunes.** http://www.apple.com/itunes/
- **VLC Media Player:** A cross-platform (PC and Mac) media player that plays virtually any type of media file: http://www.videolan.org/vlc/
- **QuickTime:** http://www.apple.com/quicktime/ - for playing audio and video files.
- **RealPlayer:** http://uk.real.com/realplayer/ - for playing audio and video files.
- **Windows Media Player:** Normally bundled with the *Windows* operating system.

3.0.1 Procedure for Loading Windows Media Player

Windows Media Player provides an intuitive, easy-to-use interface for you to play digital media files, organize your digital media collection, burn CDs of your favorite music, rip music from CDs, sync digital media files to a portable music player, and shop for digital media content from online stores. Load **Windows Media Player**

a. *Start -> All Programs ->Windows Media Player*
b. *Media Guide -> Help with Stores -> Contents*
c. *Read through the Help Contents*
d. *Load and play an audio CD, video CD, or DVD*
e. *Rip music from an audio CD to the Library*
f. *Burn music to CD.*
g. *Synchronize a video, music to a memory card.*
h. Change how videos that you play look by adjusting hue, brightness, and contrast.
i. Change how Windows Media Player looks using skins

3.1 CODECs

CODEC is short for **COmpressor / DECompressor** or **COder / DECoder**. A CODEC is software that is used to compress or decompress a digital audio or video file. CODECs are additional pieces of software that operate in conjunction with different media players, and certain types of audio and video recordings will only play back if the relevant CODEC is running in conjunction with the media player that you are using.

A CODEC can consists of two components, an encoder and a decoder. The encoder compresses the file during creation, and the decoder decompresses the file when it is played back. Some CODECs include both components, while other CODECs include only one. CODECs are used because a compressed file takes up less storage space on your computer or on the Web.

When users play an audio or video file in media player, the media player will use a CODEC to decompress the file. The extension WAV, MP3, AVI, WMA, WMV or MPEG is not a guarantee that an audio or video file can be played in the media player, as the file may have been compressed using a CODEC that is different from those already installed on your computer.

3.2 Digital Language Labs

Digital language labs incorporate a media player/recorder, but go one step further insofar as they offer, in digital format, the same kind of audio-interactive facilities found in a traditional language lab, including teacher monitoring facilities and video playback. The following businesses supply digital language labs:

- **CAN-8 VirtuaLab:** http://www.can8.com

- **Keylink Computers:** http://ds.dial.pipex.com/keylink
- **Melissi Multimedia:** http://www.melissi.co.uk
- **Robotel:** http://www.robotel.com
- **Sanako:** http://www.sanako.com
- **SANS (Software And Network Solutions), Sony Licensor:** http://www.sansinc.com
- **Sun-Tech:** http://www.suntechgroup.com
- **Televic Education (Artec):** http://www.televic.com

3.3 DVD media players

If a computer is equipped with a DVD drive it will need a media player that enables DVDs to be played. It is likely that your computer will have a DVD-compatible media player pre-installed if you have purchased a computer with a DVD drive. But many other media players will also play DVDs.

3.4 Multimedia Editing Software

A user that intends to develop multimedia applications, there is need for additional editing software to create and edit images, audio files and sound files - collectively known as *assets*. A selection of packages for creating and editing images, sound and video is described below.

- **Adobe Photoshop** and **Adobe Illustrator**: http://www.adobe.com/uk/
- **Corel Paint Shop Pro** and **Corel Painter:** http://www.corel.com
- **LView Pro:** http://www.lview.com

When using the above packages, it is important that to be aware of the different formats in which images can be stored on a computer. Most image editing packages allow you to save images in different formats and to convert from one format to another. The commonest formats are:

- **BMP:** Bitmap format. This is the standard format used by *Windows Paint*. Images stored in this format tend to be rather large, however.
- **EPS:** Encapsulated Postscript format. An image file format that is used mainly for printing images on Postscript printers.
- **GIF:** Graphic Interchange Format. This format is commonly used for storing simple graphics on the World Wide Web, e.g. line drawings and maps. GIF files use a palette of 256 colours, which makes them practical for almost all graphics except photographs. Generally, GIF files should be used for logos, line drawings, icons, etc, i.e. images that don't contain a rich range of colours. A GIF file containing a small number of colours tends to be small, but it will be big if the image has a wide range of colours, e.g. a photograph. GIF files are commonly used for storing images on the Web. GIF files are also suitable for storing animated images.

- **JPG (or JPEG):** Joint Photographic Expert Group format. The JPEG/JPG format uses a palette of millions of colours and is primarily intended for photographic images. The internal compression algorithm of the JPEG/JPG format, unlike the GIF format, actually throws out superfluous information, which is why JPEG/JPG files containing photographic images end up smaller than GIF files containing photographic images. If you store an image, say, of a flag containing just three colours in JPEG/JPG format it may end up bigger than a GIF file containing the same image, but not necessarily a lot bigger - it depends on the type and range of colours it contains. JPEG/JPG files containing photographic images are normally smaller than GIF files containing photographic images. JPEG/JPG files are commonly used for storing images on the Web.
- **TIFF or TIF:** Tag Image File Format. Files stored in this format give a high-quality image but they are huge.

3.5 Scanning and OCR software

Most image editing packages also include software for acquiring images from **scanners** above. When you buy a **flatbed scanner** it is normally supplied with software for scanning images from photographs or other printed media, and with **optical character recognition (OCR)** software for scanning in texts and converting them into a format that can be read with a word-processor and then edited.

SELF-ASSESSMENT EXERCISE 1

1. State and describe the two components of CODEC.

2. The extension WAV, MP3, AVI, WMA, WMV or MPEG is not a guarantee that an audio or video file can be played in the media player. Why? What are the meanings of these extensions?

3.6 Sound recording and editing software

Making and editing sound recordings and turning them into podcasts are not difficult. These are some of the tools available for making sound recordings:

- **Adobe Audition:** The "industry standard", the successor to *Cool Edit*: http://www.adobe.com/uk/
- **Audacity** (freeware): Allows for all the basic features of editing, but you need to download addtional software in order to create MP3 files: http://audacity.sourceforge.net. There is a tutorial on the *Audacity* site on how to use the software. Joe Dale's Blog contains many references to audio recording using *Audacity*: http://joedale.typepad.com. Joe has also set up a comprehensive set of links to tutorials on *Audacity*: http://delicious.com/joedale/audacity
- **GoldWave:** http://www.goldwave.com
- **NCH Swift Sound:** A wide range of useful tools, including some downloadable freeware: http://nch.com.au

- **Sound Recorder** - supplied with *Windows*. Rather primitive, with only basic operations. Suitable only for introducing language teachers to audio recording and editing.

It's easy to make recordings directly onto the hard disk of a computer, but it is preferable to make them first on a portable recorder (analogue or digital) and then upload them to the computer using a connection lead. See the range of audio recording devices offered by **Olympus** and **iRiver**:

- **Olympus:** http://www.olympus.co.uk/voice/
- **iRiver:** http://www.iriver.com

When using the above editing packages, it is important that you are aware of the different formats in which sound can be stored on a computer. Most sound editing packages allow a user to save images in different formats and to convert from one format to another. The commonest formats are:

- **MP3:** The standard format for storing sound files, especially music, on the Web. MP3 is the form favoured for **podcasting**. The advantage of this format is that it compresses the sound - therefore saving space - without a significant loss in quality. MP3 is a variant of MPEG .
- **MP4 AAC:** Abbreviation for **MPEG-4 Advanced Audio Coding**. The MP4 AAC file format is used to store audio files in a more manageable size without affecting the quality. MP4 AAC's best known use is as the default audio format of Apple's **iPhone**, **iPod** and iTunes media player**.** See also the reference to MPEG-4 Advanced Video Encoding.
- **WAV:** Until recently, the commonest format. Produces high-quality sound but takes up quite a lot of space.
- **WMA:** Windows Media Audio is Microsoft's own audio encoding format that is starting to gain popularity due to its high-quality output at lower file sizes.

Use Audacity rather than *Windows Recorder* to make the recordings and then save them in MP3 format. You can then copy the recordings into iTunes and onto your iPod, and you can burn selected recordings onto CD-ROM or audio CD.

3.7 Video editing software

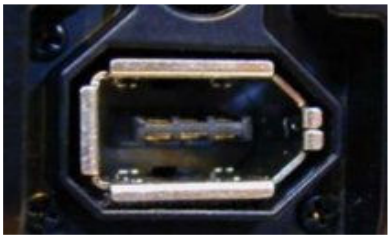
Pre-recorded video on a camcorder these can be uploaded to the computer by means of a cable connecting the camcorder to the **firewire port** (firewire socket) on the computer.

A firewire is in essence a device that allows you to transfer video recordings very quickly from your camcorder to your computer. Many modern computers already have a firewire port built in. If your computer does not have a firewire port then you have to buy a firewire card and slot it in - and here you need a bit of technical knowledge. Most modern computers systems that are designed for audio and video applications have firewire ports built into them. If you are not sure that you have a firewire port, have a look at the

sockets for connecting to external devices on your computer. A firewire port is smaller than a **USB port**, but it will probably be located near the USB port(s).

Firewire cable

USB cable



Firewire port

Firewire port (left)

There is a good range of products offered by Hauppauge for the efficient digitisation of video materials from a variety of sources http://www.hauppauge.com

- **Adobe Premiere:** http://www.adobe.com
- **Ulead VideoStudio:** http://www.ulead.com
- **Pinnacle Studio**: http://www.pinnaclesys.com
- **Final Cut Pro (Mac):** http://www.apple.com/finalcutpro
- **Matrox** offer a wide range of products: http://www.matrox.com
    - **Movie Maker** is bundled with Windows.
- **NCH Software** offers a wide range of packages: http://www.nchsoftware.com
- **VideoSpin by Pinnacle:** A free video editing package: http://www.videospin.com/Redesign/

3.8 Software Format

- **ASF:** Advanced Streaming Format. This is a Microsoft's own file format that stores both audio and video information and is specially designed to run over the Internet. ASF enables content to be delivered as a continuous stream of data (**streaming audio** or **streaming video**) with little wait time before playback begins. This means that you no longer have to wait for your audio and video files to fully download before starting to view them. Cf. the WMV format (below).
- **AVI:** Audio Video Interleave format. Still very popular, but giving way to MPEG, which takes up less storage space.

- **FLV:** Abbreviation for Flash Video, a proprietary file format used to deliver video over the Web using the **Adobe Flash Player** plug-in.
- **MOV:** The standard format for storing video files on the Apple Macintosh to be played in the **QuickTime** media player - which is also available for the multimedia PC. Economical in terms of storage space. http://www.apple.com/quicktime
- **MPG or MPEG:** Motion Picture Expert Group. Probably the commonest format for storing video, especially on the Web. Economical in terms of storage space.
- **MP4 AVC:** Abbreviation for **MPEG-4 Advanced Video Coding**. The MP4 AVC file format is used to store video files in a more manageable size wihout affecting the quality. It is also increasingly being used for storing video on iPods and similar portable devices. See also MPEG-4 Advanced Audio Encoding.
- **RM (RealPlayer):** Used for playing **streaming audio** and **streaming video**. RM enables content to be delivered as a continuous flow of data with little wait time before playback begins. This means that you do not have to wait for your audio and video files to fully download before starting to view them: http://uk.real.com/realplayer/. RealPlayer enables you to download streaming files (e.g. **YouTube** videos) from the Web.
- **WMV:** Windows Media File. This is Microsoft's own file format. WMV is the same as ASF (see above) except that it can be downloaded instead of streamed from a server located at a distance.

3.9 Plug-ins

A plug-in is an extra piece of software that a Web browser needs to run certain elements of a Web page, e.g. animated sequences and audio or video clips. You will find that when you click on an icon that signifies the availability of streaming audio or video material, your browser will link with a plug-in. If the plug-in is not already installed on your computer then you will be able to download it free of charge. Web pages incorporating multimedia often need plug-ins such as **Flash Player**, **QuickTime**, **Shockwave Player** or **RealPlayer**. Plug-ins are usually quick and easy to install, normally free of charge and open up a wealth of new material. Sites that require a plug-in usually provide a link to a site from which the essential plug-in can be downloaded. These are the sites from which Flash Player, Shockwave and RealPlayer can be downloaded:

- **Flash Player**: http://www.adobe.com/products/flashplayer/
- **QuickTime:** http://www.apple.com/quicktime
- **RealPlayer:** http://uk.real.com/realplayer/
- **Shockwave Player:** http://www.adobe.com/products/shockwaveplayer

3.10 Podcasting

A **podcast** is a broadcast digital audio recording, usually in MP3 format, made available via the Web in a way that allows the recording to be downloaded automatically for listening at the user's convenience. The term **vodcast** is used to describe a broadcast digital video recording, usually in MPG format, also made available via the Web. The term **podcast** takes its name from a combination of **iPod** (Apple's portable digital media

player) and **broadcasting**, but podcasts and vodcasts do not necessarily require the use of an iPod or similar device. Podcasts and vodcasts can simply be downloaded to a computer and played using a standard media player program.

3.11 Saving and converting streaming media for use offline

It is possible to save streaming audio or streaming video clips to your hard disk so that they can be used offline. **RealPlayer** enables you to play and save video clips from popular websites such as **YouTube** and **Metacafe** (http://www.metacafe.com), record live streams, and play a wide range of popular audio and video formats. There are many software tools available that enable you to capture streaming media and convert it from one form into another, e.g.

- **ConvertTube**: An online service for converting YouTube video clips to a variety of other formats: http://www.converttube.com
- **DVDVideoSoft:** Offers a range of different converters: http://www.dvdvideosoft.com
- **FlashLynx:** http://www.nchsoftware.com/streamvcr/index.html
- **HiDownload:** http://www.hidownload.com
- **How to Capture Streaming Media:** http://www.stream-capture.com
- **Keepvid:** http://keepvid.com
- **Orbit:** http://www.orbitdownloader.com
- **Net Transport:** http://www.xi-soft.com
- **Replay Converter:** A tool for converting audio and video files http://applian.com/replay-converter
- **YouConvertIt:** Free online media conversion. http://www.youconvertit.com
- **YouTube Tutorials:** See these tutorials on embedding YouTube video clips into *PowerPoint*: http://www.youtube.com/watch?v=Zwqyg5uNClY http://www.youtube.com/watch?v=hChq5drjQl4
- **Zamzar:** Free online file conversion. Convert images, audio files, video files and document files from one format to another without having to download software. http://www.zamzar.com

3.12 Audacity

Audacity is a free, easy-to-use audio editor and recorder for Windows, Mac OS X, and GNU/Linux. You can use Audacity to Record live audio; Cut, Copy and Paste, Delete, Duplicate, and Split audio files; Change the speed, pitch or volume of a recording; Apply effects to any part of the sound; and Align audio segments.

Audacity is a popular Open Source tool for creating and editing podcasts; it is freely available to download, install and modify, and is relatively easy to use. You can download a copy of Audacity for Mac, Linux, or Windows from

http://audacity.sourceforge.net/. For an overview of downloading and installing Audacity including the LAME MP3 encoder, see:http://www.youtube.com/

a. Download and Install Audacity from http://audacity.sourceforge.net/
b. Read through the Audacity tutorial in www.wikieducator.org/Using_Audacity/
c. Load Audacity and record audio into Audacity using a microphone.
d. Import audio files into the Track Window from your computers hard-drive.
e. Edit audio files by selecting, cutting, pasting, silencing, and deleting track, zoom-in, fade-out, fade-in etc.
f. Name, sort and label tracks.
g. Compress an audio file.

SELF-ASSESSMENT EXERCISE 2

1. What do you understand by the concept "streaming"?
2. Briefly describe the components of a multimedia editing software.

4.0 Conclusion

Software applications required to run multimedia applications have been discussed in this unit. The various files formats of audio, video and multimedia applications have also been described.

5.0 Summary

In this unit, we have learnt that:

i. A media player is a "virtual" playback machine which can be use to play an audio or video clip. It has Play, Stop, Pause, Fast Forward, Fast Reverse and Volume Control buttons.
ii. The encoder compresses the file during creation, and the decoder decompresses the file when it is played back.
iii. Most image editing software application packages allow you to save images in different formats and to convert from one format to another.
iv. it is preferable to make them first on a portable recorder (analogue or digital) and then upload them to the computer using a connection lead.
v. A plug-in is an extra piece of software that a Web browser needs to run certain elements of a Web page.
vi. It is possible to save streaming audio or streaming video clips to your hard disk so that they can be used offline.

6.0 Tutor Marked Assignments

1. State the various File Formats you can work with in *Windows Media Player, Windows Movie Maker* and *Audacity.*
2. What is a firewire and what is it used for?
3. Differentiate between a podcast and vodcast.

7.0 Further Readings and Other Resources

Steve Holden. Audacity 101. http://creativecommons.org/licenses/by/2.5/

MPEG: a reference site for, with explanations of different MPEG formats and links to sources of media players http://www.mpeg.org.

Digital Video for Teachers: resources for teachers in video capture and editing. http://www.digitalvideoforteachers.co.uk.

Movie Maker Tutorials can be found at:

- **Atomic Learning:** http://www.atomiclearning.com/moviemaker2
- **Doug Belshaw's site:**http://www.mrbelshaw.co.uk/extras/documentary/index.htm

How to transfer cassette tape to computer:
http://www.wikihow.com/Transfer-Cassette-Tape-to-Computer

How to change your (vinyl) records into CDs:
http://www.wikihow.com/Change-Your-Records-Into-CDs

Digital audio Languages ICT: What are MP3 files for MFL?
http://www.languages-ict.org.uk/technology/technology.htm

MediaWiki. Using Audacity: http://www.mediawiki.org/ Content is available under Creative Commons Attribution Share-Alike License.
http://creativecommons.org/licenses/by-sa/3.0/

Dan Elliot. Audacity 1.2 Tutorial *http://www.lifelonglearner.us/other/audacity*
www.cs.pitt.edu/~mehmud/cs134-2084/links.html

Module 2: Properties of Multimedia Element

Unit 1: Text

1.0 Introduction
2.0 Objectives
3.0 Character Sets
3.1 Digitization of Text
3.2 Text Attributes
    3.2.1 Font Type
    3.2.2 Font Style
    3.2.3 Font Size
    3.2.4 Font Colour
    3.2.5 Special Effects
    3.2.6 Font Layout
        3.2.6.1 Kerning
        3.2.6.2 Leading
        3.2.6.3 Tracking
    3.2.7 Classification of Font face
    3.2.8 Font Formats
3.3 Criteria for Choosing Text in multimedia
    3.3.1 Readability and Legibility
    3.3.2 Visual Appeal
    3.3.3 Text Layout
    3.3.4 Mood Creation
3.4 Cross platform issues
4.0 Conclusion
5.0 Summary
6.0 Tutor Marked Assignments
7.0 Further Readings and Other Resources

Module 2: Properties of Multimedia Element

Unit 1: Text

1.0 Introduction

Text plays vital role in multimedia delivery and is composed of combinations signs or symbols that are used in writing or printing and which represent a speech sound. Texts are used in effective communication of ideas, thoughts, plans, feelings and emotions precisely and without any loss of form. Text mode refers to alphanumeric or character operation mode which computer uses in displaying letters, numbers and other text characters. In actual fact, texts are numeric codes stored in computer systems.

Succinctly, text suitability is an important consideration when designing multimedia applications. This is due to the fact that text has some form of graphical element in its texture and like all graphics; it must appeals to the eyes without leaving sour taste in the mouth of the reader. The choice of appropriate text attributes to be used in multimedia applications must be based on the nature of the audience (formal, informal, children, adult etc) and the essence of the multimedia presentations (education, business, news, information or entertainment etc).

In this unit, we shall study a subject called **Typography**. Typography deals with the appearance of text in multimedia presentations, its attributes and design considerations.

2.0 Objectives

At the end of the unit you will be able to:

- explain the role of texts in multimedia applications;
- describe how text are converted into their equivalent digital representations;
- describe how text can be created and presented in most appealing ways using attributes such as Font Type, Font Style, Font Size, Font Colour etc;
- explain the criteria for choosing text in multimedia applications;

3.0 Character Sets

The visual appearance of a text come in variety of forms without altering the information it conveys. Basically, alphabets, digits, punctuations and other symbols forms the simple character set called *abstract characters* of a text. Abstract characters in a particular language are grouped into alphabets. E.g. the alphabet of English contains the upper case letters *A to Z*, the lower case letters *a to z*, the digits and a number of punctuations.

Digital representation of text involves defining a mapping *(*called *character set)* between the abstract characters and the values (called *code points)* that are stored in a computer system. The domain *(abstract characters)* of this mapping is called *character repertoire*.

3.1 Digitization of Text

Text is the common and most acceptable communication means among many computer systems which are heterogeneous in nature. A common character set is therefore desirable and essential. The American Standard Code for Information Interchange (ASCII) character set has been extensively adopted across many computing platforms to code plain text in binary forms.

ASCII has a 7-bit code range which infers that the code points can be store in 7 bits, and 127 codeable characters. Its domain only comprises 95 printable characters (A-Z, a-z, 0-9, !, @, ?, ^, &, *, (,), +, =, /, \, |, ;, :, , , #, $, %, etc). The values 0 to 31 and 127 are assigned to *control characters*.
In 19____ ISO 646 adopted ASCII as its standard and later came out with an improved standard ISO 8859 with 8-bit characters to address the inadequacy of the 7-bit ASCII character set. However, ISO 8859 have limited code points available due to its 8-bit nature and having 7-bits ASCII identical characters in all its parts. To address this shortcoming, ISO produced another standard called ISO/IEC 10646-1: *Universal Multi-Octet Coded Character Set* in 1993. ISO/IEC 10646-1 uses four hierarchical bytes (group (*g*), plane (*p*), row (*r*), column (*c*)) to encode a character, and can therefore have at most 232 code points.

Another standard is *The Unicode Standard, Version1.0* in 1991 (version 3.0 came out in year 2000). The Unicode character system uses 2 bytes (16-bit character set) to encode each character. Unicode 32-bits system is now available in some computing platforms. Unicode attempts to specify a character set to embrace all languages of the world. The Unicode transmission format 8 (UTF-8) protocols provides for support of extended ASCII characters and translation of Unicode. A UTF-8 enables a far greater range of names than can be achieved using ASCII or extended ASCII encoding for character data.

3.2 Text Attributes

Text can be created and presented in most appealing ways using combinations of the following attributes.

3.2.1 Font Type

Each character may be represented in different sizes, shapes, and shades, and a character' visual representation is refer to as *font face* or *typeface*. A *font face* is a family of graphic characters with a coherent design, similar look and feel while a *font* is a set of graphic characters with a specific design in a specific size and style. Here are some of the common families: Times, Helvetica, Courier, Garamond, and Universe. Some examples of the available *font face* are shown in figure 3.1 below.

Figure 3.1 Sample Font Types

In some other terms weight which is a measures of characters' darkness, or the thickness of the strokes is used. The names used to distinguish weight are not uniform between type suppliers. The commonly used names are: ultra light, extra light, light, semi light, medium, semi bold, bold, extra bold, etc.

3.2.2 Font Style

Font style or shape refers to the different appearance within a family. Example include regular or normal (upright), bold, sloped (oblique), *italic*, SMALL CAP

Font Style	Normal Style
Font Style	Bold Style
Font Style	Italic Style
FONT STYLE	Small CAP Style

Figure 3.2 Sample Font Styles

3.2.3 Font Size

When putting characters on to a page, we need to know some basic measurement of the types we use. Each character has a *bounding box*. This is the rectangle enclosing the entire character. Each character has an origin. It is usually place on the *baseline*. The width of the character determine where the origin of the next character will be. The distance between the origin and the left side of the bounding box is called *left side bearing*.

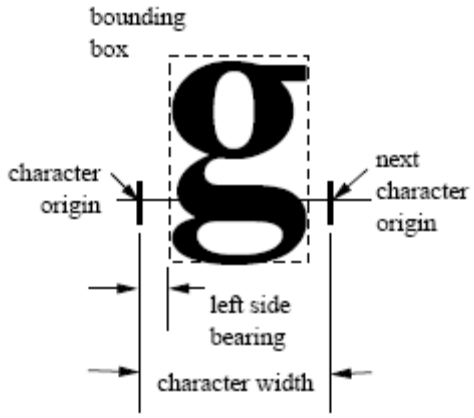


Figure 3.3 Font measurement
(Source: COMP3600/SCI2600 Multimedia Systems, Department of Computer Science, Hong Kong Baptist University)

As we all know, some of the lower case letters extend upward, like b and h, while others extend downward, like g, p and q. The height of the lower case letter without ascender and descender is called the *xheight*. The height of the upper case letters is called the *cap-height*.

Figure 3.4 Font Size
(Source: COMP3600/SCI2600 Multimedia Systems, Department of Computer Science, Hong Kong Baptist University)

Font size can be measure using any of the following two measurement criteria: point and pixel. The point measurement criterion uses dot per inch (dpi) which is the standard used in measuring computer monitor and printer resolution. It is expressed as the number of dots that a device can display or print per linear inch and the greater the number of dots per inch, the better the resolution.
A picture element (pixel) is the smallest element that computer screen, printer and software can manipulate to create letters, numbers, or graphics. The pixel measure one spot in a rectilinear grid of thousands of such spots that form an image produced on the screen by a computer or on paper by a printer. The resolution of the computer monitor is measured in term of pixels per inch (ppi) of monitor display and determines the amount of information that appears on the computer monitor.. A monitor setting of 1280 x 1024 has 1.3 million dpi while 800 x 600 monitor setting has 480,000 dpi. On a Macintosh monitor, the standard resolution is 72 dpi while on a Windows monitor, the standard resolution is 96 dpi. Low resolution, such as 640 x 480, makes items on the screen appear large, although the screen area is small. High resolution, such as 1024 x 768, makes the overall screen area large, although individual items appear small

Comparison table of points and pixels on windows computer				
Points	Pixels		Points	Pixels
6pt	8px		16pt	22px
7pt	9px		17pt	23px
7.5pt	10px		18pt	24px
8pt	11px		20pt	26px
9pt	12px		22pt	29px
10pt	13px		24pt	32px
10.5pt	14px		26pt	35px
11pt	15px		27pt	36px
12pt	16px		28pt	37px
13pt	17px		29pt	38px
13.5pt	18px		30pt	40px
14pt	19px		32pt	42px
14.5pt	20px		34pt	45px
15pt	21px		36pt	48px

Table 1: Font Size: Points vs. Pixels

(Source: L. Reid & V. Tryphonopoulos (2009). Computer Science CS1033: Multimedia and Communication, www.csd.uwo.ca/courses/CS1033)

Font Width: the amount of expansion or contraction with respect to the normal or medium in the family.

Size: 1 inch = 72.27 point in printing industry and 1 inch = 72 point in PostScript systems.

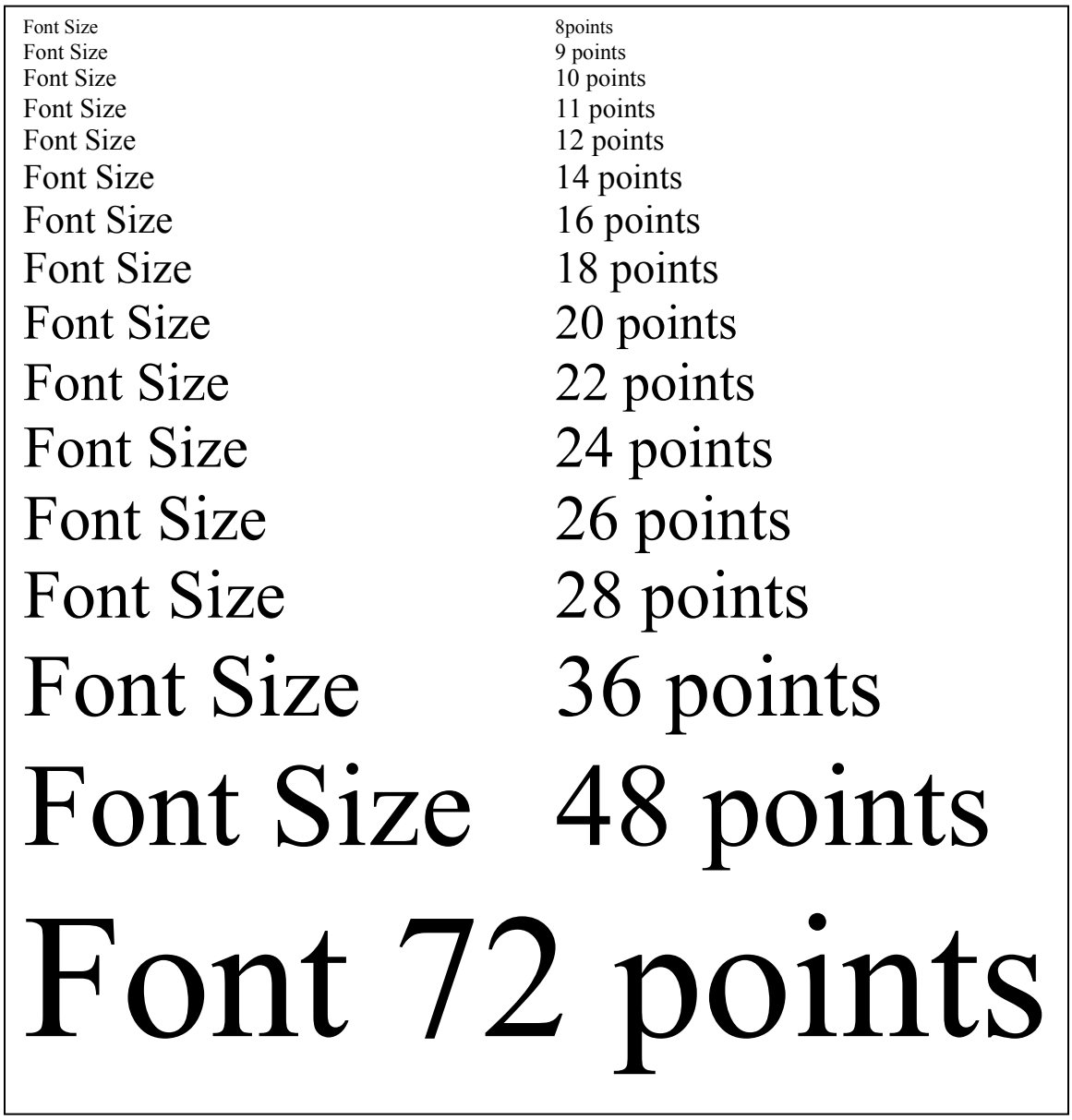


Figure 3.5 Different Font Sizes

3.2.4 Font Colour

Colours add some flavour to the general appearance and visual appeals of texts when used in the right manner and context. Over time, colours have been used to describe interesting and exciting personal, group, event, or location's details or qualities. Colours have a way somehow of reflecting our characters, attitudes, beliefs and opinions. There are some guidelines (*colour scheme*) concerning the appropriate choice and use of colours when working with texts. The colour scheme is a combination of colours

(primary and secondary) choosen to add esthetics' values to the document while ensuring the content is preserved.

Primary colour is one of three colours, red, yellow and blue which can mix together to obtain secondary colours. The multidimensional color space consisting of the cyan, magenta, yellow, and black intensities that make up a given color. Commercial color printing devices generally use this system of four-color process inks on hardcopies (papers) while the three-colour (red, green and blue) process is usually used on monitors, scanners, digital cameras, and computer printers. The following colour properties are worth considering when choosing colours for texts and background.

Properties of Color

- Colour *management:* The process of producing accurate, consistent color among a variety of input and output devices. A color management system (CMS) maps colors between devices such as scanners, monitors, and printers; transforms colors from one color space to another (for example, RGB to CMYK); and provides accurate on-screen or print previews.
- Colour *profile:* A profile contains the data needed for translating the values of a color gamut. This data includes information about color, hue, saturation, and brightness.
- *Hue*: The "colour"of the color (or the wavelength of light) is the position of a color along the color spectrum. For example, green is between yellow and blue.
- *Saturation*: The intensity of the color, the purity of a color's hue moving from gray to the pure color.
- *Brightness/Value*: This is the relative lightness or darkness of the color
- Colour *space*: A set of three values that defines how a color can be represented on computer devices such as monitors, scanners, and printers. For example, in the LAB color space, the terms luminance or whiteness (L), redness-greenness (A), and yellowness-blueness (B) are used; in the HVC system, the terms are hue (H), value (V), and chroma (C). Color space refers to the three-dimensional space that is defined by the respective values, such as L, A, and B.
- Running the *gamut:* The gamut is the particular range of colors that a device is able to produce. A device such as a scanner, monitor, or printer can produce a unique colour spectrum, which is determined by the characteristics of the device itself. The relative saturation of colors is maintained from gamut to gamut. Colors outside the gamut are changed to colors of the same saturation, but different degrees of brightness at the edge of the gamut.
- Colour *depth:* The number of colors per pixel the monitor and graphics adapter support.

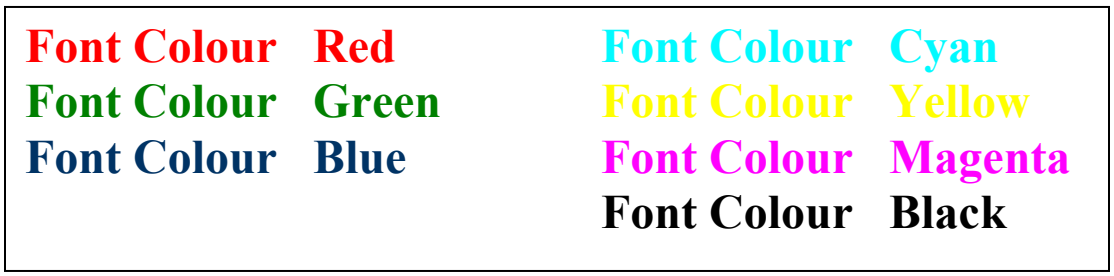


Figure 3.6 Different Font Colours

3.2.5 Special Effects

The examples below are some special effects that can be apply to texts within a multimedia presentation for emphasis, clarity, visual appeal reasons.

Underline	UNDERLINED FONT
Strikethrough	~~STRIKETHROUGH FONT~~ e.g. ~~N~~
Double Strikethrough	~~DOUBLE STRIKETHROUGH FONT~~ e.g.~~N~~
Shadow	SHADOW FONT
Superscript	SUPER^{SCRIPT} FO^{NT}
Subscript	SUB$_{SCRIPT}$ FO$_{NT}$
Outline	OUTLINE FONT
Emboss	EMBOSSED FONT
Engrave	ENGRAVED FONT

3.2.6 Font Layout

3.2.6.1 Kerning

Kerning is the extra adjustment between two specific characters and specifies the distance between adjacent individual letters and the measurement is expressed in “em” (negative, 0, positive values). Normally, characters are placed one next to the other, i.e., the distance between the origins of the adjacent characters is equal to the character width. But due to the shape of the characters, the space between certain characters may look uneven, e.g., the A and v in the figure. Therefore, we need to kern the characters.

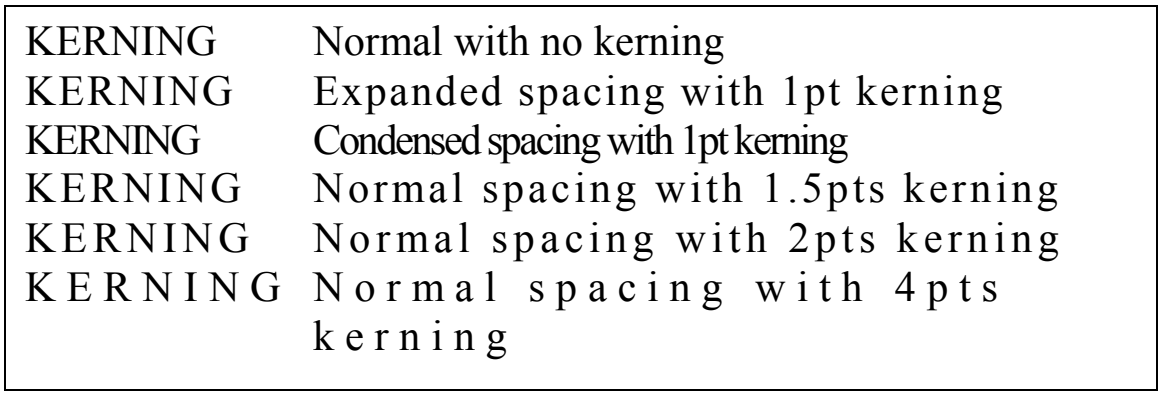


Figure 3.8 Characters Spacing with Kerning

3.2.6.2 Leading

Leading is the distance between the baselines of two adjacent lines which specifies the amount of vertical space between lines of text. It is usually measured in either positive, negative or zero points. Two commonly used leadings are 14 points for 12 points text and 12 points for 10 points text.

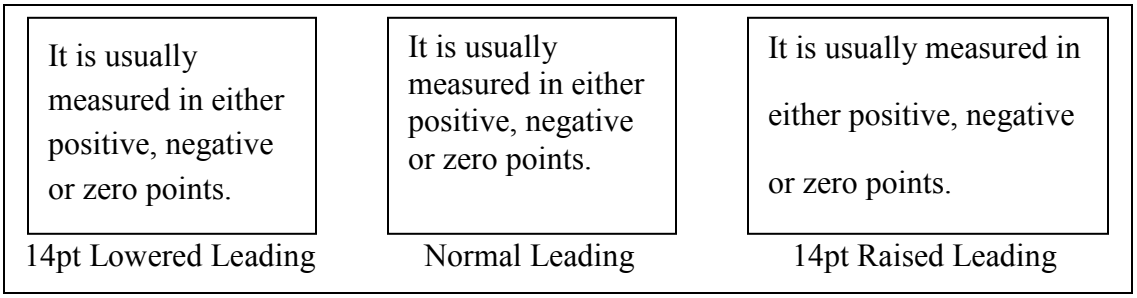


Figure 3.9 Examples of Text Lines Leading

3.2.6.3 Tracking

Tracking is the spacing between characters in text lines. Loose tracking means the space between characters are wider and fewer words can be put in a line of text.

3.2.7 Classification of Font face

Generally font faces can be classified as either *serif* or *sans serif*. *Serif* is the little flag or decoration at the end of a stroke. On printed pages, serif fonts are used for body text while sans serif fonts are used for headline because the serifs help guide the reader's eye along the line of text. Multimedia presentations are displayed on low resolution screen where sans serif fonts will be far more legible.

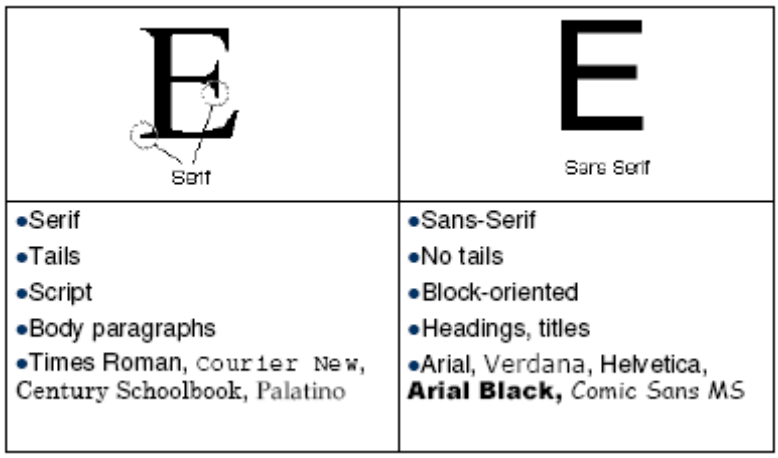


Figure 3.7 Font Faces
(Source: L. Reid & V. Tryphonopoulos (2009). Computer Science CS1033: Multimedia and Communication, www.csd.uwo.ca/courses/CS1033)

3.2.8 Font Formats

Font formats can be divided into two main categories: *bitmap* fonts and *outline* fonts.

Bitmap fonts come in specific sizes and resolutions. Because the font contain the bitmaps of the character shapes. The result will be very poor if they are scaled to different sizes. Outline fonts contain the outline of the characters. They can be scaled to a large range of different sizes and still have reasonable look. They need a rasterizing process to display on screen. Nowadays, outline fonts are much more common than bitmap fonts. There are two kinds of outline fonts: *PostScript* and *TrueType*.

All version of Windows support TrueType fonts. Windows3.1 and Windows95 require Adobe Type Manager (ATM) to display PostScript fonts. PostScript printers have a number of resident PostScript fonts.

SELF-ASSESSMENT EXERCISE 1

1. Write the ASCII equivalents of the 95 printable characters A-Z, a-z, 0-9, !, @, ?, ^, &, *, (,), +, =, /, \, |, ;, :, , , #, $, %, etc.
2. Colours have a way somehow of reflecting our characters, attitudes, beliefs and opinions. Why?
3. Load Ms-Word or Ms-Powerpoint
    a. Type “Introduction to Multimedia Systems”
    b. Highlight the typed words
    c. create and present this typed words in most appealing ways by selecting different text attributes such as Font Type, Font Style, Font Size, Font Colour etc;
    d. Click Format -> Font -> Font
    e. Click Format -> Font -> Character Spacing
    f. Click Format -> Font -> Text Effects

3.3 Criteria for Choosing Text in multimedia

Choosing the combination of fonts to use in a multimedia presentation does not come quite easy and cheap. It requires careful planning and consideration of some text design criteria which may enhance the esthetics of the presentation and thus makes it more exciting, appealing and stimulating for the audience to watch, view or listen to. We outline some of these criteria as follows:

3.3.5 **Readability and Legibility**

Legibility which means that fonts must be written or printed clearly for easy reading is a basic requirement when designing multimedia presentations. The font face, its shape and sizes must be appropriate to allow for easy reading by the intended audience. In most cases for instance, adult audience require large font size while young or children would make do with small font size. Here are some tips:

a. Use right contrasting and avoid dark text against dark background;
b. For small type, use the most legible font available, decorative fonts are useless;
c. Use as few different faces as possible in the same work, but vary the weight and the size and using italic or bold styles;
d. Vary the size of a font in proportion to the importance of the message;
e. Never underline a text in a webpage;
f. In large size headline, do proper kerning so that the spacing feels right; and
g. Use maximum of between 2 and 3 different font faces in a multimedia presentation.

3.3.6 **Visual Appeal**

Use the following tips to ensure that the fonts chosen make visual appeal to the audience eyes:

a. Make sure that both the font and graphic complement each other;
b. Choose font that coordinates with the graphics being used;
c. Explore the effects of different colours and of placing the text on various backgrounds;
d. Carefully position the font to achieve good balance with the other multimedia elements;
e. Avoid using exotic fonts in other to ensure font consistency on different computing platforms; and
f. Use maximum of 2 to 3 colours in a multimedia document or website.

3.3.7 **Text Layout**

The layout is very important when developing multimedia presentations. It provides detailed overview of how the document would look like after it must have been prepared. Font and other multimedia elements should be spread over the multimedia presentations to ensure readability and visual appealing. Thus the chosen font must be simple, clear and must make use of white spaces between characters, words and lines appropriately. In

text block, adjust the leading for the most pleasing line spacing. Lines too tightly packed are difficult to read.

3.3.8 **Mood Creation**

a. Set the mood using appropriate font attributes and text layout; and
b. Use *San Serif* for headings and *Serif* for body. *Sans Serif* headings create better visual appeal while *Serif* body looks better.

3.4 Cross platform issues

When you build your multimedia project on Windows platform, and play it back on a Macintosh platform , there will be some differences. Fonts are perhaps the greatest cross-platform concern. If a specified font does not exist in the target machine, a substitute must be provided. Some cross-platform applications, e.g., Director, allow the developer to specify the mapping of fonts.

Different encodings on different platform is also a big problem. Special characters may need to be converted to bitmaps in order to be display correctly on different platforms. Different systems and font manufacturers encode different symbols in the extended character set.

SELF-ASSESSMENT EXERCISE 2

1. State the major criteria for choosing texts in multimedia applications.
2. Why is it important to consider these factors when creating multimedia applications?

4.0 Conclusion

Text suitability is an important consideration when designing multimedia applications. This is due to the fact that text has some form of graphical element in its texture and like all graphics; it must appeals to the eyes without leaving sour taste in the mouth of the reader.

5.0 Summary

In this unit, we have learnt that:

i. Text is the common and most acceptable communication means among many computer systems which are heterogeneous in nature.
ii. Each character may be represented in different sizes, shapes, and shades, and a character' visual representation is refer to as *font face* or *typeface*.
iii. A *font face* is a family of graphic characters with a coherent design, similar look and feel while a *font* is a set of graphic characters with a specific design in a specific size and style.
iv. Font style or shape refers to the different appearance within a family.
v. Font size can be measure using any of the following two measurement criteria: point and pixel.

vi. Colours add some flavour to the general appearance and visual appeals of texts when used in the right manner and context.

vii. Some text design criteria may enhance the esthetics of the presentation and thus makes it more exciting, appealing and stimulating for the audience to watch, view or listen to, include

i. Readability and Legibility
ii. Visual Appeal
iii. Text Layout
iv. Mood Creation

6.0 Tutor Marked Assignments

1. What do you understand by the term "Character Set"
2. Distinguish between a point and a pixel.
3. Describe the following character sets fully
   a. The American Standard Code for Information Interchange (ASCII) character set;
   b. Universal Multi-Octet Coded Character Set;
   c. The Unicode Standard, Version1.0; and
   d. Unicode transmission format 8 (UTF-8).
4. Why are different encodings on different platform big problems?

7.0 Further Readings and Other Resources

COMP3600/SCI2600 Multimedia Systems, Department of Computer Science, Hong Kong Baptist University

James Khazar (2009). Arts 21: Introduction to Computer for Arts.
Licensed under a Creative Commons Attribution-Noncommercial-No Derivative Works 3.0 Licences. http://www.khazar.com/academics/portal/ucsc/2008fall/art21/

L. Reid & V. Tryphonopoulos (2009). Computer Science CS1033: Multimedia and Communication, www.csd.uwo.ca/courses/CS1033

Marshall, D. (2008), Multimedia. Module CM0340.
http://www.cs.cf.ac.uk/Dave/Multimedia/

Module 2: Properties of Multimedia Element

Unit 2: Graphics, Pictures and Images

Module 2: Properties of Multimedia Element

Unit 2: Graphics, Pictures and Images

1.0 Introduction

Graphic is concerned with drawing, printing or designing pictorial illustration of places, events, people etc. and gives a vivid description of what it is being represented. Graphics refers to drawings or images that represent objects or fact in computer software. It is a digital representation of images and non-text information (i.e drawing, chart, table, and photograph). Graphics are used to illustrate certain concepts more clearly than text can.

Graphics play an important role in teaching since many people are visual learners – think about car icons or road signs. There is no movement or animation in a graphic and as navigation aids in many software packages.

2.0 Objectives

At the end of the unit you will be able to:

- distinguish between the following terms "graphic", "images", "objects" and pictures;
- describe graphic design as it relates to the Internet and motion graphics, including graphics for web design and computer animation;
- explain how graphics are converted into their equivalent digital representations;
- create effective visual communications for online use and time-based applications;

3.0 The Nature of Digital Images

An *image* is a spatial representation of an object, a two-dimensional or three-dimensional scene or another image. Often the images reflect the *intensity* of lights. Most photographs are called *continuous-tone* images because the method used to develop the photograph creates the illusion of perfect continuous tone throughout the image. Images stored and processed by computers, displayed on computer screens, are called *digital images* although they often look like continuous-tone. This is because they are represented by a matrix of numeric values each represents a quantized intensity values.

3.1 Basic Concepts

3.1.1 Pixel (Bitmap)

A digital image is represented by a grid (array, matrix) of squared picture element known as a *pixel.* The pixel reveals the minutest details in a digital image. Each pixel is a numerical value corresponding to a graphical object. A 640-by-480 screen is capable of displaying 640 distinct dots on each of its 480 (rows) lines, or about 300,000 pixels. A 800-by-600 screen is capable of displaying 480,000 pixels.

3.1.2 Digitization

Digitization refers to the process of translating a piece of information (text, images, sound recording, or video) into *binary digits (BITS)*.

A bit is an electrical pulse or signal that represents the state at which it can be in a given moment of time. Usually, electrical pulse is either in "ON" or "OFF" state at any given time. In the computer, these pulses are represented in the binary digital form of "1" and "0" for "ON" state and "OFF" state respectively. Words and images are represented in bits or bytes where a byte is a collection of 8bits (i.e. 0000 0000). So with 8 bits there are: (28)= 256 possible combinations of 0s and 1s.

Binary	Power of 2	Decimal	Hexadecimal
1	2 to the power of 0	1	1
10	2 to the power of 1	2	2
100	2 to the power of 2	4	4
1000	2 to the power of 3	8	8
10000	2 to the power of 4	16	10
100000	2 to the power of 5	32	20
1000000	2 to the power of 6	64	40
10000000	2 to the power of 7	128	80
100000000	2 to the power of 8	256	100

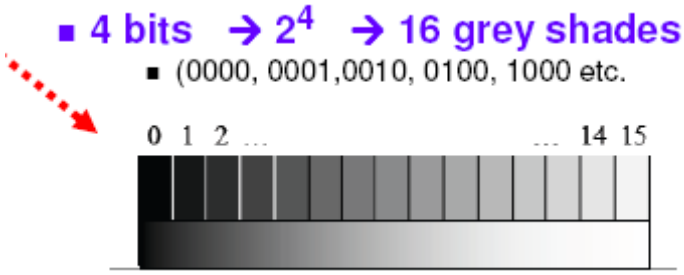
Binary	Decimal	Hexadecimal
0000	0000	0000
0001	0001	0001
0010	0002	0002
0011	0003	0003
0100	0004	0004
0101	0005	0005
0110	0006	0006
0111	0007	0007
1000	0008	0008
1001	0009	0009
1010	0010	000A
1011	0011	000B
1100	0012	000C
1101	0013	000D
1110	0014	0000E
1111	0015	000F

3.1.3 Depth

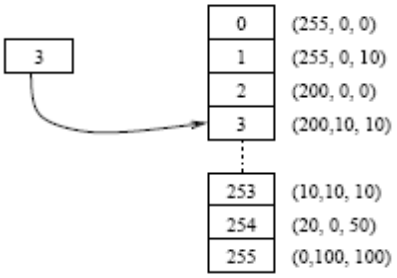
The depth of an image is measured in the number of bits used to represent each pixel.

- 1-bit black-and-white image (with no gray), also called *bitmap image*.

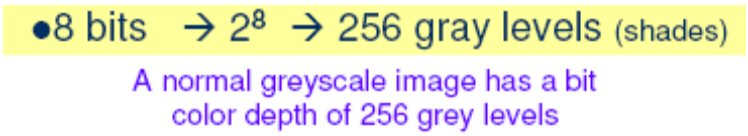
- 4-bit can represent 16 colours, used in low resolution screens(EGA/VGA)



- 8-bit can have 256 colours. The 256 colour images are often known as *indexed* colour images. The values are actually indexes to a table of many more different colours. For example, Colour 3 is mapped to (200, 10, 10).



- 8-bit grey 256 grey-levels. The image contains only brightness/intensity data without colour information.



(Source: L. Reid & V. Tryphonopoulos (2009). Computer Science CS1033: Multimedia and Communication, www.csd.uwo.ca/courses/CS1033)

- 16-bit can have 65536 colours, also known as hi-colour in Windows systems. The 16 bits are divided into 5 bits for RED, 6 bits for GREEN and 5 bits for BLUE.
- 24-bit 224 = 16,777,216 colours, true colour. Each byte is used to represent the intensity of a primary colour, RED, GREEN and BLUE. Each colour can have 256 different levels.

COLOUR	RED	GREEN	BLUE
Red	255	0	0
Green	0	255	0
Blue	0	0	255
Yellow	255	255	0
Magenta	255	0	255
Cyan	0	255	255
Light gray	127	127	127
White	255	255	255
Black	0	0	0

- 32-bit 232 = 4,294,967,296 (4G). Usually, 3 bytes are used to represent the three primary colours and the fourth byte is used as the *alpha channel*.

3.1.4 Resolution

Resolution measures how much detail an image can have as previously mentioned in Module 3 Unit 1 Section 3.2.3. There are several resolutions relating to images; some of which are the followings:

a. *Image resolution* is the number of pixels in an image. 193 x 145 = 27,985 pixels, 3088 x 2320 = 7,1641,60 pixels.
b. *Display (Monitor) resolution* — refers to number of dots per inch (dpi) on a monitor. Windows systems usually have 96dpi resolution. Some high resolution video adapters/monitors support 120dpi. For example, a 288 x 216 image displayed on a monitor with 96dpi will be 3" x 2 ¼".
c. *Output resolution* — refers to number of dots per inch (dpi) on a (hard copy) output device. Many printers have 300dpi or 600 dpi resolution. High-quality image setters can print at a range between 1200dpi and 2400dpi, or higher.

3.1.5 Sources of Digital Images

There are many sources from which digital images may be acquired or created. Notably among them are:

a. **Draw/Paint Programs**
   Make an image from scratch with a paint program. A good program will allow you to choose the depth, resolution and size.
b. **Clip Art Packages**
   Grab an image of a screen. The depth, resolution and size is determined by the screen.
c. **Digital Cameras and Camcorder**
   Capture an image from a digital camera or a camcorder. The depth, resolution and size are determined by the camera or the camcorder. The popular depth is 24-bit. The commonly used resolution is 320 x 240, 640 x 480 and 800 x 600.
d. **Scanners and Digitizers**
   - Scan or print a photograph using a scanner. You can select from a range of different depths and resolution. The choice should be determined by the type of original and the final output form.

   - Convert from existing digital media— e.g., photoCD. The attribute is determined by the original image.

e. Synthesize an image from numerical data i.e. using MATLAB Software.
f. Stock photograph agencies

3.2 Vector Graphics

In mathematical and scientific applications, images are seen as vector objects or graphics. They are thus represented by such attributes as size, colour, spatial location, dimension etc rather than pixels. This is an abstract representation of a 2-dimensional or 3-dimensional scene. A vector graphics file contains graphics primitives, for example, rectangles, circles, lines. There are many languages for describing vector graphics; some of which are:

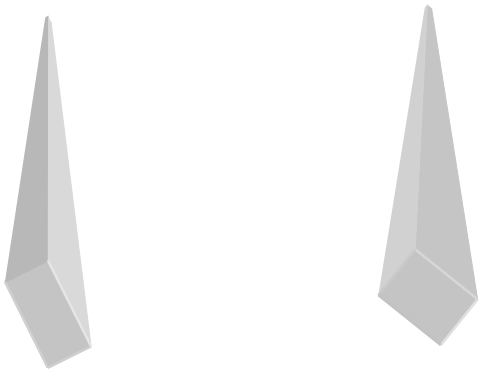
a. PostScript was developed by Adobe as a page description language.
b. Virtual Reality Markup Language (VRML) use for describing a scene in a virtual world.
c. Scalable Vector Graphic (SVG) user for describing two-dimensional graphics in XML. It allows three types of graphic objects: vector graphic shapes, images and text.

3.3 Comparison of Bitmap Graphics against Vector Graphics

Comparison Factor		Bitmap	Vector graphic
1.	*Processing*	A bitmap image is easier to render.	Displaying a vector graphic usually involves a large amount of processing.
2.	*Attributes*	A bitmap contains an exact pixel-by-pixel value of an image. Bitmaps are bound to the individual pixels that describe them.	A vector graphic contains mathematical description of objects. Vectors are bound to mathematical formulas that describe them.
3.	*Resolution*	A bitmap file is fixed in resolution. Changing size means loosing information and they tend to fall apart when you make them bigger.	A vector graphic is resolution independent. Changing size does not really affect them and they tend not to be as detailed as bitmaps.
4.	*Memory Usage*	The file size of a bitmap is completely determined by the image resolution and its depth.	The file size of a vector graphic depends on the number of graphic elements it contains. They are smaller in file size.

SELF-ASSESSMENT EXERCISE 1

1. Examine the two objects below



a. Load Ms-Powerpoint

b. Draw these objects with the following information

	Object1	Object2	Object3	Object4	Object5	Object6
Height	0.5”	1.5”	0.25”	0.94”	0.31”	1.00”
Width	0.75”	1.63”	0.5”	0.95”	0.42”	1.50”
Rotation	0^o	0^o	63^o	318^o	219^o	120^o
Scale: Height	100%	50%	100%	50%	100%	75%
Scale: Width	100%	75%	100%	50%	100%	75%

c. Print your work and copy it into a CD, and show it to your facilitator. Hint: Select the object, right click and click on *Format Object*

2. Represent this information in 1(b) above in pixel. Hint: Load Paint and work on the objects.

3.4 Colour Coding Systems

The choice of appropriate colour combination to use in multimedia presentations can be cloudy and cumbersome at times. This is due to the fact that careful choice of colour involves technical and subjective competencies. We need to understand the technical compositions of colour and how it is perceived by human beings.

Colour is the frequency or wave-length of a light wave within the narrow band of the electromagnetic spectrum (380 – 760nm) to which the human eye responds. Its perception is human physiological activities which thus involve choosing a right colour or colour combination on trial basis, and on aesthetic judgment. In true colour, each pixel represents some color shades.

3.4.1 RGB Colour Code

The RGB colour code is the most widely colour model used in computer graphics and websites. RGB is an additive coding system in which varying amount of the three primary colours (Red, Green and Blue) are added to black to produce new colours. Iimagine three light sources of the primary colours shining on a black surface. Different secondary colours can be produce by varying the intensity of the lights on the black surface as illustrated in the diagram below.

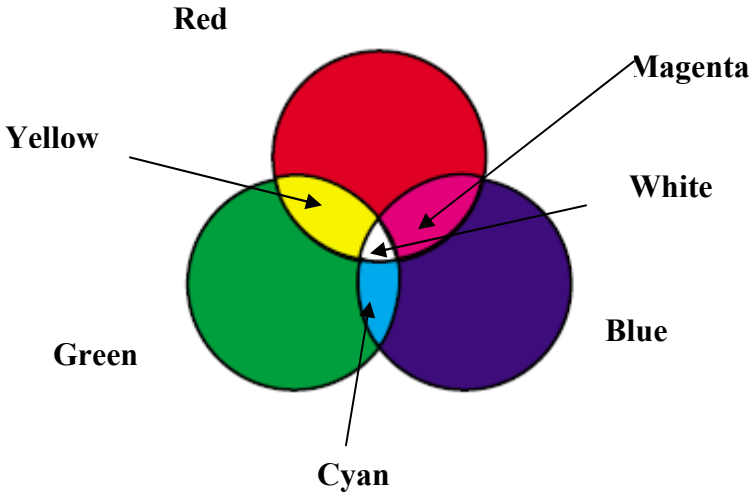


Figure …. RGB Colour Coding System

RGB code can be expressed in decimal (binary interpretation) and Hexadecimal codes. A pixel in RGB is represented by three decimal values <red, green, blue>, where each value ranges from 0 to 255 and therefore provide 256 different color shades. For example Red has a value of <255, 0, 0>, Green <0, 255, 0> and Blue <0, 0, 255>. Combination of the varying values produces different color e.g <0, 255, 255> give Turquoise, <255,255,255> gives White, <255, 0, 255 > gives Pink etc. A given colour is therefore certain mixture of red, green and blue.

The hexadecimal representation is based on the hexadecimal numbering system which comprises of numbers (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, and F). Each RGB colour can be uniquely represented by 6digits hexadecimal number preceded by "#". E.g. #00AEED Light Blue. There are sixteen predefined hexadecimal numbers in the RGB spectrum as illustrated in the figure .. below.

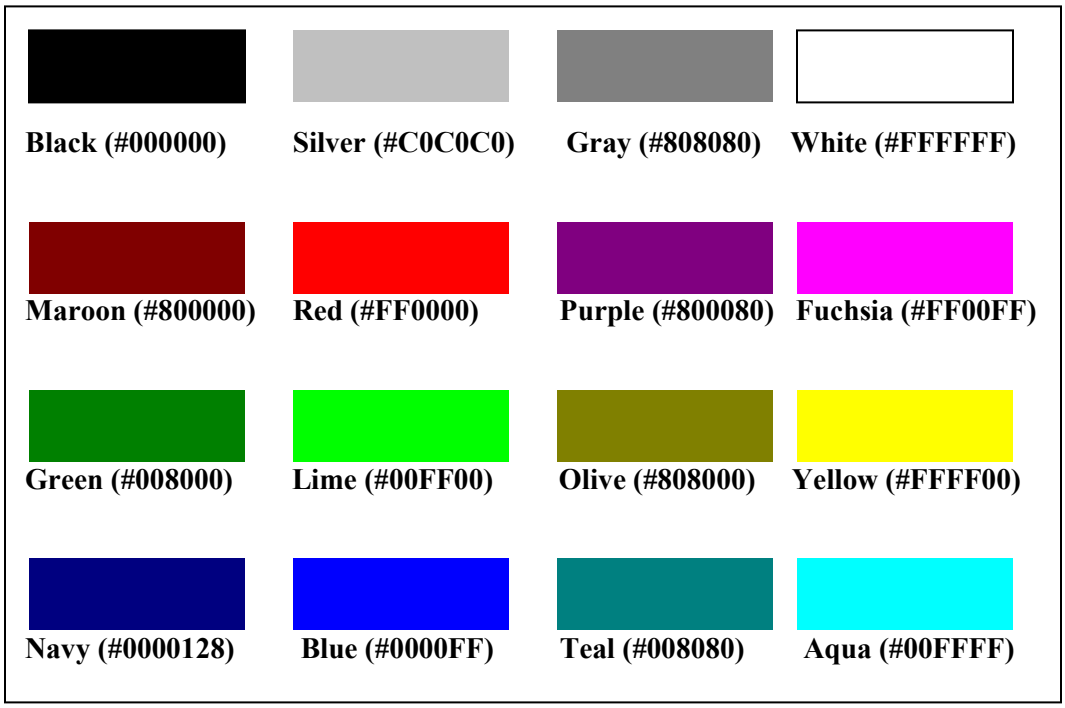


Figure .. Predefined Hexadecimal Colours

3.4.1.1 Conversion from Hexadecimal to Decimal

The RGB decimal code (i.e. <255, 0, 0> for Red) is a 3-byte binary number which means <11111111, 00000000, 00000000>.

To convert this number to its hexadecimal equivalent, simply divide each binary number into two 4-bits number, e.g. <1111 | 1111, 0000 | 0000, 0000 | 0000> and then convert each 4-bits number to its decimal equivalent, and then finally to its hexadecimal equivalent. In this instance,

<255, 0, 0>	*Given Decimal Color Code*
<11111111, 00000000, 00000000>	*Step 1.*
<1111 | 1111, 0000 | 0000, 0000 | 0000>	*Step 2.*
< 15 | 15, 0 | 0, 0 | 0>	*Step3.*
#FF0000	*Desired Hexadecimal Code*

Can you try these: #B7B7B7 = <183, 183, 183>?
#0469B3 = <4, 103,179>?
#4A2885 = <74, 40, 133>?

To convert from hexadecimal to decimal, follow the outline steps above in reverse order.

3.4.2 CMYK Colour Code

The CMYK code uses three primary colour pigments, cyan, magenta and yellow and is based on the light absorbing quality of inks printed on paper. CMYK is a *subtractive* model. The value of each primary colour is assigned a percentage from the lightest (0%) to the darkest (100%). Because all inks contain some impurities, three inks actually produce a muddy brown and a black colour is added in printing process as a result of combination of the three colours.

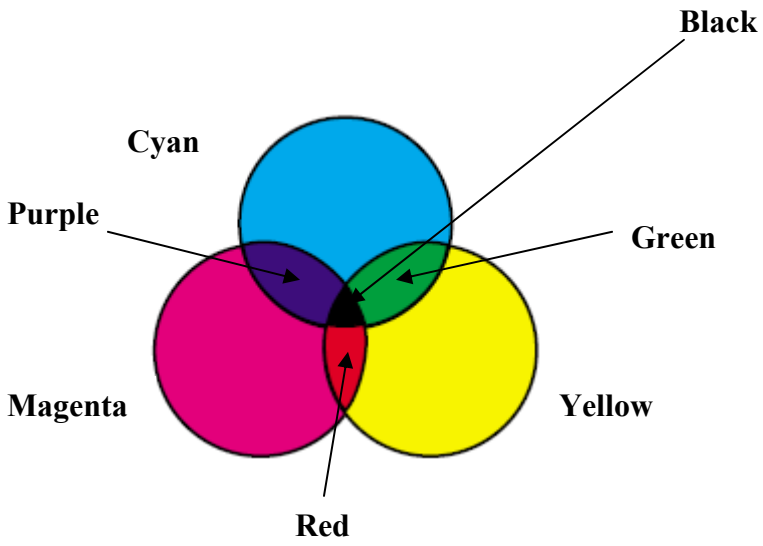


Figure The CMYK Colour Code

Some secondary colours from the CMYK as shown in the diagram above include:

a. Purple = Cyan + Magenta
b. Green = Cyan + Yellow
c. Red = Magenta + Yellow
d. Black = Cyan + Magenta + Yellow

3.4.3 HSB Colour Code

The HSB colour code is based on the human perception of colour and has three fundamental characteristics.

i. **Hue**
Hue is the wavelength of the light and Hue is often identified by the name of the colour it represents. Hue is measured as a location on the standard colour wheel as a degree between 0^{o} to 360^{o}.

ii. **Saturation**
Saturation is the strength or purity of a given colour. It represents the amount of gray in proportion to the hue and is measured as a percentage from 0%(gray) to 100%(fully saturated).

iii. **Brightness**
Brightness is the relative lightness or darkness of a given colour. It is measured as a percentage from 0%(black) to 100%(white).

3.4.4 YUV Colour Model

The YUV color code is widely used in encoding colour for use in television and video. The theory behind this model is that human perception is more sensitive to brightness than any chrominance information, so a more suitable coding distinguishes between luminance and chrominance. This also produces a system that is compatible with black-and-white TV systems.
The Y-signal encodes the brightness information which is used by the black-and-white television system while the U and V channels encode the chromatic information. The resolution of the U and V channels is often less than the Y channel for the reason of reducing the size.

3.5 Gamut

The gamut of a colour code is the range of colours that can be displayed on computer monitors or printed on papers. The colour spectrum that can be viewed by human eye is wider than any method of reproducing colour. Different colour models have different gamut. The RGB code has a larger gamut than that of the CMYK code.

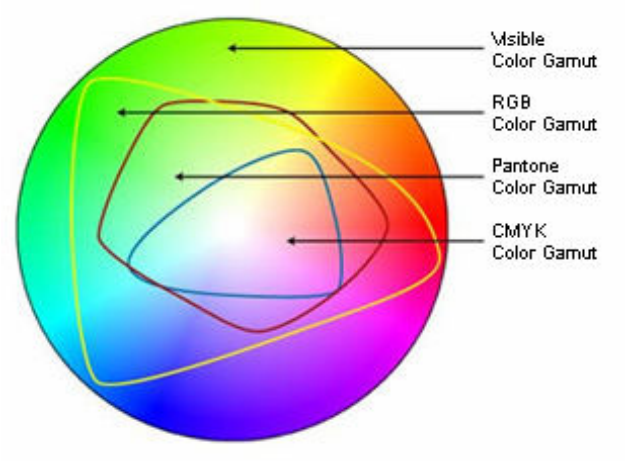


Figure …..

Colour Gamut
Source: Arts 21- Introduction to Computer for Art

3.6 Colour Palette

A colour palette is an indexed table of available colours spectrum in a given colour code. When working in 8-bit mode, a system can display only 256 colours out of a total of 16 million colours (<256, 256, 256>). The system keeps a default palette of available colours.

One major challenge in multimedia presentations is refer to palette flashing. Palette flashing is an unpleasant flash of unwanted colours that occurs on the computer monitor when working with digital images. It occurs because each graphic application has its own colour palette and may replace the computer monitor's palette with its own for the period it is active.

3.7 Dithering and Aliasing

3.7.1 Dithering

Dithering is a technique to increase the number of colours to be perceived in an image. It is based on human eye's capability for spatial integration (i.e. if you look at a number of closely placed small objects from a distance, they will look like merged together). Dithering technique groups a number of pixels together to form a cluster. When viewed from sufficient distance, the individual pixel will not be distiguishable. The cluster will look like a single block of a colour different from the individual pixel.

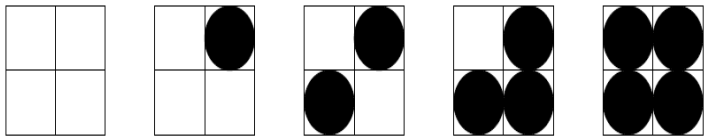


Figure Dithering
(Source: COMP3600/SCI2600 Multimedia Systems, Department of Computer Science, Hong Kong Baptist University)

3.7.2 Anti-aliasing

Aliasing is what happens when solid colors don't conform to vertical and horizontal edges. It is caused by the limited resolution of an output device that makes edges seen as staircases.

Anti-aliasing is a technique to soften the staircase effect of aliasing through color interpolation. It works by filling in pixels which should be half filled with different levels of gray or matching colours. The result is sharper edges, not blurring or smoothing them.

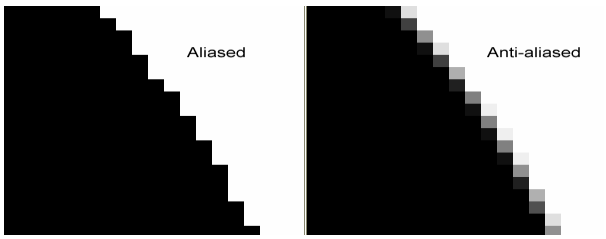


Figure ….. Colour Gamut
Source: Arts 21- Introduction to Computer for Art

3.8 Image and Graphics File Formats

A digital image stored in a computer file must conform to specific standard or format. In addition to the pixel data, the file contains some information (such as the file format, image size, image depth, colour palette and compression technique) to identify and decode the data.

Some formats are defined to work only in certain platform while other can be used for all platforms. Some formats are specific for an application. Some formats are for images, others are for vector graphics. Some formats allow compression, others contain only raw data.

Image Formats With Web Browser Support

- **GIF:** Graphics Interchange Format
- **JPEG:** Joint Photographic Experts Group
- **PNG**: Portable Network Graphics

Image Format Attributes

	GIF87a	GIF89a	JPEG	Progressive JPEG	**PNG**
Lossless Compression	**X**	**X**	**-**	**-**	**X**
Transparent Backgrounds	**-**	**X**	**-**	**-**	**X**
Interlacing	**X**	**X**	**-**	**X**	**X**
Animation	**-**	**X**	**-**	**-**	**-**
Maximum colours	**256**	**256**	**16.7MILL**	**16.7MILL**	**16.7MILL**

3.9 Compression Algorithms

Compression algorithms can reduce file size by about an order of magnitude.

Lossy schemes	**Lossless schemes**
Discard pixel information (Very high compression rates)	Do not discard pixel information
Reconstruction by approximation	Reconstruction by calculation (exact)
Range of quality / compression trade offs (The better the compression, the worse the quality. Compression usually specified within JPEG images as a percentage from 0% (low quality) to 100% (high quality))	Often suitable for digitally synthesized images (compresses well)
Often suitable for images captured from conventional camera / video (Compresses well, artefacts invisible)	Often unsuitable for images captured from conventional camera / video (compresses poorly)
Often unsuitable for digitally synthesized images (Artefacts / degradation visible)	

SELF-ASSESSMENT EXERCISE 2

1. State the RGB decimal codes for these objects and converts their RGC decimal codes into their hexadecimal equivalents.

2. State the colour palette of the RAINBOW colours in RGB decimal code and hexadecimal code.
3. What do you understand by the terms “colour” and “palette flashing”? How can palette flashing be handled in multimedia applications?

4.0 Conclusion

Graphic design is the art of combining pictures, images, objects, shapes, colours, texts, and decoration in the production of a multimedia presentations, electronic books, newspapers, journals or magazines, etc.

5.0 Summary

In this unit, we have learnt that:

i. An image is a spatial representation of an object, a two-dimensional or three-dimensional scene or another image.
ii. A digital image is a numerical value corresponding to a graphical object that is represented by a grid (array, matrix) of squared picture element.
iii. Resolution measures how much detail an image can have.
iv. Vector images are objects or graphics that are described by attributes such as size, colour, spatial location, and dimension.
v. The choice of appropriate colour combination to use in multimedia presentations involves technical and subjective competencies.
vi. The RGB colour code is the most widely colour model used in computer graphics and websites.
vii. The CMYK code uses three primary colour pigments, cyan, magenta and yellow and is based on the light absorbing quality of inks printed on paper.
viii. The gamut of a colour code is the range of colours that can be displayed on computer monitors or printed on papers.
ix. A colour palette is an indexed table of available colours spectrum in a given colour code.
x. Dithering is a technique to increase the number of colours to be perceived in an image while aliasing is what happens when solid colors don't conform to vertical and horizontal edges.
xi. A digital image stored in a computer file must conform to specific standard or format such as GIF, JPEG, PNG etc.

6.0 Tutor Marked Assignments

1. Why is the resolution of the U and V channels often less than the Y channel?

7.0 Further Readings and Other Resources

COMP3600/SCI2600 Multimedia Systems, Department of Computer Science, Hong Kong Baptist University

Dorin, A & McCormack, J. (2000). FIT5900 : Introduction to Multimedia Programming. FIT5900 courseware, CEMA Semester 1, Caulfield Campus, 2000 http://www.csse.monash.edu.au/%7Ecema/courses/FIT5900/index.html

James Khazar (2009). Arts 21: Introduction to Computer for Arts.
Licensed under a Creative Commons Attribution-Noncommercial-No Derivative Works 3.0 Licences. http://www.khazar.com/academics/portal/ucsc/2008fall/art21/

L. Reid & V. Tryphonopoulos (2009). Computer Science CS1033: Multimedia and Communication, www.csd.uwo.ca/courses/CS1033

Marshall, D. (2008), Multimedia. Module CM0340.
http://www.cs.cf.ac.uk/Dave/Multimedia/

Module 2: Properties of Multimedia Element

Unit 3: Sound and Audio

Module 2: Properties of Multimedia Element

Unit 3: Sound and Audio

1.0 Introduction

Sound is a physical continuous analog audio signals phenomenon produced by the vibration of matter and transmitted as waves. They are first captured by a microphone, digitized and store in the computer in compressed form. Sound is perceived by human beings in three ways, namely the source which emits sound; the medium through which the sound propagates; and the detector which receives and interprets the sound.

2.0 Objectives

At the end of the unit you will be able to:

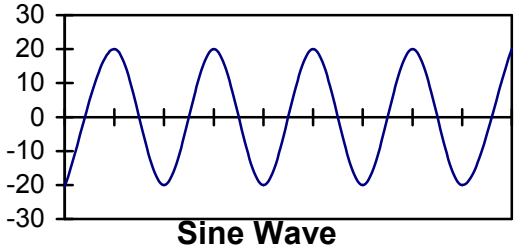
- define sound and its related concepts;
- list and describe the properties of sound;
- explain how sound are converted into their equivalent digital representations;
- distinguish between analogue music and digital music;
- adjust and control the sound properties on computers using the adds-on sound software available in but Microsoft Windows;
- record, edit and play sound with Audacity and Microsoft Windows;

3.0 Basic Concepts

3.0.1 Sound Waves

Sound waves are forms that sound takes as it travels across medium and it comprised of many different frequencies and shapes (e.g. sine wave). The sine wave is a function that occurs often in mathematics, music, physics, signal processing, audition, electrical engineering, and many other fields. Its most basic form describes a wavelike function of time**:**

$$y(t) = A \bullet \sin(\omega t + \theta)$$



where A (the amplitude) is the peak deviation from center, ω is the angular frequency measured in radians per second and θ is the phase. When the phase is non-zero, the entire waveform appears to be shifted in time by the amount θ/ω seconds. A negative value represents a delay, and a positive value represents a "head-start".

Another example is the longitudinal harmonic waves which can be described with the formula below

$$y(x,t) = y_0 \sin\left(\omega\left(t - \frac{x}{c}\right)\right)$$

where:

- y is the displacement of the point on the traveling sound wave;
- x is the distance the point has traveled from the wave's source;
- t is the time elapsed;
- y_0 is the amplitude of the oscillations,
- c is the speed of the wave; and
- ω is the angular frequency of the wave.

The quantity x/c is the time that the wave takes to travel the distance x.

The ordinary frequency f, in hertz, of the wave can be found using $f = \frac{\omega}{2\pi}$

Longitudinal waves are waves that have the same direction of oscillations or vibrations along or parallel to their direction of travel, which means that the oscillations of the medium (particle) is in the same direction or opposite direction as the motion of the wave. Mechanical longitudinal waves have been also referred to as compression waves or compression waves.

3.0.2 Sound Effect

Sound effects are artificially created or enhanced sounds, or sound processes used to emphasize artistic or other content of films, television shows, live performance, animation, video games, music, or other media

3.0.3 Sound Energy

Sound is generally known as vibrational transmission of mechanical energy that propagates through matter as a wave (through fluids as a compression wave, and through solids as both compression and shear waves) that can be audibly perceived by a living organism through its sense of hearing.

3.0.4 Sound pressure

Sound pressure is defined as the difference between the average local pressure of the medium outside of the sound wave in which it is traveling through (at a given point and a given time) and the pressure found within the sound wave itself within that same medium.

3.1 Properties of Sound Waves

Sound waves are described using the following parameters:

a. Period, Pitch and Frequency

Period is the interval (cycle) at which a periodic signal repeats regularly.

Pitch is a perception of sound by human beings It measures how 'high' a sound signal is as perceived by a listener.

Frequency measures a physical property of a wave and it is the number of occurrences of a repeating audio signal event per unit time. It is the reciprocal value of period f = 1/P and the unit of measurement is Herts (Hz) or kiloHertz (kHz).

b. Loudness and Amplitude

Amplitude is the measure of sound levels as the oscillating magnitude varies, with each oscillation, within an oscillating system.. For a digital sound, amplitude is the sample value. The reason that sounds have different loudness is that they carry different amount of power. The unit of power is watt.

The **intensity of sound** is the amount of power transmitted through an area of 1m2 oriented perpendiculars to the propagation direction of the sound.

The **threshold of feeling**: if the intensity of a sound is 1 watt/m^2, we may start feeling the sound and the ear may be damaged.

The **threshold of hearing**: if the intensity is 10^{-12} watt/m^2, we may just be able to hear it.

The **relative intensity** of two different sounds is measured using the unit *deciBel* (*dB*). It is defined by relative intensity in

$$dB = 10 \log \frac{I_2}{I_1}$$

c. Dynamic and Bandwidth

Dynamic range means the change in sound levels.

Bandwidth is the range of frequencies a device can produce or a human can hear.

3.2 Computer Representation of Sound

Sound waves are analog signals and are therefore continuous in nature. Digital computers are good at handling discrete numbers, so in order to store a sound wave in a computer, the analog signal must be digitized. Digitization of analog signal uses the pulse code

modulation technique by converting a sample each of the received analog signal into discrete number form.

Sampling of sound waves is done using some sampling technique (i.e. Nyquist sampling theorem) in order to capture all audible frequency components of a sound which is followed by digitization. The resolution (i.e. the number of bits used to represent a sample) of a given sample sound waveform is an important factor in detertmining the sound quality. 16 bits resolution which produces 96*dB* is commonly used for each sample in high quality sound.

3.2.1 Quality versus File Size

These are two important but often contradictory factors in management of sound. High quality sound files are usualll very large but can be compressed. The size of a digital recording depends on the sampling rate, resolution and number of channels. Higher sampling rate, higher resolution gives higher quality but bigger file size.

$$S = R \times \left(\frac{b}{8}\right) \times C \times D$$

where

S	is the file size bytes
R	is sampling rate samples per second
b	resolution bits
C	the channels (1 for Mono, 2 for Stereo)
D	recording duration seconds

3.2.2 Audio File Formats

The most commonly used digital sound format in Windows systems is .wav files. Sound is stored in .wav as digital samples known as *Pulse Code Modulation*(PCM). Each .wav file has a header containing information of the file.

Figure Audio File (*.wav) header contents

3.2.3 Audio Hardware Devices

Audio hardware devices can be generally group into two major categories; namely those that are use in recording and converting the analog signal into discrete form, and those that are used for playing (converting it back into analog to suite the speaker).

a. Recording and Digitizing sound

i. An *analog-to-digital converter* (ADC) converts the analog sound signal into digital samples.

ii. A *digital signal processor* (DSP) processes (filters, modulates, compresses etc.) the sample.

b. Play back sound

i. A *digital signal processor* processes (decompress, demodulate etc) the sample.

ii. An *digital-to-analog converter*(DAC) converts the digital samples into sound signal.

Audio hardware devices are integrated into small silicon chips and mounted on the sound card. Sound card comes with different digital sounds processing capability. When buying a sound card, you should look at maximum sampling rate, stereo or mono and duplex or simplex

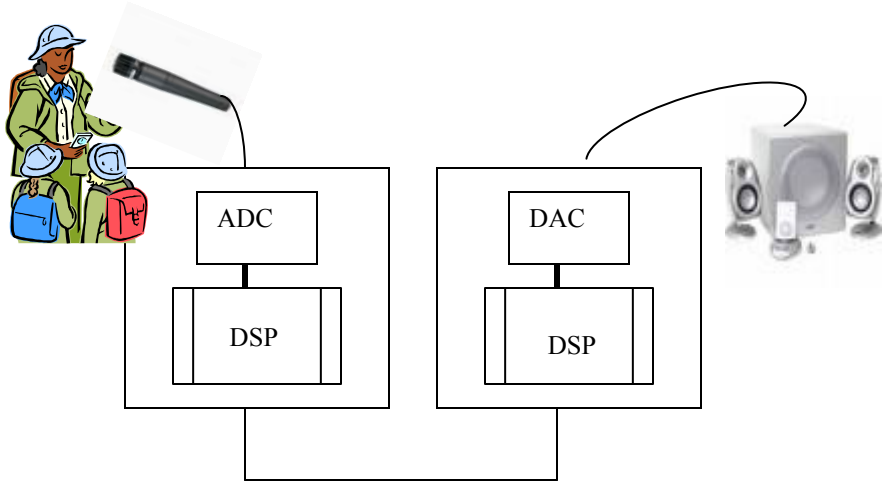


Figure ,,, Analog to Digital to Analog Sound Conversion

3.2.4 Audio Software

There is quite a number of software available for audio processing but Microsoft Windows has an adds-on device driver that controls the audio hardware device. In case where a user need to install sound card into the computer hardware, such cards would be automatically installed by Microsoft Windows since most modern cards/devices are Plug 'n' Play. In any case, sound cards always come with their drivers from the manufacturer, this can be used for installation where Plug 'n' Play could not automatically recognized and install the sound card.

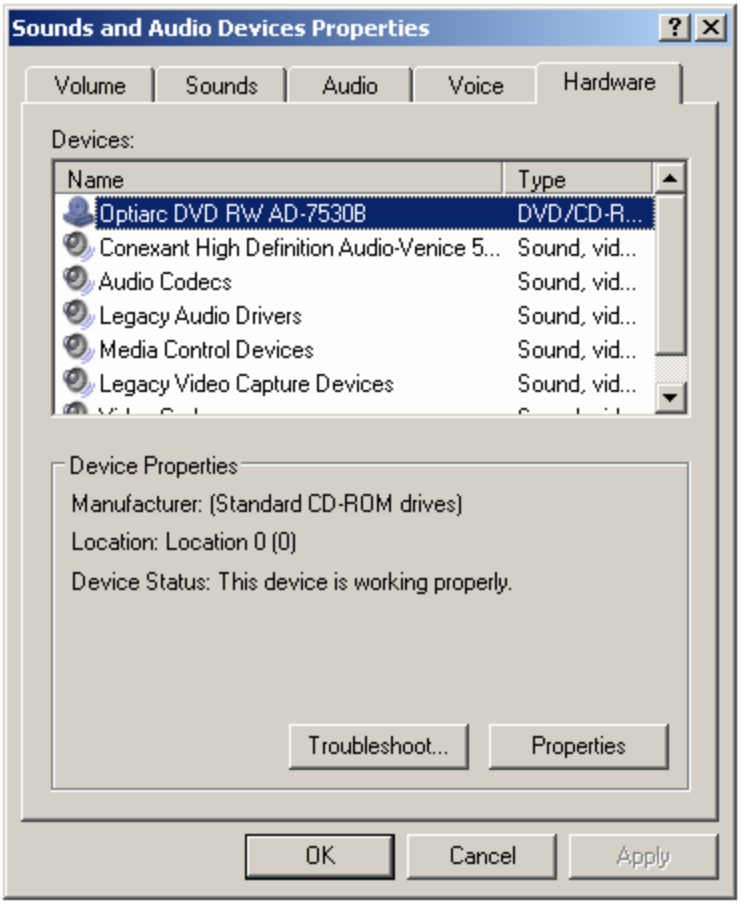


Figure MS-Windows Sound and Audio Device properties

You can adjust such settings the interrupt, DMA channels if the need arises through Windows Device Manager or Control Panel-Sound, Speech and Audio Devices. Device manager is the Windows interface to the hardware for configuring the devices, choosing desire audio device and setting the audio volume. The figure below shows some functions that are available through the Windows Sound and Audio Device driver.

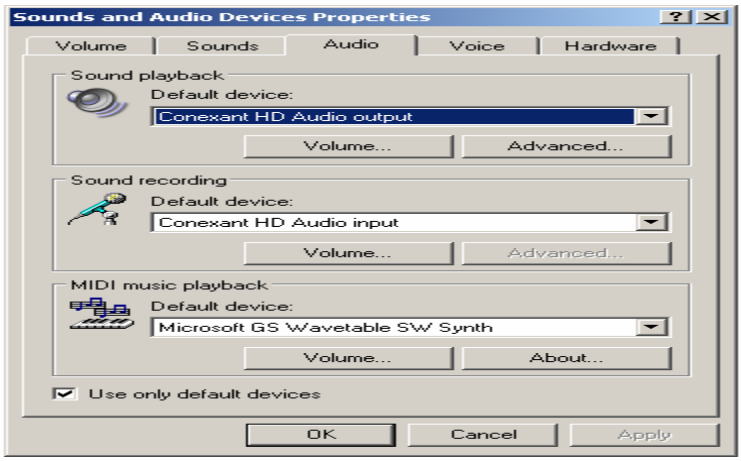


Figure Audio Facilities in Windows Device Driver

Some of these functions include Sound playback, Mixer (combine sound from different sources, adjust the play back volume of sound sources and the recording volume of sound sources), Sound recording and Editing. The Windows Sound Recorder has a limiting editing function, such as changing volume and speed, deleting part of the sound. There are many open source GPL freeware and shareware programs for sound recording, editing and processing.

SELF-ASSESSMENT EXERCISE 1

1. Discuss extensively the information contained in each .wav audio file header.
2. Using Sound Recorder, you can record, mix, play, and edit sounds.
   a. Write a documentary note about your experience so far in this course;
   b. Click Start -> All Programs -> Accessories -> Entertainment -> Sound Recorder;
   c. Read and Record the documentary note you have written in 2a.
   d. Play and edit the sound you have recorded until you are satisfied with your recording. Time Duration for the Play: 5mins
   e. Save your work.

3.3 Digital Music

Recording sound (complex by nature) is relatively easy and relatively straight forward when using digital sound equipment. But synthesizing complex sound is not quite easy. The Musical Instrument Digital Interface (MIDI) offers a better way of synthesizing high quality music via computer and digital sound devices. MIDI is a communication standard developed in the early 1980s for electronic instruments and computers, and specifies the hardware connection between equipments as well as the format in which the data are transferred between the equipments. Common MIDI devices include electronic music synthesizers, modules, and MIDI devices in common sound cards. General MIDI is a standard specified by MIDI Manufacturers Association. To be GM compatible, a sound generating device must meet the General MIDI system level 1 performance requirement outline as follows:

a. minimum of 24 fully voices;
b. 16 channels, percussion on channel 10;
c. minimum 16 simultaneous and different timbre instruments;
d. minimum 128 preset instruments; and
e. Support generic device drivers.

Computer and electronic music system that meet the hardware interface and the data format requirements is refer to as a MIDI device.

3.3.1 MIDI Hardware

Computers and other electronic musical devices that have MIDI interface come with one or more MIDI ports. The MIDI ports on musical instruments are usually labelled as:

IN — for receiving MIDI data;

OUT — for outputting MIDI data that are generated by the instrument; and
THRU — for passing MIDI data to the next instrument.

3.3.2 MIDI Data

MIDI data does not encode individual samples but data encode musical events and a command to control instruments unlike it is done with digital sound. MIDI data are grouped into MIDI messages where each MIDI message represents a musical event, e.g., pressing a key, setting a switch or adjusting foot pedals. A track contain group of sequence of MIDI messages.

3.3.3 MIDI Channels and Modes

Communication among MIDI devices takes via the 16 standard channels. Each instrument can be mapped to a single channel (Omni OFF), or it can use all 16 channels (Omni ON). Some instruments (e.g. piano) are polyphonic and are capable of playing more than one note at the same time while others are monophonic and can only play one note at a time. For effective data transfer, all the communicating MIDI devices must be the appropriate mode.

3.3.4 Instrument Patch

Each MIDI device is usually capable of producing sound resembling several real instruments and/or noise effects (e.g., animal, train). This noise effect is refer to as a patch, or preset. The general MIDI standard specifies 128 (0 to 127) patches.

3.5 MIDI Data Files

MIDI data are stored in MIDI files and each MIDI files contains a number of *chunks*. There are two types of chunks:

a. Header chunk — contains information about the entire file: the type of MIDI file, number of tracks and the timing.
b. Track chunk — the actual data of MIDI track. Multiple tracks can be played at the same time. Tracks can be assigned to a different channel while each channel can accept more than one track. A channel is assigned a patch and therefore generates sound of a particular instrument

MIDI data files are categorized as :
0 single multichannel track
1 one or more simultaneous track of a sequence
2 one or more sequentially independent single-track patterns

3.3.6 Synthesizing MIDI Sounds

MIDI sounds can be synthesized using:

i. **Frequency Modulation (FM) Synthesis**
FM uses a sine wave to modulate another sine wave, thus generating a new wave which is rich in timbre (the two original waves, their sum and difference and harmonics). The limitations of FM synthesis include artificial generated sound;

generating a particular sound does not follow any laid down principles and is thus done haphazardly.

ii. **Wave-Table synthesis**
Wave-Table stores and manipulates representative digital sound samples by changing the pitch, to create the complete range of notes.

3.4 MIDI Sound Attributes

The shape of the amplitude envelop has great influence on the resulting character of MIDI sound and there are two different types of amplitude envelop, namely:

i. Diminishing sound which phase out gradually; and
ii. Continuing sound that is sustained until turned it is turn "OFF".

SELF-ASSESSMENT EXERCISE 2

1. What is DirectX?
2. Why synthesized sounds?

4.0 Conclusion

Sound is a physical continuous analog audio signals phenomenon produced by the vibration of matter and transmitted as waves.

5.0 Summary

In this unit, we have learnt that:

i. Sound is a physical continuous analog audio signals phenomenon produced by the vibration of matter and is transmitted as waves.
ii. Digital Audio is digital representation of physical sound waves.
iii. Digitization of analog signal uses the pulse code modulation technique by converting a sample each of the received analog signal into discrete number form.
iv. The Musical Instrument Digital Interface (MIDI) offers a better way of synthesizing high quality music via computer and digital sound devices.
v. Proper setting of sound attributes determines the quality of audio output. Much better sound if the sound source is of high quality

6.0 Tutor Marked Assignments

1. Load Audacity and open the file you created and saved in SAE1 previously.
   a. Edit this file by adding background music to it.
   b. Save your work and export it to MP3 device.
   c. Play your work on the MP3 device.
2. Your hard disk has 512Mbytes of free space. You are going to record a speech with a sampling rate of 11KHz, 8-bit resolution and a single channel. What is the length of the recording that can be stored in the hard disk? (Answer in seconds)

3. A multimedia presentation has 30 minutes of CD-quality digital audio in .wav files. What is the storage required for these files?

7.0 Further Readings and Other Resources

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COMP3600/SCI2600 Multimedia Systems, Department of Computer Science, Hong Kong Baptist University

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Module 2: Properties of Multimedia Element

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Module 2: Properties of Multimedia Element

Unit 4: Video and Animation

1.0 Introduction

Video and animation adds virtual reality to the way images and graphics are viewed and perceived in multimedia applications. Video are prerecorded images (graphics) that are played back at speeds between 15 to 30 frames per second and which provide the appearance of full motion. The integration of video in multimedia has major effect on the user's experience.

Animations on the other hand involve simulation of motion to images and graphics object in multimedia applications. It aims to make images (non-living things) as having characteristics of living thing (LT) by adding the illusions of motion, emotion, and personality etc to a sequence of still images. It is a time-based script of composite images (the images changes over time).

2.0 Objectives

At the end of the unit you will be able to:

- define video and animation, and their related concepts;
- explain how video are converted into their equivalent digital representations;
- list and describe the various broadcast video standards and video formats standards;
- describe how video data files are compressed using lossy or lossless compression schemes;
- explain video streaming and buffering concepts;
- describe the animation process and the tools used in animation process;
- outline the area of interest in animation production and the different animation file formats;
- explain the various types of animation;

3.0 Basic Concepts

To enhance our understanding of how video and animation can be effectively used in multimedia applications, we need to review the following related basic terms:

3.0.1 Modelling

Modelling is the process of specifying the geometric attributes of an image or graphical object. Image modelling is carried using graphical user interface (GUI) software which allows the user to select basic primitive shapes (e.g. ovals, cubes, can, bevel etc.) and modify their attributes, decorate them with textures and connect them hierarchically.

3.0.2 Animating

Animating refer to the process of specifying the time varying properties of a model. Usually performed by a key framing process where the model is *posed* at various times and the computer mathematically determines where the model ought to be positioned between these key frames.

3.0.3 Rendering

Rendering refer to the process of synthesizing images of a model by exposing it to synthetic lights. It is a computationally expensive process whereby imaginary light rays bounced off the imaginary model at each time an image is required and for each pixel in the image to determine the colour visible to a viewer at a particular point in time and space.

3.0.4 Motion

Movement is a powerful medium through which to convey a message. Both video and animation give us a sense of motion as they exploit some properties of human eye's ability of viewing pictures. Motion video is the element of multimedia that can hold the interest of viewers in a presentation.

3.0.5 Persistence of vision

Persistence of vision is the blending together by the eye/brain of rapidly displayed sequential images, giving the illusion of movement.

3.0.6 Visual Representation

The visual effect of motion is due to the notion of *persistence of vision.* An image seen by the human eye remains mapped on the eye's retina for a brief time (approximately 25 ms) after viewing the image.

The phi notion also contributes to the visual effect of motion; when two closely light sources are illuminated in quick succession, one single light moving between the two points is perceived instead of two light sources.

A discrete sequence of individual pictures can be perceived as a continuous sequence as a result of these two notions.

The visual effect (or Temporal Illumination) of motion takes place when:

a. the rate of image repetition exposure to light sources is satisfactorily large to guarantee smooth motion from frame to frame; this rate is refer to as **fusion frequency**. Fusion frequency is positively skewed towards the brightness of the light sources, the brighter the light sources the higher the fusion frequency. Human beings perceive continuous motion at a frame rate above 15 frames/s.

Video systems have standard frame rate (e.g. PAL 25 frames/s), any rate shorter or longer than this standard rate produces rough movement of image with many starts and stops in between the movements. The periodic changes (**flicker**) in perception of brightness can be corrected by a the interleaving technique; and

b. the persistence of vision extends over the interval between flashes.

3.0.7 Frame

Individual images forming an animation are called frames. Frames may be shot in real-time using a cine or video camera to make a film or video. In order to ensure the reliability of persistence of vision, animation (film) frames are stored for rapid, sequential retrieval and display. The **interleaving** technique divides a frame into two (alternative scan lines) fields and displaying each field at twice the frames rate.

3.1 Video

Video is the process of recording and replaying still or moving images using electronic system (e.g. Video Recorder, Television, and Video Player). Video must be captured with a video camera (VCR), digitized and edited before it can be used in multimedia applications. The video adapter located on the computer motherboard generate a video signal that is sent to the computer monitor via a data cable. Video digitizer on its part enables a video camera to capture an image, display and store it in digital form in the computer memory.

3.1.1 Broadcast Video Standards

There are three major conventional broadcast analog video standards, namely

i. **National Television Systems Committee** (*NTSC*) developed in the U.S. and used in North and South America, and Japan. The NTSC produces 30 images of 525 lines per second and transmits at a frame rate that is approximately 30Hz. NTSC is based on the interleaved technique and therefore produces lesser rough movements than scanning the entire image at a go. NTSC produces 60 half images per second based on the US standard powerline frequency of 60Hz;

ii. **SEquential Couleur Avec Memoire** (*SECAM*) is a standard used in France and Eastern Europe. A picture consists of 625 lines and frame rate is 25Hz;

iii. **Phase Alternating Line** (*PAL*) was developed in Germany and is widely used in Western Europe, most part of Asia (including China and Hong Kong) and other countries. A picture consists of 625 lines and frame rate is 25Hz. SECAM and PAL were designed based on the European standard of 50Hz powerline frequency.

3.1.2 Video resolution

As previously noted, pixel is the smallest detail of an image that can be reproduced. In practice, the frames are interleaved because some of the scenes inevitably fall between scanning lines which require two lines for the pixels in the image. However, the scanning lines only capture about 70% of the vertical detail.

Conventional television systems use an **Aspect Ratio** of 1.33: 1 (4:3). The aspect ratio (also refer to as "Academy Ratio") is the ratio of the picture width to height of the screen. For the three conventional video standards, the picture width, horizontal resolution and the total detail content of the image can be determined as illustrated in the table below.

System		Total Lines	Active Lines	Vertical Resolution	Horizontal Resolution	Total Pixels
1.	NTSC	525	484	242	330	106,000
2.	SECAM	625	575	290	425	165,000
3.	PAL	625	575	290	465	180,000

Table : Analysis of Video Data

Conventional video systems have relative low resolution when compare with that of computer monitors. This resultant effect of this low resolution is that video played on computer screens are usually displayed in small windows and require large amount of storage. Hence, video data are usually compressed for economics of storage sake. For example, consider a SCAM video system that transmits at 25 frames/s, if we take a sample at 360 x 240 resolution at 16 bits per pixel, the raw video size is

$$360 \times 240 \times 25 \times 16 = 34.56 Mbit/s \cong 4 Mbytes$$

Compare this with a typical Ethernet bandwidth of 10Mbit/s or a double speed CD-ROM drive of 300Kbyte/s.

3.1.3 Digital Representation of Video

Digitization of still or moving images (video) involves the use of video camera to capture video for playing back on computers and/or integrating the video into multimedia applications. Recall that images, pictures, and graphical images are represented by sequence of frames, and that each frame is a digital form of the captured image. Also there is constant delay between the appearances off two successive frames which result in flicker.

In digitalizing a video, several samples of the image are captured. Suppose for an NTSC system that transmit at 30 frames/s, then each frame would require $1/30 = 33.33ms$. Each scan line contains $30/525 = 57.14\mu s$ since a SECAM systems have 525 scanning lines in its frame. The sampling time at a horizontal resolution of 330 pixels would be

$57.14\mu s / 330 = 0.17\mu s$ yielding a sampling rate of about 6 MHz which re requires very fast hardware.

3.1.4 Hardware Requirements

The hardware required to capture video images include the following:

a. Video sources: TV, VCR, LaserDisc player, Camcorder;
b. Video capture card; and
c. Storage space: large hard disk

3.1.5 Video Capture Cards

There are many different video capture cards on the market but they all follow the same standard illustrated in the figure below

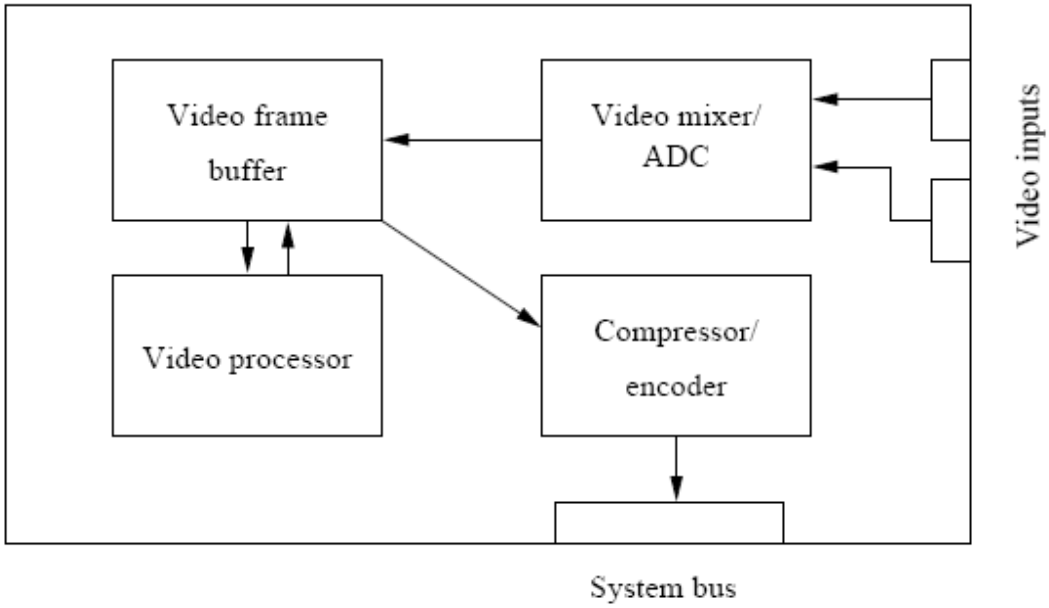

Figure …… Architecture of Video Capture Card
(Source: COMP3600/SCI2600 Multimedia Systems, Department of Computer Science, Hong Kong Baptist University)

The architecture in figure … above highlights the common features in video capture card, vis-à-vis:

i. **Video Inputs:** accept composite video (in NTSC or PAL); high-end capture cards can accept digital video (DV);

ii. **Video Input Mixer** (ADC) which is used to select/combine video sources, to convert analog video signal to digital samples;

iii. **Video Frame Buffer** used for temporary storage of video frame;

iv. **Video Processor**: filters or enhance the video frame by reducing noise, adjust brightness, contrast and colour;

v. **Compressor/Encode**r— to compress and encode the digital video into a required format; and

vi. **Interface** to the system PCI bus.

3.2 Video Standard Formats

There quite a number of standards used in video capturing, editing, storage, retrieval and display. Among them are:

i. Microsoft's AVI standard;
ii. Motion Picture Expect Group (MPEG) standard;
iii. Apple's Quicktime standard; and
iv. ITU-TS H.261 standard.

These formats are used to compress many different types of frame sequences, sets browser display using plug-ins or helper applications, play soundtracks synchronized to animation and assembled videos.

3.2.1 Microsoft's AVI Standard

The Audio Video Interleaved (AVI) format is a software-only system that was defined by Microsoft for its Video for its Windows based systems. AVI supports video playback at a frame rate of about 30 frames/s in a small window; about 300 x 200 with 8 or 16 bit colour). It and supports a number of compression algorithms

3.2.5 Motion Picture Expert Group Standard

The Motion Picture Expect Group (MPEG) is a working group within the International Standard Organization (ISO) targeted at entertainment video. MPEG standard has several versions and we shall discuss three of the se versions.

3.2.5.1 MPEG - 1

MPEG – 1 has a maximum data rate is 1.5Megabit/sec and requires hardware support for encoding and decoding on slow systems.

3.2.5.2 MPEG - 2

MPEG - 2 was developed ton improves the data rate of MPEG – 1 by increasing the maximum data rate to 15Mbit/sec and can interleave audio and video.
MP3 (MPEG II, layer 3) is a popular format for storing music and other audio. A typical MP3 file is one tenth the size of the original WAV or AIFF file, but it sounds very similar.

MP3 encoders make use of psychoacoustic models to, in effect, "throw away" the parts of the sound that are very hard to hear, while leaving the loudest and most important parts alone.

3.2.5.3 MPEG - 7

MPEG-7 (Multimedia Content Description Interface) is a standard developed by ISO/IEC for media archiving, searching, browsing, filtering, managing media delivery to diverse users, and controlling copyright and classification issues. MPEG-7 is different from its earlier versions by defining the schemes used to describe media data while MPEG-1, 2 and 4 defines coding schemes to represent the media itself. MPEG-7 is another layer on top of multimedia data. MPEG-7 presents a standard interface for media description which includes:

- The system: storing and transmitting mpeg-7 bit streams.
- Description Definition Language: XML.
- Visual – the Description Tools dealing with (only) Visual descriptions.
- Audio – the Description Tools dealing with (only) Audio descriptions.
- Multimedia Description Schemes.
- Reference software, conformance testing, profiles and levels, and schema definition.

3.2.6 Apple's QuickTime Standard

QuickTime was originally developed by Apple for storing audio and video in Macintosh systems. It supports video playback at up to 30 frames per second on a small window (typical size 300_200 with 8 or 16 bit colour). It is a software-only system and supports a number of compression algorithms

3.2.7 ITU-TS H.261 Standard

ITU-TS H.261 target at low resolution video conferencing, bit rates ~ 0.1 Mbps

3.3 Video Compression

Compressing video data files decreases their size and reduces the amount of space they use on your drives or removable storage devices. Compression schemes can be classify as either lossy or lossless. The table below gives an overview of similarity and the dissimilarity between these two compression schemes.

Lossy Compression Schemes	Lossless Compression Schemes
Discard pixel information and removed some information in the data. (Very high compression rates)	Do not discard pixel information. The data is not altered nor lost in the process of compression.
Removes redundancy	Removes redundancy

Reconstruction by approximation	Reconstruction by calculation (exact)
Range of quality / compression trade offs (The better the compression, the worse the quality. Compression usually specified within JPEG images as a percentage from 0% (low quality) to 100% (high quality))	Quality is a critical factor. Originality is considered.
Often suitable for images captured from conventional camera / video (Compresses well, artefacts invisible)	Often unsuitable for images captured from conventional camera / video (compresses poorly)
Often unsuitable for digitally synthesized images (Artefacts / degradation visible)	Often suitable for digitally synthesized images (compresses well)
Good for video and image compression	Good for computer data file compression

The efficiency of compression can be determining through the followings:

i. Compression Ratio

$$Compression\,Ratio = \frac{original\,data\,size}{compressed\,data\,size} \quad \begin{cases} +ve;\ Compressio\,n\ \ ratio \geq 1 \\ -ve;\ otherwise \end{cases}$$

ii. Figure of Merit: this is reciprocal of the compression ratio.

$$Figure\,Merit = \frac{compressed\,data\,size}{original\,data\,size}$$

Compression algorithms use either of these two encoding styles, vis-à-vis;

a. **Source encoding**: can be used in either lossy or lossless compression algorithms. It makes use of transformations which depend on the type of the original data (e.g. suppression of audio silence, exploring motion redundancies etc.); and
b. **Entropy encoding:** used for only lossless compression algorithms. It treats all data as sequence of bits and do not consider the nature of the original data.

3.4 Video Streaming and Buffering Concepts

Streaming is a method of delivering audio and video files across the computer network or the Internet without downloading an entire file before it plays. When a streamed file finishes playing, it is not stored on your computer. When you play a streaming media file,

the file is partially downloaded and stored in a buffer before it begins to play; this process is called buffering. As more information in the file is streamed to the computer video player (e.g. Windows Media Player), the Player continues to buffer the information. If traffic on the Internet interrupts the flow of information, buffering may enable the file to play back with fewer breaks or interference.

All streaming media files buffer before playing. Buffering is the process of sending a certain amount of information to the computer before the content actually plays. When streaming a file, the Player monitors network conditions and automatically makes adjustments to ensure the best reception and playback. If network traffic interrupts a stream, the Player fills those gaps with information from the buffer. If network traffic is particularly heavy, the user may notice interruptions in the stream when playing the file because the buffer is empty and more information has not been sent. If the information in the buffer runs out, there will be a break in playback. The status bar at the bottom of the Player window alerts you when information is buffering.

The amount of time that content is buffered before it is played can be adjusted by the user. If the user notices several interruptions during playback, the number of seconds that content is buffered should be increased. However, in general it is recommended to allow the Player adjust the buffering automatically.

3.5 Shooting and Editing Video

Download video from a digital or analog video camera to edit your film. You can also add sound files and even combine still digital pictures using the Windows editing software.

With Windows Movie Maker, you can transfer recorded video and audio from a source, such as an analog camcorder or digital video camera, to your computer. In addition to using your own recorded content, you can also import existing audio and video files to use in the movies you create.

To open Windows Movie Maker, click **Start**, point to **All Programs**, and then click **Windows Movie Maker**.

The following can be done with Windows Movie Maker:

a. Monitor window
b. Display a Video Clip
c. Using Monitor window controllers to

- customize the monitor window view
- play the Source or Program view
- view a different frame
- joggle or shuttle through frames

d. Use and move around the Timeline window to:

- move the edit line in the Timeline
- display the timeline in more detail
- display more of the program in the timeline

SELF-ASSESSMENT EXERCISE 1

1. Explain the concept of persistence of vision as it relates to movement of objects.
2. What is the role standards used in video capturing, editing, storage, retrieval and display?
3. Discuss the reasons for compressing video data.

3.6 Animation

Animation brings life to still images by displaying the images in rapid succession to create a visual effect of motion. Animation is variety of motion pictures that produces the illusion of movement in hand-drawn still images, pictures or graphical objects by photographing them on a single frame, then substituting the next drawing or object in the series, which shows the subject in a slightly different position, then photographing that on the next frame, and so on. It adds motion (transition effect e.g. fade, dissolve or zoom) to an image, or as elaborate and expensive as a full cartoon animation or even 3D animation. Visual effect can be of two major kinds, namely:

i. **Motion Dynamic*:*** which is time varying positions; and
ii. **Update Dynamic**: which is the time varying shape, colour, texture, or even lighting, camera position, etc.

The visual effect is the result of exploiting the properties of human vision system as described earlier in section 3.0.6 of this unit. Animation may be used for instructional/learning purposes, forensic activities, advertisement, storytelling, visualization, computer graphics and arts etc. Note however, the essence of multimedia presentations is to pass across messages to the users (audience, viewers, learners etc.), it is thus advisable for the multimedia designer not to lose sight of this fact.

3.7 Animation Process

The following diagram illustrates the various processes involved in animation of images:

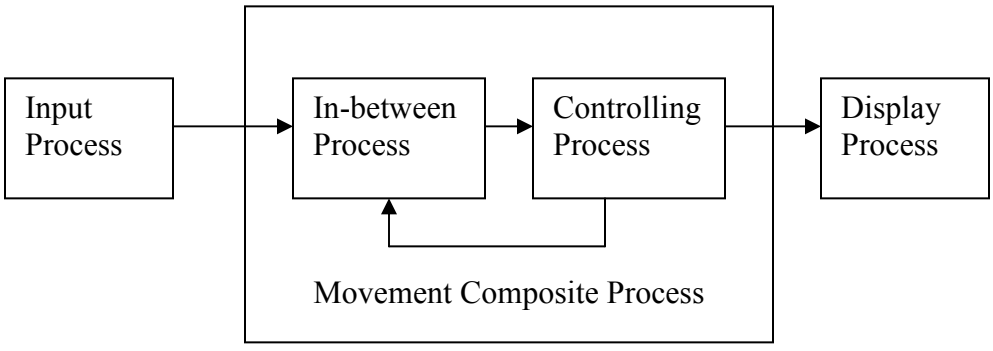

Figure …. The Animation Processes

3.7.1 Input Process

The input process is the first step required in producing computer animation. Key frames (the frames in which the objects being animated are at extreme or characteristic positions) are created and input into the computer. The frames are drawn using traditional artistic tools, such as pen and brush, and then digitized and clean up, or they can be created with computer graphics tools. In composition stage, the foreground and background figures are combined to generate the individual frames.

3.7.2 In-between Process

The animation of movement from one position to another needs a composition of frames with intermediate positions in between the key frames. The in-between process is performed in computer animation through interpolation. The system is given the starting and ending positions, and then calculates the positions in between. Two major interpolation methods namely linear and spline can be used to effect the in-between process. The linear interpolation is more simpler than the spline interpolation but its object looks unreal and does not move smoothly. Spline interpolation involve interpolating the objects' shapes and makes the object movement to be smoothly.

Some animation involves changing the colour of objects by done using colour look-up table (CLUT). By cycling through the colours in the CLUT, the objects'colours will change. One common effect in which one image transforms into another is refer to as Morphing.

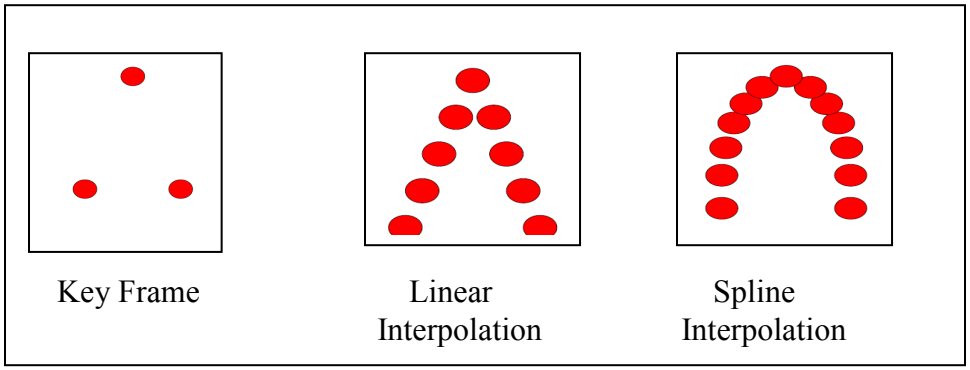

Figure …. Interpolations

3.7.3 Controlling Process

The controlling process is a scheme or algorithms of everything that occurs in the animation. It specify simple changes, such as scaling, transformation effects, the key

frames size to be used in the animation, and the procedural control (geometrical computations) on the objects.

In physical systems, the position of one object may influence the motion of another. Whereas in constraint-based systems, the movement of objects that are in contact with each other is constraint by physical laws. An animation can be specified by these two constraints. Tracking live action requires

a. People or animals act out the parts of the characters in the animation
b. The animator trace out the characters

The controlling process also focuses on kinematics (the position and velocity of points) of the objects. Suppose an image at *t=0* moves with a constant acceleration using the dimensional vector quantity [1, 1.5], the final result of an animation is the sum of all the steps. If it does not fit, the animator has to try again. This is known as forward kinematics. Inverse kinematics (IK) on the other hand is concerned with moving a skeleton from one pose to another. The required position of the end effectors is specified and the *IK* algorithm will compute the joint geometrical position, angle, etc.

3.7.4 Displaying Process

The rules governing the showing of video apply to animation as well. The frame rate should be at least 10 fps, preferably 15fps to 20fps, to give a reasonably smooth effect Acceptable multimedia animation can make do with fewer frames per second.

3.8 Types of Animation

1. Hand Drawn Animation

In hand drawn animation, multiple images are drawn on paper, canvas, acetate 'cels' and photograph one at a time onto film. Moving images were drawn on separate sheets of celluloid laid over a fixed background, drawn on paper. The positional registration between successive drawings must be taken into significant, and this can be done by having holes punched in the drawings that fitted on to pins fixed to the animation table under the camera.

2. Glass Sheet Animation

A sheet of glass is used as a board for depositing paint. Each frame of the animation is painted, and then photographed, and then the next frame is constructed by pushing the paint around on the glass, and so on. Each time the animator makes a new frame, the image for the previous frame is destroyed. The same process can be carried out by drawing images in a bed of sand.

3. Stop-Motion Animation

A figurine, ball of clay or other solid model is 'posed', photographed, moved a little and re-photographed ad-infinitum. If clay models are used, the process may also be called 'claymation'. If models resting on a table are used, the process may be called table-top animation.

4. Cartoon Animation

Scratch or draw an images directly onto a strip of cinefilm with pencil (pens) and other implements and play the images 'as is' through a cine-camera. Make an outline of the moving images to serve as a guide for the animation drawings.

5. Puppet or Model Animation

Puppet or model animation is an important element within feature-film production supplying part of the action in some fantasy films. Single frame animation of model creatures are combined with sequences of action filmed on a continuously running camera. These use models moved by internal rods actuated by hand (“muppets”) or by hydraulic or electrical remote control (“animatronics”), and also include sequences using animated computer graphics. The flexibility of modeling materials such as plastics and clay produces a flow that is well-timed to the motion as well as adding colourful characters and scripts.

6. Computer Animation

Computer animation is the simulation of movement produced by displaying a series of successive images on the computer monitor. The animation is effected on a computer using graphical tools to provide visual effects. The computer is used to model objects and manipulate them in a 'virtual' space, producing images of the objects as they are manipulated.

Computer animation can be accomplished in several ways, depending on the available hardware and software tools, and the working environment. One way of animating images involve drawing images on the computer monitor and then erased, redrawn on the monitor in slightly different location to makes the eyes believe that there was a movement. One other way makes use of the creation of entire monitor frames, which are drawn in memory and displayed in sequence on the screen. Another approach uses built-in screen-management tools that enable the programmer to specify an object, a starting point, and a destination while allowing the software to handle the process of movement.

Animation can be generated either in real time, in which each frame is created as the viewer watches, or in simulated time. In the latter, the computer generates still frames, which are then printed and photographed or are sent to a film or video animation camera. In this way, a computer can spend seconds, minutes, or hours generating each frame, but on replay the tape or film displays each frame in a fraction of a second. For successful animation sequences, images must replace one another rapidly enough to fool the eye into seeing continuous movement—at least 14 frames per second (fps). Broadcast-quality

animation typically ranges from 14 to 30 fps. Television sets run at a constant rate of 25 or 30 fps. Film animation displays at 24 fps. Animation of cartoons for film, for example, usually runs at 14 fps, but each frame is printed twice.

7. Live Action

The live-action animation involves the direct recording of real-life events, performance, teachings, drama etc. Inter-titles formed by cut-out letters that move randomly about the screen until they get into line in the right order to spell out the required message were used in the first frame-by-frame animation of objects on film. This technique required an adaptation of the ordinary motion-picture camera so that it only exposed one frame of film, and then stopped with the shutter closed, rather than the usual continuous running at 16 frames per second.

3.9 Animation File Formats

There are a number of standard file formats used in animation, amongst which are the AVI, MPEG, QuickTime Video Formats previously mentioned in section 3.2 of this unit, DIR for Director Movies, FLI and FLC for Autodesk and AnimatorPro, MAX for Studio Max and the Animated GIF89a files. The Animated GIF89a is commonly used in animation due to the following reasons:

i. It works best for frames which GIF compresses well

ii. The GIF file is linked into a web page as a normal image

iii. The GIF file contains animated frames assembled using freely available software

iv. The browser loads the GIF file and cycles through the frames to playback your animation automatically.

3.10 Major Areas of Interest in Animation Production

1. Image, Space and Motion

Images to be animated need to be identify, designed and constructed. The image is reproduced about 25 times per second of animation though complex images may take a long time to animate. This is true whether you are drawing them by hand or using a computer.

The screen space should be well set and established, the image distinguishable from the background, appropriately sparse or dense and well composed.

The image movement must keep to the production style, stimulates users' interest, display the intended message effectively, and is well edited.

2. Timing and Lighting

The timing of the image movement should ensure exciting image sequencing, do not strain the eyes, adequately dense and stimulates exciting viewing moments.

Lighting sets the mood of a shot, the time of day, reveals or hides, deepens or flattens images and make or mar animation.

3.11 Animation tools

3.11.1 Macromedia Director and Flash: is one of the most popular interactive animation tools for generating interactive multimedia applications and are used to create animation. These may be displayed in a web browser using plug-ins.

3.11.2 MetaCreations Poser: understands human motion and inverse kinematics.

3.11.3 Discreet 3D Studio Max: very popular for creating 3D animations.

3.11.4 Virtual Reality Markup Language

The Virtual Reality Markup Language (VRML) is a compact means of describing three dimensional (3D) virtual worlds usable on the WWW. Since 3D images are usually computationally intensive to display in a web browser. It therefore requires a VRML plug-in such as CosmoPlayer. Users can interact with the three-dimensional world or model using the mouse. Objects in the world may be animated or linked to other VRML scenes.

Virtual Reality (VR) aims to provide this experience synthetically by fooling a viewer into experiencing a space where there is none.

3.11.4.1 Features of Virtual Reality

1. **Consistency**: to make a virtual world "inhabitable" consistency is vital, objects' attributes such as their location, behaviour and interactions must be consistent. An inconsistent world is impossible to inhabit comfortably.

2. **Purpose**: It is also beneficial if there is a **purpose** for one's visit to a virtual world. A user might just explore, chat with others or solve a puzzle.

3. **Sophistication of Interactions:** Complex and rewarding interaction through the inclusion of other human inhabitants, storytelling, and complex artificial *agents* are also becoming viable inhabitants for interesting worlds.

3.11.5 QuickTime Virtual Reality (QTVR)

The QuickTime Virtual Reality (QTVR) provides a means of illustrating the real or imaginary world using a panoramic photograph or rendering 'stitched' into a cylinder. QTVR Users interacts with the pseudo 3D using the mouse and is not computationally expensive to display in a browser. Image locations on the image may be linked to other QTVR scenes.

SELF-ASSESSMENT EXERCISE 2

1. What do you understand by the term “animation”?
2. Explain the animation process and describe how it is different from the video production (if it is at all).
3. What is the importance of virtual reality to animation?

4.0 Conclusion

Video is the process of recording and replaying still or moving images using electronic system. Animation is very time consuming to make, great fun to make, great fun to watch, and can be made in a diverse range of ways. Animation is a very effective medium for conveying a message, information or an idea.

5.0 Summary

In this unit, we have learnt that:

i. Video must be captured with a video camera, digitized and edited before it can be used in multimedia applications.
ii. Digitization of still or moving images involves the use of video camera to capture video for playing back on computers and/or integrating the video into multimedia applications.
iii. Compressing video data files decreases their size and reduces the amount of space they use on your drives or removable storage devices.
iv. Streaming is a method of delivering audio and video files across the computer network or the Internet without downloading an entire file before it plays while buffering is the process of sending a certain amount of information to the computer before the content actually plays.
v. Animation brings life to still images by displaying the images in rapid succession to create a visual effect of motion.
vi. Computer animation is the simulation of movement produced by displaying a series of successive images on the computer monitor.

vii. There are a number of standard file formats used in animation, amongst which are the AVI, MPEG, QuickTime Video, DIR for Director Movies, FLI and FLC for Autodesk and AnimatorPro, MAX for Studio Max and the Animated GIF89a files.

viii. Animation tools include Macromedia Director and Flash, MetaCreations Poser, and Discreet 3D Studio Max.

ix. Virtual Reality ensures viewers have experience of space and motion where there is none.

6.0 Tutor Marked Assignments

1. The integration of video in multimedia has major effect on the user's experience. Why?
2. Write a short drama of about 15 minutes duration on "Good Parental Care", select and audition your casts, shoot and direct the drama using a digital camera or camcorder. Edit your recording with Windows Movie Maker. Add soundtracks and background music where possible to the movie. Package your productions into different video formats.

7.0 Further Readings and Other Resources

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Hao Jiang, (2007). MPEG-7: CS335-Principles of Multimedia Systems. Computer Science Department, Boston College, Boston, USA.

James Khazar (2009). Arts 21: Introduction to Computer for Arts.
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L. Reid & V. Tryphonopoulos (2009). Computer Science CS1033: Multimedia and Communication, www.csd.uwo.ca/courses/CS1033

Marshall, D. (2008), Multimedia. Module CM0340.
http://www.cs.cf.ac.uk/Dave/Multimedia/

Mike Christel and Alex Hauptmann (2002). Introduction to Multimedia and MSEC 20-791 http://www.cs.cmu.edu/~christel/MM2002/

MPEG-7 overview http://www.chiariglione.org/mpeg/standards/mpeg-7/mpeg-7.htm

"Multimedia: From Wagner to Virtual Reality",
http://www.artmuseum.net/w2vr/timeline/timeline.html

Scott D. James, Introduction to Multimedia

Video encoding (MPEG) http:.//faculty.nps.edu/xie/

Module 3: Multimedia Design and Development Strategies

Unit 1: Multimedia Systems Development Life Cycle

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Module 3: Multimedia Design and Development Strategies

Unit 1: Multimedia Systems Development Life Cycle

1.0 Introduction

Multimedia applications like every other system involve management of financial, human resources, equipment and time etc. for its objective to be achieved. The success or otherwise of multimedia application would depend on the amount of knowledge put into it, the appropriateness of equipment deployed, due to consideration to critical factors (e.g. users' peculiarities, costs), and so on. Multimedia applications must be designed, developed and deployed within a given budgetary provisions and timing.

2.0 Objectives

At the end of the unit you will be able to:

- describe the various types of software life cycle models that applies to multimedia development;
- outline and describe the phases various involved in multimedia software life cycles;
- write the specification which will be used to construct a design for the multimedia application;
- design storyboarding which describes a multimedia application in exact detail using words and sketches for each screen images, sound, and navigational choice;
- explain how the content of multimedia applications can be arranged to help the user find information more efficiently;
- describe the delivery tools and deployment strategies required for effective implementation of multimedia applications;

3.0 Multimedia Software Life Cycle Models

Multimedia applications development follows the system development life cycle that has been adopted in the software engineering over the years. A software life cycle is a process which is organized in some order or sequence, structuring activities as a whole. It involves activities (planning, design, development, testing, and deployment), constraints (e.g. time, project size, budget estimates) and resources (e.g. manpower, hardware, software) that produce an intended output. A process uses resources subject to constraints and must have entry and exit criteria. Multimedia designers must take into consideration for example, the relationship between a multimedia application's size and the time required to design and develop it; the relationship between its size and quantity and quality of manpower required.

Generally, multimedia system development life cycle can be broken down to the following processes or phases:

i. Preliminary Needs Assessment

ii. Analysis and Design
iii. Development
iv. Testing and Debugging
v. Deployment, Maintenance and Review

The various phases involve in development of multimedia applications are collectively refer to as life cycle since the direction activity establishes new objectives and goals this set the cycle turning through the phases. Realignment of logical systems towards the set goals considering the constraints and available new information is done when necessary. There a number of models that have proposed and deployed in specification and developments of software which are applicable to multimedia system. Amongst are

1. **Classic Waterfall Life Cycle:** The designer starts from the initial phase and move on to the subsequent one on completion of the preceding phase. This model follows the principle of gravity and therefore minimizes change and maximizes predictability of costs and risks. Projects can be divided into sub-components and given to sub-team to complete within a time frame (milestones) and with specific output (deliverables). Its limitation includes the fact that software requirements are susceptible to changes even during design and development, and realistic model encourage cycles.

2. **Rapid Prototyping Model:** A prototype is a partially developed product that enables customers and developers to examine some aspect of a proposed system and decide if it is suitable for a finished product. It is an abstraction of the real system which can be subjected to series of tests in order to predict the behaviour of the proposed system in real life. Potential users and domain experts reviewed the prototype by summarizing findings and made recommendations. Multimedia authoring tools facilitate prototyping. Prototyping is useful when the
i. workability of the proposed solution is in doubt; and
ii. objective is to minimize its impact during the system implementation.

The **throwaway** prototyping is similar to rapid prototyping but when the prototype has been used to produce a kind of animated specification, it is thrown away, and the final system is designed from scratch. It is useful for producing the requirements specification.

3. **Iterative and Incremental Model:** Incremental development of functionality involves starting with small and functional subsystem, and adding additional (secondary) functionality. Iterative development of overall system delivers a full system in the first release, then changes the functionality of each subsystem with each new release. It primitive forms of all three functions in the various versions (Releases) and then enhance (making them faster, improving the interface, etc.) in subsequent releases.

4. **Formal Methods:** Formal methods rely on the use of mathematical logic to achieve the software verification and validation to prove that its meet the specification outlined in the preliminary phase. The goal is to enhance the process of transiting from the initial phase (agreed specification) to machine executable code (version) of the

system through provision of better error-checking mechanism and avoidance of future errors.

3.1 Preliminary Needs Assessment

The multimedia designers in consultation with its client (project owners), subject expert and the intended users establish the general tasks which the proposed multimedia application is to performed, and the constraints on its production. This may involve the preliminary study of an existing system, be computerized or manual. The main concerns in this phase include

a. capturing the ideas and requirements of the clients
b. identifying the potential audience and users of the application
c. finding out the benefit that will gain from developing the application
d. evaluating the feasibility and costs of the entire project, including all tasks of production, testing and delivery

The most important thing to keep in mind during this stage is to strike a *balance* between the benefit and the cost. A checklist when capturing the ideas and requirements include the followings:

- Who will be the audience or end-users?
- What is the essence of the proposed multimedia application? What is the purposed message?
- How can the multimedia application be organized?
- What multimedia elements (text, sounds, and visuals) will best deliver the message?
- Would the available content material with leverage the multimedia application, such as videotape, music, documents, photographs, logos, advertisements, marketing packages, and other artwork?
- Is the idea derivative from an existing theme which can be enhanced with multimedia, or is it something totally new?
- What hardware is available for the development of the multimedia application? Is it enough?
- How much storage space do you have? How much do you need?
- What hardware will be available to the multimedia application end users?
- What multimedia software is available to the multimedia application designer?
- What are the multimedia application designer's capabilities and skills with both the software and the hardware?
- Can the multimedia application be design and develop alone by one person or will it require team work?
- How much time is available to complete the work?
- How much money is available? Would it be sufficient for the completion of the project?
- How will the final project be distributed?

The essentials are to capture the ideas and to quickly evaluate the feasibility of these ideas. The most important considerations are

i. H**ardware: i**s the most common limiting factor for both development time and final users
   - very poor sound output device or even no sound device
   - limited amount of storage
   - very narrow network bandwidth

ii. S**oftware**
   - the cost of development software is fairly high
   - the cost of software required in delivering to the end users may add up to a large sum

iii. **Contents:** using existing material or producing from scratch
   - existing material may not match your requirement
   - they are copyrighted, permission may not be granted
   - producing new material is expensive and time-consuming

iv. **Skill**: Does it require very broad skill?
   - computer skill
   - artistic skill
   - application domain skill

It is helpful to develop a pilot project or prototype before starting a full-scale development

The deliverables should include the followings

i. Terms of Reference;
ii. Analysis of the functional system;
iii. Summary of the software and hardware requirements;
iv. An outline description of the proposed multimedia system; and
v. Estimates of costs, benefits and timeline (milestones).

3.2 Analysis and Design

The requirements identified in the earlier phase are used as the basis for constructing a more detailed description (software specification) of the functionality of the proposed system. The analysis focuses on the flow of data, and on the processes to be carried out on these data to achieve the intended output. Tools require include flowcharts, data flow diagrams, structured English etc. Succinctly, the phase can summarized as follow:

- **Overview** - description of project goals, conceptual approach
- **Storyboard** - graphic outline of project interface, navigation, and key visual components.

- **Application Flow** - textual outline of all project components, timing, and navigation options.
- **Content Description** - detailed description of all content, including: photography, computer graphics, text, video, voice-over audio, music, sound effects, animations, etc.
- **Content Acquisition Plan** - assignment of interactive multimedia, customer and third party responsibilities in gathering, altering, and creating specific content components.
- **Implementation Strategy** - plan detailing all tasks, technologies, and performance benchmarks required for remaining project phases.
- **Budget and Schedule** - detail of costs, delivery dates, and milestones associated with project deliverables.

Design involves the process of determining how the objectives outlined in the software specification would be satisfied. The specification is used to construct a design for the multimedia application including program details, files, records etc. The focus at this stage is on the logical and physical structures and the processes which access them.

Designing a multimedia application is a creative activity which requires the knowledge and skill with computer, talent in graphics arts, video and music, and knowledge of the subject area of the application.

The design phase include the use of graphical outlines (Storyboarding) which describes the project in exact detail using words and sketches for each screen images, sound, and navigational choice. Storyboarding can be very detail, sketching out every screen, right down to specific colour and shade, text contents, attributes, etc or it may just a schematic guide. It is used to help plan the general organisation or content of a presentation by recording and organizing ideas on index cards, or placed on board/wall. The storyboard evolves as the media are collected and organised: new ideas and refinements to the presentation. Storyboards can be drawn using traditional media, such paper and pencil or by using a computer tool. The concept of storyboarding has been by animators and their like for many years.

The design should follow some kind of arrangement (architecture) of the multimedia information because a well-organised document will help the user find information more efficiently and the architecture design should start early.

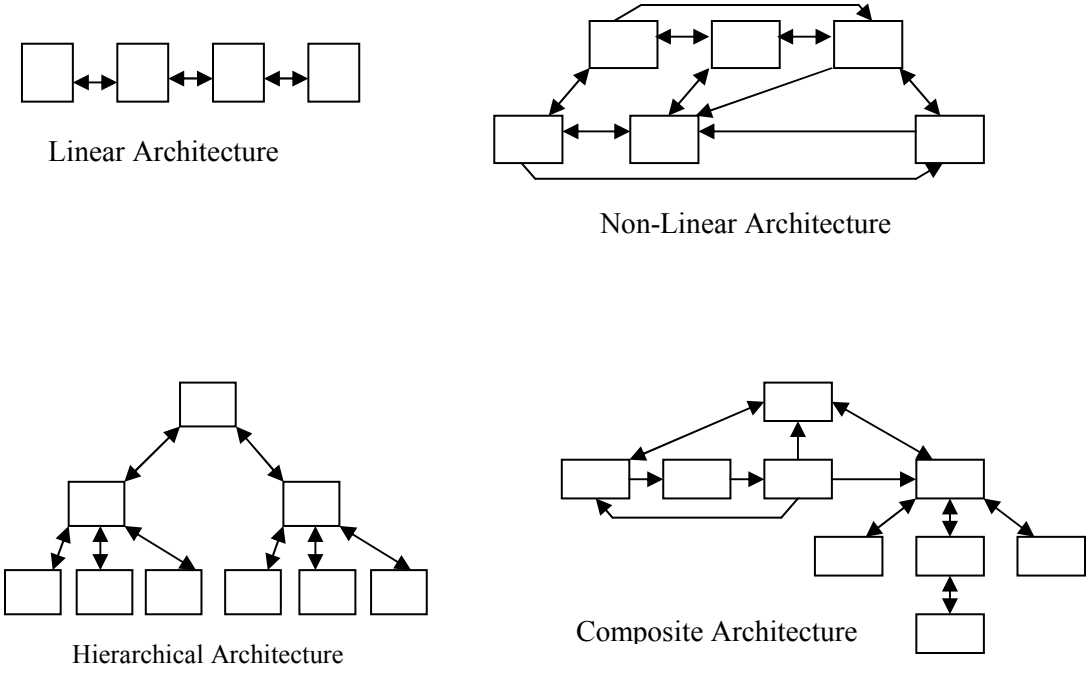

Figure Types of Design Architecture

Different navigation structure may be supported by the same document hierarchy.
For example, by subject and by time

3.2.1 Design: User Interface
The main emphasis in the design of multimedia user interface in multimedia application centers on

i. **Contents selection** is the key to convey the information to the user and the **content** can be influenced by constraints imposed by the
   - size and complexity of the presentation
   - quality of information
   - limitation of the display hardware
   - need for presentation completeness and coherence

ii. **Media** must be chosen to be "adequate"
   For example, to present a course on how to play tennis, graphics and video are more suitable than text only.

iii. **Coordination** —composition of different media

3.2.2 User interface techniques
- Keyboard —fixed control commands are assigned to keys
- Buttons in a system with Graphical User Interface (GUI)
- Scroll bars—bars may be attached to the side of the application window

- Special device —joystick may be a more natural way of controlling the device
- Direct manipulation of the video window —clicking a point in the application window, the device can be manipulated

Navigation —refers to the sequence in which the application progresses

- Direct navigation—completely predefined
- Free-form navigation— the user determines the sequence of actions
- Browse navigation—the user is provided a large number of choices

An important aspect of any multimedia system is to maintain a clear perspective and the relationship between those objects

Designing user interface

- A good user interface is defined as one that is perceived to be efficient and intuitive by most users
- A good user interface can be designed by following some structured guidelines:
    - Planning the overall structure of the application
    - Planning the content of the application
    - Planning the interactive behaviour
    - Planning the look and feel of the application

3.2.2 User-friendliness

User-friendliness is the primary goal of multimedia interface. The users do not need a long period of time before they can use the system, the learning phase should be quite simple. Users should find it easy to remember instructions and the instructions for the user interface should enable effective use of the application. Logically connected functions should be presented together and in a similar way. Graphical symbols are more effective than textual input and output. Different media should be able to be exchanged and shared among different applications. Prompt feedback after a user initiates an action is necessary.

3.3 Development

The development phase is when the multimedia project is actually rendered. At this stage, the project plan (and storyboard) must be filled with all details. The tasks to be performed in this phase are acquiring all media elements and composing the elements according to the storyboard. This is the phase when the designer's artistic talent and technical knowledge are in high demand. The methods of tracking media elements and the progress of work, and also provision for solving any technical problem that may arise are put in place.

3.3.1 Copyrights

If you acquire content from somewhere, it is very important to know who has the right of the work. Some of the works protected by copyright include computer software, technical innovation and design, literary works, dramatic works, musical works, artistic works,

sound recordings, cinematograph films, television broadcast, sound broadcasts and published editions of works etc.

It is necessary to license the rights to use copyrighted material before using it in a multimedia project. This may be done by negotiating the outright ownership of copyrighted material or procuring the rights to use that material. The designers must consider what rights to require:

- How will the material be used and distributed
- Is the license for a fixed period
- Is the license exclusive or non-exclusive
- Where will your product be distributed
- Does the content owner have the authority to assign right to you
- Will the copyright owner receive remuneration for the license

In summary, the design may observe the following outline steps:

- **Final Copy and Content Development**
  - Create, acquire and prepare all photographs, user interface graphics, and other illustrations
  - Model, animate and render all 3D animation components
  - Record, digitize and composite all audio and video components
  - Edit and process all textual components
  - Acquire and prepare all external components such as install software, databases, linked websites, etc.
- **Programming, Testing & Mastering**
  - Build authoring platform framework
  - Import content
  - Develop all programming components
  - Test for proper function and performance targets
  - Optimize performance for each platform
  - Burn beta version for customer content review and functional testing
  - Burn gold master for replication
- **Packaging and Support Literature Design**
  - Design and layout packaging and collateral materials
  - Proof and revise as needed
- **Produce make-ready films and/or digital files**

3.4 Testing and Debugging

A multimedia application may be used by many different users, many of who knows very little about computers, and on a variety of heterogeneous platforms and configurations. Therefore, it is important to test the product in a wide range of configurations. Like all other software, testing and debugging is an important and time-consuming phase. There are two types of testing namely

i. **Alpha testing:** an internal activity whereby the multimedia application is tested by in-house team; and
ii. **Beta testing** involves a wider range of testers (real users) and should not include persons who have been involved in the production of the multimedia application.

3.5 Deployment, Maintenance and Review

3.5.1 Deployment

There are two issues to be considered before a multimedia application is deployed and they are

i. Delivery Tools; and
ii. Deployment Strategies.

3.5.1.1 Delivery Tools

The delivery tools should be planned for early in the development process. CD-ROM and Internet are the two most popular means of delivering multimedia applications. All necessary distribution elements such as:

- **media elements:** e.g. movie clips, sound clips, external casts
- **runtime libraries**: e.g. Director runtime
- **drivers**: e.g. DirectX
- **helper programs**: e.g. QuickTime viewer, Acrobat Reader
- **installation program, compression and decompression programs**

should be included in the final package. The following steps may be following in the final packaging and distribution of the multimedia application:

- **Customization as required**
  - Prepare additional versions for specialized usage
- **CD Replication, Printing when required**
  - Manufacture CD-ROMs
  - Print and/or label CD-ROMs
- **Packaging/Distribution**
  - Print CD-ROM packaging and collateral materials
  - Assemble/stuff and prepare for distribution
  - Distribute

3.5.1.2 Delivery Strategies

According to the means of delivery and the target audience, the designer should plan how the application is to be installed and used. Delivery strategies include direct changeover, parallel running and phased changeover; however these strategies may also be combined.

1. **Direct Changeover:** This is a complete replacement of the old system by the new system in one move. It assumes that the multimedia application is well

organized, well implemented, well tested and the user has well trained to effectively use the application.

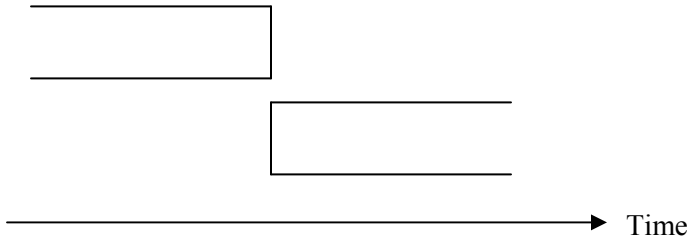

Figure Direct Changeover

2. **Parallel Running:** The old system and the new system are deploy side by side and then cross checked to ascertain the effectiveness of the new system. The old system is not discarded until the new system has been proved to be okay. Its drawbacks include the extra costs of running the two systems concurrently, and the complexity of running two different systems alongside each other.

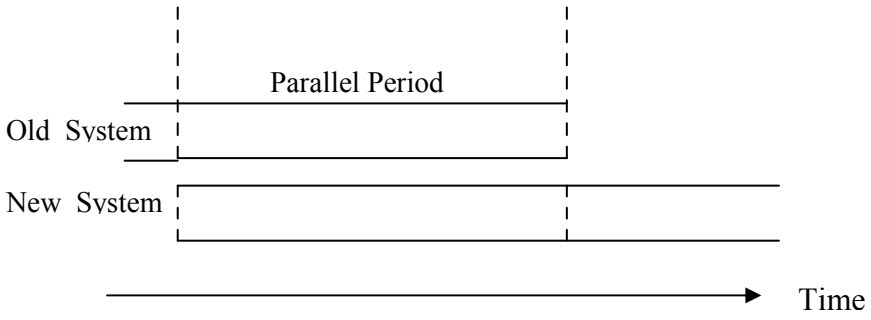

Figure …. Parallel Running

3. **Phased Changeover:** This involves a sequence of direct changeover in small proportion; the new system being introduced in piecemeal fashion. Thus, reducing the inherent risks in direct changeover and allows both the designers and end-users to learn from any mistakes that may occur during the deployment stage.

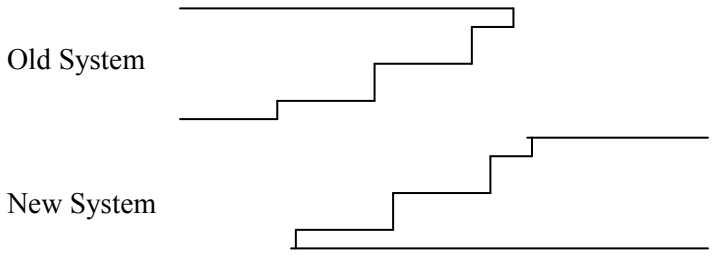

Figure …… Phased Chnageover

3.5.3 Maintenance

The ongoing development of a multimedia application to add new products, functionality, and distribution channels requires adding and revising content and functionality, and convert to additional media types (e.g. video, web, DVD, etc.).

Maintenance involves making sure that the multimedia applications runs in operational use and continues to do so for as long as it is required. It includes correcting any errors which have remained undetected, improving the implementation of system modules where necessary, and enhancing the functionality of the application whenever desired by the clients/end-users.

3.5.4 Review

The post-implementation review takes place only after the multimedia application has been running error-free for a number of cycles. Some specific aspects of the multimedia application are studied over a reasonable period and the findings are documented. These aspects will include the following:

i. **Timing**
The actual time taken to complete the various processes in the multimedia application and the time it takes for enquiries to be satisfied are studied. The aim is to obtain feedback when compared with the term of reference.

ii. **User Satisfaction**
The usefulness of the multimedia application would depend on how satisfied the end-user is with the system, especially with error-recovery and training methods.

iii. **Throughput**
This would enable the designer to measure how many transactions and enquiries the multimedia application is able to process within a given timeframe.

iv. **Error-rates**
The number and level of errors that occur during process are also considered.

v. **Gray or Problem Areas**
The designer must record any problem or gray area brought to his attention by the end-user in his evaluation report.

vi. **Actual Costs**
The total actual costs incurred in running the multimedia application are compared with the estimated running costs in the feasibility study.

vii. **Realized Benefits**
The actual benefits realized from using the multimedia application are compared with the expected benefits stated in the feasibility study.

SELF-ASSESSMENT EXERCISE 1

1. What issues are addressed in design guidelines?
2. How can a delivery tool be used to implement a well-designed multimedia presentation and its subsequent deployment?

3.6 Issues in Multimedia Applications Design

Some additional issues involved in multimedia content and technical design are discussed as follow:

3.6.1 Content Design

Content design deals with what to say and what media/tool to use. In multimedia, there are five ways to format and deliver the message, namely,

i. write the message;
ii. illustrate the message;
iii. wiggle the message;
iv. hear the message; and
v. interact with the message.

3.6.1.1 Scripting (writing) the Message

A well-scripted message would require that the multimedia application designer

1. Understand the audience of the proposed multimedia application and correctly address them.
2. Keep his writing as simple as possible. (e.g., write out the full message(s) first, and then shorten it.)
3. Make sure technologies used complement each other.

3.6.1.2 Illustrating the Message (Graphics)

The designer should make use of pictures and graphical illustrations to effectively deliver the intended messages. Visual contents are retained in the human memory longer than audio and writing message. The graphical styles such as the fonts (typeface, size, colour, style etc.) and colours (pastels, earth-colors, metallic, primary color and neon color) should be considered.

3.6.1.3 Wiggling the Message (Animation)

Sometimes, the message is better illustrated with animated objects. Objects are animated to achieve some purposes such as stressing a point, improving information delivery,

enhancing emotional impact, indicating the passage of time, showing transition (motion, cut, fade, dissolve and wipes). Various animation styles include character animation (revealing emotion, stimulating movement, enhancing visual style), highlights and sparkles), moving text, and live or digitized video.

3.6.1.4 Hearing the Message (Audio)

The following constitute the various ways audio message could be created:

1. **Music:** set the mood of the presentation, enhance the emotion, illustrate points;
2. **Sound effects**: make specific points, e.g., squeaky doors, explosions, wind etc; and
3. **Narration**: most direct message, often effective.

3.6.1.5 Interacting with the Message (Interactivity)

Interacting with multimedia contents ensures that the multimedia user come into contact with two learning domains, affective and psychomotor. Interaction enhances content comprehension, retention and recall. This due to the fact that human being remembered more than 70% of what they interacts with or put into practice. Thus, interactive multimedia provides a convenient means of setting up some simulated laboratory and practical exercises in the learning environments.

3.7 Technical Design

Technological factors may limit the effectiveness of the multimedia presentation and such technical parameters that affect the design and delivery of multimedia applications include:

1. **Video Mode and Computer Platform**

   There are many "portable", "cross-platform" software and "run-time modules", but many of them lose quality/performance during the translation.

Video Mode	Resolution	Colors
CGA	320 x 200	4
MCGA	320 x 200	256
EGA	640 x 350	16
VGA	640 x 480	256
S-VGA	1,024 x 768	$>$= 256
S-VGA	1,280 x 1,024	$>$= 256

.

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16-bit color --$>$ 65536 colors
24-bit color --$>$ 16.7 million colors

2. **Memory and Disk Space Requirement**

   Rapid progress in hardware alleviates this problem, but software requirements changes more rapidly, especially the multimedia ones.

3. **Delivery Mode**

   a. Live Presentation: short checking list for hardware/software requirements:

      - type of graphics card
      - video memory (1 MB, 2 MB, 4 MB, etc.)
      - access time of hard disk (important for real-time video)
      - type of sound card (support for General MIDI)
      - audio-video software

   b. Delivery by diskette: small in size, slow to install

   c. Delivery by CD-ROM: large capacity, access time of CD-ROM drives is longer than hard-disk drives.

   d. Electronic Delivery (ftp, www, etc.): depends on baud rate, network connection, bandwidth and monthly bill.

3.8 Visual Design

Here we summarize factors that should be considers in the visual design of a multimedia presentation:

1. **Themes and Styles**: A multimedia presentation should have a consistent theme or style, it should not be disjointed and cluttered with multiple themes. The choice of theme the style depends on the styles and emotions of the audience peculiarities the multimedia presentation is addressing. Some possible themes include:

   a. **Traditional theme**: straightforward, simple, often informative but not as interesting;
   b. **Cartoon theme**: interesting or entertaining and must be consistent with the character's personality;

c. **Technical theme**: include blueprints, 3D models of the product, e.g., start with a drawing, then transformed into a rendered image. Reveals adequate technical information and gives impression of solid design and construction; and
d. **High Tech theme:** contemporary computer art work (morphing, texture mapping, metal texture, explosions), attractive, and easy to animate.

Color schemes and art styles include:

a. **Natural and Floral:** getting back to nature (outdoor scenes, e.g., mountains, lakes, ...); and
b. **Oil paints, watercolours, colored pencils, pastels.** the art styles can be combined with e.g., cartoon or high tech themes

2. **Pace and Running Length Guidelines** include:

a. Allow a block of text to be slowly read twice;

b. Transition time should be an indication of real-time.

- dissolve - time delay, scene change
- cut - two views of same scene at same time, or abrupt scene change

c. Running length

- self running presentation: 2-3 minutes
- limited interaction: 5-6 minutes
- complete analytical, hands-on demo: < 15 minutes
- with questions, discussions: > 30 minutes

d. Interlude: build in breaks for long presentations

3. **Basic Layout**

(a) Title (b) Action area (c) Narration (d) Dialog (e) Interactive controls

- make sure that the information delivery path in the layout is smooth, not irregular/jumpy
- use headlines/subtitles, additional shapes, buttons, fonts, backgrounds and textures to enhance the visual appearance.

SELF-ASSESSMENT EXERCISE 2

1. Explain the following terms
   a. Storyboard

b. Scripting

2. What are the importances of good technical and visual designs?

4.0 Conclusion

Multimedia applications development follows the system development life cycle that has been adopted in the software engineering over the years. Multimedia applications must be designed, developed and deployed within a given budgetary provisions and timing.

5.0 Summary

In this unit, you have learnt that:

i. Multimedia software life cycle is a process which involves activities (planning, design, development, testing, and deployment) that are structured and organized in some sequential order, constraints (e.g. time, project size, budget estimates) and resources (e.g. manpower, hardware, software) that produce an intended output.
ii. Designing a multimedia application is a creative activity which requires the knowledge and skill with computer, talent in graphics arts, video and music, and knowledge of the subject area of the application.
iii. Analysis focuses on the flow of data, and on the processes to be carried out on these data to achieve the intended output.
iv. User-friendliness is the primary goal of multimedia interface. Users should find it easy to remember instructions and the instructions for the user interface should enable effective use of the application.
v. A multimedia application may be used by many different users, many of who knows very little about computers, and on a variety of heterogeneous platforms and configurations. Therefore, it is important to test the product in a wide range of configurations.
vi. There are two issues (delivery tools and deployment strategies) to be considered before a multimedia application is deployed.
vii. Delivery strategies include direct changeover, parallel running and phased changeover;
viii. Content design deals with what to say and what vehicle to use while technical design relates with such technical parameters that affect the design and delivery of multimedia applications.
ix. A multimedia presentation should have a consistent theme

6.0 Tutor Marked Assignments

1. Design involves the process of determining how the objectives outlined in the software specification would be satisfied. Discuss
2. If you were to describe your town using a multimedia presentation, by following the guides in this unit:
   a. Itemize the steps you will follow
   b. design your presentations

7.0 Further Readings and Other Resources

Salembier, P. & Smith, J.: "Overview of MPEG-7 multimedia description schemes and schema tools". In Manjunath, B.S.; Salembier, P. & Sikora, T. (ed.): "Introduction to MPEG-7: Multimedia Content Description Interface". *John Wiley & Sons, Chichester,* 2002

Schultz, D.J. & others: "IEEE Standard for Developing Software Life Cycle Processes". *The Institute of Electrical and Electronics Engineers, New York, USA,* IEEE Std, No. 1074-1997, 1997 ISBN: 1-55937-993-6

Multimedia software life cycle

Module 3: Multimedia Design and Development Strategies

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    3.7.1 Hick's Law

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Module 3: Multimedia Design and Development Strategies

Unit 2: Human Computer Interaction and User-Centered Design

1.0 Introduction

Human–computer interaction (HCI) is the field of study concerned with the interface between humans and all forms of computer systems. It is often regarded as the intersection of computer science, behavioral sciences, design and several other fields of study. Interaction between users and computers occurs at the user interface, which includes both software and hardware. The Association for Computing Machinery defines human-computer interaction as "a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them."

Because human-computer interaction studies a human and a machine in conjunction, it draws from supporting knowledge on both the machine and the human side. On the machine side, techniques in computer graphics, operating systems, programming languages, and development environments are relevant. On the human side, communication theory, graphic and industrial design disciplines, linguistics, social sciences, cognitive psychology, and human factors are relevant. Engineering and design methods are also relevant. Due to the multidisciplinary nature of HCI, people with different backgrounds contribute to its success. HCI is also sometimes referred to as man–machine interaction (MMI) or computer–human interaction (CHI).

2.0 Objectives

At the end of the unit you will be able to:

- Explain the basic knowledge involve in Human- computer interaction and itemize List the basic goals of Human-Computer Interaction;
- Explain information flow between human and computer;
- Describe why and how Human-Computer Interaction differ from other field of related study;
- Discuss the best working position of operation;
- Explain the various types of user interface, the methods used the user interface design, and their design principles
- Evaluate the effectiveness of Human-Computer Interaction in the design of multimedia applications;
- Explain the Human-Computer Interaction laws and rules

3.0 Human–Computer Interface

The human–computer interface can be described as the point of communication between the human user and the computer. The flow of information between the human and

computer is defined as the loop of interaction. The loop of interaction has several aspects to it including:

- **Task Environment:** The conditions and goals set upon the user.
- **Machine Environment:** The environment that the computer is connected to, i.e a laptop in a college student's hostel room.
- **Areas of the Interface:** Non-overlapping areas involve processes of the human and computer not pertaining to their interaction. Meanwhile, the overlapping areas only concern themselves with the processes pertaining to their interaction.
- **Input Flow:** Begins in the task environment as the user has some task that requires using their computer.
- **Output:** The flow of information that originates in the machine environment.
- **Feedback:** Loops through the interface that evaluate, moderate, and confirm processes as they pass from the human through the interface to the computer and back.

3.0.1 Goals of Human-Computer Interaction

A basic goal of HCI is to improve the interactions between users and computers by making computers more usable and receptive to the user's needs. Specifically, HCI is concerned with:

- methodologies and processes for designing interfaces (i.e., given a task and a class of users, design the best possible interface within given constraints, optimizing for a desired property such as learning ability or efficiency of use)
- methods for implementing interfaces (e.g. software toolkits and libraries; efficient algorithms)
- techniques for evaluating and comparing interfaces
- developing new interfaces and interaction techniques
- developing descriptive and predictive models and theories of interaction

A long term goal of HCI is to design systems that minimize the barrier between the human's cognitive model of what they want to accomplish and the computer's understanding of the user's task.

3.0.2 Comparison of HCI with related fields of study

HCI differs from human factors because HCI focus more on users working specifically with computers, rather than other kinds of machines or designed artifacts. In HCI the focus is on how to implement computer software on hardware platforms to facilitate effective human-computer interaction.

According to some experts, HCI also differs from ergonomics in that there is less of a focus on repetitive work-oriented tasks and procedures, and much less emphasis on physical stress and the physical form or industrial design of the user interface, such as keyboards and mice.

Over the years HCI has substantially overlap with some other areas such as:

a. **Personal Information Management (PIM)**: human interactions with the computer are placed in a larger informational context - people may work with many forms of information, some computer-based, many not (e.g., whiteboards, notebooks, sticky notes, refrigerator magnets) in order to understand and effect desired changes in their world;
b. **Computer Supported Cooperative work (CSCW)**: the emphasis of CSCW is on the use of computing systems in support of the collaborative work of a group of people; and
c. **Human Interaction Management (HIM)**: the underlying principles in HIM extend the scope of CSCW to an organizational level and can be implemented without use of computer systems.

3.0.3 Good Working Positions

- Hands**,** wrists**,** and forearms are straight, in-line and roughly parallel to the floor.
- Head is level, or bent slightly forward, forward facing, and balanced. Generally it is in-line with the torso**.**
- Shoulders are relaxed and upper arms hang normally at the side of the body.
- Elbows stay in close to the body and are bent between 90 and 120 degrees.
- Feet are fully supported by the floor or a footrest may be used if the desk height is not adjustable**.**
- Back is fully supported with appropriate lumbar support when sitting vertical or leaning back slightly**.**
- Thighs and hips are supported by a well-padded seat and generally parallel to the floor.
- Knees are about the same height as the hips with the feet slightly forward**.**

3.1 Types of User Interfaces

3.1.1. Command-line Interface (CLI)

Command-line Interface (CLI) is a mechanism for interacting with a computer operating system or software by typing commands to perform specific tasks. This method of instructing a computer to perform a given task is referred to as "entering" a command: the system waits for the user to conclude the submitting of the text command by pressing the "Enter" key (a descendant of the "carriage return" key of a typewriter keyboard). A command-line interpreter then receives, analyses, and executes the requested command.

CLIs are often used by programmers and system administrators, in engineering and scientific environments, and by technically advanced personal computer users. CLIs are also popular among people with visual disability, since the commands and feedbacks can be displayed using Refreshable Braille displays.

3.1.2 Graphical User Interface (GUI)

Graphical user interface (GUI) is a type of user interface which allows people to interact with programs in more ways than typing such as computers; hand-held devices such as MP3 Players, Portable Media Players or Gaming devices; household appliances and office equipment with images rather than text commands. A *GUI* offers graphical icons, and visual indicators, as opposed to text-based interfaces, typed command labels or text navigation to fully represent the information and actions available to a user. The actions are usually performed through direct manipulation of the graphical elements.

A GUI uses a combination of technologies and devices to provide a platform the user can interact with, for the tasks of gathering and producing information. A series of elements using a visual language have evolved to represent information stored in computers. This makes it easier for people with little computer skills to work with and use computer software., especially in personal computers. The most common combination of such elements in GUIs is the WIMP ("window, icon, menu, pointing device") paradigm.

A GUI may be designed for the rigorous requirements of a vertical market. Examples of an such GUIs are:

- Touchscreen point of sale software used by waitstaff in a busy restaurant
- Self-service checkouts used in a retail store
- Automated teller machines (ATM)
- Airline self-ticketing and check-in
- Information kiosks in a public space, like a train station or a museum
- Monitors or control screens in an embedded industrial application which employ a real time operating system (RTOS).
- cell phones and handheld game systems
- Automobiles' navigational systems and touch screen multimedia centers.

3.1.3 Zooming User Interface (ZUI)

The Zooming User Interface (ZUI) is a related technology that promises to deliver the representation benefits of 3D environments without their usability drawbacks of orientation problems and hidden objects. It is a logical advancement on the GUI, blending some three-dimensional movement with two-dimensional or "2.5D" vector objects.

3.2 Design Principles

When evaluating a current user interface or designing a new user interface, it is important to keep in minds the following experimental design principles:

- **Focus on user(s) and task(s)**: Establish how many users are needed to perform the task(s) and determine who the appropriate users should be; someone that has never used the interface, and will not use the interface in the future, is most likely not a valid user. In addition, define the task(s) the users will be performing and how often the task(s) need to be performed.
- **Empirical measurement**: Test the interface early on with real users who come in contact with the interface on an everyday basis, respectively. Keep in mind that results may be altered if the performance level of the user is not an accurate depiction of the real human-computer interaction. Establish quantitative usability specifics such as: the number of users performing the task(s), the time to complete the task(s), and the number of errors made during the task(s).
- **Iterative design**: After determining the users, tasks, and empirical measurements to include, perform the following iterative design steps until a sensible, user-friendly interface is created:

    1. Design the user interface
    2. Test
    3. Analyze results
    4. Repeat

3.2.1 Principles of User Interface Design

These are seven principles that may be considered at any time during the design of a user interface and which may improve the quality of such user interface design. These principles are:

i. *The structure principle*: Design should organize the user interface purposefully, in meaningful and useful ways based on clear, consistent models that are apparent and recognizable to users, putting related things together and separating unrelated things, differentiating dissimilar things and making similar things resemble one another. The structure principle is concerned with overall user interface architecture.

ii. *The simplicity principle*: The design should make simple, common tasks easy, communicating clearly and simply in the user's own language, and providing good shortcuts that are meaningfully related to longer procedures.

iii. *The visibility principle*: The design should make all needed options and materials for a given task visible without distracting the user with extraneous or redundant information. Good designs don't overwhelm users with alternatives or confuse with unneeded information.

iv. *The feedback principle*: The design should keep users informed of actions or interpretations, changes of state or condition, and errors or exceptions that are relevant and of interest to the user through clear, concise, and unambiguous language familiar to users.

v. *The tolerance principle*: The design should be flexible and tolerant, reducing the cost of mistakes and misuse by allowing undoing and redoing,

while also preventing errors wherever possible by tolerating varied inputs and sequences and by interpreting all reasonable actions.

vi. *The reuse principle*: The design should reuse internal and external components and behaviors, maintaining consistency with purpose rather than merely arbitrary consistency, thus reducing the need for users to rethink and remember.

vii. The affordance principle:

Also, there are two critical points that must be considered when designing a user interface namely;

i. A computer shall not harm user work or, through inactivity, allow user work to come to harm;

ii. A computer shall not waste user's time or require users to do more work than is strictly necessary

3.3 Design Methodologies

A design methodology describes how users, designers, and technical systems interact. Some design methodologies treated users' cognitive processes as predictable and quantifiable and therefore encouraged design practitioners to apply cognitive science designing user interfaces. While other design methodologies tend to focus on a constant feedback and conversation between users, designers, and engineers and push for technical systems to be wrapped around the types of experiences users want to have, rather than wrapping user experience around a completed system. We describe some important design methodologies as follows:

3.3.10 User-Centered Design

User-centered design (UCD) is a widely practiced design philosophy based on the idea that users must take center-stage in the design of any computer system. Users, designers and technical practitioners work together to articulate the wants, needs and limitations of the user, and create a system that addresses these elements. Often, user-centered design projects are informed by ethnographic studies of the environments in which users will be interacting with the system.

User-centered design can be characterized as a multi-stage problem solving process that not only requires designers to analyze and foresee how users are likely to use an interface, but also to test the validity of their assumptions with regards to user behaviour in real world tests with actual users. Such testing is necessary as it is often very difficult for the designers of an interface to understand intuitively what a first-time user of their design experiences, and what each user's learning curve may look like.

User-centered design tries to optimize the user interface around how people can, want, or need to work, rather than forcing the users to change how they work to accommodate the software developers approach. User-centered design involves simplifying the structure of tasks, making things visible, getting the mapping right, exploiting the powers of constraint, and designing for error.

Models of a user centered design process help software designers to fulfill the goal of a product engineered for their users. In these models, user requirements are considered right from the beginning and included into the whole product cycle. Their major characteristics are the active participation of real users, as well as an iteration of design solutions.

- **Cooperative design**: involving designers and users on an equal footing. This is the Scandinavian tradition of design of IT artifacts and it has been evolving since 1970.
- **Participatory design (PD)**: inspired by Cooperative Design and focus on the participation of users.
- **Contextual design**: "customer centered design" in the actual context, including some ideas from Participatory design. Contextual Design (CD) is a user-centered design process developed by Hugh Beyer and Karen Holtzblatt. It incorporates ethnographic methods for gathering data relevant to the product, field studies, rationalizing workflows, system and designing human-computer interfaces. Contextual Design can be seen as an alternative to engineering and feature driven models of creating new systems. The Contextual Design process consists of the following top-level steps: Contextual inquiry, Work modeling, Consolidation, Work redesign, User Environment Design, Prototyping and Implementation

    i. **Contextual Inquiry:** Contextual inquiry is a technique to capture detailed information about how users of a product interact with the product in their normal work environment. This information is captured by both observations of user behavior and conversations with the user while she or he works. A key aspect of the technique is to let the user lead the sessions without disruptions or guidance from the observer. Key takeaways from the technique are to learn how customers use features, why they use certain functions, and why they may not use other functions.

    ii. **Work Modeling:** Work practices are analyzed and detailed work models are created in order to understand the workflow. Contextual design consists of five work models which are used to model the work tasks and details of the working environment. These work models are:

        - ***Flow model*** - represents the coordination, interaction and responsibilities of the people in a certain work practice
        - ***Sequence model*** - represents the required steps to accomplish a certain activity

- ***Cultural model*** - represents the norms, influences, and pressures that are present in the work environment
- ***Artifact model*** - represents the documents or other products that are created while working. Artifacts often have a structure or styling that could represent the user's way of structuring the work
- ***Physical model*** - represents the physical environment where the work tasks are accomplished; often, there are multiple physical models representing, e.g., office layout, network topology, or the layout of tools on a computer display.

iii. **Consolidation:** Data from individual customer interviews are analyzed in order to reveal patterns and the structure across distinct interviews. Models of the same time can be consolidated together (but not generalized--detail must be maintained). Another method of processing the observations is making an affinity diagram ("wall"), as described by Beyer & Holtzblatt:

- A single observation is written on each piece of paper
- Individual notes are grouped according the similarity of their contents
- These groups are labeled with colored post-it notes, each color representing a distinct level in the hierarchy
- Then the groups are combined with other groups to get the final construct of observations in a hierarchy of up to three levels.

iv. **Work redesign:** Work redesign uses the consolidated data to drive conversations about how to improve work by providing a system that better supports the new work practice. The redesigned work practice is captured in a vision, a story of how customers will do their work in the new system that is being designed [1]. A vision includes the system, its delivery, and support structures to make the new work practice successful. The team develops the vision in storyboards and sketches capturing scenarios of how people will work with the new system. Understanding the current way of working, its structure and the complete workflow helps the design team address the problems and design the new workflow.

v. **The User Environment Design:** The User Environment Design captures the floor plan of the new system. It shows each part of the system, how it supports the user's work, exactly what function is available in that part, and how the user gets to and from other parts of the system. CD uses the User Environment Design (UED) diagram, which displays the focus areas, i.e., areas which are visible to the user or which are relevant to the user. Focus area can be defined further as functions in a system that supports a certain type or part of the work. The UED also presents how the focus areas relate to each other and shows the links between focus areas.

vi. **Test with customers:** Testing the design ideas with paper prototypes or even with more sophisticated demos before the implementation phase helps the designers communicate with customers about the new system and develop the design further. Prototypes test the structure of a User Environment Design and initial user interface ideas, as well as the understanding of the work, before the implementation phase [2]. Depending on the results of the prototype test, more iterations or alternative designs may be needed.

vii. **Implementations:** Contextual design has primarily been used for the design of computer information systems, including hardware [3] and software. [4]. Parts of contextual design have been adapted for use as a usability evaluation method.[5] Contextual design has also been applied to the design of digital libraries and other learning technologies.[6][7]

All these approaches follow the ISO standard Human-centered design processes for interactive systems (ISO 13407 Model, 1999).

UCD answers questions about users and their tasks and goals, then use the findings to make decisions about development and design. UCD seeks to answer the following questions:

- Who are the users of the document?
- What are the users' tasks and goals?
- What are the users' experience levels with the document, and documents like it?
- What functions do the users need from the document?
- What information might the users need, and in what form do they need it?
- How do users think the document should work?

3.3.1.1 Elements of User-Centered Design

1. **Visibility**: Visibility helps the user construct a mental model of the document. Models help the user predict the effect(s) of their actions while using the document. Important elements (such as those that aid navigation) should be emphatic. Users should be able to tell from a glance what they can and cannot do with the document.

2. **Accessibility:** Users should be able to find information quickly and easily throughout the document, whether it be long or short. Users should be offered various ways to find information (such navigational elements, search functions, table of contents, clearly labeled sections, page numbers, color coding, etc). Navigational elements should be consistent with the genre of the document. 'Chunking' is a useful strategy that involves breaking information into small pieces that can be organized into some type meaningful order or hierarchy. The ability to skim the document allows users to find their piece of information by scanning rather than reading. bold and italic words are often used.

3. **Legibility:** Text should be easy to read: Through analysis of the rhetorical situation the designer should be able to determine a useful font style. Ornamental fonts and text in all capital letters are hard to read, but italics and bolding can be helpful when used correctly. Large or small body text is also hard to read. (Screen size of 10-12 pixel sans-serif and 12-16 pixel serif is recommended.) High figure-ground contrast between text and background increases legibility. Dark text against a light background is most legible.
4. **Language:** Depending on the rhetorical situation certain types of language are needed. Short sentences are helpful, as well as short, well written texts used in explanations and similar bulk-text situations. Unless the situation calls for it don't use jargon or technical terms. Many writers will choose to use active voice, verbs (instead of noun strings or nominal), and simple sentence structure.
5. **Rhetorical Situation:** A User Centered Design is focused around the rhetorical situation. The rhetorical situation shapes the design of an information medium. There are three elements to consider in a rhetorical situation: Audience, Purpose, and Context.
    a. **Audience:** The audience is the people who will be using the document. The designer must consider their age, geographical location, ethnicity, gender, education, etc.
    b. **Purpose:** The purpose is how the document will be used, and what the audience will be trying to accomplish while using the document. The purpose usually includes purchasing a product, selling ideas, performing a task, instruction, and all types of persuasion.
    c. **Context:** The context is the circumstances surrounding the situation. The context often answers the question: What situation has prompted the need for this document? Context also includes any social or cultural issues that may surround the situation.

3.3.2 **Bodystorming**

Bodystorming is a technique sometimes used in interaction design or as a creativity technique. The idea is to imagine what it would be like if the product existed, and act as though it exists, ideally in the place it would be used.

3.3.3 **Focus Group**

A focus group is a form of qualitative research in which a group of people are asked about their attitude towards a product, service, concept, advertisement, idea, or packaging. Questions are asked in an interactive group setting where participants are free to talk with other group members.

Types of focus groups include:

- Two-way focus group - one focus group watches another focus group and discusses the observed interactions and conclusion
- Dual moderator focus group - one moderator ensures the session progresses smoothly, while another ensures that all the topics are covered
- Dueling moderator focus group - two moderators deliberately take opposite sides on the issue under discussion
- Respondent moderator focus group - one or more of the respondents are asked to act as the moderator temporarily
- Client participant focus groups - one or more client representatives participate in the discussion, either covertly or overtly
- Mini focus groups - groups are composed of four or five members rather than 6 to 12
- Teleconference focus groups - telephone network is used
- Online focus groups - computers connected via the internet are used

3.3.4 **Iterative Design**

Iterative design is a design methodology based on a cyclic process of prototyping, testing, analyzing, and refining a product or process. Based on the results of testing the most recent iteration of a design, changes and refinements are made. This process is intended to ultimately improve the quality and functionality of a design. In iterative design, interaction with the designed system is used as a form of research for informing and evolving a project, as successive versions, or iterations of a design are implemented.

The iterative design process may be applied throughout the new product development process. However, changes are easiest and less expensive to implement in the earliest stages of development. The first step in the iterative design process is to develop a prototype. The prototype should be evaluated by a focus group or a group not associated with the product in order to deliver non-biased opinions. Information from the focus group should be synthesized and incorporated into the next iteration of the design. The process should be repeated until user issues have been reduced to an acceptable level.

The typical steps of iterative design in user interfaces are as follows:

1) Complete an initial interface design

2) Present the design to several test users

3) Note any problems had by the test user

4) Refine interface to account for/fix the problems

5) Repeat steps 2-4 until user interface problems are resolved

3.3.5 **Participatory Design**

Participatory design is a design approach that attempts to actively involve the end users in the design process to help ensure that the product designed meets their needs and is usable. In participatory design, end-users are invited to cooperate with researchers and developers during an innovation process.

3.3.6 **Plastic Interface for Collaborative Technology Initiative through Video Exploration**

Plastic Interface for Collaborative Technology Initiative through Video Exploration (PICTIVE) is a participatory design method used to develop graphical user interfaces. PICTIVE is a paper mock-up technique that allows users to participate in the development process. A PICTIVE is a representation of a graphical user interface (GUI) or a Web page on paper. A PICTIVE prototype gives a user a sense of what a system or a piece of software will look like and how it will behave once it is finished. PICTIVE enables a non-technical person to contribute ideas to the development process.

A PICTIVE is usually made from simple office supplies like pens, paper, Post-It stickers, and paper clips. The developer uses those supplies to represent elements of the project, including drop-down boxes, menu bars, and special icons. During a design session, users manipulate the mock-up so it becomes easier for them to use. The development team takes notes and incorporates user ideas into its work. The development team also uses a video camera to record the physical changes a user might make to the PICTIVE. The team then reviews the ideas generated and incorporates them into the project. The ultimate goal of a PICTIVE is to simplify the design process enough that non-technical users are empowered to participate in it.

3.3.7 **Task Analysis**

Task analysis is the analysis of how a task is accomplished, including a detailed description of both manual and mental activities, task and element durations, task frequency, task allocation, task complexity, environmental conditions, necessary clothing and equipment, and any other unique factors involved in or required for one or more people to perform a given task. Task analysis emerged from research in applied behavior analysis and still has considerable research in that area.

Information from a task analysis can then be used for many purposes, such as personnel selection and training, tool or equipment design, procedure design (e.g., design of checklists or decision support systems) and automation.

An interaction task is the entry of a unit of information using a hardware or software device.

Four basic interaction tasks:

1. Position (input a position)
2. Text (input a text string)
3. Select (object identification)
4. Quantify (input a numeric value)

3.3.8 **Scenario**

In computing, a scenario is a narrative describing foreseeable interactions of types of users (characters) and the system. Scenarios include information about goals, expectations, motivations, actions and reactions. Scenarios are neither predictions nor forecasts, but rather attempts to reflect on or portray the way in which a system is used in the context of daily activity.

Scenarios are frequently used as part of the systems development process. They are typically produced by usability or marketing specialists, often working in concert with end users and developers. Scenarios are written in plain language, with minimal technical details, so that stakeholders (designers, usability specialists, programmers, engineers, managers, marketing specialists, etc.) can have a common example which can focus their discussions.

Increasingly, scenarios are used directly to define the wanted behaviour of software: replacing or supplementing traditional Functional requirements. In the Agile style of software development, scenarios are written as brief User stories. In the more deliberate style of software development, scenarios are written as structured Use cases.

Negative scenarios or misuse cases may be written to indicate likely threats which should be countered to ensure that systems have sufficient Security, Safety, and Reliability. These are categories of Non-functional requirements.

Scenarios can also be used in a number of other ways:

- As vision pieces. Vision pieces provide a high level picture of an envisioned system or product. One example is Apple's Knowledge Navigator video.
- Scenarios may focus on the value offered by a system, showing how it offers an advantage over the way things are. This type of scenario may be used to 'sell' an idea within the organization that is considering developing the system.

3.3.9 **Wizard of Oz experiment**

Wizard of Oz experiment is a research experiment in which subjects interact with a computer system that subjects believe to be autonomous, but which is actually being operated or partially operated by an unseen human being.

The term *Wizard of Oz* (originally *OZ Paradigm*) has come into common usage in the fields of experimental psychology, human factors, ergonomics, linguistics, and usability engineering to describe a testing or iterative design methodology wherein an experimenter (the "wizard"), in a laboratory setting, simulates the behavior of a theoretical intelligent computer application (often by going into another room and intercepting all communications between participant and system). Sometimes this is done with the participant's a-priori knowledge and sometimes it is a low-level deceit employed to manage the participant's expectations and encourage natural behaviors.

3.4 Display Design

Displays are human-made artifacts designed to support the perception of relevant system variables and to facilitate further processing of that information. Before a display is designed, the task that the display is intended to support must be defined (e.g. navigating, controlling, decision making, learning, entertaining, etc.). A user or operator must be able to process whatever information that a system generates and displays; therefore, the information must be displayed according to principles in a manner that will support perception, situation awareness, and understanding.

3.4.1 Thirteen Principles of Display Design

These principles of human perception and information processing can be utilized to create an effective display design. A reduction in errors, a reduction in required training time, an increase in efficiency, and an increase in user satisfaction are a few of the many potential benefits that can be achieved through utilization of these principles.

Certain principles may not be applicable to different displays or situations. Some principles may seem to be conflicting, and there is no simple solution to say that one principle is more important than another. The principles may be tailored to a specific design or situation. Striking a functional balance among the principles is critical for an effective design.

a. Perceptual Principles

1. Make displays legible (or audible): A display's legibility is critical and necessary for designing a usable display. If the characters or objects being displayed cannot be discernible, then the operator cannot effectively make use of them.

2. Avoid absolute judgment limits: Do not ask the user to determine the level of a variable on the basis of a single sensory variable (e.g. color, size, loudness). These sensory variables can contain many possible levels.

3. Top-down processing: Signals are likely perceived and interpreted in accordance with what is expected based on a user's past experience. If a signal is presented contrary to the user's expectation, more physical evidence of that signal may need to be presented to assure that it is understood correctly.

4. Redundancy gain: If a signal is presented more than once, it is more likely that it will be understood correctly. This can be done by presenting the signal in alternative physical forms (e.g. color and shape, voice and print, etc.), as redundancy does not imply repetition. A traffic light is a good example of redundancy, as color and position are redundant.

5. Similarity causes confusion: Use discriminable elements: Signals that appear to be similar will likely be confused. The ratio of similar features to different features causes signals to be similar. For example, A423B9 is more similar to A423B8 than 92 is to 93. Unnecessary similar features should be removed and dissimilar features should be highlighted.

b. Mental Model Principles

6. Principle of pictorial realism: A display should look like the variable that it represents (e.g. high temperature on a thermometer shown as a higher vertical level). If there are multiple elements, they can be configured in a manner that looks like it would in the represented environment.

7. Principle of the moving part: Moving elements should move in a pattern and direction compatible with the user's mental model of how it actually moves in the system. For example, the moving element on an altimeter should move upward with increasing altitude.

c. Attention Based Principles

8. Minimizing information access cost: When the user's attention is averted from one location to another to access necessary information, there is an associated cost in time or effort. A display design should minimize this cost by allowing for frequently accessed sources to be located at the nearest possible position. However, adequate legibility should not be sacrificed to reduce this cost.

9. Proximity compatibility principle: Divided attention between two information sources may be necessary for the completion of one task. These sources must be mentally integrated and are defined to have close mental proximity. Information access costs should be low, which can be achieved in many ways (e.g. close proximity, linkage by common colors, patterns, shapes, etc.). However, close display proximity can be harmful by causing too much clutter.

10. Principle of multiple resources: A user can more easily process information across different resources. For example, visual and auditory information can be presented simultaneously rather than presenting all visual or all auditory information.

d. Memory Principles

11. Replace memory with visual information: knowledge in the world: A user should not need to retain important information solely in working memory or to retrieve it from long-term memory. A menu, checklist, or another display can aid the user by easing the use of their memory. However, the use of memory may sometimes benefit the user rather than the need for reference to some type of knowledge in the world (e.g. a expert computer operator would rather use direct commands from their memory rather than referring to a manual). The use of knowledge in a user's head and knowledge in the world must be balanced for an effective design.

12. Principle of predictive aiding: Proactive actions are usually more effective than reactive actions. A display should attempt to eliminate resource-demanding cognitive tasks and replace them with simpler perceptual tasks to reduce the use of the user's mental resources. This will allow the user to not only focus on current conditions, but also think about possible future conditions. An example of a predictive aid is a road sign displaying the distance from a certain destination.

13. Principle of consistency: Old habits from other displays will easily transfer to support processing of new displays if they are designed in a consistent manner. A user's long-term memory will trigger actions that are expected to be appropriate. A design must accept this fact and utilize consistency among different displays.

SELF ASSESSMENT EXERCISES 1

1. Define Human–computer interaction
2. List and explain the types of user interface
3. List the Human-Computer interaction Laws

3.5 Interaction design

Interaction Design (IxD) is the discipline of defining the behavior of products and systems with which a user can interact. The practice typically centers around "embedding information technology into the ambient social complexities of the physical world. Interaction design defines the behavior of an artifact or system in response to its users and covers broad range of disciplines vis-à-vis:

i. *Cognitive Psychology:* Certain basic principles of cognitive psychology provide grounding for interaction design. These include mental models, mapping, interface metaphors, and affordances.

ii. *Human Computer Interaction:* Academic research in Human Computer Interaction (HCI) includes methods for describing and testing the usability of interacting with an interface, such as cognitive dimensions and the cognitive walkthrough.

iii. *Design Research:* Interaction designers are typically informed through iterative cycles of user research. They design with an emphasis on

user goals and experience, and evaluate designs in terms of usability and affective influence.

iv. *Architecture:* As interaction designers increasingly deal with ubiquitous computing and urban computing, the architects' ability to make place and create context becomes a point of contact between the disciplines.

There are six major steps in interaction design. Based on user feedback, several iteration cycles of any set of steps may occur.

1. **Design research:** Using design research techniques (observations, interviews, questionnaires, and related activities), designers investigate users and their environment in order to learn more about them and thus be better able to design for them.

2. **Research analysis and concept generation:** Drawing on a combination of user research, technological possibilities, and business opportunities, designers create concepts for new software, products, services, or systems. This process may involve multiple rounds of brainstorming, discussion, and refinement. To help designers realize user requirements, they may use tools such as personas or user profiles that are reflective of their targeted user group. From these personae, and the patterns of behavior observed in the research, designers create scenarios (or user stories) or storyboards, which imagine a future work flow the users will go through using the product or service. After thorough analysis using various tools and models, designers create a high level summary spanning across all levels of user requirements. This includes a vision statement regarding the current and future goals of a project.

3. **Alternative design and evaluation:** Once a clear view of the problem space exists, designers develop alternative solutions with crude prototypes to help convey concepts and ideas. Proposed solutions are evaluated and, perhaps, merged. The end result should be a design that solves as many of the user requirements as possible. Among the tools that may be used for this process are wireframing and flow diagrams. The features and functionality of a product or service are often outlined in a document known as a wireframe ("schematics" is an alternate term). Wireframes are a page-by-page or screen-by-screen detail of the system, which include notes ("annotations") describing how the system will operate. Flow Diagrams outline the logic and steps of the system or an individual feature.

4. **Prototyping and usability testing:** Interaction designers use a variety of prototyping techniques to test aspects of design ideas. These can be roughly divided into three classes: those that test the role of an artifact, those that test its look and feel and those that test its implementation. Sometimes, these are called experience prototypes to emphasize their interactive nature. Prototypes can be physical or digital, high- or low-fidelity.

5. **Implementation:** Interaction designers need to be involved during the development of the product or service to ensure that what was designed is implemented correctly. Often, changes need to be made during the building process, and interaction designers should be involved with any of the on-the-fly modifications to the design.

6. **System testing:** Once the system is built, often another round of testing, for both usability and errors ("bug catching") is performed. Ideally, the designer will be involved here as well, to make any modifications to the system that are required.

Interaction designers work in many areas, including software interfaces, (business) information systems, internet, physical products, environments, services, and systems which may combine many of these. Each area requires its own skills and approaches, but there are aspects of interaction design common to all.

Interaction designers often work in interdisciplinary teams as their work requires expertise in many different domains, including graphic design, programming, psychology, user testing, product design, etc (see below for more related disciplines). Thus, they need to understand enough of these fields to work effectively with specialists.

3.6 Evaluations Methods in HCI

3.6.1 Usability Testing

Usability testing is a technique used to evaluate a product by testing it on users. Usability testing focuses on measuring a human-made product's capacity to meet its intended purpose. Examples of products that commonly benefit from usability testing are web sites or web applications, computer interfaces, documents, or devices. Usability testing measures the usability, or ease of use, of a specific object or set of objects, whereas general human-computer interaction studies attempt to formulate universal principles.

Usability testing is a black-box testing technique. The aim is to observe people using the product to discover errors and areas of improvement. Usability testing generally involves measuring how well test subjects respond in four areas: efficiency, accuracy, recall, and emotional response. The results of the first test can be treated as a baseline or control measurement; all subsequent tests can then be compared to the baseline to indicate improvement.

- *Performance* -- How much time, and how many steps, are required for users complete basic tasks?
- *Accuracy* -- How many mistakes did users make? (And were they fatal or recoverable with the right information?)
- *Recall* -- How much does the user remember afterwards or after periods of non-use?

- *Emotional response* -- How does the person feel about the tasks completed? Is the person confident, stressed? Would the user recommend this system to a user/client?

A **Usability Lab** is a place where Usability testing is done. It is an environment where users are studied interacting with a system for the sake of evaluating the system's usability. Typically, the user sits in front of a personal computer, alongside a facilitator who gives the user tasks to perform. Behind a one-way mirror, a number of observers watch the interaction, make notes, and ensure the activity is recorded. Usually, sessions will be filmed and the software will log interaction details.

Methods: Setting up a usability test involves carefully creating a scenario, or realistic situation, wherein the person performs a list of tasks using the product being tested while observers watch and take notes. Several other test instruments such as scripted instructions, paper prototypes, and pre- and post-test questionnaires are also used to gather feedback on the product being tested. For example, to test the attachment function of an e-mail program, a scenario would describe a situation where a person needs to send an e-mail attachment, and ask him or her to undertake this task. The aim is to observe how people function in a realistic manner, so that developers can see problem areas, and what people like. Techniques popularly used to gather data during a usability test include think aloud protocol and eye tracking.

a. **Hallway Testing:** Hallway testing (or hallway usability testing) is a specific methodology of software usability testing. Rather than using an in-house, trained group of testers, just five to six random people, indicative of a cross-section of end users, are brought in to test the software (be it an application, web site, etc.); the name of the technique refers to the fact that the testers should be random people who pass by in the hallway. The theory, as adopted from Jakob Nielsen's research, is that 95% of usability problems can be discovered using this technique.

b. **Remote Testing:** Remote usability testing (also known as unmoderated or asynchronous usability testing) involves the use of a specially modified online survey, allowing the quantification of user testing studies by providing the ability to generate large sample sizes. Additionally, this style of user testing also provides an opportunity to segment feedback by demographic, attitudinal and behavioural type. The tests are carried out in the user's own environment (rather than labs) helping further simulate real-life scenario testing. This approach also provides a vehicle to easily solicit feedback from users in remote areas.

3.6.2 Heuristic Evaluation

A heuristic evaluation is a discount usability inspection method for computer software that helps to identify usability problems in the user interface (UI) design. It specifically involves evaluators examining the interface and judging its compliance with recognized usability principles (the "heuristics"). The main goal of heuristic evaluations is to identify any problems associated with the design of user interfaces. Usability consultant Jakob

Nielsen developed this method on the basis of several years of experience in teaching and consulting about usability engineering. The heuristics as published in Nielsen's book *Usability Engineering* are as follows

- *Visibility of system status*: The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

- *Match between system and the real world:* The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

- *User control and freedom:* Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.

- *Consistency and standards:* Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

- *Error prevention:* Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.

- *Recognition rather than recall:* Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

- *Flexibility and efficiency of use:* Accelerators -- unseen by the novice user -- may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

- *Aesthetic and minimalist design:* Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

- *Help users recognize, diagnose, and recover from errors:* Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.

- *Help and documentation:* Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

Jill Gerhardt-Powals also developed a set of cognitive principles for enhancing computer performance listed below.

- *Automate unwanted workload:* free cognitive resources for high-level tasks and eliminate mental calculations, estimations, comparisons, and unnecessary thinking.

- *Reduce uncertainty:* display data in a manner that is clear and obvious.

- *Fuse data:* reduce cognitive load by bringing together lower level data into a higher-level summation.

- *Present new information with meaningful aids to interpretation:* use a familiar framework, making it easier to absorb, and use everyday terms, metaphors, etc.

- *Use names that are conceptually related to function:* Context-dependent, attempt to improve recall and recognition and group data in consistently meaningful ways to decrease search time.

- *Limit data-driven tasks:* Reduce the time spent assimilating raw data and make appropriate use of color and graphics.

- Include in the displays only that information needed by the user at a given time.
- Provide multiple coding of data when appropriate.
- Practice judicious redundancy.

3.6.3 **Cognitive Walkthrough**

The Cognitive walkthrough method is a usability inspection method used to identify usability issues in a piece of software or web site, focusing on how easy it is for new users to accomplish tasks with the system. The method is rooted in the notion that users typically prefer to learn a system by using it to accomplish tasks, rather than, for example, studying a manual. The method is prized for its ability to generate results quickly with low cost, especially when compared to usability testing, as well as the ability to apply the method early in the design phases, before coding has even begun. A cognitive walkthrough starts with a task analysis that specifies the sequence of steps or actions required by a user to accomplish a task, and the system responses to those actions. The designers and developers of the software then walkthrough the steps as a group, asking themselves a set of questions at each step. Data is gathered during the walkthrough, and afterwards a report of potential issues is compiled. Finally the software is redesigned to address the issues identified.

After the task analysis has been made the participants perform the walkthrough by asking themselves a set of questions for each subtask. Typically four questions are asked:

- Will the user try to achieve the effect that the subtask has? Does the user understand that this subtask is needed to reach the user's goal?

- Will the user notice that the correct action is available? E.g. is the button visible?
- Will the user understand that the wanted subtask can be achieved by the action? E.g. the right button is visible but the user does not understand the text and will therefore not click on it.
- Does the user get feedback? Will the user know that they have done the right thing after performing the action?

3.7 HCI Models and Laws

3.7.1 Hick's Law

Hick's Law, named after British psychologist William Edmund Hick, or the Hick–Hyman Law (for Ray Hyman), describes the time it takes for a person to make a decision as a result of the possible choices he or she has. The Hick-Hyman Law assesses cognitive information capacity in choice reaction experiments. The amount of time taken to process a certain amount of bits in the Hick-Hyman Law is known as the rate of gain of information. Given n equally probable choices, the average reaction time T required to choose among them is approximately

$$T = b\log_2(n + 1)$$

where b is a constant that can be determined empirically by fitting a line to measured data; Basically $\log_2$ means that you perform binary search; the +1 is "because there is uncertainty about whether to respond or not, as well as about which response to make." The law can be generalized in the case of choices with unequal probabilities p_i of occurring, to

$$T = bH$$

where H is the information-theoretic entropy of the decision, defined as

$$H = \sum_{i}^{n} p_i \log_2(1/p_i + 1)$$

where p_i refers to the probability of the ith alternative yielding the information-theoretic entropy.

Hick's Law is sometimes cited to justify menu design decisions (for an example, see [1]). However, applying the model to menus must be done with care. For example, to find a given word (e.g. the name of a command) in a randomly ordered word list (e.g. a menu), scanning of each word in the list is required, consuming linear time, so Hick's law does not apply. However, if the list is alphabetical and the user knows the name of the

command, he or she may be able to use a subdividing strategy that works in logarithmic time.

The Hick-Hyman Law has been known to show a very obvious speed-accuracy trade-off. If the participants are asked to move as quickly as possible through the tasks, they will make more errors. Also if the participants are asked to perform a task as accurately as possible, the task will take much longer to complete.

3.7.2 **Fitts' Law**

Fitts's law (often cited as Fitts' law since it was proposed by Paul Fitts in 1954) is a model of human movement in human-computer interaction and ergonomics which predicts that the time required to rapidly move to a target area is a function of the distance and the size of the target. Fitts's law is used to model the act of *pointing*, either by physically touching an object with a hand or finger, or virtually, by pointing to an object on a computer display using a pointing device). Fitts's law has been formulated mathematically in several different ways. One common form is the Shannon formulation for movement along a single dimension:

$$T = a + b \log_2 \left(1 + \frac{D}{W}\right)$$

where:

- T is the average time taken to complete the movement. (Traditionally, researchers have used the symbol MT for this, to mean *movement time*.)
- a represents the start/stop time of the device and b stands for the inherent speed of the device. These constants can be determined experimentally by fitting a straight line to measured data.
- D is the distance from the starting point to the center of the target. (Traditionally, researchers have used the symbol A for this, to mean the *amplitude* of the movement.)
- W is the width of the target measured along the axis of motion. W can also be thought of as the allowed error tolerance in the final position, since the final point of the motion must fall within $\pm W/2$ of the target's center.

From the equation, we see a *speed-accuracy* trade off associated with pointing, whereby targets that are smaller and/or further away require more time to acquire.

Fitts's law is an unusually successful and well-studied model. Experiments that reproduce Fitts's results and/or that demonstrate the applicability of Fitts's law in somewhat different situations are not difficult to perform. The measured data in such experiments often fit a straight line with a correlation coefficient of 0.95 or higher, a sign that the model is very accurate.

Since the advent of graphical user interfaces, Fitts's law has been applied to tasks where the user must position a mouse cursor over an on-screen target, such as a button or other widget. Fitts's law models both point-and-click and drag-and-drop actions. Dragging has a lower *IP* associated with it, because the increased muscle tension makes pointing more difficult.

In its original and strictest form:

- It applies only to movement in a single dimension and not to movement in two dimensions (though it is successfully extended to two dimensions in the Accot-Zhai steering law);
- It describes simple motor response of, say, the human hand, failing to account for software acceleration usually implemented for a mouse cursor;
- It describes untrained movements, not movements that are executed after months or years of practice (though some argue that Fitts's law models behaviour that is so low level that extensive training doesn't make much difference).

If, as generally claimed, the law does hold true for pointing with the mouse, some consequences for user-interface design include

- Buttons and other GUI controls should be a reasonable size; it is relatively difficult to click on small ones.
- Edges and corners of the computer display (e.g., "Start" button in the Luna theme of Windows XP and Apple & Spotlight menus of Mac OS X) are particularly easy to acquire because the pointer remains at the screen edge regardless of how much further the mouse is moved, thus can be considered as having infinite width.
- Pop-up menus can usually be opened faster than pull-down menus, since the user avoids travel.
- Pie menu items typically are selected faster and have a lower error rate than linear menu items, for two reasons: because pie menu items are all the same, small distance from the centre of the menu; and because their wedge-shaped target areas (which usually extend to the edge of the screen) are very large.

Fitts's law remains one of the few hard, reliable human-computer interaction predictive models, joined more recently by the Accot-Zhai steering law, which is derived from Fitts's law.

The logarithm in Fitts's law is called the index of difficulty *ID* for the target, and has units of bits. We can rewrite the law as

$$T = a + bID,$$

where

$$ID = \log_2\left(\frac{D}{W} + 1\right).$$

Thus, the units for b are time/bit; e.g., ms/bit. The constant a can be thought of as incorporating reaction time and/or the time required to click a button.

The values for a and b change as the conditions under which pointing is done are changed. For example, a mouse and stylus may both be used for pointing, but have different constants a and b associated with them.

An index of performance IP (also called throughput TP), in bits/time, can be defined to characterize how quickly pointing can be done, independent of the particular targets involved. There are two conventions for defining IP: one is $IP = 1/b$ (which has the disadvantage of ignoring the effect of a), the other is $IP = ID_{average}/MT_{average}$ (which has the disadvantage of depending on an arbitrarily chosen "average" ID). For a discussion of these two conventions, see Zhai (2002). Whatever definition is used, measuring the IP of different input devices allows the devices to be compared with respect to their pointing capability.

Slightly different from the Shannon formulation is the original formulation by Fitts:

$$ID = \log_2\left(\frac{2D}{W}\right).$$

The factor of 2 here is not particularly important; this form of the ID can be rewritten with the factor of 2 absorbed as changes in the constants a, b. The "+1" in the Shannon form, however, does make it different from Fitts's original form, especially for low values of the ratio D/W. The Shannon form has the advantage that the ID is always non-negative, and has been shown to better fit measured data.

3.7.3 Steering Law

The steering law is a predictive model of how quickly one may navigate, or *steer*, through a 2-dimensional tunnel. The tunnel can be thought of as a path or trajectory on a plane that has an associated thickness or width, where the width can vary along the tunnel. The goal of a steering task is to navigate from one end of the tunnel to the other as quickly as possible, without touching the boundaries of the tunnel. A real world example that approximates this task is driving a car down a road that may have twists and turns, where the car must navigate the road as quickly as possible without touching the sides of the road. The steering law predicts both the instantaneous speed at which we may navigate the tunnel, and the total time required to navigate the entire tunnel.

The steering law is a predictive model of human movement, concerning the speed and total time with which a user may steer a pointing device (such as a mouse or stylus) through a 2D tunnel presented on a screen (i.e. with a bird's eye view of the tunnel), where the user must travel from one end of the path to the other as quickly as possible, while staying within the confines of the path. One potential practical application of this law is in modelling a user's performance in navigating a hierarchical cascading menu.

In its general form, the steering law can be expressed as

$$T = a + b \int_C \frac{ds}{W(s)}$$

where *T* is the average time to navigate through the path, *C* is the path parameterized by *s*, *W(s)* is the width of the path at *s*, and *a* and *b* are experimentally fitted constants. In general, the path may have a complicated curvilinear shape (such as a spiral) with variable thickness *W(s)*.

3.7.4 **Goals, Operators, Methods and Selections Rules**

Goals, Operators, Methods, and Selection rules (GOMS), is a kind of specialized human information processor model for human computer interaction observation. GOMS reduces a user's interaction with a computer to its elementary actions (these actions can be physical, cognitive or perceptual). Using these elementary actions as a framework an interface can be studied. There are several different GOMS variations which allow for different aspects of an interface to be accurately studied and predicted.

For all of the variants, the definitions of the major concepts are the same.

Goals are what the user intends to accomplish.

Operators are actions that are performed to get to the goal.

Methods are sequences of operators that accomplish a goal. There can be more than one method available to accomplish a single goal, if this is the case then selection rules are used to describe when a user would select a certain method over the others.

Selection rules are often ignored in typical GOMS analyses. There is some flexibility for the designers/analysts definition of all of these entities. For instance, one person's operator may be another's goal. The level of granularity is adjusted to capture what the particular evaluator is examining.

A GOMS estimate of a particular interaction can be calculated with little effort, at little cost, and in a short amount of time. The average Methods-Time Measurement data for each specific task has been previously measured experimentally to a high degree of accuracy. With a careful investigation into all of the detailed steps necessary for a user to successfully interact with an interface, the time measurement of how long it will take a user to interact with that interface is a simple calculation. Summing the times necessary to complete the detailed steps provides an estimate for how long it will take a user to successfully complete the desired task.

All of the GOMS techniques provide valuable information, but they all also have certain drawbacks. None of the techniques address user unpredictability - such as user behaviour being affected by fatigue, social surroundings, or organizational factors. The techniques

are very explicit about basic movement operations, but are generally less rigid with basic cognitive actions. It is a fact that slips cannot be prevented, but none of the GOMS models allow for any type of error. Further, all of the techniques work under the assumption that a user will know what to do at any given point - so they apply only to expert users, not novices.

3.7.5 Keystroke-Level Model

Keystroke-Level Model (KLM or KLM-GOMS), is a hard science approach to human–computer interaction (HCI). The Keystroke-Level Model is an 11-step method that can be used by individuals or companies seeking ways to estimate the time it takes to complete simple data input tasks using a computer and mouse. By using KLM-GOMS, individuals often find more efficient or better ways to complete a task simply by analyzing the steps required in the process and rearranging or eliminating unneeded steps.

It is designed to be easier to use than other GOMS methods, such that companies who cannot afford human–computer interaction specialists can use it. KLM-GOMS is usually applied in situations that require minimal amounts of work and interaction with a computer interface or software design. The calculations and the number of steps required to accurately compute the overall task time increase quickly as the number of tasks involved increases. Thus, KLM-GOMS is best suited to evaluate and time specific tasks that require, on average, less than 5 minutes to complete.

3.8 Future Developments

The means by which humans interact with computers continues to evolve rapidly. Human–computer interaction is affected by the forces shaping the nature of future computing. These forces include:

- Decreasing hardware costs leading to larger memories and faster systems
- Miniaturization of hardware leading to portability
- Reduction in power requirements leading to portability
- New display technologies leading to the packaging of computational devices in new forms
- Specialized hardware leading to new functions
- Increased development of network communication and distributed computing
- Increasingly widespread use of computers, especially by people who are outside of the computing profession
- Increasing innovation in input techniques (i.e., voice, gesture, pen), combined with lowering cost, leading to rapid computerization by people previously left out of the "computer revolution."
- Wider social concerns leading to improved access to computers by currently disadvantaged groups

The future for HCI is expected to include the following characteristics:

Ubiquitous communication: Computers will communicate through high speed local networks, nationally over wide-area networks, and portably via infrared, ultrasonic, cellular, and other technologies. Data and computational services will be portably accessible from many if not most locations to which a user travels.

High functionality systems: Systems will have large numbers of functions associated with them. There will be so many systems that most users, technical or non-technical, will not have time to learn them in the traditional way (e.g., through thick manuals).

Mass availability of computer graphics: Computer graphics capabilities such as image processing, graphics transformations, rendering, and interactive animation will become widespread as inexpensive chips become available for inclusion in general workstations.

Mixed media: Systems will handle images, voice, sounds, video, text, formatted data. These will be exchangeable over communication links among users. The separate worlds of consumer electronics (e.g., stereo sets, VCRs, televisions) and computers will partially merge. Computer and print worlds will continue to cross assimilate each other.

High-bandwidth interaction: The rate at which humans and machines interact will increase substantially due to the changes in speed, computer graphics, new media, and new input/output devices. This will lead to some qualitatively different interfaces, such as virtual reality or computational video.

Large and thin displays: New display technologies will finally mature enabling very large displays and also displays that are thin, light weight, and have low power consumption. This will have large effects on portability and will enable the development of paper-like, pen-based computer interaction systems very different in feel from desktop workstations of the present.

Embedded computation: Computation will pass beyond desktop computers into every object for which uses can be found. The environment will be alive with little computations from computerized cooking appliances to lighting and plumbing fixtures to window blinds to automobile braking systems to greeting cards. To some extent, this development is already taking place. The difference in the future is the addition of networked communications that will allow many of these embedded computations to coordinate with each other and with the user. Human interfaces to these embedded devices will in many cases be very different from those appropriate to workstations.

Augmented reality: A common staple of science fiction, augmented reality refers to the notion of layering relevant information into our vision of the world. Existing projects show real-time statistics to users performing difficult tasks, such as manufacturing. Future work might include augmenting our social interactions by providing additional information about those we converse with.

Group interfaces: Interfaces to allow groups of people to coordinate will be common (e.g., for meetings, for engineering projects, for authoring joint documents). These will have major impacts on the nature of organizations and on the division of labor. Models of the group design process will be embedded in systems and will cause increased rationalization of design.

User Tailorability: Ordinary users will routinely tailor applications to their own use and will use this power to invent new applications based on their understanding of their own domains. Users, with their deeper knowledge of their own knowledge domains, will increasingly be important sources of new applications at the expense of generic systems programmers (with systems expertise but low domain expertise).

Information Utilities: Public information utilities (such as home banking and shopping) and specialized industry services (e.g., weather for pilots) will continue to proliferate. The rate of proliferation will accelerate with the introduction of high-bandwidth interaction and the improvement in quality of interfaces.

SELF ASSESSMENT EXERCISES 2

1. What is the general function of a user interface, list and explain the types of user interface?
2. List and explain the principles of display design

4.0 Conclusion

Good design defuses the tension between functional and aesthetic goals. In any real-life situation there are always competing pressures on cost, quality and time. An understanding of cognitive design can assist in creating high-quality, user-centered objects, interfaces and multimedia.

5.0 Summary

In this unit, we have learnt that:

i. The basis of Human-Computer Interaction is cognitive science.
ii. Various interfaces are used in Human-Computer Interaction.
iii. There are some principles behind the user interface design
iv. The various design method used in the design of the user interface design
v. Human-Computer Interaction has some laws and rules guiding its design and usages.

6.0 Tutor Marked Assignments

1. Explain the effect of the display design on Human-Computer interaction

2. Explain the effect of the Human-Computer interaction laws and elements of user-centered design in the study.
3. How does Human-Computer Interaction improve the interaction between user and computer machine?

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Module 3: Multimedia Design and Development Strategies

Unit 3: Structure and Tools

Module 3: Multimedia Design and Development Strategies

Unit 3: Structure and Tools

1.0 Introduction

Multimedia presentations have structure, design layout or architecture and there are numerous ways this can be done. The designer breaks the multimedia contents into appropriately sub-sections and chooses a design layout for arranging these contents. The appropriate organization scheme and structure will depend on the user's expectations/needs and the kind of information to be organized. There are various authoring tools for implementing the chosen design layout.

2.0 Objectives

At the end of the unit you will be able to

- Identify the different ways multimedia presentations can be broken down into appropriate structures;
- Organize multimedia contents using special tools that designer uses for implementing the architecture;
- Explain how well-organized contents enable the multimedia presentations to meet its goals & convey its message;
- State and discuss the various options available for viewing or searching the multimedia presentation's contents;
- Describe how multimedia products are created and authored and list what kinds of multimedia authoring tools to use in developing the multimedia presentation;
- Explain how various multimedia authoring tools work.

3.0 Multimedia Structures

Multimedia presentations uses design structure for arranging the various sub-sections of the contents of the multimedia presentation. There are different schemes for determining how multimedia presentation can be divided into appropriate sub-sections to enhance comprehension of the inherent information, stimulates viewers' interest, reduces eyes strain, creates visual appeals and achieve some measure of effectiveness.

Navigational maps or flowcharts show overall structure of multimedia presentations. Navigational structure determines how user can go through the overall content while activity structure determines how learner interacts within a local activity on a screen. E-learning designers especially need to plan navigational and activity structures because different models of structure exist and they lend themselves to different multimedia authoring tools. Structure may be linear, hierarchical, multi-linear, web graph, or composite.

3.1 Different Types of Multimedia Structure

3.1.1 Linear Structure

The Linear structure present multimedia content in a sequential order and seem less interactive but under user's control. Linear structures are not limited by size when they are created which implies that they are able to expand and contract dynamically. Contents are ordered by position in form of an array and are not accessed directly but are referenced by their position. Thus user's can access content sequentially which might requires visiting a site that he does not have interest in visiting. This consumes user's time because to access a multimedia content (site), the user will have to traverse through the whole multimedia presentation sequentially until he gets to the desired content (site).

Figure Linear Structure

3.1.2 Hierarchical Structure

The hierarchical structure is a kind of non-linear structure which group multimedia contents into different levels in forms of a tree. The main menu display is the root of the tree while the sub-menus form the branches. Two common examples of trees are binary tree and heap tree. Accessing multimedia contents in hierarchical structures provides a more efficient means than the linear structure. Two major ways which contents can be accessed are preorder and postorder algorithms.

In preorder algorithm, the root is listed first while the branches are listed from left to right order of their roots. The branches are listed first and finally the root in the postorder algorithm.

Deep style hierarchy	Broad style hierarchy

Figure Hierarchical Structure

3.1.3 Multi-Track Structure

Multi-track involves multiple streams of synchronous media. User can switch between different channels in focus, or collage several together. For instance, user can view a full-screen movie, or call up a sidebar with text and/or control buttons.

3.1.4 Interactive Stories Structure

Interactive stories are stories which affect eye movements and also influence users' behaviour. User controls order of outcome of story. A typical example is the branching story structure which starts with common trunk and allows user to choose between different branches. Branching structures are more expensive to produce since

3.1.5 Web Stories Structure

Web stories involve initial sequence, set the stage, introduce characters, etc. User then explores a "web" of places to collect clues and meet more characters. When user solve a key to puzzle, another cut scene advances the story some more, opening the doors to new web of places.

Web	Database
	The database model requires data to be sectioned into strictly defined records. It is therefore most suitable for homogeneous data. This can then be accessed via user queries

Figure Web Stories

3.1.6 Virtual Space Structure

A virtual space is a familiar multidimensional space, such as a room or a book, which users know intuitively how to navigate through.

3.1.7 Modular Structure

Modular involve independent media objects which user can manipulate. For example, Lego allows different characters, objects to be built combining separate independent units together to make a whole. Each unit has behaviors that combine to create unpredictable interactions. The modular structure is a constructive approach which enables designers to build multimedia on top of one another. This approach is quite useful in e-learning because it permits learners to learn at his space, and ensure modularity of knowledge (i.e. from simple topics to complex topics).

3.1.8 Simulation

Simulation involves building a model of some slice of the real or imaginary world and then run it. E-learning applications such as immersive training or testing applications are especially suitable for simulations.

3.2 Authoring Tools

Authoring tools (or authoring systems) are multimedia development tools by which various media components are integrated into a structure and flow. These are tools for making a complete multimedia presentation where users usually have a lot of interactive controls. In other words, they are software for transforming multimedia design into multimedia presentations. Authoring tools match with different architectural styles.

Authoring tools are computer programs which have pre-programmed elements for the development of interactive multimedia software presentations. They vary widely in orientation, capabilities, and learning curve and there is no such thing as a completely point-and-click automated authoring system; some knowledge of heuristic thinking and

algorithm design is necessary. It is a speeded-up form of programming which require the understanding of how programs work.

It generally takes about 1/8th the time to develop an interactive multimedia project, such as a Computer Based Training (CBT) program, in an authoring system as opposed to programming it in compiled code. This means 1/8 the cost of programmer time and likely increased re-use of code (assuming that you pass this project's code to the next CBT project, and they use a similar or identical authoring system). However, the content creation (graphics, text, video, audio, animation, etc.) is not generally affected by the choice of an authoring system; any production time gains here result from accelerated prototyping, not from the choice of an authoring system over a compiled language.

3.2.1 Features of Authoring Tools:

Most Authoring tools have the following features in their development interface:

1. *A list of media events*: Occurrences of scene, images, sound,action in the end product.
2. *Iconic flowchart / timeline*: Controls event sequence.
3. *Card stack*: Easy viewing if there is too many item on screen.
4. *A series of figures*: List of images or objects in the project and information about objects

3.2.2 Categories of Authoring Tools

Authoring tools can be categorized into

1. ***Presentation software (e.g. Microsoft PowerPoint):*** This enables users to create and deliver business presentations in the form of the slide show. Each major heading forms the beginning of a new slide while templates are used to determine how the heads and subheads are formatted and displayed over backgrounds, including position, size, font style and colour.
2. ***Tools for creating production (mTropolis / AppleMedia Tool / MediaForge):*** Typically oriented toward producing content that is more ambitious, interactive & dynamic than the slide-show level. Usually integrate all types of' multimedia data into a multi-track timeline that determines the evolution of events. Interactivity takes the form of conditional branching that can make navigation decisions based on user input and other conditions. Production software creates dynamic content.
3. ***Interactive training and education (Macromedia Flash, Authorware & Director)*:** They are used to create education or training content and were designed primarily to present information in an Interactive book. Multimedia-oriented programming languages such as Visual Basic represent another authoring alternative which offers the higher flexibility, performance speed and power.

Some authoring tools can fit into more than one category

3.3 Authoring Metaphor

The authoring metaphor is the methodology by which the authoring tool accomplishes its task. Most media integration tools will take or use one of the following metaphors:

1. **Movie screen metaphor:** Movie refers to the product of the authoring which can be Linear or Interactive movie. Also refers to authoring tools paradigm that contains Cast/Score/Scripting. E.g. Macromedia Director

2. **Slide show metaphor:** A linear presentation. E.g. Microsoft PowerPoint.

3. **Linked screens:** A group of scene linked together.

SELF ASSESSMENT EXERCISES 1

1. Briefly explain Multimedia presentation using their different structures.
2. List the different types of multimedia structure.
3. Why simulation?

3.4 Types of Authoring Tools

1. **Cards and Stacks**
Cards are developed that have different elements associated with them. Cards are arrange into an indexed-stacks of cards which combined together to make up a book. The Card and Stacks paradigm provides a great deal of power but suffers from the index-card structure. It is excellently suited for Hypertext applications, and supremely suited for navigation intensive game applications and entertainment applications. Examples of authoring tools in this group include HyperCard (Mac) and ToolBook (Mac / Windows). Thus cards can link to other cards in a stack structure, and stacks link to other stacks. Cards are good for creating hierarchical and linear structures, simple interactive stories and simulations.

2. **Time-based Tools**
Time-based tools are the most popular authoring tools and uses "*timeline*" for organizing activities. They also use "*framing*" which is timely adjusted depending on the frame size. Example:- Macromedia Director / Flash (Mac/Windows). Metaphor is a film director constructing a title out of scenes in a movie set. Director assembles a cast of characters while the characters (sprites) move on a stage with plots created as a score of frames. Time-based tools are good for linear, multi-track or hierarchical structures, especially with animation, and also strong at arranging synchronization of sprite behaviors.

3. **Icon-Based Tools**
Icons are gathered along the line that provides visual development and flow chart created to show the organisation of icons or elements: including activity list, results and done with dragging the icon/elements along the lines. Each Icon

represents a particular event e.g. button, graphics, text, video. Metaphor is a flow line onto which developer drags elements.

This tends to be the fastest authoring tools in development time and is best suited for rapid prototyping and short-development time projects, linear structures and hierarchical structures supported with “maps” and “frames”. Menu structures are possible with user interactions while different elements can execute concurrently; thus multi-tracking structures and animations are possible. Many of these tools are also optimized for developing Computer-Based Training (CBT).

The core of the paradigm is the Icon Palette, containing the possible functions/interactions of a program, and the Flow Line, which shows the actual links between the icons. These programs tend to be the slowest runtimes, because each interaction carries with it all of its possible permutations; the higher end packages, such as Authorware (Mac/Windows) and IconAuthor (Windows). Authorware and IconAuthor use visual programming by combining media building blocks.

4. **Object-Oriented Tools**

Support environment based on object and their classes. Every object is modified based on the attributes, properties, functions & modifiers defined for it. Objects are arranged in hierarchical fashion (parent-child relationship) which allows an object to inherit properties of its parent object. Inheritance is a transitive relationship which involves dynamic binding; objects determine what behaviors mean at run-time. These tools are especially suitable for modular or constructive models and simulations. Examples of the tools include mTropolis (Mac/Windows), AppleMedia Tool (Mac/Windows) and MediaForge (Windows). Others are artifacts using self-contained units with well-defined interfaces including Smalltalk, C++. Python, Java, ActionScript 3.0 and ScriptX.

5. **Scripting Languages**

The Scripting metaphor is the authoring tool similar in form to the traditional programming style. The metaphor is that of a programming language, which specifies multimedia elements by filename, sequencing, hotspots, synchronization, etc. A powerful, object-oriented scripting language is usually the centerpiece of such a system; in-program editing of elements (still graphics, video, audio, etc.) tends to be minimal or non-existent. Scripting languages do vary; check out how much the language is object-based or object-oriented. The scripting metaphor tends to be longer in development time as earlier stated but is generally more interactive powerful. Since most Scripting languages are interpreted, instead of compiled, the runtime speed gains over other authoring methods are minimal. The media handling can vary widely. The Apple's HyperTalk for HyperCard, Assymetrix's OpenScript for ToolBook and Lingo scripting language of

Macromedia Director are examples of a Multimedia scripting language. Authorware and Flash also have scripting languages

6. **General Programming Languages**
Visual Basic and Java use an event-driven model: code attached to objects waits for user- or system-triggered events, then springs into action. Java comes with a rich library of classes, including Swing and Java Media Objects library. C# (pronounces C-ash) is Microsoft's answer to Java and is good for simulations and may improve performance.

3.5 Authoring Capabilities

Authoring tools should possess the following capabilities:

1. Interactivity
    - *Simple Branching*: Ability to jump to any part of the product. *E.g*:- by mouse click, keyboard input.
    - *Conditional Branching:* Ability to jump to any part of products if agreed to certain condition (statement IF-THEN).
    - *Structured Language:* complex programming to enable the interactivity and navigation.

2. Playback
    - Ability to see and to test the ongoing or the completed project.

3. Editing
    - generally, authoring tools are capable on text and image editing;
    - capable on doing other editing too, depending on the software used

4. Programming / Scripting
    - Programming used for flexibility.
    - Authoring tools offers an easier and less time consuming to develop:-
        - *Visual Programming* - Using icon, button, drag & drop graphic, audio. Eg: Authorware
        - Scripting - programming language for authoring tools. Eg: Director = **LINGO**, Flash = **ActionScript**
        - Support basic programming language - C, BASIC
            - to make it more flexible
        - *Document Development Tools*
            - Authoring tools that able to merge documents, indexing, search engine and linking

5. Cross Platform
    - Ability to perform on all platforms including MAC and Windows.

6. Internet Playability
    - Ability to create the output for web enabled application.

Eg:- **HTML**

7. Delivery/Distribution

8. Able to create a 'RUN TIME' mode.

9. This will exclude the need of the authoring tools during execution.

10. Project organization
    - *FLOWCHARTING* and *STORYBOARDING availability:* this will help on configuring interactivity

3.6 Examples of Authoring Tools

1. Macromedia Director

- Movie metaphor (the cast includes bitmapped sprites, scripts, music, sounds, and palettes, etc.)
- Can accept almost any bitmapped file formats
- Lingo script language with own debugger allows more control including external devices, e.g., VCRs and video disk players
- Ready for building more interactivities (buttons, etc.)
- Currently in version 7.0, this popular general market product follows the cast/score/scripting paradigm, which makes it the tool of choice for animation content. Its roots as a cel- and sprite-animation program are unmistakable; and its inclusion of Lingo, its object-based scripting language, has made it the animation-capable program to beat. The AfterBurner compression Xtra creates Shockwave files, allowing Web playback.

2. Authorware

- Professional multimedia authoring tool
- Supports interactive applications with hyperlinks, drag-and-drop controls, and integrated animation
- Compatibility between files produced from PC version and MAC version

Other authoring tools include:

- Microcosm : Multicosm, Ltd. ; DOS, Windows Microcosm is a Hypermedia Linkage authoring system.
- Question Mark : Question Mark Computing Ltd ; DOS, Mac, Windows; WWW (via Perception) Question Mark is optimized for Electronic Assessment production.
- Emblaze Creator : Geo International ; JavaScript, Mac, Windows95, WWW.

Emblaze Creator 2.5 is a cast/score/scripting tool which is designed for Web-based playback of interactive multimedia.

- Flash : Macromedia ; Mac, Windows95, NT, WWW (via Flash Player).

  Flash 3.0 is a cast/score/scripting tool, which primarily uses vector graphics (and can create vector graphics from imported bitmaps). It is optimized for Web delivery, and is especially common for banner adds and small interactive web deliverables.

- HyperCard : Apple Computer ; Mac, WWW (via LiveCard!).

  HyperCard is a card/scripting authoring system currently in version 2.4.1. It runs natively on both 68K and PowerMacintosh machines, and is widely used because of its easy availability at a low price. Its largest drawback is the lack of integrated color; current color implementation is via the ColorTools XCMD set (included) or via third-party XCMDs.

- HyperGASP : Caliban Mindwear.

  HyperGASP is a card/scripting authoring system currently in version 3.0; the newest version no longer requires HyperCard. Supports export to HTML for Web authoring.

- HyperStudio ; Roger Wagner Publishing ; Mac, Windows, WWW (via HyperStudio plug-in).

  HyperStudio is a card/scripting paradigm authoring system, optimized for and focussed on the educational market.

- IconAuthor : Asymetrix ; Windows, NT, Solaris, UNIX, WWW (via Windows).

  IconAuthor follows the iconic/flow control paradigm. It is notable for its SmartObject editor, which tags content files (still graphics, RTF text, etc.) for interactivity. It has the option to either embed content files or leave them external in specified directories. The biggest strength of this program is its included data handling, which makes it unparalleled for CBT data tracking. The latest version should also provide WWW porting of existing content. Avoid its internal "Move Object" path animation feature due to jerky response - use a .FLC or .AVI instead

3.7 Software Tools

a. Music Sequencing and Notation: Cakewalk, Cubase, acromedia Sound Edit, etc;
b. Digital Audio: Cool Edit, Sound Forge, Pro Tools, etc;
c. Graphics and Image Editing: Adobe Illustrator, Adobe Photoshop, Macromedia Fireworks, etc;

d. Video Editing: Adobe Premiere, Windows Movie Maker, iMovie, etc;
e. Animation: 3D Studio Max, Maya, etc;
f. Multimedia Authoring: Macromedia Flash, Macromedia Director, etc.

SELF ASSESSMENT EXERCISES 2

1. What are authoring tools.
2. List various types of authoring tools.
3. State the features of developing interfaces in the authoring tools.

4.0 Conclusion

There are different types of authoring tools, and their subsequent functions with authoring capabilities, as well as software tools for multimedia presentation. A choosen authoring tool must be suited to the multimedia structure and design choosen.

5.0 Summary

In this unit, we have learnt that:

i. Multimedia presentations have special structures, design layout or architecture and their different ways through which they can be done.
ii. Multimedia contents are broken into subsequent sub-section by the designer in other to adequately choose the design layout for arranging these contents.
iii. In all, the organization scheme and structure always relies on the user's expectation and need with the type of information to be organized.
iv. Authoring tools should be capable of these; interactivity, playback, editing, programming/ scripting, cross platform, internet playability etc.
v. Some non-trivial examples of authoring tools were mentioned like, macromedia director, authorware, etc.
vi. There are different software tools that can aid multimedia presentation.

6.0 Tutor Marked Assignments

1. Differentiate between

   a. Linear Structure and hierarchical Structures,
   b. Interactive Stories Structures and Web Stories Structures

2. List various types of authoring tools, and describe their functions and features.

7.0 Further Readings and Other Resources

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Structure and Tools

Introduction to Multimedia : Authoring Tools (SMM 2005)

Module 3: Multimedia Design and Development Strategies

Unit 4: Assembling a Multimedia Development Team

Module 3: Multimedia Design and Development Strategies

Unit 4: Assembling a Multimedia Development Team

1.0 Introduction

Multimedia design, development and deployment require a multi-disciplinary approach since diverse subject areas are involved in single multimedia applications. In actual fact real-life multimedia applications require pooling together teams of many skilled and knowledgeable people in different areas such as computer science, instructional technology, physics, visual and graphical arts, measurement and evaluations, science communication, voice and screen actors, management, psychology, mathematics (logic, algebra & geometry), digital content repository, film production and photography etc.

For instance, multimedia data elements such as sound require expertise in sound engineering and management; image and objects would require special skills in visual and graphics including 2D and 3D animation, video and audio production, image design and manipulation, and detailed web design; multimedia learning and e-learning systems would require expertise in curriculum design and instructional technology beside others; multimedia programming involve extensive knowledge in all web-based programming languages and techniques; and so on.

In all management plays an important role in assembling all the needed resources, and coordinating this array of personnel from diverse areas to achieve the team overall goals and objectives. Also the multimedia life cycle (analysis, design, implementation, testing, delivery and maintenance) must be effectively coordinated.

2.0 Objectives

At the end of the unit you will be able to:

- Explain the role of resource management in multimedia application development;
- Identify who should be members of the multimedia production team and describe what attributes, skills and knowledge they possess;
- Describe the roles and responsibilities of each member of multimedia team;

3.0 Project Manager

Multimedia applications like every other project require someone with human, material, machine, financial resources management skills. Such a person refer to as project manager (or project consultant or producer or team leader) coordinates the entire development of the multimedia project and facilitate team-spirit, team-binding and unity among members of his team. He is responsible for overseeing project timeline and priorities, quality of the final product, allocation of funds, and the time management of the project, communicating the team's objectives and achievement to team members, assists in personnel recruitment and selection, delegating duties and supervision, maintaining conducive work environment, and documentation. He has a clear

understanding of the team's roles and responsibilities, and sees to it that members remain focus on their jobs especially in times of difficulties. He is a dynamic, proactive and innovative individual with excellent team-working skills and the ability to liaise with a wide range of users.

He keeps records such as budget estimates, schedules, creative sessions, time sheets, illness, invoices, and team dynamics or personnel turnover. He provides answers to questions such as:

- Why is important to have a project timeline and set priorities?
- Why is it important to schedule meetings?
- Why is it important to keep minutes of meetings?
- Why is it important to have a project librarian?
- Where would you keep documents for your project?

Key activities of a multimedia project manager include:

- Coordinates initial start up meetings between all parties;
- Schedules additional meeting throughout the project;
- Clarify, publish, and communicate timelines and milestones (establish deadlines);
- Breakdown the allocation of tasks and ensure all agencies are aware of their schedule and responsibilities;
- Monitor the allocation of tasks and the use of resources;
- Monitor progress of work in development of the multimedia presentation;
- Manage the allocation of financial resources;
- Ensure quality control throughout the project and sign off the final deliverable;
- Evaluate the process and produce a project completion report; and
- Market the final product; ensure the product reaches the target audience.

3.1 Graphic Designer and Art Director

The ***graphic designer*** assembles together images, typography or motion graphics to create a piece of design primarily for published, printed or electronic media. He knows how to organize and communicate visual information effectively in a way that is both accessible and memorable. He is able to transform textual and mental information into visual/graphical information effectively. He is responsible for creating interactive and creative design that stimulates user's interest in the multimedia presentations and which leaves a lasting impression on their minds. He design illustrations, user interfaces and web designs, and determines how multimedia contents are presented to the users.

Some of the skills and attributes required in a graphic designer include:

- Proficiency in one or more graphic design software programs, relevant to the job function. A web designer should understand how to work with XML, HTML and basic web programming scripts while a print designer should understand the processes involved in printing to be able to produce press-ready artwork;

- Good in solving visual communication problems or challenges. He should be able to identify the communications issue, gather and analyze information related to the issue, and generate potential approaches aimed at solving the problem;
- Good understanding of the social and cultural norms of that audience in order to develop visual solutions that are perceived as relevant, understandable and effective;
- thorough understanding of production and rendering methods such as colour, drawing, offset printing, photography, and time-based and interactive media (film, video, computer multimedia);
- produce design solutions to communicate their clients' messages with high visual impact using production medium such as websites, advertising, books, magazines, posters, computer games, product packaging, exhibitions and displays, corporate communications and corporate identity;
- meet the end-users or client's objectives by developing creative ideas and concepts, choosing appropriate media and style, and ultimately working to an agreed brief with the end-users or clients; and
- have creative flair, up-to-date knowledge of industry software and a professional approach to time, costs and deadlines.

The graphic designer’s roles within a multimedia development team include:

- meeting clients or account managers to discuss the business objectives and requirements of the job;
- interpreting the client's business needs and developing a concept to suit their purpose;
- estimating the time required to complete the work and providing quotes for clients;
- developing design briefs by gathering information and data through research to clarify design issues;
- thinking creatively to produce new ideas and concepts;
- using innovation to redefine a design brief within the constraints of cost and time and client;
- presenting finalised ideas and concepts to clients or account managers;
- working with a wide range of media, including photography and computer-aided design (CAD);
- proofreading to produce accurate and high-quality work;
- contributing ideas and design artwork to the overall brief;
- demonstrating illustrative skills with rough sketches;
- keeping abreast of emerging technologies in new media, particularly design programmes such as Quark Xpress, FreeHand, Illustrator, Photoshop, 3D Studio, Acrobat, Director, Dreamweaver and Flash, as most graphic design work is now completed on a computer;
- working as part of a team with printers, copywriters, photographers, other designers, account executives, web developers and marketing specialists; and
- working to meet tight deadlines.

The ***art director*** is in charge of the overall visual appearance and how it communicates visually, stimulates moods, contrasts features, and psychologically appeals to a target audience. He makes decisions about which visual elements to use, what artistic style to use, and when to use motion.

He translates desired moods, messages, concepts, and underdeveloped ideas into imagery by brainstorming with other team members. He is ultimately responsible for solidifying the vision of the collective imagination while resolving conflicting agendas and inconsistencies between the various individual inputs.

3.2 Script / Content Writer / Science Communicator

A scriptwriter may refer to a person who writes screenplays for film and television (Screenwriter), or a person who writes scripts for live-action entertainment (Playwright) or a person who write scripts for comedy sketches, political speeches, documentaries and other presentations. He is versatile in communication and writing skills, and communicates clearly through written text. He gleaned information from subject matter experts, synthesize it, and then communicate it in a clear and concise manner.

It is duty to adapt the script to the multimedia environment and make sure that the words in the script counts by creating desire impression in the mind of end-users (audience). Computer-based multimedia requires that the scriptwriter to be knowledgeable about multimedia data elements (audio, video, text, graphics, and animation) and should adapt them appropriately for the purpose (which might be education, training, promotion, reference, entertainment, and games) of the multimedia presentation.

The scriptwriter ensures that the rules of the chosen language are responsibly adapted to suite the demands and opportunities presented by computer technology which is characterized by new media and non-traditional methods. Here are some general guidelines when writing scripts for multimedia presentations:

- keep the explanation of a concept or process concise, simpler and easier to understand;
- keep scripts in the active voice which is more direct, and usually shorter than a passive construction;
- present information in digestible chunks;
- make sure all text can be easily understood and read the scripts out loud;
- ensure the script and other multimedia data elements complement one another to allow both the ears and the eyes receive and synchronize the intended messages convey in the multimedia presentation for easier comprehension by the mind; and
- allow users some measure of control over the presentation by incorporating interactivity-led words in the script. Interactivity allows each user to actively participate in the usage (viewing) process, instead of passively watching the multimedia presentation. The nature of the material in the multimedia presentation determines the amount of interactivity that should be permitted.

3.3 Sound Designer and Sound Engineer

The *sound designer* works with the project manager to shape an overall, consistent soundtrack that exploits the expressive possibilities of the sound medium. Sound designer can also refer to a person brought on to create just one kind of sound effect. He has good ear for voice-overs and sound effects, and knows the inherent qualities and constraints of a medium which produces desire sound to the multimedia content. He chooses an appropriate sound effect that accompanies a narration. Specifically, he is responsible for designing acoustics for audio visual, audio and video conferencing, and determines the noise impact in the multimedia application.

Sound designers study the script and gather as much information as they can about any sound or music required to create the appropriate sound that would suit the theme of the multimedia presentation and as well as its content. Sound designer meet with the project manager and the design team at the very much beginning of the project in other to have good and clear understanding of the content in the multimedia presentation.

Sound designers create sound effects in multimedia presentations to:

- motivate actions during actual running of the multimedia presentation and indicate events taking place after running it;
- establish the time of day, season and weather;
- locate the action in a specific place;
- create mood and changes in mood;
- stimulate audience expectations of what is to come;
- provide information about the characters;
- build transitions between scenes; and
- offer shortcuts that rapidly advance the plot or recall past events;

The sound designer combines and varies the five controllable properties (pitch, quality, volume, direction and duration) of sound to create unique effects or music required by the production of the multimedia presentation. He makes use of planning tools such as

- *Plot:* A list of all the music and sound cues for each act/scene. It indicates where the sound or music occurs, the page number of the script where it appears, precisely when it begins and ends, and the equipment that will be used to produce it.
- *System layout:* A system layout shows the type and location of speakers on stage, on the set and in the auditorium. The system layout may also include a layout of how all of the sound equipment will be interconnected.
- *Cue sheet:* A version of the sound plot to be used by the sound technicians who will run the equipment during the performance.

The ***sound engineer*** takes the sound design by the sound designer and ensures that it can be created in a given space. This involves selecting equipment to reproduce the various

sound elements required, installing and testing it, and usually running the actual multimedia presentation.

The sound engineer's roles within a multimedia team include:

- has responsibility for some aspect of the sound at during presentations;
- taking care of setting up amps, volume, equalizers, speakers;

3.4 Videographer and Video Producer

A ***videographer*** records moving images and sound on tape, disk, other electro-mechanical device, broadcasting live, or even on actual celluloid film in some cases. He has good eyes for video and makes every megabyte count by recording important details which enhance the understanding of the multimedia contents and stimulates viewers' interest in the multimedia presentation. He is usually responsible for the camera, sound, and lighting and sometimes work underneath a director. In smaller productions (e.g. corporate and event videos), a videographer often works alone or as part of a two or three person team of camera operators and lighting and sound technicians.

Videographers are distinguished from cinematographers in that they manage smaller, event scale productions (weddings, short documentaries, short fiction pieces, simple commercials, simple training videos). Due to reduced budget compared to full length feature productions, videographers typically use electro-mechanical cameras while cinematographers record images on film. The advent of digital cinematography, however, has blurred this distinction.

Videographers maintain and operate a variety of video equipment, edit footage, and stay up to date with technological advances. The videographer is responsible for the maintenance and operation of the satellite, maintaining and repairing video walls, video tape editing in various formats, creating graphics for the cruise events and information channel, shooting and editing video tapes, programming the broadcast room such as tuning in TV, radio and playing of movies.

On the other hand, **v*ideo producer*** provides information about audio and *video* production, DVD authoring and duplication, corporate presentations and audio/visuals. Video producers work closely with all members of the multimedia development team on video productions to ensure that the process goes smoothly and is completed on time. The video producer must have a good working knowledge of all aspects of production from set design, lighting and audio through to editing, filming and working with scripts.

The video producer liaises with the project manager in making sure that all required supplies, equipment and staff are in the correct place at the correct time. Coordinating these services may be a large part of the video producer's daily responsibilities prior to the commencement of shooting. Once filming is in progress the video producer will work to coordinate the actual filming, ensuring that all aspects of filming are completed correctly.

A video producer must be creative and have an ability to work with various people and various settings, and budgets to end up with just what was wanted at the end of the project. Good communication skills as well as patience and the ability to motivate others are needed in a video producer.

The video producer's roles within a multimedia team include:

- coordinating all aspects of the filming production and confirming that all people, supplies and equipment will be available when required;
- handling all logistics of the filming including making sure that script writers, graphic designers, subject matter experts, instruction designers etc. have completed all necessary paperwork and meet all requirements in the design specification;
- editing and processing the video to produce exactly what the project manager or end-user required;
- troubleshooting issues with filming, modifying or changing scripts, or adding additional aspects to the filming to enhance the production; and
- communicating with directors or clients to determine exactly what they want and then producing that in the studio.

SELF ASSESSMENT EXERCISES 1

1. Explain the reasons for setting project timeline and set priorities in development multimedia presentations.
2. What is the importance of budget and budgetary control in multimedia development?
3. How does a graphic designer different from an art director?

3.5 Subject Matter Expert

The subject matter expert is someone skilled and knowledgeable in a given topic area and has experience teaching the topic. He is versatile in tutoring, mentoring and coaching the subject matter, and therefore serves as the primary source of authoring for the multimedia content. He identifies background resources for building the multimedia contents and reviews content design for factual integrity, completeness and educational effectiveness. He is not necessarily the multimedia a designer or developer but serves a complementary role in the multimedia development team. He knows the subject matter very well and is able to use the right messaging and terminology when teaching the subject matter.

The subject matter expert is critical to the validity of the content of Multimedia presentations. Therefore, the use of subject matter experts in providing content expertise advice toward the development of the product should not be overlooked. Subject matter experts have a stake in the multimedia project because it will reflect their degree of expertise and knowledge. In most cases they don't end up as the end-users, but certainly are involved in providing the technical expertise to the content. The quality of the content will only be as good as the expertise of the contracted subject matter experts involved in the multimedia project.

Multimedia project manager must ensure that the subject matter experts are available, understand their role, and most importantly be left to provide subject matter expertise only. It is advisable to allow subject matter expert to be focus on content, rather on the development of the multimedia presentation.

The following areas of general expertise are assumed as prerequisites and provide a basis for the competencies expected of a subject matter expert:

- a good all round knowledge of the subject-matter of the course;
- the background pedagogy that underpins the course;
- a good understanding of the limits and limitations of the information and communications technology;
- a closer working and sharing relationship with the learner;
- provide learners with "positive" support and "positive" encouragement; and
- a role of mentor/counselor as well as academic advisor

3.6 Instructional Designer

The instructional designer is a very critical key to success for effective multimedia development since he can assess educational needs and design and evaluate lessons. All multimedia presentations geared towards creating a dynamic, effective learning environment must have legitimate and sound instruction design and strategy built into the presentations.

The instructional designer's roles within a multimedia team include:

- providing advice on effective and efficient learning strategies;
- working with the subject matter experts to breakdown the content and organize it into reasonable chunks;
- designing effective learning strategies and build them into the multimedia project;
- conducting needs assessment and matching design to instructional needs;
- organizing, managing, and delivering information in such a way to create an effective learning environment;
- developing introductions, main content body, review, application, an motivational segments of the multimedia presentation;
- identifying and studying the target audience and designs the level of learning appropriate to their needs;
- identifying the key components of effective multimedia development and delivery, and ensures this built into the project;
- conducting research without agencies to acquire additional resources and references;
- designing a logical and structured format to the design decision throughout the development of the project; and
- evaluating the final "pilot" product and make necessary adjustments to fine-tune the educational effectiveness of the multimedia.

3.7 Multimedia Programmers

Multimedia programmers translate the requirements of the end-users, graphic designer, subject matter expert, instruction designer, and other team members into the programming language, working out the logical steps that must be taken by the computer to do a task so that the multimedia presentation works as planned. A multimedia programmer is a software engineer who integrates all of the multimedia elements into a seamless whole using an authoring language or programming language. Multimedia programmers make computer programs that use text, sound, graphics and pictures, 2D/3D modeling and virtual reality.

The roles of a multimedia programmer within a multimedia team include:

- meeting clients' (end-users) needs in the most effective way, and ensuring that the end product is both attractive and user friendly;
- creating multimedia presentations that use more than one way to communicate information. i.e. they may combine the different media elements such as sound, text, graphics, animation and video pictures to communicate an intended message, or concept/idea;
- collaborating with other team members (e.g. script writers, artists, graphic designers, animators and sound engineers) in developing the content of the multimedia presentations;
- translating the design into a language that the computer can understand by designing and writing computer codes, testing these codes and fixing bugs;
- developing games, educational software, websites, film, television and digital video productions;
- putting the different media in logically sequential order; making animation happen at the right time; using sound effects appropriately and generally implementing the instructions of the creative designer; and
- designing and writing web pages, program the links to databases, or create graphic effects for film studios.

Some of the relevant skills and attributes required to be a multimedia programmer include:

- the ability to mentally construct and communicate multimedia ideas;
- presenting ideas and information in writing, and explaining these ideas and information to end-users and team members;

- strong communication and interpersonal, skills to swap ideas, and to explain your work clearly and concisely to people who may not have much computer knowledge;
- have a clear understanding and appreciation of other members' role in the multimedia development team;
- enjoy solving problems, exercising logical thinking and working on a project from start to finish;
- have creative ideas about designs and styles, and the ability to create an accessible computer / user interface;
- strong interest in information technology;
- knowledge of Internet programming languages and applications;
- the ability to incorporate elements of different media into a whole presentation;
- good teamwork and co-operation with other team members;
- good organizational skills as well as ability to plan and meet tight deadlines, and ability to work well under pressure;
- preciseness, persistence, analytic, accuracy open mind to future possibilities and paying attention to minutest detail; and
- willingness to learn and improves, and be up-to-date with latest developments in a constantly changing technology industry and improving.

3.8 Quality Assurance Engineer

Quality assurance (QA) engineers are responsible for assuring that the developed multimedia presentations are effective and free from errors (defects) or operational problems by testing them to make sure they works according to design specification and meet users' need. The test is carried out under various working conditions or for verifying the information the correctness of the content in the multimedia presentation. QA engineers verify and guarantee the accuracy or performance of the multimedia presentation as well as troubleshoot the correction of any problems or issues throughout the development of the presentation through systematic quality auditing, proofing and compliancy checks at key points in the project development cycle.

The QA engineer is the tester for the product and is required to use it both as recommended and otherwise. His ability to think of how consumers may use the product incorrectly is important in liability and other legal issues for the multimedia team. The QA engineer is also expected to provide feedback on the user-friendliness (or otherwise) aspects of the product, and should suggest ideas for modifications and improvements.

QA engineer should possess the following attributes:

- an understanding of the multimedia presentation;
- the goals of the multimedia development team for the multimedia presentation;
- good background in multimedia design and development;
- experienced in data entry, accurate record keeping and attention to detail; and
- effective communication skills and the ability to work as part of the team in developing and testing products is key;

- they are problem-solvers who like a good puzzle;
- persistence, meticulous, thorough, detail-oriented, and enjoy tinkering; and
- understand the problems that users can encounter and able to build bridge between end-users and programmers, so they must.

The roles of a quality assurance engineer within a multimedia team include:

- discussing the multimedia presentations to be tested with the development team and the end-users;
- testing and assessing the effectiveness, accuracy or safety of multimedia; presentations based on existing safety standards or performance guidelines;
- entering data entry, recording of results and completion of paperwork in a timely fashion;
- making sure that all the programs work properly and that everything in a Web site functions according to plan;
- trying and making things not work so the programmer can catch errors before they occur;
- troubleshooting inaccuracies or problems in the multimedia presentations; and
- meeting with the multimedia development team to share results and recommendations.

SELF ASSESSMENT EXERCISES 2

1. What do you understand by the notion of quality? What values (if any) does a subject matter expert add to the quality of Multimedia presentations?
2. Is there a need for Instructional Designers in all Multimedia presentations? What are the distinguishable attributes of an Instructional Designer?

4.0 Conclusion

Multimedia design, development and deployment require a synergetic efforts which can only be achieve by assembling and effective coordination of the multimedia development process (pre-production, base production and post-production schedules).

5.0 Summary

In this unit, we have learnt that:

i. Management plays an important role in assembling all the needed resources, and coordinating this array of personnel from diverse areas to achieve the team overall goals and objectives.
ii. Members of the multimedia production team have some attributes, skills and knowledge which distinguish them form one another, and from other professionals.
iii. The roles and responsibilities of each member of multimedia team.

6.0 Tutor Marked Assignments

1. What effect does assembling high quality multimedia production team have on the quality of a multimedia presentation?
2. In a multimedia production team, who does what is determined by who? How is that person selected? What kinds of attributes, skills and knowledge are expected in such a person?

7.0 Further Readings and Other Resources

Assembling a Multimedia e-Learning Development Team

Managing Multimedia by Elaine England and Andy Finney www.atsf.co.uk/manmult_2e/

Project Management - Managing Multimedia Projects
www.acs.ucalgary.ca/~edtech/688/pm

Art director - Wikipedia, the free encyclopedia www.wikipedia.org/wiki/Art_director

Scriptwriter - Wikipedia, the free encyclopedia www.wikipedia.org/wiki/Scriptwriter

Writing For Multimedia: Script Guidelines http://writing.atomicmartinis.com/scripts

Audio engineering - Wikipedia, the free encyclopedia
http://en.wikipedia.org/wiki/Audio_engineering

Module 3: Multimedia Design and Development Strategies

Unit 5: e-Learning , Multimedia Learning and Cognitive Principles in Multimedia Learning Design

Module 3: Multimedia Design and Development Strategies

Unit 5: e-Learning , Multimedia Learning and Cognitive Principles in Multimedia Learning Design

1.0 Introduction

Electronic learning (E-Learning) refers to a wide range of applications and processes designed to deliver instruction through electronic means which builds new knowledge and skills. Usually this means over the Web, however it also can include CD-ROM or video-conferencing through satellite transmission. E-learning is also believed to encompass other learning environments like Computer-Based Training (CBT), on-line learning and Web-based training which signals the paradigm shift in education and training.

E-Learning though is technology-driven but its capability lies more in its social dynamics of networking. The revolutionary impact of E-Learning lies not simply in having a multimedia platform on a single desktop. It is the combined power of a world-wide network of such computers that connects authors, instructors and learners globally with the immediacy of text, graphics, audio and video, as well as interactivity and collaborative sharing.

2.0 Objectives

At the end of the unit you will be able to:

- Explain the concept of e-learning, state the inherent benefits and highlights its limitation;
- Describe the factors which are facilitators of e-learning;
- Describe e-learning environment and the tools which are used in e-learning environment;
- Explain the role of multimedia in e-learning and the reasons for multimedia learning;
- State and explain the principles which guides application of multimedia in e-learning.

3.0 Definitions

E-Learning is the online delivery of information for purposes of education, training or knowledge management. It is a web-based systems built upon the internet platform and which provide knowledge to those who need it, where and when they need it. E-learning can be useful both as an environment for facilitating learning at schools, and as an environment for efficient and effective corporate training.

3.1 Benefits of E-Learning

Among the numerous benefits of e-learning are:

1. Time Reduction: e-learning can reduce training time by as much as 50%. E-Learning lessons are generally designed to guide students through information or to help students perform in specific tasks.

2. Large Volume and Increased Access: e-learning can provide training to a large number of workers with diverse cultural backgrounds and educational.

3. Cost Reduction: Cost of instruction by other methods is high while the cost of providing a learning experience through e-learning can be reduced by 50% to 70% when classroom lessons are replaced by e-learning sessions.

4. Higher Content Retention: e-learning students are usually self-initiated and self-paced. Such self-motivation results in content retention and improved performance that could be up to between 25% and 60% higher than that of classroom-led learning.

5. Flexibility: e-learners are able to adjust the time, location, content, and speed of learning to suite their peculiar needs and capabilities.

6. Up-dated and Consistent Materials: e-learning offers just-in-time access to timely and up-to-date information unlike printed textbooks which might take between 3 and 5 years to update. E-learning has between 50% to 60% better consistency of material than classroom learning.

7. Fear-Free Environment: e-learning facilitates learning for students in distance learning or open education programme, or those who may not wish to join a face-to-face group discussion cum class participation. It provides a fear-free and privacy-protected learning environment where student can participate freely without any fear of how right or logically sound his contribution might be.

3.3 Limitations of E-Learning

1. Need for Instructor Retraining: Some instructors are not competent to teach by electronic means and may require additional training which may costs huge financial outlay.

2. Equipment Needs and Support Service: Additional funds are needed to purchase multi-media tools to provide support services for e-learning creation, use and maintenance.

3. Lack of Face-to-Face Interaction and Campus Life: Intellectual simulation that takes place through instructor-led classroom instruction cannot be fully replicated in e-learning sessions.

4. Assessment: e-learning instructors may not be competent to assess students' work, and on the other hand, ascertaining the identification of who actually completed an assignment or examination might be difficult.

5. Maintenance or Updating: The cost and instructors' time required in ensuring e-learning materials are up-to-date might be expensive for some institutions or organizations. The content of e-learning material can be difficult to maintain due to lack of ownership and accountability of website materials.

6. Protection of Intellectual Property: It is difficult to control the transmission of copyrighted works downloaded fron the e-learning platform.

7. Computer Literacy: e-learning cannot be extended to those students who are not computer literate.

8. Student Retention: Without some human feedback, it may be difficult to keep some students mentally engaged and enthusiastic about e-learning over a long period of time.

3.3 Reasons For Failure of E-Learning Projects

The following issues need to be address critically, carefully and systematically for e-learning projects to be successful.

a. E-learning can be very expensive because of the high financial capital outlay and the running costs required, especially if the student population is not sufficiently large to compensate for this huge costs.
b. In many instances, the potentials and benefits of e-learning are often over-estimated.
c. Self-study on its own has some drawbacks which are often over-looked by e-learning designers.
d. Instructors in many cases do not consider the creation, delivery and nature of the learning material in relation to the objectives of a particular course.
e. Viewing content as a commodity causes lack of attention to quality and delivery to individuals.
f. Ignoring technology tools for e-learning or on the other hand, fixating too much on technology as a solution.
g. Assuming that learned knowledge will be applied.
h. Believing that because e-learning has been implemented, employees and students will use it.

3.4 Drivers of E-Learning

1. Technological Change: Technological changes and global network connectivity have increased the complexity and speed of the work environment. Just-in-time (JIT) training is therefore critical element to organizational success.

2. Competition and Cost Pressures: Fierce competition in most industries leads to increasing cost pressure. In today's competitive environment, organizations can no longer afford to inflate trining budgets with expensive travel and lodging. Time spent away from the job, traveling or sitting in a classroom tremendously reduces per employee productivity and revenue.

3. Globalization: E-learning is an effective mechanism for global delivery of training to geographically dispersed workforce or students.

4. Continual Learning: Learning is a continual process and as such e-learning provides training techniques and delivery methods which enhance motivation, performance, collaboration, innovation, and a commitment to life-long learning.

5. Network Connectivity: The internet provides an ideal delivery vehicle for education, and thus opened the door to a global market where language and geographical barriers have been eliminated for many training products. This is made possible as a result of its simplicity of use and the increasing penetration to corporate offices, schools, governments, hospitals and homes.

SELF ASSESSMENT EXERCISES 1

1. What is e-learning? How can the limitations of e-learning be overcome?
2. Differentiate between e-learning and virtual worlds.

3.6 Multimedia Learning

According to Mayer (2005), "multimedia learning occurs when people build mental representations from words (such as spoken text or printed text) and pictures (such as illustrations, photos, animation, or video)". Mayer (2005) further posited that *multimedia* refers to the presentation of words and pictures, whereas *learning* refers to the learner's construction of knowledge. Therefore, multimedia learning could be said to be the process by which people build mental representations from words and pictures. This process is the focus of Mayer's cognitive theory of multimedia learning, Sweller's cognitive load theory, and Schnotz's integrative model of text and picture comprehension (Mayer 2005).

Multimedia instruction (or a multimedia learning environment) involves presenting words and pictures that are intended to promote learning. In short, multimedia instruction refers to designing multimedia presentations in ways that help people build mental representations (Mayer 2005). Multimedia presentations which facilitate multimedia learning are designed based on the cognitive principles of multimedia learning described in section 3.7 of this unit.

3.7 Rationale for Multimedia Learning

The major goal of multimedia learning is to assists learners towards having better understanding of the subject matter presented in multimedia presentations. The rationale behind this is that learners learn more deeply from words and pictures than from words alone. It is important to understand how best to incorporate pictures with words since not all pictures are equally effective for a given learning process. Instructors must also be known to have mastered how to effectively adopt the multimedia learning technology to promote effective teaching and learning. There is therefore the need for a research-based understanding of how people learn from words and pictures and how to design multimedia instruction that promotes learning (Mayer 2005).

According to Bransford, Brown, & Cocking (1999), the following processes constitute how people learn:

1. Build on prior knowledge
2. Connect facts & procedures with concepts
3. Support meta-cognition

Koedinger (2002) opined that learners can best build on their prior knowledge of a given subject by following the principles of instructional bridging outline below:

1. ***Situation-Abstraction***: Concrete situational <-> abstract symbolic reps
2. ***Action-Generalization****:* Doing with instances <-> explaining with generalizations
3. ***Visual-Verbal****:* Visual/pictorial <-> verbal/symbolic reps
4. ***Conceptual-Procedural****:* Conceptual <-> procedural

When words and pictures are presented together as in a narrated animation, students perform well both on retention and transfer tests (Mayer 2005). In particular, when we focus on tests of problem solving transfer (which are designed to measure the student's understanding of the presented material) students perform much better with words and pictures than from words alone (Mayer 2005).

3.10 Principles of Multimedia Learning

Multimedia learning is the common name used to describe the cognitive theory of multimedia learning. This theory encompasses several principles of learning with

multimedia and underlies how to design multimedia learning environments are discussed in this section.

3.8.1. **Cognitive Tutor Principles**

Cognitive processing of instructional materials described how instructional materials are processed by the learners' ears or eyes and information perceived from such materials are stored in corresponding working memory (WM) according to (Baddeley and Hitch, 1974). They stated that this information must be integrated to develop an understanding and stored in long term memory. The followings guidelines are propounded in the cognitive tutor principles as stated by Koedinger & Corbett (2006).

1. **Represent student competence as a production set**: The model adopted in the design of multimedia learning environment must be design in such a way that will:

    - guide curriculum design, scope & sequence, user-interface design, error feedback & hints mechanism, problem selection & promotion; and
    - interpret student actions, identify the components of learning and decomposed knowledge.

2. **Communicate the goal structure underlying the problem solving**: Successful problem solving involves *breaking a problem* down into sub-goals (decomposed the inherent knowledge). The learning tasks (or user-actions) in each user-interface must be explicitly displayed to ensure reification in the learning process.

3. **Provide instruction in the problem-solving context**: Instructions must be provide in the context-specificity of learning which describes how students learn the critical "if-part" of the production rule. Instructions should be stated before introducing the problem.

4. **Promote an abstract understanding of the problem-solving knowledge**: Conceptualization of abstract topic must be systematically observed to permit students to concretize abstract concepts into "reality". The language of instruction, hints and feedbacks should reinforce generalization.

5. **Minimize working memory load**: Avoid information overload by including relevant materials which relates to the current problem-solving procedure. This is to ensure that the information in the active memory would facilitate effective learning on the student's part. Learners' should be able to build on previous knowledge (i.e. from simple topic to complex topic). In this way extraneous and intrinsic information loads are avoided and important information load is optimized.

6. **Provide immediate feedback on errors**: Feedback from previous problem solved helps students to identify and avoid their mistakes thus making

interpretations of the procedures in the problem solving simpler. Correct solution and answer should therefore be provided especially during quizzes, puzzles, assignments, and tutorials etc. to reinforce students interest and promote effective learning.

3.8.2 **Media Element Principles of E-Learning**

1. Multimedia Principle

People learn better from words and pictures than from words alone therefore it is advisable to use both words and graphics in multimedia presentations than words alone. It has been found out that well-designed visuals and text can particularly benefit learners with less experience in the lesson content (Mayer, 2005). Multimedia presentations can encourage learners to engage in active learning by helping them to make connections between pictures and text with mental representations. Students can mentally build both a verbal and pictorial model, and then make connections between learning from both words and pictures.

2. Contiguity Principle

People learn better when corresponding words and pictures are presented near each other on the page or screen. This is due to the fact that students do not have to use limited mental resources to visually search the page. They are more likely to hold both corresponding words and pictures in working memory, and process them at the same time to make connections. Words (or text) should be placed nearer to the corresponding graphics in an integrated fashion rather than the same information in separate places. This reduces the amount of time your learner will need to spend finding the information thus reducing cognitive load. This aligning of text includes narration.

Spoken word and corresponding graphics should be presented close together on the screen. Separating text, either written or audio increases cognitive load of the learner and breaking text into smaller more manageable parts with corresponding graphics. Animations and graphics appearing on the screen at the same time rather than separated with one following the other improve retention and decreases cognitive load.

Evidence suggests that people learn best when words describing an element or event are spoken at the same time as the animation or illustration depicts that element or event on the screen (Clark and Mayor, 2003).

Spatial Contiguity Principle - Students learn better when corresponding words and pictures are presented near rather than far from each other on the page or screen.

Temporal Contiguity Principle- Students learn better when corresponding words and pictures are presented simultaneously rather than successively.

3. Coherence Principle

People learn better when extraneous material is excluded rather than included, when cues are added that highlight the organization of the essential material, when corresponding words and pictures are presented near rather than far from each other on the screen or page or in time, and people learn better from graphics and narration than from graphics, narration, and on-screen text (Mayer, 2005). Extraneous material competes for cognitive resources in working memory and diverts attention from the important material.

4. Modality Principle

People learn better from graphics and narration than graphics and printed text. Thus words in spoken rather than graphic form should be used when graphic or animation is in focus because people learn more lessons with concurrent speech than just text alone. Presenting text and animation at the same time can overload visual working memory, and therefore leaves auditory working memory unused. When visual information is being explained, it is better to present words as audio narration than onscreen text. The cognitive theory of learning adduced the following reasons for this:

a. Graphics and onscreen text compete for attention;
b. Separate information processing channels for visual and auditory/verbal processing;
c. Capacity of each channel is limited;
d. Do not overloads visual channel rather use both auditory and visual channels

When learning with multimedia the brain must simultaneously encode two different types of information, an auditory stimulus and a visual stimulus which enable the brain to simultaneously process information coming from both ears and eyes. Thus a learner is not necessarily overwhelmed or overloaded by multimodal instruction, and it can in fact be beneficial.

5. Redundancy Principle

People learn better when the same information is not presented in more than one format (Mayer, 2005). According to this principle, students learn better from animation and narration than from animation, narration, and on-screen text. Thus it's better to eliminate redundant material. This is because learners do not learn as well, when they both hear and see the same verbal message during a presentation. This is a special case of the Sweller and Chandler's *split attention effect*.

We need to accommodate different learning styles, add text to the screen for those who learn better from reading because some learns better with visual style while others learn better with auditory style or both. Therefore present both approaches to accommodate both learning styles and aid learning by adding information to memory in step-wise manner. Avoid presenting words as narration and *identical* text and slow pace of presentation. Provide learning assistance to learners with disabilities or non-native speakers and those who may not have access to speakers or headsets.

6. Personalization Principles

People learn better when the words of a multimedia presentation are in conversational style rather than formal style of instruction, and when the words are spoken in a standard-accented human voice rather than a machine voice or foreign-accented human voice (Mayer, 2005). Humans strive to make sense of presented material by applying appropriate processes. Conversational instruction better primes appropriate processes because when people feel they are in a conversation they work harder to understand material.

3.8.3 Complementary Principles to Principles of Multimedia Learning

The following principles as outlined in Mayer (2005) serves as complement to the principles described in sections 3.8.1 and 3.8.2.

1. **Split-Attention Principle:** People learn better when words and pictures are physically and temporally integrated. This is similar to spatial contiguity and temporal contiguity principles.

2. **Segmenting, Pre-training, And Modality Principles:** People learn better when a multimedia message is presented in learned-paced segments rather than as a continuous unit, people learn better from a multimedia message when they know the names and characteristics of the main concepts, and people learn better from a multimedia message when the words are spoken rather than written.

3. **Guided-Discovery Principle:** People learn better when guidance is incorporated into discovery-based multimedia environments.

4. **Worked-Out Example Principle:** People learn better when they receive worked out examples in initial skill learning.

5. **Collaboration Principle:** People can learn better with collaborative online learning activities.

6. **Self-Explanation Principle:** People learn better when they are encouraged to generate self-explanations during learning.

7. **Animation And Interactivity Principles:** People do not necessarily learn better from animation than from static diagrams.

8. **Navigation Principles:** People learn better in hypertext environments when appropriate navigation aids are provided.
9. **Site Map Principle:** People can learn better in an online environment when the interface includes a map showing where the learner is in the lesson.

10. **Prior Knowledge Principle:** Instructional design principles that enhance multimedia learning for novices may hinder multimedia learning for more expert learners.

11. **Cognitive Aging Principle:** Instructional design principles that effectively expand working memory capacity are especially helpful for older learners.

3.11 Clark & Mayer's e-Learning and the Science of Instruction Principles

Clark & Mayer (2005), highlights the following principles in their book "e-Learning and the Science of Instruction" as serving catalyst functions in promoting effecting teaching / learning of sciences.

3.9.1 Principles for Creating Online Practice Exercises

1. Interactions should mirror the job.
2. Critical tasks require more practice.
3. Apply the Media Elements Principles to exercises.
4. Train learners to self-question during receptive e-lessons.

3.9.2 Principles for Leveraging Examples in e-Learning

1. Replace some practice problems with worked examples.
2. Apply the Media Elements Principles to examples.
3. Use job-realistic or varied worked examples.
4. Teach learners to self-explain examples.

3.9.3 Principles for Online Collaboration

1. Make assignments that require collaboration among learners.
2. Assign learners to groups in ways that optimize interaction.
3. Structure group assignments around products or processes.
4. Models for structured collaboration: jigsaw, structured controversy, problem-based learning, peer tutoring.

3.9.4 Principles for Learner Control in e-Learning

1. Use learner control for learners with high prior knowledge or high metacognitive skills.
2. Make important instructional events the default navigation option.
3. Add advisement to learner control.

3.9.5 Principles for Building Problem Solving Skills through e-Learning

1. Use job contexts to teach problem solving processes.
2. Focus training on thinking processes versus job knowledge.
3. Make learners aware of their problem-solving processes.
4. Incorporate job-specific problem-solving processes

3.10 Scientific Evidence That Principles Really Work

According to Lee, Gillan, Upchurch, Melton, & Harrison (1995), recitation based lecture helped subjects scoring low on the pre-test more than those scoring high on the pre-test whereas for those using the computer, multimedia helped all subjects equally. Respondents who used the computer listed more behaviors than those who listened to the recitation.

Table 1: Summary of Research Results from the Six Media Elements Principles. (From Mayer, 2001)

Principle	Percent Gain	Effect Size	Number of Tests
Multimedia	89	1.50	9 of 9
Contiguity	68	1.20	5 of 5
Coherence	82	1.17	10 of 11
Modality	80	1.17	4 of 4
Redundancy	79	1.24	2 of 2
Personalization	67	1.24	5 of 5

* Used similar instructional materials in the same lab.

It is obvious from the table above and from the result obtained by Lee, Gillan, Upchurch, Melton, & Harrison (1995), that it is quite worth while to apply the various principles that have been mentioned in the preceding sections of this unit.

3.11 Approaches to Multimedia Learning

Two approaches to multimedia learning have been identified, vis-à-vis, technology centered and learner centered. Table 2 below summarized the salient point concerning the two approaches.

Table 2: Approaches to the Design of Multimedia Instruction

Design Approach	**Starting Point**	**Goal**	**Issues**
Technology centered	Capabilities of multimedia technology	Provide access to information	How can we use cutting-edge technology in designing multimedia instruction?
Learner centered	How the human mind works	Aid human cognition	How can we adapt multimedia technology to aid human cognition

3.11.1 Technology-Centered Approach

Technology-centered approaches begin with the functional capabilities of multimedia and the focus is generally on cutting-edge advances in multimedia technology. Technology centered designers might focus on how to incorporate multimedia into emerging communications technologies (e.g the World Wide Web) or the construction of interactive multimedia representations in virtual reality. The kinds of research issues often involve media research (i.e., determining which technology is most effective in presenting information). For example, a media research issue is whether students learn as well from an online lecture – in which the student can see a lecturer in a window on the computer screen – as they can from a live lecture – in which the student is actually sitting in a classroom.

The technology-centered approach generally fails to lead to lasting improvements in education (Cuban, 1986). Instead of adapting technology to fit the needs of human learners, humans were forced to adapt to the demands of cutting edge technologies. The driving force behind the implementations was the power of the technology rather than an interest in promoting human cognition. The focus was on giving people access to the latest technology rather than helping people to learn through the aid of technology.

3.11.2 Learner-Centered Approach

Learner-Centered Approaches

Learner-centered approaches offer an important alternative to technology-centered approaches. Learner-centered approaches begin with an understanding of how the human mind works and focus is on using multimedia technology as an aid to human cognition. Research questions focus on the relation between design features and the human information processing system, such as, comparing multimedia designs that place light or heavy loads on the learner's visual information processing channel. The premise underlying the learner-centered approach is that multimedia designs that are consistent with the way the human mind works are more effective in fostering learning than those that are not. This premise is the central theme of part 1 of this handbook, which lays out theories of multimedia learning.

Norman (1993) eloquently makes the case for a learner-centered approach to technology design, which he refers to as *human-centered technology*. Norman's (1993) assessment is that "much of science and technology takes a machine-centered view of the design of machines" so that "the technology that is intended to aid human cognition . . . more often interferes and confuses." In contrast, Norman's (1993) vision of a learner centered approach to technology design is that "technology . . . should complement human abilities, aid those activities for which we are poorly suited, and enhance and help develop those for which we are ideally suited." The design of multimedia technology to promote human cognition represents one exemplary component in the larger task of creating what Norman (1993) calls "things that make us smart."

3.10 Metaphors of Multimedia Learning:

In designing or selecting a multimedia learning environment, three views of multimedia learning may influenced the designer, namely multimedia learning as response strengthening, multimedia learning as information acquisition and multimedia learning as knowledge construction.

Multimedia Learning as Response Strengthening

If you view multimedia learning as response strengthening, then multimedia is a feedback delivery system.

According to the response strengthening view, learning involves increasing or decreasing the connection between a stimulus and a response. The underlying principle is that the connection is strengthened if a response is followed by reward and is weakened if the response is followed by punishment.

***Multimedia Learning as* Information Acquisition**

If you view multimedia learning as information acquisition, then multimedia is an information delivery system.

***Multimedia Learning as* Knowledge Construction**

If you view multimedia learning as knowledge construction, then multimedia is a cognitive aid.

SELF ASSESSMENT EXERCISES 2

1. What principles of cognitive e-Learning principles have you learned so far?
2. How can you apply at least one of them in your project design?

4.0 Conclusion

E-Learning though is technology-driven but its capability lies more in its social dynamics of networking. It is the combined power of a world-wide network of such computers that connects authors, instructors and learners globally with the immediacy of text, graphics, audio and video, as well as interactivity and collaborative sharing. Multimedia learning could be said to be the process by which people build mental representations from words and pictures.

5.0 Summary

In this unit, we have learnt that:

i. E-learning can be useful both as an environment for facilitating learning at schools, and as an environment for efficient and effective corporate training.
ii. There are some issues which need to be address critically, carefully and systematically for e-learning projects to be successful.

iii. Facilitators of e-learning include technological change, competition and cost pressures, globalization, continual learning and network connectivity.
iv. The major goal of multimedia learning is to assists learners towards having better understanding of the subject matter presented in multimedia presentations.
v. Theory used in multimedia learning encompasses several principles of learning which include the cognitive tutor principles, media element principles and some other complementary principles.
vi. Two approaches used multimedia learning are technology centered and learner centered.

6.0 Tutor Marked Assignments

1. Distinguish between the cognitive tutor principle, the contiguity principle and the coherence principle.
2. Why should the view of multimedia influence a multimedia designer in selecting multimedia learning environment?

7.0 Further Readings and Other Resources

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Module 4: Multimedia Authoring: Flash Technology and Development

Unit 1: Overview of Flash Technology

Module 4: Multimedia Authoring: Flash Technology and Development

Unit 1: Overview of Flash Technology

1.0 Introduction

Flash is a tool for creating interactive and animated Web sites. **Adobe Flash** (formerly **Macromedia Flash**) is a multimedia platform originally acquired by Macromedia and currently developed and distributed by Adobe Systems.

2.0 Objectives

At the end of the unit you will be able to:

- Explain the concept of flash technology and its application to multimedia presentations and e-learning.
- Describe the Flash workplace and the various tools and functions available in the workplace.
- tween single objects and tween groups of objects
- Use Flash to create interactive multimedia presentations.

3.0 Definitions

Flash is a multimedia graphics program especially for use on the Web and which enables a user to create interactive "movies" on the Web. It uses vector graphics, which means that the graphics can be scaled to any size without losing clarity/quality and Flash does not require programming skills and is easy to learn.

Since its introduction in 1996, Flash has become a popular method for adding animation and interactivity to web pages. Flash is commonly used to create animation, advertisements, and various web page Flash components, to integrate video into web pages, and more recently, to develop rich Internet applications.

Flash can manipulate vector and raster graphics, and supports bidirectional streaming of audio and video. It contains a scripting language called Action Script. Several software products, systems, and devices are able to create or display Flash content, including Adobe Flash Player, which is available free for most common web browsers, some mobile phones and for other electronic devices (using Flash Lite). The Adobe Flash Professional multimedia authoring program is used to create content for the Adobe Engagement Platform, such as web applications, games and movies, and content for mobile phones and other embedded devices.

Files in the SWF format, traditionally called "**S**hock**W**ave **F**lash" movies, "Flash movies" or "Flash games", usually have a .swf file extension and may be an object of a web page, strictly "played" in a standalone Flash Player, or incorporated into a Projector, a self-executing Flash movie (with the .exe extension in Microsoft Windows or .hqx for

Macintosh). Flash Video files have a .flv file extension and are either used from within .swf files or played through a flv-aware player, such as VLC, or QuickTime and Windows Media Player with external codecs added.

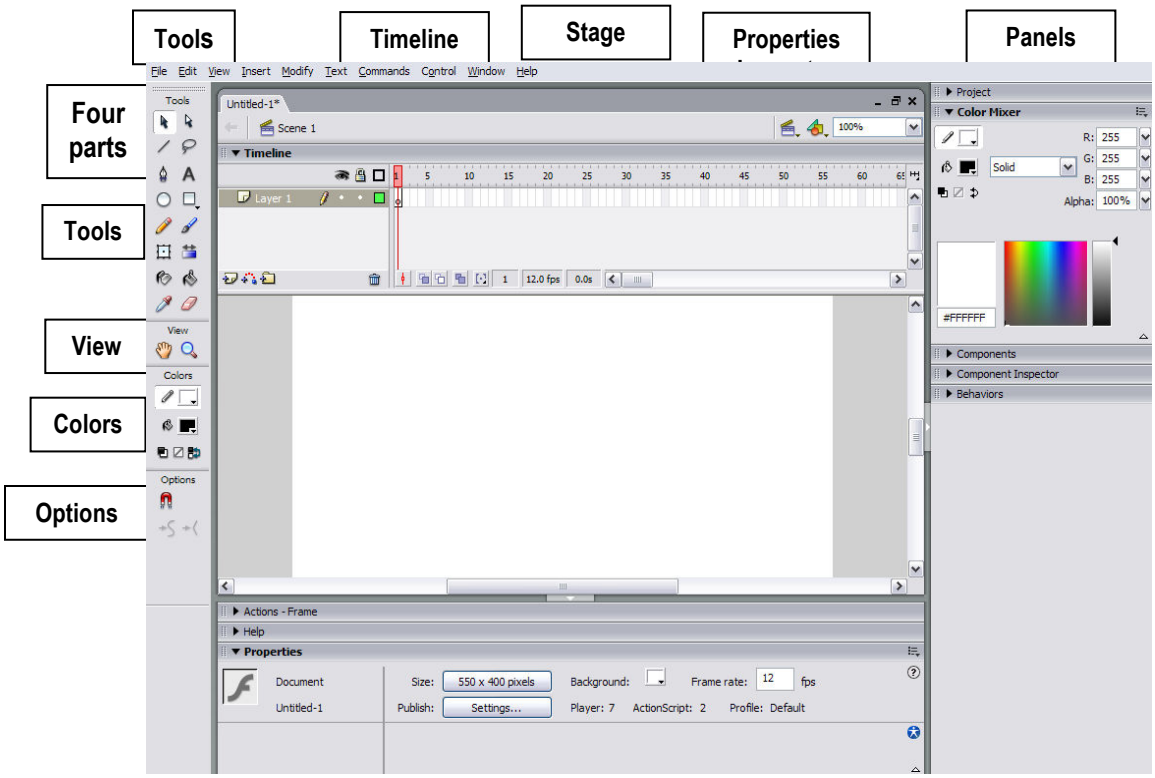
Animated images and Java applets are often used to create dynamic effects on Web pages. The advantages of Flash are:

- Flash loads much faster than animated images
- Flash allows interactivity, animated images do not
- Flash does not require programming skills, java applets do

Flash Versions include

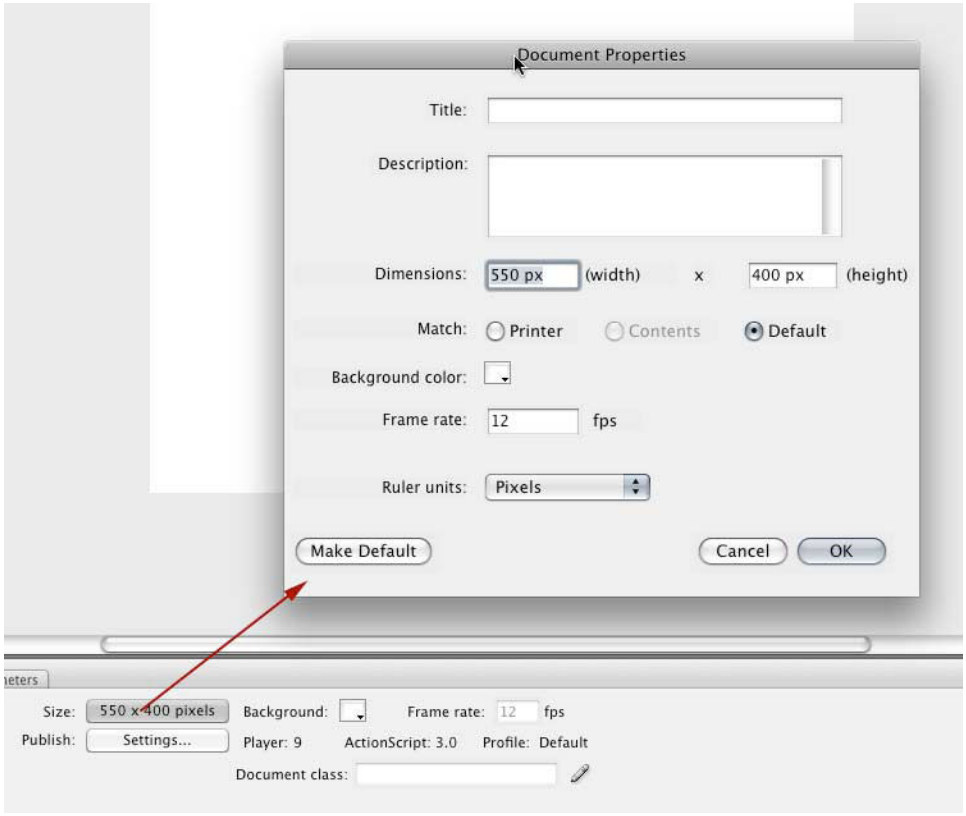
- Macromedia Flash, Flash MX … Flash 8
  - Much better help
  - New components
  - Better video quality
  - ActionScript 2.0
- Adobe Flash CS3, CS4
- Flash 8 is available on Lehigh LANs; trial version of Adobe Flash CS4 on web

3.1 The Flash MX 2004 Workspace



The main part of the workspace is the stage, or the visible part of your project. Above the stage is the timeline which controls the animation sequence. To the left is a toolbox containing selection, drawing, editing, and viewing tools. Below the stage is the properties panel (default configuration) which control the properties of certain tools or the attributes of objects on the stage. Other panels are organized to the right of the stage.

3.2 The Stage



The size of the stage and background color are controlled with **Modify > Document… from the** main menu **or in the** Properties Panel **before anything is added to the stage.**

3.3 Flash Drawing tools

Flash provides a good interface for creating graphics from scratch beside its usefulness for creating multimedia content. Graphics created in Flash can be saved in gif, jpg, png or other formats. Its vector capabilities allow for easy scaling without loss in quality or detail. Flash drawing is a **vector** graphic format, similar to Illustrator or Freehand. Vector drawings from other programs can be imported into Flash and edited or illustrations can be created directly in Flash.

There are five drawing tools in Flash, the rest are used to modify various aspects of the drawing. The drawing tools are found in **Drawing Toolbar**, which should be docked at

the left side of the screen when you first start Flash. If you don't have this toolbar open, click on **Window - Toolbar...**, check the box in front of **Drawing** and click OK.

 Line Tool  Oval Tool  Rectangular Tool

 Pencil Tool  Text Tool

Flash also has two tools for selecting objects: the **Arrow tool**  and the **Lasso Tool**  . However, in Flash, their usefulness has been increased by **modifiers**. A user can select an object with the arrow tool by either clicking on it directly or dragging a rectangular shape around the object with the left-mouse button pressed. The Lasso tool on the other hand provides a much more free form for selection. It is generally used to select irregularly shaped objects.

SELF ASSESSMENT EXERCISES 1

Activity 1. Draw Lines

a. Select 
b. Place the pointer on the Stage
c. Drag the pointer to draw a line of the length you need
d. Release the mouse

Activity 2. Draw Shapes

a. Create shapes by using the Line, Rectangle, Oval, Pen, or Pencil Tools
b. Select shapes by using the Selection Tool and the Lasso Tool
c. Edit shapes by using Selection Tool and the Eraser Tool
d. View, move, copy, and delete shapes

Activity 3. Draw Rectangles and Squares

a. **To draw a rectangle:**
    i. Select 
    ii. Place the insertion point on the Stage
    iii. Drag diagonally
b. To draw a square:
    i. Hold down the Shift key while dragging

Activity 4. Create Rounded Rectangles

a. Click 
b. Click the Round Rectangle Radius modifier
c. Specify the Corner Radius and click OK
d. Place the insertion point and drag diagonally

Activity 5. Draw an Ovals and Circles

a. **To draw an oval:**
    i. Select 
    ii. Place the insertion point on the stage
    iii. Drag diagonally
b. **To draw a circle:**
    i. Hold down the Shift key while dragging

Activity 6. Using the Pen Tool

a. **To create a straight line:**
    i. Select 
    ii. Click where you want the line to start
    iii. Click at a point where you want to place the end point
    iv. Drag the direction line
b. **To create a closed path:**
    i. Click the first anchor point
    ii. Drag to adjust the curve

Activity 7. Using the Pen Tool

a. Select 
b. Select an option from Pencil Mode list
c. Place the pointer and drag

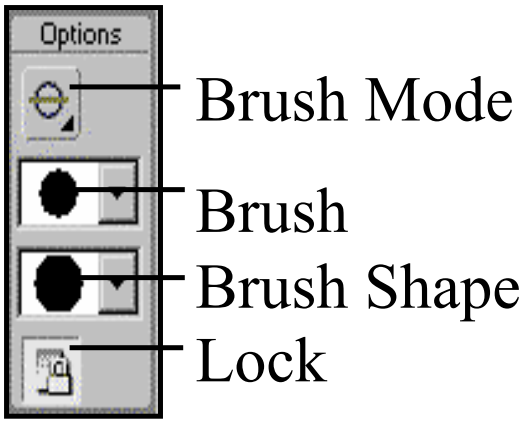
Activity 8. Copying and deleting shapes

a. **To copy a shape:**
    i. Select the shape
    ii. Choose Edit, Copy
    iii. Choose Edit, Paste
b. **To delete a shape:**
    i. Select the shape
    ii. Choose Edit, Clear

Activity 9. View Shapes

a. **The Zoom tool** 
    i. Zoom In to magnify a shape
    ii. Zoom Out to reduce a shape
c. The Hand tool 
    i. To move the Stage

Activity 10. Brush Tool modifiers



Brush tool modifiers contains the Faucet modifier, the Eraser Shape modifier, and the Eraser Mode modifier (Erase Normal, Erase Fills, Erase Lines, Erase Selected Fills and Erase Inside).

3.4 Flash Tint Tweening and Animation

With tint tweening you can change the color of an object. Tweening creates frames between keyframes. Keyframes are different cel created for each action and which synchronize motion change from one stage to another. Tweening is an action which requires calculating the number of frames between keyframes and then sketching onto a cel the series of different actions. Tint changes the color values of each keyframe and with Tint Tweening you can change the color of an object.

Computer animation can imitate the classical technique, with keyframe, tweening and layers. e.g., Macromedia Director and Flash both support these concepts, letting the computer automate the tweening process where possible. But computer animation introduces new techniques, designed to conserve resources e..g, rather than reproduce an entire cel for each frame, individual objects (called **sprites** in Director) move across a background image. Authorware motions give this effect; Director animations provide finer control of sprites. **Morphing** effect can be achieved by dissolving from one image to another, e.g., from one face to another – many specialized morphing software products available.

Example: In this example you will learn how to change the color of an object.

Step 1
Load Adobe Flash.

Choose Insert > New Symbol.

Note: To add Tint effects the object must be a symbol.

Step 2
Name the symbol "changecolor" and select the Graphic option in Behavior. Click OK.

Note: You will now be taken to the symbol generator in the Flash program. Here you create symbols. Symbols can be dragged to the stage of your movie after you have created them.

Step 3
Choose the Text tool in the left toolbox. Choose Text > Size > 36 from the top menu to make the text big. Choose Text > Style > Bold to make the text thick.

Step 4
Click in the work area and write "Color Changing Text".

Step 5
Jump back to the movie. Do this by choosin

3.5 Flash Shape Tweening

With Shape Tweening you can change one object into another. In this example you will learn how to change one object into another.

Step 1
Choose the Text tool in the left toolbox. Choose Text > Size > 48 from the top menu to make the text big. Choose Text > Style > Bold to make the text thick.

Step 2
Click in the work area and write "Hello".

Step 3
Right click on the text you just wrote and choose Panels > Align from the pop-up menu.

Step 4
In the Align box select the "To Stage" button first. Then click on the "Align Horizontal Center" button and the "Align Vertical Center" button. Close the Align box.

Step 5
Select the Arrow Tool and click on the text. Choose Modify > Break Apart from the top menu.

Step 6
Insert keyframes at Frame 24, 50 and 51.

3.6 Flash Button 1

In this example you will learn how to insert an image, convert it to a button, and add a URL to it so it becomes a link.

Step 1
Choose File > Import to import an image that will become a button. Locate the image and click Open. The image will be saved in the Library.

Step 2
Select the image with the Arrow tool.

Step 3
Convert the image to a symbol. Choose Insert > Convert to Symbol from the top menu. Name the symbol "button", choose Button from the Behavior list and click OK.

Step 4
Right click on the image. Choose Actions from the pop-up menu.

Step 5
In the Object Actions box click on the + sign. Choose Basic Actions > Get URL.

Step 6
Enter a full URL in the URL field (like http://www.w3schools.com).

Step 7
Choose target in the Window field. Close the Object Actions box.

Step 8
Choose Control > Test Movie from the top menu

3.7 Flash Button 2

In this example you will learn how to create your own button and add a URL to it so it becomes a link.

Step 1
Choose Insert > New Symbol from the top menu.

Step 2
Name the symbol "button", choose Button from the Behavior list and click OK. In the Timeline area, you will now see the four states of a button: up, over, down, hit.

Step 3
Select the Rectangle tool, pick a light red Fill Color and draw a rectangle in the work area.

Step 4
Select the Text tool, pick a dark Fill Color and write "Click Me" over the rectangle.

Step 5
Select the Arrow tool and place the text in the middle of the rectangle.

Step 6
Add a keyframe to the Over State in the Timeline. The Over State indicates what should happen when you mouse over the button.

Step 7
Select the Rectangle, change the Fill color to a light green.

Step 8
Choose Edit > Edit Movie to go back to the movie.

Step 9
Choose Window > Library to locate the button. Drag the button into the work area.

Step 10
Right click on the image. Choose Actions from the pop-up menu.

Step 11
In the Object Actions box click on the + sign. Choose Basic Actions > Get URL.

SELF ASSESSMENT EXERCISES 2

Activity 11. Working with colors

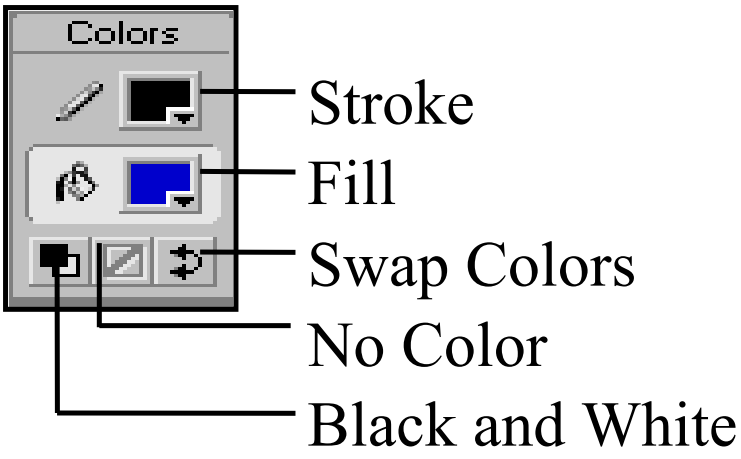
a. Apply stroke and fill colors to a shape by using the Paint Bucket, Ink Bottle, and Eyedropper tools
b. Create custom colors, swatches, and line styles

Hexadecimal Values
RGB Colors: 1st 2 – Red Value
2nd 2 – Green Value
3rd 2 – Blue Value

Each Value 00-FF (0-255)

Color Name	Hexadecimal Value
Black	#0000000
White	#FFFFFF
Red	#FF0000
Yellow	#FFFF00
Green	#00FF00
Blue	#0000FF

Activity 12. Colors section



Activity 13. Using the Paint Bucket Tool

a. Click the Paint Bucket Tool 
b. Select an option
c. Click the Fill Color box
d. Select a color
e. Click inside the shape

Activity 14. Using the Ink Bottle Tool

a. Click the Ink Bottle Tool 
b. Click the Stroke Color box
c. Select a color
d. Click the shape

Activity 15. Using the Eyedropper Tool

a. To copy the stroke color: 
   i. Click the Eyedropper Tool
   ii. Place the pointer on the outline of shape whose stroke color you want to copy
   iii. Click the stroke of the shape
   iv. Click the outline of the shape to which you want to apply the copied stroke color

b. **To copy the fill color:**
   i. Click the Eyedropper Tool 
   ii. Place the pointer inside the shape whose fill color you want to copy
   iii. Click the fill of the shape
   iv. Click inside the shape to which you want to apply the fill color

Activity 16. Creating a custom color

a. Select a color from Fill Color palette in the Color Mixer panel

b. Click the triangle on the upper-right corner of the Color Mixer panel
c. From the menu, choose a color mode
d. Edit values in R, G, B, and Alpha boxes
e. From Options menu, choose Add Swatch

Activity 17. Creating a custom gradient

a. From Fill style list, select gradient type
b. Adjust position of the various sliders
c. Display the Options menu and choose Add Swatch

Activity 18. Shape selection tools

a. Selection tool 

i. Select an object by clicking on it with mouse
ii. Or select a group of objects by click-dragging to surround them with a selection box

Making marquee selections

w. Select the Selection Tool or the Subselection Tool
x. Place the pointer at a position where you want the selection to start
y. Drag the pointer to cover all the shapes
z. Release the mouse

d. Lasso tool 

i. Select a group of objects by drawing a freehand or polygonal box around them
ii. Or click, then click to draw polygonal shapes

Making freeform marquee selections

w. Select the Lasso Tool
x. Place the pointer at a position where you want the selection to start
y. Drag the pointer to draw a line around the shapes you want to select
z. Connect the starting and ending points of the line

e. Subselection tool 

i. Lets you manipulate control points in a vector drawing

f. **Selection and Free Transform Tool modifiers**

i. Smoothes out any sharp areas 

ii. Straightens out any curves 

iii. Helps rotate a shape 

iv. Helps resize a shape 

v. Helps distort a shape 

vi. Helps warp and distort objects 

Activity 19. Combining shapes

a. Select a shape

b. Move the selected shape over the other shape to place it in such a way that it represents the shape that you need

c. Deselect the shape

Activity 20. Grouping shapes

a. **To create a group:**
   i. Select the shapes
   iii. Choose Modify, Group

c. **To ungroup shapes:**
   i. Select the group
   ii. Choose Modify, Ungroup

d. **To modify the group:**
   i. Double-click the group
   ii. Make modifications

e. **To deselect the group:**
   i. Double-click anywhere on the Stage

Activity 21. Types of Text

a.Static text
   i. Can be horizontal or vertical

b. **Dynamic text**
   i. Can load text from a data file
   ii. Can be scrollable

c. Input text
   i. Can mask text as password text

d. Creating extending text block

i. Select 

ii. Click where you want to insert text
iii. Type the text

e. Changing font and font size

i. **To change the font:**
   x. In the Properties Inspector, from the Font list, select a font
   -or-
   y. Choose Text, Font, and then choose an option

ii. To change the font size:
   x. In the Properties Inspector, drag the font size slider
   -or-

y. Choose Text, Size, and then choose an option

f. Changing font style

x. In the Properties Inspector, click the Bold or the Italic button

-or-

y. Choose Text, Style and then choose an option

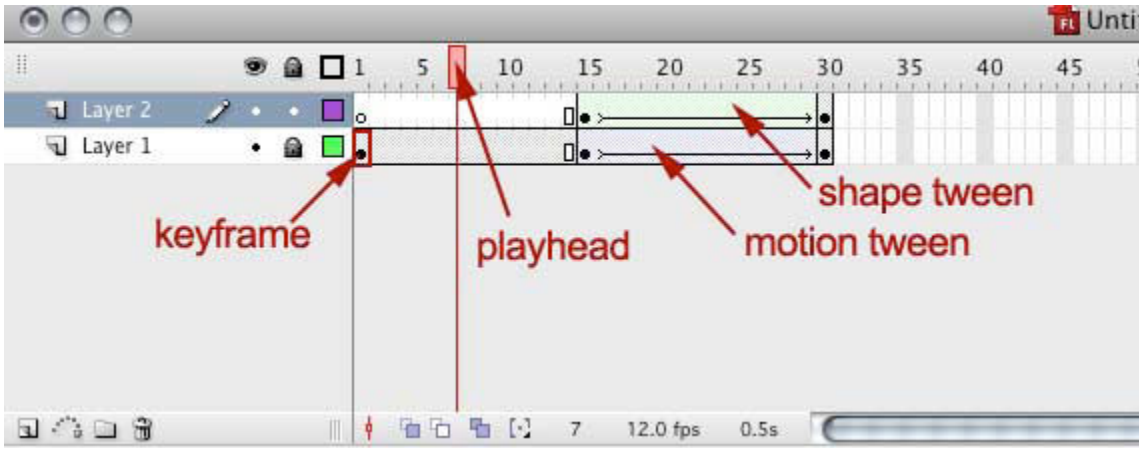
g. Aligning text

x. Choose Text, Align, and choose an alignment option

-or-

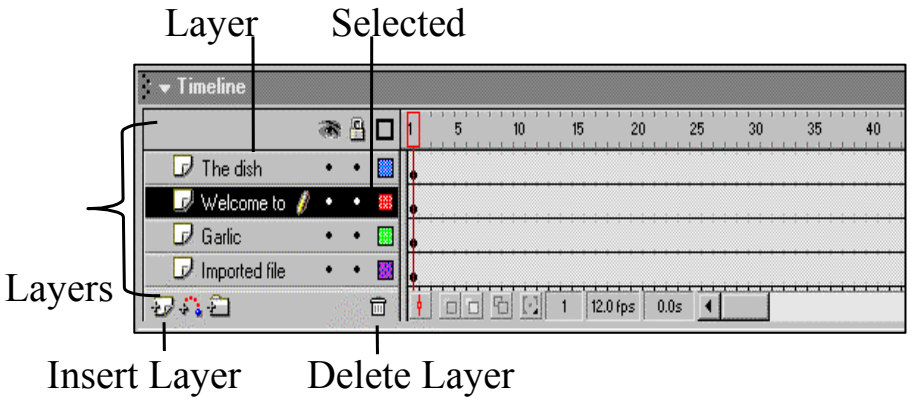
y. Select the text block and click an alignment button (Properties Inspector)

3.8 Flash Timelines and Animation



The timeline is broken into units called **frames** which are displayed in the Flash project at a rate of a certain number of **frames per second** or **fps.** The location of **playhead** along the timeline permits you to see how the stage appears at that moment. *Scrubbing* the playhead along the timeline allows you to see the animation. The action of objects on the stage is controlled by setting **keyframes** at positions along the timeline when it is necessary *to make a change to the object* (position, shape, color, etc.)

Smooth transitions between the shape of two objects or their motion can be made by placing a **tween** between the keyframe at the beginning state of the object and the keyframe at the end state of an object. The objects on the stage are controlled by their independent timelines and organized in **layers**. The layers can be thought of as a stack with the topmost layer appearing at the front of the stage, on top of the other objects.



Renaming a layer

i. Choose Modify, Layer and specify the name

or

ii. Right-click a layer, choose Properties, and specify the name

or

iii. Double-click the layer, type the new name for the layer, and press Enter

Deleting layers:

i. Click

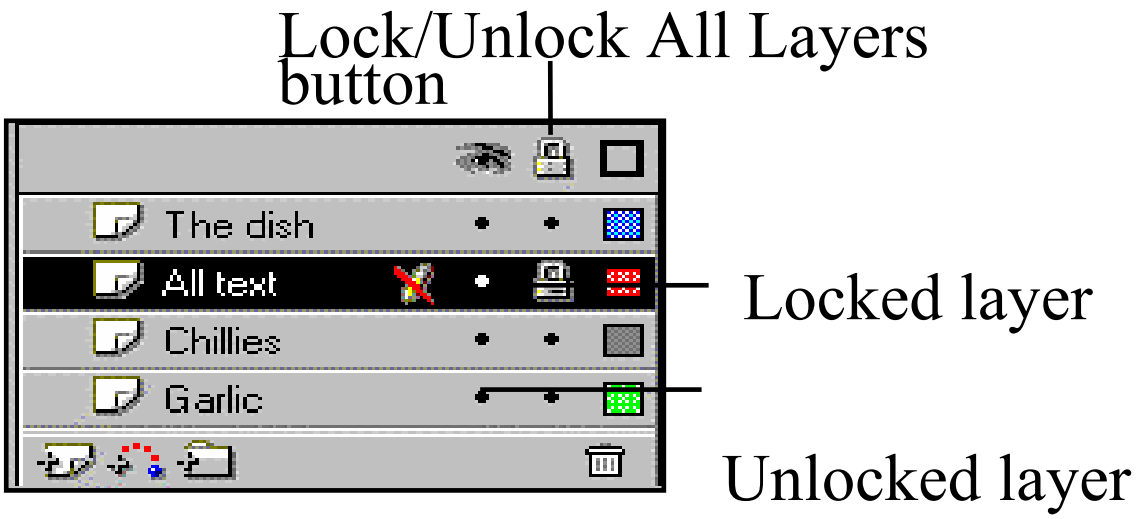
or

ii. Drag the layer to the Delete Layer button

or

iv. Right-click the layer and choose Delete Layer

Locking and unlocking layer



Locking and hiding a layer

3.9 The Panels

Flash panels serve different purposes such as the positioning and alignment of objects on the stage, the control and selection of color, a library of the objects and symbols used in the project.

The most important panel to understand as you develop a project is the **Library Panel**. Component images may be imported to the library or to the stage in their native format. Objects that you draw may also be added to the library.

As you convert the native objects to **symbols** for use in Flash, the symbol also appears in the library. The symbol is only stored once, even though it may appear several times in a project. Once you drag or copy a symbol to the stage, you are only viewing an **instance** of the same symbol.

There are 3 types of symbols:

- **Movie Clip**
- **Button**
- **Graphic**

4.0 Conclusion

Flash is commonly used to create animation, advertisements, and various web page Flash components, to integrate video into web pages, and more recently, to develop rich Internet applications.

5.0 Summary

In this unit, we have learnt that:

i. Flash multimedia authoring is used to create content such as web applications, games and movies, and content for mobile phones and other embedded devices.
ii. Flash provides a good interface for creating graphics from scratch beside its usefulness for creating multimedia content.

iii. The main part of the Flash workspace is the stage, or the visible part of your project.
iv. Flash toolbox contains selection, drawing, editing, and viewing tools.
v. Flash timeline is broken into units called frames which are displayed in the Flash project at a rate of a certain number of frames per second or fps.
vi. Flash panels serve different purposes such as the positioning and alignment of objects on the stage, the control and selection of color, a library of the objects and symbols used in the project.

6.0 Tutor Marked Assignments

1. Download and Install Adobe Flash from www.adobe.com
2. Use Flash to create interactive animated objects which can be used in a given story line.

7.0 Further Readings and Other Resources

Wininstall Macromedia Flash

Animation effects

Mike Christel and Alex Hauptmann (2002). Introduction to Multimedia and MSEC 20-791 http://www.cs.cmu.edu/~christel/MM2002/

Module 4: Multimedia Authoring: Flash Technology and Development

Unit 2: Flash Animation

Module 4: Multimedia Authoring: Flash Technology and Development

Unit 2: Flash Animation

1.0 Introduction

This unit explore flash animation using Corel R.A.V.E.™, a powerful object-based animation program designed for creating animated graphics.

2.0 Objectives

At the end of the unit you will be able to:

- add animation effects to an object
- increase the life span of objects
- tween single objects and tween groups of objects
- preview animation effects
- export a project to the Macromedia Flash™ (SWF) format

3.0 Opening the sample file

You'll start by copying or creating the NOUN logo with CORELDRAW©. If it has been previously created and saved, you can follow the following processes to retrieve it.
1 Click **File** menu ► **Open**.
2 From the **Look in** list box, choose the folder that contains the NOUN logo .
3 Double-click the filename **NounLogo.cdr**.

3.1 Increasing the life span of the logo components

Currently, the logo exists in one frame only. You'll make the logo appear in 20 frames by extending the timelines of all its objects simultaneously. To do this, you'll temporarily group all the objects in the logo.

1 In the **Timeline** docker, click the plus (+) sign to view the logo components. The coffee shop name and the steam coming out of the cup are single curve objects; the cup and the background are each a group of objects.

2 Double-click the **Pick** tool to select all the objects in the logo. Click **Arrange** menu ► **Group**.
3 In the **Timeline** docker, a new group that contains the four logo components displays.
4 Hold down **Ctrl**, and in the **Timeline** docker, drag the black dot associated with the new group to frame 20. Holding down **Ctrl** lets you simultaneously extend the timelines of all objects in a group.
5 Click **Arrange** menu ► **Ungroup**.

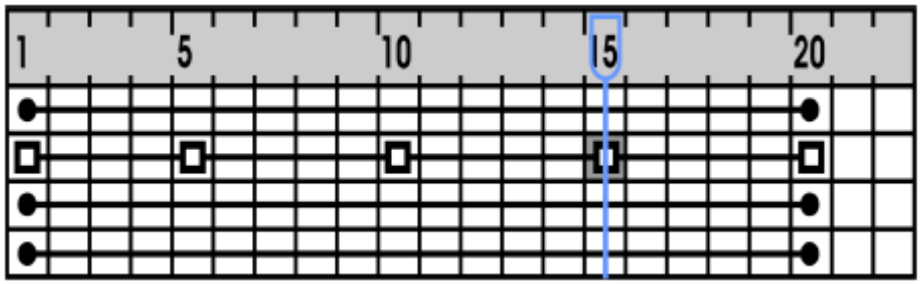
The timelines of all logo components have been extended from frame 1 through to frame 20.

3.2 Tweening an object

Now you'll tween the steam to give it the animation effect of rising from the cup. To accomplish this, you'll add keyframes to the steam's timeline and resize the steam at the keyframes.

To add keyframes

1 In the **Timeline** docker, click the object name **Steam** to select the steam.
2 Click frame 5 in the steam's timeline.
3 In the **Timeline** docker, click the **Insert keyframe** button .
A square that indicates a keyframe displays at frame 5 in the steam's timeline. Also, keyframes are automatically inserted at the start and end frames of the steam's timeline.
4 Repeat steps 2 and 3 to insert keyframes at frames 10 and 15. This is how the steam's timeline should look:



To resize the steam at the keyframes

1 Click the keyframe at frame 1 in the steam's timeline.
2 Hold down **Shift**, and on the stage, drag a corner selection handle inward to resize the steam proportionally.
Holding down **Shift** keeps the center of the steam stationary.
The **Scale factor** stacked boxes on the property bar should display values of about **20%**.
3 Drag the steam down to the top of the cup.
4 Click frame 5 in the steam's timeline.
5 Hold down **Shift**, and on the stage, drag a middle side selection handle inward to reduce the width of the steam.
The upper **Scale factor** box on the property bar should display a value of about **15%**.

3.3 Previewing the animation

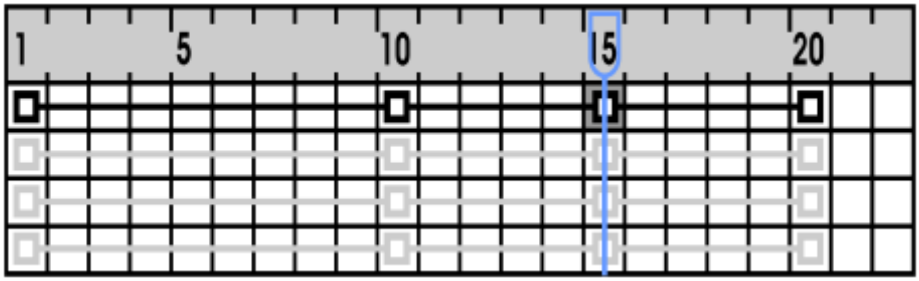
In the **Timeline** docker, drag the playhead from frame 1 to frame 20. The steam rises from the cup between frames 1 and 5 and spreads out between frames 5 and 10. Do not edit the steam at frames 10, 15, and 20, so for now, the steam does not change between these frames.

Tweening a group of objects

Tweening groups of objects lets you quickly add animation effects to images consisting of multiple objects. Now you'll make the cup and the steam appear to turn around between frames 10 and 20. Even though the cup is a group of objects, you'll add keyframes to the group's timeline and edit the group at some of the keyframes as if it were a single object.

To add keyframes to a group's timeline

1 In the **Timeline** docker, click the **Cup** group to select the cup.
2 Click frame 10 in the cup's timeline.
3 Click the **Insert keyframe** button to add a keyframe at frame 10.
4 Repeat steps 2 and 3 to add a keyframe at frame 15.
5 Expand the tree for the **Cup** group to view the timelines of the individual objects within the group. This is how the cup's timeline should look:



You are now ready to edit the cup at the keyframes. You are going to resize the cup and the steam at frame 15.

To resize the cup

1 In the **Timeline** docker, click the keyframe at frame 15 in the cup's timeline.
2 Hold down **Shift**, and on the stage, drag a middle side selection handle inward to reduce the width of the cup. Holding down **Shift** keeps the center of the cup stationary. The resized cup should be about 5 pixels wide. The width of the cup is displayed in the upper **Object(s) size** box on the property bar.

To resize the steam

1 In the **Timeline** docker, click frame 15 in the steam's timeline.
2 Hold down **Shift**, and on the stage, drag a middle side selection handle inward to reduce the width of the steam. If necessary, drag the steam to center it above the cup. The resized steam should be about 5 pixels wide.

To preview the animation by using the movie control panel .
1 On the movie control panel, click the **Play** button .
In the first part of the animation, the steam rises from the cup, while the cup doesn't change. In the second part of the animation, both cup and steam appear to turn around.
2 To stop the preview, click the **Stop** button .

3.4 Exporting a movie

To use a Corel R.A.V.E. project on the World Wide Web, you must export it. Now you'll export the animated company logo to the Macromedia Flash (SWF) format.

1 Click **File** menu **Export**.
2 In the **Save in** list box, choose the folder where you want to save the file.
3 From the **Save as type** list box, choose **SWF - Macromedia Flash.**
4 Click **Export**.
5 Click **OK**.

4.0 Conclusion

Flash animation is the use of Flash technology to create interactive and animated objects.

5.0 Summary

In this unit, we have learnt how to:

i. add animation effects to an object
ii. increase the life span of objects
iii. tween single objects and tween groups of objects by adding keyframes, resizing the steams, cups etc
iv. preview animation effects
v. export a project to the Macromedia Flash™ (SWF) format

6.0 Tutor Marked Assignments

7.0 Further Readings and Other Resources

Corel R.A.V.E. tutorial (2003). Tutorial: Creating an animated logo. Copyright 2002 – 2003 Corel Corporation.

Module 4: Multimedia Authoring: Flash Technology and Development

Unit 3: Introduction Dreamweaver and Cascading Style Sheets

Module 4: Multimedia Authoring: Flash Technology and Development

Unit 3: Introduction Dreamweaver and Cascading Style Sheets

1.0 Introduction

Dreamweaver is high level web editor that writes html,javascript and styling attributes for you. However, it's interface is a bit more complicated than a html coding web editor like Homesite. For this reason Macromedia have provided quite a few tutorials to help learners get familiar with Dreamweaver. Dreamweaver is a easy to use software that allows you to create professional web Pages.

The design edition features of Dreamweaver allow users to quickly add objects and functionality to your pages, without having to program the HTML code manually. It's possible to create tables, edit frames, work with layers, insert JavaScript behaviors, etc., in a very simple and visual way. In addition, it includes a complete FTP client software, allowing among other things to work with visual maps of the Web sites, and updating the Web site in the server without leaving the program.

2.0 Objectives

At the end of the unit you will be able to:

- Learn about Dreamweaver and its difference from using the text editor for writing html
- Be able to navigate around the Dreamweaver environment and use it's various components
- Be able to setup a Dreamweaver site
- Use the image placeholder component and insert tables flash video
- Recognize CSS scripts and be able to use for web page formatting
- Publish a site to the web/internet and it's settings on Dreamweaver

3. 0 HTML Basics

The Pages that we see in the Internet are written using HTML language (HyperText Markup Language). This language is based on tags that mark the beginning and end of each element of the web Page.

For example, the title of the web Page is written between the **<TITLE>** and **</TITLE> tags**. As you see, both labels have a command between the symbols "<" and ">". The first label indicates a beginning, and second, which includes the symbol "/", indicates the end.

The tags have attributes that allow us to define the characteristics of the element on which they act. For example, **<TABLE border="1">** indicates that the table will have a border of width 1.

A basic HTML Page will be like this:

<HTML>

<HEAD>

<TITLE> My first web Page </TITLE>

<BODY>

<A href:"http://www.teacherclick.com"> Click here to go to teacherClick</A>

rest of the web Page...

</BODY>

<HTML>

Tags that are introduced in an HTML document are not visible when the document is in a browser (Explorer, Netscape, etc). When a user requests to see a Page, the Web server sends the Page to the browser and it interprets the tags to format the Page.

When we use Dreamweaver to create a web Page we don't have to worry about HTML technicalities**.** Dreamweaver will automatically insert the tags necessary to construct the Page with the defined appearance and content in the graphical editor.

3.1 The Dreamweaver workspace layout

Dreamweaver provides an all-in one- window integrated layout. In the integrated workspace, all windows and panels are integrated into a single larger application window.

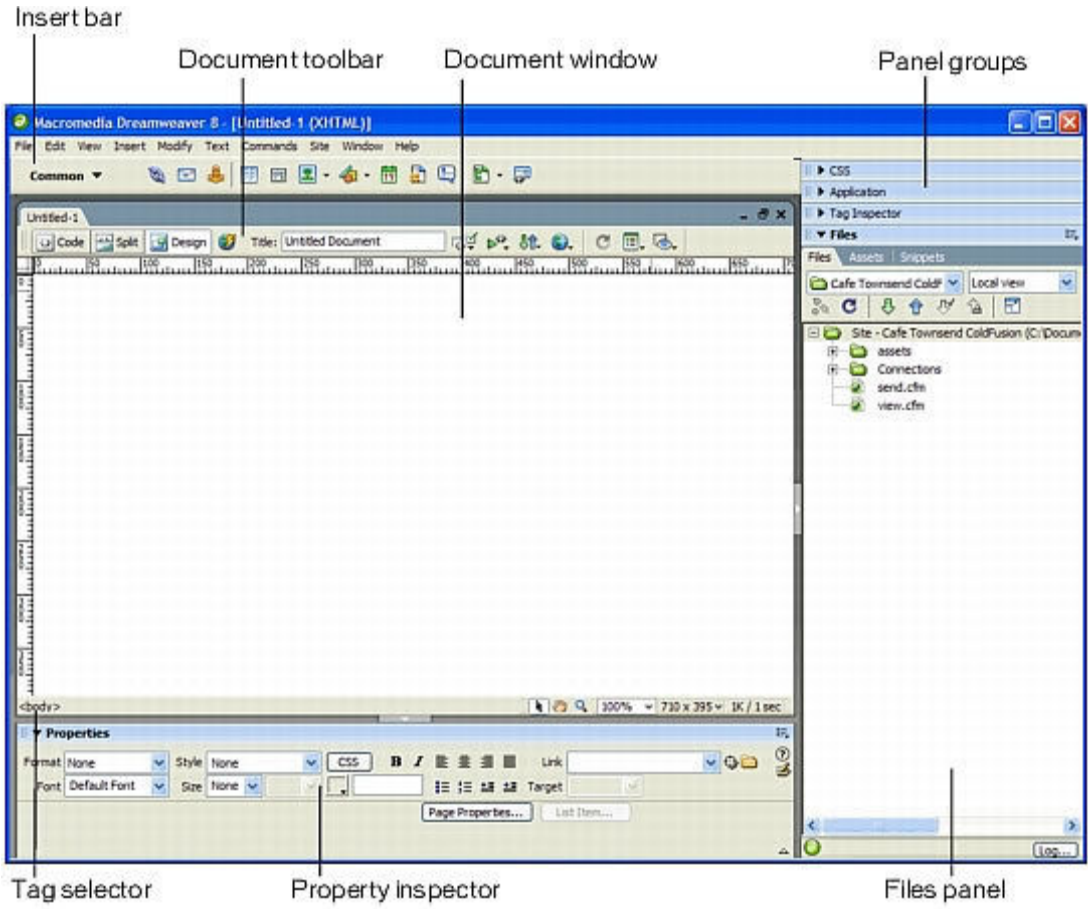
The main elements of Dreamweaver are:

- an object palette - this allows you to insert objects like images, rollovers, tables, navigational bars, email links,flash movie etc. With rollovers it writes the javascript for you.
- launcher palette - this allows you access to a site overview, a library (where you can keep templates etc), css styles (select these from a list after creating them, the

source html code and a history box that allows you to trace your path back and undo things when you change your mind.

- properties palette - this shows you the various options associated with a given tag.

1. Document window

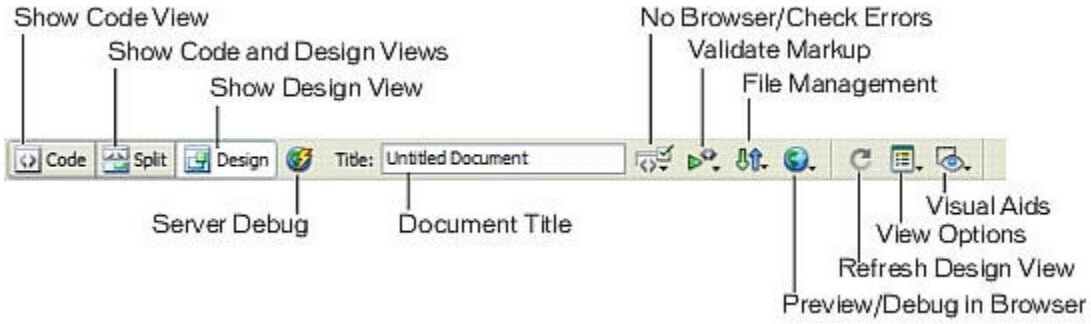


Design view is a design environment for visual page layout, visual editing, and rapid application development. In this view, Dreamweaver displays a fully editable, visual representation of the document, similar to what you would see viewing the page in a browser.

Code view is a hand-coding environment for writing and editing HTML, JavaScript, server-language code- -such as PHP or ColdFusion Markup Language (CFML)--and any other kind of code.

Code and Design view lets you view both Code view and Design view for the same document in a single window.

2. Document toolbar



Server Debug displays a report to help you debug the current ColdFusion page. The report includes errors, if any, in your page.

Document Title allows you to enter a title for your document, to be displayed in the browser's title bar. If your document already has a title, it appears in this field

No Browser/Check Errors enables you to check cross-browser compatibility

Validate Markup lets you validate the current document or a selected tag.

File Management displays the File Management pop-up menu

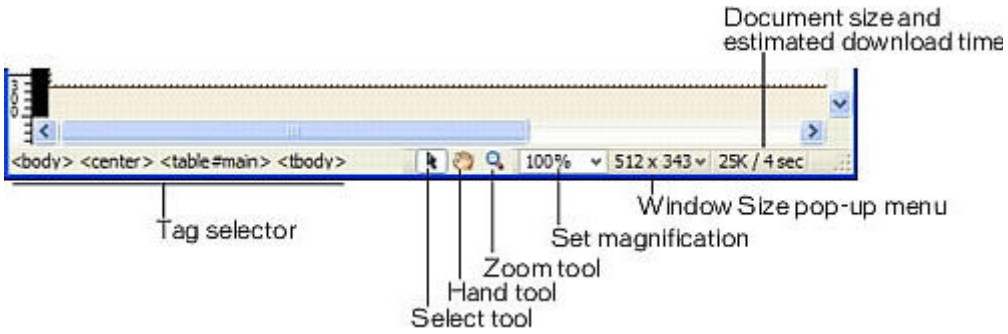
Preview/Debug in Browser allows you to preview or debug your document in a browser. Select a browser from the pop-up menu.

Refresh Design View refreshes the document's Design view after you make changes in Code view. Changes you make in Code view don't automatically appear in Design view until you perform certain actions, such as saving the file or clicking this button.

View Options allows you to set options for Code view and Design view, including which view should appear above the other. Options in the menu are for the current view: Design view, Code view, or both.

Visual Aids lets you use different visual aids to design your pages.

3. Status bar



The tag selector shows the hierarchy of tags surrounding the current selection.

The Hand tool lets you click the document and drag it in the Document window. Click the Select tool to disable the Hand tool.

The Zoom tool and Set Magnification pop-up menu let you set a magnification level for your document

The Window Size pop-up menu (visible in Design view only) lets you resize the Document window to predetermined or custom dimensions.

4. Insert bar

The Common category enables you to create and insert the most commonly used objects, such as images and tables

The Layout category enables you to insert tables, div tags, layers, and frames

The Forms category contains buttons for creating forms and inserting form elements

The Text category enables you to insert a variety of text- and list-formatting tags, such as b, em, p, h1, and ul.

The HTML category enables you to insert HTML tags for horizontal rules, head content, tables, frames, and scripts

Server-code categories are available only for pages that use a particular server language, including ASP, ASP.NET, CFML Basic, CFML Flow, CFML Advanced, JSP, and PHP.

The Application category enables you to insert dynamic elements such as recordsets, repeated regions, and record insertion and update forms.

The Flash elements category enables you to insert Macromedia Flash elements.

The Favorites category enables you to group and organize the Insert bar buttons you use the most in one common place.

5. Coding Toolbar

The Coding toolbar contains buttons that let you perform many standard coding operations, such as collapsing and expanding code selections, highlighting invalid code, applying and removing comments, indenting code, and inserting recently used code snippets. The Coding toolbar is visible only in Code view and appears vertically on the left side of the Document window.

6. Property inspector

The Property inspector lets you examine and edit the most common properties for the currently selected page element, such as text or an inserted object. The contents of the Property inspector vary depending on the element selected. For example, if you select an image on your page, the Property inspector changes to show properties for the image.

7. Dreamweaver sites

In Dreamweaver, the term "site" can refer either to a website or to a local storage location for the documents that belong to a website. A Dreamweaver site consists of as many as three parts, depending on your computing environment and the type of website you are developing.

Local folder is your working directory. Dreamweaver refers to this folder as your local site. The local folder is usually a folder on your hard disk.

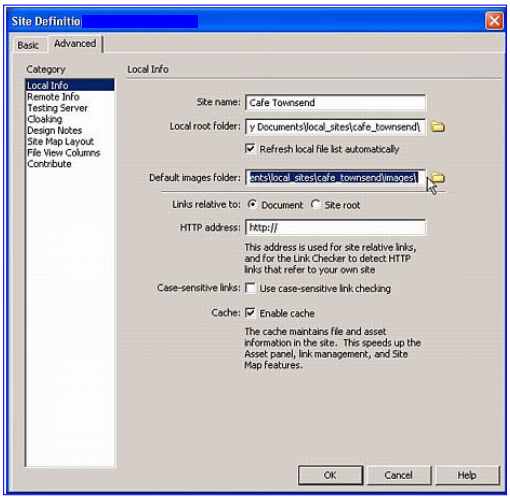
Remote folder is where you store your files, depending on your environment, for testing, production, collaboration, and publication. Dreamweaver refers to this folder as your remote site. The remote folder is a folder on the computer that's running your web server. The computer running the web server is often (but not always) the computer that makes your site publicly available on the web.

Folder for dynamic pages (Testing Server folder) is the folder where Dreamweaver processes dynamic pages. This folder is often the same folder as the remote folder. You do not need to worry about this folder unless you are developing a web application.

Set up your project files

To create a new website, a Dreamweaver local folder must be defined for each new website you create. The local folder is the folder that is use to store working copies of site files on the hard disk. The local folder must be defined for certain Dreamweaver features can work properly.

i. Create and name a new folder called *new local folder* on the hard disk.
ii. Start Dreamweaver and select Site > Manage Sites. The Manage Sites dialog box appears
iii. Click the New button and select Site. The Site Definition dialog box appears.
iv. If the wizard (Basic tab) appears, click the Advanced tab and select Local Info from the Category list (it should be the default).
v. In the Site Name text box, enter the *site name* as the name of the site.
vi. In the Local Root Folder text box, specify the *new local folder* folder that was copied to the local_sites folder in the previous section.
vii. In the Default Images Folder text box, specify the images folder that already exists in the *new local folder* folder.
viii. Click OK.
ix. Click Done to close the Manage Sites dialog box



To save Dreamweaver file

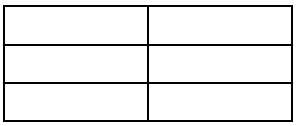
1. In Dreamweaver, select File > New.
2. On the General tab of the New Document dialog box, select Basic Page from the Category list, select HTML from the Basic Page list, and click Create.
3. Select File > Save As.
4. In the Save As dialog box, browse to and open the *new local folder* folder that was defined as the site's local root folder.
5. Enter *index.html* in the File Name text box and click Save.
6. In the Document Title text box at the top of your new document, type *site name.*

7. Select File > Save to save your page

7. Insert tables

a) First we're going to insert a table we click on the second icon down on the left on the objects palette:

Pick a table with two columns and three rows thats 100% wide.



b) Merge the first row by selecting both cells and pressing 'm' (for merge). Type in our first web page with Dreamweaver. Select this text click on the Text menu, Format submenu and then H1. Right click on now on the text and choose edit tag <h1>. Type in align=center.

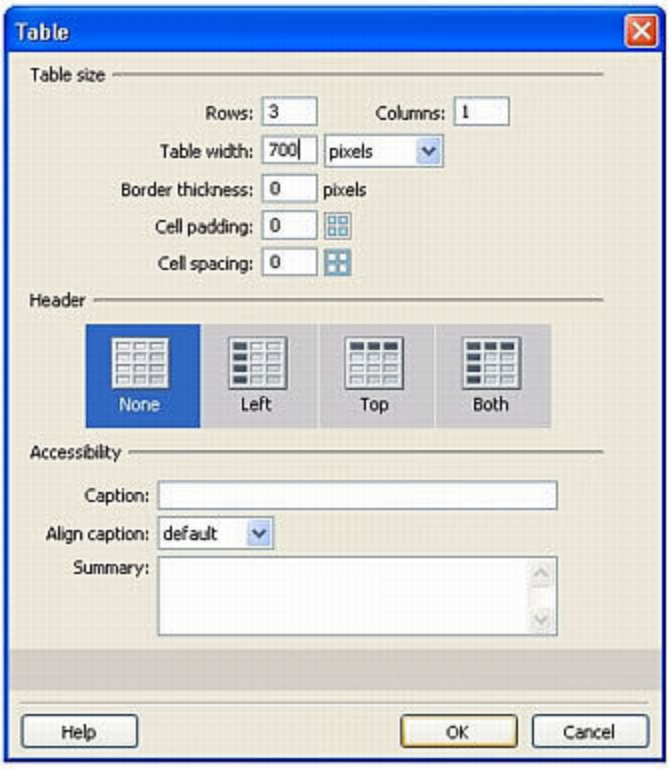
c) Styling can be approached from many different angles in Dreamweaver. To keep to the methods we've learned to date we will format this title using a style sheet.

Click on Text menu, CSS Styles submenu,Edit Style Sheet and then New. Leave the selection at the default custom style sheet (class) and type in a name i.e .title . Choose a font, a color and select underline. Note before we go on that by clicking on the different cathegories that we get access to the various styling features that we used using the TopLite styling editor in Homesite.

Now select the text again choose Text, CSS Styles and then .title which should now be listed.

To insert tables, following the steps below:

1. Click once on the page to place the insertion point in the upper-left corner of the page.
2. Select Insert > Table.



3. In the Insert Table dialog box, do the following:
    a. Enter **3** in the Rows text box.
    b. Enter **1** in the Columns text box.
    c. Enter **700** in the Table Width text box.
    d. Select Pixels from the Table Width pop-up menu.
    e. Enter **0** in the Border Thickness text box.
    f. Enter 0 in the Cell Padding text box.

4. Click OK.

A table with three rows and one column appears in your document. The table is 700 pixels wide with no border, cell padding, or cell spacing.

5. Click once to the right of the table to deselect it.
6. Select Insert > Table to insert another table.
7. In the Insert Table dialog box, do the following for the second table:
    a. Enter **1** in the Rows text box.
    b. Enter **3** in the Columns text box.
    c. Enter **700** in the Table Width text box.
    d. Select Pixels from the Table Width pop-up menu.
    e. Enter **0** in the Border Thickness text box.
    f. Enter **0** in the Cell Padding text box.
    g. Enter **0** in the Cell Spacing text box.
8. Click OK.

    A second table with one row and three columns appears below your first table.

9. Click to the right of the table to deselect it.

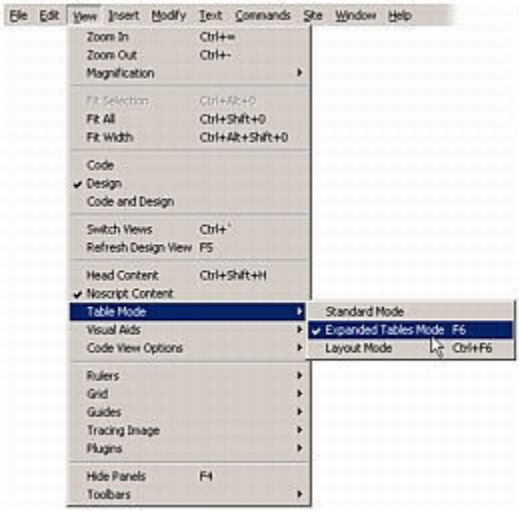
10. Insert a third table by selecting Insert > Table and entering the following values in the Insert Table dialog box:
    a. Enter 1 in the Rows text box.
    b. Enter 1 in the Columns text box.
    c. Enter 700 in the Table Width text box.
    d. Select Pixels from the Table Width pop-up menu.
    e. Enter 0 in the Border Thickness text box.
    f. Enter 0 in the Cell Padding text box.
    g. Enter 0 in the Cell Spacing text box.

11. Click OK.
    A third table, with one row and one column, appears below your second table

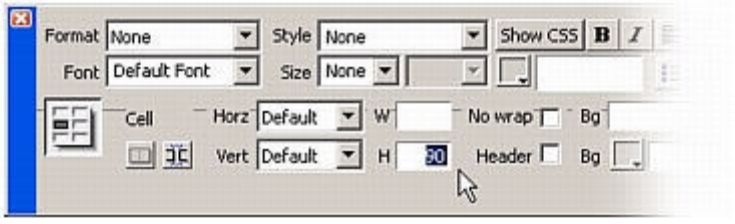
8. Tables' Properties

1. Set table properties

1. Select View > Table Mode > Expanded Table Mode.



2. Click once inside the first row of the first table.
3. In the Property inspector (Window > Properties), enter **90** in the Cell Height (H) text box and press Enter



4. Click once inside the second row of the first table.
5. In the Property inspector, enter **166** in the Cell Height text box and press Enter
6. Click once inside the third row of the first table
7. In the Property inspector, enter **24** in the Cell Height text box and press Enter

8. Click once inside the first column of the second table.
9. In the Property inspector, enter **140** in the Cell Width (W) text box and press Enter
10. Click once inside the second column of the second table.
11. In the Property inspector, enter **230** in the Cell Width text box and press Enter
12. Set the width of the third column to **330** pixels.
13. Finally, click once inside the last table (the table with one row and one column)
14. In the Property inspector, enter **24** in the Cell Height text box and press Enter
15. Click the Exit Expanded Tables Mode link at the top of the Document window to return to Standard mode.
16. Save your page

SELF ASSESSMENT EXERCISES 1

a) Create a site folder in Dreamweaver
b) Draw a table with three columns and ten rows in use colspan to give it a heading
c) Use borders in the tables and make use of background colors for the table use a different color for the column heading

3.2 Insert an image placeholder

An image placeholder is a graphic that you use until final artwork is ready to be added to a web page. An image placeholder is useful when you lay out web pages because it allows you to position an image on a page before you actually create the image.

1. In the Document window, click once inside the first row of the first table.
2. Select Insert > Image Objects > Image Placeholder.
3. In the Image Placeholder dialog box, do the following:
    a. Type **banner_graphic** in the Name text box.
    b. Enter **700** in the Width text box.
    c. Enter **90** in the Height text box.
    d. Click the color box and select a color from the color picker. For this tutorial, select a reddish brown (#993300).
    e. Leave the Alternate Text text box blank.
4. Click OK

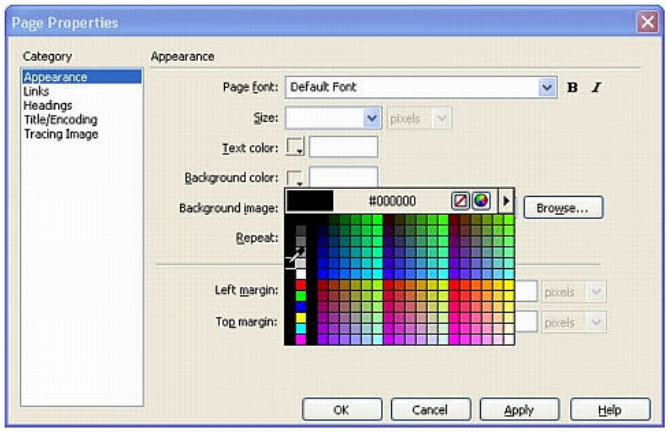
1. Add color to the page

1. Click once inside the first cell of the three columned table
2. Click the <td> tag (cell tag) in the tag selector to select the cell.
3. In the Property inspector (Window > Properties), click once inside the Background Color text box
4. In the Background Color text box, enter the hexadecimal value **#993300** and press Enter
5. Click once inside the second cell of the three columned table.
6. Click the <td> tag (cell tag) in the tag selector to select the cell.
7. In the Property inspector, click once inside the Background Color text box, enter the hexadecimal value **#F7EEDF**, and press Enter

8. Repeat steps 5 through 7 to change the color of the third table cell to light tan as well.

2. Page Properties

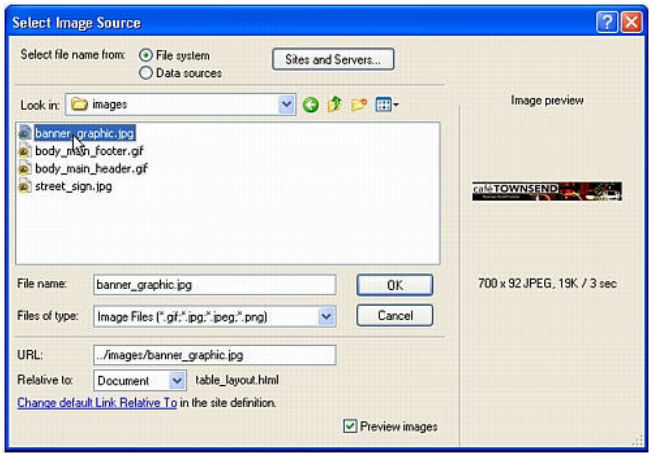
The Page Properties dialog box lets you set a number of page properties, including the size and color of page fonts, the colors of visited links, background color, page margins, etc.



1. Select Modify > Page Properties.
2. In the Appearance category of the Page Properties dialog box, click the Background Color color box and select black (#000000) from the color picker.
3. Click OK.

3 Replacing Imageholder

1. In Dreamweaver, open the index.html
2. Double-click the image placeholder, banner_graphic, at the top of the page.
3. In the Select Image Source dialog box, navigate to the images folder inside the cafe_townsend folder that you defined as your site root folder.



4. Select the banner_graphic.jpg file and click OK.
5. Click once outside the table to deselect the image.

6. Save the page.

4. Insert an image by using the Insert menu

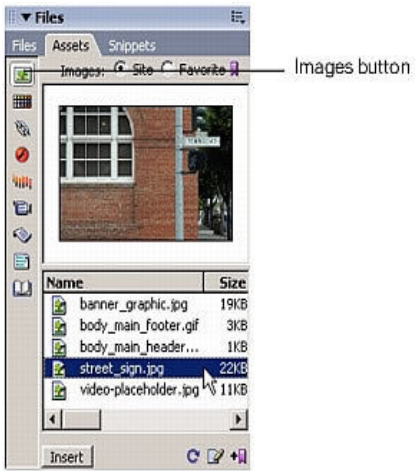
1. Click once inside the third row of the first table (two rows below the banner graphic you just inserted, just above the colored table cells).
2. Select Insert > Image.
3. In the Select Image Source dialog box, navigate to the images folder inside the *new local folder* folder, select the body_main_header.gif file, and click OK.

5. Insert an image by dragging

1. Click once inside the last row of the last table on the page (just below the colored table cells).
2. In the Files panel (Window > Files), locate the body_main_footer.gif file (it's inside the images folder), and drag it to the insertion point in the last table.
3. Click once outside the table and save the page (File > Save).

6. Insert an image from the Assets panel

1. Click once inside the center column of the three columned table (the first table cell that is colored light tan).
2. In the Property inspector (Window > Properties), select Center from the Horz pop-up menu, and select Top from the Vert pop-up menu. This aligns the contents of the table cell in the middle of the cell, and pushes the cell's contents to the top of the cell.
3. Click the Assets tab in the Files panel, or select Window > Assets. Your site assets appear.



If Images view isn't selected, click Images to view the image assets.

7. Insert and play a Flash file

1. With the index.html page open in the Dreamweaver Document window, click once inside the second row of the first table.
2. In the Property inspector (Window > Properties), select Center from the Horz pop-up menu, and select Middle from the Vert pop-up menu
3. Select Insert > Media > Flash.

4. In the Select File dialog box, browse to the flash_fma.swf file (it's in the root folder), select the file, and click OK.
5. The Flash content placeholder should remain selected after you insert the SWF file, as long as you don't click anywhere else on the page.
6. In the Property inspector (Window > Properties), click Play.

8. Insert Flash Video

1. With the index.html page open in the Dreamweaver Document window, click once above the graphic that you placed in the center column of the three-columned table.
2. Select Insert > Media > Flash Video.
3. In the Insert Flash Video dialog box, select Progressive Download Video from the Video type pop-up menu
4. In the URL text box, specify a relative path to the cafe_townsend_home.flv file by clicking Browse, navigating to the *new_ sites*_home.flv file and selecting the FLV file.
5. Select Halo Skin 2 from the Skin pop-up menu.
6. In the Width and Height text boxes, do the following:
    a. In the Width text box, type **180**.
    b. In the Height text box, type **135** and press Enter
7. Leave the default selections for the remaining options:
    a. **Constrain** maintains the same aspect ratio between the width and height of the Flash Video component. This option is selected by default.
    b. **Auto play** specifies whether to play the video when the web page is opened. This option is deselected by default.
    c. **Auto rewind** specifies whether the playback control returns to starting position after the video finishes playing. This option is deselected by default.
8. Click OK to close the dialog box and add the Flash Video content to your web page.

9. Insert body text

1. In the Files panel, locate the sample_text.txt file (in the root folder) and double-click the file's icon to open it in Dreamweaver.
2. In the sample_text.txt Document window, press Control+A (Windows), and then select Edit > Copy to copy the text.
3. Close the sample_text.txt file by clicking the X in the top-right corner of the document.
4. In the index.html Document window, click once inside the third table cell of the three-columned table (the cell to the right of the column that contains the graphic and the Flash video).
5. Select Edit > Paste.
6. Make sure the insertion point is still inside the table cell where you just pasted the text. If it isn't, click inside the table cell.
7. In the Property inspector (Window > Properties), select Top from the Vert pop-up menu. This aligns the text you just pasted to the top of the table cell. If you cannot see the Vert pop-up menu, click the expander arrow in the lower-right corner of the Property inspector.
8. Save the page.

10. Insert text for a navigation bar

1. Click once in the first column of the three columned table (the column that is colored reddish-brown).
2. Type the word **Open Learning**
3. Press the Spacebar and type **Noun**
4. Repeat the previous step until you've entered the following words with a space between each one: **Course, Faculty, Study Centre, Duration**.
5. With the insertion point still in the first cell of the three-columned table, click the <td> tag in the tag selector
6. In the Property inspector (Window > Properties), select Top from the Vert pop-up menu. This aligns the text you just typed to the top of the table cell.
7. Save your page.

3.3 Create links

1. With the index.html page open in the Document window, select the word *Open Learning* that you typed in the first cell of the three columned table. Be careful to select the word *Open Learning* only, and not the space after it.
2. In the Property inspector (Window > Properties), click the folder icon next to the Link text box.
3. In the Select File dialog box, browse to the menu.html file
4. Click once on the page to deselect the word *Open Learning*. The *Open Learning* text is underlined and blue, indicating that it's now a link.
5. Repeat the previous steps to link each word or set of words that you typed for the navigation. You want to create five more links: one for Noun, Course, Faculty, Study Centre, Duration.
6. Save your page.

3.4 Formatting Your Page with CSS

Cascading Style Sheets (CSS) are a collection of formatting rules that control the appearance of content on a web page. When you use CSS to format a page, you separate content from presentation. The content of your page (the HTML code) resides in the HTML file itself, while the CSS rules that define the presentation of the code reside in another file (an external style sheet) or in another part of the HTML document (usually the <head> section).

Cascading Style Sheets (CSS) refines HTML formatting and provides better control over positioning and layering content. CSS lets you control many properties that cannot be controlled with HTML alone. A style sheet is a text file that contains one or more rules that determines how certain HTML elements in web pages should be displayed by setting desire properties and values.. For example, you can specify different font sizes and units (pixels, points, and so on) for selected text. By using CSS to set font sizes in pixels, you can also ensure a more consistent treatment of your page layout and appearance in

multiple browsers. A CSS formatting rule consists of two parts, namely the selector and the declaration**.**

The selector is a term (such as P, H1, a class name, or an id) that identifies the formatted element, and the declaration defines what the style elements are. In the following example, H1 is the selector, and everything that falls between the braces ({}) is the declaration

```
H1 {
        font-size: 16 pixels;
        font-family: Helvetica;
        font-weight: bold;
}
```

The declaration consists of two parts, the property (such as font-family), and the value (such as Helvetica). The preceding example creates a style for H1 tags: The text for all H1 tags linked to this style is 16 pixels in size, and uses Helvetica font and bold. A font-family declaration specifies a specific font you want to use in your site:

```
<STYLE TYPE="text/css">
 .E-LEARNING {
    font-family:"Ahmadu Way", "NOUN", sans-serif;          /* Try these fonts, in order */
     font-size: 24pt;
     font-weight: bold;
     text-transform: uppercase;
}
</STYLE>
<font class="E-LEARNING">Multimedia Learning</font>
```

The term *cascading* refers to your ability to apply multiple styles to the same element or web page. For example, you can create one CSS rule to apply color and another rule to apply margins, and apply them both to the same text on a page. A major advantage of CSS is that it can be updated easily; when you update a CSS rule in one place, the formatting of all of the documents that use the defined style are automatically updated to the new style.

The following types of rules can be defined in Dreamweaver:

1. Custom CSS rules, also called *class styles,* let you apply style attributes to any range or block of text.
2. HTML tag rules redefine the formatting for a particular tag, such as p or h1. When you create or change a CSS rule for the h1 tag, all text formatted with the h1 tag is immediately updated.

CSS selector rules (advanced styles) redefine the formatting for a particular combination of elements, or for other selector forms as allowed by CSS (for example, the selector td h2 applies whenever an h2 header appears inside a table cell.) Advanced styles can also redefine the formatting for tags that contain a specific id attribute (for example, the styles

defined by #myStyle apply to all tags that contain the attribute-value pair id="myStyle").

1. Create a new style sheet

First, you'll create an external style sheet that contains a CSS rule that defines a style for paragraph text. When you create styles in an external style sheet, you can control the appearance of multiple web pages from a central location, instead of setting styles on each individual web page.

1. Select File > New.
2. In the New Document dialog box, select Basic page in the Category column, select CSS in the Basic Page column, and click Create.
3. Save the page (File > Save) as *new_folder*.css.
4. Type the following code in the style sheet:

```
P
{
        font-family: Verdana, sans-serif;
        font-size: 11px; color: #000000;
        line-height: 18px;
        padding: 3px;
}
```

2. Attach a style sheet

When you attach a style sheet to a web page, the rules defined in the style sheet are applied to the corresponding elements on the page. For example, when you attach the *new_folder*.css style sheet to the index.html page, all paragraph text (text formatted with the <p> tag in the HTML code) is formatted according to the CSS rule you defined.

1. In the Document window, open the index.html file.
2. Select the text of the first paragraph that you pasted into the page
3. Look in the Property inspector and make sure that the paragraph is formatted with the paragraph tag.
4. Repeat step 3 for the second paragraph.
5. In the CSS Styles panel (Window > CSS Styles), click the Attach Style Sheet button in the lower-right corner of the panel.
6. In the Attach External Style Sheet dialog box, click Browse and browse to the *new_folder*.css file that you created in the previous section.

3. Explore the CSS Styles panel

1. Make sure the index.html page is open in the Document window.
2. In the CSS Styles panel (Window > CSS Styles), click All at the top of the panel and examine your CSS rules
3. Click plus (+) to expand the <style> tag category if it isn't already expanded.
4. Click the body rule.
5. Click plus (+) to expand the *new_folder*.css category.
6. Click the p rule.
7. In the Document window, click once anywhere in either of the two paragraphs that you

just formatted.
8. In the CSS Styles panel, click Current at the top of the panel and examine your CSS styles. In Current mode, the CSS panel shows you a summary of properties for the current selection. The properties shown correspond to the properties for the p rule in the external style sheet.

4. Create a new CSS rule

1. In the CSS Styles panel, click New CSS Rule in the lower-right corner of the panel
2. In the New CSS Rule dialog box, select Class from the Selector Type options.
3. Enter **.bold** in the Name text box.
4. Select cafe_townsend.css from the Define In pop-up menu. It should be selected by default.
5. In the CSS Rule Definition dialog box, do the following:
    a. In the Font text box, enter **Verdana, sans-serif**.
    b. In the Size text box, enter **11** and select pixels from the pop-up menu immediately to the right.
    c. In the Line Height text box, enter **18** and select pixels from the pop-up menu immediately to the right.
    d. Select bold from the Weight pop-up menu.
    e. Enter **#990000** in the Color text box

5. Apply a class style to text

1. In the Document window, select the first four words of text in the first paragraph:
2. In the Property inspector (Window > Properties), select bold from the Styles popup menu
3. Repeat step 2 to apply the bold class style to the first four words of the second paragraph.

6. Create a new rule for the navigation

1. Open the *new_folder*.css file if it isn't already open, or click on its tab to see it.
2. Define a new rule by typing the following code in the file, after the .bold class style:

```
.navigation {

}
```

3. Open the index.html file if it isn't already open.
4. In the CSS Styles panel, make sure All mode is selected, select the new .navigation rule and click Edit Style in the lower-right corner of the panel.
5. In the CSS Rule Definition dialog box, do the following:
    a. Enter **Verdana, sans-serif** in the Font text box.
    b. Select 16 from the Size pop-up menu, and select pixels from the pop-up menu immediately to the right of the Size pop-up menu.
    c. Select Normal from the Style pop-up menu.
    d. Select None from the Decoration list.
    e. Select Bold from the Weight pop-up menu.
    f. Enter **#FFFFFF** in the Color text box
6. In the CSS Styles panel, make sure the .navigation rule is selected and click Show

List View.
7. Click in the column to the right of the background color property.
8. Enter **#993300** as the hexadecimal value and press Enter
9. Locate the display property (you might need to scroll down), click once in the column to the right, and select block from the pop-up menu.
10. Locate the padding property, click once in the column to the right, enter **8px** as the value, and press Enter
11. Locate the width property, click once in the column to the right, enter **140** in the first text box, select pixels from the pop-up menu, and press Enter
12. Click Show Set Properties so that only your set properties appear in the Properties pane
13. Click on the cafe_townsend.css file to display it. You'll see that Dreamweaver has added all of the properties you specified to the file.

7. Apply the rule

1. With the index.html page open in the Document window, click the word Open Learning so that the insertion point is somewhere in the word.
2. In the tag selector, click the rightmost <a> tag.
3. In the Property inspector (Window > Properties), select navigation from the Style pop-up menu.

8. Add a rollover effect

1. Open the cafe_townsend.css file.
2. Select the entire .navigation rule.
3. Copy the text (Edit > Copy).
4. Click once at the end of the rule and press Enter
5. Paste (Edit > Paste) the copied text in the space you just created.
6. Add the :hover pseudo-class to the pasted .navigation selector, as follows:
7. In the new .navigation:hover rule, replace the current background color (#993300) with #D03D03.

9. Publishing Your Site

Now you'll set up a remote folder so that you can publish your web pages. The remote folder often has the same name as the local folder because your remote site. is usually an exact duplicate of your local site. That is, the files and subfolders that you post to your remote folder are copies of the files and subfolders that you create locally.

1. On your remote server, create an empty folder inside the web root folder for the server
2. In Dreamweaver, select Site > Manage Sites.
3. In the Manage Sites dialog box, select the *Site Name* site.
4. Click Edit
5. In the Site Definition dialog box, click the Advanced tab if the Advanced settings aren't showing.
6. Select Remote Info from the Category list on the left.

7. Select an Access option
8. If you selected FTP, enter the following options:
    a. Enter the host name of the server (such as ftp.macromedia.com).
    b. In the Host directory text box, enter the path on the server from the FTP root folder to the remote site's root folder.
    c. Enter your user name and password in the appropriate text boxes.
    d. If your server supports SFTP, select the Use Secure FTP (SFTP) option.
    e. Click Test to test your connection.
    f. If the connection is unsuccessful, consult your system administrator. For more information, click Help in the dialog box.
9. If you selected Local/Network, click the folder icon next to the text box and browse to the remote site's root folder.
10. Click OK.

10. Upload your local files

1. In the Files panel (Window > Files), select the site's local root folder.
2. Click the blue Put Files arrow icon in the Files panel toolbar
3. When Dreamweaver asks if you want to put the entire site, click OK.

4.0 Conclusion

Dreamweaver is a easy to use software that allows you to create professional web Pages, allow users to quickly add objects and functionality to your pages, without having to program the HTML code manually. It's possible to create tables, edit frames, work with layers, insert JavaScript behaviors, etc., in a very simple and visual way.

5.0 Summary

In this unit, we have learnt that:

i. learn how to interact with the Dreamweaver application.
ii. create tables use the image placeholder for inserting images, rollover effects inserting banners and the correct layout of a webpage.
iii. explain what CSS create CSS rules and to use it in a webpage design.
iv. how to publish a website to the internet.

6.0 Tutor Marked Assignments

Create a webpage for a fiction fashion company that wants to show case it's fashion collection online to numerous people (design with the following specifications in mind and remember that good design with ease of modification would be rewarded)

- A page that shows all clothes in a season (fashion is in seasons) different pages for each season(image placeholders should be used for all images).
- A contact page for information on all the designers of the clothes

- The index page must make use of a flash banner and or video.
- Font, color, active and inactive links should be defined by CSS rules.

7.0 Further Readings and Other Resources

Castro, E. (2007). HTML, XHTML and CSS: Learn HTML, XHTML and CSS the Quick and Easy Way. Peachpit Press, Berkley CA 94710, USA.

Module 4: Multimedia Authoring: Flash Technology and Development

Unit 4: Flash Development: Dynamic HTML and AJAX

Module 4: Multimedia Authoring: Flash Technology and Development

Unit 4: Flash Development: Dynamic HTML and AJAX

1.0 Introduction

Dynamic HTML is a term for a collection of HTML tags and options that let you create Web pages more animated and more responsive to user interaction than previous versions of HTML. DHTML is not a specific technology or a particular scripting language (e.g., JavaScript), but a browser enhancement that allows browsers to be dynamic. Another way of defining DHTML is as HTML that can change even after a page has been loaded into a browser.

2.0 Objectives

At the end of the unit you will be able to:

- To create web pages that are more animated and responsive to user interaction than previous version of HTML.
- To produce browser enhancement that allows browsers to be more dynamic.
- To create (web) document that is treated as a series of components such that every tag in the document (and its contents) becomes an abstract object, as such, it can be manipulated by a programming language.

3.0 Definitions

Dynamic HTML (DHTML) combines 3 technologies, viz-a-viz;

a. **Cascading Style Sheets (CSS)** refines HTML formatting and provides better control over positioning and layering content.

b. **JavaScript** (not Java), a scripting language for web browsers. SCRIPT tag in HTML indicates language: <SCRIPTLANGUAGE="JavaScript">.

c. **Document Object Model (DOM)** exposes all the attributes of HTML and Style Sheets to JavaScript control. DOM lets JavaScript programmers view and modify the properties of web pages, dynamically. The Document Object Model (DOM) is a platform-neutral application programming interface (API) and describes the underlying framework of a document so that Web builders can access and manipulate objects in a standard way. The root of the DOM tree is the document itself; HTML elements and attributes are branches. Dreamweaver includes documentation of DOM Level 1 and Dreamweaver extensions.

Scripts are little programs that add interactivity to web pages and are perfect for moving HTML elements around a web page. They form the backbone of DHTML.

3.1 Dynamic HTML

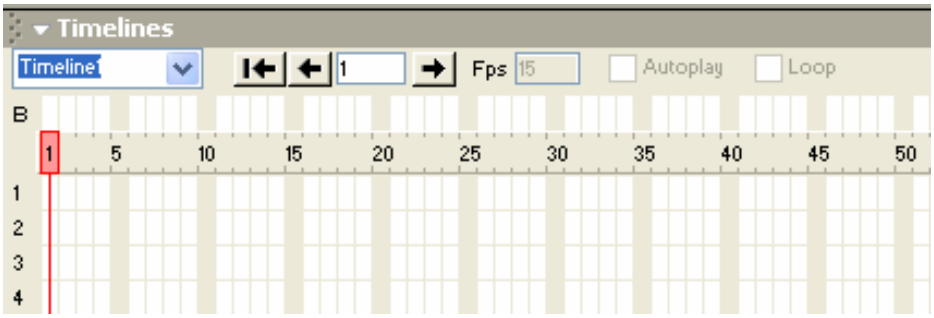
Dynamic HTML introduces the idea of a (web) document that is treated as a series of components, not a string of text. In DHTML, every tag in the document (and its contents) becomes an abstract object, as such, it can be manipulated by a programming language (moved, reformatted, searched), or can send events to a programming language (like mouse activity or time passing), and can be formatted by external style sheets (css), and repeatedly re-formatted programmatically. to accomodate for all this mutable content, the 4.0 browsers introduced the ability to layer content on the page. In everyday web authoring terms, DHTML is usually used for animation, advanced interactivity such as drag'n'drop, autoscrolling, and reactions to mouse use.

DHTML supports animations and rollover effects and it is part of HTML 4.0. Different browsers provide different support for HTML 4.0. JavaScript programs support dynamic behaviors. JavaScript functions manipulate DOM objects while Dreamweaver provides high level interface generating JavaScript code for a few common dynamic behaviors.

Rollover effect in DHTML
The rollover effect is achieved by swapping images from files into memory

a. In Dreamweaver, choose **Insert > Image** & select redlite.gif
b. In **Property Inspector**, enter: "redlight"
c. Set **Border** to 0 (no border around image)
d. Select image, then **windows > Behaviors**
e. Hold down + button and select the **Swap image**
f. Select grnlite.gif as swap image

Dreamweaver generates timeline functions which have similar interface to Flash timelines.



Rollover effect in Javascript

a. Look at source code view in DW
b. **function MM_preloadImages()**:
    i. sets local variable **d** to **document**: why?
    ii. creates **new Array** called **d.MM_p**

iii. **MM_preloadImages.arguments** reads
onLoad="MM_preloadImages('grnlite.gif')"

c. **function MM_swapImage()**:
   i. stores MM_swapImage.arguments
   ii. findObj locates the other image

SELF ASSESSMENT EXERCISES 1

1. What is DHTML?

2. Mention the 3 technology combined in DHTML

3. According to JavaScript highlight the Rollover effect.

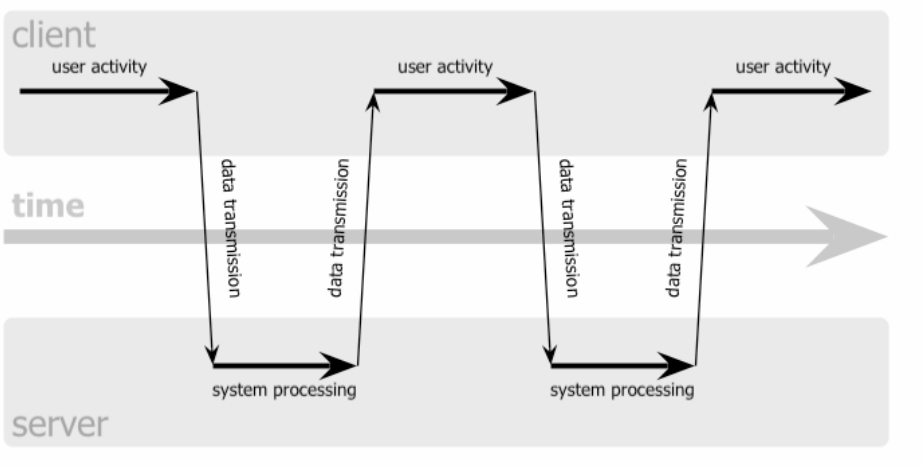
3.2 Asynchronous JAvaScript And XML (AJAX)

Asynchronous JavaScript And XML combines several existing technologies (e.g. CSS and XHTML), create rich and dynamic web pages and improves responsiveness of web based applications. AJAX has the following features

i. Dynamic display manipulation with DOM
ii. Data interchange and manipulation with XML
iii. Asynchronous data retrieval with XMLHttpRequest
iv. JavaScript functions to bind everything together

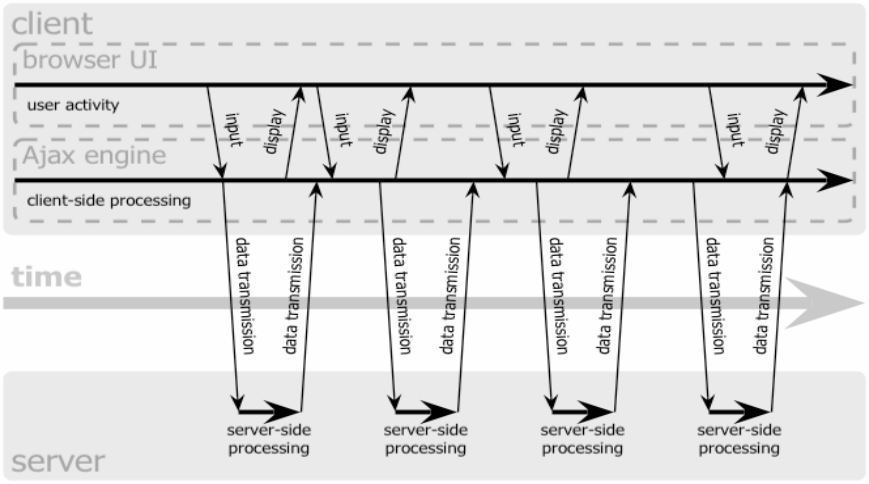
XMLHttpRequest can transfer and manipulate XML data between a client and server. XMLHttpRequest was originally an ActiveX object developed by Microsoft accessible by scripting languages (e.g. such as VBScript). Mozilla 1.0 included a compatible native version, XMLHttpRequest.

The classic web application model is largely static in nature and does not allow user interaction while the information is being processed. While a user interacting with the browser, the server is not processing information for that user.

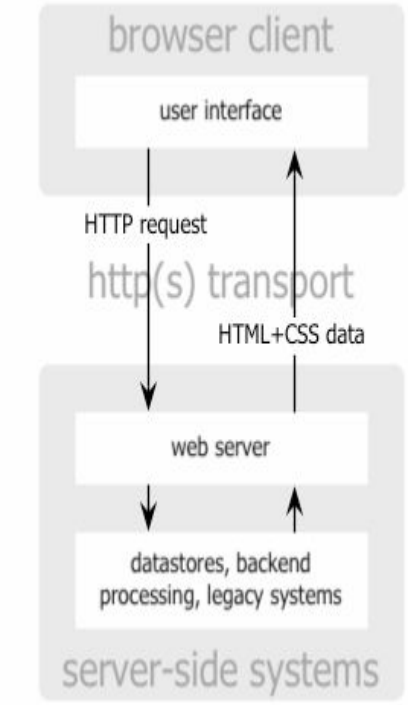


Classic Web Application Model (Synchronous)

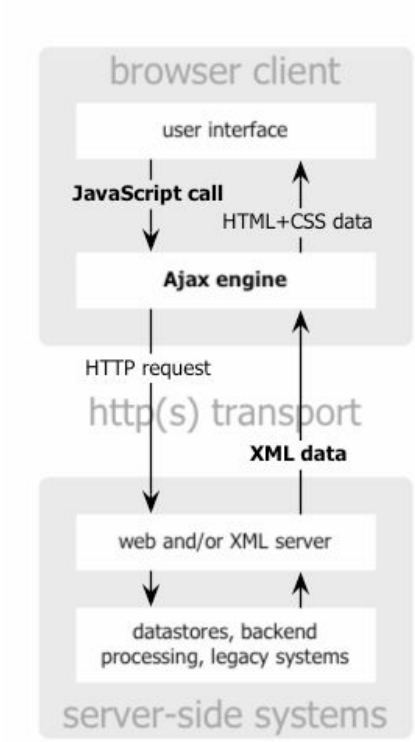
The AJAX Engine is written in JavaScript and serves as an intermediary layer between user and server. Rather than loading a webpage, browser loads the AJAX Engine. AJAX is usually located in a hidden frame, and is responsible for displaying the user interface and communicating with the server. It also allows the user to interact asynchronously – independent of communication with the server and communicates with the server, usually with XML.



AJAX Web Application Model (Asynchronous)



Classic Web Application Model



AJAX Web Application Model

The AJAX Web application model is more responsive than the classic web application model. Any action that does not require the information from the server is handled by the engine while user interaction and data processing can occur concurrently. It is however beguile by technical complexity and potential security issues.

AJAX advantages vs. Flash

i. Searchablitity: text pages are more visible to search engines than Flash
ii. Open source vs. Flash licensing
iii. AJAX does not require plug-ins
    a. However, users must have JavaScript enabled browser.
iv. Cost: Adobe has driven up cost of Flash development
v. Accessibility
    a. Font and color settings in AJAX default to those of the environment
    b. Flash applications use developer specified settings which may be more difficult for disabled users
    c. Screen readers or acceleration keys may not be available in Flash
vi. Security--Flash sites may not be as trusted as an HTML site
    a. Can be used to avoid pop-up blockers

b. Can be used to create immortal cookies

Flash pros vs. AJAX

i. Media Handling: Better handling of sound and graphics
ii. Vector Graphics
    a. May take up less space than bitmaps and are easily scalable
    b. While available in most web browsers, either native or as a plug-in, vector graphics are more commonly used in Flash
iii. Compatibility: No discrepancy between browsers
iv. Machine Access: Flash apps have better access to resources of user's computer

SELF ASSESSMENT EXERCISES 2

1. Mention the 3 technology that combines to make up AJAX.
2. Highlight the 4 features of AJAX.
3. State 4 advantages of AJAX over Flash.

4.0 Conclusion

In a nutshell, DHTML and AJAX are more animated and responsive than the classic web application model.

5.0 Summary

In this unit, we have learnt that:

- web pages created in DHTML and AJAX are more animated and responsive to user interaction than previous version of HTML.
- DHTML and AJAX produce browser enhancement that allows browsers to be more dynamic.
- They create (web) documents that are treated as a series of components such that every tags in the document (and its contents) becomes an abstract object, as such, it can be manipulated by a programming language.

6.0 Tutor Marked Assignments

1. According to the 3 technologies explained in DHTML explain the (web) document that is treated as a series of components such that every tag in the document (and its contents) becomes an abstract object, as such, it can be manipulated by a programming language.

7.0 Further Readings and Other Resources

http://www.adaptivepath.com/publications/essays/archives/000385.php

http://tool-man.org/
http://www.knownow.com/products/docs/whitepapers/KN-Beyond-AJAX.pdf
http://weblogs.macromedia.com/cantrell/archives/2006/01/flash_and_AJAX_1.cfm
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