422

Coláiste na hOllscoile Corcaigh

University College Cork

colours:
56 (assuming 8 bit)
th
cour
are

15

Uimhir Scrúdaithe
Examination Number | 9 | 1 | 7 | 1 | 6 | 3 | |

Module Code CS4405

Paper No. ____

Mír
Section ____

Do na Scrúdaitheóirí amháin **For Examiner's use only**	
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2	20
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Iomlán **Total**	55

Calculator, Please state:	No. of Books submitted
Name Casio	3
Model Fx91des	

Note: If there are different sections on this paper, a separate Answer Book MUST be used for each section.

Q1 15

A Calculate the N most frequent colours:

This is done by finding the 256 (assuming 8 bit) most popular colours by counting the number of occurrences of each colour. Once the 256 most popular colours are found the image is converted to use that colour set. [illegible] colour that is one of the 256 in the original image is that colour in the output image. Otherwise we must find the closest colour using the eucllidian distance

4

2

Q1A (ii)

It would not be effective in a number of scenarioy where the image has more than 256 colours and the colours are distinct

Example a line art image most of the image is varying shades of Red and Blue. There is a little green. the green may get completely ommited if all the other colours are more Popular than it

1

Q1

(i) A way of improving [illegible] [illegible] take the top colours out of each colours space. Example 256 colours Allocate for example 64 colours to blue. 96 colours to Red and green. This way we are guranteed that colours come from each zone of the colour space. The distribution is uneven as the eye is less sensetive to blue.

1

Q1

B(i)

① RGB

↓

② Colour space redection

↓

③ Ycb Cr

↓

Chroma sub sampling

↓

④ DCT of 16×16 blocks

↓

⑤ Quantisation

↙ ↘

(6.1) AC | (6.2) DC

↓ | ↓

⑦ Zig Zag | (8.1) Difference Encoding with other DC of other blocks

↓

⑧ Run length encoding

↓ ↙

9 Huffman

↓

Image

6

2

Q6

(ii) All of the previous are lossless except

Colour Space reduction -

It is typically lossless if there are less colours than the space we are reducing to
It is lossy otherwise as some of the colours will be lost

Chroma Sub sampling

It is lossless when the ratio is 4:4:4. otherwise we loose some of the chrominance values for red and blue

Quantisation

It is lossy as coefficients are esentially "rounded off" without the full value of the original coefficients we cant the a full Inverse DCT and the same wave will not appear back

8

4

Q1 MY.html

C ① <body> <div id="mask-me"></div> </body>

my.css

```
#mask-me {
    mask-image my.png alpha
}
```

2

my.png

A PNG image with an alpha Channel

5

This masks the image onto the contents of the div in the Body tag using alpha masking the alpha Values are got from the PNG

Q1

C(ii) my.html

```
<<canvas id="1" ></canvas>
<canvas id = "2" > </canvas>

my.js
  loadImage('1', my.png);
  loadImage('2', my_other.png);
  getDocById(1)setGlobalCompositeOperation(
      // One of the composite ops
      // such as destination-in etc
  )
  getDocById(1).setImageData(
            getDocById(2).getImageData
  );
```

What this does is creates 2 canvas elements. loads 2 PNGs into them using the canvas 1 canvas 2 is copied onto it using one of the composite operations

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be sampled

tude.

pressed

output

20

1

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Q2

A The Audio must First be sampled at both time and magnitude. Once sampled it can be compressed and converted into one of the output formats.

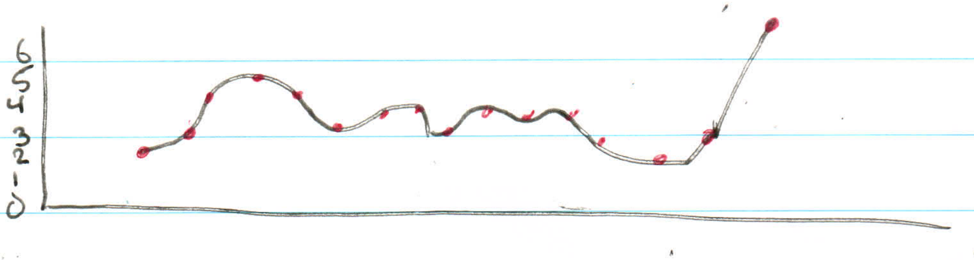
20

1

Q2

B Differential PCM is used to represent Audio data as an audio signal is a Fairly consistent wave

For example this wave



After the wave is sampled each sample has the previous sample value taken away from it

example above:

2, 3, 4, 5, 4, 3, 3, 3, 2, 3, 2, 3, 2 1, 6

Taking each of the previous values away from the next leaves us with

2, +1, +1, -1, -1, -1, 0, 0, 0, -1, +1, -1, +1, +1-1
+5

2

We can then compress these much better using run length encoding

Q1
c
(i)

After applying DCT we end up with a number of coefficients. These coefficients can be quantised and the coefficients that add little to the data be reduced to 0 then Runlength and entropy encoding can be used on these coefficients as a lossless compression method

3

5

Q1 c(ii) This approach is limited as it does not take into account the application of the sound we are compressing For example we could reduce the input sounds to a narrower range by removing sounds outside the human range of hearing when compressing voice for speech It also does not take into account other aspects of psychoaucoustics such as loud sounds masking quieter ones

2

Q1

D Motion Estimation

The motion of 1 MB from 1 frame to another need be estimated.
There are many options available here such as what is the range of our search space. what is the shape of our search space. When can we declare 2 macro blocks as a good enough match. These all need to be decided upon

Coding block preparation

Now that we've found the correct MB match what do we need to do to it before its an exact match ie what pixels do we need to change
This is dependent on 2 thresholds
1 is if the mean squared error is below a certain threshold we declare it as an exact match and make no changes, just send the motion vector. Another is if it is below a different threshold we determine the difference in the pixels and send that too

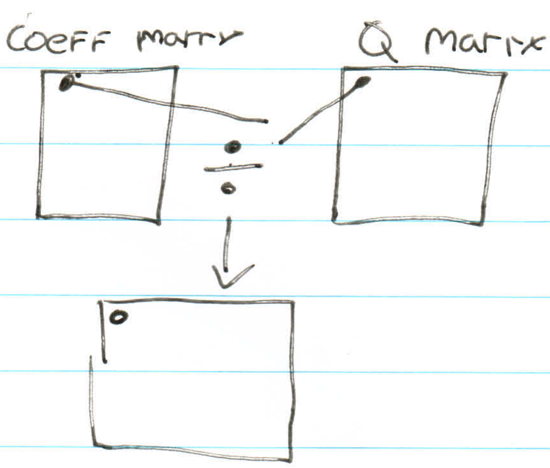
7

Discrete Cosine Transform

After applying the DCT we get a DC coefficients and a number of AC coefficients. There are no real options here

Quantisation

Using the AC coefficents generated in the DCT step we quantise them using a quantisation matrix this quantisation matrix describes for each coefficient in an 8 x 8 image block how to quantise that coefficient the quantisation process aims to reduce the entropy of the coefficients such that it is better suited to entropy encoding



Entropy encoding is a loss less compression of the coefficients as they have been mapped into a less random range we can use something like huffman encoding to encode the coefficients. We can use a predefined huffman table or generate our own

Q
E(i) I B B P B B P B B P B B P B P

I P B B P B B P B B P B B P B

The anchor picture (P) must be enoded before the B pictures that rely on it

QE
(ii) 352×288 = 101376 pixels per frame

16×16 = 256 Pixe's per MB

101376 ÷ 256 = 346 MB per frame

each MB has at most 1 MV if is predicted. 0 if not

∴ 346 Motion Vectors

Q e

(iii) It is likely as not all blocks can be predicted. If a block cannot be predicted well it will not have a motion vector

A block cannot be predicted well if the cost of encoding the MV and the corrections exceed (in bits) the cost of encoding that MB

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…oulders

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[redacted]

Q3 20

A It can be implemented in two ways.

option 1 Send DC coefficient and a few AC coefficients. each enhancement provides more AC coefficients

option 2 Send DC coefficient and start sending the MSB of all the AC coefficients and then the next most significant bit until all bits transferred

After each Refinement layer the image can be re rendered

4

Q3 b

IF it is highly compressed 1 bit error in some of the image data can effect a large section of a frame,

Compressed video streams have to maintain synchronisation between audio and video. IF the data controlling that is damaged the stream goes out of sync

No redundancy in compressed image data as this was removed as part of a good compression algorithm

3

ran out of time!

Q3

c. Audio

- high compressed stream at start of next frame

Interleaved storage of data

Video

Interpolation of missing blocks by scattering adjacent blocks throughout stream. Burst errors less likely to affect neighbouring blocks

2

Q3

D① Mobile devices with limited processing power and slow / varying connections caused a need for MPEG Dash varying meaning connection speed can change during stream

②

①

QD

(ii) An MPEG Dash S- . . .

An Itermediary CDN (optional)

An Client implementing DASH standards

Dash server publishes an MPD and makes streams of varying bitrate available

Dash client (using HTTP) reads the MPD and chooses the correct stream. Then using Partial HTTP get requests, requests the correct stream for its bandwidth / processing power

2

QD (iii)

It needs to keep its buffer full. At the same time it also needs to choose the best stream it can handle bandwith wise what it can do as it fetches each segment is count how long it took to fetch that segment. Using that and the size of the segment it can decide whether or not to start fetching a segment of better quality

If $\frac{\text{Seg size}}{\text{SFT}} > 1 +$ threshold move to next segment

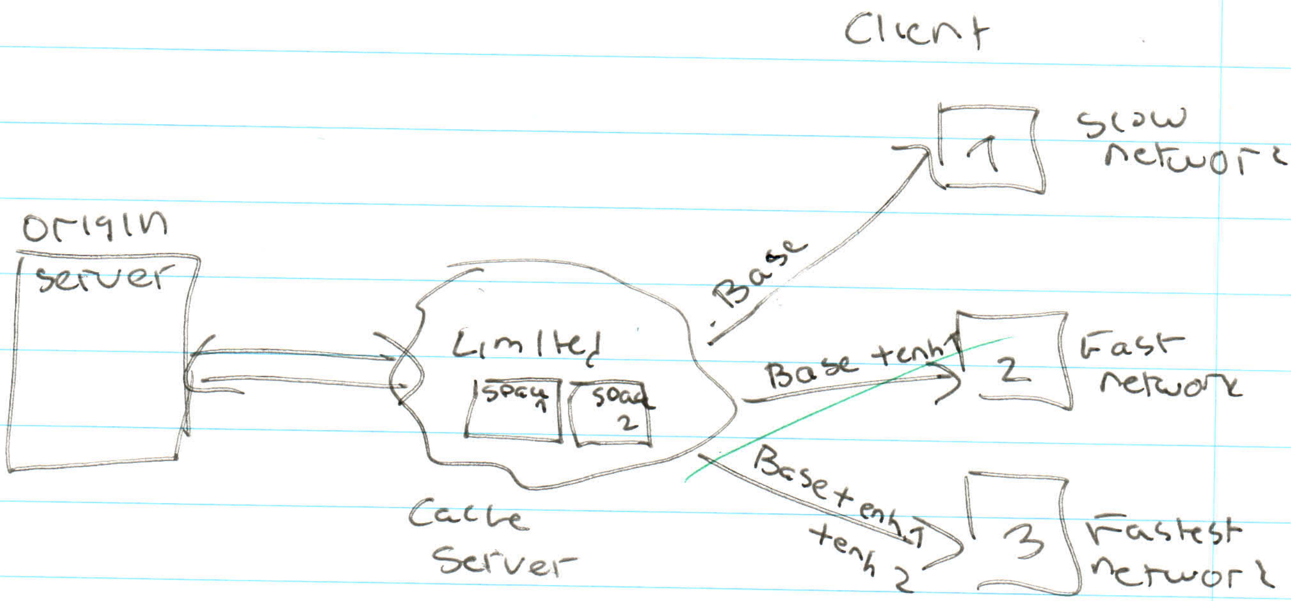
If $<$ threshold switch down to a lower quality segment

This does not take into account the fact that we may want to switch down to a lower quality segment before entire download of 1 segment (might want this if network slowed down dramatically

It also does not do much to prevent constant switch up/down which harms precieved quality

4

a
3D
w



Potential advantage is that it increases cache efficiency. If the above example the cache server may only store 2 files.
It will store the Base + enhancement 1 as they are most requested
Everyone but client 3 will have 100% cache hit

3