Introduction to Linux VisionX and Image presentation

Lab 1 Questions

A. General Image Manipulation

1. What is the pixel coordinates of Albert's right eye?

   Answer: (106,153)

2. How did you make this measurement?

   Answer: Put the cross on the central of Albert's right eye, and the coordinate can be shown on the bottom-left of the window in green.

3. What is the width of Albert's mustache?

   Answer: 47mm. Choose the line measure and drag the line across Alert's mustache, and the result will be shown on the top-left of window.

4. What are the main issues in making distance measurements on images? Consider and comment on the following:

   Mouse control: It may not be the main issue, maybe some people will be unable to control the mouse precisely, the deviation may not be big.

   Feature visibility: This is the main issue, sometimes it is so hard to locate all parts of the feature that some part of the feature may be ignored and the distance will be imprecise.

   Image Size: This is the main issue, if the image size is too big, viewers will be unable to view the whole picture clearly in a single window even they use zoom in / zoom out tools. So they need to move the picture to do distance measurement, this discontinuity will bring deviation.

   Question ambiguity: This is the main issue, people have different understanding about the content of the question, so the question ambiguity will lead people to different solutions of the question. For example, in A.1, maybe some people will consider the word "right" from their points of view, so they will get Albert's left eye's coordinate.

D. Image Set Display, Pixel Quantization

1. What does the girl image sequence show?

   Answer: When the Pixel quantization (grey level) goes down from 256 to 2, the displaying quality drops immediately, and the false contours appear. Viewer cannot clearly view the picture.

2. What do the image parameters printed in the caption of the image mean?

   Answer: It means the Pixel quantization of the image, and the bits required by each pixel to display the color value. For example, in the first image, the grey is 256 and the bpp is 8, which means the level is 256, and it need 8 bit to display the value of the pixel.

3. At what quantization does degradation in image quality become noticeable?

   Answer: When the quantization is 32, the degradation in image quality become noticeable.

4. What is the implication of this observation for image display design? Comment on the number of gray levels you would include in a product for general use and why?

   Answer: It means human visual system can distinguish 32 grey levels of pixel quantization. I would choose to use 256 grey levels in a product for general use, although the result shows that human can only distinguish 32 grey levels, it is definitely cheaper to make products using 32 grey levels. But that will lower the display quality greatly in that way. We cannot designing the product using the lowest limitation, which is not good for the consumers. When the product is required to display large images or display movies, using 32 grey level will definitely not be a good idea.

5. Many home theater systems claim to have a 4000 to 1 contrast ratio or (much) greater. Assuming that this is possible by the image encoding methods used how is such a large range useful given human visual system limitations?

   Answer: Higher contrast ratio will bring better color displaying ability and make viewers feel better when watching the images. Besides, the high contrast ratio is more important in the movie displaying than in static images displaying. Because audiences will be less possible to distinguish the transition between images in the movie because of the ultra-high contrast ratio and this is crucial to improve experience of the audiences.

E. Terminal command and log enhancement

1. What does the vmath command do?

   Answer: It apply some mathematical function to the pixels of the image and change the pixels using some functions. In the example, it apply log transform to the girl-grey.vx file and create a new file named girl-log.vx

2. How does the vmath operation affect the visibility of image features?
   Are some parts of the image easier to see after the log transform?
   Is it possible to see more or less detail after the transform?

   a. It increases the brightness of the image by increasing the value of most of the pixels from the image. For example, some dark spots on the girl's face are made brighter so that they are less obvious. And some parts of the image are made more obvious.
   b. Yes. For example, the leaf in the bouquet is more obvious than before. The girl's eye is also made easier to see.

c. I think less detail could be seen after the transform, because the brightness of the image is increased, which covers some details, such as the dark spots on the girl's face. And the contour of different objects is also less visible.

3. If more detail is visible, how is this possible? (consider your answer to question 2) (think carefully)

   Answer: It is possible. The log transform can magnify the gap between pixel of ultra-low value and high value. So that the contour of objects with large pixel value difference can be more clear.

F. Large Image Display

1. What is the size of the x-ray image?

   Answer: The size of the x-ray image is 2048*2048

2. What are the window settings?

   Answer: Primitive Setting: window setting is 4095, level setting is 2049
   After: window setting is 2, level setting is 2500

3. What is the range of pixels in the image?

   The rang is [1, 4096], from 1 to 4096

4. Which interpolation method is the best and why?

   Answer: Bicubic interpolation is the best, because under this method, the image can be displayed in high quality even it is greatly enlarged. The ability of the bicubic interpolation to make the image smother and cleaner when image is magnified is the best.

G. Segmentation Using Thresholding

1. What is the best threshold for the facsimile image?

   Answer: The best threshold for the facsimile image is level: 218

2. What is your criterion for best threshold?

   Answer: The characters and lines can be seen clearly and there is no much noise point in the image

3. What is the best threshold for the map image?

   Answer: The best threshold for the facsimile image is level: 81

4. What is your criterion for best threshold?

Answer: The lines which represents streets, buildings, rivers and other content are clear, besides the image remains clean without noise points.

5. What is the problem in thresholding the map image?

   Answer: It is hard to keep both the characters in the image and the lines (streets) in the image clear.

6. How might you get a better result on the map image? (That is, what kind of processing operations might improve the result?)

   Answer: Increase the window value

H. Using vview and vdview, Edge Detection

1. Are all the edges detected by vedge?

   Answer: Not all the edges are detected by vedge

2. Can you improve the result? (by using different options)

   Answer: Increase the level value or decrease the window value

3. What is an edge? (a) provide a definition for an edge:

   Answer: Edge is the contour of objects. It is where the change of pixel value is noticeable, the pixels between two sides of the edge have pixel value in great differences.

4. Describe what you mean by edges in the context of the caboose image.

   Answer: In the context of the caboose image, edge means the contour of the coach (wheels included), it also means the contour of the wheel, window and other objects. It also separate the table and the wall.