Challenge 1:

The idea for this assignment is basically the one introduced in the assignment file.

First create an optical flow map with the size of needle map grid, for each entry, compute the index of its corresponding index in origin image. Then search the template within a window for maximum match, and choose this point as the destination, compute the vector from source point to destination, and use this vector to draw the needle vector on the image.

Here, as the images have some parts with few textures, the optical flow for those parts are not so accurate. In order to get a better needle map, I select the points with high confidence, that is to select the point with 'normxcorr2' output higher than 0.94 (this value is selected empirically), these points have a more accurate optical flow, thus some parts of the picture are blank for that those parts have little useful texture.

Challenge 2:

In this part of assignment, first I selected the template from the first frame and compute the weighed histogram for this template for matching. And select the left-top point of this template as the starting point.

For each frame following, search each point within the searching window around the starting point, compute the normalized matching score for the weighted histogram of the points and the weighted histogram of template. Chose the point with highest matching score as current target position, and update starting point with this point.

Two things to note here,

i. The window for tracking the ball is not a rectangle with the whole ball inside, but only left bottom of it. This is because in the first frame, the shoe on the ball has an effect on the histogram and will result in the failure of object tracking.

ii. I tried to use the current window to update the template in order to have better tracking, however, this method failed. The reason is perhaps as the matching is not perfectly accurate, there might be some difference between the ideal tracking window and the actual tracking window, and this difference will have some impact on the new histogram, if we use this new histogram as the template, we will introduce noise. As the tracking continues, the tracking window will gradually deviate from the object. Thus, in the final version, there is no template updating in the code.