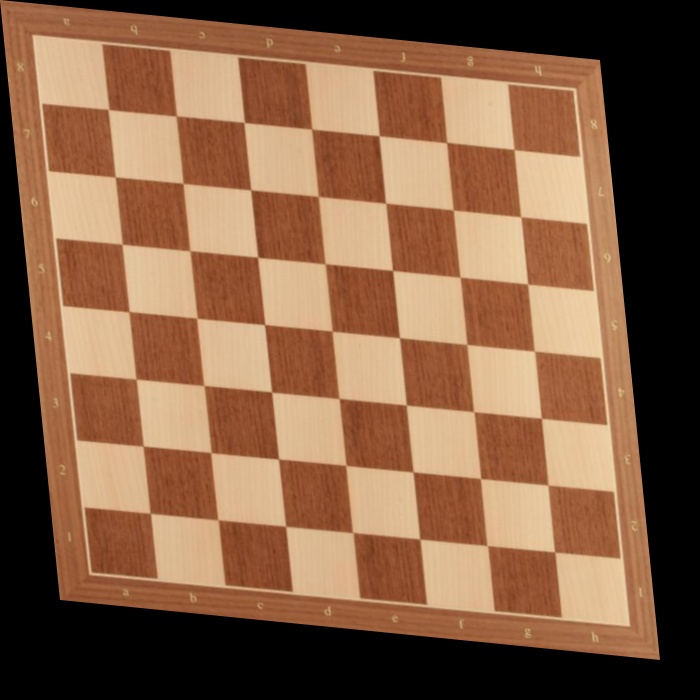
**Reflection Essay**

1. **Affine Transformation:**

Given distorted image, distorted.jpg has planar axial shear distortion. Coordinates of chessboard corners in the distorted image in clockwise direction starting from top left corner as origin are [A, B, C, D] = [(0,0), (600,-60),(660,-660),(60,-600)]. These coordiantes have been calculated using crop feature and basic math on dimensions.

The coordinates of the chessboard in the original.jpg(expected after distortion) are [A’, B’, C’, D’] = [(0,0), (600,0),(600,-600),(0,-600)] starting from top left corner as origin in the clockwise direction.

Distorted Image: distorted.jpg (700x700)



**Manual:**

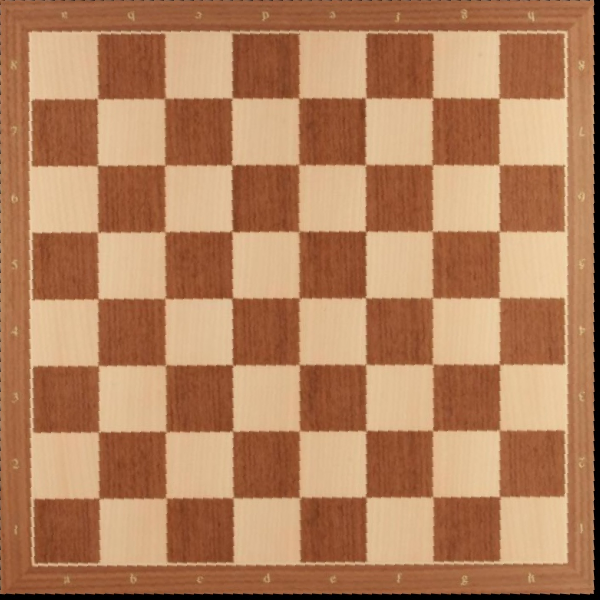
* + - To perform un-distortion we have to find the transformation matrix H manually in this case.
    - Given the coordinates of a point in an image () and the coordinates in the image after transformation (), the relation between these coordinates is:

, where .

* + - Here, in our case source coordinates of any point () would be the coordinates in the distorted.jpg and the corresponding point in original.jpg would be ().
    - We would require 6 equations to find H i.e. 3 different coordinates in source image and their corresponding points in the desired image .
    - We can find the transformation matrix (H) by solving the below shown linear equations (in matrix form):

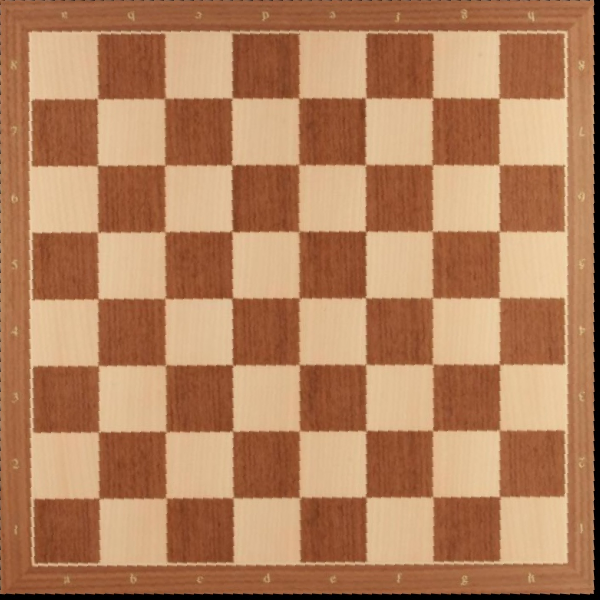
&

* + - Using cv2.warpAffine() we can reconstruct the original image from distorted image with the transformation matrix as H and flags set to cv2.WARP\_INVERSE\_MAP. This flag means that the transformation matrix is from source to desired image (dst(x,y)=src()) otherwise inversion of H matrix is done and then the image transformation.
    - Output:



**API:** To perform un-distortion, we have used cv2.getAffineTransform() to get the transformation matrix H. Then again using cv2.warpAffine() we get the Original image.

Output:



**Observation:** As you can observe the original image we got using both manual and API methods are same. We have used 3 corresponding points as the function cv2.getAffineTransform() takes 3 corresponding points of type float32.

Also, it is observed that chessboard image is of size 595x595 pixels (approx.) which is shown below (no extra part in the image at the bottom and the right side of the chessboard).

