2002 Paper 4 Question 8

Computer Graphics and Image Processing

(a) With reference to the characteristics and performance of the human visual system, provide an estimate for each of the following. In each case you are expected to justify your estimate:

  (i)   the maximum resolution required by a display device;

  (ii) the maximum number of distinct intensity levels required by a display device;

  (iii) the optimal number of dimensions required to represent colour;

  (iv) the maximum refresh rate required of a CRT monitor.

[5 marks]

(b) A programmer suggests three different implementations of a polygon drawing algorithm:

  (i)   standard z-buffer;

  (ii) standard A-buffer with an 8×8 mask size;

  (iii) standard z-buffer at 8×8 normal resolution followed by averaging operation which produces a normal resolution image by finding the average value of each 8×8 block.

  Compare the three implementations in terms of both execution speed and resulting image quality. Which would be the best implementation to use if the average polygon covers 50 pixels? Which would be the best implementation to use if the average polygon covers 2 pixels? Which would be the best implementation to use if the display resolution was equal to the answer that you gave to $(a)(i)$ above? [7 marks]

(c) Show how to perform 2D rotation about an arbitrary point. Provide a matrix in homogeneous coordinates for each step in the operation. [2 marks]

(d) Show how to perform 3D rotation about an arbitrary axis. Again, give matrices in homogeneous coordinates for each step in the operation. [6 marks]