1(a) most likely a computer generated image, the pixel do nt vary gradually or exhit any variation in color and has uniform regions

1(b) $f(x,y) = \begin{matrix} 139 & 139 & 161 & 156 \\ 139 & 161 & 161 & 156 \\ 161 & 161 & 161 & 156 \\ 161 & 161 & 161 & 0 \end{matrix}$

$$F(u,v) = \frac{2C(u)C(v)}{2\sqrt{mn}} \sum \cos\frac{(2x+1)u\pi}{2M} \cos\frac{2y+1v\pi}{2N} f(x,y)$$

$$F(3,2) = \frac{2C(1)C(1)}{2\sqrt{mn}} \cos\frac{(2(0)+1)(3)\pi}{2(4)} \cos\frac{(2(0)+1)(2)\pi}{2(4)} 139 + \cos\frac{9\pi}{8}\cos\frac{4R\pi}{8} 139$$
$$+ \cos\frac{15\pi}{8}\cos\frac{2\pi}{8} 161 + \cos\frac{21\pi}{8}\cos\frac{2\pi}{8} 156 +$$
$$\cos\frac{3\pi}{8}\cos\frac{6\pi}{8} 139 + \cos\frac{9\pi}{8}\cos\frac{6\pi}{8} 161 + \cos\frac{15\pi}{8}\cos\frac{6\pi}{8} 161$$
$$+ \cos\frac{21\pi}{8}\cos\frac{6\pi}{8} 156 + \cos\frac{3\pi}{8}\cos\frac{10\pi}{8} 161 + \frac{\cos 9\pi}{8}\cos\frac{10\pi}{8} 161$$
$$+ \cos\frac{15\pi}{8}\cos\frac{10\pi}{8} 161 + \cos\frac{21\pi}{8}\cos\frac{10\pi}{8} 156$$
$$+ \cos\frac{3\pi}{8}\cos\frac{14\pi}{8} 161 + \cos\frac{9\pi}{8}\cos\frac{14\pi}{8} 161 + \cos\frac{15\pi}{8}\cos\frac{14\pi}{8} 161$$
$$+ \cos\frac{21\pi}{8}\cos\frac{14\pi}{8}(0)$$

$F(3,2) = 0.5[(0.707)(0.382)(139) + (0.707)(0.924)(139) + (0.707)(0.924)(161) + (0.707)(-0.383)(156) + (-.707)(.382)(139) + (0.707)(0.924)(161) + (-0.707)(0.924)(161) + (0.707)(-0.383)(156) + (0.707)(0.382)(161) + (-0.707)(0.924)(151) + (-0.707)(0.924)(161) + (-0.707)(0.383)(156) + (0.707)(0.382)(161) + (-0.707)(-0.924)(16)) + (0.707)(0.924)(161) + (0.707)(0.924)(161)$

$F(3,2) = 28.30$

Q) Assume boundary pedictors are = 0 ... ?

C	B
A	X

Prediction index	Prediction
0	No predict
1	A
2	B
3	C
4	A+B−C
5	A+((B−C)/2)
6	B+((A−C)/2)
7	(A+B)/2

Mode 2

(I 1):

127	125	128	129
1	1	2	2
1	1	1	2
1	2	1	2

Entropy $= 1\frac{1}{16}\log_2(\frac{1}{16}) \times 4 + \frac{7}{16}\log_2\frac{7}{16} + \frac{3}{16}\log_2\frac{3}{16}$
$= 2.0462$

(I 2):

127	125	128	129
0	0	0	0
-5	-7	-11	-15
0	-20	-4	-4

Entropy $= \frac{5}{16}\log_2\frac{5}{16} + \frac{1}{16}\log_2\frac{1}{16}$ (11)

$= 3.274$

Mode 4:

I_1

127	-2	3	-1
1	0	1	0
1	0	0	1
1	1	-1	1

	#
127, -2, 3, -1	1
1	8
0	4

I_2

127	-2	3	1
0	0	0	0
5	-12	-4	-4
6	20	-24	3

	#
127, -2, 1, 5, -12, 20, -24	7
0	5
3	2
-4	2

$$\text{Entropy} = \frac{1}{16}\log_2\frac{1}{16} \times 4 + \frac{8}{16}\log_2\frac{8}{16} + \frac{4}{16}\log_2\frac{4}{16}$$

$$= 2$$

$$\text{Entropy} = \frac{1}{16}\log_2\frac{1}{16}(7) + \frac{5}{16}\log_2\frac{5}{16} + \frac{2}{16}\log_2\frac{2}{16} + \frac{2}{16}\log_2\frac{2}{16}$$

$$= 2.0244$$

Mode 4 is better $2.0462 > 2$

$3.274 > 3.0244$

2(b) DC components are reconstructed using DPCM, this are dependent on preceeding rows. if first row is lost, all DC coefficients will be affected making the entire image shifted in gre levels, the details will remain intact since AC coffients are not dependent on top row

3(a) To compute the motion vector, a $(2p+1)*(2p+1)$ neighborhood is searched for the best match according to a distance measure (MAD or SAD). The matching block with the smallest distance determines the motion vector which is represented as $mv(x,y)$.

$2p+1 = 5$ image dimension 5×5 $p = 2$

Total operations $= (8 \times \lceil \log_2 p \rceil + 1) \cdot N^2 3 = 243$ $(p=2, N=3)$

3(b) $C_1 = Mad(-1,-1) = \frac{1+1+3+9+3+3+6+7+41}{9} = 4.111$

$C_3 = Mad(0,1) = \frac{4+3+4+4+3+0+1+5+6}{9} = 3.33$

$C_2 = Mad(1,0) = \frac{0+2+7+4+3+1+1+1+3}{9} = 2.44$

C_2 is best match, thus $MV = (1,0)$

4.The main component of the argument reality is spilt into two main components: the hardware, the software. [1] The hardware is made processors, input devices, sensors and display. [1] The main role of sensors is to provide information about location and orientation of the participant. In the mobile market and gaming market, the main role of sensors is to act as a surrogate for the participant. [2] The sensors take in information about the player uses this information to allow the virtual environment to interact with the user. The processor role is to decide and to model the environment based upon the data received. Each processor is made up of different architecture based upon which type of device it is ie handheld system such as smart phone, desktop; however, in the end, they perform the same tasks. The role for visual display is to create signals of light that impinge to the eyes that can be perceive as visual imagery. [2]

The software component is spilt into different categories: low level programming libraries, rendering and application building libraries, standalone application, plugin software for existing application, content for the AR application. The tracking library is used to recognize the fiducial marker and features. [2] The libraries are used for camera tracking and sensors. The model loading and animation which provides the augmented elements of the game. [2] The game logic and game engine which loads the actual game/ virtual environment. [2] A rending software to provide images for the display. [2]

The argument reality is used widely on the market and the mobile market is not an exception. The most popular market application of an augmented reality is the application Pokémon Go. The application of Pokémon go is based on location based augmented reality. The location based uses the digital compass, GPS, accelerometer and provides dynamic data based on the user's location. [1] In the application Pokémon Go, the user can see Pokémon at certain locations based on the server and can capture Pokémon when the user physical go to that location. Another application of the argument reality is superimposition in which the actual view of the object is amplified with a new view. [1] An application that uses this is Knight fall AR. It uses the cameras on the phone to detect a flat surface. After it detects the flat surface, it imposes the game board on the camera picture. It makes the game more interactive because it gives the user a 3D view of battlefield and the cannon can aim based upon the phone is aimed.

References

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[2] A. B. Craig, *Understanding augmented reality: concepts and applications*. Amsterdam: Morgan Kaufmann, 2013.