Robotics Club
IIT Kanpur

IIT KANPUR
ELECTRONICS CLUB

IMAGE PROCESSING AND OPENCV

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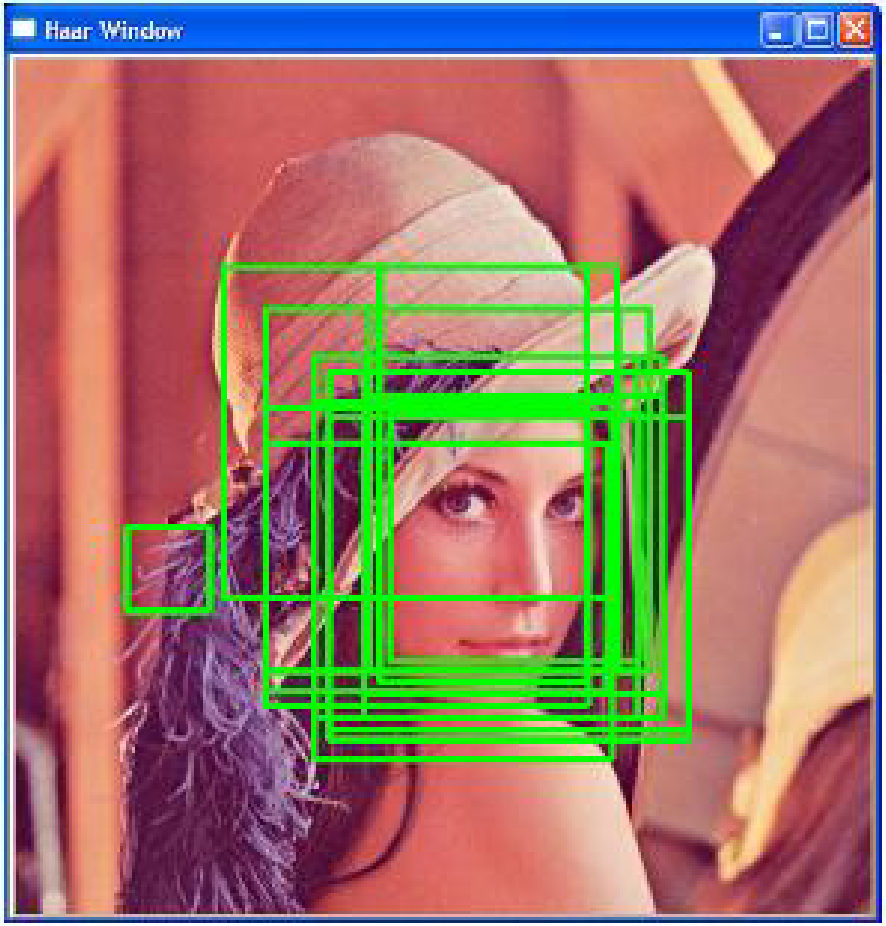
WHAT IS IMAGE PROCESSING?

- IMAGE PROCESSING
  =
IMAGE + PROCESSING



WHAT IS IMAGE?

- IMAGE = Made up of PIXELS.
- Each Pixels is like an array of Numbers.
- Numbers determine colour of Pixel.

TYPES OF IMAGES :

- 1.BINARY IMAGE
- 2.GREYSCALE IMAGE
- 3.COLOURED IMAGE

BINARY IMAGE

- Each Pixel has either 1 (White) or 0 (Black)
- Depth =1 (bit)
- Number of Channels = 1

0	0	0	0	0	0	0
0	0	1	1	1	0	0
0	0	1	1	1	0	0
0	0	1	1	1	0	0
0	0	1	1	1	0	0
0	0	0	0	0	0	0

GRAYSCALE

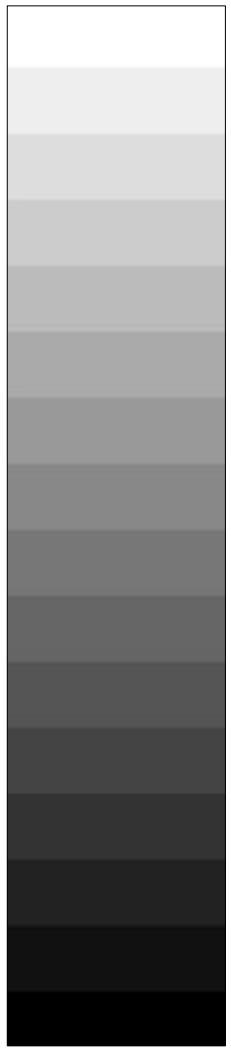
Each Pixel has a value from 0 to 255.

0 : black and 1 : White

Between 0 and 255 are shades of b&w.

Depth=8 (bits)

Number of Channels =1



GRAYSCALE IMAGE

RGB IMAGE

Each Pixel stores 3 values :-

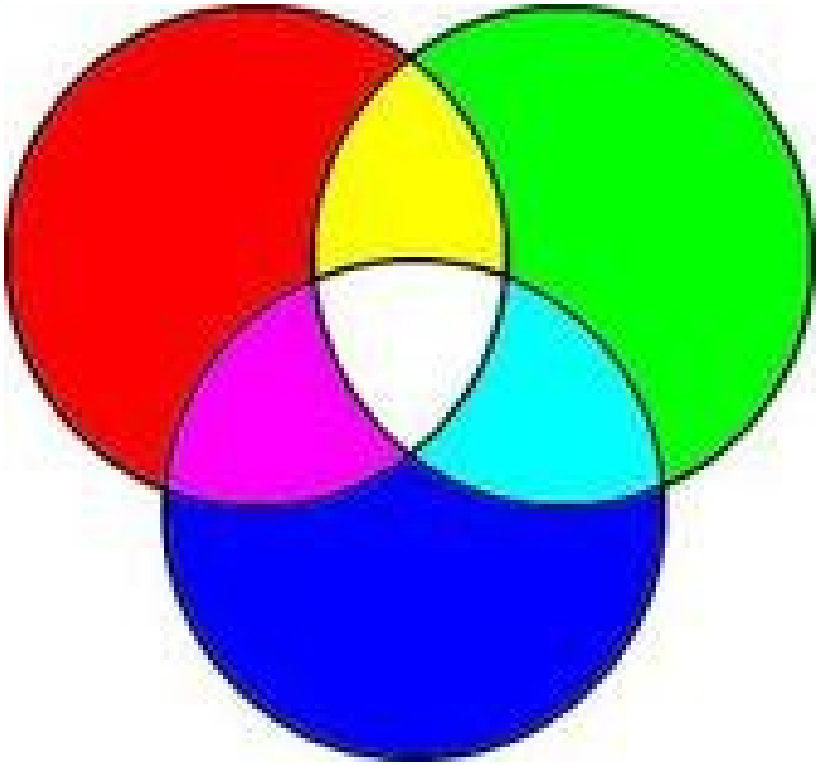
R : 0- 255

G: 0 -255

B : 0-255

Depth=8 (bits)

Number of Channels = 3



RGB IMAGE

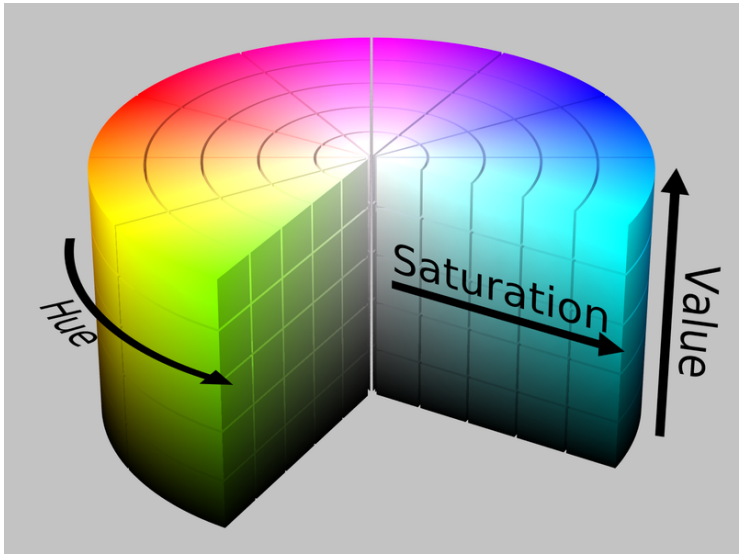
HSV IMAGE

Each pixel stores 3 values. In OpenCV

H (hue) : 0 -180

S (saturation) : 0-255

V (value) : 0-255



Depth = 8 (bits)

Number of Channels = 3

Note : Hue in general is from 0-360 , but as hue is 8 bits in OpenCV , it is shrinked to 180

STARTING WITH OPENCV

- OpenCV is a library for C language developed for Image Processing.

HEADER FILES FOR OPENCV

- After embedding openCV library in Dev C include following header files:-

#include "cv.h"

#include "highgui.h"

IMAGE POINTER

An image is stored as a structure *IplImage* with following elements :-

int height

int width

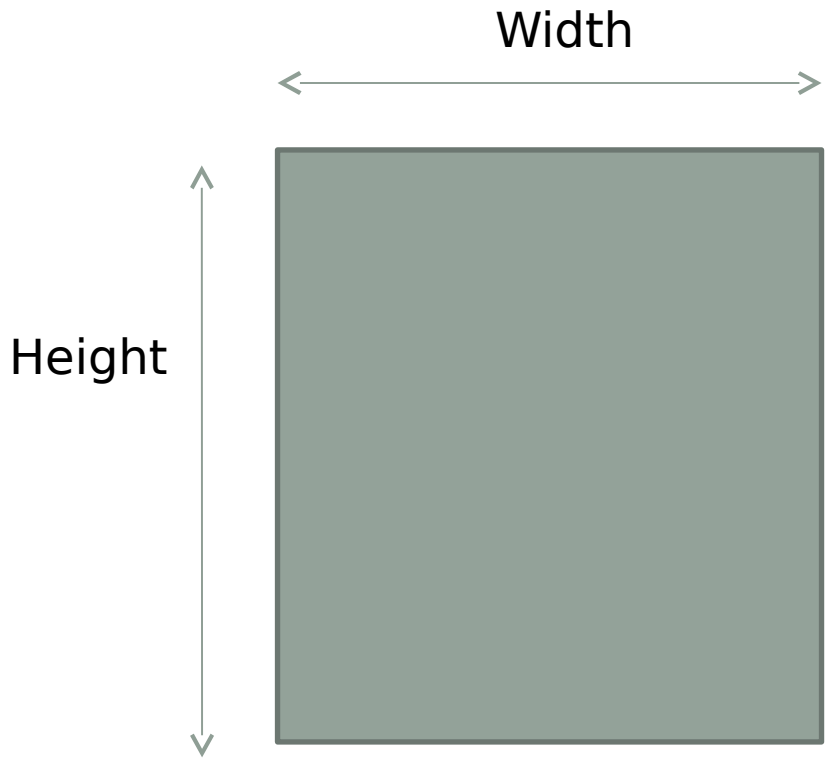
int nChannels

int depth

char *imageData

int widthStep

….. So on



imageData

An image’s data is stored as a character array whose first element is pointed by :-

Input->imageData (char pointer)

widthStep

Number of array elements in 1 row is stored in :-

input->widthStep

IMAGE POINTER

- Initialising pointer to a image (structure) :-
  IplImage input*

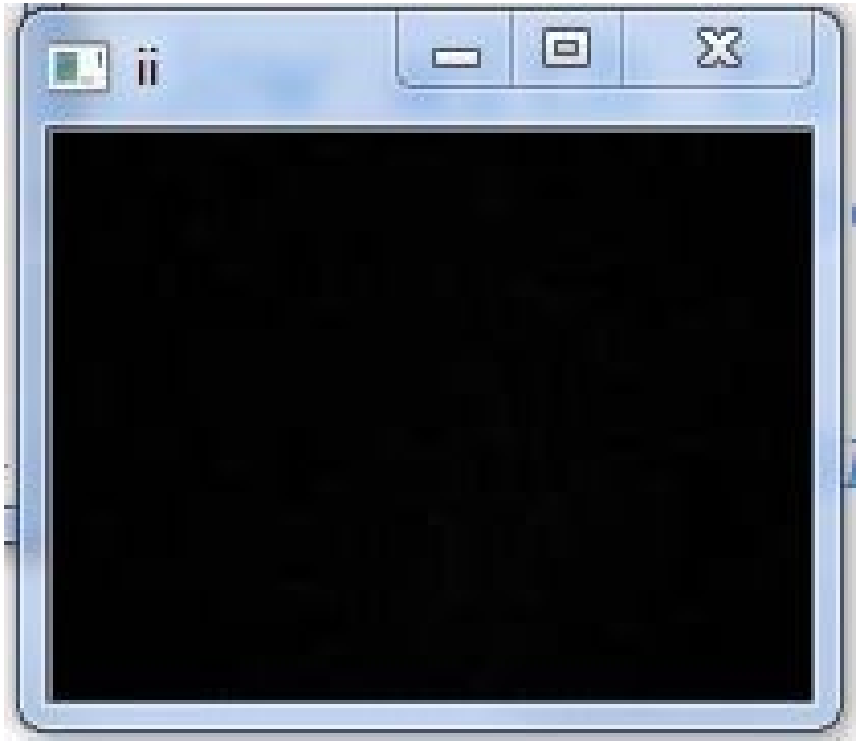
- Load image to the pointer [0=gray;1=colored]
  input=cvLoadImage("apple.jpg",1)

Note :The image apple.jpg must be in same folder where you save your C program

cvNamedWindow("ii",1)

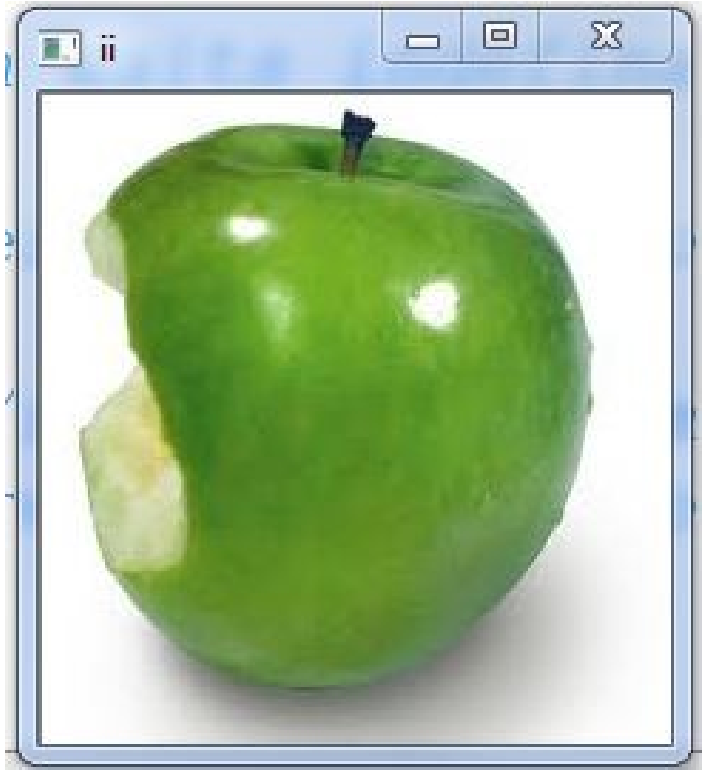
Creates a window named ii

1 = Coloured 0 = Grayscale



cvShowImage("ii",input)

Shows image pointed by input , in the window named ii



CREATE AN IMAGE

To create an image you need to specify its :-

- Size (height and width)
- Depth
- Number of Channels

output=cvCreateImage(cvGetSize(input),IPL_DEPTH_8U, 3)

cvWaitKey(*a number*)

If 0 or negative number is given as input:-
Waits indefinitely till key press and returns the ASCII value of the key pressed

If positive number is given as input :-
Waits for corresponding milliseconds.

Command	Function
cvDestroyWindow("ii")	Destroys window named *ii*
cvReleaseImage(&input)	Releases image pointer *input* from memory
output=cvCloneImage(input)	Copies image from input to output
cvCvtColor(input, output, conversion type) Conv. type : CV_BGR2GRAY ,CV_BGR2HSV	Saves input image in output pointer in other color space
cvSaveImage("output.jpg",output)	Saves image pointed by output naming it output
cvDilate(input , output, NULL, iterations)	Dilates an image for given number of iterations and saves it in output
cvErode(input,erode,NULL,iterations); Note:here NULL is a structural element	Erodes an image for given number of iterations and saves it in output

cvThreshold(input, output, threshold, maxValue, thresholdType)

Threshhold types:-

- CV_THRESH_BINARY
  max value if more than threshold, else 0
- CV_THRESH_BINARY_INV
  0 if more than threshold , else max value
- CV_THRESH_TRUNC
  threshold if more than threshold,else no change
- CV_THRESH_TOZERO
  no change if more than threshold else 0
- CV_THRESH_TOZERO_INV
  0 if more than threshold , else no change

SAMPLE CODE

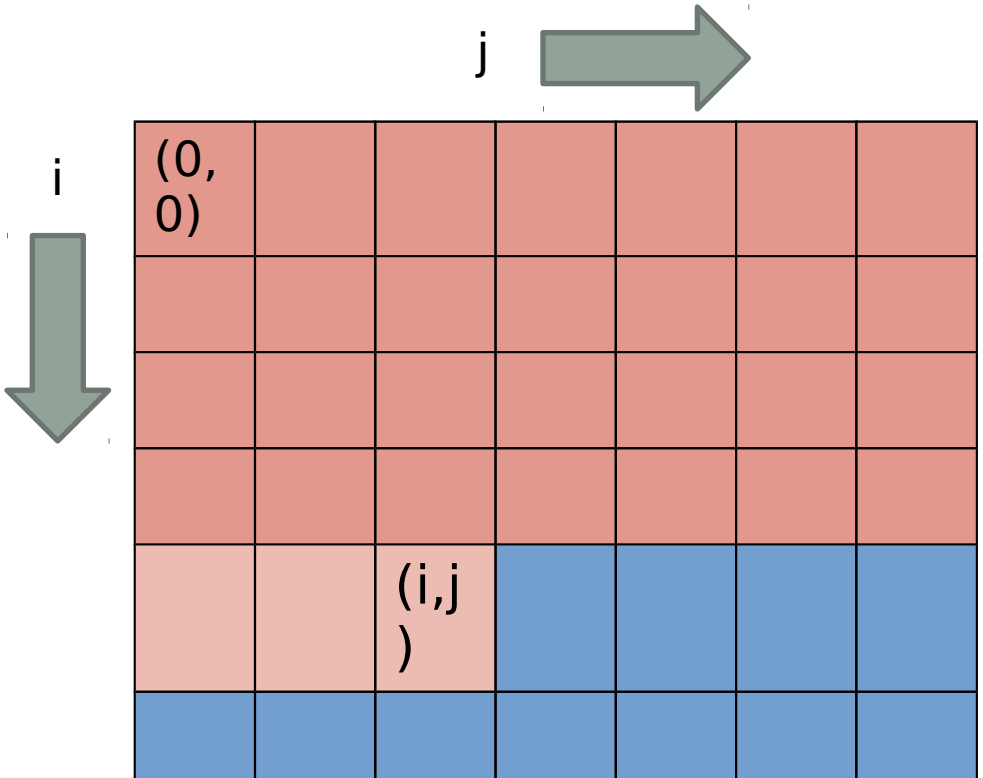
```
#include <cv.h>
#define IMAGEWIDTH  (640)
#define IMAGEHEIGHT (480)
int main(void)  {
    IplImage *img;
    unsigned int x, y, channels, imgstep;
    unsigned char *imgData;

img=cvCreateImage(cvSize(IMAGEWIDTH, IMAGEHEIGHT), IPL_DEPTH_8U,
3);
    channels = img->nChannels;
    imgstep  = img->widthStep / sizeof (unsigned char); // Values per row
    imgData  = img->imageData;
    for (y = 0; y < (img->height); y++)  {
        for (x = 0; x < (img->width); x++)  {
            imgData[(y * imgstep) + (x * channels) + 0] = 255;  // Blue
            imgData[(y * imgstep) + (x * channels) + 1] = 128;  // Green
            imgData[(y * imgstep) + (x * channels) + 2] = 0;    // Red
        }
    }
    return 0;
}
```

ACCESSING (I,J) PIXEL OF AN IMAGE

- Grayscale

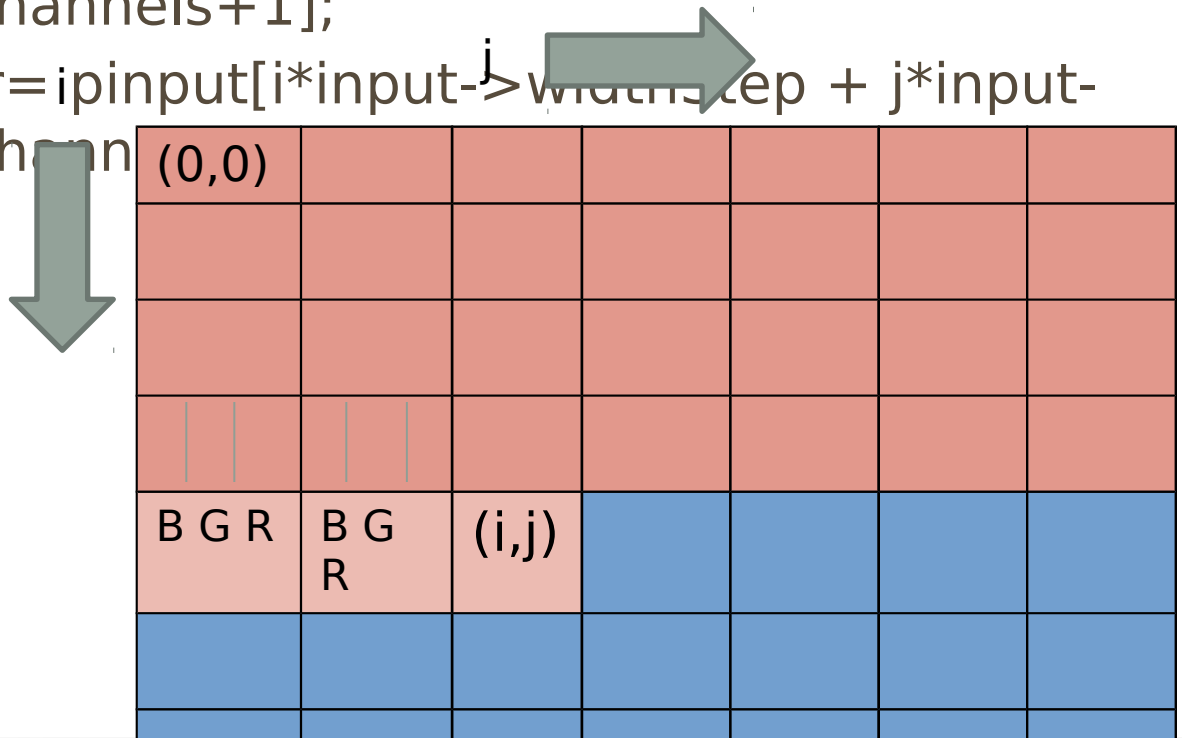
  uchar *pinput = (uchar*)input->imageData;

  int c = pinput[i*input->widthStep + j];



3 CHANNEL IMAGE (BGR):-

```
uchar *pinput   =  (uchar*)input->imageData;
int b= pinput[i*input->widthStep + j*input->nChannels+0];
int  g= pinput[i*input->widthStep + j*input->nChannels+1];
int  r=ipinput[i*input->widthStep + j*input->nChannels+2];
```



CHANNELS

- IplImage* blue=cvCreateImage(cvGetSize(frame), 8, 1);
- cvSetImageCOI(frame, 1);

/*Here CvCopy sees the COI and ROI and then copies the channels to be copied. Here we set the first channel as the channel of interest*/

- cvCopy(frame, blue, NULL); /*Copy the first channel */

VIDEO POINTER

CvCapture capture* - is a video pointer.

- To take video from camera :-

```
CvCapture
*capture=cvCreateCameraCapture(0);
```

Note : Here 0 - Default & 1 - External

- To take video from a saved video file :-

```
CvCapture*
capture=cvCreateFileCapture("trial.avi" );
```

TAKING IMAGE FROM CAMERA

```
CvCapture *capture=cvCreateCameraCapture(0);
for(int i=0;i<100000000;i++);
if(capture!=NULL)
                    IplImage
*frame=cvQueryFrame(capture);
```

Note : Here for loop is used to compensate time of initialization of camera in Windows

PLAYING VIDEO

```
CvCapture *capture=cvCreateCameraCapture(0);
 IplImage *frame;
 if(capture!=NULL){
            frame=cvQueryFrame(capture );
                  while(1){
                        cvShowImage(“Video",frame);
                        frame=cvQueryFrame(capture);
                        c=cvWaitKey(1);// frame rate
                if(c>0&&c<255)
                break;
                        }
                 }
```

MOUSE POINTER INFORMATION

```
void my_mouse_callback(int event, int x, int y,int flags,void* param ){
    uchar *pimage   =  (uchar*)image->imageData;
    int r=pimage[y*image->widthStep + x*image->nChannels+2];
    int g=pimage[y*image->widthStep+x*image->nChannels+1];
    int b=pimage[y*image->widthStep x*image->nChannels+0];
     printf( " x=%d y=%d r=%d  g=%d  b=
%d\n",x,,y,,r,g,b);              }
main(){ ........
    cvNamedWindow("image",1);
    cvSetMouseCallback("image", my_mouse_callback, NULL);
    cvShowImage("image",image);
    }
```

Note : cvSetMouseCallback is set for a NamedWindow and not for an image.

IP PROBLEM STATEMENTS

In general , all IP problem Statements have to discard one color and accept another in output image .

Input Image → Output Binary Image

```
If( color pixel value >
threshhold)
    output pixel=255;
else
    output pixel =0;
```

Note : In general , HSV format is highly useful to distinguish RGB colors (Why ?)

QUESTIONS

THANK YOU