Introduction to Multimedia

• Aims of the lecture
• What is multimedia?
• Why the computer?
• Multimedia defined
• Why multimedia?
• Multimedia building blocks
• IT’s perspective

Aims
• To obtain a general introduction to Multimedia
• To define multimedia in terms of:
  – its components, its purpose, its structure
• To look at the reasons why multimedia can be defined as:
  – informative, integrated, interactive
• To briefly examine the value of multimedia, particularly in terms of the delivery of information
• To become familiar with multimedia building blocks

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What is multimedia?

• When different people mention the term multimedia, they often have quite different, or even opposing, viewpoints.
  – A PC vendor: a PC that has sound capability, a DVD-ROM drive, and perhaps the superiority of multimedia-enabled microprocessors that understand additional multimedia instructions.
  – A consumer entertainment vendor: interactive cable TV with hundreds of digital channels available, or a cable TV-like service delivered over a high-speed Internet connection.
  – A Computer Science (CS) student: applications that use multiple modalities, including text, images, drawings (graphics), animation, video, sound including speech, and interactivity.

What is multimedia?

• Related disciplines in Multimedia and Computer Science:
  – Graphics, HCI, visualization, computer vision, data compression, graph theory, networking, database systems.

What is multimedia?

1. Video teleconferencing.
2. Distributed lectures for higher education.
3. Tele-medicine.
5. Searching in (very) large video and image databases for target visual objects.

What is multimedia?

7. Including audio cues for where video-conference participants are located.
8. Building searchable features into new video, and enabling very high- to very low-bit-rate use of new, scalable multimedia products.
10. Building "inverse-Hollywood" applications that can recreate the process by which a video was made.
11. Using voice-recognition to build an interactive environment, say a kitchen-wall web browser.
What is multimedia?

- Multimedia is a term that everybody uses and apparently understand, but how do we define it?
- Some definitions:
  - "Multimedia is any combination of text, graphic art, sound, animation and video delivered to you by a computer." (Vaughan, p.4)
  - "Multimedia is the use of computers to present text, graphics, video, animation and sound in an integrated way." (Webopedia)
  - "Multimedia is the use of a computer to present and combine text, graphics, audio and video with links and tools that let the user navigate, interact, create and communicate." (Hofstetter, p.2)
- What are the similarities in these definitions?
  - Similarity 1: "Delivered via a computer"
    - Hofstetter has an extra dimension in his definition.
    - Hofstetter says that multimedia presentations are also created using a computer.
    - Computers are used to combine the various components of multimedia.
    - Important aspect of multimedia missing in other two definitions.

- Similarity 2: "Media"
  - "Medium" = instrument
  - "Media" = plural of medium
  - "Multimedia" = more than one instrument, i.e. text, graphics, audio, video, animation
  - Definition of "media":
    - "The form and technology used to communicate information."
  - So the "media" in multimedia means the instruments (text, graphics, audio, video, animation) for communicating information.

What is multimedia?

- Similarity 1: "Delivered via a computer"
  - But Hofstetter has an extra dimension in his definition.
  - Hofstetter says that multimedia presentations are also created using a computer.
  - Computers are used to combine the various components of multimedia.
  - Important aspect of multimedia missing in other two definitions.

- Two important concepts:
  1. Multimedia is for communicating information.
  2. Information has to be communicated.

- Information, by definition, needs to be communicated. For information to be information, it needs to be communicated to somebody in order to inform them.

- Design objective 1:
  - Use the multimedia components to communicate information.
What is multimedia?

- Many forms of communication, e.g.
  - Human-to-human communication.
  - Human-to-computer communication.
  - Computer-to-computer communication.

- One aspect of this course is concerned with the last form.
  - We will look at the Internet as a channel for communicating multimedia information.
  - We will look briefly at LANs, WANs and MANs, i.e. networked computers.
  - But we will also at cognitive aspects of how computer-to-computer multimedia communication affects humans (the user).

What is multimedia?

- Hofstetter’s definition of multimedia includes two components that are not in the other definitions:
  - **Links**
    - Links are also known as hyperlinks or hot links or even “hot spots”.
  - **Interacting**
    - Multimedia is about the user interacting with various media.
    - The user is not just reading text, looking at pictures, listening to sounds.
    - The user is active, interacting with the media, driving the process of navigating around the web pages.

What is multimedia?

- Another perspective from the Webopedia’s definition of multimedia …

  - … the various media are integrated.
    - “Integrated” - two or more components merge together into a single system
    - So a multimedia presentation is a single system, not just a series of components cleverly combined.
    - The combination - or whole - produces something more than its parts.

  - **Design objective 2:**
    Produce a combination of media which together integrate to form a single system.

What is multimedia?

- Interactive
  - The term “multimedia” used in this unit actually refers to Interactive Multimedia.
  - Interactive means the user has control and can, e.g. influence the order in which information is being provided.
  - Multimedia can mean just that combination of media (text, graphics, animation, audio, video).
    - Therefore a television ad or movie can be classified as multimedia.
    - But a television ad is not interactive, you can’t interact with the ad (fiddling with the sound or controls on the TV is not considered interactive because it is not possible to influence, e.g. the sequence of information).
What is multimedia?

• Two kinds of interactive multimedia.
  1. Linear interactive multimedia
     • Linear = “line”. That is, the user interacts and drives the process but only in two directions - forward or backward.
     • Example: PowerPoint presentations, which have a beginning and an end.
  2. Nonlinear interactive multimedia
     • Nonlinear = “not in a line”. That is, the user chooses the path through a network of locations (data nodes, web pages, etc).
     • Almost all web pages are nonlinear, offering the user multiple directions for moving around.

What is multimedia?

• When you develop your multimedia presentation, you can’t determine what the user is going to do, where the user is going to go, what links the user is going to follow.

  • Design Objective 3:
    The design of your project will need to not only accommodate, but facilitate user interaction.

Why the computer?

• Remember that all three definitions of multimedia included “delivered via a computer”?
• Why does a presentation have to be delivered via a computer to be multimedia?

Why the computer?

• First, to be multimedia, a number of media need to be integrated into a single system.
  • A film might appear to have integrated video and sound, but each medium is filmed in a sequence and then combined.
  • Why? Because in their physical or analogue form, video and sound have a different format.
  • Digital technology has allowed us to represent different formats using a single language. That is, everything is either a “0” or “1” ie. (on or off)
Why the computer?

• Second, to be multimedia, it has to communicate information.
  – This is where Information Technology provides the solution as IT combines computer and communications technology.
  – Example: Think about these books delivered via a computer (either CD or on the Web).
• More information, more diverse, caters for different learning styles and learning rates
  – The computer has the capacity to deliver information, whether it is text, graphics and sound, in an integrated digital format.

Why the computer?

• Third, to be multimedia, it has to be interactive in a nonlinear way.
  – Think about those home pages again … Could that information be communicated in a way that the user can decide what to look at and in what order without a computer?
  – The computer gives us a “menu” of options to choose from.
  – The difference between a multimedia menu (or index) and, say, an index in a book is speed, convenience and ease. With a computer, we can interact with the process of gathering information, gather more information much quicker than ever before, and in the sequence we want.

Multimedia defined

• So, our definition of multimedia is:
  – “Multimedia is an integration of two or more media into a single system, with the purpose of communicating information, created and delivered by computer, and allowing the user to interact in a nonlinear mode.”
• So, we have the three “I’s”:
  – Information
  – Integration
  – Interaction

Why multimedia?

• Multimedia is taken for granted by today’s generation.
• Why should older generations adopt its use?
• First, people learn in different ways:
  – Studies show that some people think in words; other people think in pictures.
  – We each have our own cognitive learning style.
  – Information presented through multimedia means that there is likely to be something which is helpful to a wider range of learning styles.
Why multimedia?

- Riding (1995) identifies two cognitive style dimensions:
  - Analytic vs Wholistic
    - Has to do with the way material is structured
  - Verbaliser vs Imager
    - Has to do with the way information is represented

Information

- Dimensions are divided into 9 groupings.

Why multimedia?

- Multimedia allows us to use more of our senses and the more senses used, the more that is remembered.
- A saying: “Tell me and I will forget, show me and I may remember, involve me and I will understand.”
Why multimedia?

- Ease of use
  - Multimedia makes an application or web page easier to use.
  - Images, icons, visual and audible responses must be intuitive. A user should know which control to click because it looks like what it’s intended to do. For example:
    - Disk to save file
    - Rubbish bin to delete file
    - Warning sign to be cautious
    - What do these mean?
    - Be aware that iconography is culturally dependent.

- Self-paced interaction
  - User can determine his/her own pace.
  - Example: Browsing a video of this lecture vs live lecture.

- More fun
  - If it’s fun, it’s more efficient.
  - Hint: Don’t overdo it though. Remember, the simpler the better. Remember: KISS

History of Multimedia

1. **Newspaper**: perhaps the *First* mass communication medium, uses text, graphics, and images.
2. **Motion pictures**: conceived of in 1830’s in order to observe motion too rapid for perception by the human eye.
3. **Wireless radio transmission**: Guglielmo Marconi, at Pontecchio, Italy, in 1895.
4. **Television**: the new medium for the 20th century, established video as a commonly available medium and has since changed the world of mass communications.
5. The connection between computers and ideas about multimedia covers what is actually only a short period:

1945- Vannevar Bush wrote a landmark article describing what amounts to a hypermedia system called Memex. Link to full V. Bush’s article, “As We May Think”: [http://www.cs.sfu.ca/CC/365/mark/material/notes/Chapter1/VBushArticle/](http://www.cs.sfu.ca/CC/365/mark/material/notes/Chapter1/VBushArticle/)
1960- Ted Nelson coined the term hypertext.
1968- Douglas Engelbart demonstrated the On-Line System (NLS), another very early hypertext program.
1969 - Nelson and van Dam at Brown University created an early hypertext editor called **FRESS**.

1976 - The MIT Architecture Machine Group proposed a project entitled **Multiple Media**, resulted in the **Aspen Movie Map**, the first hypermedia videodisk, in 1978.

1985 - Negroponte and Wiesner co-founded the **MIT Media Lab**.

1989 - Tim Berners-Lee proposed the **World Wide Web**.

1990 - Kristina Hooper Woolsey headed the **Apple Multimedia Lab**.

1991 - **MPEG-1** was approved as an international standard for digital video - led to the newer standards, **MPEG-2**, **MPEG-4**, and further **MPEGs** in the 1990s.

1991 - The introduction of **PDAs** in 1991 began a new period in the use of computers in multimedia.

1992 - **JPEG** was accepted as the international standard for digital image compression - led to the new JPEG2000 standard.

1992 - The first **MBone** audio multicast on the Net was made.

1993 - The University of Illinois National Center for Supercomputing Applications produced **NCSA Mosaic** - the first full-fledged browser.

1994 - Jim Clark and Marc Andreessen created the **Netscape** program.

1995 - The **JAVA** language was created for platform-independent application development.

1996 - **DVD video** was introduced; high quality full-length movies were distributed on a single disk.

1998 - **XML** 1.0 was announced as a W3C Recommendation.

1998 - **Hand-held MP3 devices** first made inroads into consumerist tastes in the fall of 1998, with the introduction of devices holding 32MB of flash memory.

2000 - WWW size was estimated at over **1 billion pages**.

...and the story goes on....

**Typical Multimedia Applications**
- Digital video editing and production systems.
- Electronic newspapers/magazines.
- On-line reference works: e.g. encyclopedias, games, etc.
- Home shopping.
- Interactive TV.
- Multimedia courseware.
- Video conferencing.
- Video-on-demand.
- Interactive movies.
Multimedia building blocks

- Our taxonomy of multimedia was composed of five media:
  - text, graphics, video, sound, animation
- Each medium has a number of different types.
  - **Text**: printed, scanned, electronic, hypertext
  - **Graphics**: bitmaps, vector images, clip art, digitised pictures, hyperpictures
  - **Sound**: waveform audio, MIDI, audio CD, enhanced CD, MP3, podcast
  - **Video**: live feeds, videotape, videodisc, digital video, DVD, video conferencing
  - **Animation**: frame, vector, computational, morphing

Text

- Text: scanned, electronic, hypertext
  - **Scanners** convert printed text to machine readable form.
    - technological advances in optical character recognition (OCR) have increased scanning accuracy
  - **Electronic texts** are created in word processors. Some are converted to another electronic format such as PDF (Portable Document Format). Most books nowadays are printed directly from Word or PDF.

Hypertext

- Hypertext is the most important type of text for multimedia because it refers to the process of linking, which makes multimedia interactive.
  - Hypertext refers to text that has been linked.
  - When you click on a word that has been linked, your computer launches the object of that link.
- The object of the link can be any one of the objects listed in this taxonomy of multimedia.
- The links can be to resources external to the document, giving the text an added dimension, which is why it is called **hyper**.
Hypertext

- Human cognition appears to be organised as a semantic network in which concepts are linked together by associations. Yet we have adapted to traditional linear texts because text is represented on paper. Producing the Semantic Web is a current project of Tim Berners-Lee, the titular inventor of the internet.
- Hypertext systems try to exploit the nonlinear nature of human cognition and facilitate exploration.
- We form and think in associative chunks and build a network of concepts (e.g. Miller, 7 plus or minus 2).
- Experiment: 2 groups of 10 Web users performed 15 tasks using either an alphabetical index or a table of contents index to facilitate finding specific information (Borges et al., 1998).

Results: average of about three times faster using alphabetical index.
Hypertext

• **Why was it faster using the alphabetical index?**
  – The designers’ associations of contents may not be meaningful to the user.
  – Ensure that the associations you use for navigation and information retrieval are commonly accepted associations

  – **Design objective 4:**
    Your design will **facilitate** ease of information retrieval.

Multimedia building blocks

– Read these pages from Vaughan’s book: Multimedia Making it Work. (or any other relevant sources)
  • Text: pp. 147-200
  • Images (graphics): pp. 241-276
  • Audio: pp. 201-240
  • Video: pp. 295-323
  • Animation: pp. 277-294

– These building blocks of multimedia will be covered in later lectures.

Multimedia Software Tools

1. **Music Sequencing and Notation**
2. **Digital Audio**
3. **Graphics and Image Editing**
4. **Video Editing**
5. **Animation**
6. **Multimedia Authoring**

IT’s perspective

• Two important aspects of software.
  – First, it is important that people know how to correctly use software.
  – Second, given this, it is essential that software perform correctly. This involves a variety of concepts including:
    • correct specification of the original design problem
    • correct method of solution
    • Successful implementation of the software.
IT’s perspective

• Teams of people are involved in the development of software.
  – Modern software requires years of work in development, testing and maintenance.

• It has been proven useful to develop a framework and methodology for problem specification, program design, implementation, testing and documentation.
  – This is well known for developing “traditional” (non-multimedia) software.
  – Unfortunately the development of multimedia software is at the stage where traditional software development was some decades ago.

• Rigorous software development principles have to be applied for all software development.

• Visit http://www.zenger.informatik.tu-muenchen.de/persons/huckle/bugse.html to find out examples of bugs and the problems they have caused.
Introduction to computers

- If you are not familiar with the basics of computers, read the topic 1 notes about hardware and software, especially:
  - Types of hardware
    - Input
    - Output
    - Storage devices
    - Processing
  - Simplified structure of a computer system hardware
- Types of software
  - Application software
  - System software

Multimedia Research Topics and Projects

1. Multimedia processing and coding: multimedia content analysis, content-based multimedia retrieval, multimedia security, audio/image/video processing, compression, etc.
2. Multimedia system support and networking: network protocols, Internet, operating systems, servers and clients, quality of service (QoS), and databases.
3. Multimedia tools, end-systems and applications: hypermedia systems, user interfaces, authoring systems.
4. Multi-modal interaction and integration: "ubiquity" web-everywhere devices, multimedia education including Computer Supported Collaborative Learning, and design and applications of virtual environments.

Current Multimedia Projects

1. Camera-based object tracking technology: tracking of the control objects provides user control of the process.
2. 3D motion capture: used for multiple actor capture so that multiple real actors in a virtual studio can be used to automatically produce realistic animated models with natural movement.
3. Multiple views: allowing photo-realistic (video-quality) synthesis of virtual actors from several cameras or from a single camera under differing lighting.
4. 3D capture technology: allow synthesis of highly realistic facial animation from speech.
5. Specific multimedia applications: aimed at handicapped persons with low vision capability and the elderly - a rich field of endeavor.
6. Digital fashion: aims to develop smart clothing that can communicate with other such enhanced clothing using wireless communication, so as to artificially enhance human interaction in a social setting.
**Current Multimedia Projects**

7. **Electronic Housecall system**: an initiative for providing interactive health monitoring services to patients in their homes

8. **Augmented Interaction applications**: used to develop interfaces between real and virtual humans for tasks such as augmented storytelling.

**References**

- Lowe, D., Hall, W., 1995, Hypermedia and the Web, John Wiley and Sons.
- Raskin, J. The Humane Interface

**Class Discussion**

- Based on the following topics, investigate the diversity and implications of multimedia applications and technologies. Your findings should be based on readings and exploration from the Internet.
- Prepare a 5 minutes talk for each week and if possible, include some media presentations. (Additional discussion topics will be added during the semester.)

- How multimedia is transforming business and industry into a global economy
- How such technologies are being used in the local community
- What it is like to shop for merchandise on the World Wide Web (WWW)
- How multimedia can enable students to go beyond traditional teaching methods – especially where teachers become guides and mentors.
- How multimedia computers are being used across the curriculum in a wide range of subjects.
- Whether technology will make any major difference in the structure of schooling.
7. How multimedia is transforming the entertainment industry by moving from passive to interactive art forms
8. How multimedia techniques are being used to create cinematic special effects
9. How realistic and violent arcade games have become
10. How virtual reality is making interactive environments more immersing and persuasive
11. How multimedia can be used to improve access to state and local governments.
12. How your state or nation is using multimedia, and determine whether the way it is using is good or bad for its citizens.

13. How politicians are using the WWW for virtual campaigning.
14. The breadth of multimedia applications in health care for medical training, emergency preparedness and virtual surgery
15. How health care professionals in your community should be using multimedia computers to prepare for emergency situations.
16. The encyclopedic resources available on CD-ROM, DVD and the Internet.
17. The power of online searching as a research tool.
18. How market forces can influence the decision to go online.