Task 4: Tag-based Augmented Reality (AR) (15 points)

Use the pyAprilTag package to detect an April Tag in an image, for which you should take a photo of a tag. Use the K matrix you obtained above, to **draw** a 3D cube of the same size of the tag on the image, as if this virtual cube really is on top of the tag. **Document** the methods you use, and **show** your AR results from at least two different perspectives.

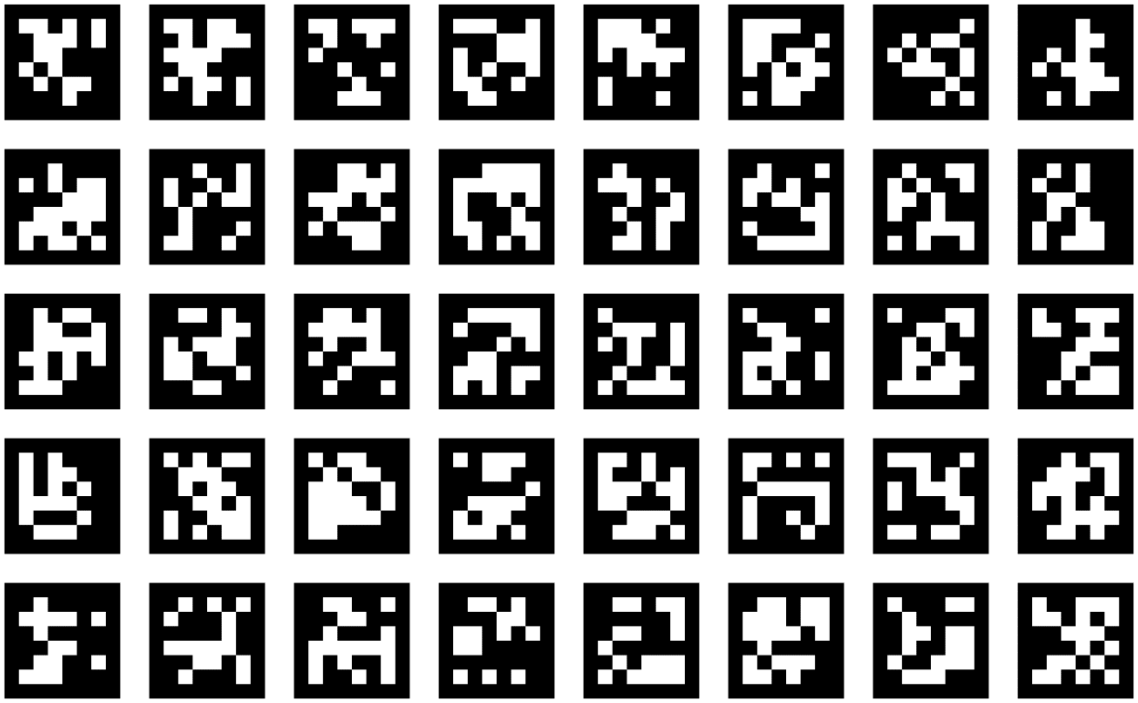
Solution:

In this problem, I need to make a cube on top of a specific April Tag. To solve this problem the first thing I need to do is obtain a Homography matrix for transformation of points properly. I used 5 points for Homography between the two frames, that is the base frame and the moving frame captured in Camera. The four corners and centre of the tags in Image pixels Ire taken by the distance of 160 pixels per side of the square tag, making the centre at 80 pixels from both coordinates. The number 160 can be replaced by anything, as it is not a specific value, but only a unit. From here, I derive the corresponding points of Homography in the camera feed.

In order to solve the problem, firstly the corners Ire extracted by pyAprilTag package. The .find () function is inbuilt, and gives us the IDs, centre and corners of each April Tag. These corners Ire used to determine the Translation and Rotation vectors from the Tags. The K matrices Ire copied from Task 3 along with the distortion matrix. In addition, the new H matrix was put to use.

$$K^{-1}H = [X_1 X_2 X_3] \quad Translation = \frac{X_3}{|X_1|} \quad Rotation = [\frac{X_1}{|X_1|} \frac{X_2}{|X_1|} \frac{X_1 * X_2}{|X_1|^2}]$$

Open CV has a simple function built in for this, Solve PnP, so that was used. There onwards, I used the projectPoints function to project the given axis on to the image. For this case, the axis was decided early on only, of a box. The camera keeps on applying the Homography in order to keep the image stable. Therefore, I can keep a set of April Tags in front pf the camera and it would form the box only on the top of the April Tag whose ID is matched. The picture used for this Task was:



My results are as follows: