CLASS : B.E. E &TC **SUBJECT: DIVP**

EXPT. NO. : 11 **DATE :14-07-2020**

TITLE : EXTRACTION OF BMP HEADER AND COMPARISON OF VARIOUS IMAGE FILE FORMATS

CO 1:	Apply the fundamentals of digital image processing to perform various operations on an image-enhancement in spatial domain/ frequency domain, image-restoration, image compression, video filtering and video compression on a given gray image. Examine the effect of varying the mask size and density of noise in an image and comment on the obtained results.
CO4:	Carry out experiments as an individual and in a team, comprehend and write a laboratory record and draw conclusions at a technical level.

AIM : To extract header of a BMP image and compare various file formats like – Monochrome, 16-color BMP, 256 – color BMP, 24-bit BMP, PNG, tif

SOFTWARES REQUIRED: C++ IDE, G++ Compiler, matlab

THEORY : Image Format describes how data related to the image will be stored. Data can be stored in compressed, uncompressed or vector format. They are standardized means of organizing and storing digital images. There are numerous image file types.

They are –

- JPEG (or JPG) - Joint Photographic Experts Group
- PNG - Portable Network Graphics
- GIF - Graphics Interchange Format
- TIFF - Tagged Image File
- PSD - Photoshop Document
- PDF - Portable Document Format
- EPS - Encapsulated Postscript
- AI - Adobe Illustrator Document
- INDD - Adobe Indesign Document
- RAW - Raw Image Formats
- BMP - Bitmap

Let's Discuss the BMP or Bitmap format in detail -

Bitmap Image Format (BMP) :

BMP or Bitmap Image File is a format developed by Microsoft for Windows. There is no compression or information loss with BMP files which allow images to have very high quality, but also very large file sizes. The BMP file format is capable of storing two-dimensional digital images both monochrome and color, in various color depths, and optionally with data compression, alpha channels, and color profiles. Among others, wingdi.h defines BMP constants and structures.

The bitmap file consists of –

Structure name	Optional	Size	Purpose	Comments
Bitmap file header	No	14 bytes	To store general information about the bitmap image file	Not needed after the file is loaded in memory
DIB header	No	Fixed-size (7 different versions exist)	To store detailed information about the bitmap image and define the pixel format	Immediately follows the Bitmap file header
Extra bit masks	Yes	3 or 4 DWORDs (12 or 16 bytes)	To define the pixel format	Present only in case the DIB header is the BITMAPINFOHEADER and the Compression Method member is set to either BI_BITFIELDS or BI_ALPHABITFIELDS
Color table	Semi-optional	Variable size	To define colors used by the bitmap image data (Pixel array)	Mandatory for color depths ≤ 8 bits
Gap 1	Yes	Variable size	Structure alignment	An artifact of the File offset to Pixel array in the Bitmap file header
Pixel array	No	Variable size	To define the actual values of the pixels	The pixel format is defined by the DIB header or Extra bit masks. Each row in the Pixel array is padded to a multiple of 4 bytes in size
Gap 2	Yes	Variable size	Structure alignment	An artifact of the ICC profile data offset field in the DIB header
ICC color profile	Yes	Variable size	To define the color profile for color management	Can also contain a path to an external file containing the color profile. When loaded in memory as "non-packed DIB", it is located between the color table and Gap1.

The breakdown of header is given below :

Name	Size	Offset	Description
Header	14 bytes		Windows Structure: BITMAPFILEHEADER
Signature	2 bytes	0000h	'BM'
FileSize	4 bytes	0002h	File size in bytes
reserved	4 bytes	0006h	unused (=0)
DataOffset	4 bytes	000Ah	Offset from beginning of file to the beginning of the bitmap data
InfoHeader	40 bytes		Windows Structure: BITMAPINFOHEADER
Size	4 bytes	000Eh	Size of InfoHeader =40
Width	4 bytes	0012h	Horizontal width of bitmap in pixels
Height	4 bytes	0016h	Vertical height of bitmap in pixels
Planes	2 bytes	001Ah	Number of Planes (=1)
Bits Per Pixel	2 bytes	001Ch	Bits per Pixel used to store palette entry information. This also identifies in an indirect way the number of possible colors. Possible values are: 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	001Eh	Type of Compression 0 = BI_RGB no compression 1 = BI_RLE8 8bit RLE encoding 2 = BI_RLE4 4bit RLE encoding
ImageSize	4 bytes	0022h	(compressed) Size of Image It is valid to set this =0 if Compression = 0
XpixelsPerM	4 bytes	0026h	horizontal resolution: Pixels/meter
YpixelsPerM	4 bytes	002Ah	vertical resolution: Pixels/meter

Colors Used	4 bytes	002Eh	Number of actually used colors. For a 8-bit / pixel bitmap this will be 100h or 256.
Important Colors	4 bytes	0032h	Number of important colors 0 = all
ColorTable	4 * NumColors bytes	0036h	present only if Info.BitsPerPixel less than 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			
Pixel Data	InfoHeader.ImageSize bytes		The image data

Conclusion:

1. Indexed color images use a so-called lookup table with a limited amount of colors. The maximum amount of colors in GIF images is, for example, 256.
   Every single pixel in a GIF image uses an index to designate its color. The index points to a specific color in the lookup table.
2. Compared to indexed color images, true color images lack a color lookup table.
   A pixel doesn't have an index referring to a specific color in the color lookup table.
   Every pixel has its own (RGB) color-value, and, depending on the file format, a value for transparency (RGBA).
3. bitmap is a raster graphics image file format used to store bitmap digital images, independently of the display device (such as a graphics adapter), especially on Microsoft Windows and OS/2 operating systems, JPG is commonly used by digital cameras to store photos, GIF is commonly used for images on the web and sprites in software programs, TIFF is primarily used in photography and desktop publishing, PNG was created to replace the GIF. Used commonly for web pages.
4. Bit depth is the number of bits used to indicate color of each pixel in the image.
   Having bit depth 'n' means a pixel can have 2^n color levels.
   Monochrome : 2 , 16-color bmp : 4 , 256 color bmp : 8 , 24 bit bmp : 24
   GIF : 8 , JPEG : 24 , PNG : 24 , TIFF : 32.
5. All BMP's and GIF are indexed color images whereas JPEG, PNG and TIFF are true color images.

References:

i. Gonzalez R, Woods R, "Digital image processing", Pearson Prentice Hall, 2008.

ii. Gonzalez R, Woods R, Steven E, "Digital Image Processing Using MATLAB®", McGraw Hill Education,2010.

iii. Jayaraman S, Esakkirajan S and Veerakumar T,"Digital Image Processing" Tata McGraw Hill, 2010

iv. Joshi, Madhuri A. "Digital Image Processing: an algorithm approach", PHI Learning Pvt. Ltd., 2006.

v. Pictures taken from: http://www.imageprocessingplace.com/root_files_V3/image_databases.html

(Course Teacher)

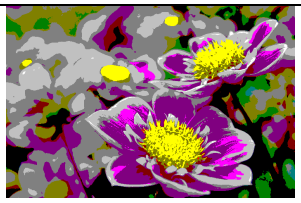
CLASS	**:**	**B.E (E &TC)**	**COURSE**	**:**	**DIVP**
AY	**:**	**2020-21 (SEM- I)**	**DATE**	**:**	**14-07-2020**
EXPT. NO.	**:**	**11**	**CLASS & ROLL NO**	**:**	**BE VIII 42428**
TITLE	**:**	**EXTRACTION OF BMP HEADER AND COMPARISON OF VARIOUS IMAGE FILE FORMATS**			

I. CODE:

```
clear all;
close all;
clc;
imfinfo('images\All_Formats\mono-bmp.bmp')
imfinfo('images\All_Formats\16-color-bmp.bmp')
imfinfo('images\All_Formats\256-color-bmp.bmp')
imfinfo('images\All_Formats\24-bit-bmp.bmp')
imfinfo('images\All_Formats\gif.gif')
imfinfo('images\All_Formats\jpg.jpg')
imfinfo('images\All_Formats\png.png')
imfinfo('images\All_Formats\tiff.tif')
```

II. RESULTS:

Input Images:

			
Monochrome	16- color	24 Bit BMP	256 Color BMP
			
PNG	JPEG	TIFF	GIF

Comparison of the File Formats and Applications :

File Format	Monochrome Bitmap	16 color Bitmap	256 color Bitmap	24-bit Bitmap	JPEG	GIF	TIFF	PNG
Image Info (imfinfo)	FileSize: 41158 Format: 'bmp' FormatVersion: 'Version 3 (Microsoft Windows 3.x)' Width: 700 Height: 467 BitDepth: 1 ColorType: 'indexed' FormatSignature: 'BM' NumColormapEntries: 2 Colormap: [2x3 double] RedMask: [] GreenMask: [] BlueMask: [] ImageDataOffset: 62 BitmapHeaderSize: 40 NumPlanes: 1 CompressionType: 'none' BitmapSize: 41096	FileSize: 164502 Format: 'bmp' FormatVersion: 'Version 3 (Microsoft Windows 3.x)' Width: 700 Height: 467 BitDepth: 4 ColorType: 'indexed' FormatSignature: 'BM' NumColormapEntries: 16 Colormap: [16x3 double] RedMask: [] GreenMask: [] BlueMask: [] ImageDataOffset: 118 BitmapHeaderSize: 40 NumPlanes: 1 CompressionType: 'none' BitmapSize: 164384 HorzResolution: 11811 VertResolution: 11811 NumColorsUsed: 0 NumImport	FileSize: 327978 Format: 'bmp' FormatVersion: 'Version 3 (Microsoft Windows 3.x)' Width: 700 Height: 467 BitDepth: 8 ColorType: 'indexed' FormatSignature: 'BM' NumColormapEntries: 256 Colormap: [256x3 double] RedMask: [] GreenMask: [] BlueMask: [] ImageDataOffset: 1078 BitmapHeaderSize: 40 NumPlanes: 1 CompressionType: 'none' BitmapSize:	FileSize: 980754 Format: 'bmp' FormatVersion: 'Version 3 (Microsoft Windows 3.x)' Width: 700 Height: 467 BitDepth: 24 ColorType: 'truecolor' FormatSignature: 'BM' NumColormapEntries: 0 Colormap: [] RedMask: [] GreenMask: [] BlueMask: [] ImageDataOffset: 54 BitmapHeaderSize: 40 NumPlanes: 1 CompressionType: 'none' BitmapSize:	FileSize: 88530 Format: 'jpg' FormatVersion: '' Width: 700 Height: 467 BitDepth: 24 ColorType: 'truecolor' FormatSignature: '' NumberOfSamples: 3 CodingMethod: 'Huffman' CodingProcess: 'Sequential' Comment: {} Make: 'Canon' Model: 'Canon EOS 20D' Orientation: 1 XResolution: 300 YResolution: 300 ResolutionUnit: 'Inch' Software: 'Bibble 4.9.8b'	FileSize: 186060 Format: 'GIF' FormatVersion: '89a' Left: 1 Top: 1 Width: 700 Height: 467 BitDepth: 8 ColorType: 'indexed' FormatSignature: 'GIF89a' BackgroundColor: 1 AspectRatio: 0 ColorTable: [256x3 double] Interlaced: 'no' DelayTime: 0 TransparentColor: 253 Disposal Method: 'DoNotspecify'	FileSize: 700124 Format: 'tif' FormatVersion: [] Width: 700 Height: 467 BitDepth: 32 ColorType: 'truecolor' FormatSignature: [73 73 42 0] ByteOrder: 'little-endian' NewSubFileType: 0 BitsPerSample: [8 8 8 8] Compression: 'LZW' PhotometricInterpretation: 'RGB' StripOffsets: [1x117 double] SamplesPerPixel: 4 RowsPerStrip: 4 StripByteCounts: [1x117 double] XResolution: 299.9990 YResolution: 299.9990 ResolutionUnit: 'Inch' Colormap: [] PlanarConfiguration: 'Chunky' TileWidth: [] TileLength: [] TileOffsets: [] TileByteCounts: [] Orientation: 1 FillOrder: 1 GrayResponseUnit: 0.0100 MaxSampleValue: [255 255 255 255]	FileSize: 613458 Format: 'png' FormatVersion: [] Width: 700 Height: 467 BitDepth: 24 ColorType: 'truecolor' FormatSignature: [137 80 78 71 13 10 26 10] Colormap: [] Histogram: [] InterlaceType: 'none' Transparency: 'alpha' SimpleTransparencyData: [] BackgroundColor: [] RenderingIntent: 'perceptual' Chromaticities: [1x8 double] Gamma: 0.4545 XResolution: 11810 YResolution: 11810 ResolutionUnit: 'meter' XOffset: [] YOffset: [] OffsetUnit: [] SignificantBits: [] ImageModTime: '1 Jul

	HorzResolution: 11811 VertResolution: 11811 NumColorsUsed: 0 NumImportantColors: 0	antColors: 0	326900 HorzResolution: 11811 VertResolution: 11811 NumColorsUsed: 0 NumImportantColors: 0	980700 HorzResolution: 11811 VertResolution: 11811 NumColorsUsed: 0 NumImportantColors: 0	DateTime: '2007:07:01 15:39:54' DigitalCamera: [1x1 struct] ExifThumbnail: [1x1 struct]		MinSampleValue: [0 0 0 0] Thresholding: 1 Offset: 683664 Make: 'Canon' Model: 'Canon EOS 20D' Software: 'Bibble 4.9.8b' DateTime: '2007:07:01 15:39:54 Predictor: 'Horizontal differencing' ExtraSamples: 2 XMP: '<?xpacket begin='□ｻ□' id='W5M0MpCehiH...' ExposureTime: 0.0025 FNumber: 5.6000 DigitalCamera: [1x1 struct] ExposureProgram: 'Aperture priority' ISOSpeedRatings: 100 DateTimeOriginal: '2007:07:01 15:39:54' DateTimeDigitized: '2007:07:01 15:39:54' ShutterSpeedValue: 8.6439 ApertureValue: 4.9709 ExposureBiasValue: 0 Flash: 0 FocalLength: 72 UserComment: [1x264 double] CPixelXDimension: 3504 CPixelYDimension: 2336 FocalPlaneXResolution: 3.9593e+03 FocalPlaneYReso	2007 15:39:54 +0000' Title: [] Author: [] Description: [] Copyright: [] CreationTime: '2007:07:01 15:39:54' Software: 'Bibble 4.9.8b' Disclaimer: [] Warning: [] Source: 'Canon EOS 20D' Comment: [] OtherText: {'CreationTime' '2007:07:01 15:39:54'}

							lution: 3.9593e+03 FocalPlaneResolutionUnit: 2 ExposureMode: 'Auto exposure' WhiteBalance: 'Auto white balance' SceneCaptureType: 'Standard' Contrast: 'Normal' Saturation: 'Normal' Sharpness: 'Normal' UnknownTags: [5x1 struct]	
Applications	As it displays only a single colour, usually black, it is often used in the creation of simple graphics	To store general information about the bitmap image file	To store general information about the bitmap image file	To store general information about the bitmap image file	Commonly used by digital cameras to store photos since it supports 16777216 colors and varying levels of compression	Commonly used for images on the web and sprites in software programs (Unlike jpeg it uses lossless compression that does not degrade quality)	Is lossless raster format and is of extremely high quality. Primarily used in photography and desktop publishing.	It was created to replace the GIF. Used commonly for web pages.