Paper 102: Programming & Problem solving through C

Lecture-22:VDU Basics

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Components of VDU

- The video system consists of two basic components:
  - A video screen on which we actually see the images either in text or graphics
  - A video display adapter which is a special printed circuit board.
    - Video card
- The microprocessor does not have the ability to send signals necessary to produce the images on the screen
- The display adapter acts as an agent between the microprocessor and the video screen.
- The display adapter consists of
  - Special memory called vdu memory
  - Circuitry which transfer the contents of the VDU memory on to the screen.

Components of VDU

- The microprocessor writes the information to be displayed on the screen into the VDU memory
- The display adapter transfer this information from VDU memory on to the screen.
  - A memory map display
  - Each address in VDU memory corresponds to a specific location on the screen
  - The adapter repeatedly reads information from VDU memory and places it on the screen, making the images displayed on the screen clear and steady
    - Refreshing the screen
    - The rate at which the adapter refreshes the screen is called 'refresh rate'

VDU memory

- The memory map is divided into 16 blocks of 64KB each.
- Out of these, block A and B are reserved for unconventional and conventional VDU memory respectively
- Which of these is used depends on the display adapter used in the computer system.
- CGA and MA are called conventional display adapters
  - Uses block B
- MCGA, EGA, VGA, SVGA, XGA are called unconventional display adapters and use a block of VDU memory

Video display modes

- Each modes has different combination of disdplay characteristics
- These characteristics include:
  - Whether text or graphics is to be displayed
  - The amount of text to be displayed in one line
  - The resolution
  - The number of possible colors
- Each mode requires certain hardware and programming approaches
  - Monitor and adapter
- Each and every mode will not be supported by a particular combination of monitor and display adapter
- All the modes are basically of two types
  - Text and graphics

Commonly used combinations

1. VGA monochrome monitor and VGA adapter
2. VGA color monitor and VGA adapter
3. VGA color monitor and SVGA adapter

- When computer is initially booted it usually boots up in mode 3, which is text mode
- To draw graphics it is required to switch from text mode to another mode available with the adapter
- Each mode uses a particular resolution
- All modes are fundamentally of two types , text and graphics.
- Most text mode uses block B in the memory map, and graphics uses block A

Different modes available

Mode no.	Type	Resolution	Memory required
3	Text	80x25	2 bytes/char (ascii code, attribute)
5	Graphics	320x200	2 bits/pixel
6	Graphics	640x200	1 bit/pixel
7	Text	80x25	2 bytes/char
12h	Graphics	640x480	1 bit/pixel
13h	Graphics	320x200	1 byte/pixel

How characters actually are displayed on screen

- The ASCII value in vdu memory must be translated into a character and drawn on the screen
- This drawing is done by a character generator that is part of the display adapter
- The CGA has a character generator that uses 8 scan lines and 8 pixels each of these scan lines to produce a character on screen
- The MA character generator uses 9 scan lines and 14 pixels in each of these scan lines to produce a character
- Multiple character sets may reside in Ram simultaneously
  - 4 for EGA and 8 for VGA

How characters actually are displayed on screen

- Each character set can contain 256 characters
- Each character in the standard character set provided with the EGA is 8 pixels wide and 14 pixels tall
- VGA provides a 9 pixel wide by 16 pixels tall character set

Colours in text mode

- In mode 3, for each character on screen there are two bytes in VDU memory
  - ASCII value and attribute
  - The attribute byte controls the color of the character
  - It contain three components
    - Foreground
    - Background
    - Blinking component
  - The first four bits can produce 16 different colours
  - The red, green and blue component of background can produce 8 different colors

Bit setting

7	6	5	4	3	2	1	0	purpose
							1	Blue component of fg color
						1		green component of fg color
					1			red component of fg color
				1				intensity component of fg color
			1					Blue component of bg color
		1						green component of bg color
	1							red component of bg color
1								Blinking

Black(oooo),blue,green,cyan,red,magenta,brown,white,light black,light blue,light green,light cyan,light red, light magenta, yellow,intense white(1111)

e.g., 00010100, red text and blue background

Colors in graphics mode

- Setting colors in this mode is different
- Each pixel has a color associated with it
- There is no fg or bg

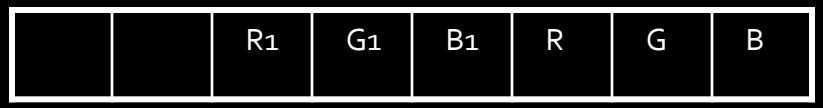
Colors in CGA

- It supports two graphics modes
  - 320x200 and 640x200
- Mode 5 of CGA supports palette 0 and palette 1
- The table shows the colors present in each palette

Palette	Bits	color
0	00	Black
0	01	Green
0	10	Red
0	11	Brown
1	00	Black
1	01	Cyan
1	10	Magenta
1	11	Light gray

Colours in EGA

- The EGA has several registers
- Some of these registers are responsible for determining the number of colors that EGA can support
- EGA's display memory is organized in four planes
- Each plane provides one bit of data for each pixel
- The bits for a given pixel from each of the four plane are combine into a nibble that identifies one of the 16 palette registers
- Each palette registers is 8 bits long, of these 6 bits are used to represent color



- These six bits can represent 64 colors, but since there are only 16 palette registers, they can contain only 16 out of 64
- Hence EGA can display 16 colors at a time

Colours in VGA

- VGA also has four planes-red , green, blue and intensity
- One bit from each plane contributing towards 1 pixel value
- The four bit pixel value from the display memory is used as the address of 1 to 16 palette registers
- A pixel value 0 selects the latte register 0, and a pixel value 1 selects the palette register 1, etc
- VGA supports several graphics modes
- Two popular ones are 640x480, 16 color mode and 320x200, 256 colour mode

Video pages

- Mode 3 permits a maximum of 4 video pages fro CGA and 8 for VGA and EGA
- Each character on screen takes 2 bytes in display memory, a total of 2000 characters (25x80) would require 4000 bytes(4KB)
- The display memory is split into several chunks of 4KB each, these are called video pages
- At any given time contents of one video page are displayed on the screen
- Using this technique while one page is displayed the others are being written into

Writing to VDU memory in text mode

- There are three ways of displaying characters on the screen
  - Using the standard library procedures
  - Using ROM-BIOS or DOS routines
  - Writing characters directly into VDU memory
- The block B is further divided into 32 KB, first one is used by MA, rest by CGA/EGA/VGA
- Beginning address for MA is oxBoooo and for CGA/EGA/VGA is oxB8ooo

Writing to VDU memory in text mode

```
/* Screenful of 'A's*/
Void main()
{
    int I;
    char far *vidmem=oxB8oooooo;
    for(i=o;i<=3999;i=i+2)
        *(vidmem + i)='A';
}
```

Writing to VDU memory in text mode

```
/* Changing the Screen attribute*/
void main()
{
    int I;
    char far *vidmem=oxB8oooooo;
    for(i=1;i<=3999;i=i+2)
        *(vidmem + i)=112;
}
```

Class assignment

- Write a program to change the case of all uppercase letter present on the current screen.
- Write a general purpose function writestring() which will display a message on the screen by writing it directly into VDU memory. The function should be able to display the message with an attribute sent to it