From Photo to 3D-Printed Model

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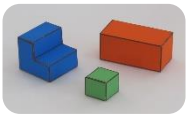
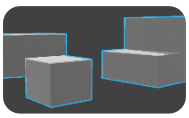
MOTIVATION

As one of the most cut edge technology, 3D print becomes a source of innovations due to its flexibility and relatively low-cost immediately after its commercialization. However, constructing a 3D printable model usually involves complicated operations in business software and highly professional skills. In order to make this powerful technology truly available to general business and daily life, we have worked out a solution to print out 3D objects given 2D photos which enables beginners to enjoy the fruitfulness of 3D print in one-click.

INTRODUCTION



Take a photo.



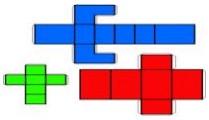
Reconstruct the 3D-model.

Print it out!

FROM PHOTO TO 3D-PRINTED MODEL

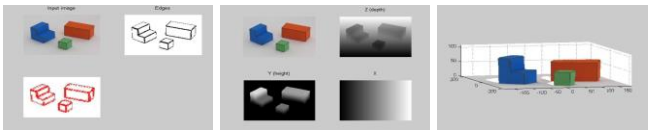
This section contains a detailed protocol of the idea to demonstrate its feasibility and viability.

A. Take a Photo



Due to the limitation of accuracy, we expect the photo to be simple. Specifically, the photo should be taken within a plain context (e.g. white paper or yellow wall) to avoid interference, parallel lines should remain parallel in photo by avoid taking it from an abnormal angle, and the object itself should not be too complicated.

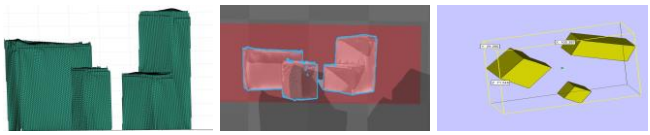
B. From Photo to 3D-Surface



By applying simple inference scheme[1]:

for edges $\partial Y/\partial(-n_y,n_x) = 0, \partial Y/\partial y = 1/cos(\theta)$, for planar faces $\partial^2 Y/\partial x^2 = \partial^2 Y/\partial y^2 = \partial^2 Y/\partial y \partial x = 0$. We can detect edges, planar faces and then reconstruct the shape in 3D coordinate from graph in 2D coordinate based on simple information and strong assumption.

C. Restore 3D-Object from 3D-Surface



Three files containing the X,Y,Z coordinates information respectively are loaded into workspace. We first seal the 3D image by a trivial adjustment of the matrices. Then we use a function[2] to triangulates the gridded data into a triangular surface which match the STL-property and write it into a STL file. Customized modifications can be done on this file with SolidWorks or Blender.

D. 3D-Print

IMPROVEMENTS

In 3D surface reconstruction, by simple inference scheme, we can deal with the simple-world case, while with the help of Canny edge detector[3] and trained feature extraction model (training data required), we would be able to achieve a better reconstruct quality and looser limitation. We also expect color supported 3D-print and multi-photos reconstruction in the near future.

Complete implementation is done and open-sourced here: ***https://github.com/anchen1011/photo-to-3D-model***

[1]MIT CSAIL, Advances in Computer Vision.

[2]Sven, MathWorks Community.

[3]Perona, Pietro, and Jitendra Malik. "Scale-space and edge detection using anisotropic diffusion."