**LAB 2**

**I. Algorithm: This lab we use affine transformation to process image**

1. **Definition:** An affine transformation is any transformation that preserves collinearity (i.e., all points lying on a line initially still lie on a line after transformation) and ratios of distances (e.g., the midpoint of a line segment remains the midpoint after transformation)
2. **Type of affine transformation**

**Graphical user interface, text, application

Description automatically generated**

* X is pixel we input and y is pixel output
* Input pixel is pixel of destination image and output is pixel of original image, and then we use output pixel to interpolate the corresponding pixel for destination

**Table

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**A picture containing table

Description automatically generated**

1. **Bilinear interpolation:**

* In mathematics, bilinear interpolation is an extension of linear interpolation for interpolating functions of two variables (e.g., x and y) on a rectilinear 2D grid.
* Bilinear interpolation is performed using linear interpolation first in one direction, and then again in the other direction. Although each step is linear in the sampled values and in the position, the interpolation as a whole is not linear but rather quadratic in the sample location.
* Bilinear interpolation is one of the basic resampling techniques in computer vision and image processing, where it is also called bilinear filtering or bilinear texture

Text

Description automatically generated

1. **Nearest neighbor interpolation:**

* Nearest-neighbor interpolation (also known as proximal interpolation or, in some contexts, point sampling) is a simple method of multivariate interpolation in one or more dimensions.

**A picture containing text, electronics

Description automatically generated**

**II. Apply affine transformation**

**3. Zoom in/out an image.**

Explain the algorithm:

+ For zooming, we use scale method in affine transform

+ After affine transformation, we use interpolation method corresponding

Running code:

Open folder contains exe file in cmd, and write the following command:

Graphical user interface, text, email

Description automatically generated



Command: Lab2.exe -zoom -bl 1.5 1.5 img.jpg zoom\_bl.png

A picture containing text, dog, mammal

Description automatically generated



Command: Lab2.exe -zoom -nn 1.5 1.5 img.jpg zoom\_nn.png

A close-up of two dogs

Description automatically generated with medium confidence

**4. Resize an image.**

Explain the algorithm:

+ Resize an image also use scale method like zoom, but we need to compute the sx, sy by using weight and height before use scale method

Running code:

Open folder contains exe file in cmd, and write the following command:

Graphical user interface, text, application, email

Description automatically generated



Command: Lab2.exe -resize -bl 100 150 img.jpg resize\_bl.png

Graphical user interface, application, PowerPoint

Description automatically generated



Command: Lab2.exe -resize -nn 100 150 img.jpg resize\_nn.png

Graphical user interface, application

Description automatically generated

**5. Rotate an image around its center, and crop the result image such that the result size is unchanged.**

Explain the algorithm:

+ Affine transform for rotate un keep image: move to origin -> rote by angle degree -> return to old place

+ After have affine transform, you can use interpolation method to find your image

Running code:

Open folder contains exe file in cmd, and write the following command:

Graphical user interface, text, application, email

Description automatically generated



Command: Lab2.exe -rotK -bl 45 img.jpg rotK\_bl.png

Graphical user interface, application

Description automatically generated



Command: Lab2.exe -rotK -nn 45 img.jpg rotK\_nn.png

Graphical user interface, application

Description automatically generated

**6. Rotate an image around its center, keep the whole image, and fill the missing area with black color**.

Explain the algorithm:

+ I depend on an algorithm in stack over flow to find new height and new width for my image

Graphical user interface, text, application, email

Description automatically generated

+ Affine transform for rotate un keep image: move to origin with new height and width -> rote by angle degree -> return to old place (with source width and height)

+ After have affine transform, you can use interpolation method to find your image

Running code:

Open folder contains exe file in cmd, and write the following command:

Graphical user interface, text, email

Description automatically generated



Command: Lab2.exe -rotP -bl 45 img.jpg rotP\_bl.png

Graphical user interface, application

Description automatically generated



Command: Lab2.exe -rotP -nn 45 img.jpg rotP\_nn.png

Graphical user interface, application

Description automatically generated

**7. Flip an image vertically.**

Explain the algorithm:

* We change order of pixel in column

Table, calendar

Description automatically generated

Running code:

Open folder contains exe file in cmd, and write the following command:

Graphical user interface, text, application

Description automatically generated



Command: Lab2.exe -flipV -bl img.jpg flipV\_bl.png

A screenshot of a dog

Description automatically generated with low confidence



Command: Lab2.exe -flipV -nn img.jpg flipV\_nn.png

A collage of a dog

Description automatically generated with low confidence

**8. Flip an image horizontally**

Explain the algorithm:

+ We change order of pixel in row

Running code:

Graphical user interface, text, application, email

Description automatically generated



Command: Lab2.exe -flipH -bl img.jpg flipH\_bl.png

A screenshot of a dog

Description automatically generated with low confidence



Command: Lab2.exe -flipH -nn img.jpg flipH\_nn.png

A screenshot of a dog

Description automatically generated with low confidence

**III. References**

1. <https://en.wikipedia.org/wiki/Bilinear_interpolation#:~:text=In%20mathematics%2C%20bilinear%20interpolation%20is,again%20in%20the%20other%20direction>.
2. <https://en.wikipedia.org/wiki/Affine_transformation>
3. <https://en.wikipedia.org/wiki/Nearest-neighbor_interpolation>
4. <https://en.wikipedia.org/wiki/Bilinear_interpolation>
5. <https://www.geeksforgeeks.org/how-to-vertically-flip-an-image-using-matlab/>
6. <https://cboard.cprogramming.com/c-programming/142074-how-flipping-image-horizontally.html>
7. <https://github.com/hmhuan/HCMUS_HK5_XLAV/commits?author=hmhuan>
8. <https://github.com/TanThinNguyen>
9. <https://www.geeksforgeeks.org/rotate-image-without-cutting-off-sides-using-python-opencv/>
10. <https://stackoverflow.com/questions/57648391/how-do-i-rotate-an-image-manually-without-using-cv2-getrotationmatrix2d>
11. <https://stackoverflow.com/questions/22041699/rotate-an-image-without-cropping-in-opencv-in-c>