COURSE NAME

Multimedia Technology

THE COURSE CURRICULUM IS DEVELOPED BY THE OPEN UNIVERSITY MALAYSIA

CMMT6103 MULTIMEDIA TECHNOLOGY

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COURSE GUIDE

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WELCOME TO CMMT6103 MULTIMEDIA TECHNOLOGY

CMMT6103 Multimedia Technology is one of the fundamental courses for the Masters of Information Technology programme. We assume that you have little previous knowledge related to multimedia technology. This three-credit hour course will be conducted over a semester of 14 weeks.

WHAT WILL YOU GET FROM DOING THIS COURSE?

DESCRIPTION OF THE COURSE

Recently multimedia has become widely popular, resulting from the advancement of computing and Internet technology. There are many applications for multimedia in various fields such as entertainment, marketing, simulation and education. This course focuses on basic and general knowledge in multimedia technology. Knowledge on multimedia technology and related skills acquired from this course would update you in a fast-paced world of multimedia.

AIM OF THE COURSE

The objective of the course is to enhance your knowledge in depth about the nature of multimedia technology. You will also be able to examine multimedia hardware and software requirements to create and deliver various types of multimedia applications. We believe this goal can best be accomplished by providing a clear explanation about various principles of multimedia technology. We will supplement this material with problems, examples and cases that illustrate how such multimedia principles and theories are applied.

COURSE LEARNING OUTCOMES

This course aims to provide the basic concepts and principles of multimedia technology and their applications. At the end of this subject, students should be able to:

1. Know the concept of multimedia, multimedia components and multimedia technologies in creating multimedia application projects.
2. Identify elements in multimedia such as text, graphics and animation.

3. To know how to develop each of the elements into a single integrated multimedia application project.
4. Utilize multimedia elements in various multimedia application development projects.

HOW CAN YOU GET THE MOST FROM THIS COURSE?

LEARNING PACKAGE

In this Learning Package you are provided with THREE kinds of course materials:

1. The Course Guide you are currently reading;
2. The Course Content (consisting of 10 chapters); and
3. The Course Assessment Guide (which describes the assignments to be submitted and the examinations you have to sit for) will be given to you in a separate folder.

Please ensure that you have all of these materials.

MIND MAP

The diagram below illustrates how the chapters in this module are divided:

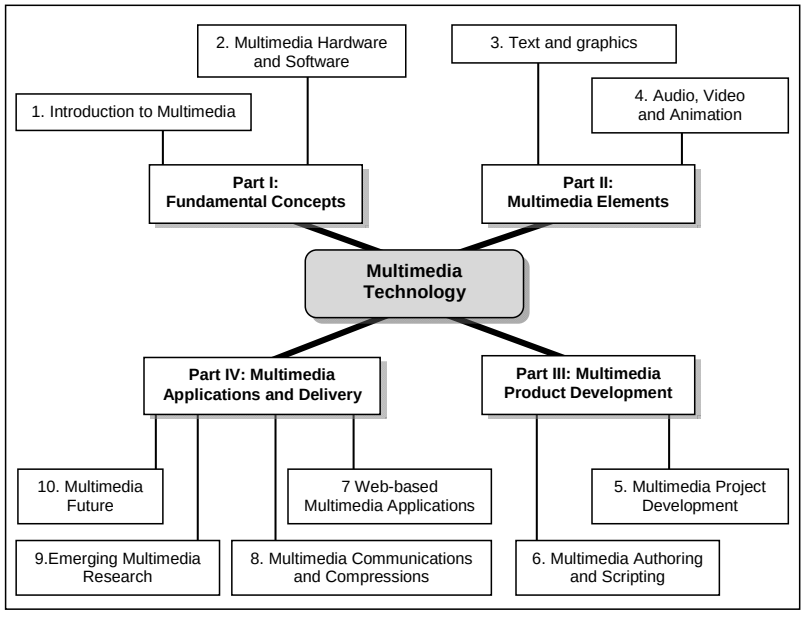

TABLE OF CONTENT

COURSE CONTENT

This course is divided into four parts. Each part consists of between 2-4 chapters. There are 10 chapters altogether.

Part I focuses on the fundamental of multimedia. It introduces what multimedia is as well as the hardware and software that make multimedia work.

Topic 1 Introduction to Multimedia

Topic 2 Multimedia Hardware and Software

Part II deals with five main elements of multimedia which are text, graphics, audio, video and animation.

Topic 3 Text and Graphics

Topic 4 Audio, Video and Animation

Part III discusses various issues with interactive multimedia product design and development process. This part also looks at how authoring and scripting could produce a multimedia system.

Topic 5 Multimedia Project Development

Topic 6 Multimedia Authoring and Scripting

The final part (part IV) deals with multimedia applications and its delivery such as web-based multimedia, as well as communication and compression of multimedia data. The last two chapters expose you to the current trends in multimedia research and the future prospects of multimedia.

Topic 7 Web-based Multimedia Applications

Topic 8 Multimedia Communications and Compressions

Topic 9 Emerging Multimedia Research

Topic 10 Multimedia Future

ORGANISATION OF COURSE CONTENT

In open and distance learning, the module replaces your lecturer. The specially designed learning materials allow you to study at your own pace, anywhere, anytime. It means that you are actually reading the lecture instead of listening to it. The module tells you what to read, when to read and when to do the activities—just as a lecturer might ask you questions in class. Your module also provides exercises for you to do at appropriate points.

To help you understand the individual chapters, numerous examples support the definitions, concepts and theories. Diagrams and text are combined into a visually attractive, easy-to-read module. All the way through the course content, diagrams, illustrations, tables and charts are used to reinforce important points and simplify the more complex concepts. The module has adopted the following features in each chapter:

ACTIVITY

These are situations drawn from situations to show how knowledge of the principles of learning may be applied to real-world situations. The activities illustrate key points and concepts dealt with in each chapter.

SELF-CHECK

Questions are interspersed at strategic points in the chapter to encourage review of what you have just read and retention of recently learned material. The answers to these questions are found in the paragraphs before the questions. This is to test immediately whether you understand the few paragraphs of text you have read. Working through these tests will help you determine whether you understand the chapter and prepare you for the assignments and the examination.

SUMMARY

The main ideas of each chapter are listed in brief sentences to provide a review of the content. You should ensure that you understand every statement listed. If you do not, go back to the chapter and find out what you do not know.

KEY TERMS

Key terms discussed in the chapters are placed at the end of each chapter to make you aware of the main ideas. If you are unable to explain these terms, you should go back to the chapter to clarify.

READINGS

At the end of each chapter, a list of articles and chapters of books is provided that is directly related to the contents of the chapter. As far as possible, the articles and books suggested for further reading will be available in OUM's *Digital Library* which you can access and OUM's Library. Also, relevant Internet resources are available to enhance your understanding of selected curriculum concepts and principles as applied in real-world situations.

HOW WILL YOU BE ASSESSED?

ASSESSMENT FORMAT

There are two aspects in the assessment of the course – one assignment and final examination. A summary of the assessment requirements and the dates for these requirements are shown in the table below.

Component	Marks	Due Date
Final Exam	Final Exam (3 hours) 40%	Examination week at the end of the semester
Assignment	Marks 60%	Seminar 4

WHAT SUPPORT WILL YOU GET IN STUDYING THIS COURSE?

SEMINARS

There are 15 hours of seminars or face-to-face interaction supporting the course. These consist of FIVE seminar sessions of three hours each. You will be notified of the dates, times and location of these seminars, together with the name and phone number of your facilitator, as soon as you are allocated a seminar group.

MYLMS ONLINE DISCUSSION

Besides the face-to-face seminar sessions, you have the support of online discussions. You should interact with other students and your facilitator using MyLMS. Your contributions to the online discussion will greatly enhance your understanding of course content, how to go about doing the assignment and preparation for examination.

FACILITATOR

Your facilitator will mark your assignment. Do not hesitate to discuss during the seminar session or online if:

- You do not understand any part of the course content or the assigned readings.
- You have difficulty with the self-tests and activities.
- You have a question or problem with the assignment.

LIBRARY RESOURCES

The Digital Library has a large collection of books, journals, thesis, news and references which you can access using your student ID.

LEARNER CONNEXXIONS

This is an online bulletin which provides interesting and relevant information to help you along the programme. There are many useful study hints and you can read about the experiences of other distant learners.

HOW SHOULD YOU STUDY FOR THIS COURSE?

1. Time Commitment for Studying
   You should plan to spend about six to eight hours per chapter, reading the notes, doing the self-tests and activities and referring to the suggested readings. You must schedule your time to discuss online. It is often more convenient for you to distribute the hours over a number of days rather than spend one whole day per week on study. Some chapters may require more work than others, although on average, it is suggested that you spend approximately three days per chapter.

2. Proposed Study Strategy
   The following is a proposed strategy for working through the course. If you run into any trouble, discuss it with your facilitator either online or during the seminar sessions. Remember, the facilitator is there to help you.

   (a) The most important step is to read the contents of this Course Guide thoroughly.

   (b) Organise a study schedule. Note the time you are expected to spend on each chapter and the date for submission of assignments as well as seminar and examination dates. These are stated in your Course

Assessment Guide. Put all this information in one place, such as your diary or a wall calendar. Whatever method you choose to use, you should decide on and jot down your own dates for working on each chapter. You have some flexibility as there are 10 chapters spread over a period of 14 weeks.

(c) Once you have created your own study schedule, make every effort to 'stick to it'. The main reason students are unable to cope is because they get behind in their coursework.

(d) To begin reading a chapter:

- Remember in distance learning much of your time will be spent READING the course content. Study the list of topics given at the beginning of each chapter and examine the relationship of the chapter to the other nine chapters.
- Read the chapter overview showing the headings and subheadings to get a broad picture of the chapter.
- Read the chapter learning outcomes (what is expected of you). Do you already know some of the things to be discussed? What are the things you do not know?
- Read the introduction (see how it is connected with the previous chapter).
- Work through the chapter. (The contents of the chapter has been arranged to provide a sequence for you to follow)
- As you work through the chapter you will be asked to do the self-test at appropriate points in the chapter. This is to find out if you understand what you have just read.
- Do the activities (to see if you can apply the concepts learned to real-world situations)

(f) When you have completed the chapter, review the learning outcomes to confirm that you have achieved them and are able to do what is required.

(g) If you are confident, you can proceed to the next chapter. Proceed chapter by chapter through the course and try to pace your study so that you keep yourself on schedule.

(h) After completing all chapters, review the course and prepare yourself for the final examination. Check that you have achieved all chapter learning outcomes and the course objectives (listed in this Course Guide).

FINAL REMARKS

Once again, welcome to the course. To maximise your gain from this course you should try at all times to relate what you are studying to the real world. Look at the environment in your institution and ask yourself whether the ideas discussed apply. Most of the ideas, concepts and principles you learn in this course have practical applications. It is important to realise that much of what we do in education and training has to be based on sound theoretical foundations. The contents of this course provide the platform for conducting research whether it be in a school, college, university or business organisation.

We wish you success with the course and hope that you will find it interesting, useful and relevant in your development as a professional. We hope you will enjoy your experience with OUM.

COURSE ASSIGNMENT GUIDE

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INTRODUCTION

This guide explains the basis on which you will be assessed in this course during the semester. It contains details of the facilitator-marked assignments, final examination and participation required for the course.

One element in the assessment strategy of the course is that all students should have the same information as facilitators about the answers to be assessed. Therefore, this guide also contains the marking criteria that facilitators will use in assessing your work.

Please read through the whole guide at the beginning of the course.

ACADEMIC WRITING

(a) **Plagiarism**

(i) **What Is Plagiarism?**

Any written assignment (essays, project, take-home exams, etc) submitted by a student must not be deceptive regarding the abilities, knowledge or amount of work contributed by the student. There are many ways that this rule can be violated. Among them are:

Paraphrases:	A closely reasoned argument of an author is paraphrased but the student does not acknowledge doing so. (Clearly, all our knowledge is derived from somewhere, but detailed arguments from clearly identifiable sources must be acknowledged.)
Outright plagiarism:	Large sections of the paper are simply copied from other sources, and the copied parts are not acknowledged as quotations.
Other sources:	These often include essays written by other students or sold by unscrupulous organizations. Quoting from such papers is perfectly legitimate if quotation marks are used and the source is cited.
Works by others:	Taking credit deliberately or not deliberately for works produced by others without giving proper acknowledgement. These works include photographs, charts, graphs, drawings, statistics, video clips, audio clips, verbal exchanges such as interviews or lectures, performances on television and texts printed on the Web.
Duplication	The student submits the same essay for two or more courses.

(ii) **How Can I Avoid Plagiarism?**

- Insert quotation marks around 'copy and paste' clause, phrase, sentence, paragraph and cite the original source.
- Paraphrase clause, phrase, sentence or paragraph in your own words and cite your source
- Adhere to the APA (American Psychological Association) stylistic format, whichever applicable, when citing a source and when writing out the bibliography or reference page
- Attempt to write independently without being overly dependent of information from another's original works
- Educate yourself on what may be considered as common knowledge (no copyright necessary), public domain (copyright has expired or not protected under copyright law), or copyright (legally protected).

(b) **Documenting Sources**

Whenever you quote, paraphrase, summarize, or otherwise refer to the work of another, you are required to cite its original source documentation. Offered here are some of the most commonly cited forms of material.

- Direct Citation — Simply having a thinking skill is no assurance that children will use it. In order for such skills to become part of day-to-day behavior, they must be cultivated in an environment that value and sustains them. "Just as children's musical skills will likely lay fallow in an environment that doesn't encourage music, learner's thinking skills tend to languish in a culture that doesn't encourage thinking" (Tishman, Perkins and Jay, 1995, p.5)

- Indirect Citation — According to Wurman (1988), the new disease of the 21st century will be information anxiety, which has been defined as the ever-widening gap between what one understands and what one thinks one should understand.

(c) **Referencing**

All sources that you cite in your paper should be listed in the Reference section at the end of your paper. Here's how you should do your Reference.

Journal Article	DuFour, R. (2002). The learning-centred principal: *Educational Leadership*, 59(8). 12-15.
Online Journal	Evnine, S. J. (2001). The universality of logic: On the connection between rationality and logical ability [Electronic version]. *Mind*, 110, 335-367.
Webpage	National Park Service. (2003, February 11). *Abraham Lincoln Birthplace National Historic Site*. Retrieved February 13, 2003, from http://www.nps.gov/abli/
Book	Naisbitt, J. and Aburdence, M. (1989). *Megatrends 2000*. London: Pan Books.
Article in a Book	Nickerson, R. (1987). Why teach thinking? In J. B. Baron & R.J. Sternberg (Eds). *Teaching thinking skills: Theory and practice*. New York: W.H. Freeman and Company. 27-37.
Printed Newspaper	Holden, S. (1998, May 16). Frank Sinatra dies at 82: Matchless stylist of pop. *The New York Times*, pp. A1, A22-A23.

DETAILS ABOUT ASSIGNMENT

FACILITATOR-MARKED ASSIGNMENT (FMA)

There is ONE facilitator-marked assignment in this course. The assignment counts for 60% of your total course marks. You must be able to complete the assignment from the information and materials contained in your suggested readings and course content. However, it is desirable in graduate level education that you are able to demonstrate that you have read and researched more widely than the required minimum. When you have completed the assignment, submit it together with a FMA form to your facilitator. Make sure that your assignment reaches the facilitator on or before the deadline.

GENERAL CRITERIA FOR ASSESSMENT OF FMA

In general, your facilitator will expect you to write clearly, using correct spelling (please use your spell checker) and grammar. Your facilitator will look for the following: That

- You have critically thought about issues raised in the course
- You have considered and appreciated different points of view, including those in the course
- You have given your own views and opinions
- You have stated your arguments clearly with supporting evidence and proper referencing of sources
- You have drawn on your own experiences

Topic 1 ▶ Introduction to Multimedia

LEARNING OUTCOMES

By the end of this topic, you should be able to:

1. Define multimedia;
2. Discuss the effects of multimedia in your daily life;
3. Identify the five multimedia components;
4. Explain why multimedia is powerful in increasing human-computer interaction; and
5. Describe multimedia applications in several areas.

▶ INTRODUCTION

In the 21st century the evolution of multimedia technology has drastically changed how we communicate, work and play. Multimedia is commonly used nowadays for advertising, entertainment, information dissemination and education, just to name a few. Figure 1.1 shows the various uses of multimedia.

Figure 1.1: The various uses of multimedia
Source: http://www.webmediastudio.com.ar

In this topic you will be introduced to the definition of multimedia. Then we will discuss the main elements of multimedia. In addition, this topic will also examine the popular multimedia applications.

1.1 DEFINITION OF MULTIMEDIA

Multimedia has many definitions. The best way for us to understand the definition of multimedia is by seeing it from our desired perspective or point of view. According to Heller, Martin, Haneef, and Gievska-Krliu, (2001),

"Multimedia (MM) is a polysemous term, a term with many definitions, and in this case, many roots. In this paper, multimedia is defined as the seamless integration of two or more media."

The word "multi" literally means multiple or many (not singular), while "media" is any type of medium that we as human beings can perceive and comprehend. Multimedia thus can be defined as a combination of media types i.e. any combination of text, graphic, sound, animation, and video.
In simple terms, we may say "multimedia" is "more than one media" or multiple media. Multimedia is therefore a blend of a range of communication channels into a co-coordinated communicative experience.

From this definition, we can conclude that multimedia is all about communicating through a combination of various types of media. Multimedia application is concerned with the computer-controlled integration of texts, graphics, drawings, still and moving images, animation, audio, and any other media. These various forms of information can be represented, stored, transmitted and processed digitally.

In the future however, the definition of multimedia can be characterised by the convergence of technology in computers, telecommunications, and television. These incorporate multimedia elements into vivid presentation of data.

However for now we can conclude that multimedia communication is a human-computer interactive process that involves the digital elements of text, graphic, audio, video, and animation.

SELF- CHECK 1.1

1. Define multimedia in your own words.
2. What are the digital elements involved in multimedia?

ACTIVITY 1.1

Visit http://search.yahoo.com. You will see the tabs named Web, Images, Video, etc. on the list. Check out specific multimedia content available on these pages.

Discuss these multimedia contents in myLMS forum and obtain your classmates' feedback.

1.2 MULTIMEDIA AND YOUR DAILY LIFE

Did you know that multimedia has been around since more than 300 years ago? The first mass communication medium to use multimedia was the printed newspaper. At that time it combined two elements of multimedia - text and graphic (printed image). Now we have the e-newspaper or electronic news complete with all elements – text, graphic, animation, audio, and video.
And did you know that the first ever personal computer - digital multimedia computer - was produced in 1975? Built by International Business Machines (IBM), the IBM 5100 had low processor power and just black and green text-only screens (Figure 1.2). Bigger storage space was only developed later when more complicated tasks needed to be done quickly and automatically.

Figure 1.2: The first IBM PC (IBM 5100)
Source: http://www.cedmagic.com/history/ibm-pc-5100.jpg

1981 saw the beginning of the era of multi-display and multi-interaction, spurred on by the use of Microsoft Windows. As we are very well aware of - Microsoft

Windows interfaces multi-content of media through window metaphors. It was at that time aptly named Interface Manager.

In 1987 and the following years it became apparent that those personal computers (PCs) would have a multitude of uses, especially with the onset of colour display. However, until graphical user interfaces (GUI) emerged in the 1990s, the choice of digital media for representing information had been limited to text, iconic symbols, and sounds (Alty, Al-Sharrah & Beacham, 2006).

Now take a look at the first ever mouse – shown in the following Figure 1.3. It made its first appearance in 1973. Compare it with the current mouse that you are using for your PC. What differences do you see?

Figure 1.3: The first Mouse in 1973
Source: http://www.oldmouse.com/mouse/xerox/alto.shtml

Multimedia computing began developing in 1995. Computer systems also progressed tremendously with capabilities to integrate digital video, sounds, and text into hardware and software packages. This, together with the increasing demand for worldwide communications and data sharing also resulted in the rapid "proliferation" of Internet use.

Today, online multimedia content is widely used to enhance communication and understanding. We find numerous multimedia applications in interactive courseware, video conferencing, video-on-demand, interactive television, home shopping, virtual reality, and video editing and production. In our daily lives we see more and more content being delivered in multimedia for advertising, entertainment, training, and education purposes.

Multimedia is now essential in various environments and utilised everywhere (van Nimwegen, van Oostendorp, Burgos, & Koper, 2006). The development of multimedia technology has been one of the fastest growing technologies in the last decade. And this trend is expected to continue tremendously in the near future.

SELF-CHECK 1.2

1. What were the two multimedia elements found in the early version of newspapers?
2. Draw a figure or timeline of the history and development of multimedia technology.

1.3 MULTIMEDIA COMPONENTS

Multimedia data is more complex than textual data in structure and content (Al Bouna & Chbeir, 2006). However an increasing amount of information in various multimedia formats is being stored today. We can see this trend clearly on the Web whereby we find the amount of rich multimedia content increasing rapidly.

There are five multimedia components namely:

(a) Text;

(b) Graphic;

(c) Audio;

(d) Video; and

(e) Animation.

1.3.1 Text

We use text normally as headlines, subtitles, or captions. We can also use text to give direction and to communicate. Text-based menus and buttons help guide us through the navigation process when we use an application. Text is therefore an important aspect of multimedia presentation. An example is shown in Figure 1.4.

Figure 1.4: Examples of text
Source: http://www.mediachance.com/pbrush/help/Resources/text3.jpg

1.3.2 Graphic

The use of graphic is crucial in multimedia to enable better visualisation and information representation. The right **graphic** helps a user learn and retain more information, in less time, and with less effort.

Graphical representation can enhance the information visualisation process better compared to the use of text alone. For example if you want students to "see" a household yearly expense, then you can present the data graphically as shown in Figure 1.5.

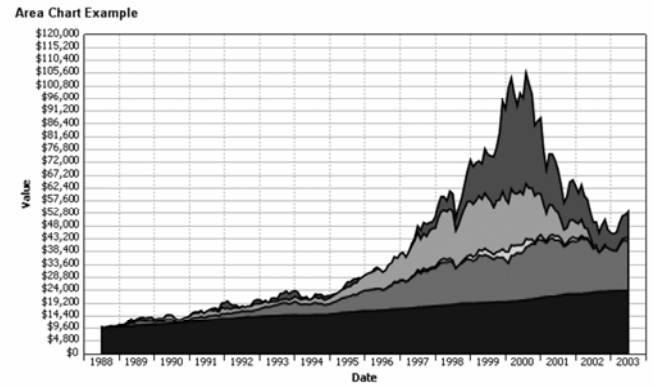

Figure 1.5: Household yearly expense
Source: http://www.ecrion.com/Support/Resources/XSL-FOTutorial/Graphic-2.jpg

Graphics can be broadly categorised into two types - still images or motion images (or video). You have to be very particular about the choice of image that you make for your multimedia application. This is very important because graphics can increase the effectiveness of a teaching and learning process, or it can distract from the purpose. Image editor software such as Adobe Photoshop enables you to modify various elements of images, e.g. by rotating or resizing the image.

1.3.3 Audio

Sound and audio play an important role in multimedia. In multimedia, an analogue sound that has been digitised is called digital audio. You can create audio by capturing a natural sound or your own voice into a personal computer using a microphone. You may also play a set of musical instruments from a keyboard that you connect to a computer.

The technology used here is called MIDI (Musical Instrument Digital Interface).. The most popular sound formats are MP3 (**M**oving **P**icture **E**xperts **G**roup -1 Audio Layer **3**) and WAV (**Wav**eform audio format).

1.3.4 Video

Video can help you enhance a presentation or illustrate a sequence of steps or techniques more clearly. Video files are actually static photographic images played at a certain speed. The images then appear as though they are in full motion. Depending on the screen size of the video file, a single second of uncompressed video running at 30 frames per second may require more than 30 MB of storage space.

An example of video can be seen in Figure 1.6; this is a local video of "Ipin and Upin".

Figure 1.6: Example of video - "Ipin and Upin"

Video is interesting because it is a complete multimedia package by itself. It can be considered a complete multimedia because video consists of almost all the multimedia elements of text, graphic, audio, and animation. There are three major stages in video production - capturing, editing, and presentation.

1.3.5 Animation

Animation refers to static images that change or move. Animation can deliver information, add visual interest, or draw attention to crucial information. Animation can also be an excellent learning aid in a computer-based training program. Animation is created by displaying a series of pictures or frames. Generally there are two types of animation - 2D and 3D.

SELF-CHECK 1.3

1. Identify the five multimedia components.
2. Explain what the capabilities of animation compared to static images.

ACTIVITY 1.2

History Comes Alive as Momentous Aug 31, 1957 Is Re-enacted

KUALA LUMPUR: At the *Merdeka* mammoth celebrations at Stadium Merdeka in 2007, the **multimedia presentation** was inspiring and impressive, and the performances were colourful and lively.

... A holographic image of the Tunku then came on, with the soundtrack of him reading out the credentials. Figure 1.7 shows the multimedia presentation at the *Merdeka* celebrations at Stadium Merdeka.

Figure 1.7: A Holographic Image
Source: The Star, 1 September 2007

Based on the five multimedia components described in Section 1.3 (Multimedia Components), discuss with your friends how the multimedia presentation adds "life" to the Malaysian *Merdeka* Celebration Ceremony.

1.4 FUNCTIONS OF MULTIMEDIA

We can learn about the functions of multimedia though using animation as a learning tool. Animation helps us understand better other visual-based applications and their usefulness. Animation can also help us overcome any fear of technology and programming. Besides that animation can help us develop our creative potential. Through animation learners can therefore become more self-confident and develop courage to work with other applications.

Now let us look at the functions of multimedia, which are as follows:

- Enabling positive and active interaction through intuitive interfacing
- Providing an entertaining and enjoyable experience
- Enabling self-pacing
- Enabling better information retention
- Facilitating better understanding of learning content

(a) Enabling Positive and Active Interaction through Intuitive Interfacing

Representations on the computer screen in the early days were just monochrome i.e. a single colour only. This dull interface does not attract a learner to interact with the application. In multimedia however, the colourful display not only attracts viewers, but within a well designed interface also encourages them to interact further with the elements on screen. A user-friendly interface enables you to intuitively determine computing tasks quickly and easily. An intuitive interface provides hints and guides you to interact more actively and smoothly. Thus you will experience a more effective interaction and positive outcome.

(b) Providing an Entertaining and Enjoyable Experience

Through multimedia you can "magically" immerse yourself in the world of the subject matter you engage in. This immersive experience mimics being face-to-face in the real world. For example some computer games have become so realistic to the point of them becoming addictive. Without multimedia a game is not as challenging, a combat less exciting.

In multimedia-aided learning you may actually find yourself absorbed in the contents. For example, now you have interactive multimedia electronic books. Gone are the days when you only have the textbook to refer to. A subject matter can become alive with the aid of multimedia tools, thus learning no longer needs to be dull but instead becomes more enjoyable and entertaining.

(c) **Enabling Self-Pacing**
Multimedia allows us to control our interaction with the content. We can pace ourselves – we decide how fast or how slow we want to proceed with the content. For example a slow learner can repeat the same educational content as many times as he wishes, until he fully understands it. A fast learner on the other hand may skip the easier topics to move on to more advanced sections.

(d) **Enabling Better Information Retention**
Visuals, sounds, and colours help us remember things. A colourful presentation helps learners retain information better and longer, as opposed to reading silently a single colour textbook.

(e) **Facilitating Better Comprehension of Learning Content**
Multimedia educational tools can provide a boost to students' thinking processes, comprehension, and capability to remember what they have learnt. Studies have shown that by seeing, hearing, and doing simultaneously, we can remember up to 80%. On the other hand, if we only see what we perceive, we may be able to remember up to 20% only.

Through multimedia, simulations and internal processes can be created, "re-enacted", and displayed. For example complex chemical reactions are hard to fully understand. A simplified simulation can be developed using a multimedia system, thus enabling a learner to understand better the complex internal reactions or process.

In a nutshell, the functions of multimedia are as follows (Figure 1.8):

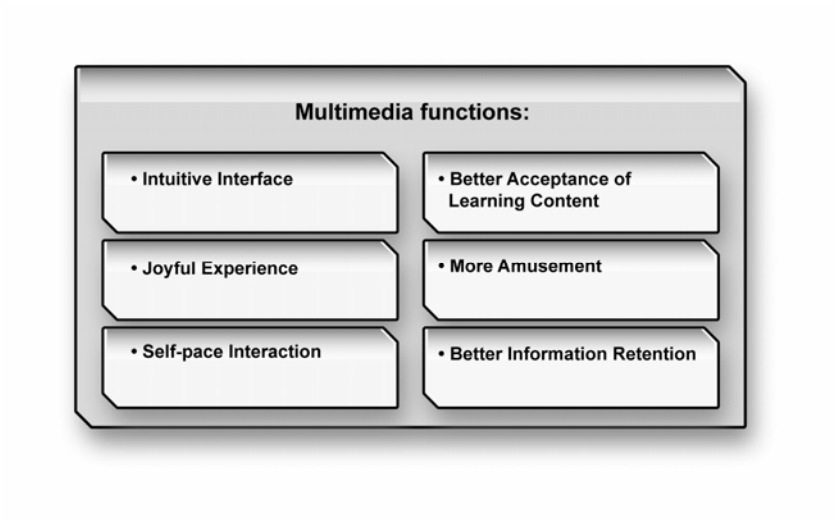

Figure 1.8: Functions of multimedia

1.5 MULTIMEDIA APPLICATIONS

Multimedia applications have become a leading computing trend. Multimedia products are extensively used in education, advertising, entertainment, business, government, and many other fields.

1.5.1 Education and Entertainment

Research suggests that in the teaching and learning process, multimedia plays a larger role in the activities of a course session (Pobiner, 2006). Two main examples of multimedia applications in education that have been used widely are the Computer-Assisted Instruction (CAI) and Computer-Based Instruction (CBI). Further significant development in educational multimedia has also taken place in the form of interactive courseware since more and more multimedia teaching materials are being used extensively in education.

Interactive multimedia courseware helps us present information in a more interactive and interesting way compared to the traditional teaching method. It has been proven that teaching delivered through multimedia is more effective for students. As a result, students have a better understanding of the concepts or subjects learnt.

Figure 1.9 is an example of an application of multimedia combining "education" with "entertainment" - termed "edutainment". It shows two screenshots of children's software that has been used in the teaching and learning process to help children understand concepts better. As we can see this edutainment makes educational delivery more interactive and interesting.

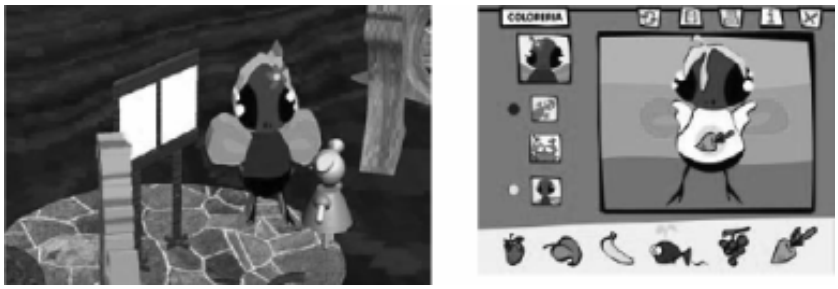

Figure 1.9: Application of multimedia in edutainment
Source: Garzotto & Forfori (2006)

The idea underlying edutainment is to promote learning by merging educational contents and entertainment activities that increase engagement, emotion and motivation (Garzotto and Forfori, 2006). Edutainment is a form of entertainment designed to teach as well as to entertain. Edutainment usually inquires about

how to instruct or entertain its audience or learners by embedding lessons in some well-known form of entertainment.

One very good example of edutainment is a hugely popular educational TV programme called "Sesame Street". Compared to reading a book, this programme helps children understand better as the learning environment is not only interactive, but also so much fun. Multimedia elements such as animation and sound effects are all combined with texts and images to provide a total edutainment experience.

Multimedia use in infotainment - "information" and "entertainment" - just like edutainment also makes information delivery more interactive and interesting. The emergence of broadcasting, entertainment and telecommunications technology has increased the demand for computers. Interactive TV, computer games and the Internet offer you not only with the ability to select specific content for your infotainment, but also to modify the content. One example is the local ASTRO channel.

Nowadays digital libraries and the development of digital editions of books allow contents, the "e-books" to be made available online and transferred electronically. The digital library of Open University Malaysia (see Figure 1.10) represents an opportunity to apply new technologies to provide library services to an increasingly diverse and distributed population. The OUM digital library has a user-friendly interface for you to access all kinds of printed resources such as articles, proceedings, journals, and books.

Figure 1.10: OUM digital library

ACTIVITY 1.3

1. List out the popular educational and training titles or packages currently available in the market.
2. Discuss why some packages are more popular compared to others.

1.5.2 Business and Advertisement

Multimedia applications are used in businesses to manage company information systems such as in accounting, sales and marketing, and customer relationship management. Multimedia is used in business promotions and presentation purposes. For example the company corporate video is an important promotional tool to attract clients. Other than that, sales promotions employ multimedia contents to promote products and services. Multimedia presentations are also used in showrooms to describe products or services of the organisation. Company websites encompassing organisational multimedia contents for public relations and marketing purposes have become an online business showcase available 24/7/365 (24 hours a day, 7 days a week, 365 days a year) for the whole wide world to view.

Multimedia has greatly benefited the business world as it has been applied in various advertising purposes for different products through channels such as the broadcasting media. For example to create appealing advertisements for TV broadcast, millions of dollars have been invested. E-mail advertising is another application of multimedia for interactive promotion of a product or service to individuals or specific potential markets. With the integration of multimedia elements such as video and animation, potential clients and customers are able to interact through the contents of an email.

1.5.3 Entertainment

Multimedia is extensively used in the entertainment industry especially to develop special effects in movies and animations. Animated pictures are used to represent the dynamic aspects of complex scenes through 3D modelling. This model is often used in science fiction (sci-fi) films as well as TV advertisements.

The application of multimedia systems in games makes possible innovative and interactive entertainment that greatly enhances players' experience. The use of multimedia elements in designing games enables more interesting layouts,

exciting experiences, and enhanced interactive settings. The interactive multimedia system is the multimedia application that allows players to actively participate instead of just sitting by as passive recipients of information.

With further new digital multimedia applications in entertainment, future entertainment could be structurally different from entertainment offered in the past.

1.5.4 Medical

Multimedia applications are also utilised in the medical field. For example, in the human anatomy model, the functions of the human body are displayed through the use of multimedia presentation. By using this method, the concepts presented become more effective and understandable for students to grasp. Hence they can relate the process of the human functions to others using the same method.

A medical simulator is another example of multimedia application in the medical field. More recently interactive multimedia anatomy models have also been developed; these are able to respond to actions taken by a student or physician.

DISCUSSION 1

MULTIMEDIA CURRENT TREND

The curent trend toward the removal of any conceiveable bottleneck for those using multimedia data, from advanced research organizations to home users, has left to the explosive growth of visual information available in the form of digital libraries and online multimedia archives.

This explosive growth of multimedia data accesible to users poses a whole new set of challenges relating to data storage and retrieval. The current technology of text-based indexing and retrieval implemented for relational database does not provide practical solutions for this problem of managing huge multimedia repositories.

(Bashir, Khanvilkar, Khokhar & Schonfeld, 2005)

Discuss this trend with your classmate in MyLMS forum.

DISCUSSION 2

LOCAL MULTIMEDIA CONTENT

CYBERJAYA: The Multimedia Development Corp (MDeC), custodian of the MSC Malaysia Initiative, is increasing its efforts to help develop the local creative content industry.

Its efforts now include the building of the Malaysian Animation Creative Content Centre (MAC3) in Cyberjaya as well as initiating a new business matching programme **to develop and promote local content.**

Speaking after the National IT Council meeting last week, MDeC chief executive officer Datuk Badlisham Ghazali said MAC3 can help in the unearthing of new talents to help develop the local creative content industry.

[The Star, 28 August 2007]

Discuss in myLMS forum how you would define local creative multimedia content, and obtain your classmates feedback.

SUMMARY

- Multimedia communication is defined as a human-computer interactive process that involves the digital elements of text, graphic, audio, video, and animation.
- The development of multimedia technology has changed the way we work and play.
- Interactive multimedia has several capabilities in enabling intuitive interfacing, better comprehension of learning content, enjoyable experience, self-paced interaction, and better information retention by the users.
- Multimedia applications can be found extensively in education, business, entertainment, and the medical field.

KEY TERMS

Computer-Assisted Instruction (CAI)	Intuitive Interface
Computer-Based Instruction (CBI)	Mobile Multimedia
Edutainment	Monochrome Display
Interactive Courseware	Multimedia
Interactive TV	Video-on-Demand (VOD)

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Topic 2 ▶ Multimedia Hardware and Software

LEARNING OUTCOMES

By the end of this topic, you should be able to:

1. Recognise analogue and digital conversion process;
2. Discuss the hardware requirements of a multimedia system; and
3. Classify multimedia software based on its function.

▶ INTRODUCTION

In Topic 1, we were introduced to basic multimedia concepts. In this second topic, we will learn about multimedia hardware and software. The hardware and software are the components that will determine whether the multimedia needs can be met.

The components which display the data or information that has been processed by the CPU are the output devices. Examples of main output devices are the monitor, speaker, and printer. Several current hardware technologies such as the DDR2-SDRAM (**D**ouble **D**ata **R**ate **2** - **S**ynchronous **D**ynamic **R**andom **A**ccess **M**emory) will also be introduced here in this Topic 2. We will also get to know a few multimedia editing tools and other software.

2.1 ANALOGUE AND DIGITAL DATA

The need for multimedia rich data has been greatly and rapidly increasing and this type of data requires high processing power and memory. Not only that, if

the data is in a non-digital or analogue form, it has first to be converted into a digitised form.

Initially multimedia data has been stored in the form of bits and bytes. For this data to be processed and stored digitally, it must first be changed from its original analogue signals into digital ones. From the nature of the process you can guess what the process is called - the analogue-to-digital conversion.

Figure 2.1 shows the graph of the data value over time for analogue and digital signals.

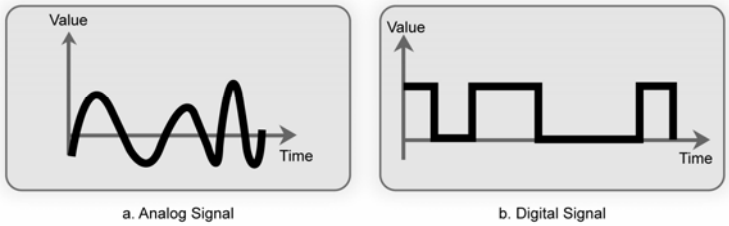

Figure 2.1: The Graph of (a) Analogue; and (b) Digital Signal

The process of obtaining digital data from its analogue form is called **digital processing.** The most common situation where digital processing is involved is the digital audio processing. This process uses a converter called **D**igital-to-**A**nalogue **C**onverter (DAC). On the other hand, the reverse process needs an **A**nalogue-to-**D**igital **C**onverter (ADC).

Figure 2.2 shows the process involved in transforming a digital signal to analogue and vice-versa.

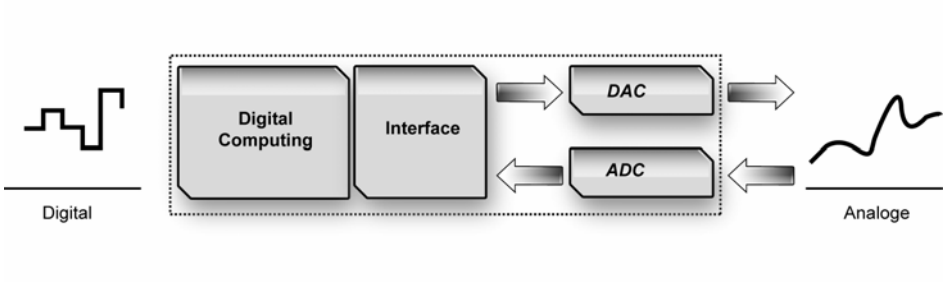

Figure 2.2: Process of transforming digital signal to analogue and vice-versa

SELF-CHECK 2.1

1. Draw a process diagram to show the conversion of digital data into analogue and vice versa. What are the digital elements involved in multimedia?
2. Why does a multimedia computer only process digital data?

2.2 HARDWARE REQUIREMENTS

Multimedia hardware requirements consist of the following items:

(a) The processing unit;

(b) The memory;

(c) **U**niversal **S**erial **B**us (USB) Device;

(d) Graphics Card and **G**raphical **P**rocessing **U**nit (GPU);

(e) Hard drive;

(f) Monitor; dan

(g) External storage and optical device.

2.2.1 Processing Unit

I am sure you agree that the **C**entral **P**rocessing **U**nit (CPU) is the most important component of a computer. Think of how important the brain is to us. The CPU works like a brain. Some of the more popular CPU brands in today's market are AMD (**A**dvance **M**icro **D**evice) and Intel. The CPU is also known as a processor or microprocessor.

The functions of the CPU are as follows (Table 2.1):

Table 2.1: Functions of the CPU

Functions of the CPU	
1.	Interpret data or input given to it
2.	Assess logic of instruction
3.	Process instruction received and execute program
4.	Produce expected result of process
5.	Control combination of input and output devices

Have you ever seen the inside of the CPU case of your computer? If you have, you would probably have found it similar to the following Figure 2.3.

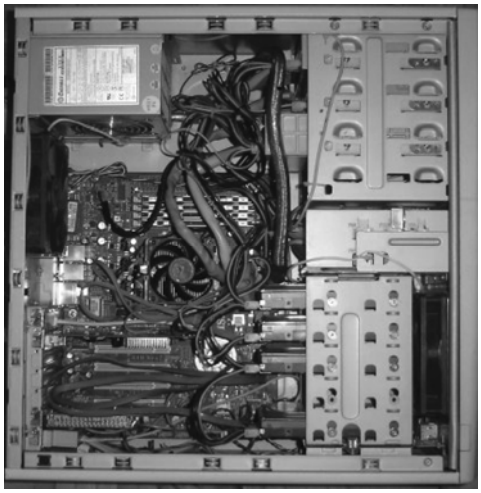

Figure 2.3: CPU Components
Source: http://blog.aurel32.net/wp-content/athlon64_box.jpeg

2.2.2 Memory

Computer memory or normally just referred to as the "memory" is the **computer recording component** that retains digital data on your computer. Primary storage (the **R**andom **A**ccess **M**emory or RAM) system is volatile or unstable; therefore we cannot rely on it for our files to be saved once we shut down the computer. To overcome this shortcoming, we need other secondary memory peripherals such as a hard disk or hard drive. This permanent storage ensures that our file or data is saved inside the computer.

In terms of RAM, the most current desktop computer uses the **D**ouble **D**ata **R**ate **S**ynchronous **D**ynamic **R**andom **A**ccess **M**emory (DDR SDRAM). This type of memory is far better compared to the preceding **S**ingle **D**ata **R**ate SDRAM (SDR SDRAM) or commonly known as just SDRAM. Now we have the DDR2 SDRAM - its transfer rate is almost double that of the (SDR) SDRAM.

For example, with a bus frequency of 100 MHz, DDR SDRAM performs a maximum transfer rate of 1600 MB/s. DDR2 SDRAM technology is used for high-speed storage and memory requirement. Its primary ability is in speed, which enables faster processing demands for high-speed storage of the computer data or other electronic devices.

2.2.3 Universal Serial Bus (USB) Device

The computing term "bus" stands for **B**i-directional **U**niversal **S**witch (which in a way is not quite different from our normal understanding of the bus used for travelling). The term **bus** in computing systems refers to the system that **transfers data between computer components** or between computers. Now, to transfer data between computers, a standard interface between the computer devices or peripherals is needed. This is where the USB or **U**niversal **S**erial **B**us is required – it is a serial bus standard to interface with a series of computer devices or peripherals. USB is a new personal computer interconnection protocol.

The USB allows us to connect our computer devices such as the digital camera, thumb drive, and printer using a standardised socket. We just simply need to plug these devices into our PC USB port. The USB has been developed so that we can connect these peripheral devices to our computers easily and efficiently.

2.2.4 Graphics Card and Graphical Processing Unit (GPU)

The function of a graphics card is to generate better output images on a monitor. This card is normally a separate card that we plug into an expansion slot in our computer motherboard. Some graphics cards offer added functionalities such as video capture. This card is not only for PC, but also for other platforms such as the Apple Macintosh.

Higher-end graphics cards were released in the late 90s following a higher demand for 3D display. "Voodoo" cards by 3dfx and TNT and TNT2 by NVIDIA were among the early ones marketed. Figure 2.4 is an example of a graphics card.

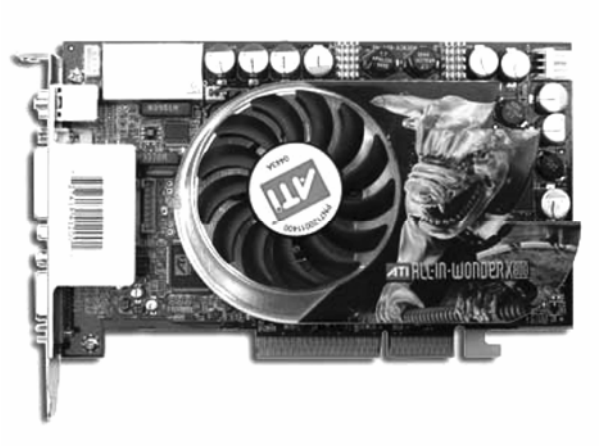

Figure 2.4: Graphics Card
Source: http://byteintotechnology.files.wordpress.com/2007/05/graphics-card-4.jpg

Besides the graphics card, another processor is needed. Termed the **G**raphics **P**rocessing **U**nit or GPU, this is a special processor for graphics rendering that we can find in PCs or game consoles such as the PS2. The GPU is important to enable the best computer graphics output display such as 3D image rendering. Current GPUs even support almost-real video-related functions. We can obtain better gaming experience if we have a GPU fixed at our computer. Among the GPU manufacturers are AMD, NVIDIA, Matrox, and XGI.

Figure 2.5 shows the GeForce 6600 GT GPU produced by NVIDIA.

Figure 2.5: GPU
Source: http://en.wikipedia.org/wiki/Image:6600GT_GPU.jpg

2.2.5 Hard Drive

A hard disk drive (HDD) is a non-volatile storage device we find in almost all computers. It stores digital data on rotating platters with magnetic surfaces. The magnetic hard disk drive has undergone immeasurable technological development since it was introduced over 50 years or so ago. The top HDD manufacturers today are Seagate and Western Digital.

HDD is typically a sealed unit attached to your computer motherboard components. Nowadays applications of HDDs have extended beyond computers. Versions of HD can now be found in our **p**ersonal **d**igital **a**ssistants (PDAs) and digital cameras.

Technically - to read and write on the surface of the disks - the drive uses a small electro-magnet assembly referred to as the "head". We can estimate the capacity or size of a hard disk in terms of gigabytes (previously in megabytes). In terms of data transfer rate, it ranges from 44.2 MB/s to 111.4 MB/s. Its random access time ranges from 5 ms to 15 ms.

The physical size of the hard disk in our desktop PC is 3.5 inches wide. Figure 2.6 shows the dismantled component of a hard disk.

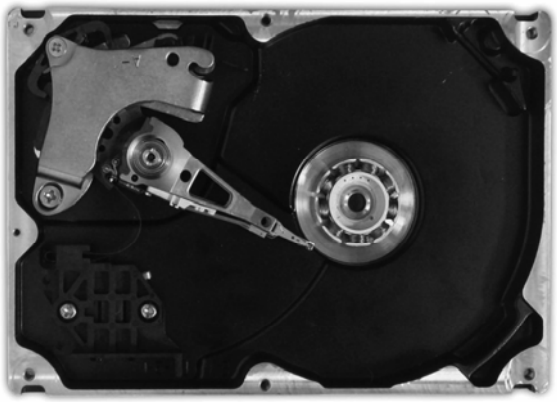

Figure 2.6: Hard Disk
Source: http://en.wikipedia.org/wiki/Image:Hard_disk_dismantled.jpg

2.2.6 Monitor

A monitor keeps us informed of the result of the computing process that we want. Can you imagine how hard it is for us to "monitor" our computing tasks if our computer set does not have a monitor?

Many kinds of monitors have been designed over the past two decades. Traditionally, the main component of a monitor was the Cathode Ray Tube (CRT) used in traditional TVs. Nowadays we have the flat panel displays which are much lighter and thinner than traditional monitors. Its thickness is usually less than 10 cm thick.

Over the last few years a new type of screen monitor came into the market. Called the **L**iquid **C**rystal **D**isplay (LCD) monitor, it is a thin and flat display device, unlike the old bulky CRT monitor. LCD monitors also use the three standard colours for monitor display - red, green, and blue (RGB). However, one of the setbacks of the LCD monitor system is its heavy electric power consumption, especially when interactive applications such as games are running.

A better version of the LCD is the **T**hin **F**ilm **T**ransistor **L**iquid **C**rystal **D**isplay (TFT LCD). A variation of the LCD, it uses a thin film transistor technology that improves image quality. TFT-LCD is utilised in the flat panel screen of our laptops.

Besides the TFT LCD, there is another type of flat panel display called the **A**ctive **M**atrix LCD (AMLCD). AMLCD is relatively lightweight and produces excellent image quality; hence it is currently a popular choice for notebook computer manufacturers. Figure 2.7 depicts the flat screen LCD monitor.

Figure 2.7: Flat Screen LCD Monitor
Source : http://accessories.us.dell.com/sna/images/products/large/24053YR.jpg

Monitors come in various sizes and resolutions. The current popular choice for desktop PC monitor dimensions is 1024 768 pixels.

2.2.7 External Storage and Optical Device

Multimedia projects or applications need high volume files; therefore a large and suitable storage technology is needed to fulfil the need. Various storage technologies that support different levels of multimedia applications are available. Some examples are as follows:

(a) **Compact Disk-Read Only Memory (CD-ROM)**
CD-ROMs, which use laser beam technology instead of magnetic technology for hard disks, have capabilities to store up to 600MB data. Being excellent multimedia storage devices due to their robustness and low costs, they are commonly used to store data and audio files.

(b) **Digital Versatile Disc (DVD) and High Density DVD (HD-DVD)**
The Digital Versatile Disc (DVD) has a far better capacity than the CD for storing data. DVD is therefore a very feasible storage device if you need to store huge multimedia applications such as interactive movies or games. Double-sided dual layer DVD supports up to 17 Gigabytes of data. However dual layer High Density DVD (HD-DVD) supports much more - up to 30 Gigabytes of data.

This standard is developed jointly by Toshiba and NEC.

- **Blu-ray Disc (BD)**
The Blu-ray Disc (BD) is a high-density optical disc to store digital media, especially high-definition video. It is the next-generation optical disc format intended for recording, rewriting, and playback of high definition videos. BD is over five times better compared to DVD. It supports up to 50 Gigabytes on a dual layer disc. This capability thus makes BD a great multimedia storage device. Developed by Sony, BD is used in the Sony VAIO AR notebook (the first notebook of course, to use the technology.)

ACTIVITY 2.1

1. Besides digital camera, what are other examples of popular USB devices that you can think of?
2. What makes BD a main competitor to HD-DVD?

ACTIVITY 2.2

Help your friend buy a new computer!

Your friend who has no basic knowledge of computers wants to buy a PC. He needs your help to educate him on computer terms that he does not understand. Refer to the advertisement below (Figure 2.8) for your explanation. Do some research on the PC to help him.

Do you think that the specifications listed would provide value for money for your friend?

Dell™ Inspiron™ 530
Blazing Speed + 3Yr Warranty for your Peace of Mind

RM 3,399

Processor
Intel® Core™ 2 Duo Processor E6550 (2.33GHz, 1333FSB, 4MB)

Operating system
Genuine Windows Vista® Home Premium

Memory
1GB DDR-2 SDRAM

Monitor
19" Dell Wide Screen Flat Panel LCD Monitor - SE198WFP

Hard Drive
250GB* Hard Drive

Optical Drive
16X Dual Layer DVD Burner*

Graphic Card
128MB NVIDIA® Geforce® 8300GS

Speakers
Dell™ A525 Stereo Speakers with Subwoofer

Figure 2.8: Specifications
Source: http://www1.ap.dell.com/content/products/features.aspx/desktops_best?c=my&cs=mydhs1&l=en&s=dhs

2.3 MULTIMEDIA SOFTWARE

The types of multimedia software we are going to discuss next are those used for graphics and image editing, audio and sound editing, video editing, and animation authoring.

2.3.1 Graphic and Image Editing

An image editing software is often distinguished by its array of toolbars, filters and transformations functions (Brooks & Dodgson, 2005). Some of us may already be familiar with a certain image editing software if we have edited our own digital photo albums before. Many of us though probably would have our own collection of favourite images if we have been taking photographs using the digital or mobile phone camera. With graphics software programs we now can manipulate our digital images through resizing, cropping, enhancing, or transforming them.

There are a few digital image editing software that you can download free from the internet. Their image editing tools maybe fewer than that provided by the commercial ones but they are useful enough for amateur image editors. Examples of the more popular commercial ones are Adobe Photoshop, Paint Shop Pro, Visualizer, Photo Studio, and Corel Photo-Paint. Adobe Photoshop is claimed by Adobe Systems as the industry standard for graphics professionals.

The following list indicates what image editing tools such as Photoshop can do:

(a) Merge images;

(b) Alter image size;

(c) Crop image;

(d) Adjust colours;

(e) Remove unwanted elements;

(f) Orientate image (change direction);

(g) Sharpen and soften image;

(h) Contrast change and brighten image; dan

(i) Add text onto image.

2.3.2 Audio and Sound Editing

In the 90s the only popular audio wave file editor was the Sound Designer. Today, the most popular audio editing programs are Sony Sound Forge, Audacity and Adobe Audition.

Sony Sound Forge (known formerly as Sonic Foundry Sound Forge) is a digital audio editing software for the professional as well as amateur or non-

professional user. Sound Forge lets us create a stunning audio clip with various sound effects such as fading, echo, etc. from raw audio files.

Figure 2.9 shows a screen shot of Sound Forge.

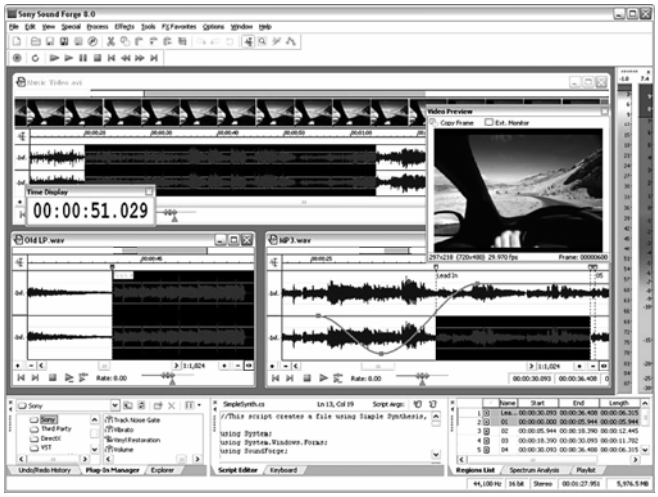

Figure 2.9: A screen shot of Sound Forge
Source: http://en.wikipedia.org/wiki/Image:SoundForge8Screenshot.jpg

2.3.3 Video Editing

Numerous commercial video-authoring tools exist today. The number of applications that can be utilised for editing digital videos has been growing as a result of the progress in computer technology (Wang & Hirakawa, 2006).

Digital video brings the power to our multimedia presentation or project. With video editing software, we can create our own original and unique movies for our personal or business purposes. Examples of video editor software that we may choose from are Avid's Media Composer and Xpress Pro, Apple's Final Cut Pro and Adobe's Premiere.

Creating a video is always a complex, expensive and time-consuming task (Nahrstedt and Balke, 2005). Hence building a complex multimedia package such as a video clip is a challenging problem. However with user friendly video editing software, we can become a semi-pro film producer. We can fully utilise the software re-arranging or modifying segments of our raw video to form another piece of video.

To use a video editing tool such as Adobe Premier we first arrange our video clips (or “footages”) on a timeline. Then we can apply the built-in special effects

for our movie production. However we have to be careful because video editing involves dual tracks of audio and video. Therefore we need to make sure that the audio and video are synchronised.

For the final package we can opt to distribute it using a CD-ROM or DVD. If we wish to distribute it online we can use streaming technology or the program QuickTime.

Figure 2.10 shows a screenshot of the Adobe Premiere Pro.

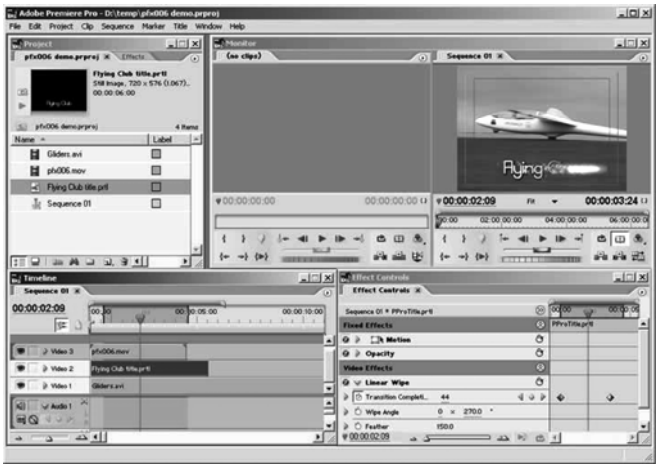

Figure 2.10: A screen shot of Adobe Premier
Source: http://www.showstoppersfx.com/editors/tips/ppro/ppro01.jpg

2.3.4 Animation Authoring

As more and more Flash movies are created, delivered, and viewed by over millions of Internet users, Flash has emerged as the main online animation format (Yang, Li, Wenyin & Zhuang, 2007). Since its introduction in 1996, the phenomenal growth of online Flash movies has made Flash more and more popular on the Web. Do you know that the first version of Flash was Flash version 1.0?

We can use Flash to create simple animation, advertisements, or even online banners for our personal homepage or web log (blog). We can even embed or integrate flash video into our web pages.

Various Flash file formats include standalone Flash Player (in .SWF or .EXE format) or flash video (.FLV). Adobe Flash has the capability to create online content such as web applications, games and movies.

Recent development shows that TV animation production studios such as Warner Bros. and Cartoon Network have started to produce industry-standard animation using Flash as well.

Figure 2.11 shows a screenshot of a Flash animation.

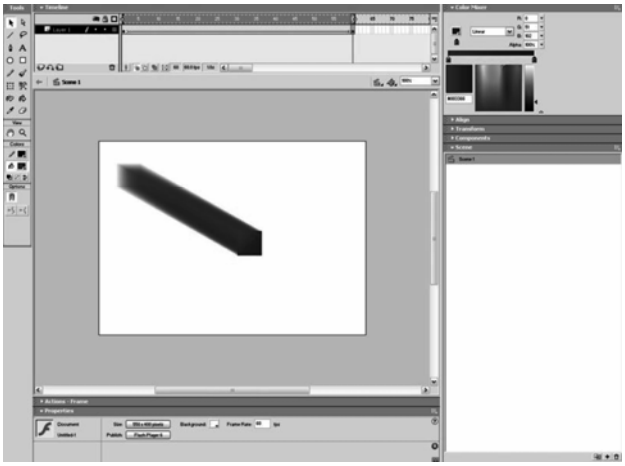

Figure 2.11: A Screen Shot of Flash Animation
Source: http://en.wikipedia.org/wiki/Image:Flash_Screenshot.JPG

SELF-CHECK 2.2

1. What are the factors that we have to consider when choosing graphics editing software?
2. Discuss why Flash is so popular.

DISCUSSION

MAKING THE RIGHT DESIGN CHOICES

There are many things involved in coming up with a good design for your multimedia system. The most important consideration is to understand the audience of the presentation (or the user of the system). The audience requirements will drive the use of appropriate media elements, the choice of colours used, the quality of the language used and the amount of interactivity included in the system.

In a multimedia software product, the emphasis should be on **the ease with which a new user can use the system.** In a multimedia presentation, the main objective is to pass a message to the viewer. Each multimedia element used should move towards giving that message to the audience.

(Bhatnagar, Mehta & Mitra, 2004)

Discuss ease of use of multimedia software with your classmates in MyLMS forum.

SUMMARY

- All multimedia data must be in digital format. We need DAC (digital-to-analogue converter) and ADC (analogue-to-digital converter) to convert from one format to another.
- The CPU (Central Processing Unit) is the most important component of a computer. It needs strong memory support from RAM (Random Access Memory) technology such as the DDR2 SDRAM (Double-Data-Rate 2 Synchronous Dynamic Random Access Memory).
- The Graphics Card and a GPU (Graphical Processing Unit) are needed to generate the highest quality output images on a monitor.
- AMLCD (Active matrix liquid crystal display) is relatively lightweight and produces excellent image quality for our monitor.
- CD-ROMs (Compact Disk-Read Only Memory), HD-DVDs (High Density Digital Versatile Disc), and BDs (Blu-ray Disc) are the best choices for saving and distributing multimedia data and video.
- Multimedia software tools can be divided into graphics and image editing, audio and sound editing, video editing, and animation authoring tools.

KEY TERMS

Active Matrix Liquid Crystal Display (AMLCD)
Analogue-to-Digital Converter (ADC)
Animation Authoring Software
Audio and Sound Editing Software
Blu-ray Disc (BD)
Central Processing Unit (CPU)
Digital-to-Analogue Converter (DAC)
Double-Data-Rate 2 Synchronous Dynamic Random Access Memory (DDR2 SDRAM)
Graphic and Image Editing Software
Graphical Processing Unit (GPU)
Graphics Card
High Density Digital Versatile Disc (HD-DVD)
Universal Serial Bus (USB)
Video Editing Software

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Topic 3 ▶ Texts and Graphics

LEARNING OUTCOMES

By the end of this topic, you should be able to:

1. Explain how text can be used in multimedia;
2. Discuss hypertext and hypermedia;
3. Explain the importance of graphics;
4. Compare and contrast bitmaps and vector graphics;
5. Explain how to obtain graphics; and
6. Describe graphics editing software.

▶ INTRODUCTION

The last two topics introduced the basic concepts of multimedia and its requirements. Now in this topic we will discuss two multimedia elements - text and graphic.

We will start this topic by introducing text. We shall learn about textual communication, font, and typeface. This topic will also provide some important guidelines and usability tips when communicating in text.

Next we will learn about graphics in multimedia. We need to differentiate between bitmaps and vector graphics. We will then discuss graphics formats and resources as well as highlight various graphics software available in the market today.

3.1 TEXT

There are two terms in textual communication that we often use interchangeably because we have not been able to differentiate between them. Can you determine what a font is, and what a typeface is? Perhaps you can give an example for each

of the term. Once you are able to identify these two, then we will discuss serif vs. sans serif, text design guidelines, text editing software, and finally hypertext and hypermedia. We will begin with the concept of textual communications.

3.1.1 Textual Communications

We use text to describe information as this seems the most natural method other than through oral or verbal means. Communicating via text hence is still popular and widely used today, even after more than 6000 years ago when the first traditional text-based communication method began. An example of an ancient text is shown in Figure 3.1. This is a Sumerian medical text believed to be over 4000 years old, printed on a clay tablet.

Figure 3.1: Ancient Sumerian Medical Text
Source: http://images.encarta.msn.com/xrefmedia/sharemed/targets/images/pho/t044/T044979A.jsm

You find text almost everywhere - from traffic signs to the Internet. With text you can express your ideas, send messages. Can you think what will happen if the world is without text? It would be almost unthinkable, because almost every one of us has been exposed to texts long before we learnt how to read and write. In fact nowadays with mobile communications systems, more and more texts are being used extensively. Through short message systems (SMS), thousands of text messages are being sent every minute of the day.

Text documents in fact became more abundant after the rapid widespread growth of the Internet. The 2005 statistics by Yahoo! says that there were more than 19 billion documents on the internet (at that time). Can you imagine what the volume is today??

3.1.2 Font and Typeface

Firstly, we need to differentiate between "font" and "typeface". They are actually two different things but yet are used interchangeably. Once we see the difference, we should identify correctly whenever we use them.

Typefaces are basically designs - like Arial or Papyrus. A typeface is a family of graphic characters. Normally a typeface also includes style and size. Further examples of typefaces are shown in Figure 3.2.

Figure 3.2: Typeface
Source: http://www.miraclemunchkins.com/images/np/font.bmp

Fonts, on the other hand, are actually computer files that enable the typefaces to be printed. A font file is a collection of characters of a single size. We can also have a font style such as **bold** or italic.

One example of a typeface is "Times New Roman". However **11-point Times New Roman bold** is an example of a font. This font is *14-point Times New Roman italic.* However the typeface is the same Times New Roman.

3.1.3 Serif vs. Sans Serif

Study Figure 3.3 below which shows the letters "AV" printed twice. The lettering style obviously looks different – the top one labelled Serifs appears more "stylish" than the bottom "simpler" one No Serifs. Can you identify a significant difference?

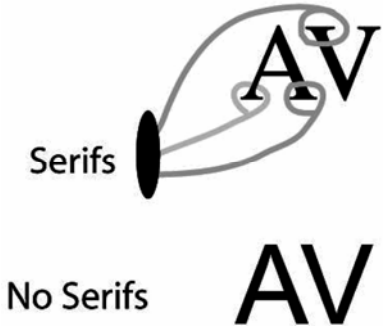

Figure 3.3: Serif vs. Sans Serif
Source: http://www.logo-design99.com/serifs2.jpg

Were you able to notice that the top AV letters have at their ends little squiggly items? Whereas the bottom AV does not have those little "squigglies" at the end of the letters – thus appearing comparatively "plain"?

Those little squiggly items are called "serifs". Now "sans" means "without". Hence Sans Serif is "without or no serif".

So, the top AV lettering is a "serif" typeface while the bottom one is a "Sans Serif" typeface.

A good example of serif typeface is this current font - Palatino Linotype – used as the body text typeface throughout this module. Another example of serif that is commonly used is the Times New Roman.

Examples of Sans Serif typefaces are Arial, Comic Sans, and Tahoma.

3.1.4 Text Design Guidelines

When using text in any of your multimedia or visual presentation, adhere to these simple text design guidelines:

(a) Use a text colour that is in high contrast with its background colour;

(b) Use font sizes large enough so that your texts are easily readable;

(c) Make sure the type is clear and legible so that the meaning of the text/word can be communicated clearly and easily understood;

(d) Ensure suitable spacing between the letter forms in a word or line of text;

(e) Use correct spacing to guide the reader from one line to the next. If the spacing is too narrow, the lines may be touching each other. If too wide,

then your reader may have difficulty finding the next line or paragraph as the texts will be too far apart;

(f) DO NOT SET ALL WORDS IN UPPER CASE. It is less legible and thus harder to read. Can you feel the difference in reading the two "different" lines of texts in Figure 3.4?

Figure 3.4: Uppercase vs. Lowercase
Source: http://www.tomontheweb2.ca/CMX/4D5E2/Image3.jpg

(g) Also consider font weight. The weight or **"heaviness"** of a font is a major factor affecting its legibility (See Figure 3.5);

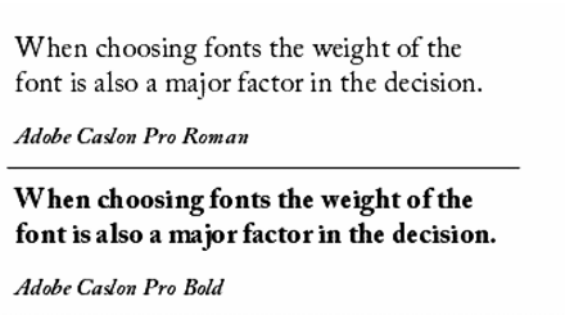

Figure 3.5: Font weight affects legibility
Source: http://www.tomontheweb2.ca/CMX/4D5E2/Image3.jpg

(g) Use an appropriate font and typeface based on the theme and nature of activity; and

(h) Serif fonts such as Times New Roman for example can be read faster than ornate sans serif fonts (See Figure 3.6). Use them correctly.

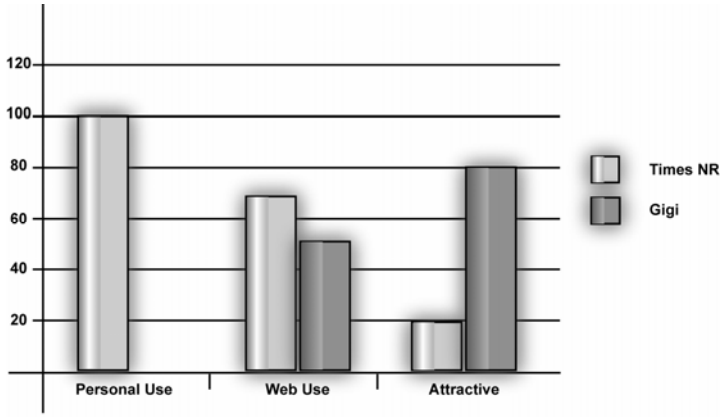

Figure 3.6: Times New Roman is the best for personal and web use, but less attractive
Source: http://psychology.wichita.edu/surl/usabilitynews/52/UK_fon1.gif

ACTIVITY 3.1

Imagine that you are a graphic designer assigned to create a newspaper advertisement for a company to market a breakfast cereal product named "Rise & Shine". The tagline for the advertisement is "*Rise & Shine, the Best Breakfast Cereal in Town".*

Choose the most suitable fonts for the advertisement tagline, so that it will attract consumers to buy the product. Provide reasons for your choice of fonts.

3.1.5 Text Editing Software

In text editing software, we are going to discuss word processors and desktop publishing software, as well as font creation and editing.

(a) **Word Processor and Desktop Publishing Software**

Are you bored with your Microsoft Word? If you are you can choose a different software such as Word Perfect. In 1979 the first commercial word processing software was WordStar. Nowadays we have free web-based processors such as those offered by Google Docs, Zoho, ThinkFree, or Glide. Other open source word processors are Open Office or Bean.

Have you ever tried creating an invitation card using Microsoft Word? Was it easy? Actually for that particular purpose you need desktop publishing software which is more suitable, and not a word processor. Other examples of desktop publishing software are PagePlus, Print Shop Pro Publisher, and Microsoft Publisher.

(b) **Font Creation and Editing**

Would you like to have your own home-made font? If so, first of all you need to download or purchase a font design and creation tool. Examples are FontLab, ScanFont, and Fontographer (Figure 3.7). Anyone of these tools will enable you to create your own font.

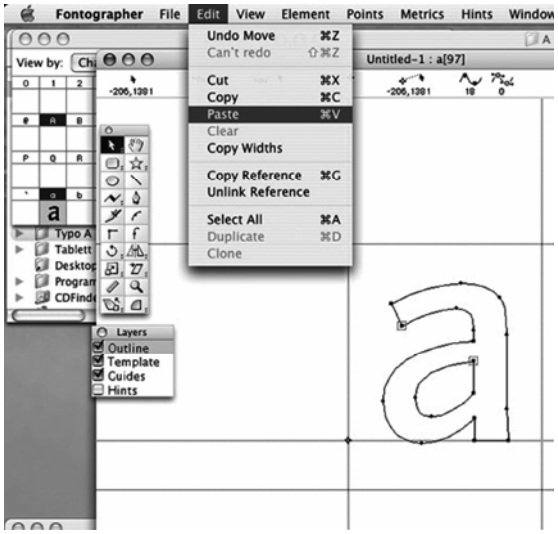

Figure 3.7: Fontographer
Source: http://www.gemeinsame-sache.de/paste.jpg

3.1.6 Hypertext and Hypermedia

Hypertext is what the World Wide Web is all about. Hypertext is defined as a **body of written or pictorial material interconnected** in such a way that it can not be conveniently represented on paper. The principle of hypertext is to **connect information** through links (Figure 3.8) as a coherent organisation.

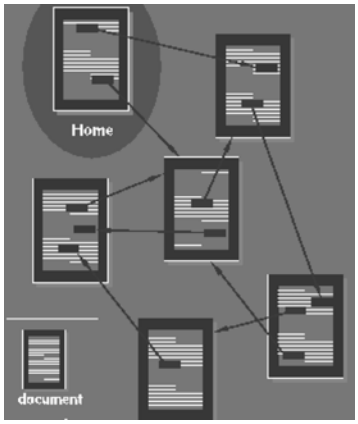

Figure 3.8: Basic Hypertext
Source: http://www.w3.org/Illustrations/BasicHyperText.ai_cut.gif

Once we have hypertext, we can move on to develop hypermedia. Let's assume we already have our hypertext. Now if we were to **connect our hypertext** *with other media,* we will then have a **hypermedia system.** For example we can turn our boring PowerPoint presentation into an interactive one. Just add linked-multimedia elements that will allow others to navigate and interact with our presentation.

Figure 3.9 shows the structure of a hypermedia system.

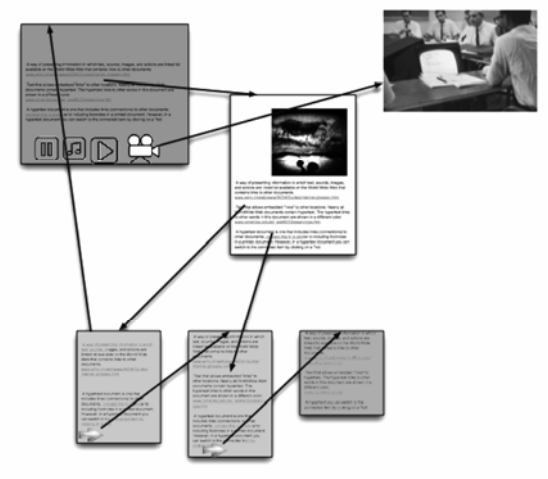

Figure 3.9: Hypermedia
Source: http://escience.anu.edu.au/lecture/comp1710/introduction/image/hypermedia.png

SELF-CHECK 3.1

Differentiate between:

(a) Font and Typeface;

(b) Serif and Sans Serif; and

(c) Hypertext and Hypermedia.

3.2 GRAPHICS

Next we are going to learn about the importance of graphics. Here we will delve into bitmaps and vector graphics, computer colour representations, graphics file formats, graphic resources and finally graphics editing software.

Graphics has become a crucial element in multimedia technology. It is used widely in advertisements and the commercial sector. Without graphics our computer screen, internet and the world will appear dull as we will be faced with just plain textual elements only.

3.2.1 Importance of Graphics

In computer science, a graphic is defined as the pictorial representation and manipulation of data. On or off the computer screen, a graphic is basically a visual presentation of an object or idea.

Graphics, or images, have been used since pre-historic times as a tool for story telling and information distribution. When the use of computers became widespread, computer generated graphics or images began to develop.

Desktop and computer graphic artists then started to embrace new tools to express their ideas visually and digitally. Graphics are used significantly in computer-aided design and manufacturing, in type setting and the graphic arts, and in educational and recreational programs (Answers.com, 2008). Graphics makes a presentation more unique through the use of images. Computer artists have been trying to create virtual people (Figure 3.10) to look as real as possible using advanced computer techniques.

Figure 3.10: Virtual people - 3D mermaid
Source: http://content.answers.com/main/content/img/CDE/_NVNALU.JPG

Graphic is one of the key elements of multimedia because it is one of the strongest aspects to attract user attention. We need to explore the human side of the multimedia experience to see how the user perceives a message conveyed through graphical representation (Gulliver and Ghinea, 2006).1

3.2.2 Bitmap vs. Vector

Let us now look into what bitmap is and what vector graphic is.

(a) **Bitmap Graphic**

Bitmap graphic is the most common graphic format used in computers. These graphics are composed of minutely small rectangular grids or pixels. Each pixel contains specific colour information. Thus each pixel in an image has its own colour properties.

We cannot however, scale a bitmap image to a higher resolution without it losing some of its quality. The image becomes blocky when it is enlarged a little bit too much.

We can create a bitmap graphic image by scanning a photo and saving it into the computer. Or, we can use the screen capture program (Print Screen). Other than that, we use software such as Photoshop or Painter.

Figure 3.11 shows an example of a bitmap graphic.

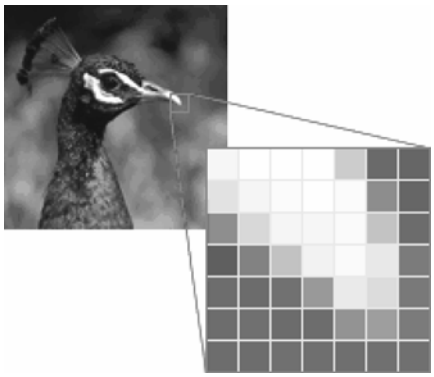

Figure 3.11: Bitmap Graphic
Source: http://www.eastbywest.com/pub/vectorbitmap/figure1.gif

Now let us do a little experiment with bitmap. Using a bitmap drawing tool such as Paint, draw a circle and fill it with the colour red. Then use Flash (a tool using vector graphics) to draw and colour a similar circle. After this magnify a part of the circle edge of both circles.

Are you able to see any difference between the magnified images of the two circle edges?

The difference that you see should be similar to Figure 3.12.

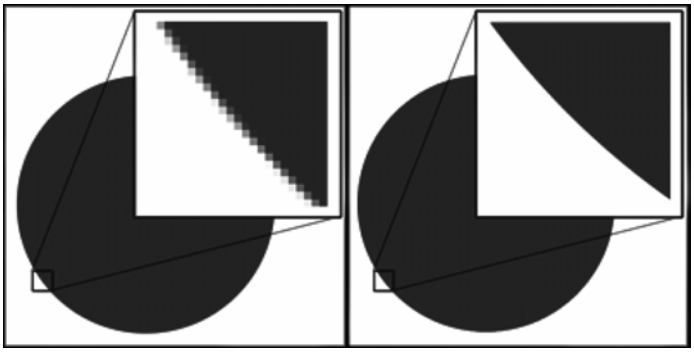

Figure 3.12: Effect of Zooming In on Bitmap (left) and Vector (right)
Source: http://toi.bk.tudelft.nl/toi-pedia/images/0/0d/Bitmap_vector.jpg

Hence when magnified, the saw-tooth pattern of the edge is clearly visible in the bitmap image as opposed to the magnified vector image which still appears smooth (created with Flash). This experiment thus also shows that when you zoom in on a vector object, the shape can still be accurately maintained.

(b) **Vector Graphic**

Vector Graphics are used for geometrical objects such as points, lines, or curves. These vector graphics can be extended to any size without losing detail. They are therefore good for reproducing crisp outlines such as logos or illustrations, and more practical for typesetting or graphic design. Images of vector graphics however cannot provide the realism of a photograph due to the nature of line drawn images.

Figure 3.13 shows a vector graphic image of a flower.

Figure 3.13: Example of a Vector Graphic
Source: http://www.eastbywest.com/pub/vectorbitmap/figure4.gif

3.2.3 Computer Colour Representation

Colour is very important in our life. Our eyes are sensitive to three main light colours, which are red (R), green (G) and blue (B). The two basic methods of making colours in computers are as follows:

(a) **Additive**
A colour is created from a combination of coloured light sources in the three primary colours (RGB). The next Figure 3.14 shows if we set the RGB value to maximum (255), we will have the maximum amount of that colour in the mixture.

(b) **Subtractive**
Subtractive colour process is used to create colour in printing technology. The printed page is made up of three primary colours which are cyan (C), magenta (M) and yellow (Y). The fourth colour (Black-K) forms CMYK.

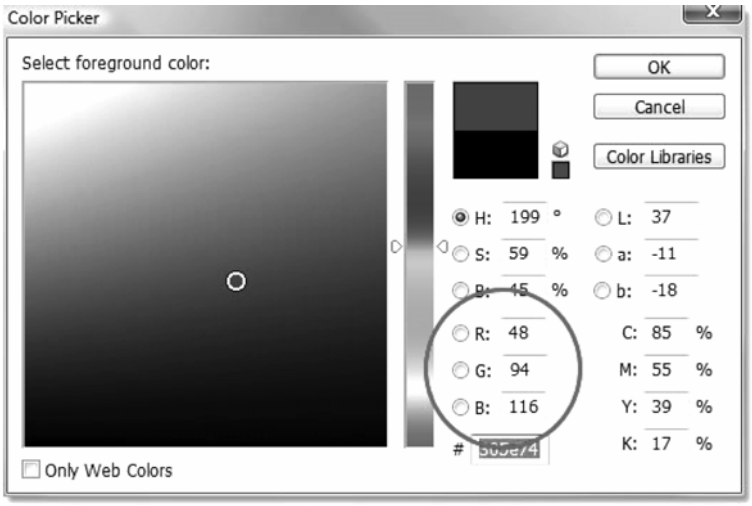

Figure 3.14: Colour Picker Window for RGB Code
Source: http://www.photoshopessentials.com/images/photo-effects/bourne-blur/color-picker.jpg

3.2.4 Graphics File Formats

In this section we will be introduced to the following graphics file formats:

- Graphics Interchange Format (GIF)
- Joint Photography Expert Group (JPEG)
- Tagged Image File Format (TIFF)

- Portable Network Graphics (PNG)
- Bitmap (BMP)

(a) **Graphics Interchange Format (GIF)**
As you may know GIF is the most widely supported web image graphic format. GIF allows us to have high-quality and high-resolution graphics, and provides support for animation. Compared to JPEG, GIF can only save 256 colours but it has a higher quality and smaller size image.

(b) **Joint Photography Expert Group (JPEG)**
JPEG can contain more than 16 million different colours, so if you want to save images that require a continuous and smooth colour blend, choose JPEG. JPEG is therefore the format to use when you need to have the sharp-edged graphic element or line art such as for logos.

Look at Figure 3.15. Do you notice the difference in colour tone of the two images below?

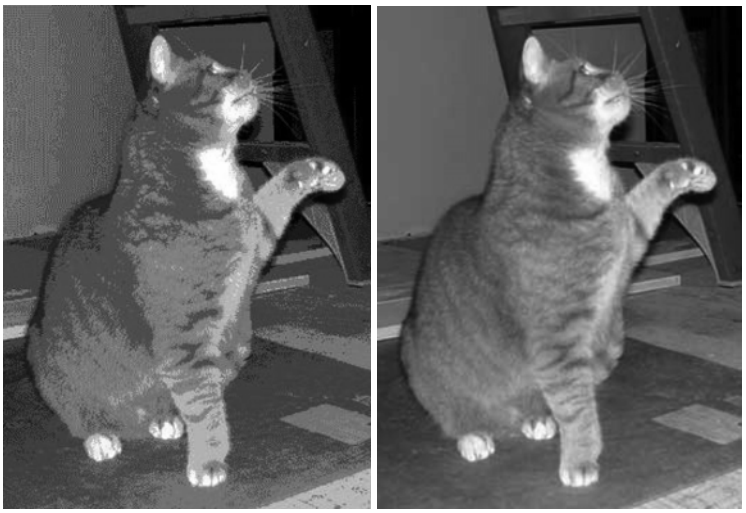

Figure 3.15: GIF (left) and JPEG (right)
Source: http://faculty.umf.maine.edu/~hodges/Designing_Web_page/simon.gif

JPEG is the best for saving pictures of paintings or portraits. However JPEG sizes are larger than GIF images. This is due to the compression method that performs badly on these types of images (for which the PNG and GIF formats are more commonly used).

(c) **Tagged Image File Format (TIFF)**
IFF is a popular format for high colour depth images. This format is widely supported by image manipulation tools such as Photoshop. TIFF format is

standard in document imaging. We can use the TIFF format to store multiple images in one file such as for FAX (**FACS**imile) images.

(d) **Portable Network Graphics (PNG)**
Portable Network Graphics (PNG) is a bitmap image format that was created to improve the GIF format. This format was developed in 1995 to support modern web browsers. PNG format is the optimal choice for exporting small and repeating icon or images for the web as shown in the next Figure 3.16.

Figure 3.16: PNG Icons
Source: http://www.axialis.com/objects/lg_preview_icon_01.jpg

PNG has transparency options but it does not support animation.

(e) **Bitmap (BMP)**
Bitmap (BMP) is the traditional format used to store virtually any type of bitmap data. It is the system standard graphic file format for Microsoft Windows. We can create a BMP image by using Paint.

Most graphics applications support the display of BMP format files. In uncompressed BMP files, image pixels are stored with a colour depth of 1, 4, 8, 16, 24, or 32 bits per pixel.

3.2.5 Graphics Resources

Under copyright laws, we cannot simply download graphics or images from the internet and use them freely as our own. We either purchase images or photos from stock photo sites or CDs, or we produce ourselves the images that we require. To obtain the digital form of printed pictures for example we can use a scanner. Or, we can use a digital camera to capture a favourite image. And finally, unleash our talent by creating and producing our own logo or images using appropriate software.

Figure 3.17 shows how to find graphic resources for a multimedia project.

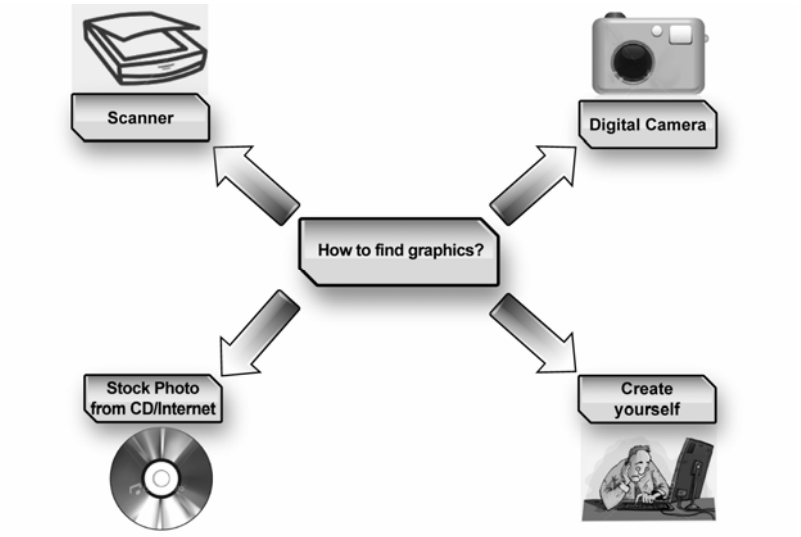

Figure 3.17: Graphics resources
Source: http://www.istockphoto.com

3.2.6 Graphics Editing Software

Have you used any popular graphic editing software such as Photoshop before (Figure 3.18)?

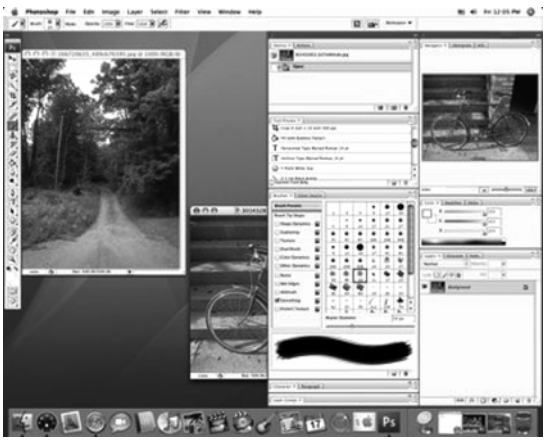

Figure 3.18: Photoshop
Source: http://www.gadgetell.com/images/2006/12/pscs32.jpg

Photoshop is used for simple-to-complex image manipulation. It offers special effects tools such as blur, sharp, filters, etc. to transform our original image to something different.

Other software includes AutoCAD, Microsoft Designer, Adobe Illustrator, and Freehand.

SELF-CHECK 3.2

1. Why are graphics very important in communication today?
2. Draw a comparison table to differentiate GIF from JPEG.
3. Explain four ways to create graphic images.

DISCUSSION

BEST FONT OF 2006

Swan Song

A masterfully expressive calligraphy font

The best calligraphic font and #1 font of 2006 is Swan Song. Reflecting the rich lettering period of the mid-20th century, Swan Song's brush strokes were created in the spirit of calligrapher Professor Alexander Nesbitt.

Discuss when you should and should not use this font.

SUMMARY

- **Text-based communication** is believed to have existed since more than 6000 years ago.
  - Fonts are computer files that enable us to print typefaces.
  - A typeface is the design of a font.
  - Sans Serif does not include the squiggly items in the text, unlike Serif.
  - Basic text design guidelines include having ample spacing between texts as well as high contrast between foreground text and background colour.

  - We can create our own fonts by using FontLab, ScanFont, or Fontographer.
  - Examples of word processing and desktop publishing software tools are PagePlus, Print Shop Pro Publisher, and Microsoft Publisher.
- **Hypertext** is a body of interconnected written or pictorial materials.
- **Hypermedia** is hypertext interconnected with other types of media.
- **Graphics** are visual presentations of objects or ideas.
  - Bitmap graphics are composed of minutely small rectangular grids or pixels.
  - Vector graphic is used for geometrical images like points, lines, or curves.
  - The shape of a vector graphic is still accurately shown when the image is enlarged or zoomed in, unlike bitmap graphics.
  - Examples of graphics file formats are GIF, JPEG, TIFF, PNG, and BMP.
  - To get the digital form of a printed picture, we need a scanner or a digital camera. We can also purchase digital pictures online or from a CD, or create them ourselves by using appropriate software.
  - Examples of graphics editing software are Photoshop, AutoCAD, Microsoft Designer, Adobe Illustrator, and Freehand.
- Two ways of getting **colours** to be displayed or printed are the additive method and the subtractive method.
  - There are two colour representation methods – RGB and CMYK.

KEY TERMS

Bitmap Graphics	Hypertext
Cyan, Magenta, Yellow (CMYK)	Red, Green, Blue (RGB)
Desktop Publishing	Sans Serif
Font	Serif
Font Creator	Text-based
Graphics Editing Software	Typeface
Graphics File Format	Vector Graphic
Hypermed	Word Processing

Answers.com. Retrieved February 3, 2008, from http://www.answers.com/topic/graphics

Gulliver, S. R., & Ghinea, G. (2006). Defining user perception of distributed multimedia quality. *ACM trans. Multimedia computing communication. Application* 2(4), 241-257.

Topic 4 ▶ Audio, Video, and Animation

LEARNING OUTCOMES

By the end of this topic, you should be able to:

1. Describe audio digitisation, file formats, and software;
2. Identify digital video standards, formats and technology;
3. Explain basic principles behind the applications and techniques of animation; and
4. Discuss how animation is applied in learning.

▶ INTRODUCTION

In Topic 3 we learnt about the two important multimedia elements - text and graphic. In this topic we will move on to the next three elements which are audio, video, and animation.

First we will be introduced to the use of digital audio in multimedia. Then we will identify a few digital audio formats such as WAV and MIDI. We will also touch upon audio software capabilities such as WavePad.

In this topic, we will also discuss digital video technology. Finally, we will learn briefly about animation history. We will discuss some basic animation techniques such as cell animation, keyframes and tweening, before learning further about animation applications.

4.1 AUDIO

Audio is one important element we expect to find in a multimedia presentation. Quite often we find that including audio in a textual or graphical presentation is intended not so much for viewers "listening pleasure", but more for enhancing or highlighting the message that is being presented or delivered. And can you

imagine if there were to be no audio, no sound at all in video or animation? We can say that we would end up with a "dead" presentation; or rather there was truly no presentation at all.

In this section we will first be introduced to the concept of converting analogue sounds to digital and the use of digital audio for multimedia purposes. Then we will take a look at audio file formats available and audio software and production.

4.1.1 Audio Digitisation

Let us first recall the basic concept of sound waves before we move on to understanding the necessity of digitising analogue audio for multimedia purposes.

As you probably know, sound is a type of wave that propagates through air (well, not just air but all forms of matter). We can model that sound movement using the sine wave, as shown in Figure 4.1.

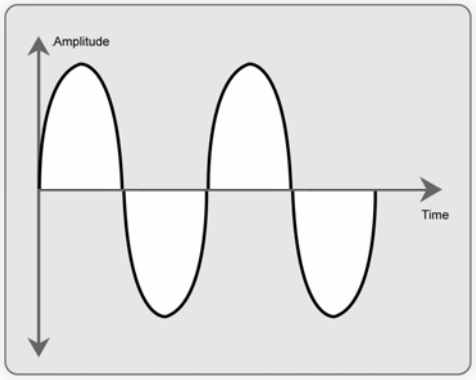

Figure 4.1: Sine Wave
Source: http://themixbus.com/wordpress/wp-content/themes/dusk-10/images/sine.jpg

Now, to record a digital audio, a process called sampling is first needed. Two factors need to be taken into account - sample rates and bit depths. To make sure that we have the best audio quality, these two factors must be at the highest level possible.
Figure 4.2 shows the sampling process of a digital audio.

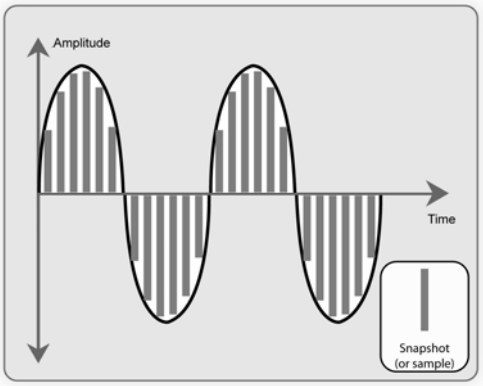

Figure 4.2: Audio Sampling
Source: http://themixbus.com/wordpress/wp-content/themes/dusk 10/images/samples.jpg

To convert analogue sound into its digital form, an Analogue-to-Digital Converter (ADC) is used. The digital sound is then kept in computers as a digital audio file format such as WAV or MIDI. This process is called digitisation of sound.

Sound digitisation is necessary because computers can only detect digital signals. Speech, songs, music, and sound effects in our daily lives are analogue signals, so to make our analogue sounds applicable in computers we need to convert them into the digital form.

Computer manipulation of sound involves capturing and modifying an audio data file. Software such as Sound Forge, GoldWave, or Window Movie Maker can be used to manipulate sound. For most audio editing systems, a graphical interface is provided to monitor the waveform signal. We can use this interface or viewer to help us edit or cut the unneeded segments.

There are numerous advantages of using audio in multimedia. Audio can be used to deliver lectures over the web or in a multimedia class. The lecturers do not need to depend entirely on text to convey their message. Music adds to emotion and interest during a presentation, causing it to be more interesting. Listening through the web or to a multimedia presentation is thus also an effective learning method that we can utilise to enhance our reading of notes or learning modules.

The current development in network technology has allowed for streaming audio technology. Now we find audio files delivered in real time to users throughout

the world. With streaming sound, a Web user does not have to wait to download a large file before listening to it.

Digital audio technology today is so advanced that the quality of recorded sound has also tremendously improved. Digital audio can be applied in many other different areas. One of the major areas is music production. For example, sound created by original musical instruments such as the piano can be produced using a sound synthesiser. The sound produced by this technology is almost the same as, if not better than the one produced by the original instrument.

4.1.2 Audio File Format

Now let us identify the various audio file formats available today - MP3, WAV, MIDI, RA, AIFF and WMA.

(a) **MP3**

MP3 (MPEG-3 or **M**oving **P**icture **E**xperts **G**roup-3 Layer 1) is a professional-quality audio format which can be played on Windows, UNIX, or Macintosh systems. The best thing about MP3 is that its compression ratio is among the best around. It can compress a CD-quality sound by a factor of 10. For example a song from a CD track with the size of 40 MB can be converted to just 4MB using the MP3 format! With this we can copy the file into an MP3 player and enjoy the song anywhere we want (Figure 4.3).

Figure 4.3: MP3 Player
Source: http://pan.fotovista.com/dev/1/2/00037521/l_00037521.jpg

(b) **WAV**

WAV is the default Microsoft and IBM sound format; it is an audio file format standard for us to store audio on PCs. WAV has the highest quality sound files but also the largest file size. This is because generally WAV sounds are not compressed - for five minutes of WAV sound, we need 50MB of memory!

(c) **MIDI**
Musical Instrument Digital Interface (MIDI) is a text file that contains a text-based description that tells a synthesiser how to play musical notes. MIDI is a code that allows various musical devices to exchange the information that creates a musical clip. MIDI files do not contain waveforms.

(d) **RA**
RealAudio (RA) is the trademark name of the leading streamed audio format. We can use RA format to deliver voice-quality audio even over dial-up connection. This means that if we do not have high speed broadband, real audio is the only means of streaming audio. It is the classic streaming audio solution by Real Networks. To use this file, we need to have RealPlayer installed on our PC.

(e) **AIFF**
Audio Interchange File Format (AIFF and AIF), originally developed by Macintosh, is for music and high quality sound. This format can also be used by IBM and Silicon Graphics. AIFF offers the same sample rates and bit depths as a WAV file.

(f) **WMA**
Windows Media Audio (WMA) refers to the audio file format developed by Microsoft. It is used as streaming audio as well. WMA files use the ".wma" file extension. Recently WMA has become the second most widely supported compressed audio format after MP3.

4.1.3 Audio Software and Production

We can use several types of audio software in a multimedia project development. We can record a song and convert it into MP3 format. Then we can use the sound editing tools such as Sound Forge to edit our MP3 sound files. We can also easily change our original audio clip by enhancing it with various special effects.

Figure 4.4 shows a screenshot of WavePad. Examples of audio effects are the amplifier and equaliser. We can even add echo to enhance our audio clip.

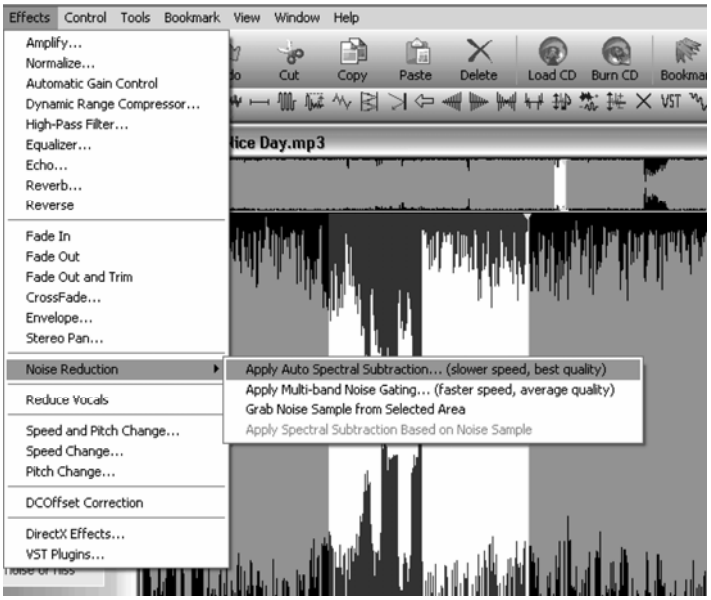

Figure 4.4: WavePad
Source: http://www.nch.com.au/wavepad/screenshots/effects.gif

The next Figure 4.5 illustrates the functional aspects of various sound inputs that must be determined before we record an audio or speech.
We need a sound card (which is normally readily available in our computers today). Then using an audio software application such as Wave Pad or Adobe Audition, the recording, editing, and encoding processes can be carried out.

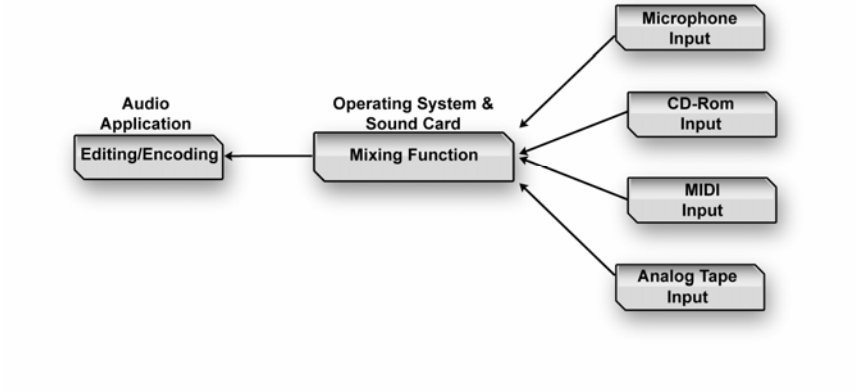

Figure 4.5: Sound Input, Mixing, and Editing Process
Source: http://www.uth.tmc.edu/scriptorium/howto/ra-training/gen_audio.jpg

ACTIVITY 4.1

1. Sketch a sine wave graph to model the audio sampling process.
2. Compare and contrast three audio file formats.
3. List several special audio effects that are available in a sound editor software such as WavePad.

4.2 VIDEO

In this section, we are going to take a look at broadcast video standards, and digital video format and technology.

4.2.1 Broadcast Video Standards

Let us now find out about the three broadcast video standards used globally today.

(a) **NTSC**
NTSC stands for National Television System Committee. NTSC standards define a method for encoding information into the electronic signal that is to be broadcasted as a television picture. NTSC is used by many countries on the American continent. It is also popular in many Asian countries like Japan. NTSC runs on 525 lines/frame.

(b) **PAL**
PAL (Phase Alternating Line) was introduced in the early 1960s, and has been in use in most European countries (except France). The PAL standard utilises a wider channel bandwidth than NTSC. Hence it allows for a better picture quality. PAL runs on 625 lines/frame.

(c) **SECAM**
SECAM is the acronym for Sequential Couleur Avec Memoire, a French standard (Sequential Colour with Memory). As the name implies, this standard was implemented in France. SECAM uses the same bandwidth as PAL, running on 625 lines/frame.

The countries that use these standards are colour-coded in the world map illustrated in Figure 4.6.

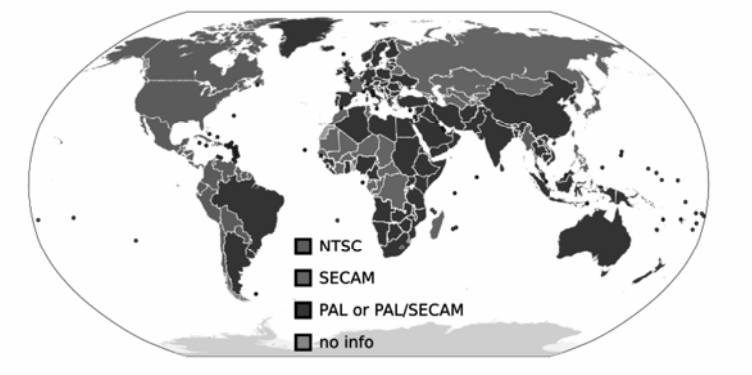

Figure 4.6: Usage of video standards
Source: http://upload.wikimedia.org/wikipedia/commons/thumb/0/0d/PAL-NTSC-SECAM.svg/800px-PAL-NTSC-SECAM.svg.png

4.2.2 Digital Video Format and Technology

I am sure that you have used various types of digital video formats. Some of the common ones and their file names are as follows:

(a) **Moving Pictures Expert Group (MPEG)**
MPEG is a popular and generic means of compactly representing digital video and audio signals for consumer distribution. MPEG is also the name of the committee - the Moving Pictures Expert Group - in charge of the development of video and audio encoding standards.

(b) **Digital Video Interface (DVI)**
DVI is used to store a wide variety of data, both still-images and motion video data. It is a form of video connector, which is made to maximise the display quality of high-end video graphics cards and flat panel LCD monitors.

(c) **Windows Media Video (WMV)**
WMV is a name for the set of video coded technologies by Microsoft. We can play WMV files using players such as MPlayer or Windows Media Player. The first version of WMV format was WMV7 released in 1999.

(d) **Real Media (RM)**
Real Media is a multimedia container format by Real Networks. Support for audio and video format of Real Media is available in a wide variety of multimedia players including RealPlayer.

(e) **QuickTime (QT)**
QuickTime, a multimedia framework developed by Apple is capable of handling various digital video and media clips. It is available on Microsoft Windows operating systems and provides essential support for software packages including iTunes.

(f) **Audio Video Interleave (AVI)**
AVI is the video format of Microsoft's Video for Windows multimedia framework. However with the increasing popularity of DVD movies, AVI is not that popular anymore.

To create a digital video out of analogue footage recording, we need to consider some important aspects. We must make sure that the software and hardware meet certain minimum requirements. Things to consider include:

(i) Fast Processors and plenty of Random Access Memory (RAM);

(ii) Fast hard disk (with at least 8 mbps transfer rate, 13GB for one-hour footage);

(iii) External Speaker and Audio Mixer; and

(iv) Video digitiser card and video editing software such as Adobe Premiere, etc.

Figure 4.7 shows a screenshot of VLC media player. We can use this software to play various video formats such as MPEG-4 and DivX.

Figure 4.7: VLC media player
Source: http://www.videolan.org/vlc/skins2/blissta_1.jpg

Let us say that we have ensured the above hardware and software requirements are met. So now what do we do then to capture a video on PC?

To help us understand how to capture a video, we shall now take a look at the process as outlined in Figure 4.8.

The next step (assuming that the video footage is already in our digital camera) will be to transfer that footage from the camera to our PC. To make sure that this transfer works there should already be a video card in our PC (available normally in today's computers). A video capture software (assuming pre-installed) will then capture this video footage for editing. After editing we store the video file inside the hard disk.

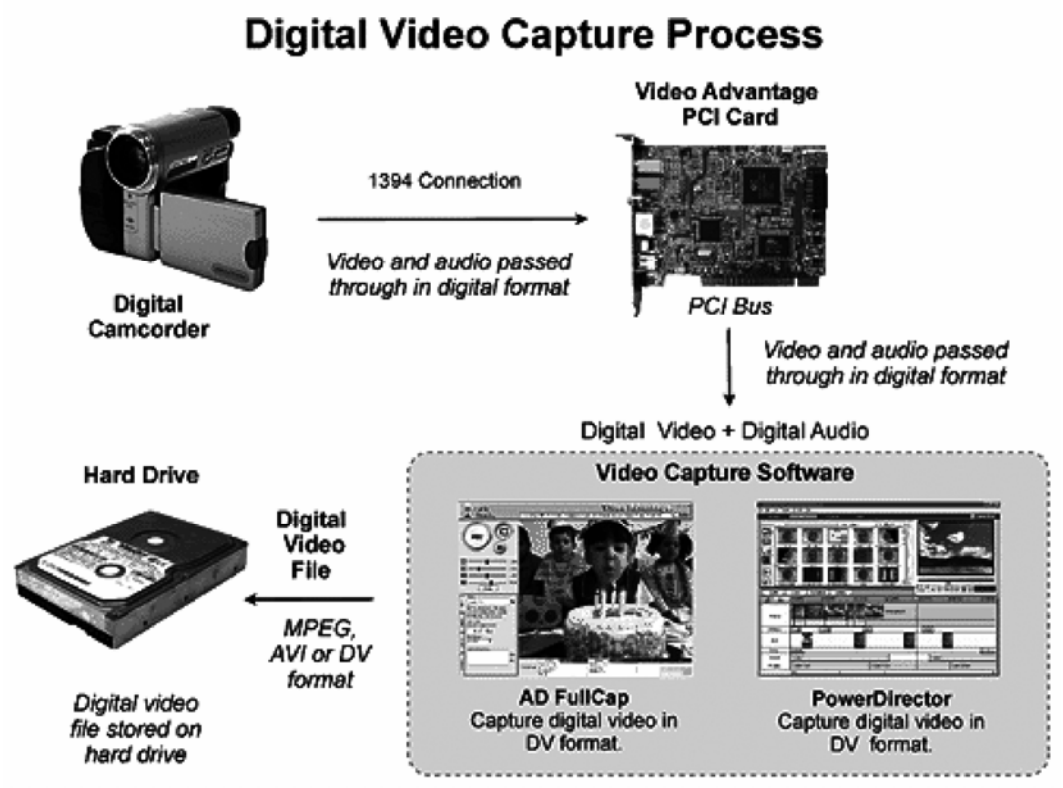

Figure 4.8: Digital capture process
Source: http://www.turtlebeach.com/Portals/0/images/products/VA_ADX/diagrams/digital_capture.gif

Now we have our digital video stored in the computer. What next? Well, we can copy them into multiple files or send them to our friends through e-mail. We can also upload them to our personal homepage, or instead if we wish we could upload onto YouTube.com.

However, video files are huge. Let us say we have recorded and stored a coloured video clip with a size of 320 X 240 pixels, recorded in 15 frames per second, with a duration of 30 seconds. Can you imagine that just for this half-minute video the size needed is 103 MB?

Video data then needs a big storage size and hence consumes huge bandwidth capacity. As a result multimedia applications such as video will have specific delay and bandwidth requirements. In general these have not yet been satisfactorily fulfilled by existing network standards (Fallah & Alnuweiri, 2005).

But today's video compression technology has enabled video file size to be reduced. We can now store video files in our mobile phones or iPods. For example in 2006 students at York University, Canada could study on the go. They were able to attend lecture sessions with the aid of video lectures delivered via their iPods. This technology is called video podcasting (Larraga & Coleman, 2007).

Figure 4.9 shows a student watching a lecture through his iPod.

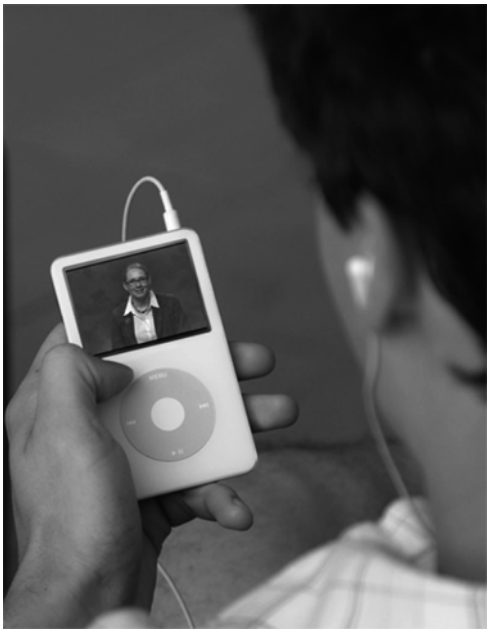

Figure 4.9: Lecture video podcasting
Source: http://www.yorku.ca/mediar/archive/photos/2006/ipod3.jpg

4.3 ANIMATION

We shall now learn about animation which has become very popular and widely used in multimedia technology. We will identify principles of animation, and get to know the history of animation. Next we will find out about cell animation, keyframes, tweening, morphing, inverse kinematics, animation software, application of animation, web-based animation and how animation is applied in learning.

4.3.1 Principles of Animation

Today we can find animation almost everywhere – not just in movies, TV programmes, but also in advertisements and education too. Can you imagine watching TV without any animation at all today, but just static images? What a dull world it would be!

What is your favourite animation movie? Can you recognise the character in Figure 4.10?

Figure 4.10: Ratatouille animation film
Source: http://www.cinemagazine.ch/dotclear/images/ratatouille_poster.gif

Yes, you may have guessed it – "Ratatouille" - an animation by Pixar about a rat who dreams of becoming a master chef in Paris! Can you think of why animation is so special and entertaining, especially for children?

Animation makes things come "alive" – not just animals, but also objects. Animation refers to the process of making an object "move". This process makes the object looks as if it is alive. The term animation originated from the Latin word which means "brought to life".

Animation can thus be defined as an act of **making something come alive.** This is because an object by its nature cannot move or be animated by itself, but through the animation process, it is made to come alive.

How does this animation process work to make us "see" as though this object is moving and alive? Animation is made possible partly through our biological phenomenon termed "persistence of vision".

"Persistence of vision" in simple terms tells us that the vision "persists or continues". It basically means that after we looked at an object, the vision of that object in our eye still remains mapped on our retina, though for a short time frame. So when images directly in our sight or right in front of our view - are moved very quickly, at a certain (high) speed rate, our eyes can be tricked into "seeing" the series of images as continuous moving objects. So we perceive the series of static images as a continuously moving image rather than as separate individual static frames. That is the "trick" used in the principle of animation.
This persistence of vision also states that if images are flashed before our eyes for at least 10 frames per second, we will assume that the images are a single moving image. Animation uses a series of static images closely related to each other, but when the series is shown to us at a high enough speed, the vision in our eyes will seem to be a moving image due to "persistence of vision". Whereas the truth is that the motion object that we "see" is just a combination of static images shown very quickly in a sequence.

Figure 4.11 shows the images of a bouncing ball. If we see them fast enough, from the first frame to the last, our eyes will perceive as if the red ball is bouncing. However what actually happened is that the whole six balls and frames have not moved at all.

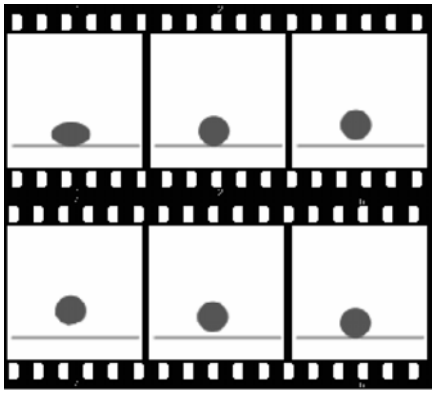

Figure 4.11: Bouncing ball animation
Source: http://upload.wikimedia.org/wikipedia/commons/e/ee/Animexample3edit.png

The frame rate (in frame per second—FPS) will determine the quality of an animation. To create a smooth animation, this rate must be taken into consideration. If the rate is less than 10 FPS, the animation will look awkward. However if too fast the animation will be blurred.

Animation can be categorised by the nature of its dimensionality: 2D (two-dimension) animation or 3D (three-dimension). An example of an old 2D animation is Popeye which is an animated cartoon.

Computer animations are computer generated animations. However, this term also applies to the type, system, software, and other devices used during the process of making an animation.

4.3.2 History of Animation

In the history of animation, Walt Disney would probably be the name that comes to mind, having been in the industry since 1920s.

"Snow White and the Seven Dwarfs" (Figure 4.12) in 1937 was born of an animation created from a combination of 477 thousand frames of static characters.

Figure 4.12: Animation of Snow White and the seven dwarfs
Source: http://fest07.sffs.org/i/stills/main/films/snow_white.jpg

In the late 70s and early 80s when the computer system was being developed, animation technology with the aid of computer also progressed. Did you know that the cartoon series "The Simpsons" - even though was only limited to two dimensions - was one of the first computerised animations?

In 1995 Toy Story (an animation film again by Pixar) marked the biggest history in the world of animation as the first 3D animation that was generated totally by using computers only. It also has 3D effect elements such as an object's shadow. Since then the animation industry has been booming.

4.3.3 Cell Animation, Keyframes, and Tweening

The word "cell" (the spelling "cel" is more commonly used in the US) is derived from the clear celluloid sheets that were used for drawing animation frames. Before computers were used to create animation, the cell was the only solution for most Hollywood animation studios. The clear cell was used to paint and ink the drawings which were then laid over the background. Figure 4.13 is an example of a cell.

Figure 4.13: Cell animation
Source: http://www.shoppingtoshop.com/sitebuildercontent/sitebuilderpictures/twogunmickey.JPG

In the Figure 4.13, there are six frames and six balls. The important first and last frames of an animation scene or action are the **keyframes.**

In the next Figure 4.14, the blue ball is located at frame number 1 (red-circled). So here if we want to animate the ball from left to right, we have to set it at the final location and make frame number 20 as another keyframe.

How many keyframes then do you have now? In this case you have two keyframes.

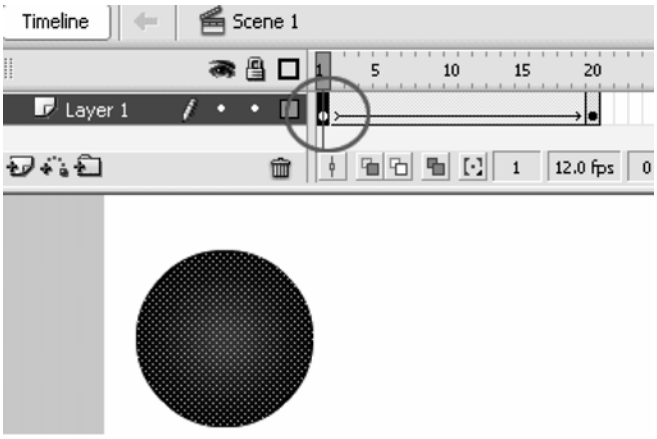

Figure 4.14: Keyframing process
Source: http://www.adobeflashtutorial.com/imagen-tutorial/010/simple-animationreturn-01.gif

Now what about the intermediary frames? How do you draw these frames? These will now be produced by the computer animation technology, through a process called tweening.

Let's say that now we have a circle and we want to transform or morph it into a rectangle (Figure 4.15). The tweening process will draw the remaining shapes in between those two main shapes.

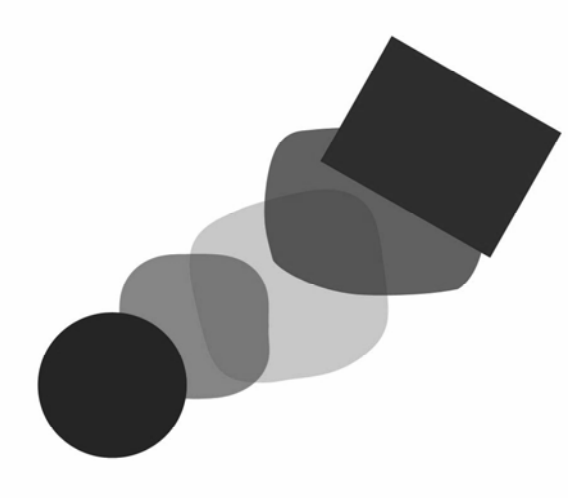

Figure 4.15: Tweening process
Source: http://www.piercecollege.edu/departments/cosci/Images/Shape%20Tween%20Morph.jpg

4.3.4 Morphing and Inverse Kinematics

Morphing combines **2D interpolations** of normally two images to create a new special image. Morphing is a special effect in animation that changes (or morphs) the original images through a seamless transition.

By using the morphing software such as WinMorph and Fun Morph, we can try to morph our parents' photos for example. The software will produce a new photo that has a mix of our father's and mother's faces. Figure 4.16 shows the final rendered image (bottom) after two images (top) are morphed.

Figure 4.16: Morphing process
Source: http://www.toptenreviews.com/i/rev/misc/sloppy-morph.jpg

In human movements, **kinematics** is the study of the science of motion that includes positions, angles, velocities, and accelerations of body segments and joints during motion. In computer animation, it is vital to make sure that the animated character we draw does follow this logic kinematics law.

In high-end 3D animation tools such as Maya and Lightwave, **inverse kinematics** is an important process. This process is related to how we determine the arms and joints move within limits and follow rules of kinematics. The 3D animation software will "help" us control the arms and legs movement so that they are logical.

Figure 4.17 shows the inverse kinematics process used to control leg bending while the character sits.

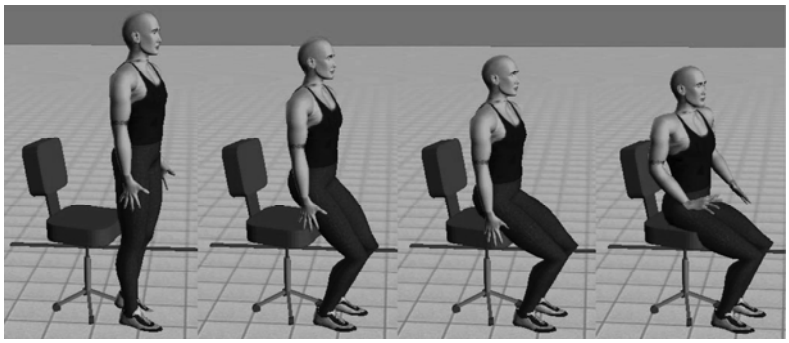

Figure 4.17: Inverse kinematics
Source: http://vrlab.epfl.ch/~kallmann/hp_seq_sitting.jpg

4.3.5 Animation Software

Besides hardware devices, application software is also very important in the process of making and authoring animation. Animation software functions like a brain that processes the making of animation, step by step.

There are hundreds of animation software available in the market—from the simplest to the most sophisticated ones. Examples of software focusing on the creation of animated cartoons are Moho, MediaPegs, and Creatoon.

Examples of popular 3D animation software are 3Dstudio Max, Alias WaveFront and LightWave 3D. All these software consist of two basic processes—modelling and conversion. The conversion process involves rendering and animating.

Figure 4.18 shows a screenshot of the open source animation software called Pencil.

Pencil is an animation and drawing software created for Mac OS X, Windows, and Linux platform. It lets us create traditional hand-drawn animation or cartoon using both bitmap and vector graphics.

Figure 4.18: Pencil animation cartoon tool
Source: http://www.les-stooges.org/pascal/pencil/contents/Screenshots/image2.png

4.3.6 Application of Animation

Parallel with the advancement of computer technology, computer animation has also been utilised in other areas. Animation has been widely used in education, filming, advertising, and simulation, just to name a few.

Animation can strongly support the traditional classroom with more packed and fun animated learning. Explanation of complicated concepts is made easier through animation. Hence student comprehension in the classroom can be improved.

In the filming and advertising industries, special effects that are difficult to shoot can be generated through 3D animation. Impossible scenes such as the jumping bus in the film "The Speed" were made "possible" using 3D animation.

Also using such techniques, air crash incidents have been simulated through sophisticated 3D animation software. Animation enables us to visualise the real cause of accidents and aid us in investigations.

Malaysia's first 2D animation film was "Silat Lagenda" in 1998. More than 10 years later, in 2009 "Saladin the Animated Series" (Figure 4.19) would become the first local product of our 3D animation industry for broadcast TV. (This series would later be exported to other countries such as Qatar).

Figure 4.19: Saladin the Animated Series
Source: http://www.saladin.tv

4.3.7 Web-Based Animation

For web-based animation, we will look at animated GIF, Dynamic HTML, JavaScript, Java Applet and Flash.

(a) **Animated GIF**
Animated GIF (Graphical Interchange Format) is created by combining several static images into a single file with the file extension of gif. As a

result an animation of sequences of various images can be displayed in one frame.
The production of animated gif usually involves a process to determine a sequence of static images. The separated frames will be imported to an animated GIF maker animation program to create a single animation file. Next the file will be uploaded onto the web using special instructions like HTML tags.

Popular animated GIF production software includes Ulead GIF Animator, Advanced GIF Animator, and Artful GIF animator. There is also some free software available for download from the internet.

(b) **Dynamic HTML, JavaScript, and Java Applet**

Full screen complex animation can actually be done without using large size images through dynamic HTML layers. We can use Macromedia DreamWeaver to create web animation by inserting it into a dynamic HTML web page.

I believe most of you often come across websites that implement cascading menu for navigation purposes. In this case, dynamic HTML works as the instruction that determines the next menu. It can be used to create an animated cascading website menu (refer to Figure 4.20).

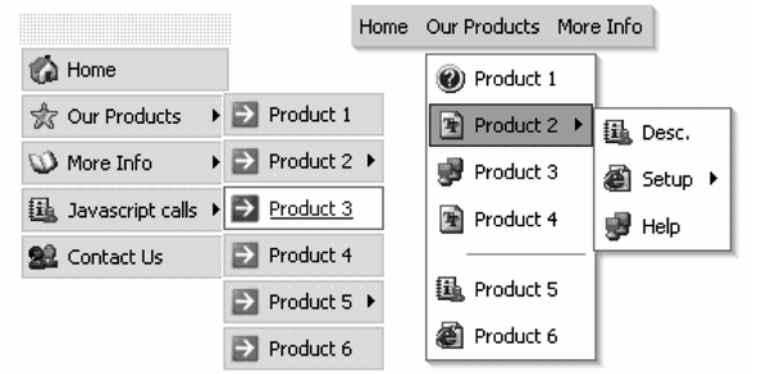

Figure 4.20: DHTML Cascading Menu
Source: http://dhtml-menu.com/apdhtml.gif

Besides the dynamic HTML, JavaScript application allows animation to be played with the presence of interaction between the user and the web. For example, when the user moves the cursor to a graphical image, certain animation such as image transformation would appear. This can also be applied as web menu too.

On the other hand, Java applet is a type of application or small-scaled software that can be programmed to display a desired animation. Due to the small size application which is not as large as big scaled software, such an application can be run even with low speed internet connection.

(c) **Flash**

Web interface can be enhanced by using Flash animation. The most popular application implemented is the animated banner. Besides that, an intro movie created by using Flash can improve the look of a page. Similarly a perfectly done animation gives a great positive impact on web visitors' first impression. There are some web sites that adapt Flash in the menu navigation system. Flash is also capable to form an application that is similar to an interactive map (Figure 4.21).

Figure 4.21: Interactive Europe map using Flash
Source: http://www.softpicks.net/screenshots/Interactive-Flash-Map-of-Europe.jpg

4.3.8 Animation for Learning

The two important features of animation are image and motion. Image and motion can play a very important role in the learning process to assist learners understand and remember what they study. Thus animation has opened up a new dimension in education. Instructional technology now uses animation to illustrate learning contents.

Animation is used in creating visuals especially to introduce new concepts. The interactive features of animation provide students with the environment to experience new learning concepts in a dynamic way. For example in subjects

such as science, a visual or video illustration of a certain principle in action can help students comprehend a difficult concept better. Animation also allows scientific processes that are time consuming to be explained in a shorter time. Through animation a long process such as embryo development can be explained without missing any essential aspects involved in the process. On the other hand, a process that happens too fast can be shown in slow motion using interactive animation.

The use of animation also enables us to produce illustrations on how to build an object, or to effectively present the inner functions of 3D objects. 3D animation effectively shows the inner workings of machine parts and systems of an automotive engine. We are able to grasp better internal processes by studying simulated motion visuals than by just merely reading text explanations illustrated with static images.
There are some students who need to "see" a concept presented visually for them to truly understand. These are visual type students. Some students take more time to learn, while there are others who are more auditory inclined. These differences in learning capacity and learning needs can be catered to through the use of educational multimedia technology. Students interacting with educational animated materials are usually able to control for example the animation tempo and speed according to their desires. The image and motion elements in animation can be also used as mnemonic devices to facilitate understanding and remembering in the learning process.

Figure 4.22 shows an animated pedagogical agent called Steve (**S**oar **T**raining **E**xpert for **V**irtual **E**nvironments). Steve's role is to teach students how to perform specific tasks such as operating or repairing complex devices.

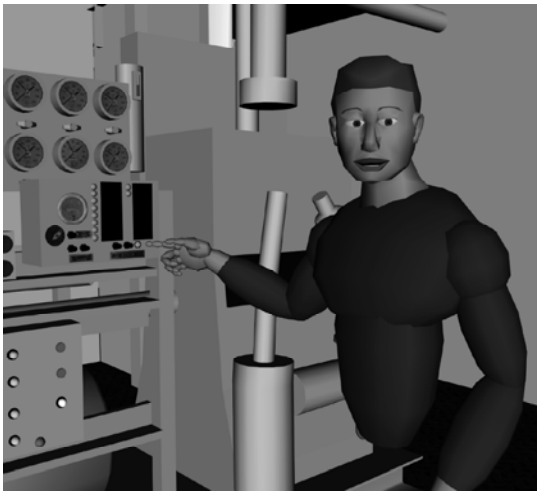

Figure 4.22: STEVE animated character
Source: http://www.isi.edu/isd/VET/point-at-tmpower.jpg

Animation is an excellent tool to teach not only scientific matters, but also mathematical concepts. Animation can help some students who may still be unclear on some difficult concepts even after receiving a thorough verbal explanation. Other explanations that could be clearly illustrated by animation are for example on calculation steps, angle calculations, and gradients in trigonometry. A moving image to support a verbal description can greatly improve a student's understanding (Figure 4.23).

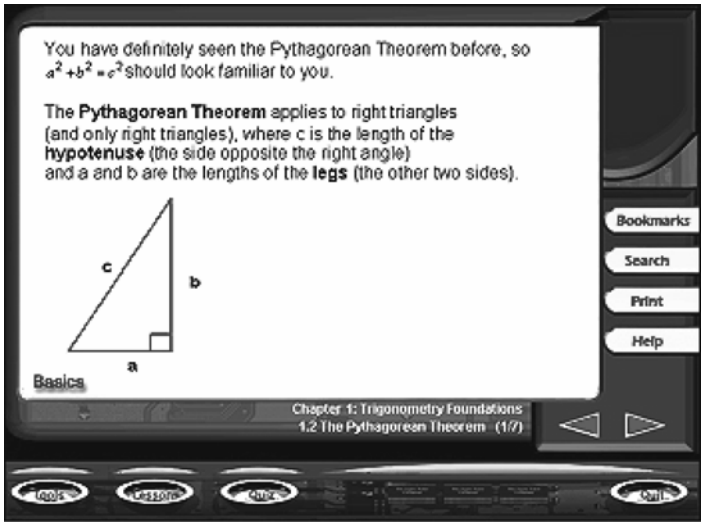

Figure 4.23: Animation for learning Trigonometry
Source: http://www.imgsrv.worldstart.com/store/images/high-achiever-trigonometry-1.jpg

Applying animation in the learning process makes learning more enjoyable. Research has shown that animation, compared to the traditional way of learning, is able to maintain students' concentration towards learning material. Animation attracts attention. Thus it is not surprising that animation is one excellent way to motivate students in their learning.

4.3.9 Animation Design and Usage Guidelines

According to Neilsen (December, 1995), animation is good for:

(a) Showing Continuity in Transitions
The changes between states will be much easier for users to understand if the transitions are animated.

(b) Illustrating Change Over Time
Animation uses time-varying display, hence it can easily provide one-to-one mapping to a phenomenon that changes over time.

(c) Enriching Graphical Representations

We can easily understand some types of information when presented for example as images in slow motion than if they were displayed in still pictures only.

(d) Attracting Attention

Animation can be used to dominate users' visual awareness. We can use animated banners to enhance our boring static website interface.

SELF-CHECK 4.1

1. Explain the morphing technique.
2. Why is web-based animation more popular nowadays?
3. Name three animation applications in education.
4. Discuss animation design guidelines.

DISCUSSION

CELL ANIMATION

Work in pairs. Discuss the origin of cell animation.

What are the concepts that go into creating these animations?

Use image search engine to find ten screen shots of cell animation that were used in the Hollywood animation film industry. Share your findings with your partner.

Were the animations you found popular animation titles?

SUMMARY

- Sound is a type of wave signal that propagates through air (and other matter). It can be modelled by using the sine wave.
- MP3, WAV, MIDI, RA, AIFF, and WMA are among the popular digital audio formats.
- Various audio software, for example Sound Forge and WavePad can be used to edit sound files such as MP3.

- NTSC, PAL, and SECAM are the three main broadcast video standards.
- MPEG, DVI, WMV, RM, QT, and AVI are the important digital video formats.
- Animation is defined as an act of making something to come alive.
- The term cell is derived from the clear celluloid sheets that were used for drawing animation frames.
- Keyframes are the important first and last frames of an animation scene or action.
- The tweening process produces the remaining intermediary frame content in between two keyframes.
- Morphing combines 2D interpolations of two images normally to create a new special image.
- In computer animation, it is important to make sure that the animated character does follow the inverse kinematics law.
- Examples of popular 3D animation software are 3D Studio Max, Alias WaveFront, and LightWave 3D.
- Animation technology is applied widely in various applications in industries such as advertising, filming, medical, military, etc.
- Animated GIF, Dynamic HTML, JavaScript, Java Applet, and Flash are examples of popular web-based animation technologies.
- The understanding process for certain scientific concepts is made easier with the aid of animation.
- Animation is good for showing continuity in transitions, illustrating change over time, attracting attention, and enriching graphical representations.

KEY TERMS

Animated GIF	Dynamic HTML
Animation Software	Inverse Kinematics
Audio Software	Java Applet
Broadcast Video	JavaScript
Cell Animation	Keyframes
Celluloid	Morphing
Digital Audio	Sine Wave
Digital Video	Tweening

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Topic 5 ▶ Multimedia Project Development

LEARNING OUTCOMES

By the end of this topic, you should be able to:

1. Plan a multimedia development project;
2. Explain the steps involved in multimedia design;
3. Describe the processes involved in multimedia development; and
4. Discuss the usability and design guidelines in multimedia project development.

▶ INTRODUCTION

In topics 3 and 4, you were introduced to the five elements of multimedia - text, graphic, audio, video, and animation.

In Topic 5 now we will first learn about multimedia project development and its three main phases which are:

(a) Phase I – Planning;

(b) Phase II – Design; and

(c) Phase III – Development.

After that we will look at two major factors that we should also consider in multimedia project development. These are the design process and design usability.

5.1 PHASE I - PLANNING

For most novice users, authoring multimedia documents remains a complex task (Deltour & Roisin, 2006). One solution to deal with this difficulty is to make available template-based and wizard-style authoring tools although this has its own drawbacks with limited tool functionality and capability. However, regardless which approach you maybe thinking of, the planning phase of a multimedia project is probably the most important stage that will hugely determine the success, or failure of your project.

Creating even a simple multimedia title or project demands considerable responsibility and no small effort. Success depends a lot on the amount of work and effort that you are willing to spend not just up front, but right through the whole preparation stage. You need to figure out the most effective development process so that your multimedia project can accomplish the goals that you and your team anticipate.

The simplest tip that is basic to any project is to write down clearly your project topic and its purpose. Bear in mind who your intended audience is. Always decide clearly early in the planning stage the development approach you want to take. Then stick to it throughout the entire design and development process.

I have divided the planning stage further into three sub-phases:

(a) Idea, goals, and constraints;

(b) Style and concept; and

(c) Storyboard and prototype.

5.1.1 Idea, Goals, and Constraints

It is said that everything starts with an idea. A design idea may not necessarily represent a complete final product of the multimedia package that you intend to develop. However, you need to come up with a solid idea first because the idea is the heart of your project.

Your design idea may come from your desire to provide something better for your client. Even though there may be other similar multimedia products, you still can find ideas to innovate and improve on them.

Besides having a good design idea, you also need to set your design project goals. A general goal or vision is a broad statement of what your multimedia project intends to achieve. From this vision you identify further goals because

having more specific goals can make you become more focussed and committed to succeed.

Goal setting is very important because when you set a goal you will also need to develop a timeline, together with a roadmap. These planning tools help you be on track and on time to move your multimedia project forward in the right direction.

Figure 5.1 is a cartoon to emphasise the importance of knowing the goal for a football player to succeed.

Figure 5.1: The importance of knowing the goal
Source: http://www.cartoonmotivators.com/images/football-goal.gif

In addition to ideas and goals, you also need to identify early on the potential constraints under which your project will run. You need to have a thorough understanding of the factors that will affect the design and development of your project. These factors may include technical aspects such as development software and hardware, or non-technical aspects such as budget and time limitations.

5.1.2 Style and Concept

For a multimedia project, a statement of design style or standard is normally available in a standard document called the style manual. Sometimes it is called the project standard manual. This document acts as a "driver" for you and your team members to establish a set of expectations of how your project would look like. The style manual determines the look and feel of the screen design in terms of logo placement, font and text style, colours, button style, etc.

The term "concept" here means a general or generic idea about a particular subject or topic. For your multimedia project, you must determine its concept first, and then stick to that style and concept all the way throughout the development of your project.

Figure 5.2 shows an interior view of a Nokia concept store. This store concept will be applied to all other Nokia stores throughout the country using the same colour, style, and look and feel.

Figure 5.2: The Nokia concept store
Source: http://360east.com/blogfileupload/nokiaconceptstore.jpg

You must remember that style and concept are vital to your multimedia development project. Once you have decided on your design style and concept, you should be consistent in applying them throughout the entire project. For example if you chose to play around with a blue colour concept, stick to it till the end, do not deviate.

Air Asia uses a distinctive red as its concept and corporate colour. You find the colour on almost everything that is related directly to the airline -- from their crew attire to the in-flight menu card. It may make one thinks that there are no other colours available on earth other than red.

5.1.3 Storyboard and Prototype

Storyboard is a visual planning tool for your multimedia project design. It helps you to visually illustrate the sequence of the design process involved in your multimedia project. A storyboard has been traditionally used in the animation and filmmaking industry, and is still being used until today. The storyboard acts as a graphic organiser to handle the multimedia elements involved such as images, audio, etc.

By using the storyboard you can communicate your design style, concept, and sequence effectively to your project client. For a multimedia program or title, your storyboard design can be extended so that it has a sequence number and a designer's comments section, besides just a sketch of the screen elements. Figure 5.3 shows an example of a storyboard.

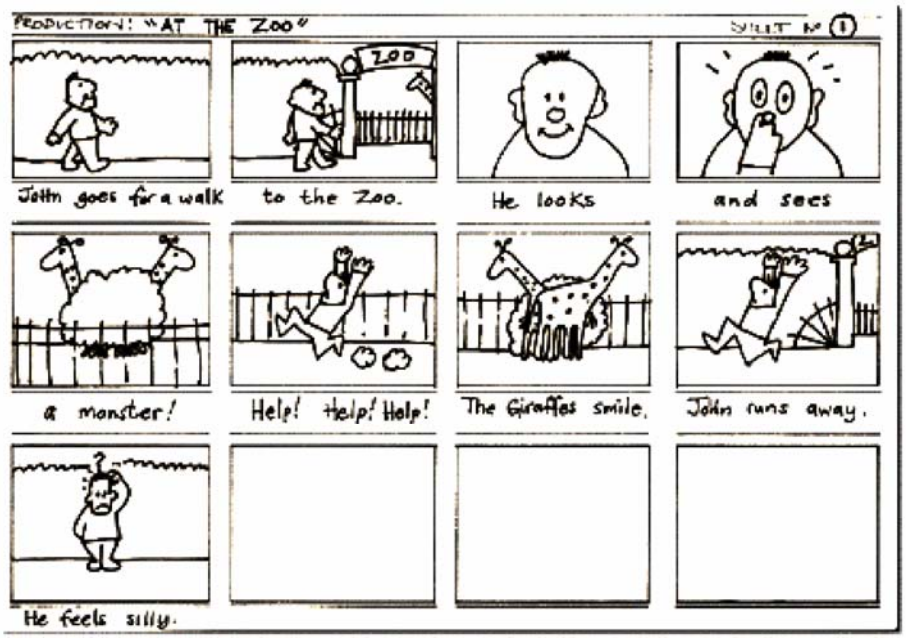

Figure 5.3: A storyboard
Source: http://www.makemovies.co.uk/curriculum/curriculum_images/storyboard.gif

Once you have your storyboard design confirmed, you may start to create an early prototype of your multimedia project. A prototype is simple rendition of how your final multimedia package may work.

Can you think of the possible reasons why producing a prototype is important? Having a simple prototype version of your product can help you smoothen out the whole design process before the major work begins. You can even present the early design of your prototype to your client (though it could be a rather shallow rendition of the final multimedia package).

You can conclude that in the first phase of the multimedia project development, you need to produce a simple prototype. This mock-up version of your multimedia title or program is important for you to portray the look and feel of the whole product. It is also a concrete proof for your client that you have started work on the concept, even though it is just in the early stages of the development process.

SELF-CHECK 5.1

1. Why do you need to follow a standard style or concept in your multimedia design?
2. Sketch a simple storyboard for a three scene animation.

5.2 PHASE II - DESIGN

5.2.1 Content Design

Before we discuss the various steps in multimedia design, it is useful for you to understand what the purpose of the design project is. As the multimedia designer, you are required – to not only incorporate multimedia design guidelines in your efforts, but to also create multimedia software that suits your intended audience requirements.

In view of this you may need a bigger team to assist you in the design process. The composition of your design team will vary depending on the nature of your project. First you need a pool of experts to provide you with professional-quality multimedia materials. For example you need a programmer, an audiographer, a videographer, or a photographer. Then a graphics artist is also needed to create a sleek illustration for your project. Besides that, you need advice from the content expert or the instructional designer if you are designing an educational multimedia package.

Once you have developed the initial content idea (explained in section 5.1) you then need to have a brainstorming session with your group members. You may find that you have to eliminate some irrelevant ideas that are not directly related to your project.

After that at every step of the design process, you need to do task and concept analysis. Then a design document is to be prepared. It helps for your development team to work with a standard process, method, and objective. To communicate with your client as well as the team members, you may use flowcharts to show a bird's-eye view of the design process structure and sequence.

Later on, after gathering the multimedia contents, you need to review them for appropriateness and quality. Animation and video require special attention since it can be difficult to explain some ideas without using text. You may need to ask

an expert to review the quality. If your multimedia product includes speech or video, you need to produce a script. Throughout the design process, be mindful of the importance of ongoing evaluation and assessment of project completion percentage.

During the design process, you may sometimes experience a fussy client who is always asking you to change the design every now and then. This project creep may occur even when you are designing a multimedia project for yourself. To solve this problem, you must be disciplined in your design approach so as not to be taken off track.

5.2.2 Multimedia Compilation

Under multimedia compilation, first you have to locate and assess potential multimedia materials that you want to include in your project. In assessing materials, clear any copyright and Intellectual Property (IP) issue before proceeding further.

Next, in the digitisation step, you need to convert hard copy files into soft copy (by scanning the text or typing it again entirely). For digital images you can use the digital camera to capture the pictures that you need. You also need to convert sounds and audio into their digital versions if they are not already so. Finally compile all the digitised multimedia content using multimedia authoring software.

The process involved in multimedia compilation can be summarised in Figure 5.4.

Figure 5.4: Multimedia Compilation Stages

Even with advanced multimedia authoring tools today, the compilation of multimedia applications is still a challenging task. It is not easy to gather, digitise, and produce an excellent multimedia package. This is because multimedia is not only about presentation, but also about production and thinking (Gershon, 2006). You need to think deeply whether your audience will accept your idea and design or not.

SELF-CHECK 5.2

1. Explain the tasks that should be handled by an audiographer, a videographer, and a photographer.
2. In your own words, explain the stages involved in multimedia compilation.

5.3 PHASE III – DEVELOPMENT

5.3.1 Development Process

In the development stage, again a plan is needed. At this stage you need a project management plan. In this plan, you need to set a time frame and dateline for each development process involved. For this purpose, use a Gantt chart. Also do not forget about the management of budget.

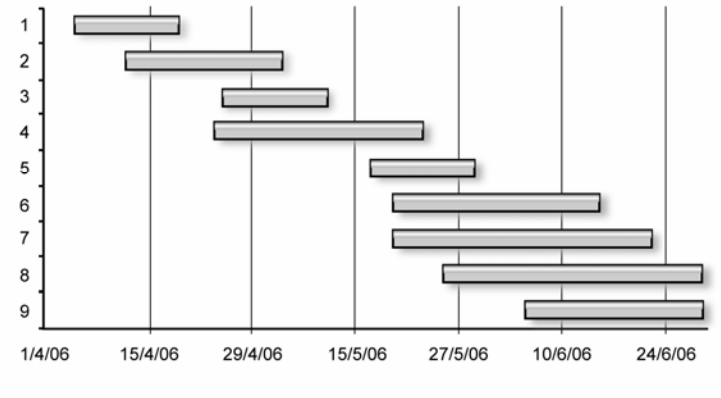

Figure 5.5: A Gantt chart
Source: http://hsc.csu.edu.au/ind_tech/design_mgt/3291/gantt_chart.gif

To help you be clear about the development process, you may divide the process based on the multimedia elements that you need. So first you may need a text component of your project. If it involves automated functions, simple authoring is insufficient. You also need to have a programming stage. For other multimedia elements, you need to create graphics, and produce audio, video, and animation.

The most important stage of the development is to assemble these separate pieces of multimedia elements into one single compilation. Then once the overall

product is completed you will need to prepare supporting documents such as the user manual.

In designing a multimedia application, the challenges involved in integration of multimedia data include how to produce convenient packages that use minimal storage. To meet this mounting challenge, all the efforts to achieve minimal storage have to be done during the three stages of development which are namely:

(a) content design;

(b) technical design; and

(c) visual design.

To ensure that the content we design match intended user requirements, we should for example consider the immediate feedback based on user choices for each interaction. Finally we should remember that people can only remember 80% of what they interact with.

Technical design ensures that the multimedia application runs properly. For instance, effective technical design and use of multimedia digital libraries need to deal with the process of building efficient content annotation and retrieval tools.

In terms of visual design, a multimedia presentation should have a consistent theme and style. Authoring interactive multimedia presentations is much more complex than authoring purely audiovisual applications or text.

The authoring of multimedia content is a challenging task. It has become more challenging when the targeted multimedia presentation needs to meet a specific user context (Scherp & Boll, 2005).

Figure 5.6 summarises the process involved in multimedia development.

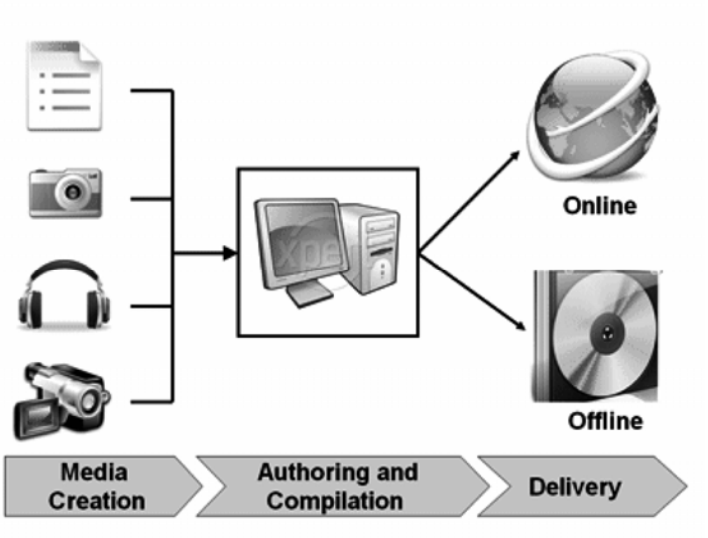

Figure 5.6: Multimedia development process
Redesigned from Source: http://en.wikipedia.org/wiki/Multimedia, http://www.joeuser.com/sdfiles/mormegil/IAD/88-CDR(01).jpg, http://images.stockxpert.com/pic/m/a/ag/agb/192406_35175349.jpg

5.3.2 Product Testing

Any type of multimedia software development project needs at least two major testing processes. The first one is carried out internally by the development team themselves, and is called alpha testing. The other major testing is done later – the beta test - that involves the client or external testers.

In alpha testing you may prepare a customised evaluation form or a checklist based on the style manual. Under alpha testing, you want to recheck whether the look and feel as well as the style convention suits the requirements that you have set earlier (before you started the development process). Most importantly however, it is the functionality of your application that you want to test thoroughly. You want to make sure that all buttons are clickable and menus are functioning perfectly. Then based on what you have evaluated in the alpha testing, revisions and corrections are done.

On the other hand, the beta test is a complete testing of a final product, to be carried out by the client of your project. It is a sort of a formal quality evaluation done externally. You may ask your client to do it independently, but I expect you to take the collaborative testing approach. In this way you can hear the comments

directly from your client. Immediate response and correction can also be done on the spot.

These two major types of multimedia software testing are illustrated in Figure 5.7.

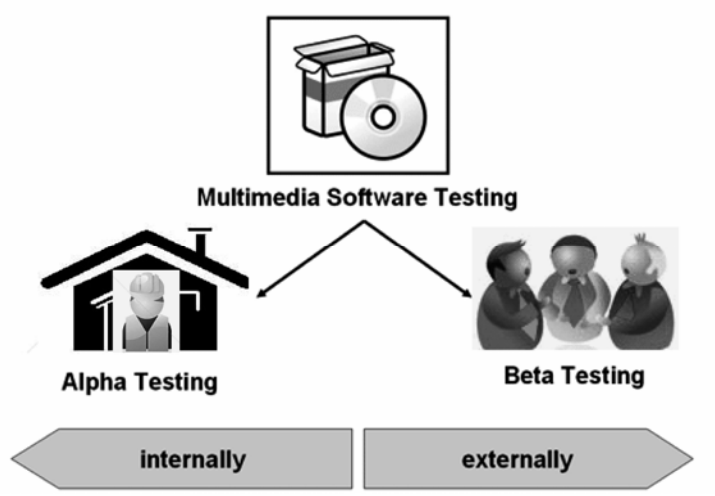

Figure 5.7: Multimedia software testing
Redesigned from Source: http://blog.1time.ie/wp-content/uploads/2006/03/software-package-zoom.jpg, http://www1.istockphoto.com/file_thumbview_approve/2363185/2/istockphoto_2363185_shiny_icons_configuration.jpg

SELF-CHECK 5.3

1. What are the challenges in the multimedia development process?
2. Discuss the factors you must take into account when conducting user testing sessions.

5.4 USABILITY AND DESIGN GUIDELINES

5.4.1 Functionality and Navigation

It is very important to develop a multimedia application system that functions thoroughly. This must be ensured before the application can be launched to reach the intended audience. To determine the correct functional system, you need to understand the characteristics of your target computer or running platform.

Functionality is defined as "capable of serving a purpose well" (Answers.com), hence you need to be clear of the purpose of your multimedia application. To get a clearer description of what your audience would expect, consult your project client.

The primary purpose of navigation on the other hand is to help the user move forward while interacting with your multimedia application. Can you imagine how frustrating it can be when a user gets stuck and is not able to navigate through the screen? The characteristics of a good navigation system are that it is user-centric, besides being attractive. A good navigation system helps the user finds his way around – "navigates" - easily through the multimedia application.

5.4.2 Usability Issue

Usability is defined as the effectiveness of a product regarding its fitness for purpose, ease of use, and ease of learning. The objective of usability testing is not only to determine whether the product is easy to learn, satisfying to use and contains the functionality that the users desire, but also to identify difficulties, weakness, and areas for improvement.

When doing usability testing make sure that you consider the following factors:

(a) Learning ability;

(b) Performance effectiveness;

(c) Flexibility;

(d) Error tolerance and system integrity; and

(e) User satisfaction.

Once you have conducted the usability test, analyse the testing data. Then report the results to your client. This is important to improve the design and the effectiveness of your multimedia application or product.

Figure 5.8 illustrates some of the issues related to multimedia software usability.

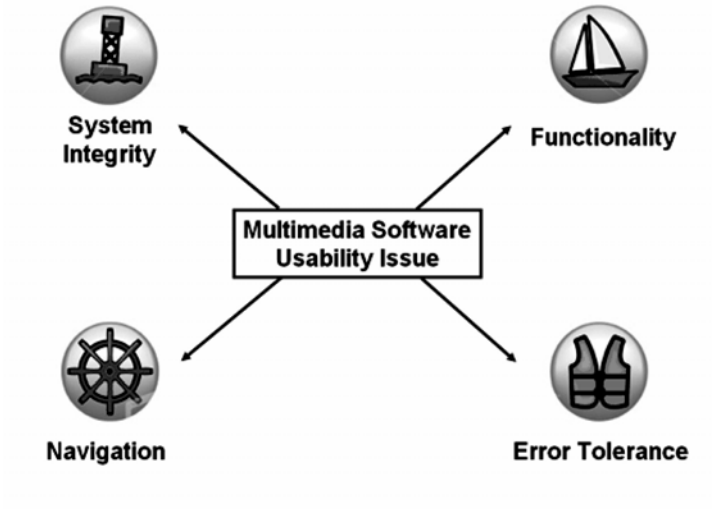

Figure 5.8: Multimedia software usability issues
Redesigned from Source: http://www1.istockphoto.com/file_closeup/nature/elements/water/3479221_aqua_icons.php?id=3479221

SELF-CHECK 5.4

1. Summarise the multimedia design guidelines outlined in this unit.
2. Select several multimedia titles and study their screen designs on the basis of functionality, navigation, and usability.

DISCUSSION

Windows Vista Interface Causes Problems For Consumers, Support Firm Says

By Antone Gonsalves, InformationWeek, July 13, 2007 10:06 AM

Navigating Windows Vista's Aero user interface is a big problem for many consumers learning Microsoft's 6-month-old operating system, a technical support company said Thursday.

Support.com, which offers technical support to consumers, said the top three reasons people called for Vista help were to solve navigation problems, device incompatibility, and home networking issues. While Vista is "a leap forward in terms of usability and functionality," it requires consumers used to working with older versions of Windows to learn something new"

(http://www.informationweek.com/news/showArticle.jhtml?articleID=201001268)

Discuss how to solve the usability and functionality problem of Windows Vista with your colleagues.

SUMMARY

- The planning stage has three sub-phases: idea, goals, and constraints identification; style and concept; and storyboard and prototype development.
- In every step of the design process, you need to do task and concept analysis.
- The multimedia development process should be carried out based on the multimedia elements that you need.
- The process involved in multimedia development is: media creation, authoring and compilation, and delivery.
- There are two types of testing: Alpha – to be done by the developer/designer; and Beta—to be done by the client or final user.
- To develop a multimedia application that functions correctly, understand the characteristics of the target user.
- Usability is important to ensure the effectiveness of a multimedia product.

KEY TERMS

Alpha and Beta Testing	Prototype
Authoring Tool	Storyboard
Content Expert	Style and Concept
Copyright and Intellectual Property (IP)	Style Manual
Functionality and Navigation	Technical Design
Gantt Chart	Usability

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Topic 6 ▶ Multimedia Authoring and Scripting

LEARNING OUTCOMES

By the end of this topic, you should be able to:

1. Describe multimedia authoring, paradigm, and tools; and
2. Discuss multimedia scripting and programming.

▶ INTRODUCTION

By now you should be familiar with the processes involved in multimedia development (explained in Topic 5). In this topic we will first learn basic multimedia authoring and scripting concepts. Then we will study about the main approach to develop a multimedia software or application.

Let me start with an analogy. Have you ever seen someone arranging flowers in a vase? He or she normally needs various colours and types of flowers. Similarly, with multimedia we need the elements such as images, video, text, etc. So with multimedia also you can create a beautiful and engaging multimedia "arrangement" of those elements with the help of an authoring tool.

In addition, in this topic you will learn about multimedia programming and we will identify the common scripting languages used to develop multimedia. Finally you will also learn how multimedia content can be developed for the web.

6.1 MULTIMEDIA AUTHORING

6.1.1 What is Multimedia Authoring?

Multimedia authoring is defined as the assembly and synchronisation of all the media components prepared for a multimedia application. It can be done using a software application known as an authoring tool. Thus the authoring tool is used to create an interactive multimedia application or presentation. In recent years, many multimedia authoring tools have been developed e.g. Authorware and Flash.

To author interactive multimedia presentations is much more complex than authoring merely audio visual or textual applications (Bulterman and Hardman, 2005). Multimedia authoring is a resource demanding and knowledge-intensive process. Hence it can be an extremely complicated activity for a user new to multimedia authoring.

Multimedia authoring is a program which has built-in elements for the development of interactive multimedia software. Authoring is just a speeded up version of programming. You do not need however, to know the details of a programming language. What you do need though is the skill to use the icons and menus available to create a new interactive or linear multimedia application.

Figure 6.1 shows an example of an educational multimedia application created with a multimedia authoring tool. A multimedia authoring tool provides the important framework that you need to organise your multimedia resources such as graphics, text, video etc.

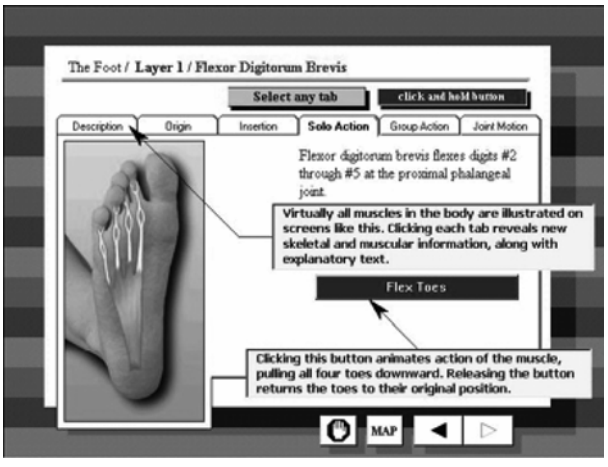

Figure 6.1: An educational multimedia application
(**Source:** http://www.csus.edu/atcs/images/kinessnap1_lg.jpg)

6.1.2 Authoring Paradigm

Multimedia authoring paradigms, also known as authoring metaphors is an authoring concept used to represent the tools interface concept to the user. The authoring system accomplishes its task through the use of these paradigms or metaphors.

There are various multimedia authoring paradigms. A number of different authoring paradigms can be identified based on how you interact with them. Basic paradigms are icon- or flowchart-based, card- or page-based, and timeline-based, described below:

(a) **Icon or Flowchart-based**
In this authoring paradigm, you need to organise the multimedia elements and events (such as clicking) in a structural process. The core of the paradigm is the Icon Palette that contains possible functions and the flow line. Examples of iconic or flowchart-based authoring tools are Authorware and Toolbook (refer to Figure 6.2).

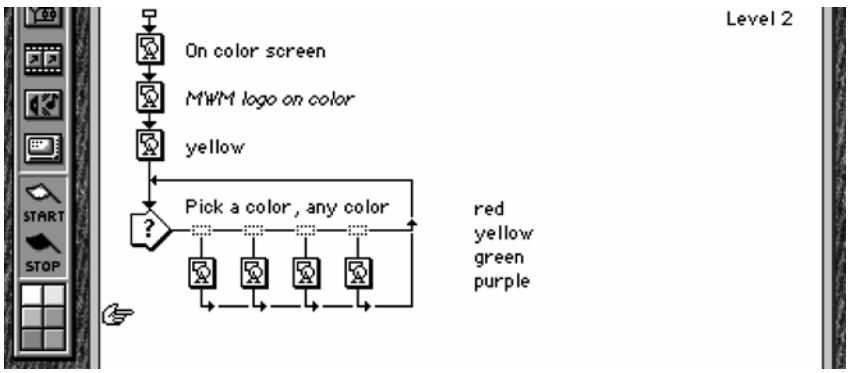

Figure 6.2: Macromedia Authorware Iconic/Flow Control
(**Source:** http://www.cs.cf.ac.uk/Dave/Multimedia/authorware.gif)

This metaphor lets you see visually the flow of your program. You can opt to use this paradigm if the nature of your project is a short development project.

(b) **Card or Page-based**
In this authoring system, multimedia elements are organised using a "card" or "page" as the basic unit of organization. Just as a book may consist of hundreds of "pages", in this authoring system, a new multimedia application may be composed of many cards.

As in reading a book, in this authoring tool too you can jump to any page you wish, linked usually by some programming logic. Examples of card-based tools include Multimedia ToolBook and HyperCard. The advantage of using this metaphor is that you can see clearly the relationship between your multimedia pages or cards.

(c) **Timeline-based**

Thanks to the timeline metaphor, authoring tools have become easier. The timeline metaphor basically includes a timeline representation to allow you to specify the sequence of animations and interactions (Kurihara, Vronay, & Igarashi, 2005).

Figure 6.3 shows a sample of a timeline used to visualise the evolution of the spider.

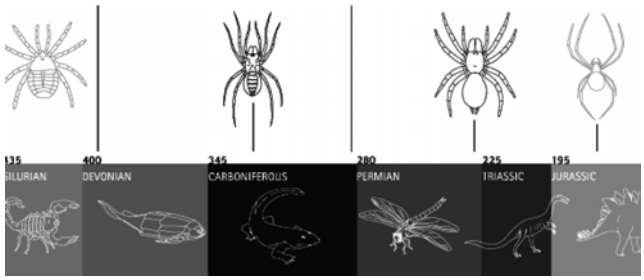

Figure 6.3: Timeline of the evolution of the spider
Source: http://www.amonline.net.au/spiders/images/diversity/evolution_timeline.gif

The timeline-based tool uses a music score as its primary authoring metaphor. The synchronous elements are shown horizontally. The media elements and events are organised along this time-line. The timeline-based tool allows you to precisely control the temporal characteristics of your multimedia application. You can drag your multimedia element on the same frame to make sure that they appear simultaneously. Some examples of timeline-based tools are Flash, Director, and Power Media.

Figure 6.4 shows a Director Score window with the timeline.

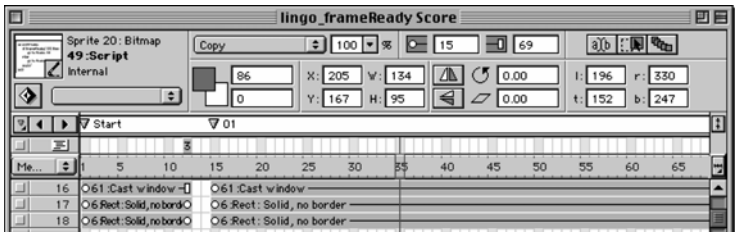

Figure 6.4: Director Score window
Source: http://www.cs.cf.ac.uk/Dave/Multimedia/dir_score.gif

6.1.3 Authoring Software and Tools

Multimedia authoring software is designed to help you to create an interactive or linear multimedia application. It contains tools for making a complete multimedia presentation such as corporate presentations or teaching materials (if you are a teacher). You may also create your own family animated albums, or even screen savers using this tool. The most popular tools are Flash, Director, and Authorware.

(a) Flash

Adobe Flash is widely used to create multimedia-rich content. You can even use it to create an advertisement. Flash file (in .swf extension) can be embedded in your HTML file to be uploaded to the Internet. The advantage of this tool is that is produces vector graphics. Previously known as Macromedia Flash, this tool is commonly used for the Web.

Figure 6.5 shows the Flash design environment with the timeline and the stage.

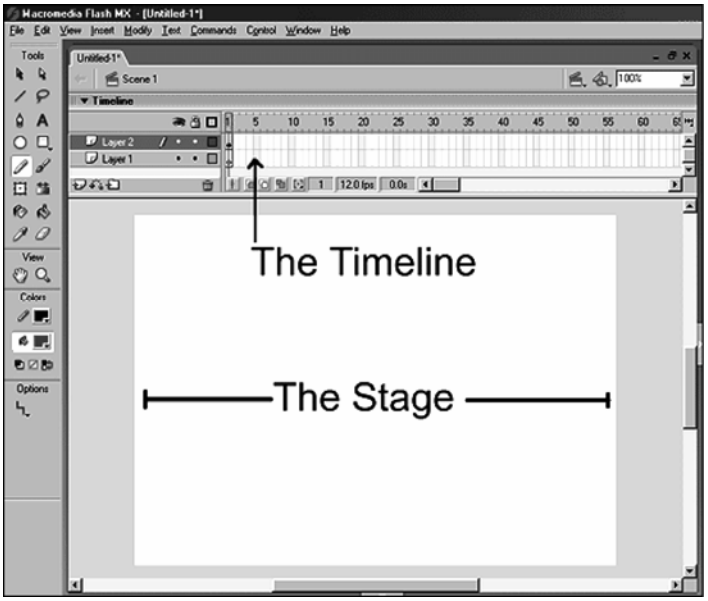

Figure 6.5: The Flash MX authoring environment
Source: http://www.abdn.ac.uk/webpack/images/web/25.4.gif

(b) Director

Director is a professional multimedia authoring tool. It comes together with broad media support for various media types for high-performance and industry-quality multimedia production. The applications that you have created using Flash can be distributed using CDs, DVDs, kiosks, or the

Internet. Director has been a best-selling multimedia authoring program. It was once the leading tool for creating interactive media products.

This tool is based on the concept of a movie containing one or more casts. It uses the movie metaphor and still can be used to develop interactive applications with interactive buttons, etc. It follows the cast/score/scripting paradigm, same as Flash. You can use this software to create dazzling animations or short films. You can even create interactive product demonstrations or online learning applications. What you really need is a bit of creativity.
Figure 6.6 shows the Director authoring environment.

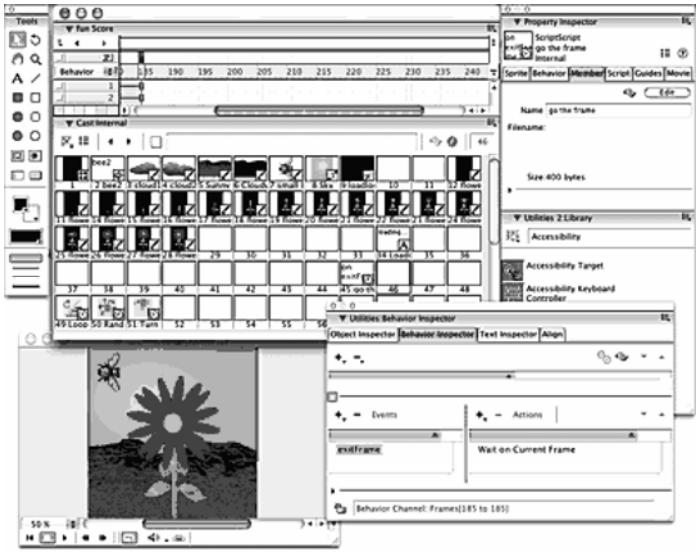

Figure 6.6: Director authoring environment
Source: http://www.webmonkey.com/webmonkey/03/03/stuff/total_ui_reduced.gif

(c) Authorware

Authorware is now the top visual authoring tool for creating rich-media applications. Authorware supports interactive application development with hyperlinks and integrated animation. Figure 6.7 shows the Authorware design environment.

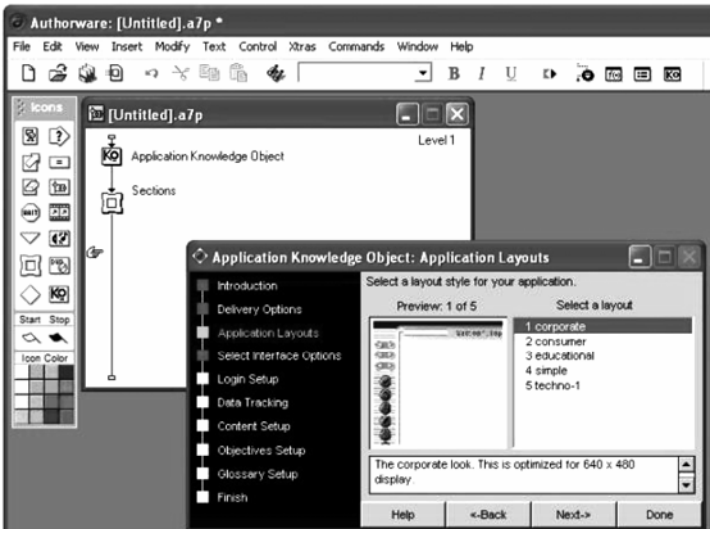

Figure 6.7: Authorware environment
Source: http://www.webmonkey.com/webmonkey/03/03/stuff/total_ui_reduced.gif

SELF-CHECK 6.1

1. Define multimedia authoring.
2. Draw a table to differentiate the various authoring paradigms.
3. Discuss the characteristics of three main multimedia authoring tools.

6.2 MULTIMEDIA SCRIPTING AND PROGRAMMING

6.2.1 Scripting and Programming Language

Multimedia programming has been growing tremendously over several decades (Wang, Boujemaa & Chen, 2007).

Script-based tools depend principally on a scripting language for programming. The production of a dynamic website may utilise tools such as Flash, Authorware and Director but with strong scripting. Examples of command programming software are C++ and Visual Basic. It is useful to create new applications such as a catalogue or a salary payment program. Scripting language is the closest form to traditional programming. Examples of scripting language are Lingo for Director and ActionScript for Flash. Scripting allows you to incorporate

interactivity and non-linearity in your multimedia design. Compared to complete packages of programming languages such as C++ and Pascal, scripting languages do not have much complex features.

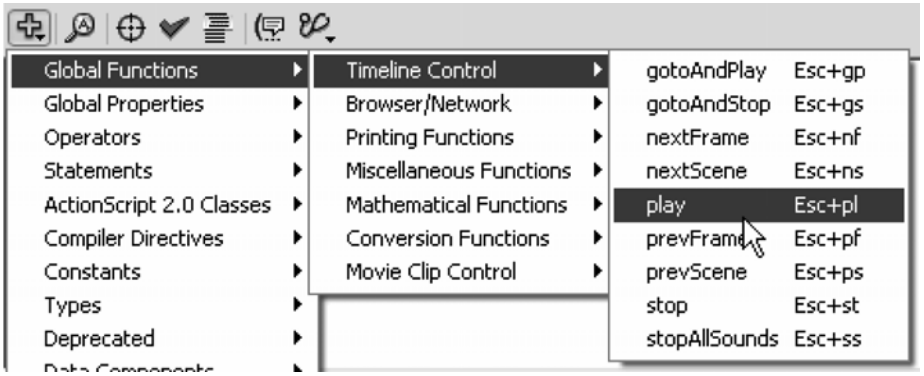

Figure 6.8: Flash Action Script

Source: http://education.sdsc.edu/teachertech/flash101/images/script3.png

In scripting command, the action in Figure 6.8 is similar to:

```
on (release) {
 play ();
}
```

6.2.2 Web-based Multimedia

In recent years web-based applications have become more and more popular in computer-based applications. Hence learning and mastering web programming environment, techniques, and methods have become essential for multimedia designers. Development of web-based information systems with forms processing and database applications may involve web programming using ASP, PHP, ColdFusion, etc.

A powerful multimedia application now hence needs to be developed using a high-end programming language. To index and retrieve large quantities of multimedia data results of a search presents a highly difficult and challenging problem. To add more interactivity on the web, Dynamic HTML (DHTML) scripts can be used to create a more dynamic website menu. Many web developers use this type of menu style to provide a user-friendly interface with clear webpage hierarchical levels.

Figure 6.9 shows an example of a DHTML menu.

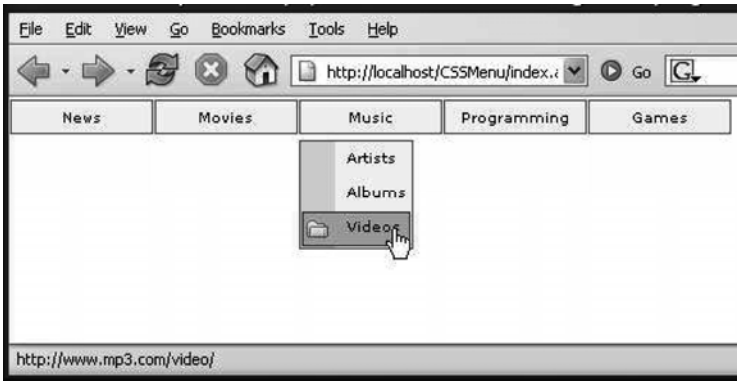

Figure 6.9: DHTML Menu
Source: http://www.codeproject.com/aspnet/DHTMLMenuASPNET/cssmenu2.jpg

SELF-CHECK 6.2

1. What do you understand about multimedia scripting?
2. What are the other capabilities of DHTML?

DISCUSSION

The Best-Value Tool Suite for Creating Multimedia Presentations, Movies, and Podcasts!

MediaWorks combines simple-to-use video, sound, animation and paint editors with a powerful multimedia authoring program. Easily create amazing "movie-type" productions that are difficult or not possible in other consumer-level movie and slide show editors, and precisely-timed linear and interactive presentations without the learning curve and expense of high-end media editing and authoring tools. Use your exported movies in other applications or deliver on a consumer DVD player, iPod®, iPhone™, Apple TV®, YouTube, or other web pages. Deliver your finished presentations on a computer or data CD/DVD.

(http://www.mediaworkssoftware.com/products.html)

Based on the information above, discuss the specifications of the powerful multimedia authoring tool.

SUMMARY

- Multimedia authoring is the process to assemble multimedia components using an authoring tool.
- Multimedia authoring paradigms or metaphors is the authoring concept to represent the authoring tools interface concept.
- Basic multimedia paradigms are icon- or flowchart-based, card- or page-based, and timeline-based.
- The most popular authoring tools are Flash, Director, and Authorware.
- Script-based techniques add power to create more interactive multimedia authoring. Compared to a complete package of programming languages, a scripting language does not have complex features.
- Development of web-based information systems with forms processing and database applications may involve web programming using ASP, PHP, ColdFusion, etc.

KEY TERMS

Authoring Software	Multimedia Authoring
Authoring Tools	Multimedia Programming
Card/Page-Based Paradigm	Multimedia Scripting
DHTML	Timeline-Based Paradigm
Icon/Flow-Chart Based Paradigm	Web-based Multimedia

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Wang, J. Z., Boujemaa, N., & Chen, Y. (2007). High diversity transforms multimedia information retrieval into a cross-cutting field: Report on the 8th Workshop on Multimedia Information Retrieval. *SIGMOD rec.*, 36 (1), 57-59.

Topic 7 ▶ Web-based Multimedia Applications

LEARNING OUTCOMES

By the end of this topic, you should be able to:

1. Describe the characteristics of web-based systems;
2. Examine the examples of web-based multimedia applications; and
3. Discuss online issues such as copyright and cyber crime.

▶ INTRODUCTION

In Topic 6 we learnt what multimedia authoring and scripting is. You should now be able to differentiate between them. As explained in the previous topic, multimedia content can be delivered online. To do so however, you first need to understand about web-based multimedia applications.

In this topic, I will explain why traditional stand-alone applications are being migrated to web-based. You will then understand the characteristics of web-based systems and the fundamental concepts.

In addition, in this topic you will also learn about modern web-based multimedia applications such as e-learning and e-commerce. Finally, we will discuss some current issues pertaining to online and web-based multimedia applications.

7.1 WHY WEB-BASED?

7.1.1 Development of Web Applications

What do you understand by the word "Web"? The World Wide Web (WWW) had its first online presence with a usable interface in the 1990s. A web application is defined as an application that is invoked with a Web browser, with the Internet as the main backbone (Jazayeri, 2007). The main objective that triggered the development of the web was to ensure that information is accessible from any source in the world. Since then WWW has become a massive, gigantic collection and repository of information and online applications.

Normally, a web-based system has several characteristics such as:

(a) Capable of handling database and multimedia contents;

(b) Has a good graphical presentation for user-friendly navigation; and

(c) Has supporting proactive user interaction such as search query.

In terms of structure, the workings of WWW is based on the client and server concept. To call or invoke the online document, the client first has to request or send a query for the information to be viewed from the server. Then the server will do the searching process from the data repository. Finally the server will respond by sending the required data to the client.

Figure 7.1 illustrates the client and server concept.

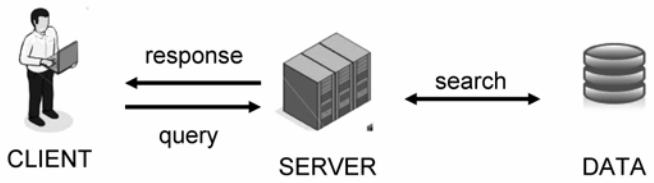

Figure 7.1: Client-Server computing.
Source: http://www.istockphoto.com

The three fundamental concepts in web applications are as follows:

(a) Document referring (Uniform Resource Locator - URL) ;

(b) Document writing (HyperText Markup Language - HTML); and

(c) Document access protocol (HyperText Transfer Protocol - HTTP).

URL is the whole combination of HTTP, domain name, and HTML document name. The HTTP and HTML part in a web browser is highlighted in figure 7.2 below:

Figure 7.2: HTTP and HTML
Source: http://www.google.com

7.1.2 Modern Web-Based Multimedia Applications

(a) Web Portal

A web portal is defined as a point of access for internet information. Web portals offer various types of information, databases, and applications based on a unified nature or background of information. For example, if you want to know about the Malaysian Government the portal is at www.gov.my. Here you can find loads of information as well as online services provided by the Malaysian government.

As a one-stop centre, the portal is vital to overcome the problem that has become increasingly challenging in the way we use the web. Web users always want to surf and find easily the information they seek. As the complexity of web sites expands dramatically, a web portal is necessary to organise the information to be presented. This is often done through a list or directory.

Figure 7.3 illustrates the web portal architecture.

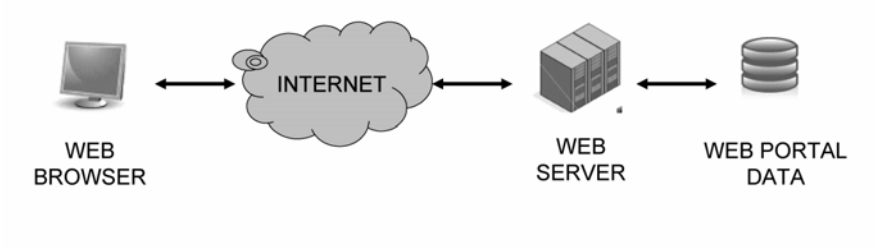

Figure 7.3: Web portal architecture
Source: http://www.istockphoto.com

There are hundreds of thousands of web portals on the Internet. Since the portals manage to attract a lot of web visitors, they offer advertisers the opportunity to showcase their products or services. Hence Internet advertising has become a multi-million dollar industry. Web portals also provide the opportunity for multimedia content providers and artists to create online banners, graphics, etc.

Figure 7.4 shows the Malaysian Government portal. Here you can find a lot of important information relevant to the Malaysian citizen such as matters related to education, employment, and health. The portal also offers online governmental services through the website e-transaction centre.

Figure 7.4. Malaysian Government Portal

(b) Wikipedia

Articles that had been created by Wikipedia contributors based on November 2007 statistics numbered more than 1.9 million. And that is in English alone. The popularity of Wikipedia has made it among the top 100 websites of the world.

Have you ever thought of how all the Wikipedia information came about? It was all contributed by Wikipedia own users who entered and edited all the information that you find on Wikipedia. That is the key feature of Wikipedia – users' contribution. The first wiki was created by one Ward Cunningham in 1995.

As an encyclopaedia, Wikipedia grows every hour. This happens as its volume of information grows whenever it records thousands of changes per hour. However Wikipedia faces a problem of information correctness and validity since anyone – amateur or professional, expert or novice can write about anything in Wikipedia.

Figure 7.3 shows how Wikipedia works. Wiki users are free to enter and edit the entry on a particular topic. The topic will then be saved in the article database.

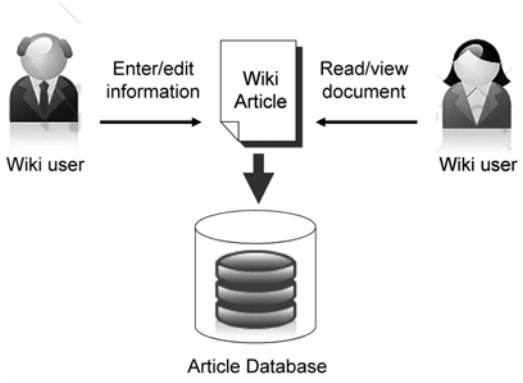

Figure 7.5: How Does Wikipedia Work?
Source: http://www.istockphoto.com

(c) Photo Sharing

I am sure that you have a collection of personal or family photos. Why not share it through the web with family and friends? Photo sharing is the process of publishing digital photos online. It enables sharing of photos through a website that allows us to upload, display, and manage our image collections. The collection can be accessed through thumbnail views. You can also preview them using the slideshow menu.

Online photo sharing is becoming easier day by day since nowadays you can capture a photo even by using your mobile phone. After that you just need to use a Bluetooth device to upload it to your computer. Then with Internet connection available, simply upload the image to your online photo sharing site. With the advancement of ICT, this application is

expected to become a killer application in the near future, if it is not already so by now.

Figure 7.6 shows a screenshot of Flickr, the most popular photo sharing site today.

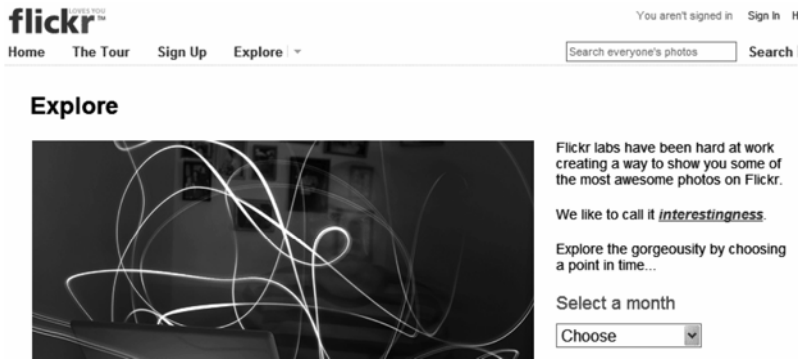

Figure 7.6: Flickr Website

(d) YouTube

YouTube.com accounts for more than half of all videos watched online in the US. This user-centred web-based application is so attractive because it allows you to upload your videos online. Moreover, you can share it with the rest of the world; readers or viewers can post comments and others can respond. You can even become a member of certain groups. In the future, YouTube is expected to become better than TV in terms of coverage. This is because anyone in the world can record a TV program or advertisement, and then upload it to YouTube.com.

Figure 7.7 shows a screenshot of YouTube.com.

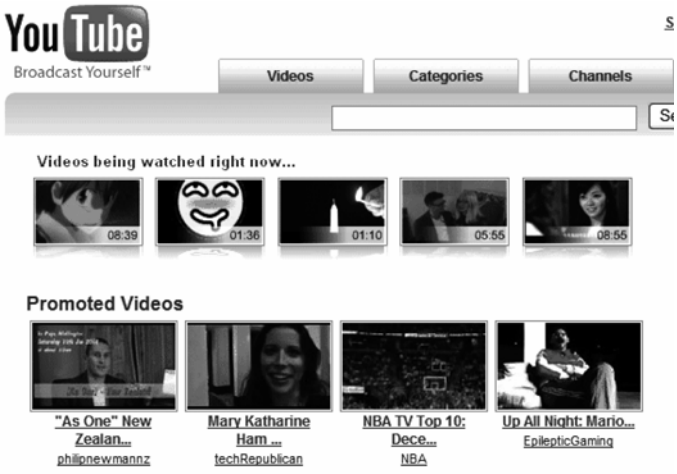

Figure 7.7: YouTube.com

(e) Blog System

A blog (shortened for weblog or "web log") is a digital online diary wherein you can type an entry. It is displayed commonly in reversed chronological order, with the last entry or posting appearing first on the web page. Your blog visitors can even leave their comments on what you have written. You can then also reply to their comments. The original intention for someone (known as a blogger) to blog was just for personal daily notes, but now the activity of blogging has become a phenomenon due to its huge popularity.

The proof is in the number of blogs that has been doubling (Tirapat, Espiritu & Stroulia, 2006). This trend seems to show as though the blog is competing with traditional media (like newspapers and journals). As the popularity of blogs expands, various styles and instances of blogs have been created and developed. There are now photoblogs (for photographs) and vlogs (video blogs).

Due to the blog's increasing popularity and extensive topics covered by the variety of bloggers, blogs present a wealth of information for all of us. If previously e-mail was chosen as the main medium for personal communication, nowadays blogs provide a more powerful social interaction stage. A blog offers a more personalized way for informal interaction.

Figure 7.8 shows a screenshot of my personal blog. You can visit it at snjunaini.wordpress.com.

Figure 7.8: Screenshot of my personal blog

SELF-CHECK 7.1

1. Explain what you understand about URL, HTML and HTTP.
2. What are the elements related to web portal architecture?
3. Why is the blog very popular nowadays?

7.2 WEB-BASED APPLICATIONS

7.2.1 E-Learning

E-learning (Electronic Learning) is the delivery of learning materials over the Web whereby the storage, maintenance and administration of the materials are on the Web server. By having course materials online, learner effectiveness can be increased. Thousands of learners can simultaneously take part in the learning at their own pace.

Delivering the study content online has changed the nature of knowledge dissemination. It makes the learning process more convenient and cost effective. It is a great way of providing lifelong learning especially for distance and open learning students such as those from Open University Malaysia (OUM). In the development of web-based learning tutorials and other educational applications, the ultimate goal is to help students raise their performance in the learning process.

However, the evaluation of e-learning applications needs special attention from content experts as well as educators. It is equally important to assess not only how students use the e-learning portal, but also the quality of the e-learning contents. One of the other issues that have been raised is whether e-learning can be as effective as face-to-face classroom interaction.

E-learning can significantly save precious time for both educators and students'. But do you think that e-learning can also produce better results than classroom meetings? Increasing the effectiveness of e-learning has also become a main issue in online educational content delivery (Lee & Lee, 2008).

Figure 7.9 shows the OUM Learning Management System (LMS).

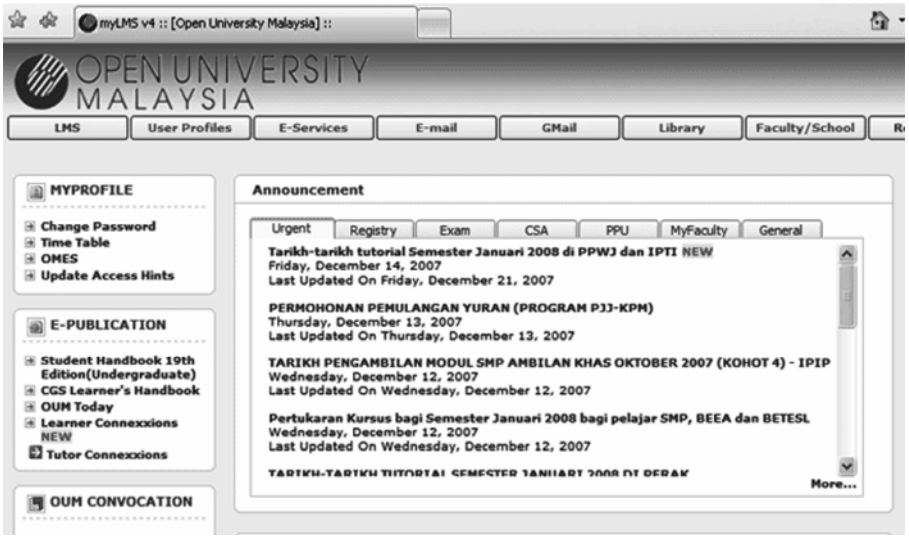

Figure 7.9: OUM LMS

7.2.2 E-Commerce

The vast advancement of the Internet has rapidly transformed the way companies conduct their business. It has become an important medium to connect businesses worldwide. Companies therefore are no longer prohibited from doing business for the reason that they are located away from their targeted consumers or potential business partners. It is not only opening wide and new opportunities but has also tremendously changed the business process involved.

The mushrooming growth and popularity of WWW has motivated companies to use it as a medium to promote and sell their products virtually. Companies begin having an online existence through the use of electronic catalogues on their websites. These electronic catalogues offer, as a marketing and advertising medium, a range of new ways to reach the customer. They allow customers to obtain related product information, and if they wish they may order through the online store. Business is then conducted through electronic commerce (e-commerce).

As electronic shopping grows, it becomes an important part of our contemporary culture. For instance a Virtual Reality (VR) shopping mall enables customers to be engaged in an "immersion" in a 3D-mediated environment providing virtual sensory experiences of a shopping mall.

Figure 7.10 shows one of the Malaysian e-commerce portals for online shopping, e-bay.

Figure 7.10: www.ebay.com.my

7.2.3 E-Government

Since the term e-government (EG) covers such an extensive range, it is difficult to find one standard definition that sums up exactly what e-government really stands for. EG is basically the use of information and communication technologies (ICT) by a governmental organisation to support their services to the citizens through electronic or digital systems and virtually through the internet. EG is a way through which citizens can access public services that has traditionally been done manually. This activity thus helps them accomplish government-related transactions and activity through electronics means. EG is basically a digital bridge linking people and/or businesses to government and vice-versa.

Governments around the world, including in Malaysia have acknowledged the potential applications presented by information and communication technologies (ICT) especially the Internet. New ways to distribute services and to interact with citizens are continually being explored through the existence of EG. It optimises government working procedures without time and space restrictions. Successful e-government application improves working efficiency and thus offers highly efficient service to the society. The migration from paper-based services to the electronic version has opened wide the potential of e-government applications. An electronic communications system for example is very useful when millions of citizen queries need to be replied immediately (Sagheb-Tehrani, 2007).

Table 7.1 lists several e-government website addresses.

Table 7.1: E-Government website addresses

Country/Government	URL
Malaysia	www.gov.my
Australia	www.australia.gov.au
Canada	www.canada.gc.ca
Singapore	www.ecitizen.gov.sg
United Kingdom	www.direct.gov.uk
Indonesia	www.indonesia.go.id
Brunei	www.brunei.gov.bn
New Zealand	www.newzealand.govt.nz
Philippines	www.gov.ph

7.2.4 E-Entertainment

The astonishing spread of the Internet has also given the opportunity for online entertainment. The field of e-entertainment has aroused great interest among users. It has shown great promises bringing exciting new forms of human computer interactions (Cheok & Yu, 2006). I think perhaps the most important effect of the Internet is that it presents new forms of leisure and entertainment.

For example, you can collectively share music and video on the internet as it is the greatest platform that provides forums for you to participate in such activities. The most popular site that you probably hear everyday now is YouTube.com.

Other than that you can share MP3 files that you have with others through peer-to-peer applications. For example with Piolet (www.piolet.com) you can share or download MP3 files easily.

In addition you can play games and interact with someone else from an unknown corner of the earth. Do you still remember playing board games such as Checkers during your childhood? Now you can play it for free -- not alone, but with an opponent whom you can pick from another country.

Figure 7.11 shows a screenshot of a Yahoo Checkers online game.

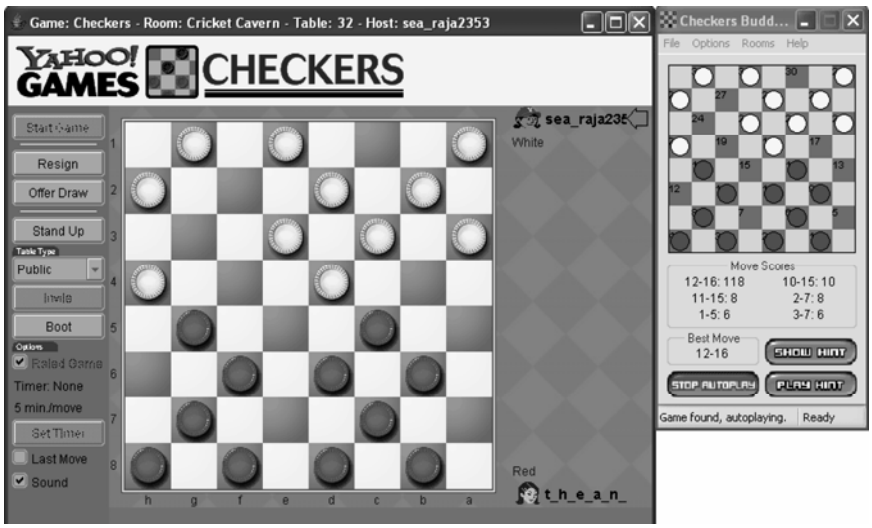

Figure 7.11: Yahoo Games - Checkers
Source: .http://www.playbuddy.com/images/screenshots/ssCheY2.gif

As traditional media makes the transition to the web, the need for a systematic way of delivering entertainment online becomes increasingly important. Electronic entertainment (e-entertainment) services are deployed and delivered through the Internet and there is a great demand for rich 3D e-entertainment content. However, the challenge is to render very large 3D models and environments on the network. Therefore you need to be aware that here the issue of network quality becomes the main factor to be considered.

SELF-CHECK 7.2

1. What are the advantages of e-learning?
2. Do you think that virtual shopping will be very popular in the near future?
3. What is your comment on the performance of the Malaysian e-government portal?

7.3 WEB AND INTERNET ISSUES

7.3.1 Harmful Information and Communications

The Internet has brought a massive information explosion, but it also has some drawbacks. I am sure that you receive a lot of e-mails with at least 10% percent being spam or garbage e-mail. Some of the information available on the net is also ambiguous and cannot be totally accepted. You can also easily find offensive materials as well such as pornography and recipes for making bombs. Sometimes when you chat using the Internet Relay Chat (IRC) you find that the conversation becomes disrespectful or malicious. The internet can thus be misused easily to harass and discredit others.

7.3.2 Plagiarism and Copyright

With increasing internet access worldwide, plagiarism has also become a major epidemic especially among many institutions (Higgins, Gray, Symeonidis & Tsintsifas, 2005). The overall trend on plagiarism is that it is serious, rising, prevalent, and chronic. The availability of enormous quantities of electronic texts existing on the Internet has made plagiarism much easier.

Briefly, plagiarism is defined as the act of taking another person's ideas and then using them as one's own. It is a form of cheating as it is truly stealing another person's ideas. For instance, in the United States, if you are charged for public domain material copyright infringement, you can be fined up to USD2500.

7.3.3 Cyber Crime and Cyber Security

Cyber misconduct such as hacking and fraud has been part and parcel of the Internet since its early development. As files are easily downloaded and distributed, dissemination of harmful viruses and worms also spread as quickly. Various Internet scams and cheating pacts have been roaming the WWW looking for unsuspecting prey. So have fake websites and e-mail (including spam). Just because you can hide your identity on the Internet, it does not mean that you can also cheat and commit cyber crime.

As cyber crime has been dynamically on the increase, we have to admit that the effort to combat cyber crime is a collective one (Team Cymru 2006). We should not get involved in any offensive internet activity. In the United States, the government bodies concerned with this issue are for example the National Security Telecommunications Advisory Council (NSTAC), the National Security Information Exchange (NSIE), and the Cyber Security Industry Alliance (CSIA).

In Malaysia we have CyberSecurity Malaysia (formerly known as National ICT Security and Emergency Response Centre - NISER).

SELF-CHECK 7.3

1. Give examples of harmful information on the Internet.
2. In your own words, explain why fighting the cyber criminal is important and should not to be taken lightly?

DISCUSSION

Why are companies resistant to report cyber crimes?

According to the FBI and the Computer Security Institute annual survey of 520 companies and institutions (Sukhai, 2004):

- More than 60% reported unauthorised use of computer systems over the past 12 months.
- 57% of all break-ins involved the Internet.
- As many as 60% of attacks go undetected.
- About only 15% of exposed attacks are reported to law enforcement agencies.

Discuss why we see such a low number of attack reports? Why is cyber security very important? Suggest what should be done to overcome the problem of cyber crimes.

SUMMARY

- The characteristics of web-based systems are capability of handling database and multimedia contents, good graphical presentation and friendly navigation, and support of proactive user interaction.
- Three fundamental concepts in web applications involve the Uniform Resource Locator (URL), HyperText Markup Language (HTML) and HyperText Transfer Protocol (HTTP)
- A web portal is an access point for Internet information that offers various types of information, databases, and applications.
- The wikipedia and blog allow visitors to freely enter and edit their comments on the page, as opposed to traditional websites.
- Flickr.com and YouTube.com are web-based systems through which you can upload, view, and share photos and videos.
- E-Learning, e-commerce, e-government and e-entertainment are examples of web-based applications.
- Issues pertaining to the Web involve harmful information and communications, plagiarism and copyright, and cyber crime and cyber security.

KEY TERMS

Blog (Web Log)
Copyright
Cyber Crime
Cyber Security
E-Commerce
E-Entertainment
E-Government
E-Learning
HyperText Markup Language (HTML)
HyperText Transfer Protocol (HTTP)
Plagiarism
Portal
Uniform Resource Locator (URL)
Wikipedia

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Topic 8 ▶ Multimedia Communication & Compression

LEARNING OUTCOMES

By the end of this topic, you should be able to:

1. Describe the development in multimedia communication;
2. List five basic types of communications network;
3. Discuss technological advancement and challenges in communications;
4. Discuss why we need compression;
5. Differentiate between lossy and lossless compression; and
6. Explain several image and video compression techniques.

▶ INTRODUCTION

In the previous topic, you learnt about web-based multimedia. In this topic, I will explain how to deliver multimedia files on multimedia communication channels. First you need to understand the reasons for the sudden increase in requirements for multimedia files on the Internet to be transferred quickly. To understand this, you need to understand the five basic types of communications network for online multimedia communication.

This topic will also help you understand the basics of multimedia compression. You will learn three basic image and video compression formats.

8.1 MULTIMEDIA COMMUNICATION

8.1.1 Multimedia Communication Basics

The most basic multimedia communication might be as simple as having a telephone conversation via a regular Plain Old Telephone Service (POTS). Later came modem-based dial up connection, with the wide spread use of the computer and Internet.

Before we discuss multimedia communication further, let us first revise the basics of communication. I believe that you understand the basic elements of communication. They are namely - the sender, the channel, and the receiver. The channel includes the telephone, e-mail, etc. But the communication must go through the message operation centre first before it can reach the recipient (Figure 8.1).

Figure 8.1: Basics of Communications
Source: http://www.istockphoto.com

In recent years the use of wireless broadband networks has been increasing tremendously. You can find people using laptops browsing the Internet at airports, and in hotels and shopping complexes. However, multimedia transmission over wireless local area networks is a challenging issue. It seeks a better method or new solutions (Choudhury, Sheriff, Gibson & Belding-Royer, 2006)

Figure 8.2 shows a wireless broadband router, an apparatus needed for wireless Internet access.

Figure 8.2: Wireless broadband router
Source: http://img.alibaba.com/photo/11687021/4_port_IEEE_802_11B_G_MIMO_Wireless_Broadband_Router.jpg

Research in the past decade has drastically advanced hardware and software support for networked and distributed multimedia applications. These significant improvements have led to increasing commercialisation of online multimedia presentations. They also present technical challenges to commercial presentations such as Web TV, online learning, online ticketing, etc. (Sans and Laurent, 2006).

Figure 8.3 shows the basic concept of networked multimedia communications. To be able to access the Internet, each and every personal computer (and laptop) must first be connected to the web server.

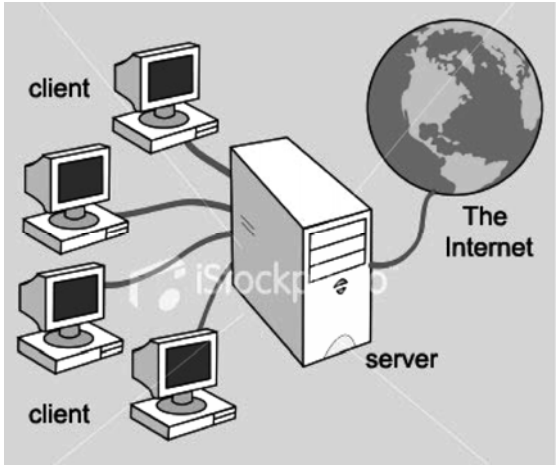

Figure 8.3: Basics of multimedia communications
Source: http://www.istockphoto.com

To meet end user Quality-of-Service (QoS) requirements, online quality management of multimedia applications on the web must have suitable computing resources. Also advanced technology has to be designed to afford robust multimedia services with capable features like QoS, reliability, and security (Sher and Magedanz, 2006).

8.1.2 Multimedia Network

One of the many unique features of the multimedia network is its ability to simultaneously transmit digital multimedia data such as text, graphics, or video over the network. In recent years, the multimedia network has become more and more important especially in the business world. Basically a multimedia network is nothing but the technology itself. It enables message and data communications. According to Halsall (2001), there are five (5) basic types of communications network to deliver multimedia data:

(a) Telephone Network;

(b) Data Network;

(c) Broadcast Television Network;

(d) Integrated Services Digital Network (ISDN); and

(e) Broadband Network.

They are as illustrated in Figure 8.4.

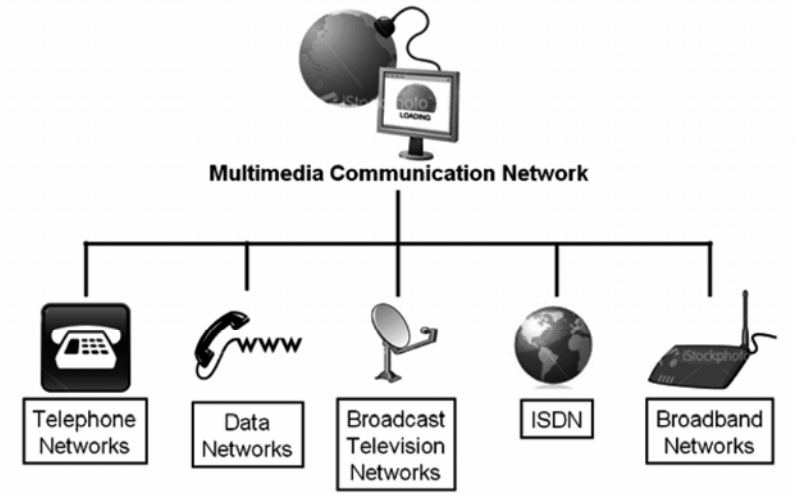

Figure 8.4: Basic types of communications network
Source: http://www.istockphoto.com

(a) **Telephone Network**

Initially the Public Switch Telephone Network (PSTN) was operated on the basis of speech signal processing. However after technological advancement, it does not only support speech applications, but also encompasses a variety of multimedia data. You need to understand that PSTN is a global collection of interconnected voice communications infrastructure. In your home, the PSTN phone line is normally a copper cable. You can connect your computer modem to this phone line to access the Internet on a 56 kbps (Kilobits per second) bandwidth.

(b) **Data Network**

A data network can be used for basic data communications such as e-mail and file transfer using FTP. To do so, you need more than a basic PSTN. What you need is an Internet connection with an e-mail or file server. To gain access to the worldwide Internet connection, you need to subscribe to a service provided by an Internet Service Provider (ISP) like JARING or TMNET.

Figure 8.5 is a diagram that shows the services that can be provided by the ISP.

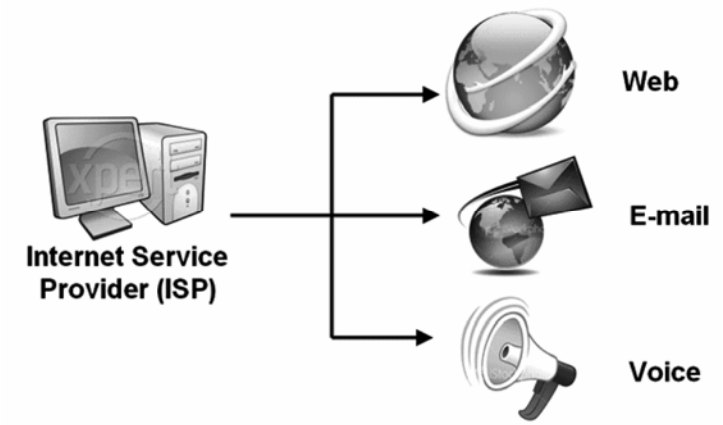

Figure 8.5: ISP services
Source: http://www.istockphoto.com

(c) **Broadcast Television Network**

Do you know how a broadcast television works in a satellite TV system?

Basically there are five (5) major components involved in a satellite TV system. These components as illustrated in Figure 8.6 are:

(i) Programming Sources;

(ii) The Broadcast Centre;

(iii) The Satellite;

(iv) Viewer's Dish; and

(v) The Receiver.

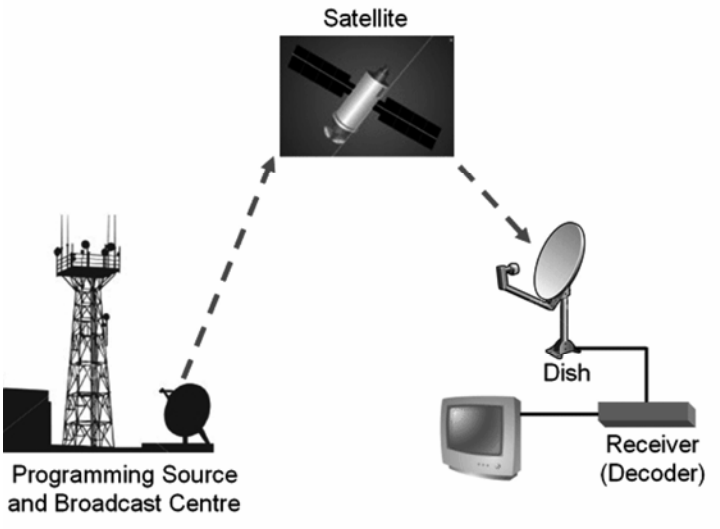

Figure 8.6: Satellite TV network
Source: http://www.istockphoto.com

(d) **Integrated Services Digital Network (ISDN)**

Normal telephone lines carry analogue signals. These analogue signals must be first converted to digital signals for data to be transmitted. This process however causes slow transmission as well as data signal distortion.

However with an Integrated Services Digital Network (ISDN), this problem is overcome. ISDN is a fully digital telephone service that is able to transmit text, audio, and video over the currently available telephone cables. ISDN was developed in 1976 by the International Telecommunication Union - Telecommunication Standardisation Sector (ITU-T). A basic ISDN line offers up to 128 kbps data transmission speed.

With ISDN your internet access is faster. ISDN digital technology ensures better connection as opposed to the old analogue technology of telephone lines. ISDN connection is thus more economical and cost-effective in terms of processing speed. Popular ISDN applications include Internet access, video conferencing, and data networking.

You can configure a group of computers to connect to the Internet using ISDN. All the computers however first need to be connected to the Intranet (local) connection using network adapters.

Figure 8.7 shows how an Internet connection can be shared using ISDN connection.

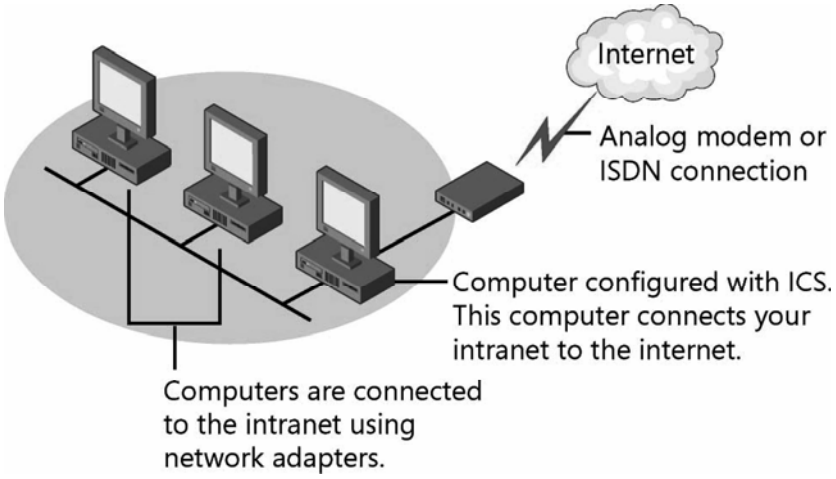

Figure 8.7: ISDN Connection to the Internet
Source: http://www.microsoft.com/library/media/1033/technet/images/prodtechnol/winxppro/reskit/ch25/f25zs07_big.jpg

(e) **Broadband Network**

The much better way to share a broadband connection is using a hardware called a broadband router. In this method, all computers are connected using a hub. The router is used as a gateway (see Figure 8.7) to connect to the internet. The router would normally be left on so that any computer on the network can gain access to the connection at any time.

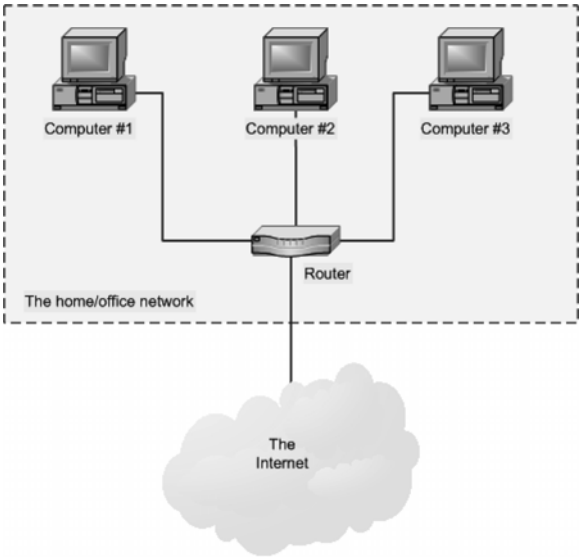

Figure 8.8: Broadband network using router
Source: http://www.microsoft.com/library/media/1033/technet/images/prodtechnol/winxppro/reskit/ch25/f25zs07_big.jpg

8.1.3 Communications Standards

In multimedia communications that involve a personal computer (PC) or workstation, the protocol layers that are normally used are based on TCP/IP (Transmission Control Protocol/Internet Protocol (TCP/IP). This is a basic communication language if you need to connect your PC to the Internet.

In this protocol, the higher layer TCP (Transmission Control Protocol) manages the setup and assembling of file into smaller packets that are transmitted over the Internet. Then the message or file is to be received by a TCP layer that later reassembles the packets into the original message. You can check your network connection from a setup window shown in Figure 8.9.

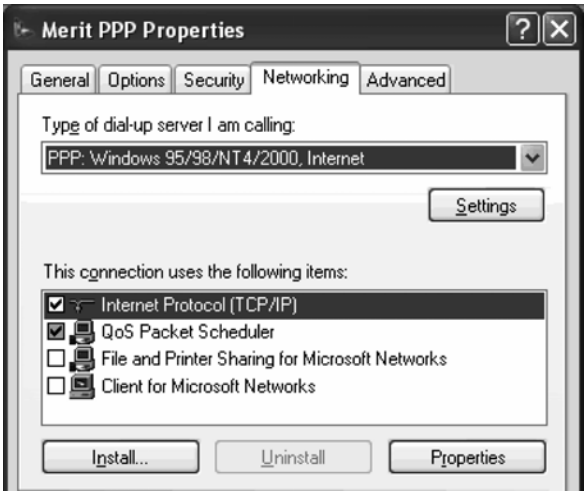

Figure 8.9: Internet Protocol Setup Window
Source: https://ict.emich.edu/helpdesk/winxp/images/xpnetworking.gif

This protocol also allows you to have data exchange by dividing them into a number of blocks of data that are called packets. Packet switching is a network technology that breaks up a message into small packets individually for transmission. Through a communications device called a router, each packet of message travels to its destination at its own pace.

8.1.4 Technological Advancement and Challenges

Real-time multimedia streaming is progressively becoming more crucial in networked multimedia applications. It has also become a popular application. One of the main challenges in multimedia streaming is the requirement that the link must be continuously available throughout a period of time. This is to enable uninterrupted data transmission and a smoother multimedia performance (Qin, Zimmermann & Liu, 2005).

Meanwhile peer-to-peer (P2P) applications have also attracted enormous attention. Peer-to-peer networking applications such as Napster, Kazaa, BitTorrent and Skype have witnessed tremendous success. As a result multimedia streaming and online gaming has been on the rise. Recent statistics shows that P2P traffic accounts for as much as 70% of the whole Internet traffic (Li, 2006). With these high capability Internet communication standards, now we can browse and find information that we need easily and quickly (Figure 8.10).

Figure 8.10: Benefits of the Internet
Source: http://www.chrismadden.co.uk/computer-cartoons/internet-weather.jpg

Technological challenges in networked multimedia can be seen from three different perspectives:

(a) Interoperability and connectivity;

(b) Performance and price; and

(c) Bandwidth and standards.

SELF-CHECK 8.1

1. Explain why providing multimedia documents online has become very popular.
2. What are the five basic types of communication networks?
3. What do you understand by packet switching?
4. Discuss the technological challenges in networked multimedia.

8.2 MULTIMEDIA COMPRESSION

8.2.1 Why Compression?

The growth of computing and multimedia technology has also resulted in an increasing demand for massive multimedia data and applications. I guess many of you surf the Internet. Have you ever become so frustrated waiting for a huge graphic to download and open? So why do you think we need to compress multimedia data?

Compression is a process of deriving more compact or smaller representations of data. Take for example an uncompressed image with a resolution of 640 x 480 pixels thus totalling 307200 pixels. A true colour (24 bit) image of that size takes about 1 MB of storage space (each pixel uses 3 bytes). Can you imagine how much space is needed if you do not compress a 2-hour video on a full screen of 1024 x 768 pixels?

You need to be aware that Quality of Service (QoS) is increasingly becoming an important issue in distributed multimedia systems. Therefore compression is necessary especially of video. This is because video consumes the largest size of storage space compared to other elements of multimedia like animation, graphics, and text. Compression reduces the memory space. Hence to provide cost effective solutions most multimedia systems use compression techniques.

Furthermore sending multimedia data over a computer network consumes large amounts of bandwidth. So compression strategies are very important. Therefore you find that multimedia data and applications today are dominated by compression and decompression. Data compression technique is thus very important as it affects computing performance (Drini , Kirovski & Vo, 2007).

8.2.2 Lossy and Lossless Compression

Compression techniques or algorithms can be divided into two main groups namely, lossy and lossless. Lossy and lossless compressions are terms used to describe whether or not, in the compression of a file, all original data can be recovered when the file is decompressed.

When you want to compress let's say a Word document, you must be able to decompress it back later to a perfect original file without losing even a single character. This type of compression is known as lossless compression. With this type of compression, every single bit of data that was originally in the file still remains after the file is decompressed.

However, for audio and video which are large (data size), you may need to compress it down to as little as 5% of its original size. In this case you need the lossy compression technique. With lossy compression however, some data is actually lost. However, being ordinary human beings, we are not able to notice the tiny losses with our naked eye.

The difference in lossless and lossy compression is illustrated in Figure 8.11 below. Notice the size of the package not just after compression but also after decompression.

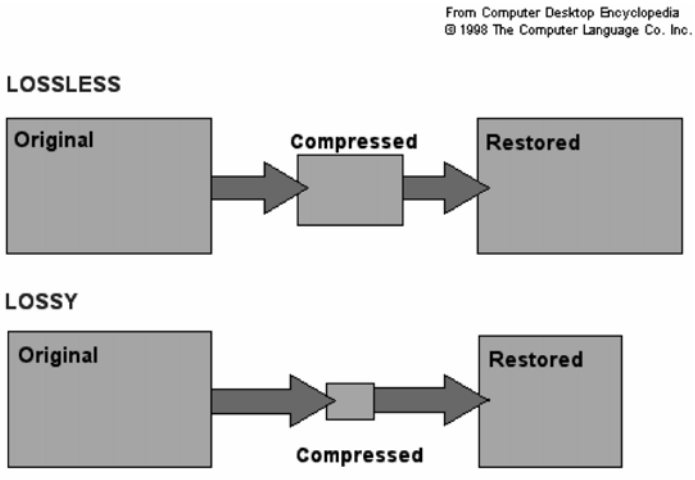

Figure 8.11: Lossless and Lossy Compression
Source: http://content.answers.com/main/content/img/CDE/LOSSY.GIF

(a) Lossy Compression

The main reason we use the lossy type of compression is to control the size of the multimedia data. However, when the data is decompressed, it must be still in the original quality, if not 100% perfect. The percentage of lossy compression usually is larger in magnitude compared to lossless techniques. Therefore this technique is the most suitable way to compress audio and video.

However we have to admit that there is one weakness, i.e. lossy compression formats suffer from generation loss. This means that when you repeatedly compress and decompress the file, the quality will gradually decrease.

In Figure 8.12, do you notice the 'broken' pixels in the right image? This image is the result of a high 98% compression; the final image size was down to only 1.14 Kb from the original 60Kb.

Figure 8.12: Image size and quality with lossy compression
Source: http://www.answers.com/topic/lossy-compression?cat=technology

For image compression, the lossy compression standard that is often used is that of the Joint Photographic Experts Group (JPEG). Meanwhile for video compression, the techniques are those of the Moving Picture Experts Group (MPEG) and Flash. For Audio compression, MP3 (MPEG-1 Audio Layer 3) is the best technique. An original CD-quality can be compressed down to 1/10th of its original size, and yet the quality still remains superb.

You need to understand the main advantage of lossy methods over lossless methods. A lossy method in some cases can produce a much smaller compressed file than lossless method, while still meeting the requirements of the application.

(b) Lossless Compression

Traditional lossless data compression techniques can potentially free up more than 50% of the memory resources (Ekman and Stenstrom, 2005). Lossless type of data compression refers to the way of reducing the number of data bits. With lossless compression each bit of original data in the file remains after the file is decompressed.

A lossless type of algorithm will not affect or change the contents of the data. There will be no significant change in the data. Lossless data compression allows the exact original data to be reconstructed from the decompressed data, as opposed to lossy data compression.

Lossless data compression is used in the popular ZIP file format for WinZip applications. Some image file formats such as Portable Network Graphics (PNG), Graphics Interchange Format (GIF), and Tagged Image File Format (TIFF) also use lossless compression. Lossless compression is also used in audio file formats like Windows Media Audio (WMA Lossless) and RealPlayer.

Table 8.1 below differentiates lossy and lossless compression.

Table 8.1: Differences between Lossy and Lossless Compression

Lossy	Lossless
Some data is lost	No data is lost
Irreversible	Reversible
Eliminating redundant information	The originally data remains
JPEG	TIFF, GIF, and PNG
Cause the image to become "pixelated"	Without losing image quality

8.2.3 Image and Video Compression

(a) JPEG

JPEG is a compression technology for photographic images widely used for the web. JPEG uses the lossy compression scheme. As from the compression name 'lossy' - this implies that you will find some image information is lost. However the quality of the image display is not significantly distorted due to the limitations of our normal eye vision to detect them.

The two photos in Figure 8.13 are the same images in JPEG format. The difference is just that they were compressed using different compression ratios or percentage. Despite that, the image quality is still almost the same.

Figure 8.13: JPEG Compression Ratios
Source: http://www.blc.lsbu.ac.uk/aa/aa/Communication/Visuals/Visuals2_HTI(43)/V2_PP-5.jpg

(b) GIF

As GIF is a lossless compression, you can expect that no image information is lost during the compression process. The decompressed image will be still the same as the original. It is important for you to know the difference between JPEG and GIF compressions for photographic images. The same colour-rich photographic that takes up to 85K of size may only require 35K if you save it as JPEG format. An almost 60% significant reduction in memory space, yet you still have the same image quality.

Figure 8.14 below shows an original image in JPEG format (top) and two other images after compression. Notice that the image quality remains the same if you are use JPEG (bottom, left). However, the image looks terribly "pixellated" and blocky if you compress it in GIF (bottom, right).

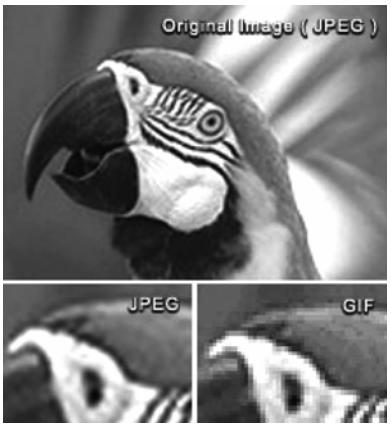

Figure 8.14: JPEG vs. GIF Compression
Source: http://warc.calpoly.edu/images/diagrams/jpg_vs_gif.jpg

(c) MPEG

MPEG stands for Moving Picture Experts Group. MPEG was established in 1988 as a standard for digital audio and video formats development. There are five MPEG standards currently in use or under development:

- MPEG-1 (for the compression of moving pictures and audio – MP3);
- MPEG-2 (for Digital Television and DVD);
- MPEG-4 (for Web);
- MPEG-7 (under development); and
- MPEG-21 (under development).

SELF-CHECK 8.2

1. What do you understand by the word compress?
2. Differentiate between lossy and lossless compression.
3. Why is JPEG sometimes preferred over GIF compression?

DISCUSSION

Why Compression?

CD-ROM
648 MB or 72 minutes of uncompressed stereophonic CD-quality sound.

DIGITAL TV
A 90-minute movie would take about 120 GB, which is about 189 CD-ROMs.

(http://www.cdt.luth.se/~johnny/courses/smd074_1999_2/CodingCompression/kap28/slide1.html)

Discuss further why compression is very important.

SUMMARY

- The basic elements of communication are the sender, the channel, and the receiver.
- The five basic types of communications network to deliver multimedia data are Telephone Networks, Data Networks, Broadcast Television Networks, Integrated Services Digital Networks (ISDN) and Broadband Networks.
- In multimedia communication the protocol normally used is based on TCP/IP (Transmission Control Protocol/Internet Protocol).

- Real-time multimedia streaming and Peer-to-Peer (P2P) multimedia file sharing have continuously been in great demand.
- Technological challenges in networked multimedia can be seen from the perspectives of interoperability and connectivity, performance and price, and bandwidth and standards.
- The growth of multimedia computing has increased the demand for massive multimedia data, thus compression strategies are very important.
- Compression techniques can be categorised into two main groups, which are lossy compression and lossless compression.
- Lossy compression is usually larger in magnitude compared to lossless techniques.
- Lossless compression reduces the number of data bits when it allows the exact original data to be reconstructed from the compressed data.
- JPEG and GIF are the compression formats for images while MPEG is used for video compression.

KEY TERMS

Bandwidth	Lossless Compression
Broadband Network	Lossy Compression
Broadcast TV Network	Multimedia Network
Communications Standards	Packet Switching
Data Network	Peer-to-Peer (P2P)
Image Compression	Real Time Multimedia Streaming
Interoperability & Connectivity	Telecommunications Standards
ISDN	Video Compression

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Topic 9 ▶ Emerging Multimedia Research

LEARNING OUTCOMES

By the end of this topic, you should be able to:

1. Discuss how multimedia research has contributed to our lives;
2. Describe emerging multimedia applications such as in the home and for entertainment; and
3. Discuss advanced multimedia technology and applications such as human-robot interaction.

▶ INTRODUCTION

In the previous topic, you learnt about multimedia communication and compression. Now in this topic, I will introduce several new and emerging topics in multimedia research.

As explained in earlier topics, multimedia applications nowadays are distributed online through the Internet. The trend to have an online presence has caused new multimedia applications to be also available online. Among the emerging applications are online gaming, and web and social networking.

In this chapter you will also learn about promising research and development in multimedia such as Virtual Reality (VR), Geographical Information Systems (GIS), Human-Robot Interaction (HRI), visualisation and medical imaging, and 3-D modelling and reconstruction.

9.1 HUMAN-CENTERED COMPUTING

9.1.1 Home Entertainment and Computing

There has been great interest in the field of home computer entertainment technology amongst researchers and developers from both the academia and industry. Digital entertainment services will soon be available to home users through a single media centre that orchestrates and controls all entertainment appliances such as the TV, the radio, etc.

In the near future the television set will be used not only for watching your favourite movies, but also for recording your favourite episodes. With the advancement of home multimedia computing, you may choose to burn your favourite episodes into a CD without the need to copy the video to your computer. Then you may choose to upload it to your personal blog or video portal.

You can also send e-mail through your television set using a wireless keyboard. A universal remote controller will enable you to switch between the functions of your TV. Fast wireless internet connection at home allows you to keep in touch with your office through e-mails. You can even browse the Internet with your daughter while both of you are in different rooms.

Figure 9.1 shows a home entertainment system.

Figure 9.1: Home entertainment system
Source: http://www.theavlounge.com/images/snowboard.jpg

Soon you may also find your Personal Computer (PC) looking more like a sophisticated piece of furniture. The PC will soon blend nicely with your home

interior decoration just like your sofa, the cabinet, the sideboard, etc. Research efforts are trying to make sure that these home computers can be connected easily.

9.1.2 Massively Multi-Player Online Gaming

Over the last decade, Massively Multi-player On-line Role Playing Games (MMORPGs) have become big business. Normally if you want to play this game, you need to pay a monthly subscription to the game publisher. They are the hosts of the game providing periodic content updates. Can you guess how many players subscribe to the game? The 2006 statistics shows that its total membership globally (of both subscription and non-subscription status) by then had exceeded 15 million!

MMORPGs are extremely popular amongst network gamers. MMORPGs involve large numbers of simultaneous players—up to hundreds of thousands per game per session. Social interaction is believed to be the primary driving force for gamers to continue to play MMORPGs. Here they can interact and get to know each other online while playing the game.

MMORPGs are still expected to continue remaining a popular, lucrative and most profitable sector of the gaming market. In terms of network connection, most MMORPGs you see today are based on client-server architecture. Faster network connection, processors, and 3D accelerator cards have contributed to the push for the growth of MMORPGs.

Figure 9.2 shows a screenshot of Daimonin, an example of an MMORPG.

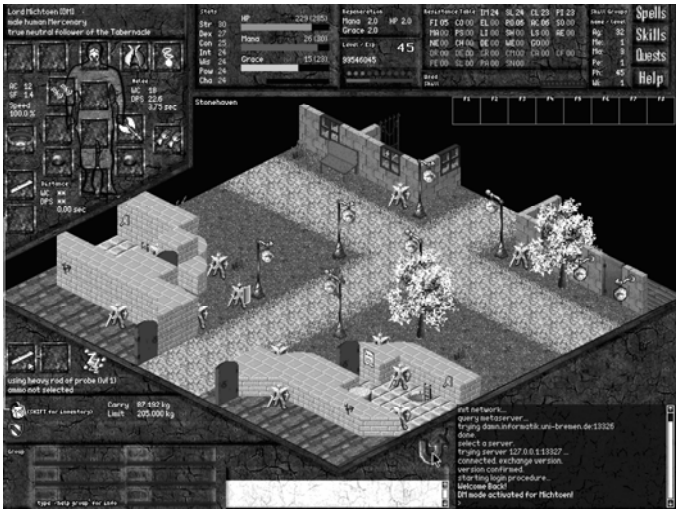

Figure 9.2: Daimonin – MMORPG
Source: http://pcwin.com/media/images/screen/Daimonin_1744.png

9.1.3 Web 2.0 and Social Networking

Have you heard of Web 2.0? Are you aware that there exists Web version 1.0? Actually the term Web 2.0 is coined by the web design community to refer to the second generation of web-based communities. Web 2.0 is a change in web paradigm from Web 1.0 that brings with it new approaches to Web content.

If previously you can only view and read but not leave a message or comment on your friend's personal homepage, now you can, through their web log (blog). When this happens, a two-way virtual interaction begins. Web 2.0 therefore makes online presence more interesting and interactive. From a personalised portal, you can conduct countless everyday activities such as seeking information and making appointments easily. Web 2.0 has initiated a new age of web interaction that is more effective and cheaper.

Do you realize that until a few years ago, the major activity amongst internet users was just accessing information and data? However these days, the internet is increasingly used for communication purposes. The same group of people now interact socially on portals and blogs, instead of just merely searching and reading passively online.

Virtual social networking has thus turned into a phenomenon whereby a group of people that have a common interest are linked to each other on the Internet. It often involves grouping specific individuals or organisations together.

Figure 9.3 shows the concept of social networking.

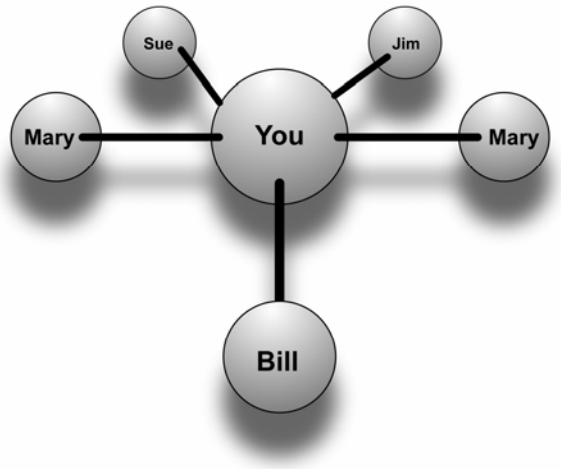

Figure 9.3: Social networking concept
(**Source:** http://www.whatissocialnetworking.com/networking.gif)

Social networking websites function as a "club house" for a group or a community of internet users. You can initiate a social networking site for your batch of students using MySpace.com, for instance.

Other than that, you can almost "share" your diary and activities on sites like Multiply.com. Can you imagine 7.5 million Multiply.com members uploading more than 2 million photos and 17 000 videos on average every day?

You could also create blogs, share photos, and post reviews on the site – just to name a few of the things you can do. You can also find new or old friends using Friendster.com. Social networking services have thus become a fast-growing business on the Internet.

Table 9.1 lists several popular social networking sites and their purpose. The list is sorted according to the number of estimated registered users worldwide.

Table 9.1: Social networking sites and purpose

Site	Purpose	No. of registered users
Classmates.com	School or college alumni	40 million
Tagged.com	General social online meeting	30 million
Reunion.com	Locating friends and family,	28 million
LiveJournal.com	Blogging	12.9 million
Yahoo! 360	Yahoo.com users community	4.7 million
Soundpedia.com	Music sharing	3.5 million
Student.com	Teens and colleges	800 000

Figure 9.4 shows the homepage of Yahoo! 360 . If you have a Yahoo account, you can create an online site for your group in less than a minute.

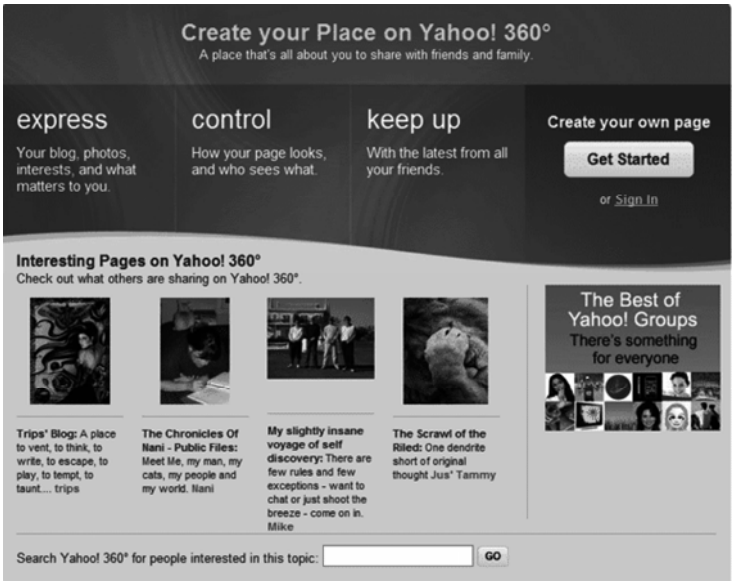

Figure 9.4: Yahoo! 360

9.1.4 Face Recognition Technology

Human face detection has always been an important problem especially for security purposes. Do you know that the fundamental challenge in face recognition is to find useful features on the face of someone? The simplest way to do it is by comparing selected facial features from the image and a facial pattern database. Once those features can be detected, it can be easily compared with the database.

Face recognition is one of the most successful applications of image analysis and understanding (Zhao, Chellappa, Phillips, & Rosenfeld, 2003). As a result it has received significant attention especially during the past several years. Recognizing faces is done by computer algorithms that compare the faces in a photo with all faces that are available in the photo database. However, face recognition technology faces challenging problems such as variations in pose and photo ray illumination.

You can try to upload your photo to MyHeritage.com. Basically MyHeritage Face Recognition runs in three steps:

(a) The digital photo that is provided by the user is first loaded;

(b) Face detection technology is applied to automatically detect a human face; and

(c) Face recognition technology is applied to recognise the faces detected.

Figure 9.5 shows MyHeritage.com face recognition online site.

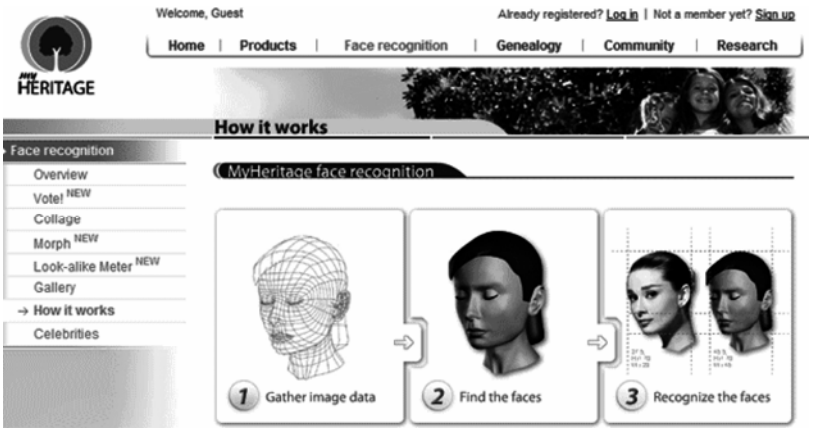

Figure 9.5: MyHeritage.com Face Recognition Site

9.1.5 Wireless Communications: Wireless City

Have you ever heard of the news that in the near future, Kuala Lumpur will become the first "Wireless City"? Through the Wireless@KL Project, 3500 Wi-Fi (Wireless Fidelity) zones will be made available for the KLites for free (Sharif, 2007). A Memorandum of Agreement (MoA) has been finalised between KL City Hall (DBKL), the Malaysian Communications and Multimedia Commission (MCMC) and Packet One Networks Sdn Bhd in 2007.

KL is expected to become the first city in the world to apply high speed wireless infrastructure called WiMAX 2.3 Ghertz. Currently the network technology used for wireless communication is the Wireless Local Area Network (WLAN) 802.11b by Cisco. Hence, we expect that sooner or later, Penang, Ipoh, Johor Bahru, and Melaka will also become Wireless Cities.

Are you staying in Kuala Lumpur? Imagine soon you could enjoy sending e-mails from your Personal Digital Assistant (PDA) while you jog in Taman Tasik Titiwangsa. You could also pay your utility bills while sipping "Teh Tarik" at the Mamak Stall around Jalan Masjid India.

Figure 9.6 shows how the Wireless City concept works.

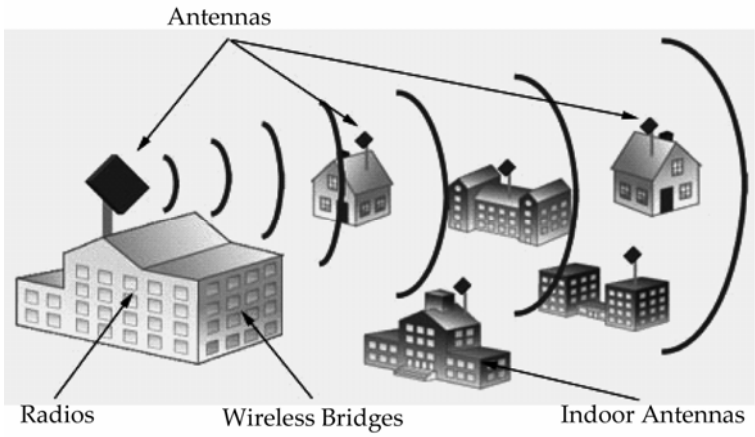

Figure 9.6: Wireless city concept
Source: https://www.huttononline.com/HuttonOnline/Images/Hutton/Towers/Antenna2.jpg

SELF-CHECK 9.1

1. Explain why MMORPGs are hugely popular.
2. List as many online social interaction sites that you can think of.
3. Explain three basic processes in face recognition technology.
4. What would happen if Kuala Lumpur becomes a total Wireless City?

9.2 ADVANCED MULTIMEDIA TECHNOLOGY AND APPLICATIONS

9.2.1 Virtual Reality (VR) Applications

Virtual Reality (VR) technology allows you to interact with a computer-simulated environment, as though you are experiencing a real one. To engage in a VR, you will still normally need a computer screen or a special stereoscopic display like a head-mounted or helmet-mounted display (HMD).

Figure 9.7 shows an example of an HMD on a US Navy personnel using a VR parachute.

Figure 9.7: VR parachute trainer
Source: http://upload.wikimedia.org/wikipedia/commons/thumb/e/ef/VR-Helm.jpg/800px-VR-Helm.jpg

In computer science, VR is an area that seeks better methods for implementing three-dimensional, immersive, and interactive worlds (Chang & Insler, 2004). You need to understand that VR technology aims to find a solution that can allow you to experience situations that may be impossible in the real world.

For example can you imagine that in future, you do not need to hold a map to find directions to your destination? What you need is a pair of chic glasses. As you walk down the street, the glass lenses turn into a monitor that feed your eyes with the map information. It perhaps could also give you directions through a digital voice.

By the year 2020, it is expected that online virtual reality will allow more productivity than working in the "real world". It means that people will choose to work virtually than doing them in real situations.

However, for most of the virtual Internet life communities, the attractive nature of VR can also lead to serious addiction problems.

9.2.2 Geographical Information Systems (GIS)

Basically a Geographical Information System (GIS) is a collection of computer hardware, software, and geographic data. A GIS is used for capturing, managing, analysing, and displaying all forms of geographically referenced information. With a GIS, you can link attributes or information to the location data. For example you can link people to addresses and buildings to areas.

GIS data can be viewed in three ways:

(a) The Database View (Geodatabase);

(b) The Map View (Geovisualisation); and

(c) The Model View (Geoprocessing).

Can you give a reason why the GIS is important? One good example is its critical function in emergency situations - geospatial information is essential towards effective and collaborative decision-making and disaster management (Rauschert, Agrawal, Sharma, Fuhrmann, Brewer & MacEachren, 2002).

GIS can integrate and relate any data that has a spatial component. Rather than you working hard to analyse and understand your data, GIS helps to process the data for you. GIS can provide you with powerful information that you cannot process manually, or quickly. Moreover, it can make a prediction of a future situation based on the parameter changes that you apply. Hence, GIS has been used to solve diverse problems, not limited to geographical data only.

However, the research on Internet distribution of GIS contents is still in its infancy. This is due to technological challenges and various types of geographical data. Soon the growth of geo-spatial data on the Internet will allow a much wider access to data that is currently available only in various GISs. Advances in computer technologies will enable sophisticated visualisation techniques to be introduced in the development of GIS applications.

Figure 9.8 shows an ArcGIS screenshot. ArcGIS is a complete and integrated GIS software product system for building, authoring, serving, and using geographic information.

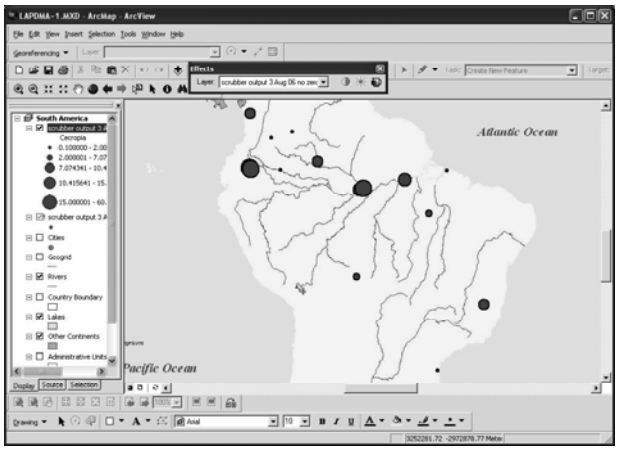

Figure 9.8: ArcGIS screenshot
Source: http://www.personal.leeds.ac.uk/~geoitl/ArcGIS_screenshot.jpg

9.2.3 Human-Robot Interaction (HRI)

Human-robot interaction (HRI) is a multidisciplinary study of interactions between people (users) and robots. It has emerged from various fields such as human-computer interaction, artificial intelligence, robotics, cognitive science, multimedia design as well as human factors. Basically the goal of HRI is to develop principles and algorithms that allow more effective communication between humans and robots.

To achieve this target Torrey, Powers, Marge, Fussell & Kiesler (2006) proposed that HRI be improved by developing robots that could have some sort of natural dialogue with users. This advancement in technology later was to be applied in critical domain human activities such as search and rescue, mining and scientific exploration, and hospital care.

In addition, robots are used in aerospace exploration research conducted by America's National Aeronautics and Space Administration (NASA).

Figure 9.9 shows the experiment to team human and robot for space activity.

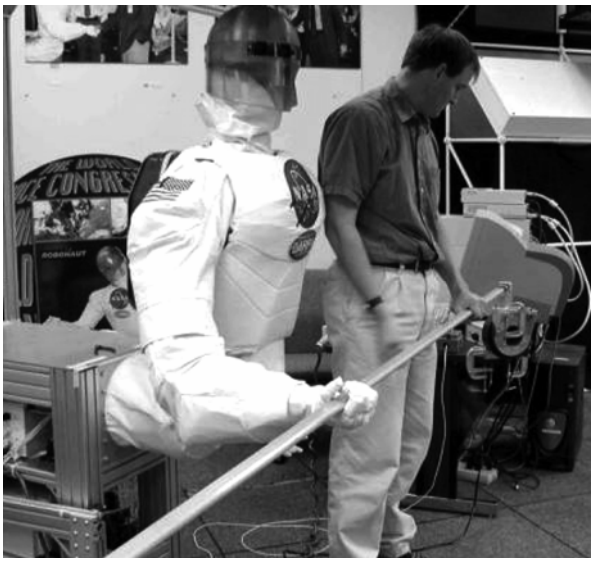

Figure 9.9: Human-robot teaming experiment
Source: http://robonaut.jsc.nasa.gov/status/RoboReport_11_02_files/image025.jpg

9.2.4 Data Mining and Knowledge Discovery

Data mining is the process of extracting previously unknown, but actionable information from large databases for the purpose of making crucial related

decisions. Traditionally, if you want to analyse certain data for example, you have to perform the data extraction from data records manually. However, as data sets have grown tremendously and become more complex, better and sophisticated tools must be used. The tools mentioned here are data mining tools.

Data mining consists of three components:

(a) The capturing of data

(b) The mining of information

(c) The organisation and presentation of this mined information

The Data Mining process is illustrated in Figure 9.10 below. The captured or recorded data is stored in the Data Warehouse. Then the selected data will be transformed and mined to extract valuable patterns of information.

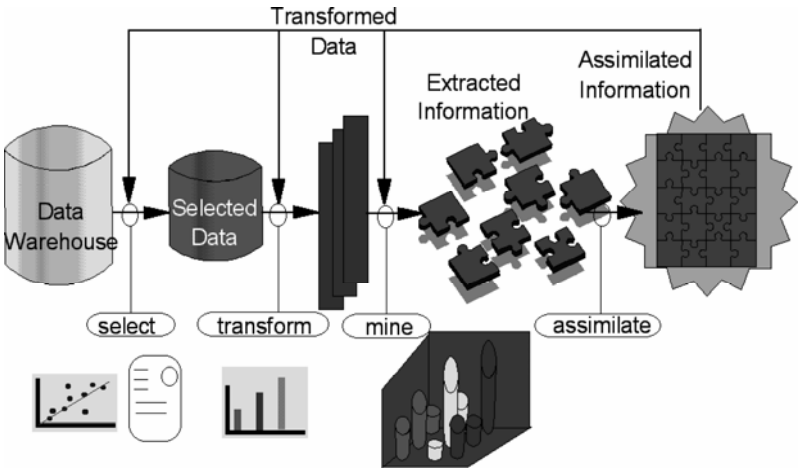

Figure 9.10: The data mining process
Source: http://www.csu.edu.au/special/auugwww96/proceedings/crawford/IBM.gif

Meanwhile knowledge discovery is a concept in the field of computer science that involves the process of deriving knowledge from the input data by searching for patterns from volumes of data. Traditionally, as mentioned above, human experts have to derive the knowledge from their own personal observation.

However, with advanced computing technology, automated knowledge discovery has become an important research topic. Knowledge discovery can be defined as the learning of previously unknown non-trivial knowledge from data or observations (Fu, 1999). The most well-known branch of knowledge discovery is data mining.

9.2.5 Visualisation and Medical Imaging

Visualisation is a branch of computer graphics and user interface design. This field is concerned with presenting data to users by means of images, normally called information visualisation. Meanwhile scientific visualisation seeks ways to help users explore scientific data and make sense of it.

Even though this is an emerging area of research in multimedia, the use of visualisation to present information is not at all new. Visualisation techniques have been used in maps for thousands of years. Nowadays data visualisation techniques are widely used in various areas from social science to engineering.

Figure 9.11 shows a graphical visualisation from a certain raw data.

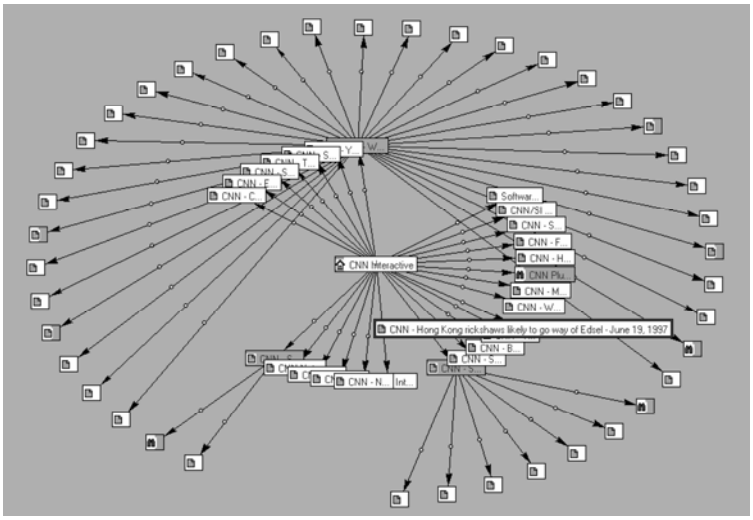

Figure 9.11: Information visualisation
Source: http://www.cybergeography.org/atlas/mapuccino3.gif

Another important application of visualisation is in the medical imaging area. Visualisation and imaging thus has also become an important part of bio-medical research field. An example of Java-based visualisation software in this area is Medical Image Processing, Analysis, and Visualisation (MIPAV). This application enables medical data analysis as well as visualisation of medical images.

Other than that the visualisation of the human brain structure poses an important challenge in the area of computer graphics (Klein, Ritter, Hahn, Rexilius & Peitgen, 2006). The significant point for you to understand here is that performing the same diagnosis, without using visualisation and image processing tools would take essentially much longer.

Figure 9.12 shows an output of the CT scan of a patient's heart.

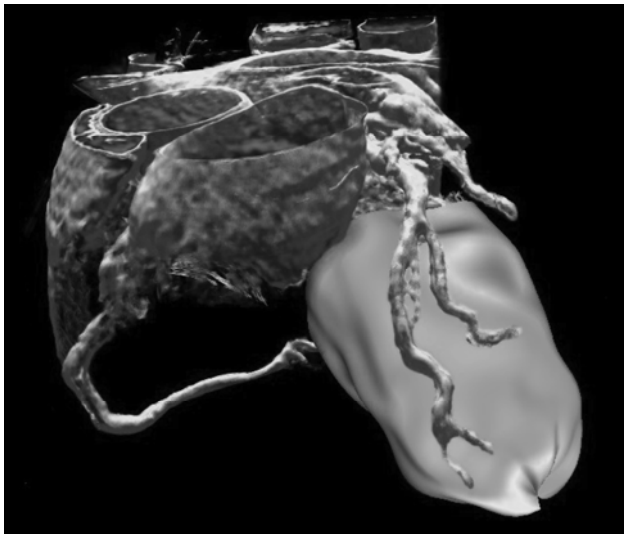

Figure 9.12: Medical visualisation screenshot
Source: http://www.cs.uni-paderborn.de/fileadmin/Informatik/AG-Domik/research/Medicine/CT_Koronarien_und_PET_Perfusion.jpg

9.2.6 3D Modelling and Reconstruction

Three-Dimension (3D) modelling in computer graphics is a process of developing a wire frame representation of 3D objects via computer programming or specialised software. 3D modelling technology has been widely used in various applications. 3D models are designed using 3D modellers and tools to create for example a new car model or design.

This technology is also used in 3D simulation for example to simulate flight crash incidents. Human crowds and other flock-like groups such as fish movements are often modelled in 3D. They are used in Playstation 3 game platforms too.

Figure 9.13 shows a 3D model of a head created with LightWave 3D animation tool.

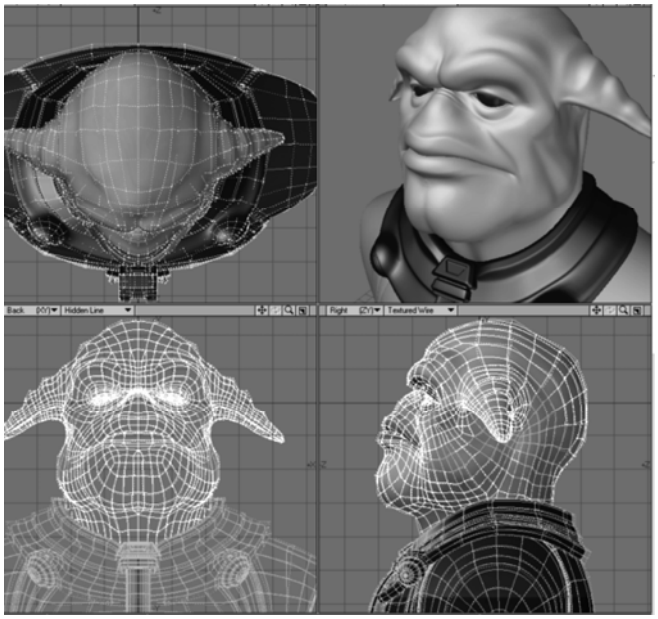

Figure 9.13: 3D model of a head
Source: http://upload.wikimedia.org/wikipedia/en/thumb/d/d1/Modeler83.png/750px-Modeler83.png

Most recently computerised methods for 3D facial reconstruction have been developed by researchers, made possible by the advancement of multimedia computing technology. Contemporary developments in 3D digitised image capture, graphical modelling, and animation are some of the multimedia technologies instrumental in the success of the computerised methods. This advanced technology has also been successfully applied in forensic facial reconstruction and animation of accident or crime scenes.

Figure 9.14 shows the process of 3D reconstruction from a real 2D photo.

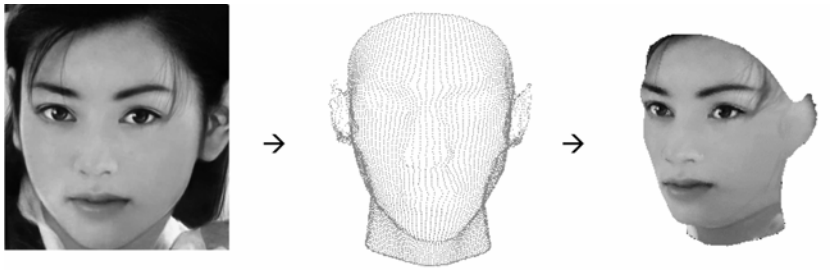

Figure 9.14: 3D face reconstruction
Source: http://research.microsoft.com/users/i-yuxhu/FaceReconstruction/Reconstruction%20Project.htm

SELF-CHECK 9.2

1. How can addiction pose to be a danger to VR users?
2. Explain three basic components of data mining.
3. List several other applications of 3D modelling.

DISCUSSION

Most Expensive 3D Animated Movies! (in US $ Million)

No.	Movie Title	Production Cost
1	The Polar Express	170
2	Final Fantasy: Spirits Within	137
3	Dinosaur	128
4	Monsters Inc.	115
5	Treasure Planet	100
6	Finding Nemo	94
7	The Incredibles	92
8	Toy Story 2	90
9	The Wild	80
10	Shark Tale	75

(http://www.your3dsource.com/most-expensive-3d-animated-films.html)

List your favourite movies that use 3D modelling.
Discuss with your friend why these movies were so successful.

SUMMARY

- In the future Personal Computers (PC) will look more like furniture and blend nicely in the home interior.
- Massively Multi-player On-line Role Playing Games (MMORPGs) have attracted millions of players playing together simultaneously continuously.
- Web 2.0 refers to the second generation of web-based communities, popularly applied for social networking.
- Face recognition technology compares selected facial features from the image with a facial pattern database.

- KL is expected to become the first wireless city in the world to apply high speed wireless infrastructure WiMAX 2.3 Ghertz.
- Virtual Reality technology allows interaction with a computer-simulated environment through stereoscopic displays such as a head-mounted display (HMD).
- The Geographical Information System (GIS) is a collection of computer hardware, software and geographic data used for capturing, managing, analysing, and displaying geographic information.
- Human-robot interaction (HRI) is a study of interactions between people (users) and robots with the goal of developing a solution that allows more effective communication between humans and robots.
- Data mining is a process of extracting actionable information from large databases for decision making purposes.
- Computer visualisation is concerned with presenting data to users by means of images to seek ways to help users explore the data and make use of it.
- 3D modelling is a process of developing a representation of a 3D object via computer programming or specialised software to create a new model or design.

KEY TERMS

3D Modelling	Medical Imaging
Data Mining	MMORPG
Entertainment Computing	Social Networking
Face Recognition	Visualisation
GIS	Web 2.0
Human-Robot Interaction	Wireless City
Knowledge Discovery	

Chang, C. and Insler, B. (2004). Addressing fear of heights through virtual reality. *J. Comput. Small coll.* 19, 5 (May. 2004), 308-309.

Fu, L. (1999). Knowledge discovery based on neural networks. *Commun. ACM* 42, 11 (Nov. 1999), 47-50.

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Rauschert, I., Agrawal, P., Sharma, R., Fuhrmann, S., Brewer, I., and MacEachren, A. (2002). Designing a human-centered, multimodal GIS interface to support emergency management. In *Proceedings of the 10th ACM international symposium on advances in geographic information systems* (McLean, Virginia, USA, November 08 - 09, 2002). GIS '02. ACM, New York, NY, 119-124.

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Zhao, W., Chellappa, R., Phillips, P. J., and Rosenfeld, A. (2003). Face recognition: A literature survey. *ACM comput. Surv*. 35, 4 (Dec. 2003), 399-458.

Topic 10 ▶ The Future of Multimedia

LEARNING OUTCOMES

By the end of this topic, you should be able to:

1. Discuss future multimedia computing technologies;
2. Discuss how we will interact with future computers;
3. Describe advanced web technology and computing; and
4. Explain how computers can be used further in future communications.

▶ INTRODUCTION

Previously we learnt about new and emerging technologies related to multimedia. These multimedia technologies are either in use or at their early stages of development.

In this topic, you will learn about future multimedia technologies currently still under research or in their early prototype development. I will be introducing some advanced topics, which could seem too futuristic for you.

I will also then discuss technologies that employ advanced human-computer interaction technology. We will touch on Web 3.0 and pervasive computing, and I will conclude with a discussion on how people in the future will communicate in the next couple of decades.

10.1 FUTURE COMPUTING TECHNOLOGY

10.1.1 High Speed Processing

The microprocessor has evolved dramatically over the past. Do you know that Intel processors have been enabling programs to run on your PC for over 25

years? This indicates that the demand for greater memory capability and computer processing power has been steadily constant.

The development of microprocessor chips has enabled you to enjoy playing 3D games or watching High Density (HD) video. In the future these processors are expected to be not just faster, but also almost 25-50% smaller than the current version. Ultra-fast quantum computer is expected to be in action by 2035.

What do you think would happen as a result of the shrinking size of the chip? Well, laptops or PDAs will become smaller and smaller. Other than that, the microprocessor clock frequency has also risen from kilo-hertz in the 70s to multi giga-hertz today (Borkar, Jouppi & Stenstrom, 2007). I am sure the era of tera-scale integration of computing power is fast approaching.

Figure 10.1 is a graph showing the normalized scalar performance for multiple generations of Intel microprocessors vs. the normalized power.

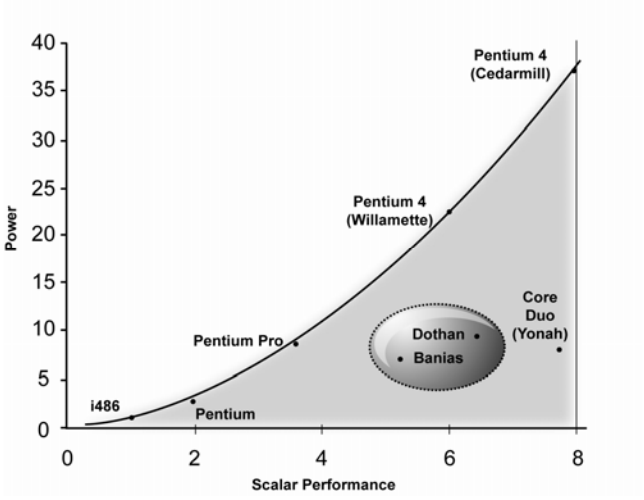

Figure 10.1: Performance of multiple generations of Intel microprocessors
Source: http://www.intel.com/technology/magazine/pix/et_fig2.gif

10.1.2 Super-Intelligent System

Do you find that you often cannot get the information you want from the search engine? It can be very frustrating, can't it? Well, this may be a thing in the past soon. A super-smart Web search application is expected to be made available to the public in the near future. This super-smart application would be able to guess better word combinations in the context that you want. Its intelligent web search algorithm can automatically learn how words are used in various combinations.

Hence you can then easily find the web information that you are searching for in a faster and better way.

One thing you should always remember is that computing technology is applicable not only in computers, but also in other equipment. More and more intelligent products using advanced computing technology are being made available in homes and even on playgrounds.

For example, a prototype of an intelligent spoon has been designed. This spoon is enabled with advanced technology to provide you with integrated information about any food that comes in contact with it. It will also be able to offer you suggestions to improve the food quality. This smart future spoon is equipped with sensors that measure temperature, acidity, salinity, and viscosity. It is connected to a computer.

Figure 10.2 shows an intelligent spoon prototype design.

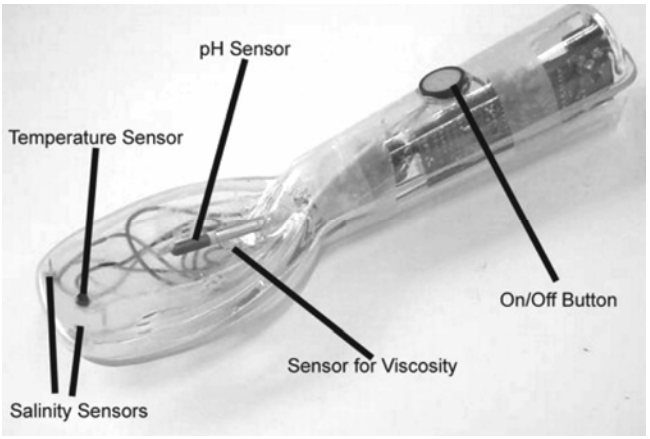

Figure 10.2: Intelligent spoon prototype
Source: http://blog.makezine.com/SpoonLabeled2.jpg

10.1.3 Genetic and Evolutionary Computation

Evolutionary computation is a subfield of computational intelligence that uses iterative progression. An example of this type of process is the growth or development of a population. Such processes are often inspired by the mechanisms of biological evolution such as reproduction, mutation, and recombination.
Today, evolutionary computation is a blooming field. Genetic algorithms will be used widely in the future to solve problems of everyday interest. Evolutionary computation and genetic algorithms will be applied in various areas as diverse as

stock market prediction, aerospace engineering, or biochemistry and molecular computational biology.

Indeed, the field of evolutionary computation is one of the fastest growing areas of computer science and engineering. Why? Because it addresses many problems that were previously beyond reach (Fogel, 2000).

Figure 10.3 is a cartoon showing an arm-fist fight to illustrate the tensed competition between genetic computation technology and traditional medical practice in finding a solution to medical challenges.

Figure 10.3: Genetic computation vs. traditional medical solution
Source: http://www.genetic-programming.org/hc2005/hclogomf.jpg

10.1.4 Nano-Computing

An Apple iPod Nano Second Generation MP3 Player can store up to 4GB of files. This means you can store up to 1000 songs. Soon, through the advancement of nano technology, you can easily store up to 30 000 full-length movies into your iPod gadget!

Nano-computing research is geared towards the goal of having computers that function at the tiniest molecular level. Nano-computing is a major development for the computing future. Nano-computing is actually the emergence of nano-science and nano-technology, and it has been identified to be hugely applicable in the major areas of electronics, biochemical, and mechanical technology.

It will be a great blessing to have the convenience of such high level storage in a tiny gadget. However, can you imagine the nightmare of losing such an enormous amount of information if you lose your iPod nano?
It is also expected that in 2011 you will witness the most anticipated world's first nanometre supercomputer. This quantum computer offers an enormous gain in

terms of the use of computational resources. You will see that in the future, the computer power will increase tremendously, thanks to nano-computing technology.

Figure 10.4 shows a cordless laser mouse for notebooks. It uses a "plug-and-forget" nano-receiver. It works with PC and MacBook computers.

Figure 10.4: Cordless laser mouse
Source: http://www.digitaltechnews.com/photos/uncategorized/2007/07/23/vx_nano_logitech.jpg

SELF-CHECK 10.1

1. In your opinion, what are the advantages of the smaller computer size?
2. Do you think that the intelligent spoon will become popular one day?
3. What inspires evolutionary computing?

10.2 ADVANCED HUMAN-COMPUTER INTERACTION

10.2.1 Wearable Computing

Currently most computer machines such as PCs sit on the desk. You cannot bring along your PC wherever, or whenever you want. Wearable computing is a

technology that enables you to "wear" your computers in a way similar to using your eyeglasses or having your clothes on.

In the future, this type of wearable computer which uses goggles or eyeglasses type displays equipped with personal wireless local area networks (WLAN), will become your intelligent future gadget.

A research on a wearable computer gadget named iBand was carried out by Kanis, Winters, Agamanolis, Gavin & Cullinan (2005). It is a bracelet equipped with infrared (IR) transceiver that uses handshaking detection technology. So when we shake hands with one another, an exchange of information occurs between the two *iBands.*

Figure 10.5 shows an *iBand* prototype.

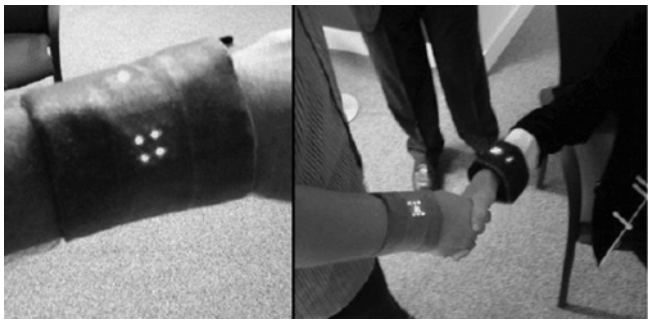

Figure 10.5: Handshaking detection technology
Source: Kanis, Winters, Agamanolis, Gavin & Cullinan (2005)

The advancement of computer and cloth making technologies makes wearable computing possible in the near future. Primary concerns for a wearable system usually include:

(a) small size and weight;

(b) long battery life;

(c) display functionality; and

(d) computer functionality.

Figure 10.6 shows the development in research in wearable computing from 1980s (a) to late 1990s (e).

Figure 10.6: Development in wearable computing research
Source: http://genesis.eecg.toronto.edu/steveforneilg5upwithlinescc.jpg

10.2.2 Computing without Keyboards

You may feel that typing in data using a keyboard is slow or tiring. Well in the future you may not see the physical keyboard attached to your computer anymore, thanks to laser technology.

A prototype of a virtual keyboard has been produced by Golan Technology. The unit consists of a red laser image projector which displays a laser ray of a keyboard right in front. Using infrared technology, it detects your movements and translates them into texts.

Figure 10.7 below shows a prototype of the future laser beam keyboard.

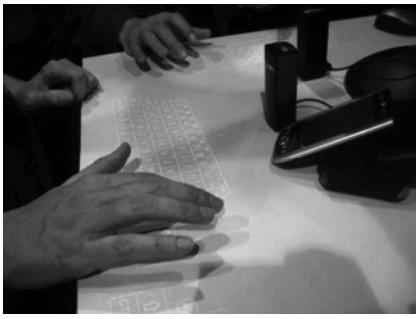

Figure 10.7: Future laser beam keyboard
Source: http://www.sfgate.com/blogs/images/sfgate/techchron/2007/01/09/CES2007_064500x375.jpg

10.2.3 Natural Human Computing

Can you ever imagine that in the near future, a computer will be able to understand what you want it to do, just by your smile or frown? If this could

happen, then in the next couple of decades, the mouse or keyboard would not be needed anymore. A team of researchers from the University of Southern California in Los Angeles have been investigating more natural ways to interact with computers (Chartier, 2007).

The concept of human computing aims to make computer use as easy and as natural as possible (Ruttkay, Reidsma & Nijholt, 2006). One goal of human-centred computing and natural computing is that the computer system can understand human behaviour.

In addition, this type of future computing should also be able to respond appropriately. The computer should be able to process what you want from your interaction with it. So it must be able to detect your facial expression and emotion, process it, and evaluate. However, to control and animate the facial expression of a computer-generated 3D character is not an easy task at all.

Figure 10.8 shows a computer-controlled 3D facial expression.

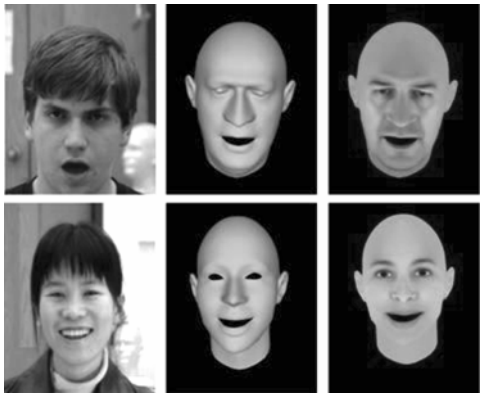

Figure10.8: 3D computer facial expression
Source: http://faculty.cs.tamu.edu/jchai/projects/face-animation/face_pa.jpg

SELF-CHECK 10.2

1. What are the primary concerns for a wearable computer system?
2. The mouse and keyboard will be useless in the future? Why?
3. Why should interaction with future computers be as natural as possible?

10.3 WEB 3.0 AND PERVASIVE COMPUTING

10.3.1 Web 3.0

Web 3.0 signifies the third-decade of the technological development of the Web from year 2010 to 2020. This era will focus on improving the back-end of the Web. It concentrates on how you work with the Web, not how the web works. Several key technologies will become widely used and would be the flagship applications of Web 3.0. The focus is on the creation of high-quality content and services. Web 3.0 will show a paradigm shift in the gigantic Web usage throughout the world.

I think some of you may never have even heard of a conceptual version of the web. If you are a bit confused, let me explain. What happened in Web 1.0 was that you could only view information on a website. Then in the Web 2.0 era, you may have experienced a two-way shared web. This technological development is illustrated in Figure 10.9.

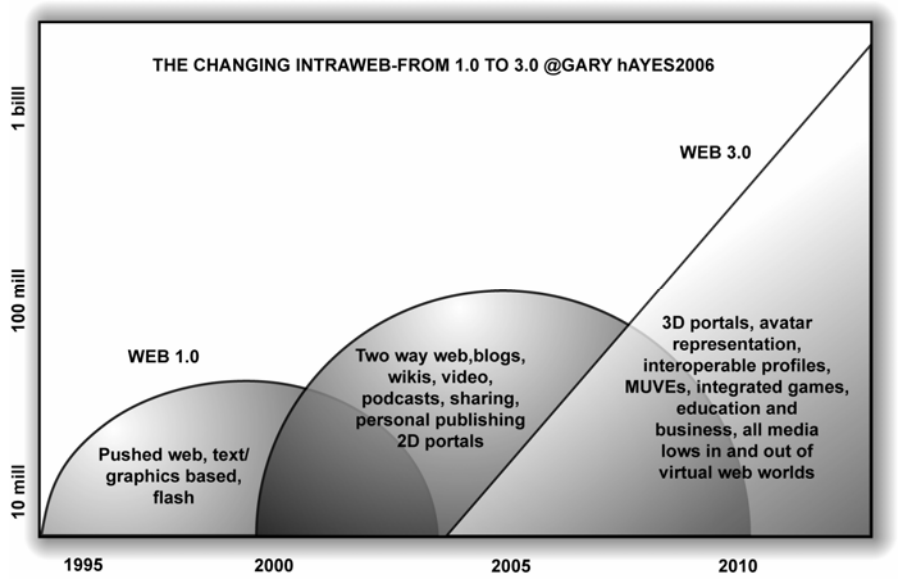

Figure 10.9: From Web 1.0 to Web 3.0
Source: http://www.personalizemedia.com/wpcontent/uploads/ 2006/08/web1to3.jpg

The first time people used the web, the media was limited to static text and graphics. However from 2002 onwards interactive web sites developed, whereby you can leave comments on your friend's blog or sites you visited. From then on, massive social networking communities such as Flickr and YouTube quickly established themselves. Then now in the third era which is Web 3.0, the situation

is more proactive in that the web develops from just being interactive to a real time collaborative one stop centre.

10.3.2 Pervasive Computing

Pervasive computing is also called ubiquitous computing. The idea of pervasive computing goes beyond the reality of the normal personal computers. In the future, almost any device including items like the coffee mug can be imbedded with chips. Then it can be connected to the Internet. Similarly your wallet, mobile phone, digital calendar and PDA, music and movie player will have connectivity in such a way that they are always available anytime, anywhere (see Figure 10.10).

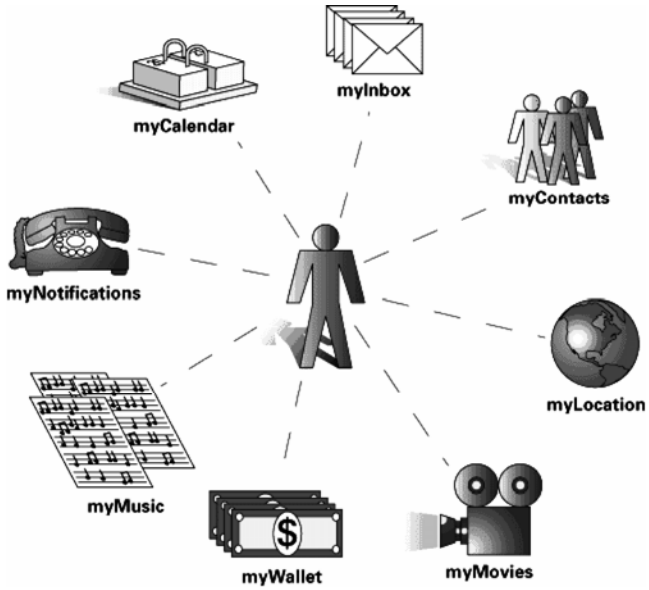

Figure 10.10: Pervasive computing
Source: http://www.ewh.ieee.org/r10/bombay/news4/Pervasive_World.gif

10.3.3 Augmented Reality

An Augmented Reality (AR) system generates an extended virtual view for the virtual user. It is a combination of the real scene viewed by the user and a virtual scene generated by the computer. The augmented reality presented to you enhances your performance in the real world activity. The ultimate goal is to create a system such that the user cannot tell the difference between the real world and the virtual augmentation of it.

Currently most AR applications use live video imagery. It is digitally processed and augmented with the help of advanced 3D computer graphics technology. In brief, applications of this technology use virtual objects to aid your understanding of your real environment.

Augmented reality applications are found in the following domains:

(a) Medical;

(b) Entertainment;

(c) Military Training;

(d) Engineering Design;

(e) Robotics and Telerobotics;

(f) Manufacturing, Maintenance and Repair; and

(g) Consumer Design.

Augmented Reality technology is also used in architecture and urban planning projects. Figure 10.11 shows users experiencing augmented reality.

Figure 10.11: Augmented reality technology
Source: http://www.vr.ucl.ac.uk/projects/arthur/arthur2.jpg

10.3.4 Surface Computing

Have you seen the movie "The Island"? It is a futuristic film set in the year 2019 presenting an amusing sci-fi adventure. The computer interaction used in the film relates to surface input technology. The best thing that you can see is that your computer will look more like a coffee table than a computer per se.

Figure 10.12 depicts an office environment of the future, as shown in "The Island". Here you can see the future desk, equipment, and documents that have been replaced by an interactive computer desk.

Figure 10.12: Future impression of surface computing from "The Island"
Source: http://www.istartedsomething.com/wp-content/uploads/2007/06/surfacedeskisland.jpg

In reality, Microsoft has already announced its Surface Computing technology. It is an advanced future computing interaction style that uses a giant table-like display. Users can interact with the software just by tapping and touching the flat glass on the table. Details on Microsoft Surface Computing can be found at www.microsoft.com/surface.

Figure 10.13 shows how you just can use your fingers to interact with a coffee table surface computer.

Figure 10.13: Table surface computing
Source: http://img.domaintools.com/blog/coffeetable-surface.gif

SELF-CHECK 10.3

1. Describe the key developments from Web 1.0 to Web 3.0.
2. Why will pervasive computing be very popular in the future?
3. List examples of augmented reality applications.
4. What is your opinion on future surface computing?

10.4 INFORMATION COMMUNICATION TECHNOLOGY IN THE FUTURE

10.4.1 Personal Area Networks

Currently the next generation of Wireless Personal Area Network (WPAN) is still under development. Briefly, WPAN will allow you to transfer information and communicate over relatively short distances among a few participants.

When you are on the move, you probably carry quite a number of electronic devices. Soon you find that you can easily connect your mobile phones, laptops, PDAs, digital watches, etc. using advanced WPAN.

Nowadays what you probably have been using is a relatively simple PAN. The most popular technology that is being used currently is the "Bluetooth". Bluetooth is intended for transmitting low volumes of data between very close devices.

Figure 10.14 shows the interconnected peripherals using Bluetooth technology.

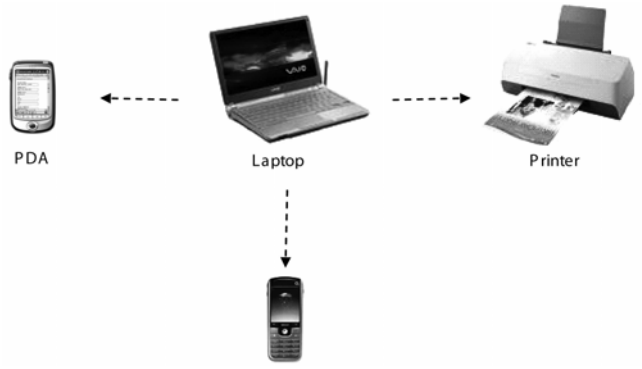

Figure 10.14: Bluetooth technology

10.4.2 4G Mobile Communications Systems

Currently I am sure that some of you have already been using 3G (Third Generation) mobile phones with a video camera. In the next half decade or so, the new generation of wireless mobile technology will replace the current 3G system. Sending and receiving a large volume of data such as video is one of the key elements of the 4G infrastructure.

Figure 10.15 illustrates the elements and techniques to support the adaptability of the 4G domain. This future mobile system will all encompass the vast array of communication channels and platforms—from satellite broadband and cellular systems to WLAN (wireless local area network) and PAN (Personal Area Network).

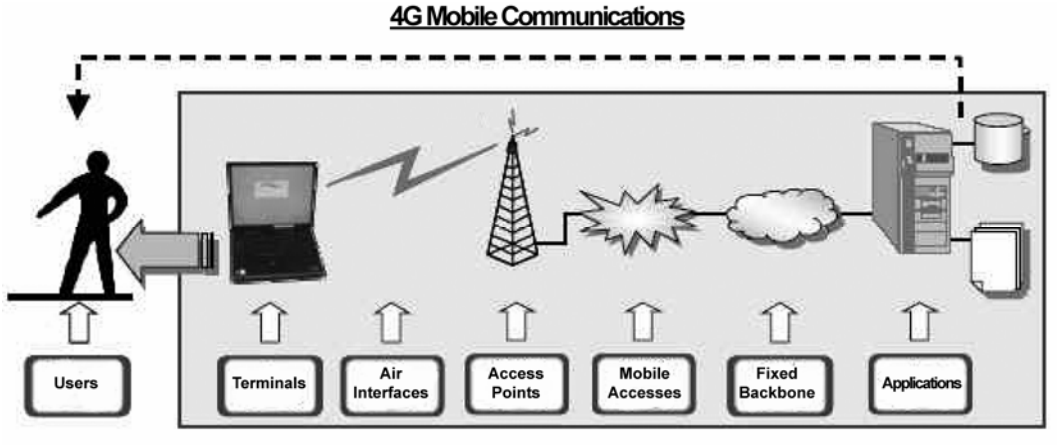

Figure 10.15: 4G mobile communications
Source: http://www.m-indya.com/images/4g_feature1.jpg

The future wireless network is expected to support diverse IP multimedia applications that allow multiple resources sharing among users. All mobile and multimedia applications must be easily adaptable in this seamless connection.

Figures 10.16 demonstrates key elements of the 4G networks.

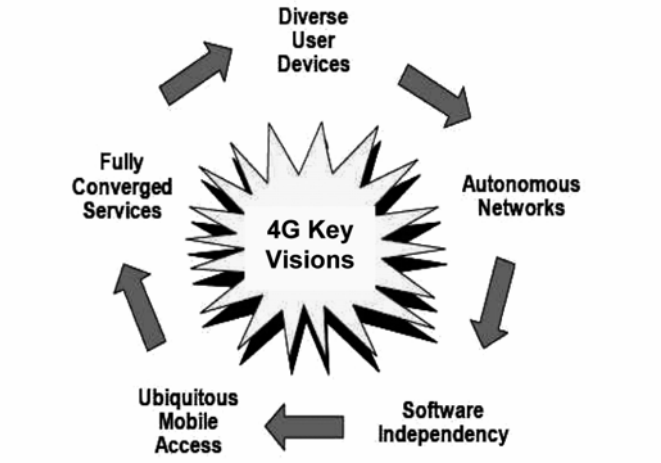

Figure 10.16: 4G key vision
Source: http://www.m-indya.com/images/4g_feature5.jpg

10.4.3 RFID Communications

Radio Frequency IDentification (RFID) incorporates electromagnetic technology in the radio frequency (RF) to identify an object or a person. Currently RFID is used as an alternative to bar codes. RFID technology has opened up new opportunities in various areas such as logistics, material management, and goods production.

Figure 10.17 shows a handheld RFID computer that can read tag IDs and be used in hospitals, etc.

Figure 10.17: Handheld RFID computer
Source: http://www.m-indya.com/images/4g_feature5.jpg

SELF-CHECK 10.4

1. What are the capabilities of Wireless PAN?
2. Explain the difference between 3G and 4G communications.
3. List the applications of RFID communications - current and future.

DISCUSSION

0845 hrs. January 20, 2036.

You are at the Kuala Lumpur International Airport (KLIA). Your flight will depart in 40 minutes. Your earring vibrates, receiving an SMS alert as an indicator that you need to hurry. Your flight itenary is saved in your wristwatch.

According to the discussion throughout this topic, predict how future multimedia computing will affect your life in the next 30 years.

Discuss your idea with your coursemates.

SUMMARY

- High-speed processor ability is important to cater to the steady demand for more capable computer memory. One example is for fast 3D display in games and High Definition (HD) video display.
- In the future more super-intelligent systems and products will be available even in our homes.
- Evolutionary computation is a subfield of computational intelligence that is inspired by the mechanisms of biological evolution.
- Nano-computing has emerged from nano-science and nano-technology. Nano computing is applied mainly in electronics, biochemical, and mechanical technology.
- Wearable computing technology enables you to "wear" your computers in ways similar to you putting on your eyeglasses or clothes.
- In the future, laser technology will replace the physical keyboard that is currently attached to computers.
- Human computing makes computer use as easy and as natural as possible.

- Web 3.0 signifies the third decade of advancement in Web technology.
- Pervasive computing will allow you to be connected to the seamlessly connected world anytime, anywhere.
- Augmented reality generates an extended virtual view of a mixture of both virtual and real scenes.
- Surface computing allows you to interact with the computer just by tapping and touching the flat glass screen.
- Wireless Personal Area Network (WPAN) will allow you to communicate over relatively short distances.
- The Fourth Generation (4G) mobile communications will allow you to send and receive a large volume of data over interconnected mobile and computer devices.
- Radio Frequency IDentification (RFID) incorporates electromagnetic technology in the radio frequency (RF) to identify an object or a person.

KEY TERMS

4G Communication Systems	Personal Area Networks
Augmented Reality	Pervasive and Computing
Genetic and Evolutionary Computation	Radio Frequency IDentification (RFID)
Human-Computer Interaction	Surface Computing
Intelligent System	Wearable Computing
Nano Computing	Web 3.0
Natural Human Computing	Semantic Web

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MODULE FEEDBACK

MAKLUM BALAS MODUL

Should you have any comment or feedback, you are welcomed to:

1. E-mail your comment or feedback to modulefeedback@oum.edu.my

OR

2. Download and fill up the feedback questionnaire from
   URL: http://lms.oum.edu.my/ via myLMS
   and
   e-mail to modulefeedback@oum.edu.my

Thank you.

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