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3D Model Reconstruction from Single View

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Abstract— In this paper the general problem of 3D surface reconstruction from single View image has been considered with prominence on combined source of information about the surface from image data. The aim is to construct a realistic, freeform wireframe 3D model of an object from a single view. We can easily construct the 3D model from multiple view and different known camera parameters but from the single 2D image it is very difficult without much detail. Single view reconstruction (SVR) is a most ill posed under-constrained problem and relies on cues like shading, texture, occluding contour etc. Here Method is suggested which is used to reconstruct Wireframe 3D model of objects which have symmetric curved surfaces.

Keywords: 3D Reconstruction, modelling, SVR, contour, Silhouette, Texture.

I. INTRODUCTION

In the field of Computer Vision and Graphics, the reconstruction of three-dimensional models of objects from multiple images has been an extensively researched problem. Methods like triangulation and space carving give us an estimate of the depth of a scene, in the presence of multiple images and camera information. For one image however, triangulation (or space carving) cannot be performed. An infinite number of 3D models can be found which project to the object in the image.

In the absence of multiple images, other image cues such as shading, geometry, texture, occluding contour etc. can still help in the retrieval of shape information. Again, a large amount of work has been done in these areas.

Most 3D models are acquired either thorough painstaking modelling on part of a user of a modelling system such as CAD, or through measurement devices such laser range systems. Such software, hardware and human effort is expensive. In many situations, acquiring multiple images is not possible, or practical. Forensic data, virtual paintings (Van Gogh self-portrait), archive photographs of people or towns form a few such examples. For many sketch-based modelling methods the user wants to create rapid 3D prototypes with minimal input. Multiple illustrations involve a lot of input, making the modelling framework less worthwhile. This is why the problem of single view reconstruction is relevant. The fundamental problem in computer vision is to create a partial or even complete 3D model of an object from a set of images. A lot of work has been done in this area and lots of techniques are used for establishment of such modelling. An interesting area of work is ***Single View Reconstruction,*** which is, developing the 3-dimentional model from a single image. The developments in this direction started with the SVR technique proposed by Horry *et al.[1]* which reconstructed the scene in a piecewise planar fashion. Further work was done to improve the accuracy by using multiple vanishing points and vanishing lines [3]. But essentially, these systems focused on planar surfaces. Along with this, several authors demonstrated techniques for reconstruction of special classes of curved surfaces, e.g. surfaces of revolution. Terzopoulos *et al.* [2] proposed a technique wherein the reconstruction is based on the apparent contour of the object in the image. This technique is iterative, and thus tends *to* get stuck in local minima. The technique that we study here is based on forming a linear system for the desired surface using a set of linear constraints on a quadratic objective (energy) function. In the following sections, we describe the surface representation, formation of appropriate constraints and thus forming the linear system which can be solved to obtain the surface points. Also, the reconstruction is done assuming orthographic projection. There are two main effective area of this research in hits paper. First the given 2D image for reconstruction, so how the surface should be represented? And second, how can the image data can be used most effectively to recover this surface representation?

In this paper the I section is for introduction and then the flow of paper as follows: the II for various methods for construction of 3D model then the various methods are described and at last the comparison of that methods are described in the table format.

II. VARIOUS METHODS

From the above method I have proposed a new approach that can be used to generate free form wire frame 3D model of the object from the singe view image.

In this paper we deal with the problem of object reconstruction from single view.

The process method of reconstruction involves the following steps: (i) applying 2D Photo (ii) After inputting the processing like object detection and segmentation and (iii) finding a plausible 3D model for the given image. In this chapter we will take a quick tour of existing methods for different aspects of the problem.

We are going to discuss the various subjects applicable to this area in this paper. First, the existing methods of single view reconstruction of objects in the presence of specific cues like contour, geometry, shading etc. are introduced in (see fig 3.1).

This, along with the discussion of surface representations in is useful for a better understanding of image-based and user-driven information to perform single view reconstruction from image silhouettes.

Colour and texture statistics to group image pixels into super pixels and constellations. In addition to colour and texture, their method uses location, shape and geometry to infer geometric labels (like 'ground', 'sky' etc.) for constellations using models learnt from training images. These labels are then used to 'cut and fold' the image into a pop-up model. The automatic nature of this algorithm naturally means that good reconstruction is produced only for very simple images. However, the information used by this approach is largely based on constellation based methods ignoring the more geometric approaches preceding it.

The popular methods of producing piecewise planar reconstructions exploit the constraints provided by the joint of different planes and constraints for creating pop-up models but fail to incorporate other cues in the form of occluding contours and more global class based priors

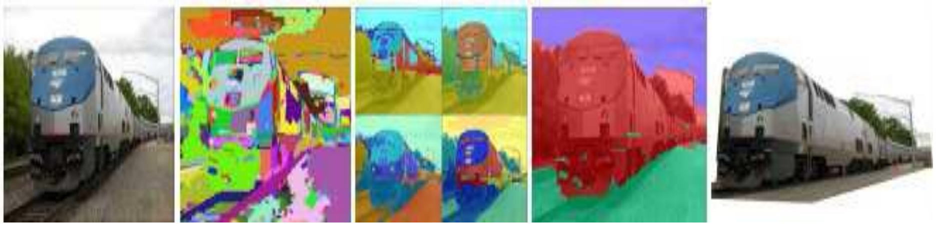

Fig 1: Image -> superpixels -> constellations -> labelled based on models ->3D scene; from Hoiem et al. [12]

III. SKETCH-BASED MODELLING

Sketch-based modelling methods use intuitive and approximate user input for rapid prototyping of objects and are important in graphics and animation.

Zhang et al. [10] (see Fig. 3.4) proposed an approach for Reconstructing high quality, free-form, texture-mapped, 2D scene models (Monge patches) from a single image with arbitrary reflectance properties. It uses a set of user-specified inputs in the form of positions and normal's to create a smooth 3D surface (by minimizing a convex objective function) which satisfies these constraints. The technique is interactive and allows fast reconstruction. The specialty of this system is the use of linear constraints and a convex objective function, which inspires us greatly. The downside is that they construct a 2D representation of the scene User-drawn 2D freeform strokes are used to construct a 3D polygonal surface: it inflates the silhouette using silhouette-medial axis distances and constructs an object of spherical topology. This is a good system for rapid prototyping. It has gestural operations allowing for complex editing of an object. With simple strokes the user can extend or scoop out parts of the object. The ad-hoc inflation process is designed for simple silhouettes and complex topologies cannot be constructed. This representation of smoother surfaces has the side-effect of rounding off sharp corners. Importantly, it allows the user to express complex notions such as cusps and T-junctions and infers the correct parts of the hidden contour from incomplete user-drawn silhouettes. Sketch-based methods eliminate certain issues from the reconstruction process such as reliability in feature detection. Also, there is scope to construct effective user-input environments to ensure maximal output for minimal effort. In the absence of accurate automatic systems, effective sketch-based input mechanisms are important for the purpose of single view reconstruction.

(a) (b)

Fig 2: (a) Zhang et al. [14]: 3D modeling a Van Gogh painting using Zhang's technique. (b) Sketch: A series of strokes is drawn in the film plane in red (left). The salient vertex is projected into the scene thus defining the placement of new geometry (green)

IV. SHAPES FROM TEXTURE (SFT)

Witkin [11] pointed out that the distorting effects of projection must be distinguished from texture properties themselves and proposed a method for reconstruction of planar and curved surfaces. He assumes orthographic projection and uniformity of texture in all directions (isotropy).

An inhomogeneous, marked Poisson point process is used to model the surface texture.

For generic orthographic view and texture, each texture element yields the surface gradient unique up to a two-fold ambiguity. Each image texel can be expressed as an affine transform (with a degree of freedom = 3) of the model texel. By assuming one of the taxes as a model texel, the transforms for the rest can be found. In order to recover the surface, the texture imaging transformation is found at each of a set of scattered points up to a sign ambiguity. Using priors over the surface with an Expectation-Maximization like formulation, the ambiguity of each texture element's transformation is removed, to yield a smooth surface. There is however the need for global models and other cues such as occluding contour. In general, research in SFT methods has taken a backseat in recent times in favor of more class-specific methods with global models and probabilistic treatments.

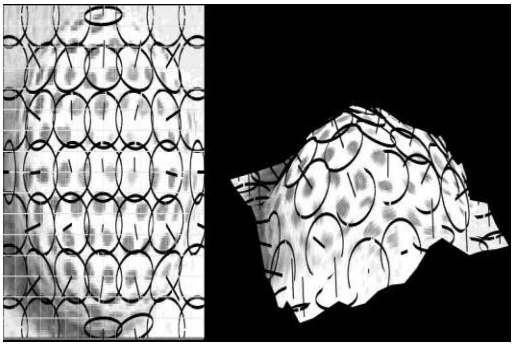

Fig 3: My implementation of [11] is used to reconstruct a golf ball using normal derived from texture.

V. MODELLING FROM SILHOUETTES

Recent advances in single-view reconstruction (SVR) have been in modelling power (curved 2.5D surfaces) and automation (automatic photo pop-up). They extend SVR along both of these directions. They increase modelling power in several ways: (i) They represent general 3D surfaces, rather than 2.5D Monge patches; (ii) They describe a closed-form method to reconstruct a smooth surface from its image apparent contour, including multi local singularities ("kidney-bean" self-occlusions); (iii) They show how to incorporate user-specified data such as surface normal's, interpolation and approximation constraints; (iv) They show how this algorithm can be adapted to deal with surfaces of arbitrary genus. They also show how the modelling process can be automated for simple object shapes and views, using a-priori object class information. They demonstrate these advances on natural images drawn from a number of object classes. [13]

Horry *et al*.'s 1997 "Tour into the picture" [1] might be considered the first SVR system, allowing piecewise planar reconstructions of paintings and photographs. The above systems are restricted to planar scenes. In parallel, reconstruction of special classes of curved surfaces, such as surfaces of revolution and straight homogeneous generalized cylinders was developed by several authors.

By specifying the local surface normal, height, and surface discontinuities, relatively complex scenes could be extracted. However the surface representation was rather limited, being restricted to 2.5D Monge patches. Prasad *et al*. [13] extended this scheme to allow the reconstruction of 3D mesh surfaces of simple topology given simple apparent contour constraints, and providing the entire contour generator is visible.

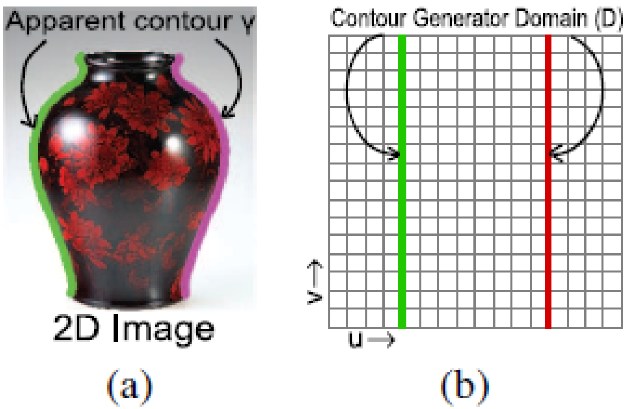

Fig 4: (a) Original Image (b) contour generation domain. [13]

VI. PROPOSED METHOD

From the above method I have proposed a new approach that can be used to generate free form wire frame 3D model of the object from the singe view image. After generating contour generation domain the main problem is how to calculate the depth of this symmetric objects.

Here is the methodology to calculate the depth of given object.

Algorithm:

The very first step in single view reconstruction is to find out the object for which we want to generate the 3-D model. That can be achieved by following step:

Step1: Suppose we have only the object in 2-D photo. Extract the contours of the object.

Step2: First convert the image into gray scale and then convert it into Binary image.

Step3: Then by finding the edges from the image, and relevant edges can be selected.

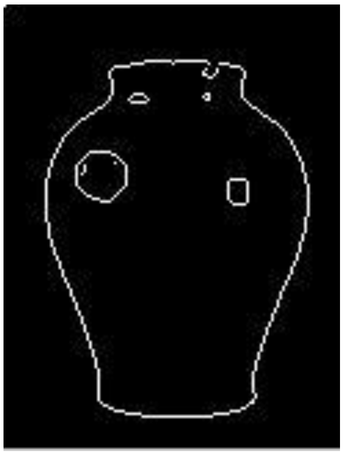

Fig 5: Edge detection

Step4: Then find out the connected component and do the labeling. So the segmented image can be easily found.

Step5: Now find out the Contours from that segmented image. For that get the feasible points from that image.

Step6: Then Find out left contour and right contour. Compare each row and each column and whenever we get pixels equal to 1 then store it in separate array. Similarly do for right contour.

Step7: Then plot the both left and right contour.

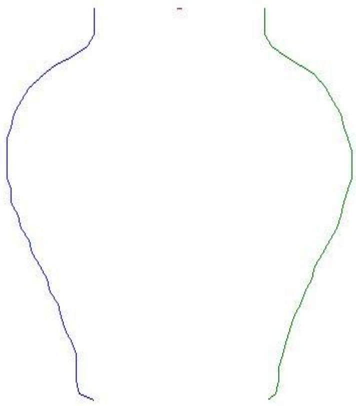

Fig 6: Left and Right Contour

Step8: After plotting the contour now find out the radius from bcoz we assumes that object is symetric object.

$$R = rc\ (i, 2) - lc\ (i, 2)$$

Then calculate the each and every center pixel between the Contour lines.

$$Qy = ((rc\ (i, 2) - lc\ (i, 2))/2) + lc\ (i, 2)$$

Step9: After getting that depth take the any of the either left or right contour points and draw the pixels which generates the 3d wireframe model.

Step10: Thus we have got the 3D wireframe model from the single view.

VII. RESULTS

Fig 7 (a) Original Image (b) 3D Model

VIII. CONCLUSION

In this paper, From above described method we can conclude that there are various methods for constructing the 3D model from single image. All methods have their own merits and demerits. But the proposed method is used to generate freeform wireframe 3D model for symmetric images from single view. By results we can conclude that we can generate 3D model from single view by using this approach easily and efficiently in less time. Again the some complexity issues are there but still we can construct 3D model for simple one object.

REFERENCES

[1] Youichi Horry, Ken-ichi Anjyo Kiyoshi Arai* Tour Into the Picture: Using a Spidery Mesh Interface to Make Animation from a Single Image. Hitachi, Ltd.

[2] D. Terzopoulos, A. Witkin, and M. Kass. Symmetry-seeking models for 3D object reconstruction. Proc. ICCV, pages 269–276, 1987.

[3] A. Criminisi, I. Reid, and A. Zisserman. Single view metrology. IJCV, 40(2):123–148,Nov 2000.

[4] M. Kass, A. Witkin, and D. Terzopoulos. Snakes: Active contour models. In Proc.ICCV, pages 259–268, 1987.

[5] D. Liebowitz. Camera Calibration and Reconstruction of Geometry from Images.PhD thesis, University of Oxford, Dept. Engineering Science, Jun 2001.

[6] D. Liebowitz, A. Criminisi, and A. Zisserman. Creating architectural models from images. In Proc. EuroGraphics, volume 18, pages 39–50, Sep 1999.

[7] D. Liebowitz and A. Zisserman. Metric rectification for perspective images of planes. In Proc. CVPR, pages 482–488, Jun 1998.

[8] D. Liebowitz and A. Zisserman. Combining scene and auto-calibration constraints. In Proc. ICCV, Sep 1999.

[9] P. Sturm and S. J. Maybank. A method for interactive 3D reconstruction of piecewise planar objects from single images. In Proc. BMVC., 1999.

[10] L. Zhang, G. Dugas-Phocion, J.S. Samson, and S.M. Seitz. Single view modeling of free-form scenes. In Proc. CVPR, pages I:990–997, 2001.

[11] A. P. Witkin. Recovering surface shape and orientation from texture. Artificial Intelligence, 17(1–3):17–45, Aug 1981.

[12] D. Hoiem, A. A. Efros, and M. Hebert. Automatic photo pop-up. ACM Trans. Graph., 24(3):577–584, 2005.

[13] Mukta Prasad, Andrew Zisserman and Andrew Fitzgibbon : Single View Reconstruction of Curved Surfaces University of Oxford, U.K.

[14] Mukta Prasad, Andrew Zisserman and Andrew W. Fitzgibbon : Fast and Controllable 3D Modelling from Silhouettes. Robotics Research Group, University of Oxford Microsoft Research, Cambridge.

