Project 1, Part 2.

Procedure

$$PH = \begin{pmatrix} x_1 & y_1 & 1 & 0 & 0 & 0 & -x_1x_1' & -y_1x_1' & -x_1' \\ 0 & 0 & 0 & x_1 & y_1 & 1 & -x_1y_1' & -y_1y_1' & -y_1' \\ x_2 & y_2 & 1 & 0 & 0 & 0 & -x_2x_2' & -y_2x_2' & -x_2' \\ 0 & 0 & 0 & x_2 & y_2 & 1 & -x_2y_2' & -y_2y_2' & -y_2' \\ x_3 & y_3 & 1 & 0 & 0 & 0 & -x_3x_3' & -y_3x_3' & -x_3' \\ 0 & 0 & 0 & x_3 & y_3 & 1 & -x_3y_3' & -y_3y_3' & -y_3' \\ x_4 & y_4 & 1 & 0 & 0 & 0 & -x_4x_4' & -y_4x_4' & -x_4' \\ 0 & 0 & 0 & x_4 & y_4 & 1 & -x_4y_4' & -y_4y_4' & -y_4' \\ x_5 & y_5 & 1 & 0 & 0 & 0 & -x_5x_5' & -y_5x_5' & -x_5' \\ 0 & 0 & 0 & x_5 & y_5 & 1 & -x_5y_5' & -y_5y_5' & -y_5' \\ x_6 & y_6 & 1 & 0 & 0 & 0 & -x_6x_6' & -y_6x_6' & -x_6' \\ 0 & 0 & 0 & x_6 & y_6 & 1 & -x_6y_6' & -y_6y_6' & -y_6' \\ x_7 & y_7 & 1 & 0 & 0 & 0 & -x_7x_7' & -y_7x_7' & -x_7' \\ 0 & 0 & 0 & x_7 & y_7 & 1 & -x_7y_7' & -y_7y_7' & -y_7' \\ x_8 & y_8 & 1 & 0 & 0 & 0 & -x_8x_8' & -y_8x_8' & -x_8' \\ 0 & 0 & 0 & x_8 & y_8 & 1 & -x_8y_8' & -y_8y_8' & -y_8' \end{pmatrix} \begin{pmatrix} h_0 \\ h_1 \\ h_2 \\ h_3 \\ h_4 \\ h_5 \\ h_6 \\ h_7 \\ h_8 \end{pmatrix}$$

This system is formed by choosing 8 points from the pictures. Solving this using Single Value Decomposition, $P{=}USV^T$ and select the last singular vector of V as the solution to H.

This procedure is used in Task 1, 2 and 3 to compute the Homography matrix H.

Task 1

Inputs

Points Chosen

	Left top	Left Bottom	Right Top	Right Bottom	Top Median	Bottom Median	Left Median	Right Median
Image A (x,y)	(0,0)	(0,507)	(499,0)	(499,507)	(249,0)	(249,506)	(0,253)	(499,253)
Image B (x',y')	(186,153)	(184,464)	(346,174)	(344,433)	(266,164)	(264,448)	(186,308)	(345,303)

Homography Matrix

Using the following 8 points in image A, and comparing them to their corresponding points in image B, we get 8 equations. By solving for these equations, the following matrix is obtained:

$$H = \begin{matrix} 0.0018 & 0.0004 & 0.0000 \\ -0.0000 & 0.0025 & -0.0000 \\ 0.7670 & 0.6416 & 0.0041 \end{matrix}$$

Applying Homography x' = Hx

Using the following matrix H to warp the image A, we get the following transformed image:

Overlaying image

We overlay this image onto image B to obtain the required results:

Task 2

Inputs

Points chosen

	Left top	Left Bottom	Right Top	Right Bottom	Top Median	Bottom Median	Left Median	Right Median
Image A (x,y)	(0,0)	(0,276)	(182,0)	(182,276)	(91,0)	(91,276)	(0,138)	(182,138)
Image B (x',y')	(708,151)	(710,330)	(870,132)	(872,325)	(788,141)	(791,327)	(707,240)	(872,228)

Homography Matrix

Using the following 8 points in image A, and comparing them to their corresponding points in image B, we get 8 equations. By solving for these equations, the following matrix is obtained:

$$H = \begin{matrix} -0.0008 & 0.0002 & 0.0000 \\ -0.0000 & -0.0009 & 0.0000 \\ -0.9783 & -0.2073 & -0.0014 \end{matrix}$$

Applying Homography x' = Hx

Using the following matrix H to warp the image A, we get the following transformed image:

Overlaying image

We overlay this image onto image B to obtain the required results:

Task 3

Inputs

Points Chosen

	Left top	Left Bottom	Right Top	Right Bottom	Top Median	Bottom Median	Left Median	Right Median
Image A (x,y)	(0,0)	(0,240)	(479,0)	(479,240)	(239,0)	(239,240)	(0,120)	(479,120)
Image B (x',y')	(543,81)	(553,474)	(965,81)	(1053,457)	(756,80)	(806,465)	(549,278)	(1009,270)

Homography Matrix

Using the following 8 points in image A, and comparing them to their corresponding points in image B, we get 8 equations. By solving for these equations, the following matrix is obtained:

$$H = \begin{matrix} -0.0017 & 0.0000 & -0.0000 \\ 0.0004 & -0.0025 & 0.0000 \\ -0.9876 & -0.1570 & -0.0018 \end{matrix}$$

Applying Homography x'=Hx

Using the following matrix H to warp the image A, we get the following transformed image:

Overlaying image

We overlay this image onto image B to obtain the required results:

Task 4

The lines $x+2y+1=0$ and $3x+6y-2=0$ are parallel in the Euclidean Plane.

These lines intersect at the ideal point in the homogeneous plane because they are parallel. All parallel lines have their corresponding intersection at infinity, on the ideal point that lies on the ideal line.