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Three-Dimensional Face Reconstruction From a Single Image by Neural Network

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Abstract:

Construction of a 3-D face model from a 2-D face image is fundamentally important for face recognition and animation because the 3-D face model is invariant to changes of viewpoint, illumination, background clutter, and occlusions. Given a coupled training set that contains pairs of 2-D faces and the corresponding 3-D faces, we train a novel Neural network (Feed Forward Back Propagation)to recover the 3-D face model from a single 2-D face image. The particular face can be reconstructed by its nearest neighbors, we can assume that the linear combination coefficients for a particular 2-D face image reconstruction are identical to those for the corresponding 3-D face model reconstruction. Therefore, we can reconstruct a 3-D face model by using 2-D face image based on the Neural networks.

I.INTRODUCTION

Reconstructing a 3D model from a set of images is a popular field of work in computer vision. Scene reconstruction involves building 3-D models of scenes, given several 2-D photographs of the scenes. It has its applications in the field of virtual reality, tele-presence, and visual navigation.

3-D scene reconstruction has been carried out for many years from now and many algorithms have been proposed so far. The improved GVC algorithm [13] that has been proposed takes into the account histogram based consistency checks and edge detection. The Generalized Voxel Coloring of Culbertson and Malzbender [3], (GVC) generalises Space Carving so that all
views can be considered simultaneously, rather than with separate passes. It removes the camera positioning restrictions that existed in the original voxel coloring algorithm.

Any reconstruction algorithm is based on certain rules that specify whether the surfaces or regions shown in the images should be represented in 3-D reconstruction or not. One of the rules is based on color consistency. This paper talks about histogram consistency check that is well suited for characterising multi modal distributions of color sets. This measure has its own advantages over other consistency checks such as the ones based on standard deviation, means and variances. This paper highlights those advantages and discusses this photo consistency check in detail. It proposes a two stage consistency check where at first stage various sets of pixels belonging to the different footprints of a particular voxel are compared for similarity and consistency. In case the consistency holds, voxel is kept in the 3-D model, else it is declared inconsistent. At the second stage, all the voxels that were declared inconsistent at stage one, are re-evaluated for edges and other features to test whether the regions that voxel projects onto contain edges or not. In case it does, voxel is declared consistent, else it is carved out. Finally, all the voxels that are consistent, are kept in the 3-D reconstructed object, others form a part of the background. This paper discusses the improved GVC 2-stage consistency check algorithm in detail and the role of histogram measure in detail.

II.PREVIOUS RELATED WORK

Various consistency measures have been using for image based rendering algorithms in the past. When reconstructing a scene using a reconstruction algorithm, there are two key factors that affect the quality of the reconstructed model. The first is the visibility that is computed for the voxels. The second factor is the test that is used to judge the photo consistency of voxels. The consistency test just can be thought of as being too strict for declaring voxels that belong in the model to be inconsistent. Tests can also be too lenient, declaring voxels to be consistent when they do not belong in the model; this can lead to voxels that appear to float over a reconstructed scene. A single consistency test can simultaneously be both too strict and too lenient, creating holes in one part of a scene and floating voxels elsewhere. In most space carving implementations there has been an implicit assumption that the pixel resolution is greater than the voxel resolution—that is, a voxel

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projects to a number of pixels in at least some of the images. We believe this is reasonable and expect the trend to continue because runtime grows faster with increasing voxel resolution than it does with increasing pixel resolution. We make the assumption in this section that the scenes being reconstructed are approximately Lambertian, and we use the RGB color space, except where noted. Most of the color consistency checks require a threshold value. One of the earlier methods used was the method of standard deviation. Using standard deviation as a photo consistency measure is proposed by Seitz and Dyer.

III.PROPOSED SYSTEM

We are concerned about only the object, so we don't want region outside the object. So, we are going to find the edges of the object in the given 2D Image. A feature is defined as an interesting part of an image. It is an most important step in processing an image. There are many types of features available in an image like edges, corners and ridges. We are going to use corner because edge detection intern uses corner detection as the primary model. Harris corner method is used to detect the corners in the 2D-Image.

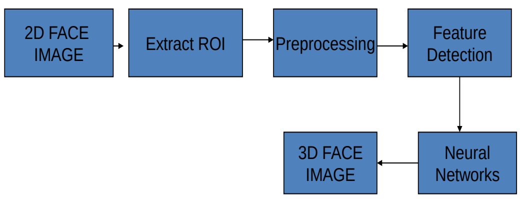


FIGURE 1:BLOCK DIAGRAM

3.1.Harris Corner method:

Step1:
Compute x and y derivatives of the 2D-Image.

$Ix=Gx*I;Iy=Gy*I;$

Step2:
Compute product of derivatives at every pixel.
$Ix^2=Ix*Ix;$
$Iy^2=Iy*Iy;$
$Ixy=Ix*Iy;$

Step3:
Compute the sums of the products of the derivatives at each pixel;
$Sx2=G*Ix^2$
$Sy2=G*Iy^2$
$Sxy=G*Ixy;$

Step4:
Define at each pixel(x,y) the matrix

$$H(x,y)= \begin{matrix} Sx2(x,y) & Sxy(x,y \\ Sxy(x,y) & Sy2(x,y) \end{matrix}$$

Step5:
Compute the response of the detector at $R=Det(H)-K(H)^2$

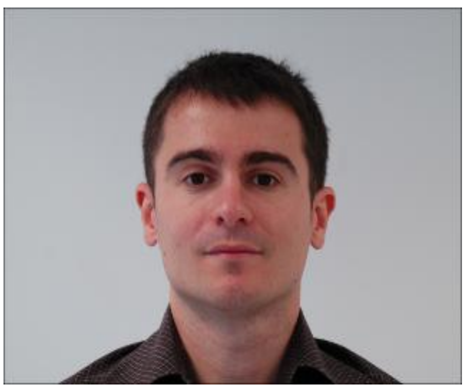
Step6:
Threshold on value of R .If it exceeds the predefined value mark that pixel.

3.2.Neural Networks:

The back propagation algorithm is used in layered feed-forward ANNs. This means that the artificial neurons are organized in layers, and send their signals "forward", and then the errors are propagated backwards. The network receives inputs by neurons in the input layer, and the output of the network is given by the neurons on an output layer. There may be one or more intermediate hidden layers. The back propagation algorithm uses supervised learning, which means that we provide the algorithm with examples of the inputs and outputs we want the network to compute, and then the error (difference between actual and expected results) is calculated. The idea of the back propagation algorithm is to reduce this error, until the ANN learns the training data. The training begins with random weights, and the goal is to adjust them so that the error will be minimal.

IV.SIMULATION RESULTS

INPUT IMAGE



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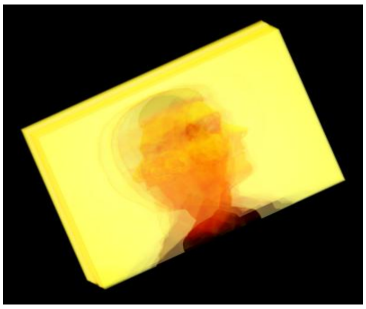
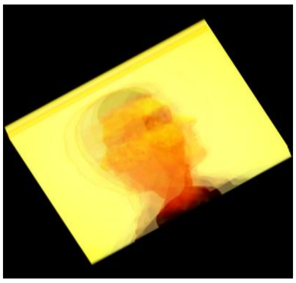
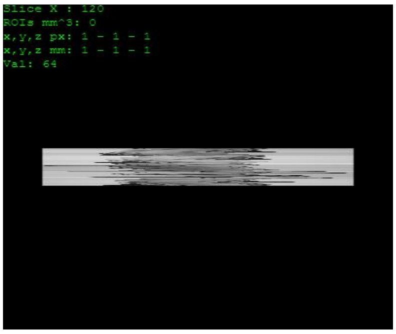
3D Viewer Screenshot:



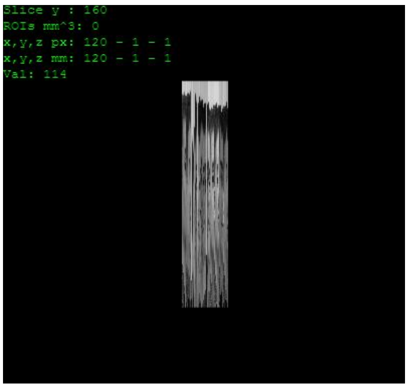
3D Viewer Screenshot



X slice view



Y slice view



Performance Analysis:

Methodology	Time Cost
Radial NN	125 sec
Feed Forward Back Propagation NN	15 sec

V.CONCLUSION

The given single 2D input image was reconstructed into 3D face image by using Back Propagation Neural Networks. The proposed Neural network (Back Propagation Neural Network) to reconstruct a 3-D facial shape from a single 2-D image is used. The neural network discovers the intrinsic features of 2-D face images and 3-D faces, which are constrained to be identically distributed, and the nonlinear mappings between faces and their intrinsic representations are also learned. Furthermore, a face can be reconstructed by a linear combination of its neighbors. The combination coefficients obtained from the intrinsic representation of a given 2-D face image can be utilized to estimate the intrinsic representation of its 3-D face since they have identical distributions. In order to conduct experiments to evaluate our method by comparing it with C-RBF and example-based methods. We also apply the model trained on the BU3D face database on images outside the database. The experiment results demonstrate that our approach is quite effective.

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