

```
bar(x1-1,y1-1,x2+1,y2+1);
}
```

TESTBTN.CPP

//A C++ Program demonstrating the above button classes

```
#include "button.cpp"
#include <graphics.h>
#include <conio.h>
#include <dos.h>
```

```
void main(void)
```

```
{
    int gd=VGA,gm=VGAHI;
    initgraph(&gd,&gm,"c:\\tc\\bgi");
    button main_menu(320,200,"Button Bulged");
    delay(1000);
    main_menu.reshape("Button Pressed");
    main_menu.pressed();
    delay(1000);
    main_menu.reshape("Button Bulged");
    main_menu.bulged();
    delay(1000);
    main_menu.reshape("Button Pressed");
    main_menu.pressed();
    getch();
}
```

Solved Exercises

2.1 Compute the following:

- Size of 800×600 image at 240 pixels per inch.
- Resolution of 2×2 inch image that has 512×512 pixels.
- Height of the resized image 1024×768 to one that is 640 pixels wide with the same aspect ratio.
- Width of an image having height of 5 inches and an aspect ratio 1.5.

Solution

- 240 pixels correspond to 1 inch.
 $\Rightarrow 800$ pixels will correspond to $800/240$ inch = $31/3$ inch
 Similarly 600 pixels $\Rightarrow 600/240 = 21/2$ inch.

Hence the size of the image is $31/3$ inch \times $21/2$ inch.

- $512/2 = 256$ pixels per inch.
- Aspect ratio of the 1024×768 image is $768/1024 = 3/4$.
 Hence, width of the image having height of 640 pixels having aspect ratio $3/4$ is $640 \times 3/4 = 480$.
- Width of the image of aspect ratio 1.5 = $5 \times 1.5 = 7.5$.

$$1.5 = \frac{w}{h}$$

- ✓ 2.2 Find the number of colours a frame buffer of 8 bit planes each of red, green and blue, and 10 bit white lookup table can produce.

Solution

Each colour (red, green or blue) can have 2^8 colours from a palette of 2^{10} .
Hence the total number of colours it can produce is $(2^8)^3$ colours from a palette of $(2^{10})^3$.
 $= 2^{24}$ colours from a palette of $2^{30} = 16777216 \times 1073741824$ colours.

- ✓ 2.3 Find the amount of memory required by an 8 plane frame buffer each of red, green and blue, having 1024 × 768 resolution.

Solution

Each frame buffer is a replica of 1024 × 768 bits = 786432 bits.

Total number of frame buffers = $8 \times 3 = 24$.

Hence, total amount of memory required = 24×786432 bits = 18,874,368 bits = 2,359,296 bytes
= 2304 kilobytes = 2.25 bytes.

Note: 8 bits = 1 byte and 1 kilobyte = 1024 byte.

Similarly, 1 M byte = 1024 kilobyte.

- 2.4 Find the refresh rate of a 512 × 512 frame buffer, if the access time for each pixel is 200 nanoseconds (ns).

Solution

Total number of pixels in a 512 × 512 raster screen = $512 \times 512 = 262,144$ pixels.

Total time for full frame to be accessed at the rate of 200 ns/pixel

= $200 \times 10^{-9} \times 262144 = 0.0524288$ seconds.

Hence the refresh rate = $1/0.0524288 = 19.073$ frames per second ≈ 19 frames/second.



Review Questions

- 2.1 Explain what is meant by resolution of an image and an image's aspect ratio?
Hint: Resolution is the number of pixels per unit length in a horizontal as well as vertical direction. The ratio of image width to its height is known as aspect ratio.
- 2.2 Explain the architecture of a raster display.
- 2.3 How are different shades of colour generated on the RGB monitors?
- 2.4 What is refresh buffer? Identify the contents and organization of the refresh buffer for the case raster display and vector display?
[University Question]
- 2.5 Compare DVST and refresh display. List the properties of phosphor used in CRT monitors.
- 2.6 What is the need for a lookup table? Give the organization of a colour lookup table providing 12 bits per entry, per colour for pixel position and with 8 bits per pixel in the frame buffer.
[University Question]
- 2.7 Find the amount of memory required by a 3 plane frame buffer each of red, green and blue of 800 × 600 screen resolution.
- 2.8 Find the refresh rate of a 1024 × 1024 frame buffer, if it can access 32 pixels in a group simultaneously in an access time of 200 ns.

- 2.9** Find the number of colours that is possible on a 512×512 raster screen with a 3 plane frame buffer each for red, green and blue.
- 2.10** How can the light pen differentiate between two points on the screen when both have the same colour and intensity?
- 2.11** Name some digital input devices and briefly explain them with respect to their functioning.
- 2.12** Discuss and explain GUI and its important components.
- 2.13** Mention some of the general practices which should be maintained to develop an effective GUI.
- 2.14** Discuss with examples the various interactive input methods and their modes of operation.
- 2.15** What are the six major classifications of input devices as per GKS?

3.1 INTRODUCTION

3.2 REPRESENTING IMAGE

Fig. 3.1 Square image data description