**Aim:** Processing image with openCV3
**Objective:** To conversion between different color space

**Theory:**

**Fourier Transform :**The Fourier Transform is an important image processing tool which is used to decompose an image into its sine and cosine components. The output of the transformation represents the image in the Fourier or frequency domain, while the input image is the spatial domain equivalent. In the Fourier domain image, each point represents a particular frequency contained in the spatial domain image.The Fourier Transform is used in a wide range of applications, such as image analysis, image filtering, image reconstruction and image compression. In the frequency domain image, each point represents a particular frequency contained in the spatial domain image. if an image has more high-frequency components (edges, stripes, corners ), there will be a number of points in the frequency domain at high-frequency values.

**Low pass filter:** Low pass filter is the type of frequency domain filter that is used for smoothing the image. It attenuates the high-frequency components and preserves the low-frequency components.

**High pass filter:** High pass filter is the type of frequency domain filter that is used for sharpening the image. It attenuates the low-frequency components and preserves the high-frequency components.

**Application of high pass and low pass:**

1. audio processing, image processing, communication systems
2. biomedical signal processing.
3. Understanding the characteristics of these filters and their applications is essential for signal-processing engineers and researchers.

**Conversion of BGR to RGB :**

RGB and BGR are both color models used to represent colors in digital images. However, the main difference between these two color models is the order in which the color channels are arranged.In the RGB color model, the colors are represented by the Red, Green, and Blue color channels. The red channel shows information about the amount of red color similarly for the blue and green channel. On combining this information, we get the whole image.Whereas in the BGR model

which is also called OpenCV model the color channels are a reverse of the RGB model. But the particular light contains information about the intensity of that particular light.The layout of the Red, Green, and Blue subpixels is the primary distinction between RGB and BGR. Although BGR is basically the reverse of RGB, there is no difference in the vibrancy and accuracy of the colors. While some BGR screens, like the Gigabyte M27Q, even give a color accuracy score that's suitable for editing work, they look great for games and movies.

**Grayscale to RGB Conversion :**

convert a color image into a grayscale image. There are two methods to convert it. Both have their own merits and demerits. The methods are:

- Average method
- Weighted method or luminosity method

Average method: it is the most simple one. You just have to take the average of three colors. Since it's an RGB image, it means that you have to add r with g with b and then divide it by 3 to get your desired grayscale image.

Grayscale = (R + G + B/ 3)

Weighted method or luminosity method

You have seen the problem that occurs in the average method. Weighted method has a solution to that problem. Since red has more wavelength of all the three colors, and green is the color that has not only less wavelength then red color but also green is the color that gives a more soothing effect to the eyes.

It means that we have to decrease the contribution of red color, and increase the contribution of the green color, and put blue color contribution in between these two.

So the new equation that form is:

New grayscale image = ( (0.3 * R) + (0.59 * G) + (0.11 * B) ).

**HSV and HSL**:

HSL (Hue, Saturation, Lightness) and HSV (Hue, Saturation, Value) are two popular color spaces commonly used in machine vision and image processing. Both color spaces are derived from the RGB color model, but they represent colors in different ways, making them advantageous for certain applications.

HSL (Hue, Saturation, Lightness) is another color space commonly used in computer graphics, image processing, and computer vision. Like HSV, it is also derived from the RGB color model and provides a different way to represent and manipulate colors, focusing on three main components: hue, saturation, and lightness.

HSV is commonly used in machine vision for color-based object detection and tracking. By fixing the hue and adjusting the saturation and value thresholds, it becomes easier to segment objects of a specific color from the background, even under varying lighting conditions. HSV is also more intuitive for describing and working with color ranges, making it well-suited for applications such as image thresholding and region-of-interest extraction. channel range from 0 to 179 whereas the Lightness and Saturation channels range from 0 to 255.

**Conclusion:** Low-pass and high-pass filters are two fundamental types of filters used in signal processing. These filters have opposite characteristics and are used to filter out unwanted frequency components from a signal and understand how to convert an image from one color space to another using the OpenCV library and since Images are non – periodic. And since the images are non periodic , the Fourier transform is used to convert them into frequency domain that we understand through this experiment.