Lab Home page

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Polska wersja

Structure of BMP file

Bitmap file in RAM or ROM contains a header, which should be omitted (we do not check it, assuming that the bitmap already has the required format). After the header there is data section, containing information on pixels' colours. Single byte (8 bits) contains colour information on two pixels, 4 MSB concerns pixel on the left side, 4 LSB - pixel on the right side. Colour is encoded as a 4-bit address in colour table (which can be found in BMP header). The colour table used in the file from this exercise has the following structure (parameter **Bits per pixel=4, NumColors=16**):

Pixel (hex)	Driving outputs of Spartan-3 Starter Kit board			Displayed colour
	red_o	grn_o	blu_o	
0	0	0	0	**black**
1	X	X	X	*unused*
2	X	X	X	*unused*
3	X	X	X	*unused*
4	X	X	X	*unused*
5	X	X	X	*unused*
6	X	X	X	*unused*
7	X	X	X	*unused*
8	X	X	X	*unused*
9	1	0	0	**red**
A	0	1	0	**green**
B	1	1	0	**yellow**
C	0	0	1	**blue**
D	1	0	1	**magenta**
E	0	1	1	**cyan**
F	1	1	1	**white**

Fig. 1 Colour table

The order of the pixels in BMP file is as follows: from left to right, from bottom to top (first pixel is from lower left corner of the picture). In the first approach, the picture can be displayed upside down, just to test the reading data from memory.
Each line is filled with zeros at the end, so each line has a length of multiple of 32 bits. In this example filling is not used, since each line has 256 pixels, i.e. exactly 32 groups of 32 bits.

Basic BMP File Format		
Name	**Size**	**Description**
Header	14 bytes	Windows Structure: BITMAPFILEHEADER
Signature	2 bytes	'BM'
FileSize	4 bytes	File size in bytes
reserved	4 bytes	unused (=0)
DataOffset	4 bytes	File offset to Raster Data
InfoHeader	40 bytes	Windows Structure: BITMAPINFOHEADER
Size	4 bytes	Size of InfoHeader =40
Width	4 bytes	Bitmap Width
Height	4 bytes	Bitmap Height
Planes	2 bytes	Number of Planes (=1)
BitCount	2 bytes	Bits per Pixel 1 = monochrome palette. NumColors = 1 4 = 4bit palletized. NumColors = 16 8 = 8bit palletized. NumColors = 256 16 = 16bit RGB. NumColors = 65536 (?) 24 = 24bit RGB. NumColors = 16M
Compression	4 bytes	Type of Compression 0 = BI_RGB no compression 1 = BI_RLE8 8bit RLE encoding 2 = BI_RLE4 4bit RLE encoding
ImageSize	4 bytes	(compressed) Size of Image It is valid to set this =0 if Compression = 0
XpixelsPerM	4 bytes	horizontal resolution: Pixels/meter
YpixelsPerM	4 bytes	vertical resolution: Pixels/meter
ColorsUsed	4 bytes	Number of actually used colors
ColorsImportant	4 bytes	Number of important colors 0 = all
ColorTable	4 * NumColors bytes	present only if Info.BitsPerPixel <= 8 colors should be ordered by importance
Red	1 byte	Red intensity
Green	1 byte	Green intensity
Blue	1 byte	Blue intensity
reserved	1 byte	unused (=0)
repeated NumColors times		
Raster Data	Info.ImageSize bytes	The pixel data

Fig. 2 Structure of BMP file