Tour Into The Picture

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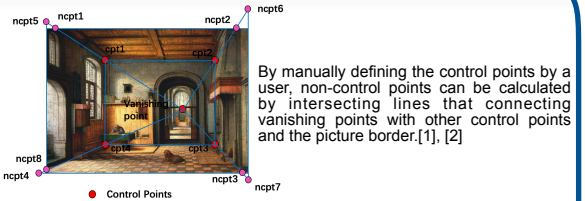
overview: This is a program that generates a 3D scene model from an image. It follows the techniques described in Tour Into the Picture by Horry et al., modeling the scene as an axis-parallel box with five faces.

Methodology of Background

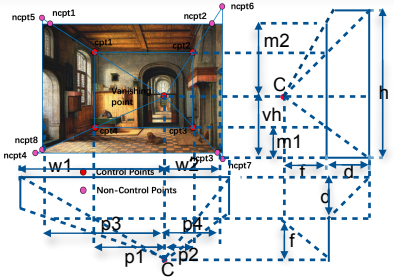


By manually defining the control points by a user, non-control points can be calculated by intersecting lines that connecting vanishing points with other control points and the picture border.[1], [2]

Fig. 1 Vertices to be calculated

Fig. 2 Segmented images

Depth height and width of the 3D reconstruction[3]



$$depth = \frac{m1*f}{vh-m1}$$

$$height = vh + \frac{m2*(f+d)}{f}$$

$$width = w1 + w2 = \frac{(p1+p2)*(f+d)}{f}$$

Fig. 3 Calculation of depth height and width

Transform the cropped images

Set 4 of the non- and control points to the vertices of a rectangle. Transform the cropped images from any quadrilateral to a rectangle, whose length and width are determined by calculation.

Fig. 4 Converted image

Methodology of Foreground

Fig. 5 Get the foreground image

Fig. 6 Foreground image

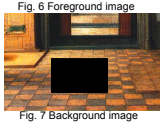


Fig. 7 Background image

After the foreground is intercepted, the subtracted foreground part is set to black in the background image. Then this area is filled with its neighbor area and then a gaussian filter is applied to remove dissonance.

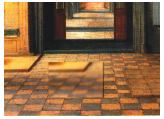


Fig. 8 New background image

3D localization of foreground coordinates

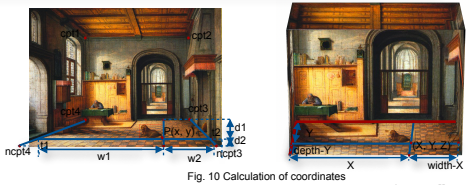


Fig. 10 Calculation of coordinates

$$\frac{t1(y)-cpt4(y)}{ncpt4(y)-cpt4(y)} = \frac{P(x)-cpt4(x)}{ncpt4(x)-cpt4(x)} \qquad w1 = P(x) - t1(x)$$

$$\frac{t2(y)-cpt3(y)}{ncpt3(y)-cpt3(y)} = \frac{P(x)-cpt3(x)}{ncpt3(x)-cpt3(x)} \qquad w2 = t2(x) - P(x)$$

$$\frac{w1}{w2} = \frac{X}{width-x} \qquad \frac{d1}{d2} = \frac{Y}{depth-y} \qquad Z = 0$$

Resize foreground

Fig. 11 Calculation of resize ratio

$$\frac{height\_3d}{height\_f} * heigh\_dog = height\_dog\_3d$$

$$\frac{width\_3d}{width\_f} * width\_dog = width\_dog\_3d$$

[1] Youichi Horry, Ken-Ichi Anjyo, and Kiyoshi Arai. Tour into the picture: using a spidery mesh interface to make animation from a single image. In Proceedings of the 24th annual conference on Computer graphics and interactive techniques, pages 225-232, 1997.

[2]Koh Bing Xiong.Tour-Into-Picture with Kinect. School of computer Engineering, Nanyang Technological University, 2013

[3]Cao Zhiqing, Shi Jiaoying. A mid-stream method based on relative depth calculation. china, ZL 200410052974.0 2007-01-24.

Result and Challenge

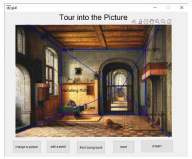


Fig. 12 Image with vanishing points and Spidery Mesh

Fig. 13 3D reconstruction

Fig. 14 Perspective shift

Fig. 15 Scene zooming

By using vanishing points and Spidery Mesh, a 2D single image can **be reconstructed in 3D scene**.
Using the keyboard and mouse can perform several functions

- Perspective shift (Fig. 14)
- Scene zooming (Fig. 15)
- (optional) Background and Foreground separation

When a foreground object i.e., target is present, foreground object and background can also be separated.

Gallery

All images are produced from the program. As you can see, after such transformations, we can create new viewpoints of the scene from only one image.

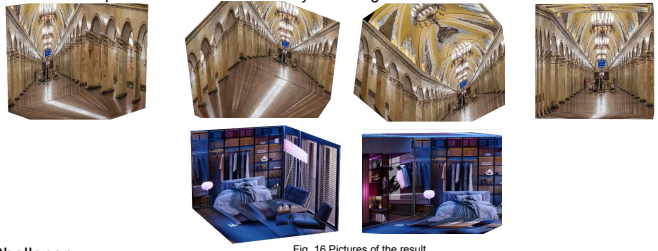


Fig. 16 Pictures of the result

Challenge

1. When the vanishing point is much offset from the central in the background. Our algorithm does not solve this problem very well.
2. Our algorithm cannot restore the image when the background is not rectangular.
3. The remaining part of the foreground cannot be filled properly after cropping out the foreground.
4. Our algorithm is only applicable when there are five points on the image.

Group task division

Sirou Chen: Readme.txt(Version 2. 0), main.m, ForegroundCalculation.m, ProjectiveRectification.m
Sijia Li: Poster, CutForeground.m, ForegroundCalculation.m, ProjectiveRectification.m
Xuhui Li: ImageCropping.m, ProjectiveRectification.m, ForegroundCalculation.m, CalculatePointCoordinates.m
Jiaying Guo: Poster, Transform3D.m(except Funktion: KeyDown), ForegroundCalculation.m
Yanjun Guo:Transform3D.m(Funktion: KeyDown), Readme.txt(Version 1. 0)