realtime technology

Computer Graphics & Image Processing

(a) There are many assumptions which need to be made:

- resolving power of human foveal vision, 0.5 – 2.0 minutes of arc
- size of movie screen 5 – 20 metres wide
- distance of viewer from screen 5 – 30 metres

Say a 15m wide screen viewed from the closest seat in the house, say 5m away, with the standard 1 minute of arc resolving power.

Size of a pixel: $5m \times \sin\left(\frac{1}{60}°\right) \approx 1.5mm$ wide

So screen resolution on a 15m wide screen is about 10000 pixels horizontally by about half this vertically, as movies have a roughly 2:1 aspect ratio

(b) Process pixels from left to right, top to bottom.
For each pixel calculate its new, black or white, value

$$b_{i,j} = \begin{cases} 1, & \text{if } f_{i,j} \geq 128 \\ 0, & \text{otherwise} \end{cases}$$

Calculate also an error value

$$e_{i,j} = \begin{cases} -255 + f_{i,j}, & f_{i,j} \geq 128 \\ f_{i,j}, & \text{otherwise} \end{cases}$$

Let $f_{i+1,j} = f_{i+1,j} + \frac{1}{2} e_{i,j}$

$f_{i,j+1} = f_{i,j+1} + \frac{1}{2} e_{i,j}$

$f_{i,j}$ is the pixel value which ranges from 0 – 255 initially in the greyscale image

$b_{i,j}$ is the bi-level pixel value which is either 0 or 1

(c) Apply the algorithm in (b) independently to each of the R, G, and B planes

Then let $C = 1-R$, $M = 1-G$, $Y = 1-B$, $K = 0$

If $C = M = Y = 1$ then let $C = M = Y = 0$, $K = 1$

CONTEXT

This question is based on the first and last section of this four section course: background (a & c) and image processing (b & c) (b) is bookwork; (a) is a variation on bookwork; (c) requires understanding & will stretch the students

PRELIMINARY MARKING SCHEME

(a) estimate of resolving power of human eye
   * estimate of screen width ~~illegible~~
   sit in closest seat!
   estimate of this distance
   reasonable answer   2   6

   * N.B. could answer without this, but must be clear about what they're doing to get full marks

~~illegible~~

~~illegible~~

(b) correct order   1
   correct f → b   2
   correct error calculation   2
   correct passing of errors   2
   overall correctness   1   8

(c) apply to each independently   2
   convert RGB → CMY   2
   correct use of K   1
   overall quality   1   6

20