

Advanced Computer Vision – HW3

Projective Geometry

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Part 1: Estimating Homography

- **Method:**

For calculating the Homography matrix H , I implement both solution mentioned in the slides.

— Solution 1: set $h_{33} = 1$:

$$v_x = \frac{h_{11}u_x + h_{12}u_y + h_{13}}{h_{31}u_x + h_{32}u_y + 1}$$
$$v_y = \frac{h_{21}u_x + h_{22}u_y + h_{23}}{h_{31}u_x + h_{32}u_y + 1}$$

— Solution 2: impose unit vector constraint

$$v_x = \frac{h_{11}u_x + h_{12}u_y + h_{13}}{h_{31}u_x + h_{32}u_y + h_{33}}$$
$$v_y = \frac{h_{21}u_x + h_{22}u_y + h_{23}}{h_{31}u_x + h_{32}u_y + h_{33}}$$
$$h_{11}^2 + \dots + h_{33}^2 = 1$$

- **Input data:**

— Canvas



— Material



- **Result:**



Part 2: Unwarp the Screen

- **Method:**

Implement *Bilinear Interpolation* to prevent holes in output space when *Backward Warping*.

- **Input data:**



- **Result:**

Decoded link: <http://media.ee.ntu.edu.tw/courses/cv/19F/>

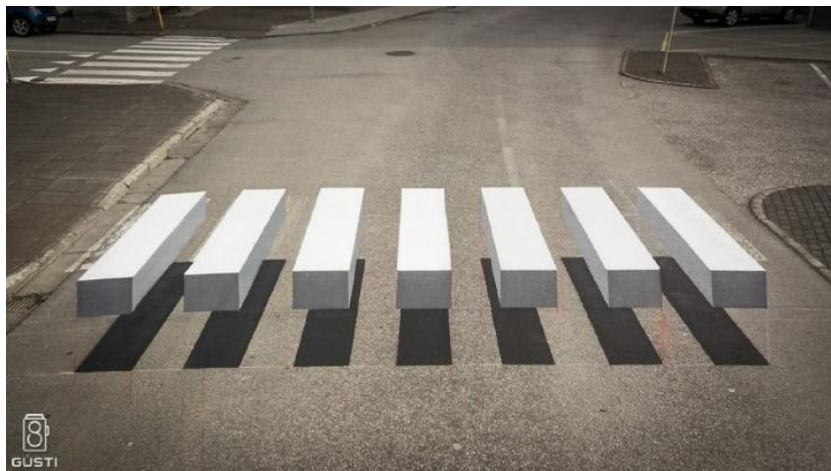


Part 3: Unwarp the 3D Illusion

- **Method:**

Implemented *Backward Warping* on the specific area in the image to obtain the top view.

- **Input data:**



- **Result:**



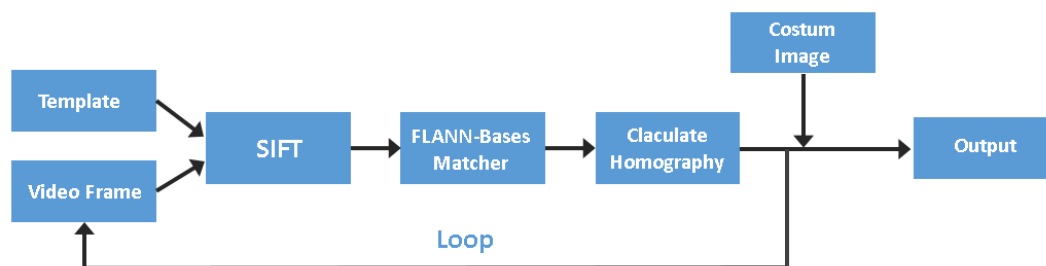
- **Discussion:**

The result is slightly different from the ground truth, because we assume the road is a flat plane. But actually the road is curved, therefore the transformation result was distorted.

Part 4: Simple AR

- **Method:**

Firstly, we use feature matching algorithm to match the video frames and the template. After matching, then we can calculate the Homography matrix between them to finally implement a simple AR.



- **Input data:**

— Template



— Video



- **Result:**



- **Discussion:**

For the choices of the feature detecting algorithm, I implemented with SIFT and SURF. Although SIFT is not the most efficient way to obtain interest points, it is much more accurate than SURF. Considering the overall performance, SIFT is my final choice.