Design and Implementation of High-Resolution Sea-Lane Image Texture for Marine Virtual Environment

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Abstract. In this paper, we propose the efficient approach for constructing virtual reality simulation of ship navigation that supports navigator. Therefore, we propose that simple constructing environments surrounding ships. Structures along the yard can easily displayed with one texture mapping on one NURBS (Non Uniform Rational B-spline) surface. Using this method, we take only 15 s to make one structure including cutting textures.

Keywords: NURBS surface · Virtual reality · Texture mapping · Image based rendering

1 Introduction and Related Work

There is a study based on real image in driving simulations. These many systems use a route panorama method. A width of a road and a height of driver's eyes are decided to a certain extent. The most important thing is that a distance from a car to buildings on both sides is the shortest. In most simulations, they move a virtual camera keeping a certain height. To keep positional relationship of construction in virtual reality simulation when users move around the system, we need individual stereoscopic model of each construction. In this study, we do simple modeling of stereoscopic structures using image-based rendering [1] and texture mapping on NURBS surface. We need image of constructed model from each view point.

We captured front and top image along the river with Phantom II that is multirotor and camera attached small vessel.

To use one NURBS surface and one combined texture when we generate model of building, we reduce number of textures and polygons which is needed to construct one model. It's simple and need short time and light capacity.

2 Proposed Method

As suitable for image segmentation of marine virtual environment, we improved Grow Cut [2].

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Shown as Figs. 1 and 2, we compress input image horizontally long before labeling, and resize masking image to original size after labeling, we make calculation speed one by three hundred while maintaining the original image resolution.

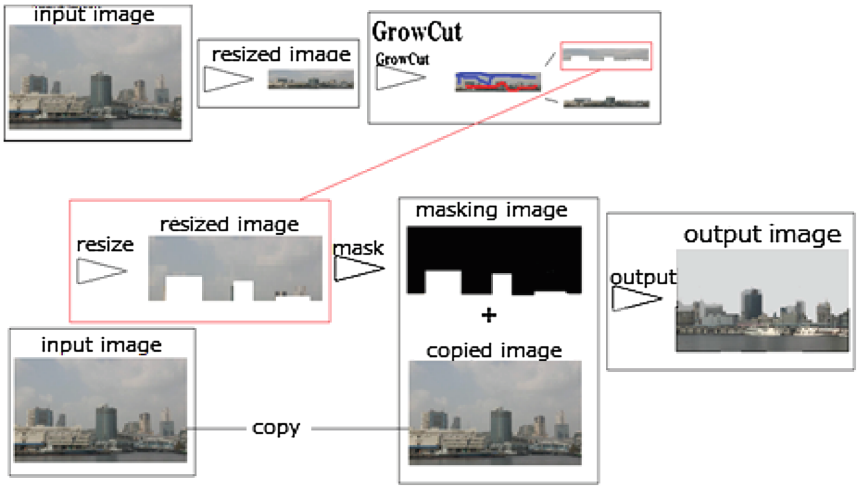

Fig. 1. Grow Cut

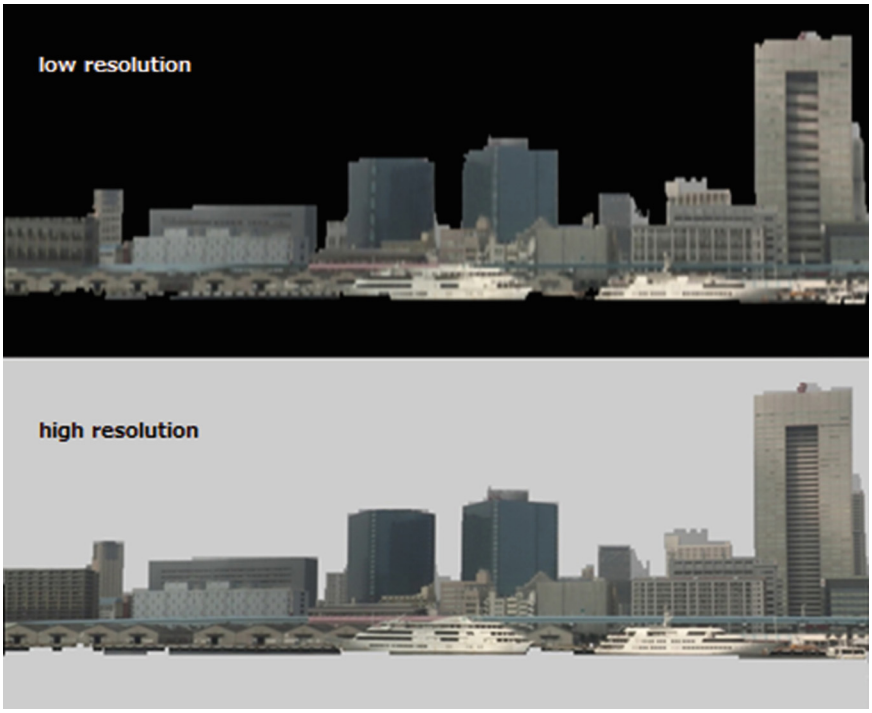

Fig. 2. Comparison of resolution

The reason we compress input image horizontally is to simplify input of restriction because buildings along the river is in a row, so we can write straight input of restriction on compressed image.

We choice NURBS surface to texture mapping. NURBS surface is easy controllable free-form surface. It is parametric and consists from control point and knot vector, like Fig. 3.

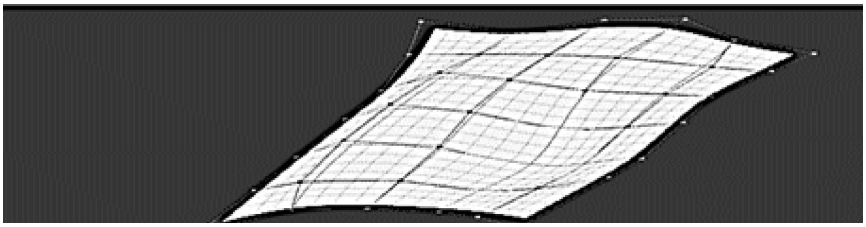

Fig. 3. NURBS surface

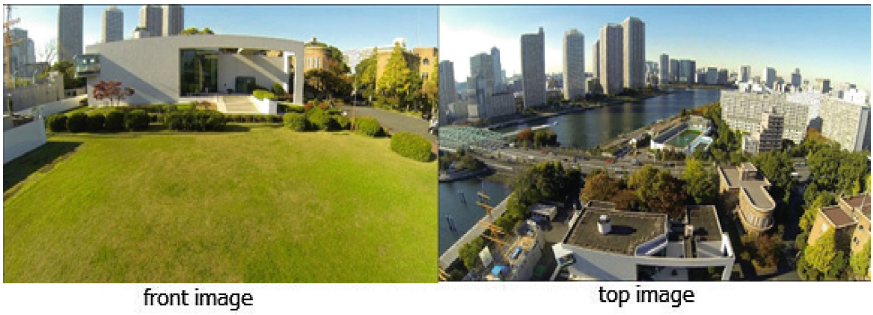

Fig. 4. Front and top image

Since NURBS surface can change any form, we can generate favorite shape. Mapping on the NURBS surface, then move control points, sticked image changes together NURBS surface's shape.

We prepare two images which are front image and top image of constructed building. Figure 4 is the image from Phantom II that flew from the bottom to the top at the "meijimaru square".

As shown in Fig. 5, we need only 15 s to complete texture mapping.

By cutting out some textures, and measure appropriate width, height and depth from texture, we acquire coordinates of control points on virtual space and texture mapping on the NURBS surface which transformed into the form of building.

We cut out front texture and top texture from two images with rectangular selection, and we combine clipped images into one texture like part of upper right of Fig. 6. This texture is made from flipped and resized those images, and red part will be transparency with alpha blending when the model has constructed.

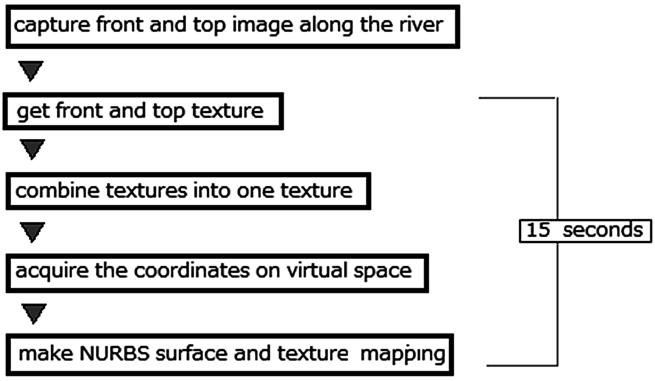

Fig. 5. Series of flow

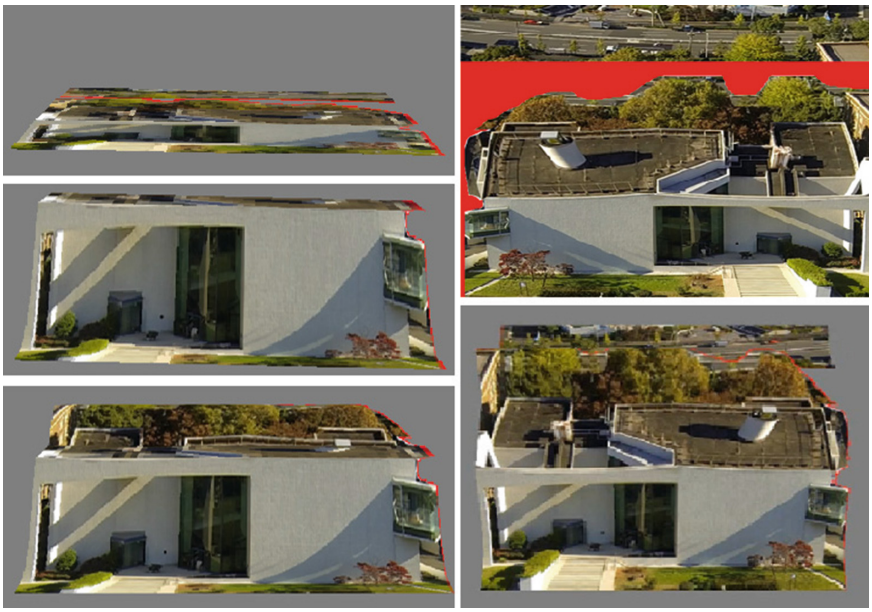

Fig. 6. Generate model

To automatically acquire the coordinates on virtual space of control points which make NURBS surface,

NURBS surface can change its shape into structure of purpose without our help.

With the acquired coordinates of control points, the NURBS surface is pushed to shape of building, like left part of Fig. 6. We take only 15 s to generate one model including time of cutting texture images. We can see the model at the point of view on the diagonal, like lower right part of Fig. 6.

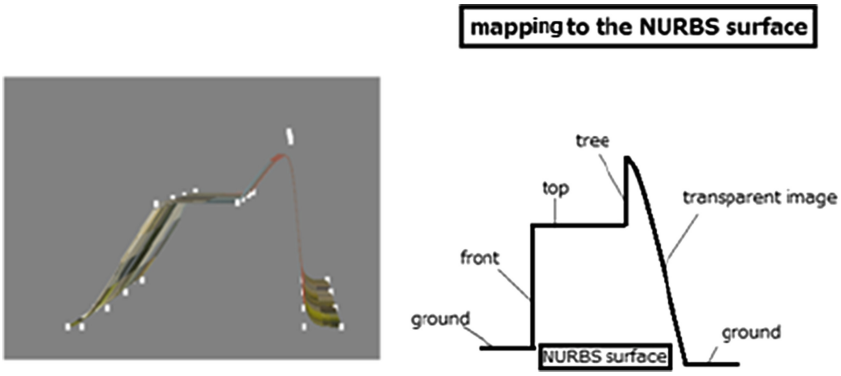

Fig. 7. Model seen from the right side

This 3-dimentional model consists of 4 × 12 control points. To push each surface to the upper, like Fig. 7, we get purpose structures.

Although image-based rendering needs multiplex textures and projection planes to generate one stereoscopic model, this method shows one model with one NURBS surface and one texture.

Figure 8 is other model which is a building along the river. Even though the shape and size of purpose model is different, it's automatically adjusted it to a certain extent.

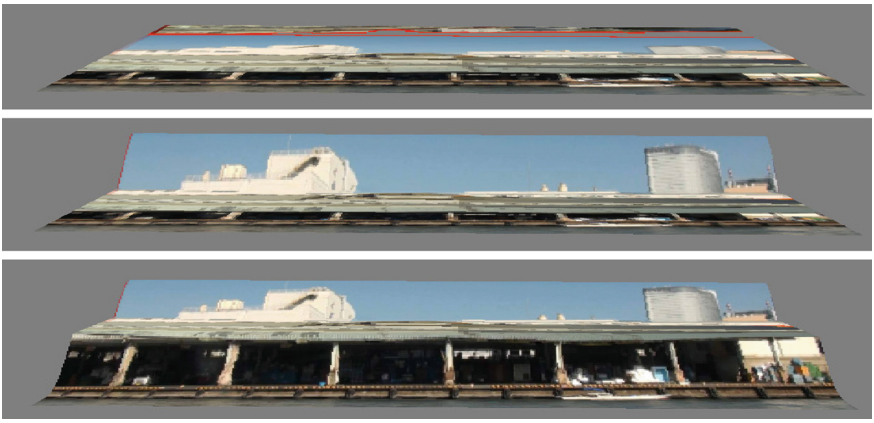

Fig. 8. Model along the river

3 Conclusions and Future Works

In this study, we proposed an efficient method of model construction of wide range virtual reality. Image segmentation is easier by using Grow Cut, and model construction is more quickly by texture mapping on NURBS surface.

Since constructed model by this method is three-dimensional, we can view it from different angles.

It is hard work to modeling a lot of structures along the bay, but using this method, it changes to easy work. All we need is one texture and one NURBS surface, so we don't have to map for one by one textures. This method saves our time, computer's memory and cost.

The generation of virtual environment on a route of ships is available not only to shipping but also in various fields. Before occurring disasters, we can consider measures to watch the environment we captured. Our originality is to generate a system utilizing both entertainment and business. In the future, we generate both sides of model, and aim to improve the quality of model with matrix transformation.

Although we cut textures manually, cutting out texture from original image will become more quickly to recognize front of buildings with Bags of Feature [3], and Deep Learning.

We generate only one model this time, but we will construct more wide area at one time with spreading and pushing out the NURBS surface.

References

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