AUTOMATION OF BASIC BUILDING BLOCKS FOR GEOMETRIC MODELLING

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Abstract

Photo-realistic 3D computer models of real objects and scenes are key components in many 3D multimedia systems. The quality of these models often has a large impact in the acceptability of applications like virtual walk-throughs. Although the rendering of 3D computer scenes can often be performed in real-time even on hand-held devices, the creation and design of 3D models with high quality is still time consuming and thus expensive. This has motivated the investigation of a large number of methods for the automatic acquisition of textured 3D geometry models from multiple views of an object. The main research work in this problem can basically be divided into two different classes of algorithms. The first class of 3D model acquisition techniques computes depth maps from two or more views of the object. Here, depth is estimated from changes in the views caused by altering properties like position of cameras (shape from- stereo, structure-from-motion), for each view, a depth map can be computed that specifics for each pixel the distance of the object to the camera. Since the object is only partially represented by a single depth map due to occlusions, multiple depth maps must be registered into a single 3D surface model. In a second class of reconstruction methods which relies on a recovering structure of the scene.

Key words: 3D model, Stereo calibration, Structure from motion, 3D Reconstruction, feature Extraction of Images, Edge detection, contour detection.

I. INTRODUCTION

3D modelling is the process of developing a mathematical representation of any three-dimensional surface of object (either inanimate or living) via specialized software. The product is called a 3D model. It can be displayed as a two-dimensional image through a process called 3D rendering or used in a computer simulation of physical phenomena. The model can also be physically created using 3D printing devices. In this paper, we develop a new interactive system for modelling architectural scenes from an unordered collection of photographs. We use computer vision techniques throughout to accelerate the modelling process. With our system, users can quickly generate a detailed textured 3D model of a scene.

Recently, creating models directly from photographs has received increased interest in computer graphics. Since real images are used as input, such an image based system has an advantage in producing photorealistic renderings as output. Since real images are used as input, such an image-based system has an advantage in producing photorealistic renderings as output.Computer vision deals with automatic extraction of various kinds of information from images. The main aim of machine vision is to let machine visualize the world as we humans do and let them interact it.

One of the purposes of computer vision is the creation of computer models of 3D objects from its digital images. In general, image processing works on 2D images of an object so it misses the depth parameter of that object. Depth information of an object is very useful and plays a significant role in many decisions. The main aim of 3D reconstruction is to regenerate that depth information from simple 2D images of an object. 3D reconstruction produces a 3D model as an output, which could be stored and modified in future. Nowadays computer graphics allows to render realistic images of the 3D world. However, before such images can be generated, graphics models of the world must be available. Traditionally, these models where obtained using 3D modelling packages. This is a very time consuming process and the achievable level of detail and realism is limited. Therefore, more and more 3D models are obtained by samplingthe world. From the early beginnings of photography, pictures have been used to obtain 3D measurements of the world. In the second half of the 19th century photographs were already used for making maps and measuring buildings. This technique is called photogrammetry. It has many limitation because of the loss of many features due to noise present in the the image.

"Digital image processing is the processing of images which takes input as an image and produces image as an output". It is asubfield of digital signal processing , and digital image processing has many advantages over analog image processing; it allows a much wider range of algorithms to be applied to the input data, and can avoid problems such as the build-up of noise and signal distortion during processing.With the advances of image processing and computer vision, techniques being developed are no-longer limited to plane vision. Instead, stereo vision system has become the research of interest in many areas because of its ability to yield the depth information similar to human vision.

Nowadays, computer vision based 3D Reconstruction is gaining importance, because of its better visualization, low cost and accurate depth measurement. In recent research, many techniques for 3D Reconstruction and depth measurement has been developed.

II.RELATED WORK

The problem of 3D modelling from images and video has received tremendous interest in the computer graphics and vision communities. The process of recovering 3D structure from 2D images and the process of rendering such recovered structures is a subject receiving increased interest in computer graphics. [3] Although no general technique exists to derive models from images, four particular areas of research have provided results thatareapplicable to the problem of modelling and rendering architectural scenes. They are: Camera Calibration, Structure from Motion, Stereo Correspondence, and Image-Based Rendering. [1] Nowadays computer graphics allows to render realistic images of the 3D world. However, before such images can be generated, graphics models of the world must be available. These models where obtained using traditional modelling approach. This is a very time consuming process and the achievable level of detail and realism is limited.

On the other hand, Dick et. al. [1] showed that a probabilistic model-based method with appropriate priors could also be used to reconstruct buildings. While these results are impressive, they require dense photo collections and their quality tends to suffer if either the camera motion is degenerate or the scenes lack adequate textures. [3] These limitations can be overcome by having a user in the loop to interactively guide the geometry creation image-based modelling systems designed for modelling architectural scenes which later gave rise to a commercial product called Canoma. It provides a set of parameterized 3D primitives such as cuboids, prisms, and pyramids. The user selects the appropriate primitive to model a part of the scene and then aligns it by pinning its vertices or edges to specific locations in the different photographs. These systems often require the user to manually specify correspondences of geometric primitives in multiple photographs although single-view reconstruction is sometimes possible in special cases using symmetry or vanishing point constraints. Adding many photographs can be quite laborious in these systems, so only a few well-planned photographs are typically used. The approach we are implementing in this paper takes advantage of the structure in architectural scenes so that it requires only a parse set of photographs along with applying enhancement techniques on it . For example, our approach has yielded a virtual fly-around of a building from standard photographs.

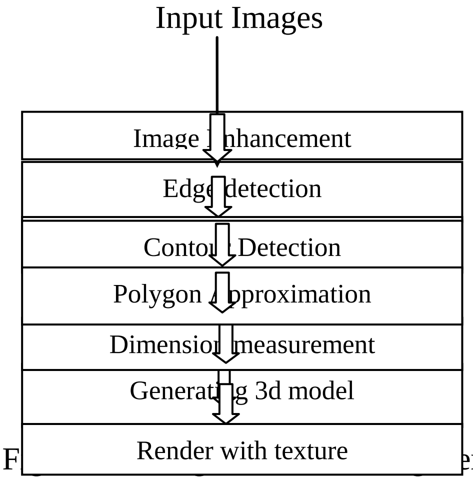
III. PROBLEM STATEMENT

The problem we have focussed on is to allow a computer to automatically generate a realistic 3D model when provided with a sequence of images of an object or scene. This problem can be divided in a number of smaller problems.

IV. OVERVIEW OF WORK

This work mainly aims to produce a 3D model with less time consumption rather than the existing approaches and concentrates on depth recovery in 2D input images with less user interaction to generate a 3D visualizing model. Overview of the work describes a brief idea about generating a model with step by step in detail and also the techniques that are needed to build the 3D model with its dimension measurement by depth recovery process.

Figure 4.1 shows the overview of the overall work These are main important stages in generating a 3D model of any image with its 2D images as an input.



F[illegible]eration

V. IMPLEMENTATION DETAILS

Details of the implementation can be summarized as follows.

A. Image enhancement :

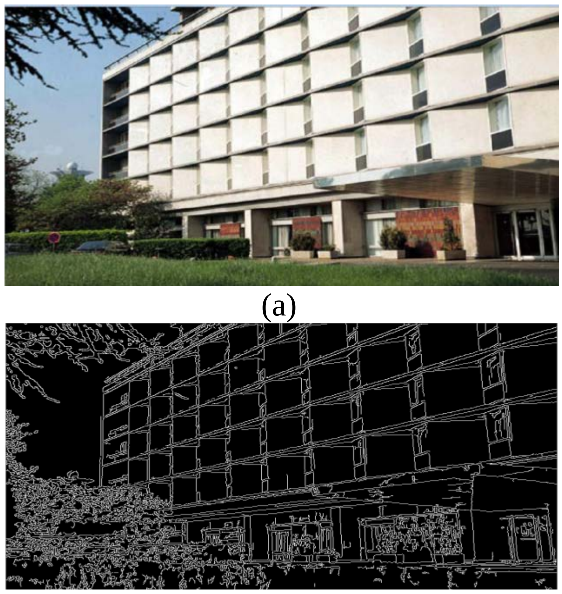
After capturing a set of images needed for generating a model it follows the different image enhancement techniques like image smoothing ,sharpening of images and etc so that it helps us to reduce noise present in the images there in turn to produce noise free images to get the desired outcome from those images. To perform a smoothing operation we will apply a *filter* to our image. The most common type of filters are *linear*, in which an output pixel's value (i.e. g(i,j)) is determined as a h(k,l) is called the *kernel*, which is nothing morethan the coefficients of the filter. weighted sum of input pixel values (i.e. : f(i+k,j+l))

$$g(i,j) = \sum_{k,l} f(i+k, j+l)h(k,l)$$

h(k,l) is called the *kernel,* which is nothing more than the coefficients of the filter.Sharpening is the process of creating or refining a sharp edge of appropriate shape on a tool or implement designed for cutting. Sharpening is done by grinding away material on the implement with an image substance harder than the material of the implement, followed sometimes by processes to polish the sharp surface to increase smoothness and to correct small deformations without regrinding.

B. Edge detection :

This is the second important step in this work , after enhancing the features it is easy to detect edges or the boundary regions to extract the shapes, ex: polygons shapes. In this work we areusing canny edge detection [8][9]because canny edge detector is the optimal method. Canny's aim was to discover the optimal edge detection algorithm.



(a)

(b)

Figure 5.1.1: (a) Original image (b) Resultant image after canny edge detection.

In this situation, an "optimal" edge detector means:

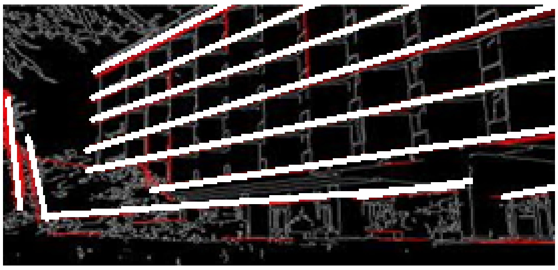
i. Good detection – The algorithm should mark as many real edges in the image as possible.

ii. Good localization – Edges marked should be as close as possible to the edge in the real image.

iii.Minimal response – A given edge in the image should only be marked once, and where possible, image noise should not create false edges.

Another such edge detection technique is the use of hough transforms to detect the edges. The Hough Transform is a global method for finding straight lines (functions) hidden in larger amounts of other data. It is an important technique in image processing. For detecting lines in images, the image is first binarised using some form of thresholding and then the positive instances catalogued in an examples dataset. This is an efficient technique for detecting long edge segment with the isolation of the image features.

(a)



(b)

Figure 5.1.2: (a) Source building image (b) resultant image after applying hough transform.

The algorithm for the Hough transform can be expressed as follows:

1. Find all of the desired feature points in the image.
2. for each feature point
3. For each pixel *i* on the target's boundary
4. Get the relative position of the reference point From *i*
5. Add this offset to the position of *i*
6. Increment that position in the accumulator
7. Find local maxima in the accumulator.
8. If desired, map each maxima in the accumulator back to image space using the target boundary table.

Algorithm 5.2.1: Generalized Hough transform algorithm for line detection .

C. Identifying Basic Building Blocks:

In this stage a sequence of such edges are identified to know whether it is a polygon . This is done through the contour detection method.

1 .Contour Detection algorithm

It is an iterative end-point fit algorithm or the split-and-merge algorithm.Contour detection is a major issue in image processing. For instance, in classification and segmentation, the goal is to split the image into several parts. This problem is strongly related to the detection of the connected contours separating these parts. It is quite easy to detect edges using local image analysis techniques, but the detection of continuous contours is more complicated and needs a global analysis of the image.Problem after edge detection is we just get an image with all those points on the contour as 1 while all the others as 0,we need to get the coordinates of those 1 pixels (vertices).

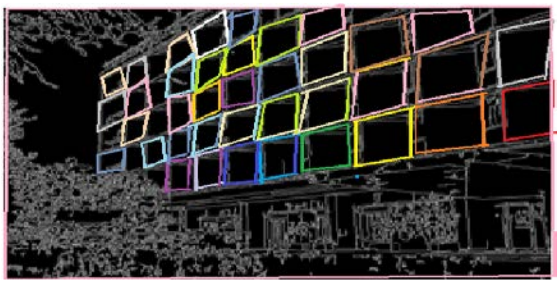
The algorithm can be summarized as follows.

1. Find all of the desired feature points in the image.
2. For each feature point and its index
3. For each pixel jon the target's boundary
4. Find the maximum distance $\varepsilon > 0$point from j
5. For each j to (length(PointList) - 1)
6. Find distance d = PerpendicularDistance of the first and the end point
7. Increment the position in the accumulator
8. If max distance is greater than epsilon, recursively simplify.
9. Find distance d=PerpendicularDistance of the first and the end point
10. Build the result
11. Return the result

Algorithm 5.3.1: Generalized Douglas - peucker algorithm for contour detection.

After performing contour detection polygon shapes are identified by approximation of shapes.

(a)



(b)

Figure 5.3.1: (a) Original image (b) Resultant image after contour detection for detecting polygonal shapes using polygon approximation.

D. Dimension Measurement :

This is the very important and the time consuming stage in building a 3D model. Input images taken are 2-dimensional images captured from a monocular camera means there is a loss of depth information in it so to recover that depth information we need a process called calibration. There are different methods in calibration still we are working on it.

5.5 Generating 3D Model :

In this stage a model with depth information i.e a 3D model is generated using hough transform results , [5] [6] contour detected points along with graphical library like OpenGL with specific image points automatically than generating it manually so that the result is more realistic than the input images.

5.6 Render with Texture:

This is the last stage in 3D model generation after generating a model the plane shapes are wrapped by the images over it that process is called "texturing". [7]After applying texture the model is rendered with different viewpoints with user interaction.

VI.CONCLUSION

In this work we can conclude that, automating the basic building blocks for geometric modelling concepts is simple compare to other existing technique with very low loss of image info in recovering image data and takes less time consumption in producing a better results. It also satisfies the automatic recovery of edges and shapes than any other manual approaches.

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