UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 1998/99

February 1999

CSI534 - Multimedia in Education

Duration : [3 hours]

INSTRUCTION TO CANDIDATE:

- Please ensure that this examination paper contains **FIVE** questions in **FIVE** printed pages before you start the examination.
- Answer **ALL** questions.
- You can choose to answer either in Bahasa Malaysia or English.

ENGLISH VERSION OF THE QUESTION PAPER

1. The Penang state government would like to develop a multimedia system: Penang Tourist Information System. When completed, the system will be pressed on CD-ROM and will be used to promote Penang.

   (a) You were asked to prepare a project proposal for the above project. Outline and briefly explain the contents of the project proposal.

   (8/25)

   (b) Using one of the hypermedia design techniques, prepare a general system organizational structure for the multimedia system above. Explain why you chose the design technique.

   (8/25)

   (c) Prepare a list of computer hardware specifications that are needed for the development process.

   (5/25)

   (d) Slide projector, book, card stack, and tape recorder are some of the metaphors cited during the lecture. Discuss the role of metaphors in multimedia applications. Suggest a metaphor for the project above. Explain?

   (4/25)

2 (a) Design an evaluation form that will be used on an educational multimedia system for the focus group beta testing process. The evaluation form should be divided into various evaluation criteria groupings.

   (5/25)

   Answer either (b) or (c)

   You were asked to develop a multimedia information kiosk for a shopping complex.

   (b) List some of the features of the multimedia development software/tools that are needed in the system development.

   (5/25)

   (c) How would you determine which multimedia elements to use in this project?

   (5/25)

(d) Prepare a menu screen that provides access to four other panels: Introduction, USM, School and Quit panel. Briefly explain how you develop the menu screen with the following characteristic using Macromedia Director 6.0:

- The Introduction screen is at frame 50 in the same movie while the USM screen is in another director movie, USM.
- The School panel will link to the school's home page.
- The color of the text panel is blue and it is only visible when a mouse pointer is move over the text.
- The Quit button has a roll over facility that says "I'm a button - click me". The color of the button will change into another color when the button is clicked.
- There is also a USM logo on the menu screen. As you move the mouse pointer around the logo, a visual feedback occur by playing a USM logo animation located at Animate marker. When a mouse is clicked on the logo, the system will display a dialog box with a message - Logo USM.

(15/ 25)

3. Sampling and quantization is the process through which information is captured into the computer. An audio signal of a piece of music is sampled and quantized using a microphone and audio input card. The level of the audio alternates between very soft (low signal levels) and very loud (high signal levels), with no intermediate loudness. The recording is required to preserve the fidelity of the audio signal as much as possible.

(a) Why is it necessary to sample at a minimum of twice the highest frequency of the input signal?

(2/10)

(b) Explain the difference between linear (fixed) and non-linear (variable) quantization steps.

(3/10)

(c) Two approaches are used to record the audio signal, using (i) linear quantization steps, and (ii) non-linear quantization steps. Which approach will result in a smaller uncompressed data size? Please explain your reasoning.

(3/10)

(d) Would it be possible to use Delta Modulation as a compression technique on this audio signal if high fidelity is required? Why?

(2/10)

4. Discrete Cosine Transform (DCT) based Compression is used for photographic image compression in JPEG and I-frame compression in MPEG. However, the compression ratio achievable in MPEG is much higher than if successive frames were compressed using the JPEG algorithm. A video of a real-time Magnetic Resonance Imaging (MRI) sequence is to be stored for a hospital patient. This MRI video will be used by the radiologist to perform diagnosis at a later time.

   (a) During which step in the JPEG compression process is the redundant image information is removed from the image data? Explain why zig-zag encoding of the DCT coefficients is necessary.

   (3/20)

   (b) What additional feature that is present in MPEG compression algorithms to allow it to achieve higher compression rates than is possible through just applying JPEG to each successive image in turn?

   (2/20)

   (c) The use of MRI images for diagnosis requires that no information is lost during the compression. How is the JPEG algorithm able to provide lossless compression for images?

   (2/20)

   (d) Given that one MRI image has 256 x 256 pixels, and each pixel has a 10 bit grayscale value,

      (i) What is the minimum uncompressed image size?

      (ii) If the compressed JPEG image is 26KB in size, what is the compression ratio?

   (8/20)

   (e) The additional capability of MPEG described in (b) introduces errors into the video data. Suggest ways in which we can modify MPEG compression to store the MRI video data if we also require that no data is lost during the decoding of the video sequence?

   (5/20)

5. A videoconferencing application is used by two people on their respective systems (X and Y) to communicate across the Internet. The videoconferencing application can be divided into two parts, for encoding (multimedia capture) and decoding (multimedia playback). Each system is equipped with a video capture camera and microphone, as well as necessary hardware peripherals. The encoding part of the application transmits an audio stream (A) and an video stream (V) from one person to the other such that both persons can see each other and talk at the same time. The decoding part of the application displays a video stream of the person seated at that system, as well as the received video and audio stream of the person at the other side. The system does not playback the audio stream of the person seated at that system to avoid audio feedback, but the audio stream is transmitted to the other side. Audio and video for system X and system Y are given as Ax, Vx, and Ay, Vy, respectively.

(a) Draw a diagram with the correct number of Synchronous Channel Groups (SCG) between the two systems X and Y. Indicate the direction of data flow, the information stream (Ax, Ay, Vx, Vy) contained in each SCG, as well as the source (SCG+) and destination (SCG-) for each SCG.

(4/20)

(b) Describe the decoding part of the application using a Stream List for the user at System X (with one received audio stream, one received video stream, and one transmitted video stream). Give the corresponding Stream List for the user at System Y.

(4/20)

(c) Using a Temporal Relationship Diagram (TRD), sketch the following sequence of actions for the decoding part of System Y:

The videoconferencing application starts up and displays a Program Title screen (S) for 3 seconds. Immediately after the screen display, the local video stream (Vy1) is enabled. This local video stream is active until the end of the videoconference session. The incoming audio stream (Ax1) and video stream (Vx1) is activated 5 seconds after the start of Vy1, during the time that the video stream Vy1 is being displayed. The incoming audio and video streams (Ax1 and Vx1) are synchronized and have equal duration, lasting 2 minutes. The end of the incoming audio and video streams (Ax1 and Vx1) also finishes the local video stream (Vy1).

(6/20)

(d) The decoding part of the videoconferencing application (which handles two video and one audio stream) is being analyzed for its real-time scheduling requirements on a particular system. The video is played back at 15 frames per second, and audio is played back at 8 kHz; while the decoding time per audio sample is 1 ns, and decoding time per frame of video is 20 ms.

(i) What is the processor utilization?

(ii) Is the system able to handle the decoding part of the videoconferencing application?

(iii) Given that the encoding part of the application utilizes a total of 12 ms of processing time every 48 ms, is it possible to execute the videoconferencing application on this system? Please explain.

(6/20)

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