Automated Stereoscopic 3D Image Reconstruction for the Web

Judit Tövissy, Sándor Kopácsi
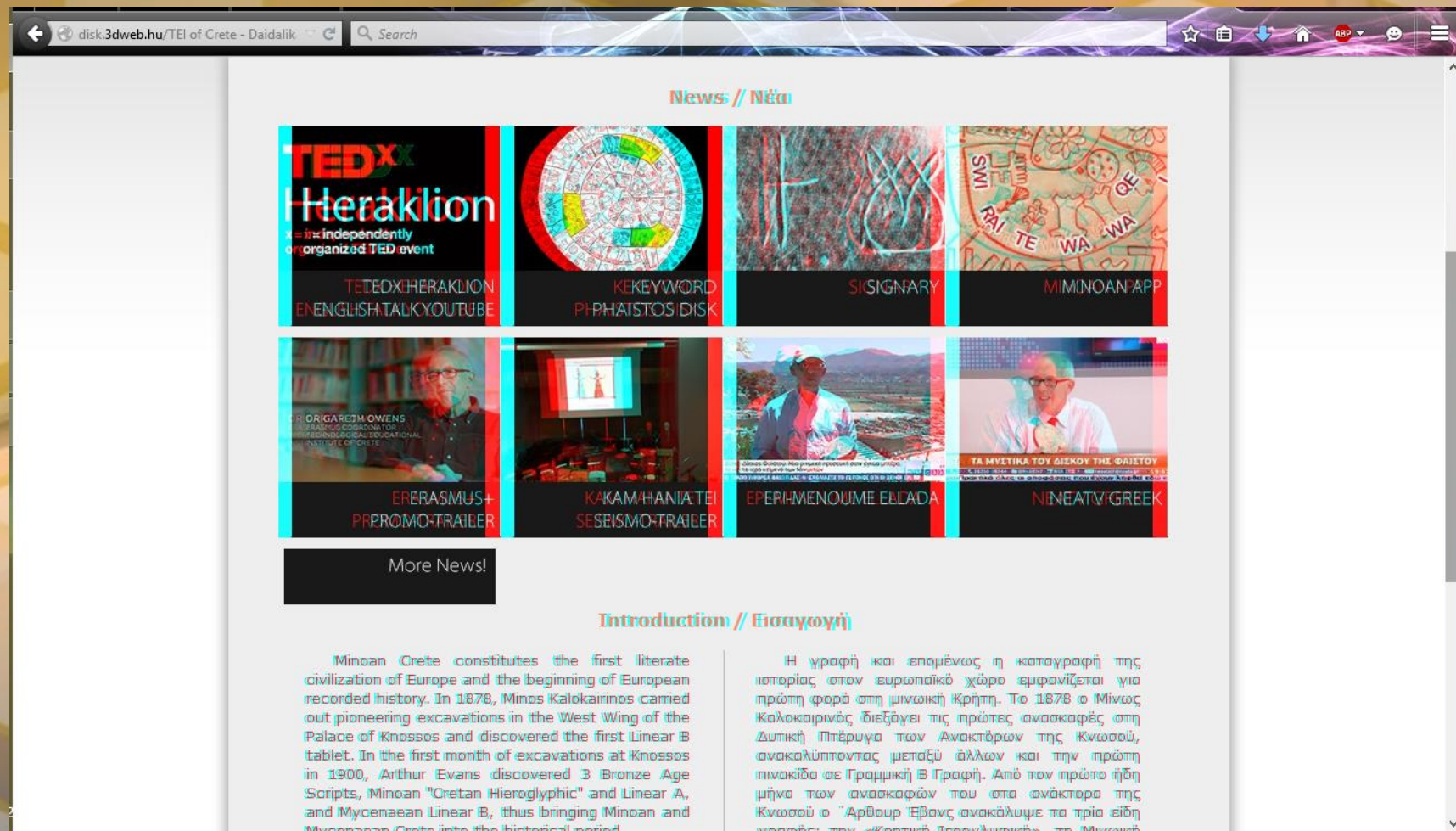
Dennis Gabor College, Budapest, Hungary

Heraklion, June 18-21 2015

Stereoscopic 3D on the Web

- Project started in Hungary, in 2012

- Collaboration between DGC and HAS ICSC

- www.3dweb.hu

Phaistos Disk

TEI of Crete
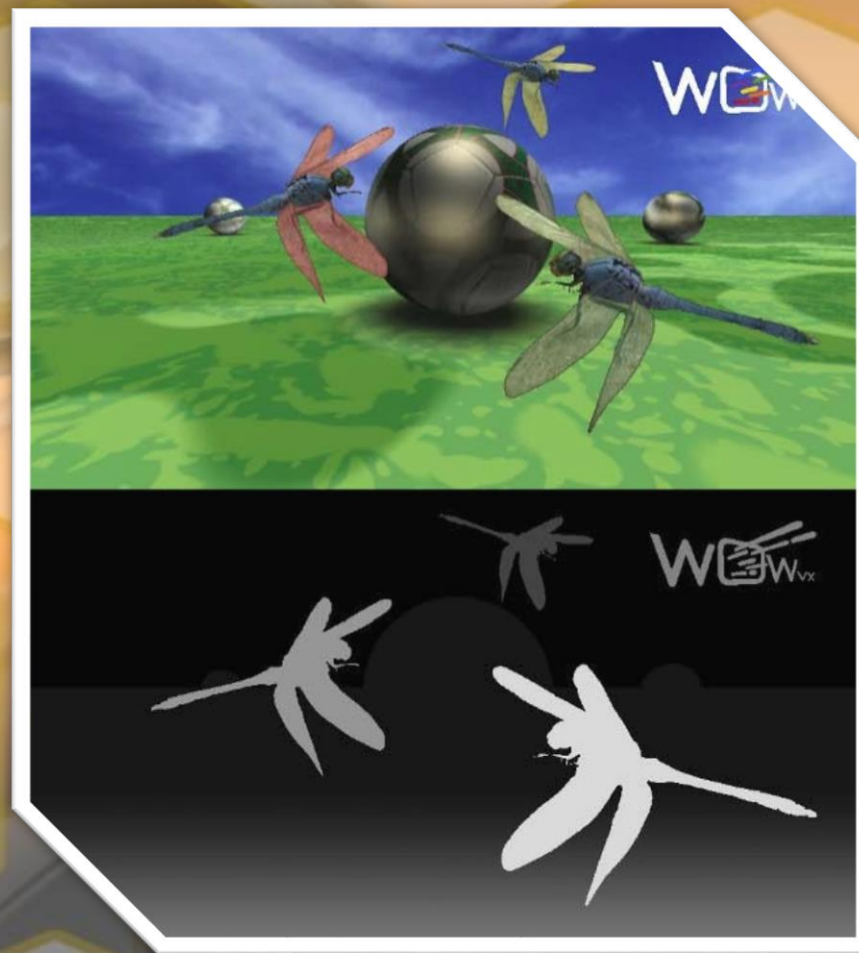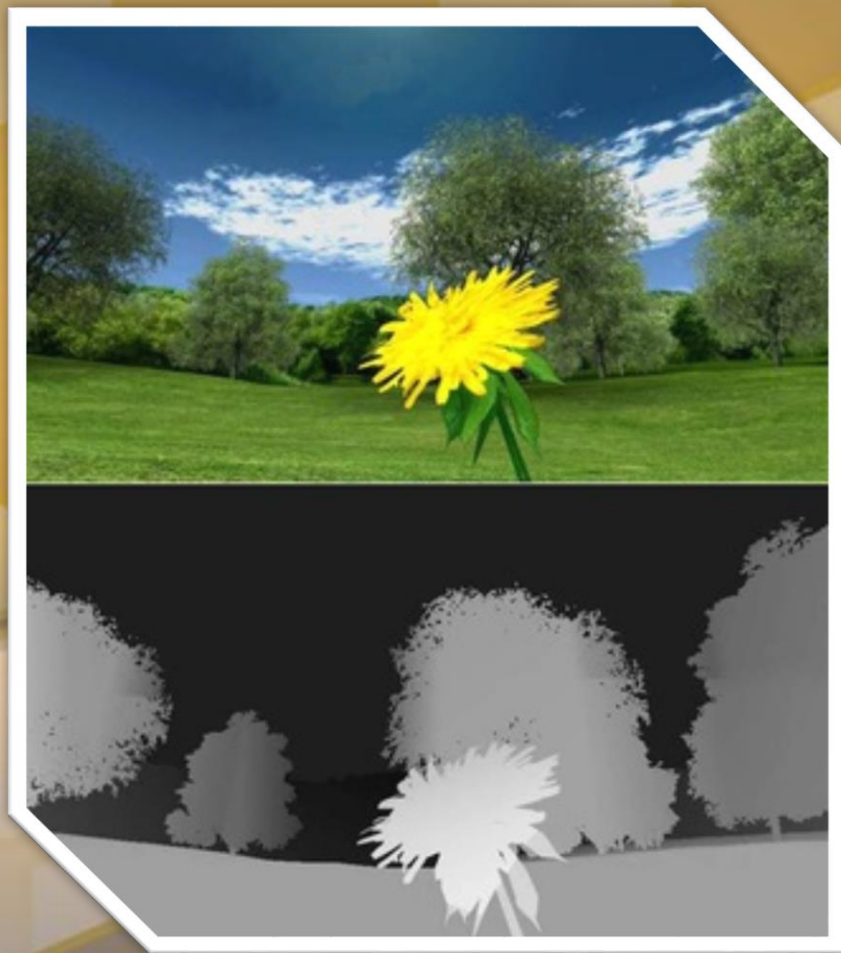Technological Educational Institute of Crete

disk.3dweb.hu

Phaistos Disk

MINOAN APP

ERASMUS+ PROMO TRAILER

KEYWORD PHAISTOS DISK

TEDX HERAKLION ENGLISH TALK YOUTUBE

# Distance Representation with Depth Maps

Depth Map Generation for 2D Images

- Issue:
  - Reverse-engineering of an entire dimension is non-trivial.
  - Reconstruction needs to be based on agreed upon guidelines

- Assumption #1:
  - Objects **in focus** are likely to be closer to the camera than others.

- Assumption #2:
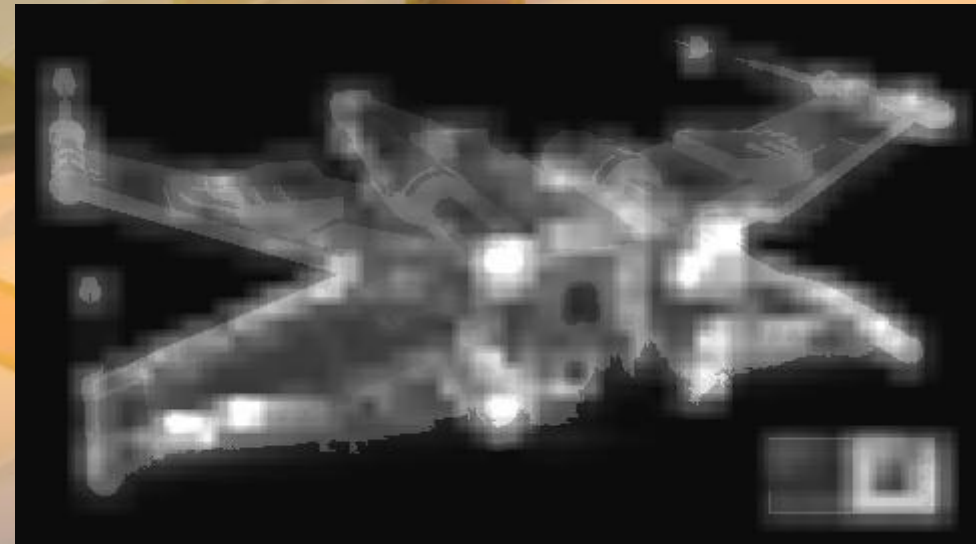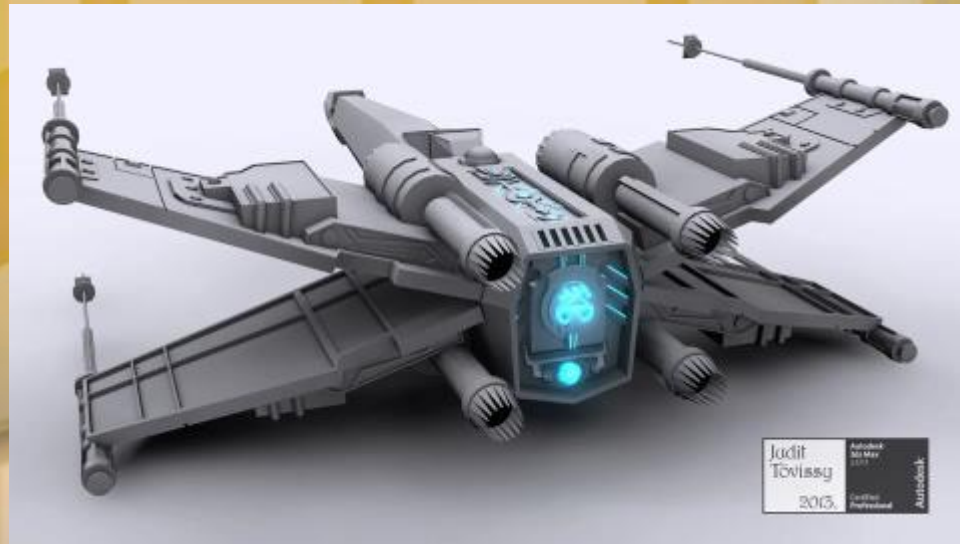 - Objects that are **brighter** are likely to be in the foreground of an image.

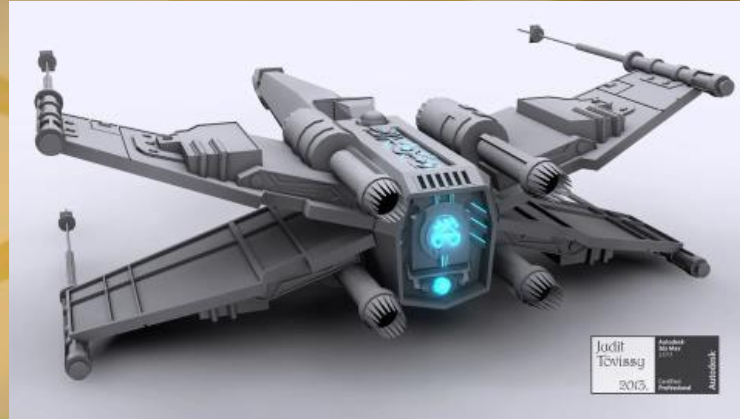# Depth Map Generation for 2D Images

Resulting 3D Conversion
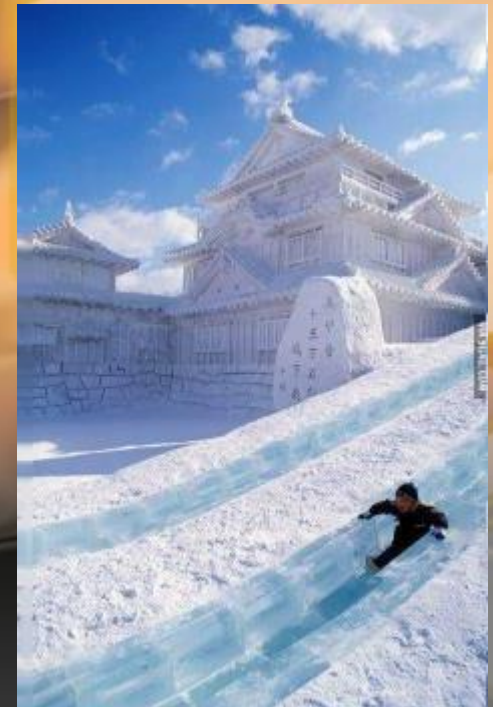
Depth Map Generation for 2D Images

Resulting 3D Conversion

Steps
of
Reconstruction

Image Segmentation

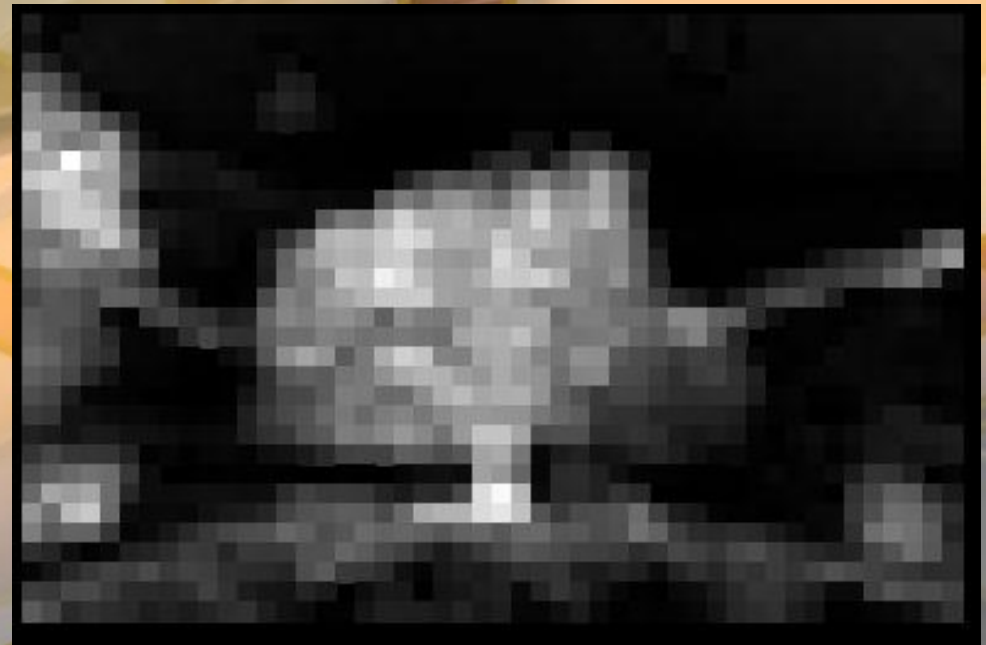- Clustering by Mean Shift Algorithm

Qualitative Depth Map (QDM)

- Absolute Brightness:
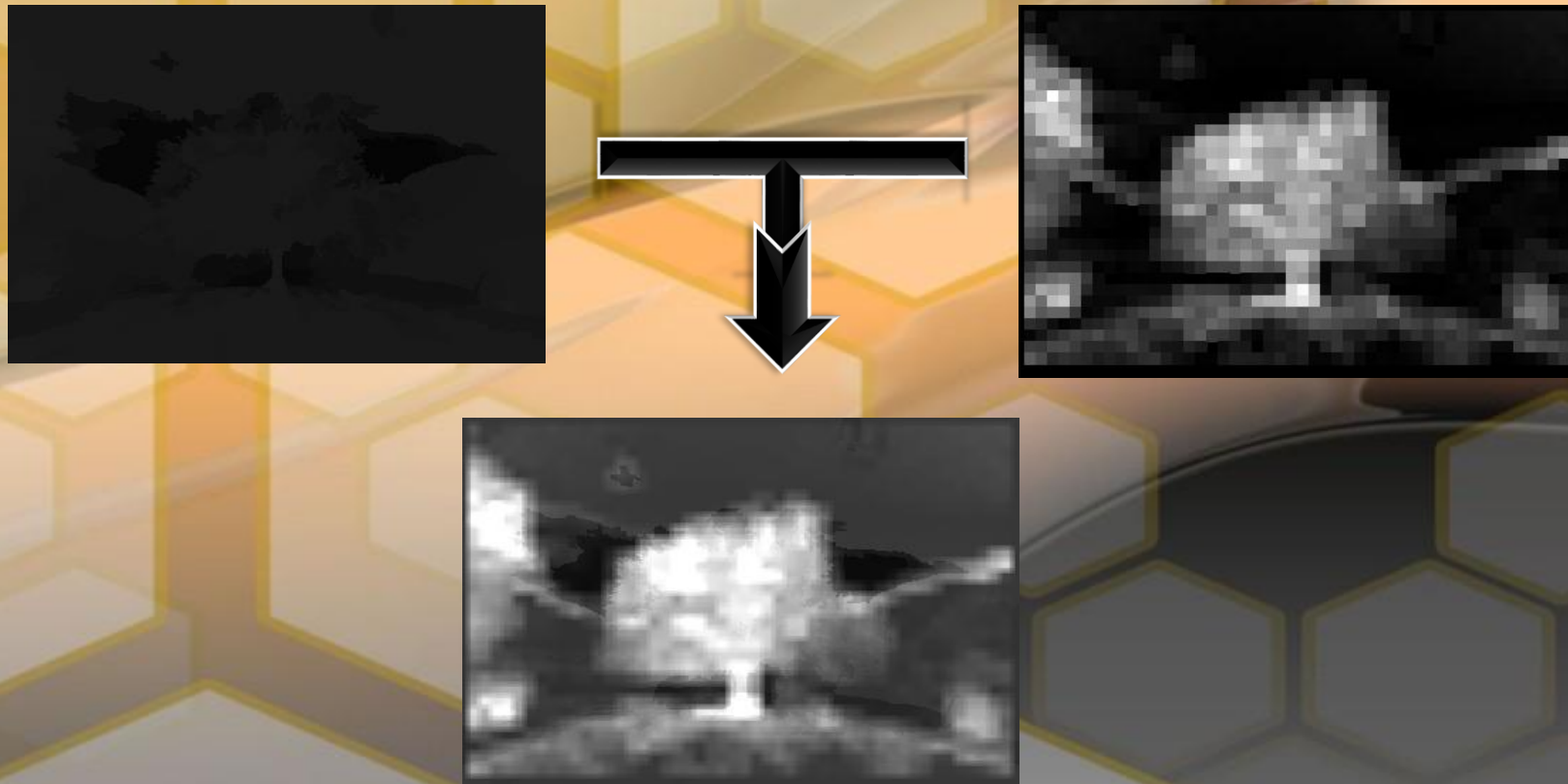$$A(x)=\sqrt{(255-R(x))^2+(255-B(x))^2+(255-G(x))^2}$$

Focus Detection

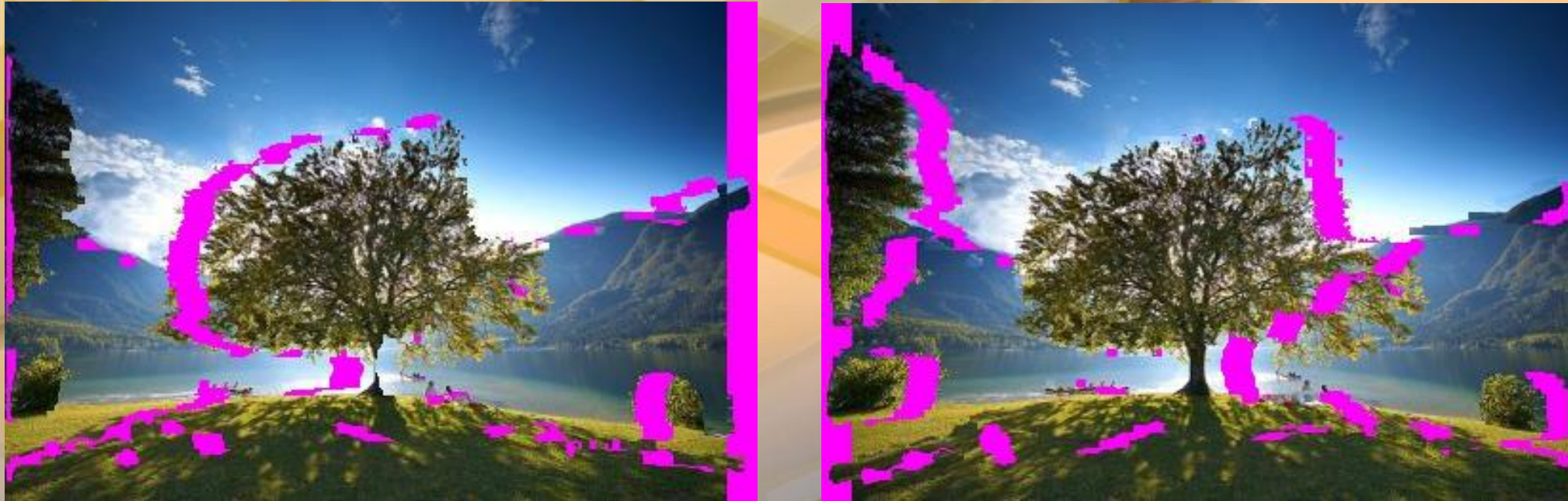- Previously Developed by HAS ICSC

Depth-Focus Map
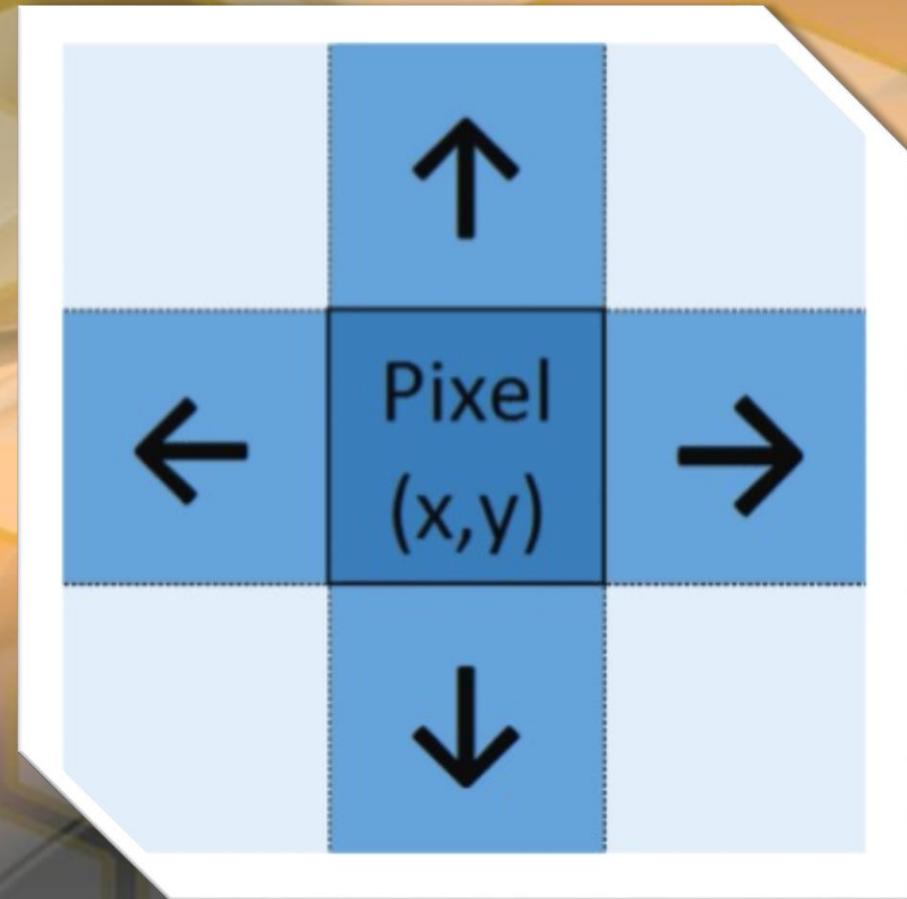
- Combination of a QDM and a Focus Map

Stereoscopic Generation

- Based on the previous Depth-Focus Map

Innovation: Stencil Filtering
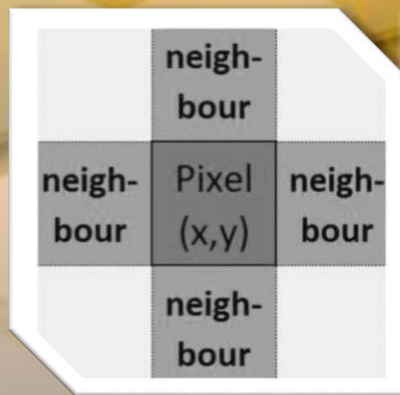
- Pixel-based 2D Graphics
  - **Von Neumann Neighbours**

- 3D Rendering
  - **Raytracing**

- Instead of Von Neumann neighbouring pixels
- Initiate a *Recursive Ray* in each direction
- Find the first non-blank pixel

Innovation: Stencil Filtering

- ***Recursive Von Neumann Stencil***

- Never documented before

- Objective: Find relevant pixels

- Will result in most relevant data
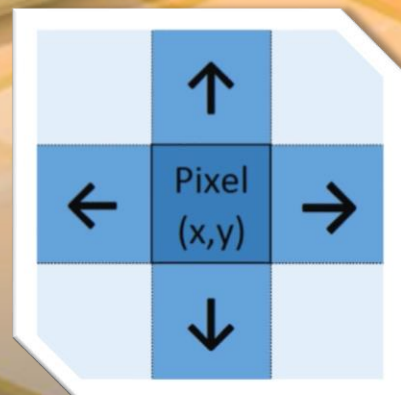
Stencil Filtering

$$P(x,y) = \phi\ (RVNS(x,y),\ S(x,y))$$

Resulting Pixel

Filtering Kernel

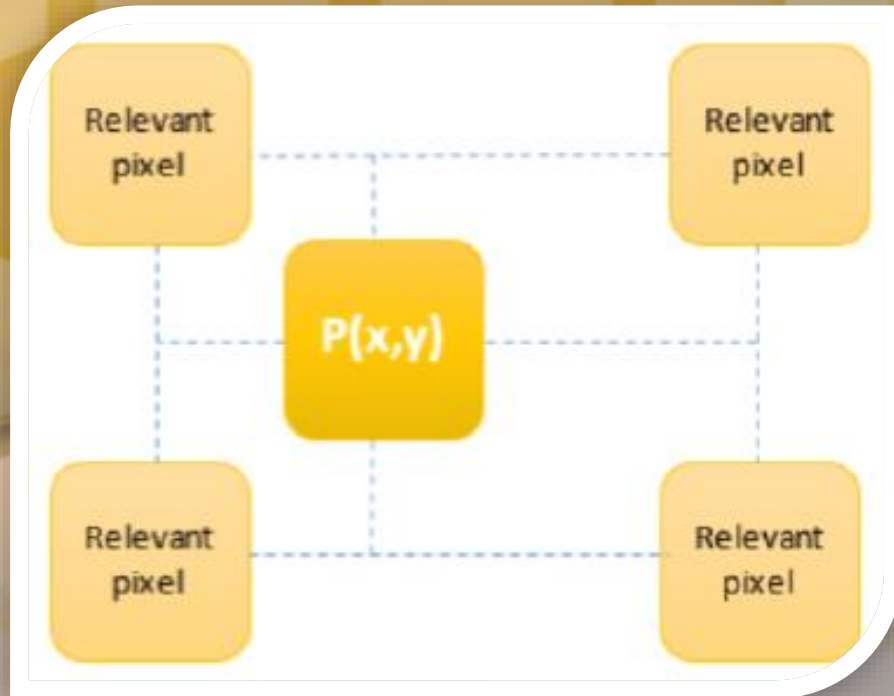Recursive Von Neumann Neighbouring Pixels

Original Pixel

Stencil Filtering – Basic Filtering Kernel

- Result of an averaging process
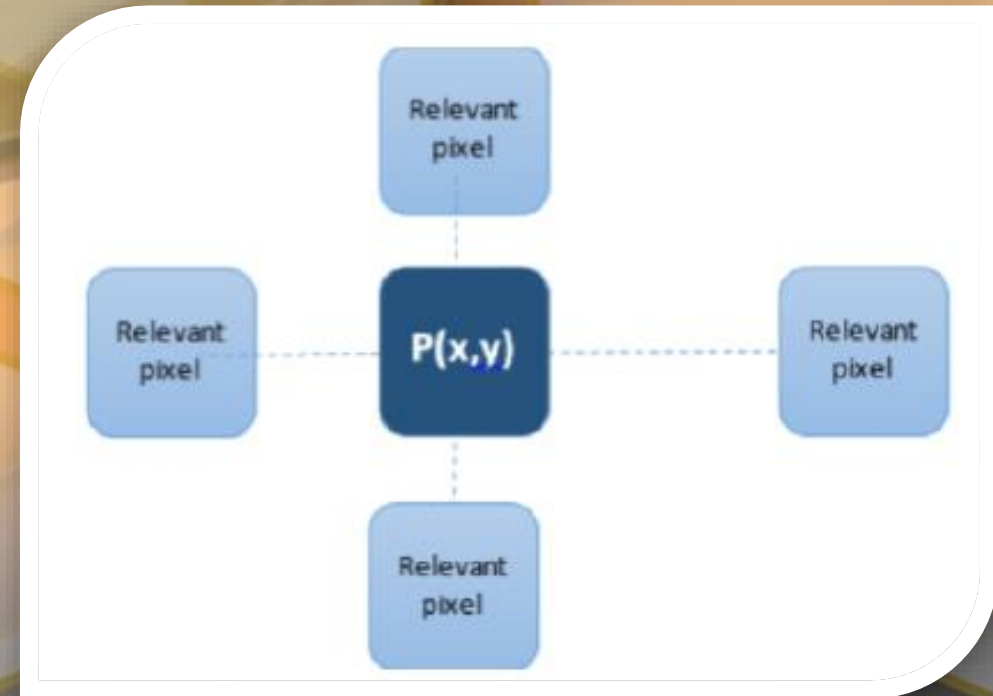- Clearly visible edges

Stencil Filtering – Cross Filtering Kernel

- Representation of relevance
- Pixels weighted according to distance

Bilinear Interpolation

Cross Filtering

Stencil Filtering – Cross Filtering Kernel

Conclusion:
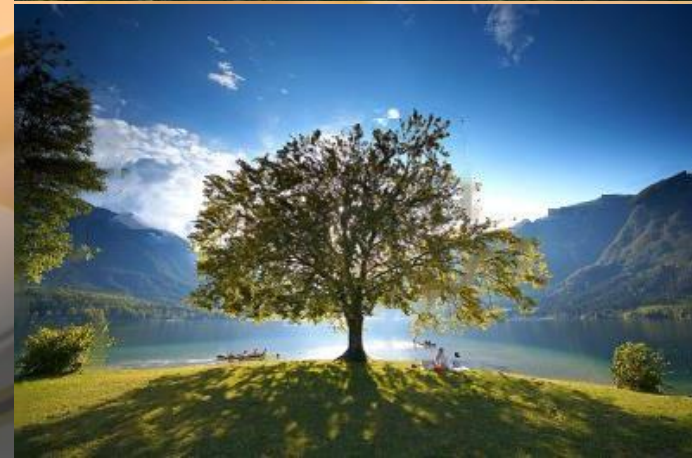   Distance is less relevant than was believed

Stencil Filtering –
Median Filtering Kernel

Advantage in Realism:
 Each new pixel is an instance of already existing values in the image

Stereoscopic 3D Conversion

Main Bibliographical References

- S. Battiato, S. Curti, M. La Cascia, M. Tortora and E. Scordato, "Depth map generation by image classification," *Three-Dimensional Image Capture and Applications VI,* pp. 95-104, April 16, 2004.

- L. Kovács and T. Szirányi, "Focus Area Extraction by Blind Deconvolution for Defining Regions of Interest," *Pattern Analysis and Machine Intelligence, IEEE Transactions on,* pp. 1080-1085, June 2007.

- G. Neumann and S. Kopácsi, "Development of 3D Webpages," in *CSIT'2013. Proceedings of the 15th international workshop on computer science and information technologies,* Vienna-Budapest-Bratislava, 2013.

- S. Battiato, A. Capra, S. Curti and M. La Cascia, Writers, *3d Stereoscopic Image Pairs by Depth-Map Generation.* [Performance]. 2004.

Automated Stereoscopic 3D Image Reconstruction for the Web

Judit Tövissy, Sándor Kopácsi

Dennis Gabor College, Budapest, Hungary

Heraklion, June 18-21 2015