Inpainting for Interactive 3D Indoor Modeling

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Abstract—This paper describes an interactive 3D indoor modeler and the inpainting techniques for the modelers. We have developed an interactive indoor modeler in which the user can create 3D indoor models from a single photo or multiple photos by simple interaction techniques based on computer vision principles. There are often invisible regions on some of the 3D planes since it is not easy to take a set of photos so that every region of the 3D models is included at least in one of those photos. We employ inpainting techniques for making up for the invisible regions with computer-generated texture patches and for merging the inpainted region with the neighboring visible regions smoothly.

Keywords: Inpainting, 3D modeling, Mixed Reality, co-creative Intelligence Cycles, Service Cooperation

I. INTRODUCTION

Virtualized real objects made from photos can make virtual environments more realistic. This reduces the gap between the real and virtual world for a number of applications such as personal navigation, visualization, and simulation. We have developed an interactive modeler [1] [2] to enable the users to easily create 3D indoor models from a single or multiple photos. However, some of 3D planes in the models often have imperfect or no texture due to occlusion by the target itself or other objects.

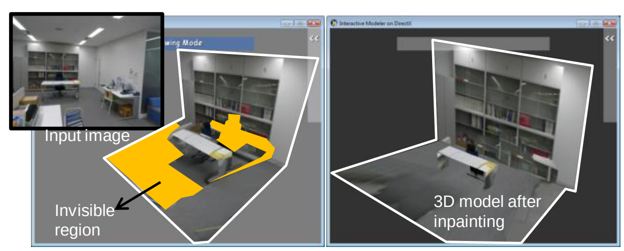
II. INTERACTIVE MODELER

The interactive modeler initiates 3D modeling by analyzing input photos. The viewpoint and the rotation angles at which each photo was taken are estimated by using the vanishing points obtained from pairs of lines in the actual 3D world. The origin of the ground plane is interactively set by the user over which the texture-mapped 3D planes are added one by one for developing the 3D indoor model. The developed 3D planes can be translated, rotated, deformed or deleted using simple interaction techniques based on geometric constraints derived from the photos.

III. INPAINTING FOR THE INDOOR MODELER

The regions which are invisible in any of input photos inevitably hold textures of their frontal objects due to projective texture mapping with GPU. At present, we employ an exemplar-based inpainting method proposed by Criminisi et al. [3] for inpainting the invisible regions. The exemplar-based method fills the invisible region with the texture patches from the neighboring region in such a way that the structure of the texture is maintained. Figure 1(a) shows the 3D model which consists of a floor and a wall, created by the modeler from the input image. The created 3D model contains the invisible region due to the objects in the room. The inpainting mask is automatically generated by the modeler by casting the shadows of the objects that causes the occlusion. The exemplar-based algorithm sets the priority for the pixels in the mask boundary since the filling order is important in propagating the structure inside the mask region. The highest priority is given to the pixel which is surrounded by most of the data pixels and is in continuation of the strong edges. The suitable texture patch is selected by calculating the sum of the squared differences (SSD) of the pixel values between the texture patches. Figure 1(b) shows the 3D model after inpainting where the invisible region in the floor and the portion of the bookshelf are filled by suitable textures from the neighborhood.

Our future work will aim for a suitable inpainting algorithm for the modeler which will make use of the indoor modeling details and image processing features.



(a) (b)

Fig.1. Inpainting for indoor modeler. (a). Invisible region in the floor and the wall caused by the frontal objects. (b). Filling the invisible region by exemplar-based inpainting.

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