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CGRA 352 - Assignment 4 - Report

All the code is written within one .cpp file. I only included that one .cpp file, since the entire project is stored in a very large folder. To get the code to run, you can copy paste all the text within the .cpp (or .txt) file into any IDE that is currently running C++ with OpenCV. The only change that needs to be made to the code is on line 209, where the file path is defined for the location of the image-sequences images, as this will be specific to where the images are stored on the machine that is running the code. Be sure to use forward-slashes, and not backslashes between each directory.

Functions:

float calc_ssd_KeyPoint_KeyPoint(KeyPoint feature_point_1, KeyPoint feature_point_2)
This function returns a float that is the SSD between two KeyPoint values. This function is useful for calculating what feature point matches are inliers or outliers.

float calc_ssd_KeyPoint_Point2f(Point2f feature_point_1, Point2f feature_point_2)
This function returns a float that is the SSD between two Point2f values. This function is useful for calculating what feature point matches are inliers or outliers.

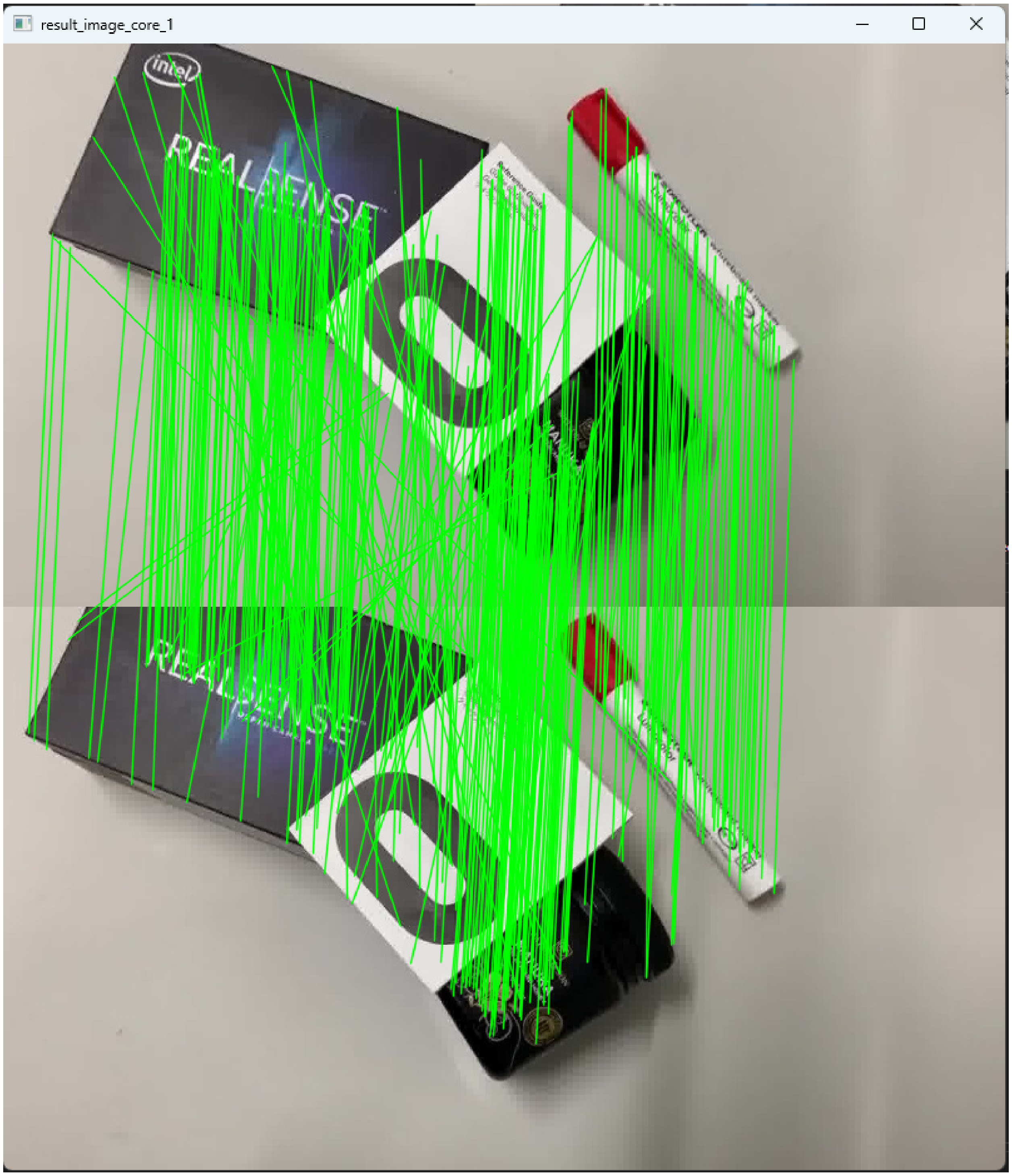
cv::Mat calc_best_homography(cv::Mat current_frame, Mat next_frame)
This function detects all the SIFT feature points of the two input images from the function's parameters and stores them in corresponding vectors. Then brute force matching is processed using cv::BFMatcher and stores the matches in a vector of type DMatch. Then the RANSAC process is started, which iterates 100 times. For each iteration, four random matching pairs are selected and are used to find the homography transform between the matching points. This homography transform is used to identify inliers and outliers by applying the homography transform to one of current frame's feature points, then computes the SSD to where the result is compared to its known matching feature point. If the SSD is less than the epsilon value, then it is an inlier, if it is greater than the epsilon value, then it is an outlier. The inliers' and outliers' corresponding indices are stored in respective vectors of int's. Additionally the number of inliers is counted in order to determine which iteration had the most inliers, which determines which homography transform was the best and most accurate version. The best homography transform found in the 100 iterations is then applied to the best iterations' found inliers, which produces the final and best homography transform. This homography transform is returned as a cv::Mat.

Core Section
The core section is very similar to the calc_best_homography() function; however it specifically performs the operations of frame_039 as the current frame, and frame_041 as the next frame. The results of all the feature points matches are displayed in core part 1 as green lines connecting the points across the two images. In core part 2, the green lines correspond to the inliers, while the red lines correspond to the outliers. Core part 3 attempts to warp frame_041, using the best homography transform found from the RANSAC process, then overlay the resultant image on top of frame_039. While the warped version of frame_041 appears to produce a somewhat accurate warping result, the overlay of the images seem to be off. This is possibly due to the border offset and how the images are aligned afterwards.

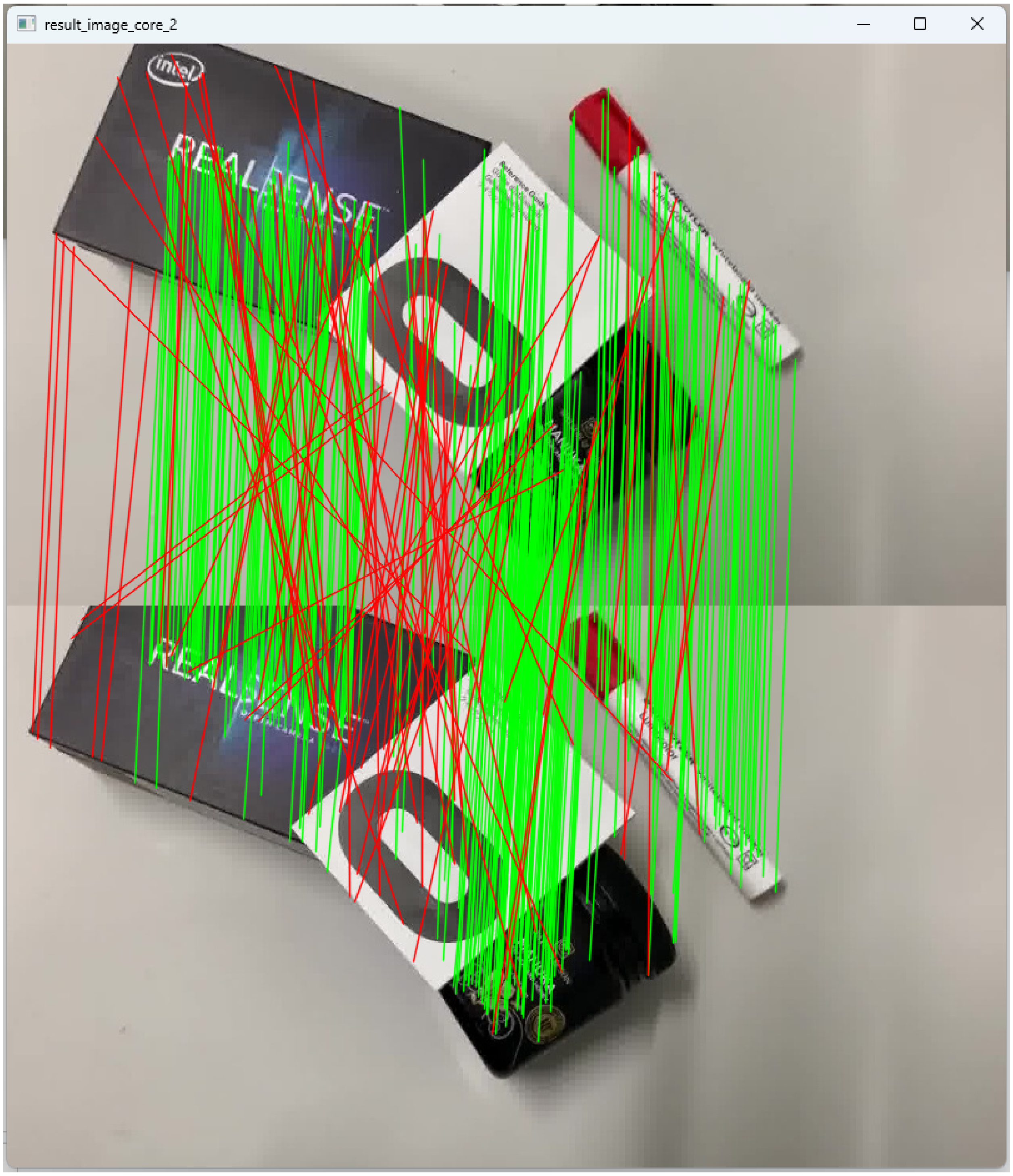
Completion Section
Completion is an attempt to implement the found homography transforms to produce a video stabilization algorithm across the entire image-sequence. I believe the general algorithmic process that I've implemented is correct; however, the results are either difficult to see if they are working, or are not making a significant change from the original image sequence. I found the homography transform between each frame, while cumulatively creating and storing all the H_tilde values in a vector, as well as a cv::Mat for the current H_tilde value. I found the gaussian of every H_tilde value by applying the formula with discrete weighted values producing a gaussian result. I then computed the inverse of all the H_tilde_gaussian values and stored them in a vector with corresponding indices to the H_tilde_gauss vector. Having those two vectors enabled me to compute the U transform values for each respective frame where a warp should be applied. I then iterated through all the original frames and applied the U transform to the frames that should be warped and output those resultant images as png's to the disk.

<u>Results images:</u>

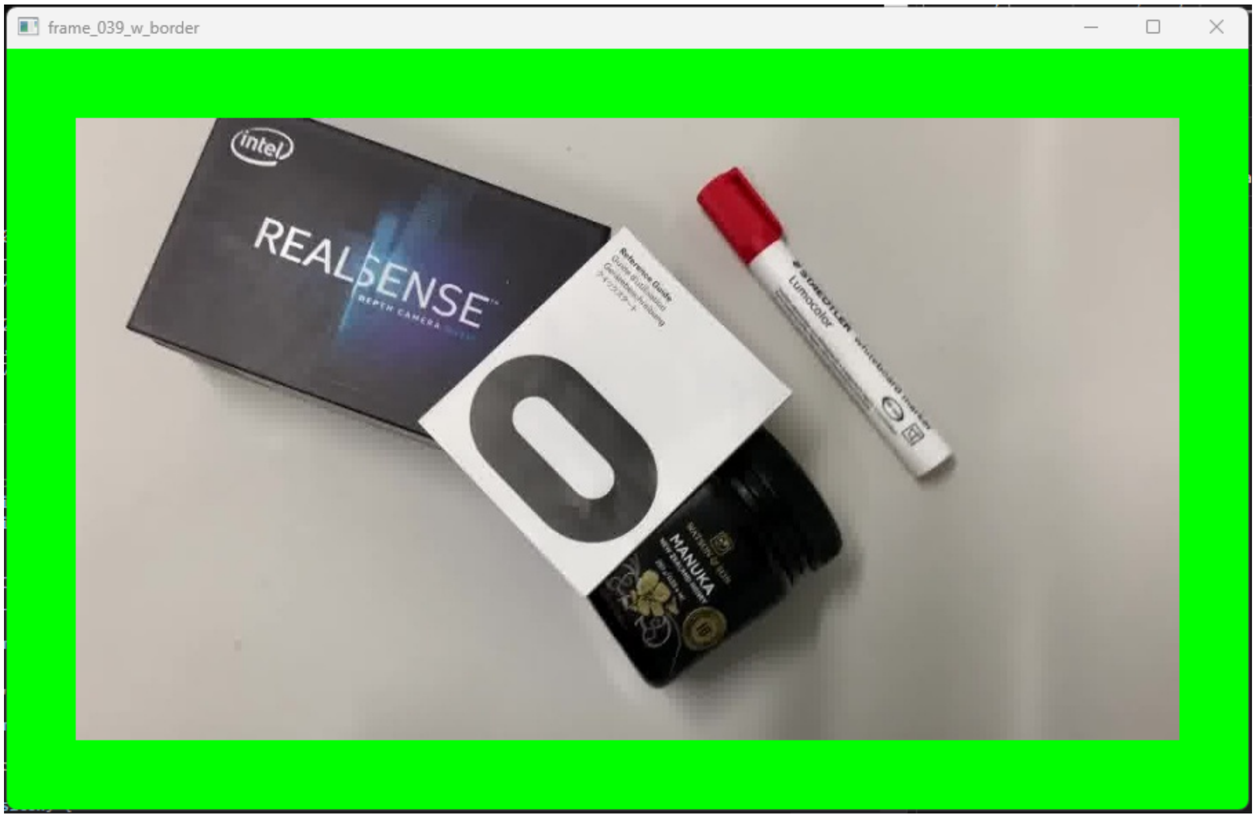
<u>Core Part 1:</u>



Core Part 2:



Core Part 3: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REALSENSE
DEPTH CAMERA
Reference Guide
STAEDTLER Lumocolor whiteboard marker
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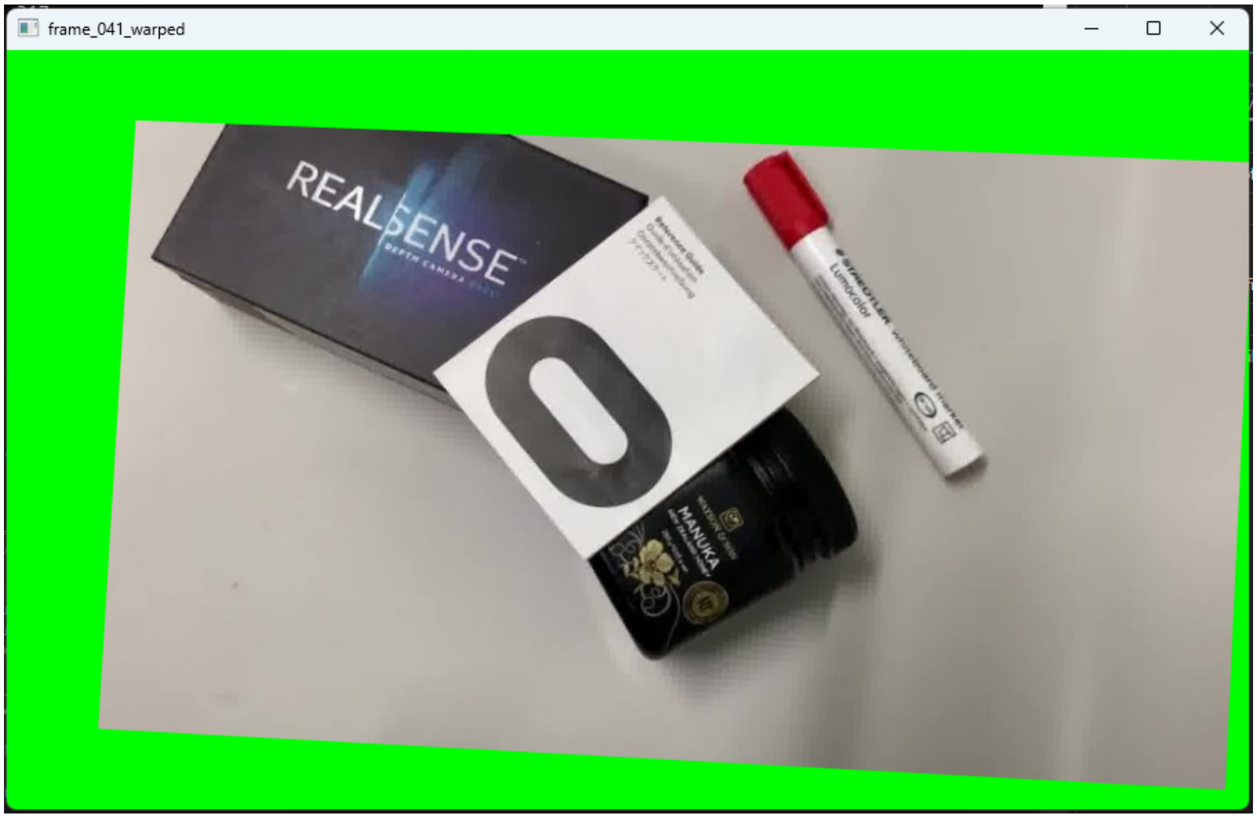
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STAEDTLER Lumocolor whiteboard marker
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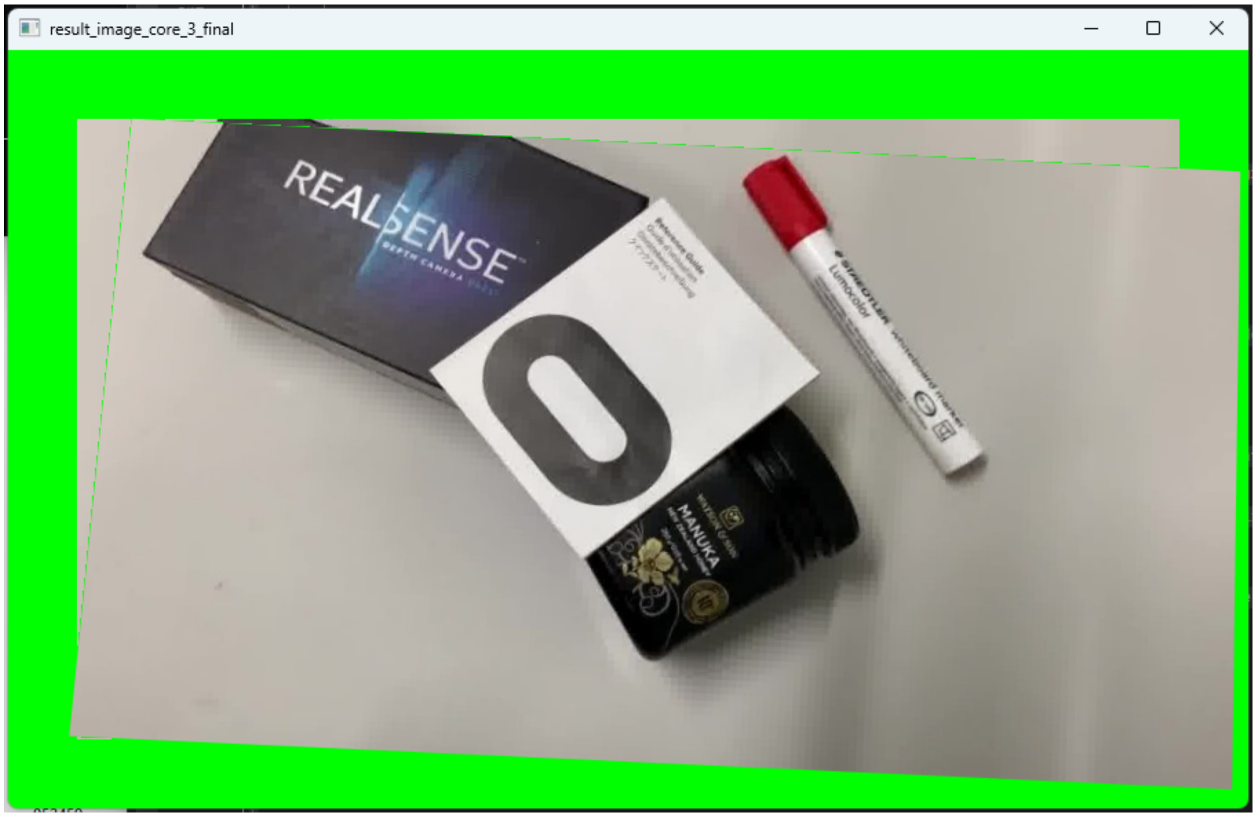
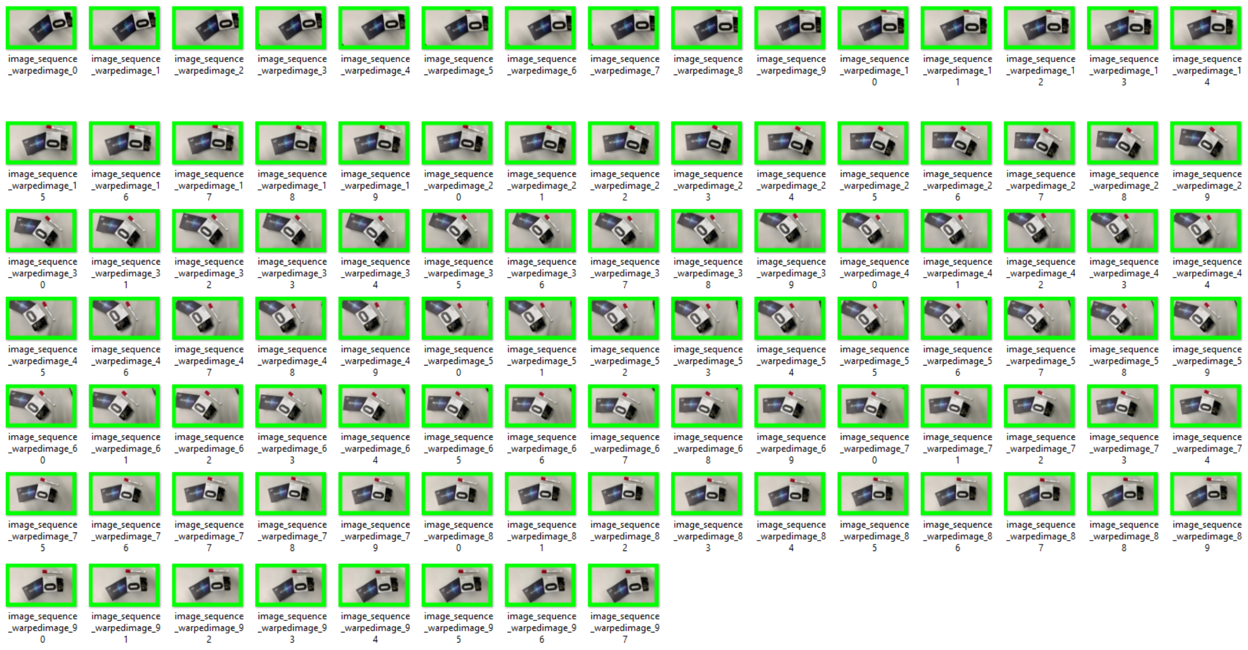


Completion: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