Universität Bamberg

Digitale Objekterfassung
Digital object acquisition/ digital object recording

Modul 3 / WS 1

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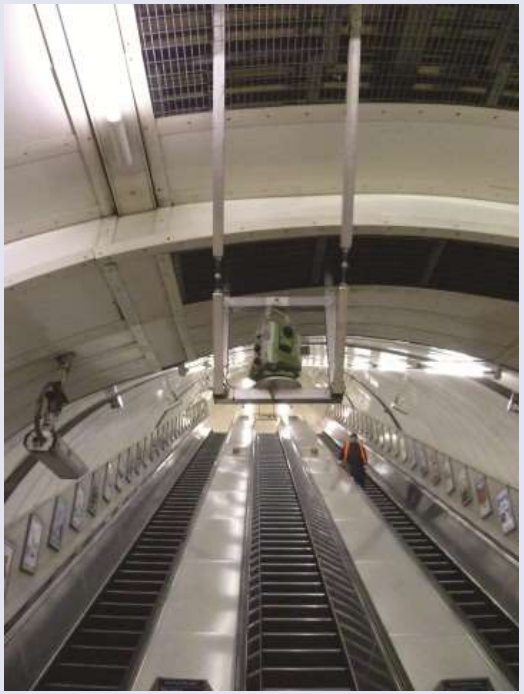
KDWT

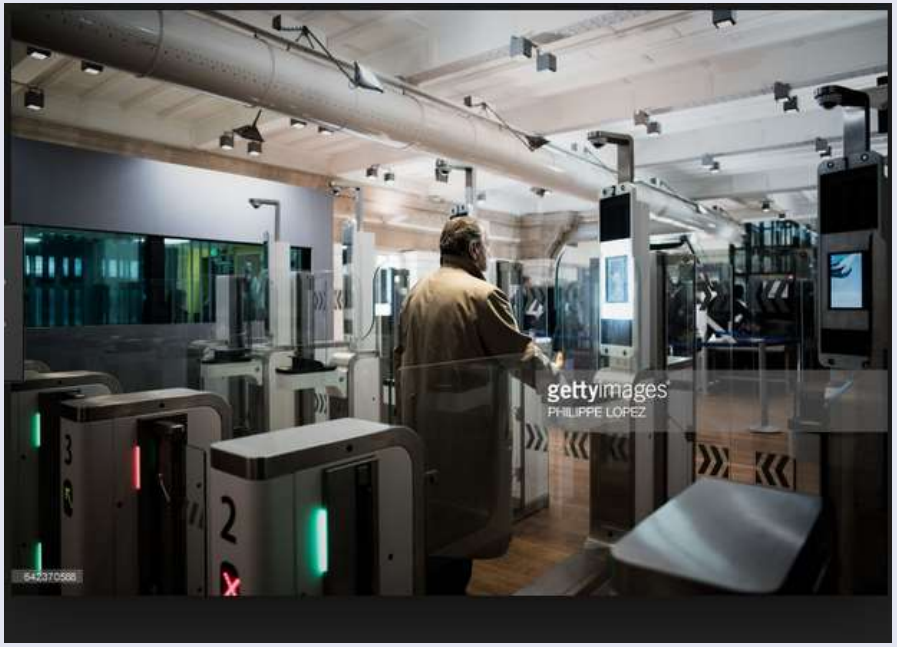
Inhalte dieser Vorlesung

Statistik, Interferometrie, Low Cost 3D (günstige Konsumersensoren)

1. Low Cost 3D
2. Indoor Beacons

Monitoring and Sensing (Pass Control)/ Sensoren im täglichen Leben





Digital Imaging for authentic reproduction
Bildgebende Verfahren

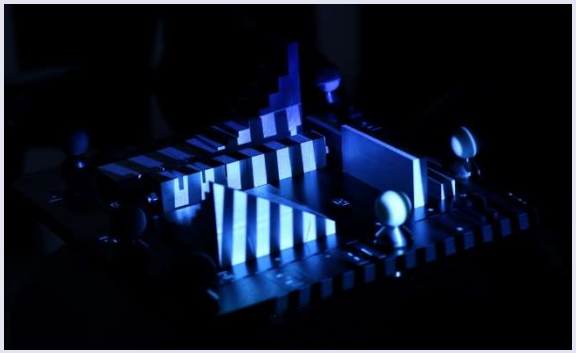
https://www.artec3d.com/news/president-obama-3d

Low-Cost Sensoren

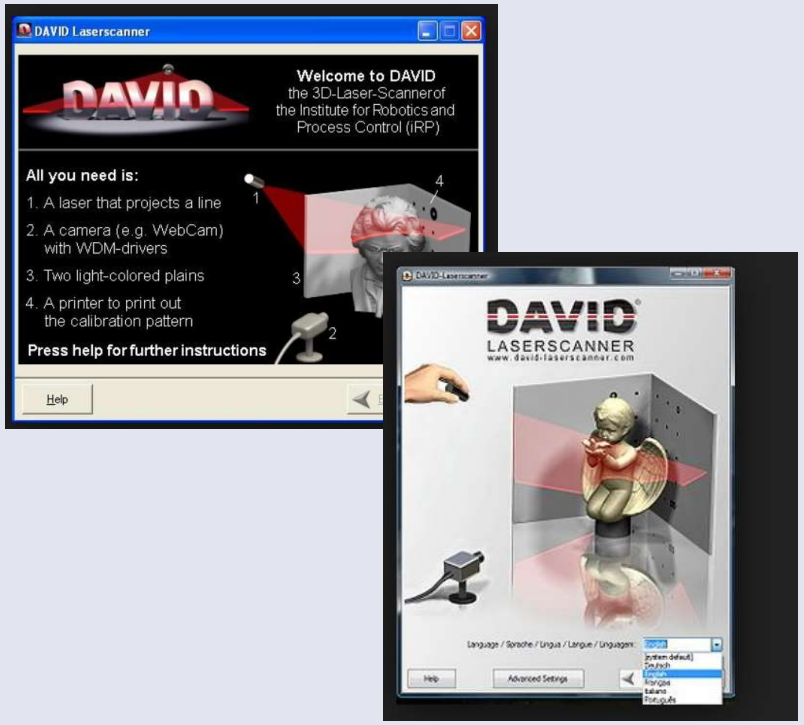
Kostengünstige 3D Gestenerkennung und schnelle Objekterkennung Konsumerprodukte und massenware

Modelle Marke Eigenbau

Example for structured light scanning: Mephisto EX-Pro and EOS (4DDynamics)., The D-SLR camera (middle, EOS system) can be swapped over to the higher-resolution machine vision camera (right, EX-Pro system) to communicate with the projector



[Bauen wir einen David Laserscanner http://www.gunook.com/david-3d-scanner/](http://www.gunook.com/david-3d-scanner/)



Lichtoptischer 3D Digitalisierer

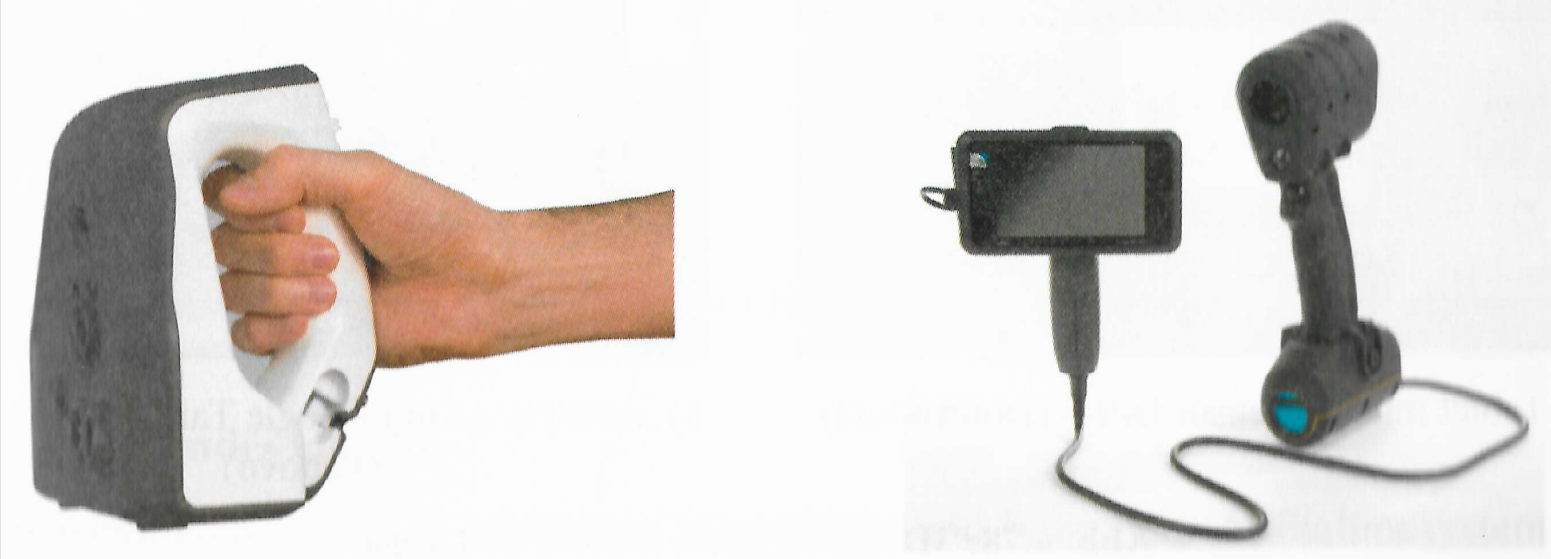
Picoscan Technical Specification and Software Interface

- Canon EOS 1000D, 18-55 mm lens, Pico projector
- Resolution geometry: 968 x 644, 8 bits
- Texture resolution: 1936 x 1288, 8 bits
- Projector resolution: 800 x 600
- Working range: 0.15m - 0.8m
- Point to point distance : 0.16 mm
- Point accuracy: 0.1 mm (average)
- Acquisition time: 20 Sec
- Mephisto 3D Scan engine software
  (Calibration, processing and reconstruction)

https://www.rsi-3dsystems.com/3d-scanner/pico-scan/

3D Handscanner

- Spider
- Eva
- Mantis Vision F5 Short Range

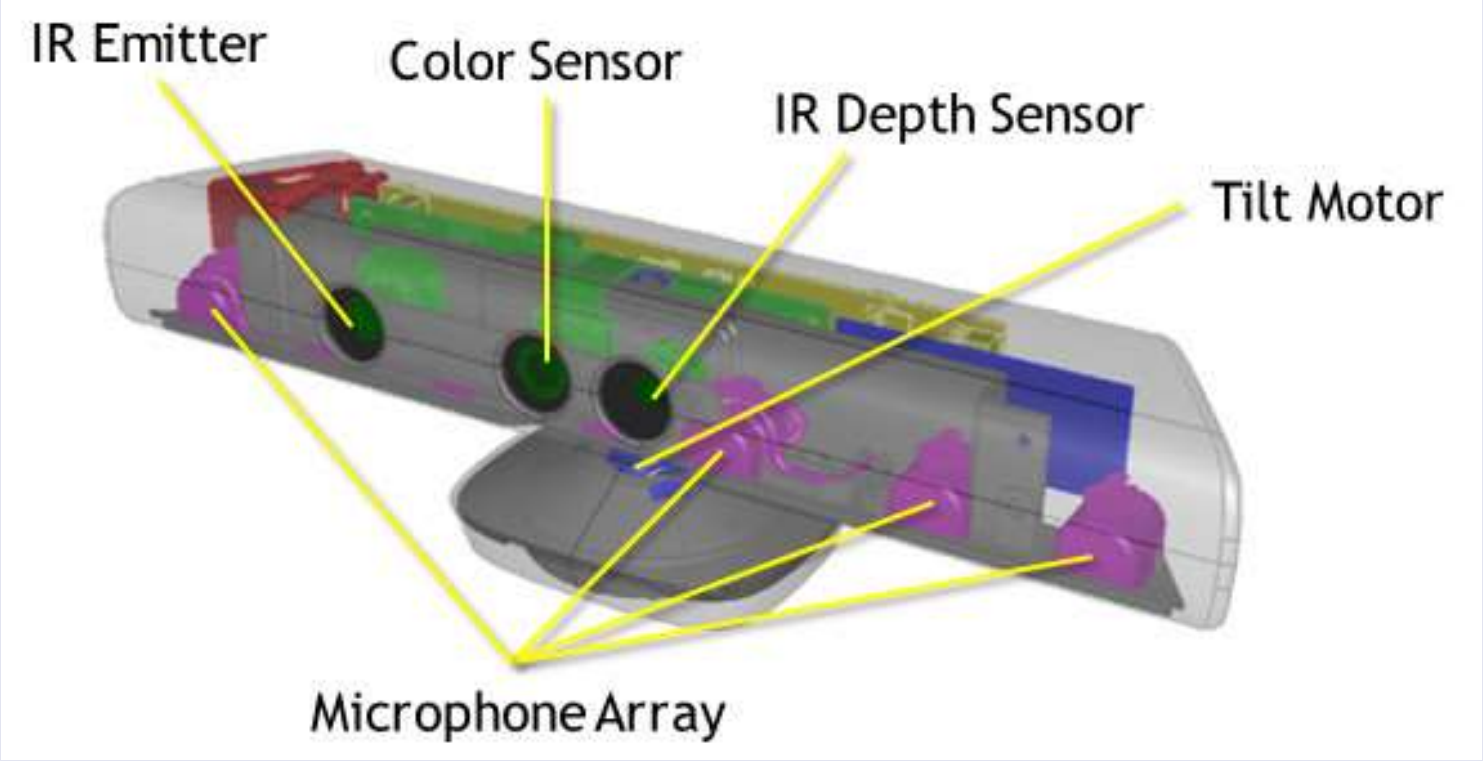


Kinect air guitar

Chris O'Shea emailed in with his super sweet Kinect hack, allowing him to play air guitar!

Im Jahr 2010 : https://makezine.com/2010/12/10/kinect-air-guitar/

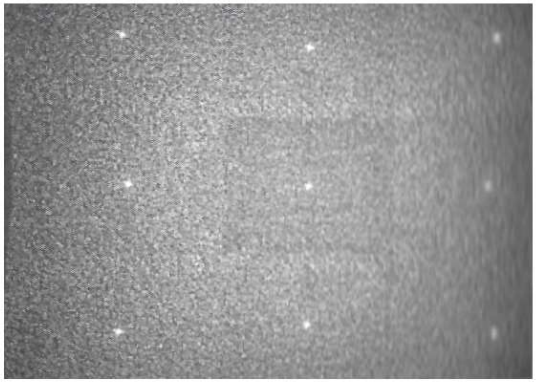
Messsysteme zur Gestenerkennung
Kinect 1 (640*480 Pixel)



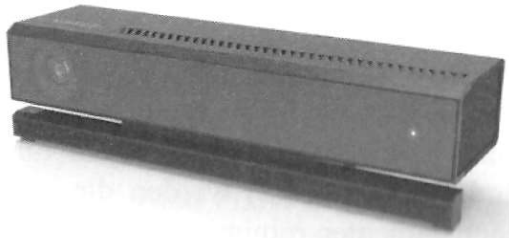
Messsysteme zur Gestenerkennung

- Kinect

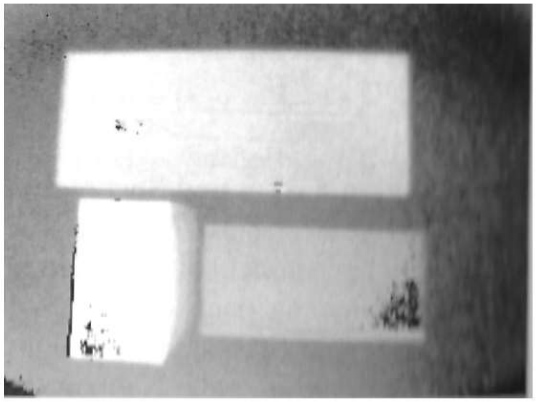
Kinect 1 basierend auf PrimeSense ChipSet



Projiziertes Punktmuster



Kinect 2 basierend auf ToF-Prinzip



Distanzbild

Low cost 3D: Structured light using a fixed pattern projection

P 253-254 Low Cost Consumer-grade range 3D cameras Luhmann, Thomas, Stuart Robson, Stephen Kyle, and Jan Boehm. *Close-Range Photogrammetry and 3D Imaging*. 2nd ed. Berlin, Boston: De Gruyter, 2013. https://doi.org/10.1515/9783110302783.

Boehm, J. “Natural User Interface Sensors for Human Body Measurement.” *ISPRS - International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* XXXIX-B3 (August 1, 2012): 531–36. https://doi.org/10.5194/isprsarchives-XXXIX-B3-531-2012.

ASUS Xtion Pro

http://www.asus.com/Multimedia/Xtion_PRO_LIVE/

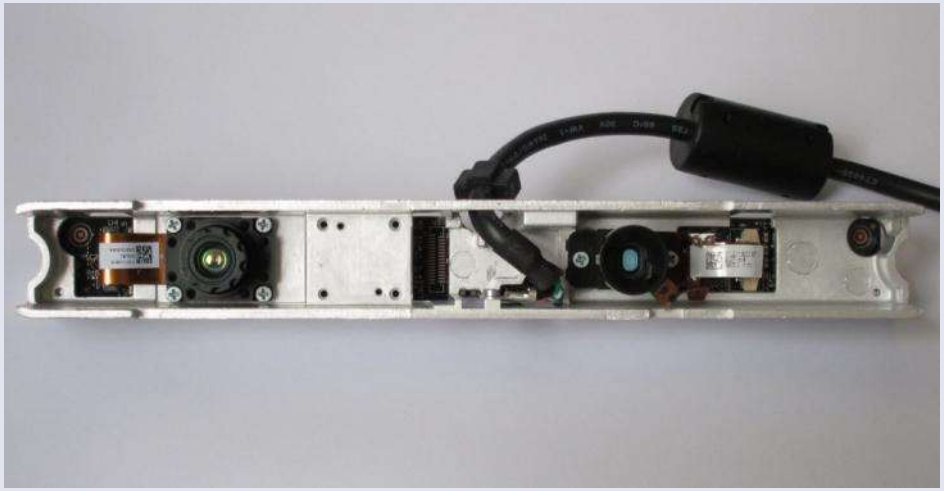


Image: Jan Boehm , Senior Lecturer, UCL CEGE

NUI Sensor Packages

- Microsoft Kinect
- PrimeSense PSDK 5.0
- ASUS Xtion Pro Live
- ASUS Xtion Pro

- “Mechanical” packaging differs

Slide: Jan Boehm , Senior Lecturer, UCL CEGE

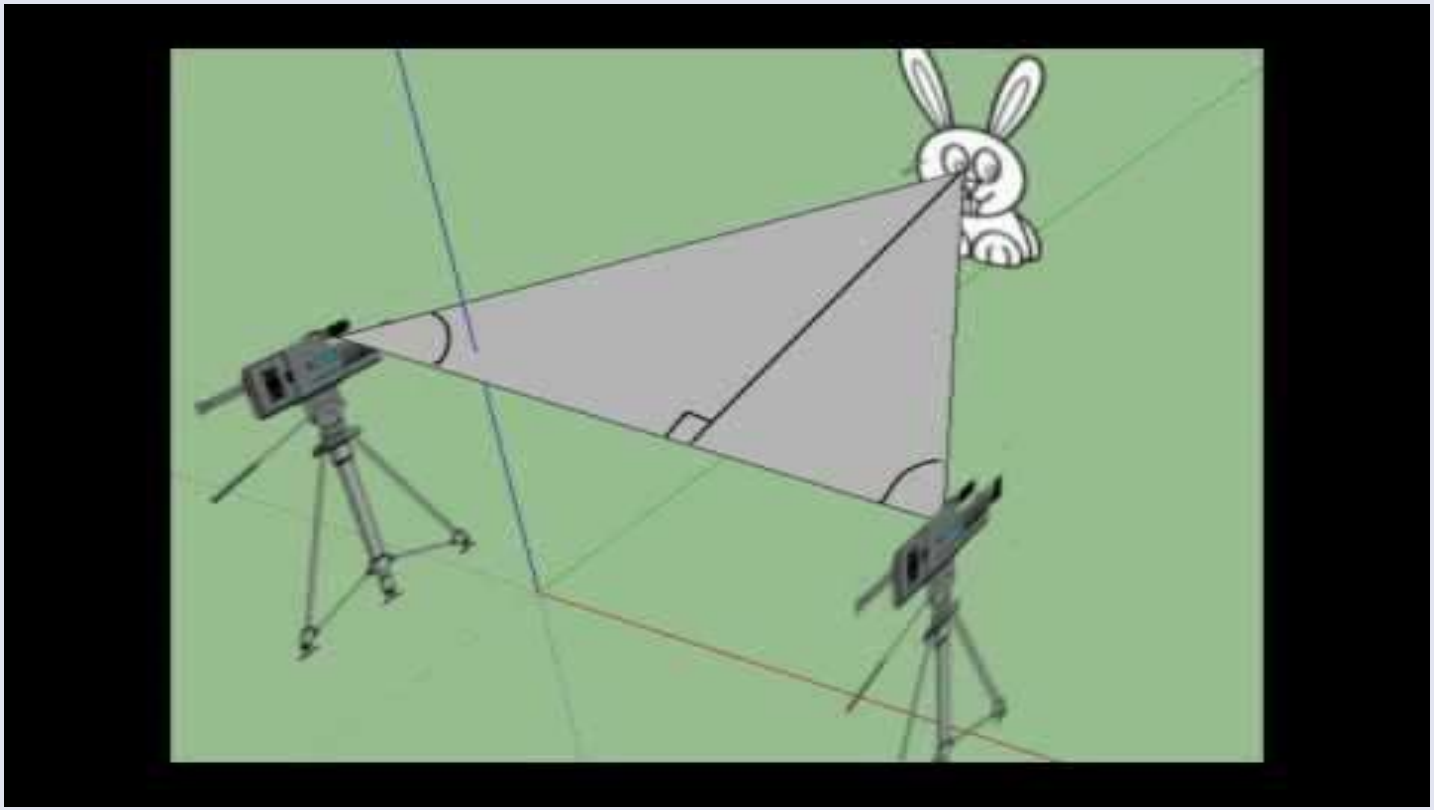
Field of View (Horizontal, Vertical, Diagonal)	58° H, 45° V, 70° D
Depth Image Size	VGA (640x480)
Operation range	0.8m-3.5m
Spatial x/y resolution (@2m distance from sensor)	3mm
Maximal image throughput (frame rate)	60fps

Table 1. Specifications of the PrimeSense reference sensor design as given by the manufacturer.

…single depth frame is quite low at only VGA resolution (640 x 480), this number has to be seen in relation to the frame rate. If we multiply the number of points of a single frame with the frame rate of 30 frames per second we receive a sampling rate of 9.216.000 points per second. This outperforms current terrestrial laser scanners by an order of magnitude.

Artec Spider > 1 Mio points/sec
Breuckmann /Zeiss T-scan is 210.000 points/sec
Breuckmann/ Zeiss L3D

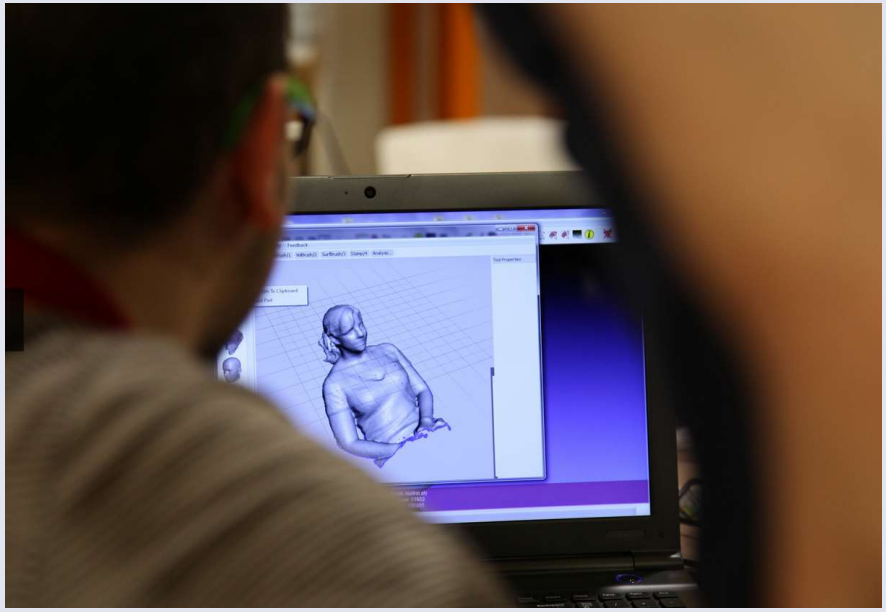
Speckle pattern.



The camera uses a single LED to emit sinusoidal infrared light.
A synchronised imaging chip takes four samples of one period of the sinus signal.
This allows the computation of the pase- shift and subseqently depth for each pixel.

Low

Low cost laser scanning



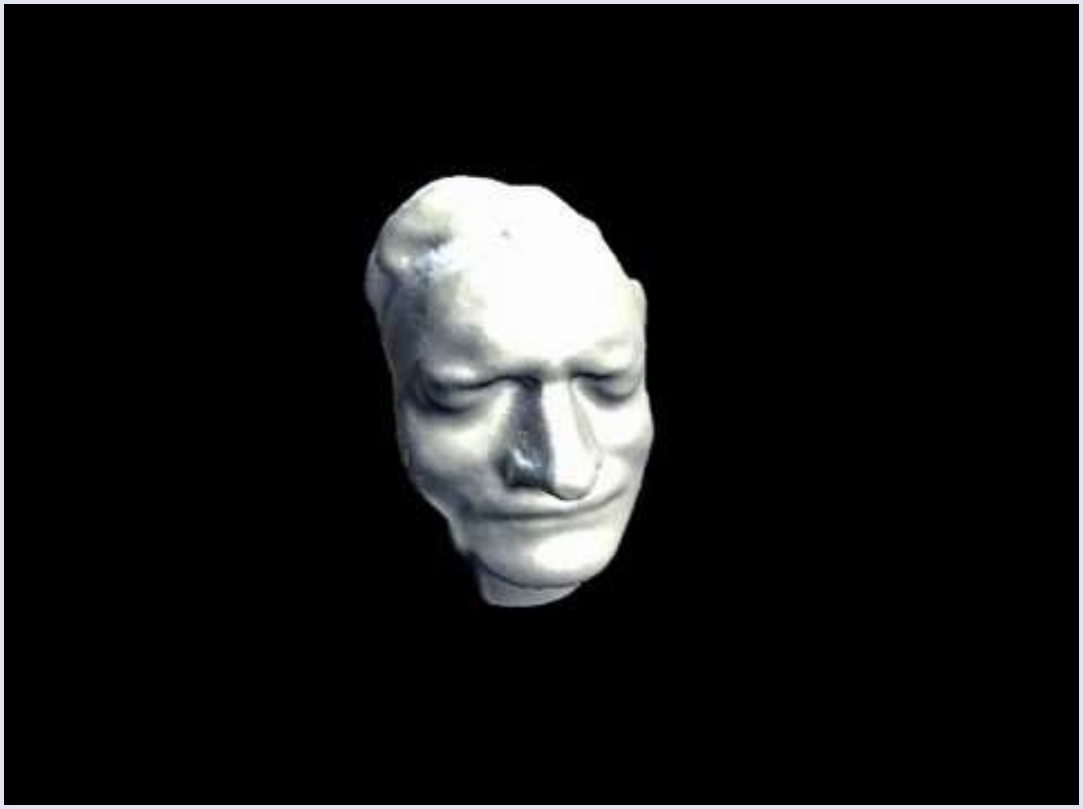
Yesterday (Thursday 8th November), with Jeremy Bentham's Auto Icon taken out of its display case for cleaning, the UCL Geomatics Photogrammetry, 3D Imaging and Metrology Research Group took the opportunity to add to their portfolio of scanning case studies using a low-cost Kinect-type sensor to capture JB's 3D geometry. As 3D Imaging experts, they could not resist creating a quick 3D model! A first rendering can be viewed on YouTube via the following link: http://www.youtube.com/watch?v=Gy7muFzA1e0

(Photo taken by Subhadra Das)

The team left to right: Jan Boehm, Mona Hess, John Hindmarch, Ali Hosseininaveh Ahmadabadian , Ben Sargeant.

Primesense 3D Scanning

Isaac Newton Death Mask and Xbox



https://pictures.royalsociety.org/image-rs-8492

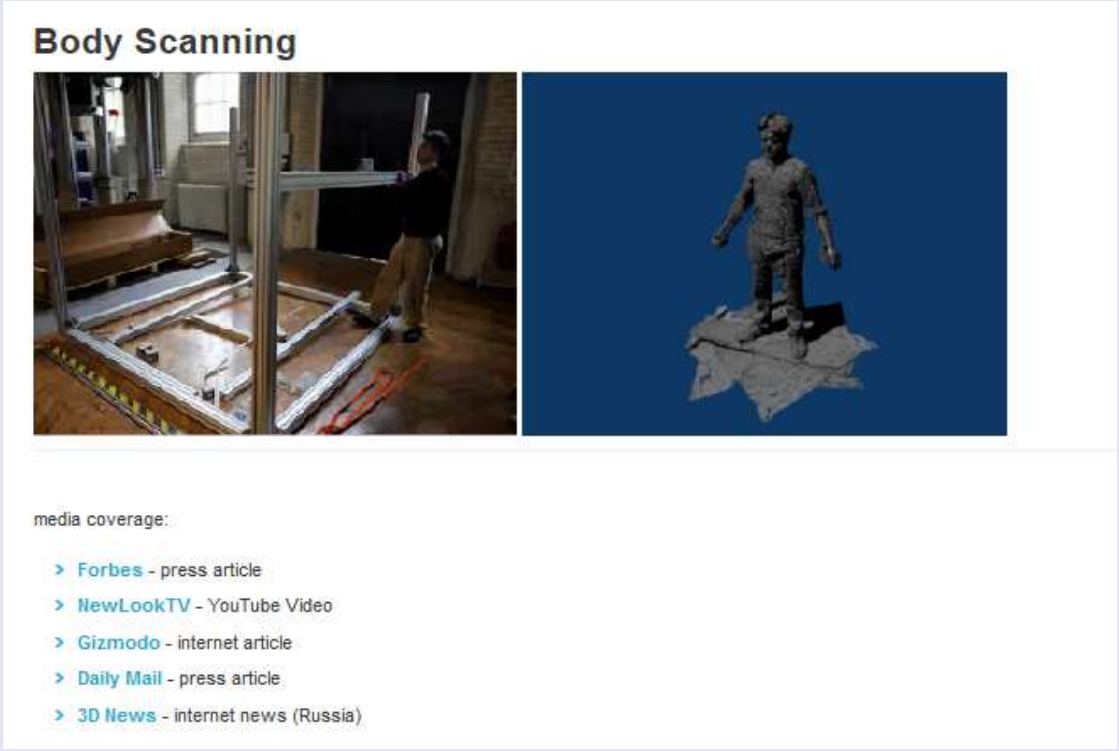
Sir Isaac Newton Deathmask possibly Original

Low cost 3D

- **Jeremy Bentham in 2 x 3D!**
- https://uclgeomatics.com/2012/11/09/jeremy-bentham-in-3d/
- **Sir Isaac Newton in Digital 3D**
- https://uclgeomatics.com/2014/02/07/sir-isaac-newton-in-3d/

Bodyscanning with 8 primesense sensors

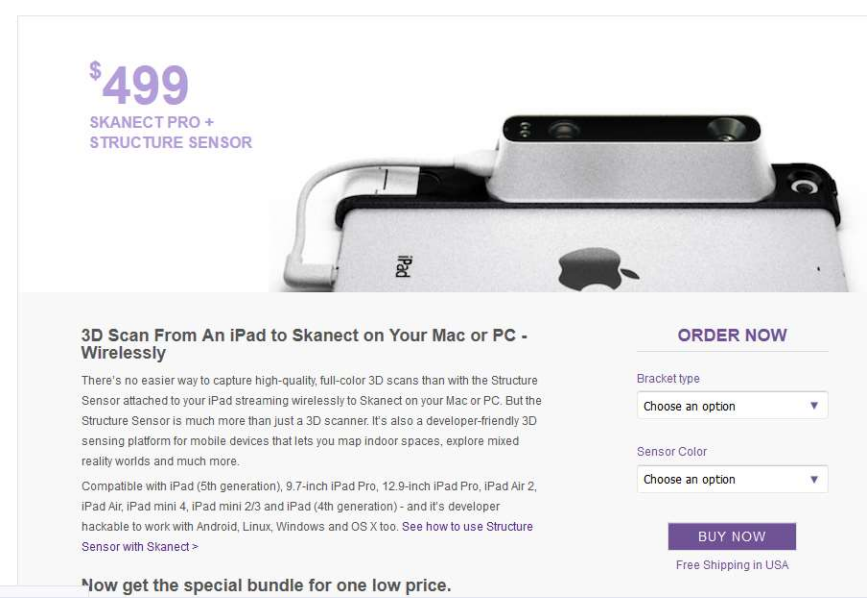
http://www.ucl.ac.uk/3dim/bscanner



Bodyscanning with 8 primesense sensors

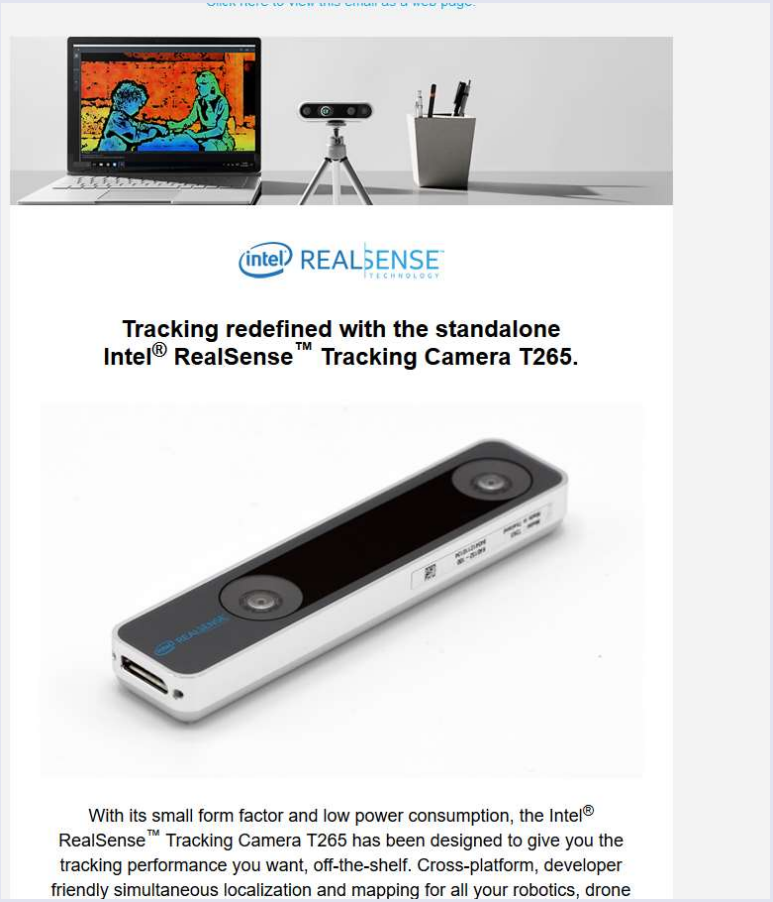
https://gizmodo.com/5853065/clothing-store-body-scanners-know-your-every-curve

Software für die Nutzung von Primesense/ Kinect Sensoren



- http://skanect.occipital.com/download/
- http://reconstructme.net/

Tracking Camera / SLAM

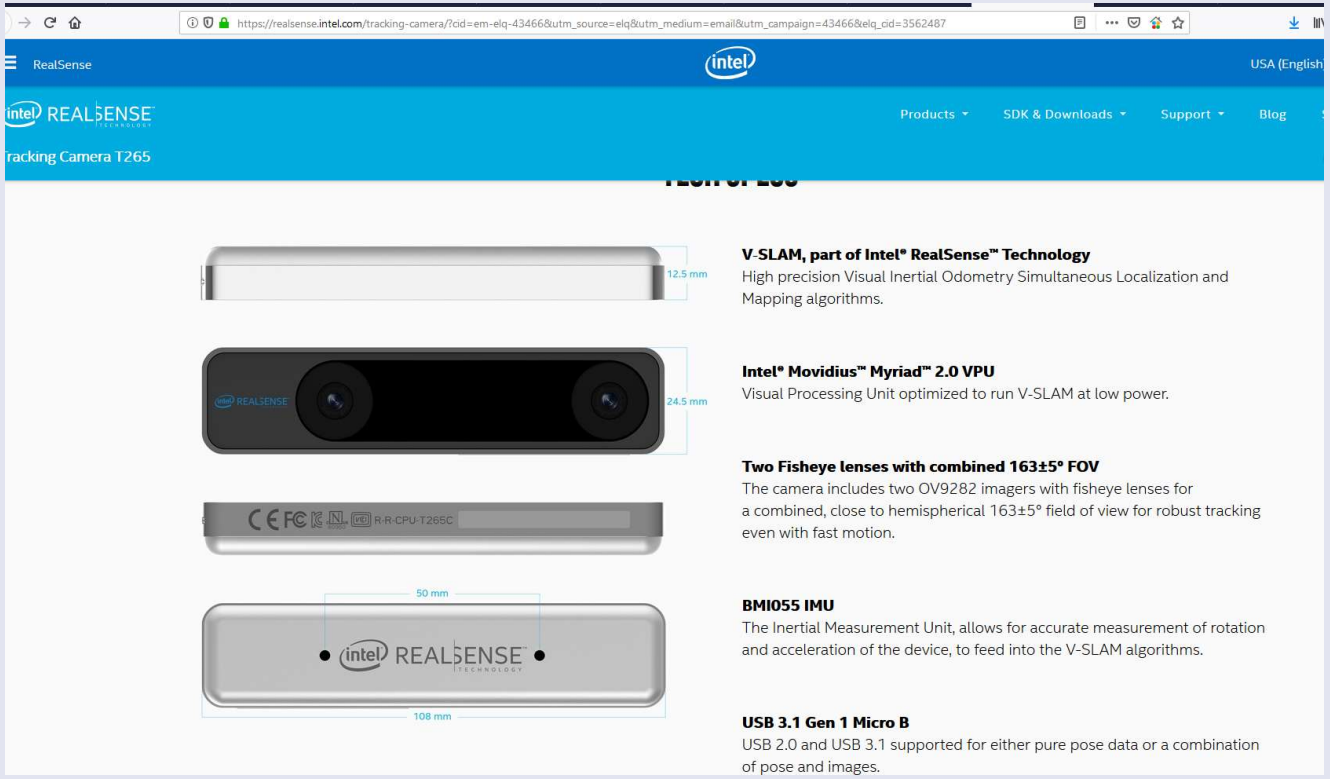


https://structure.io/
https://structure.io/structure-core

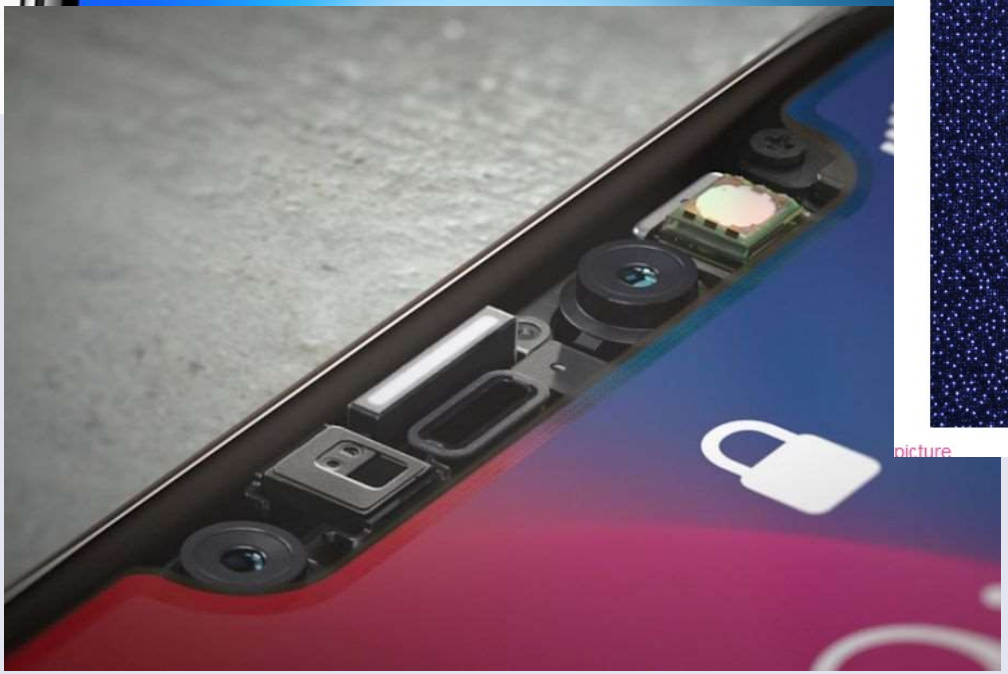
https://www.intel.de/content/www/de/de/architecture-and-technology/realsense-overview.html

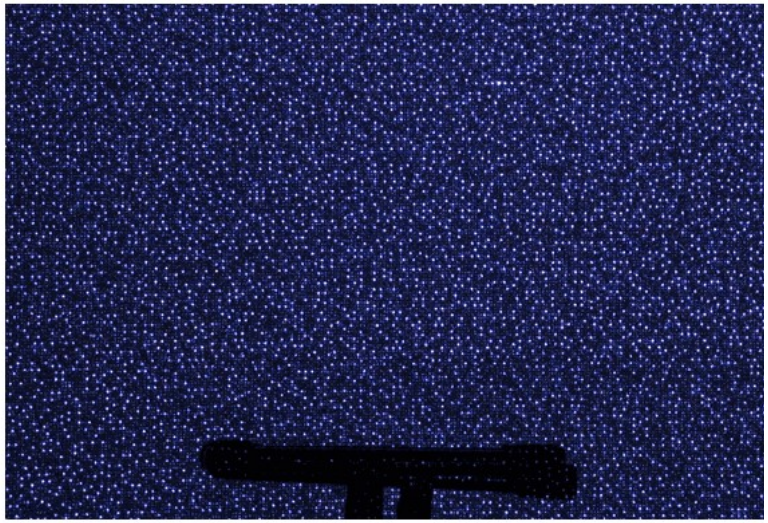
https://en.wikipedia.org/wiki/Intel_RealSense

Tracking camera / SLAM



https://realsense.intel.com/tracking-camera/





https://www.theverge.com/circuitbreaker/2017/9/17/16315510/iphone-x-notch-kinect-apple-primesense-microsoft

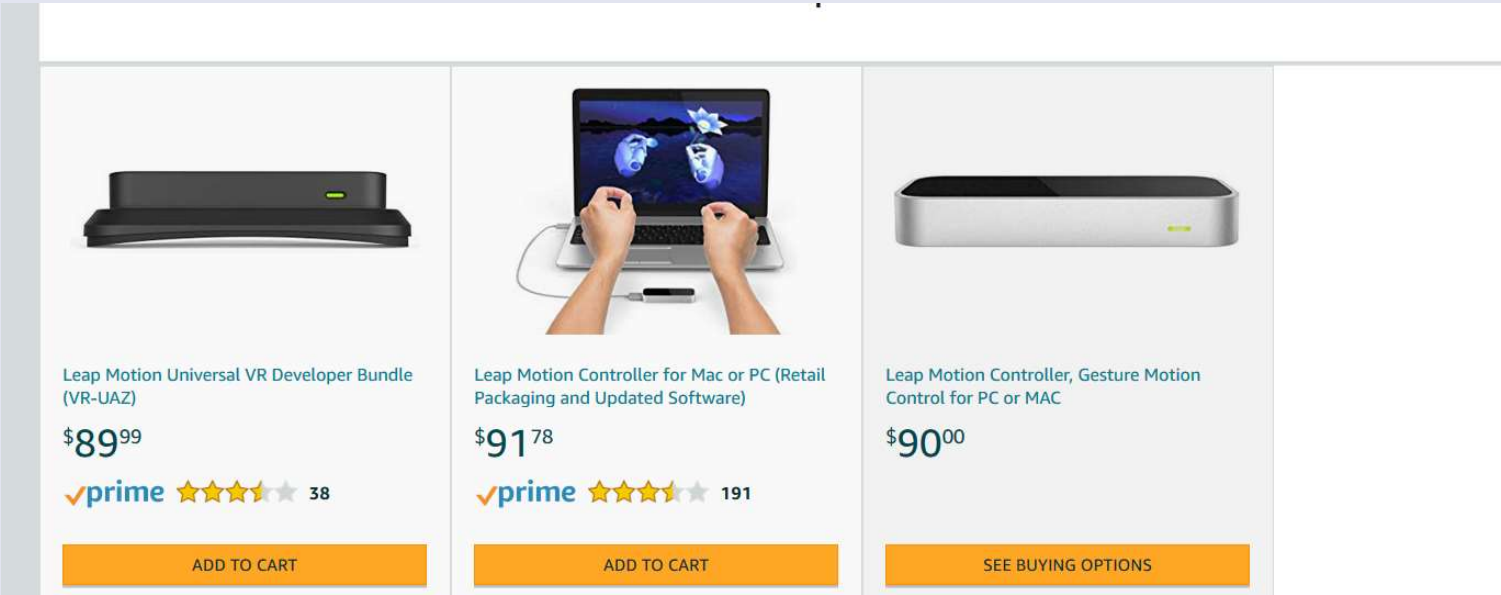
Gesture Recognition

Leap Motion

3dimaginguc l
Published on 30 Jul 2013
Leap Motion on a Windows 8 Tablet
http://www.ucl.ac.uk/3dim/

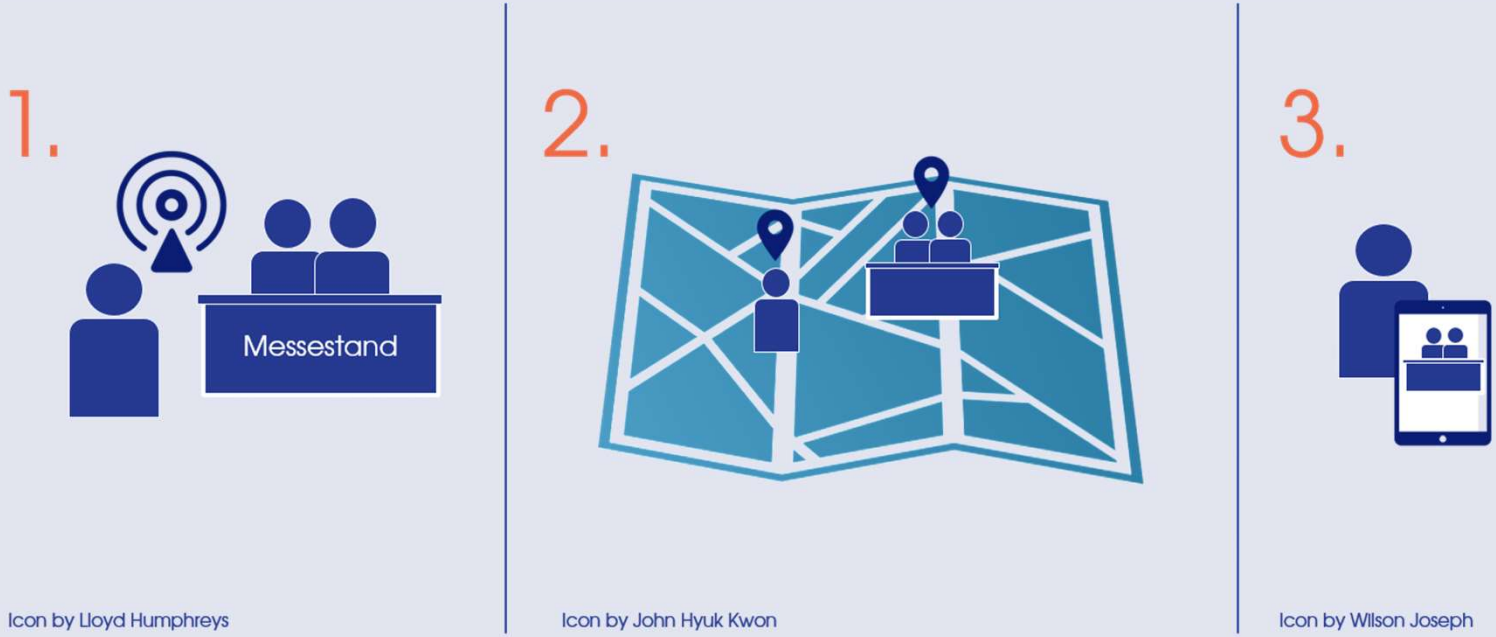
https://www.leapmotion.com/
https://gallery.leapmotion.com/cat-explorer/

Gesture recognition



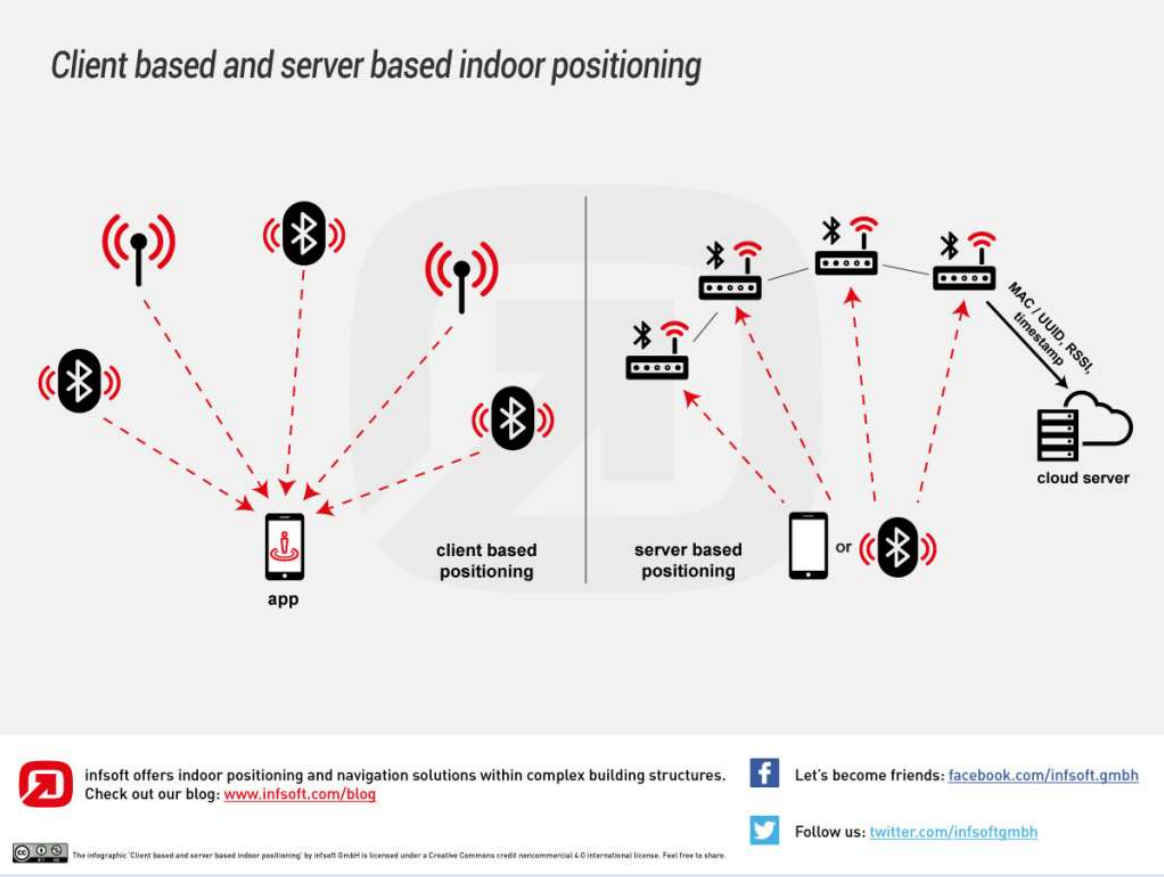
https://www.leapmotion.com/
https://gallery.leapmotion.com/cat-explorer/

Beacons/ Indoor GPS



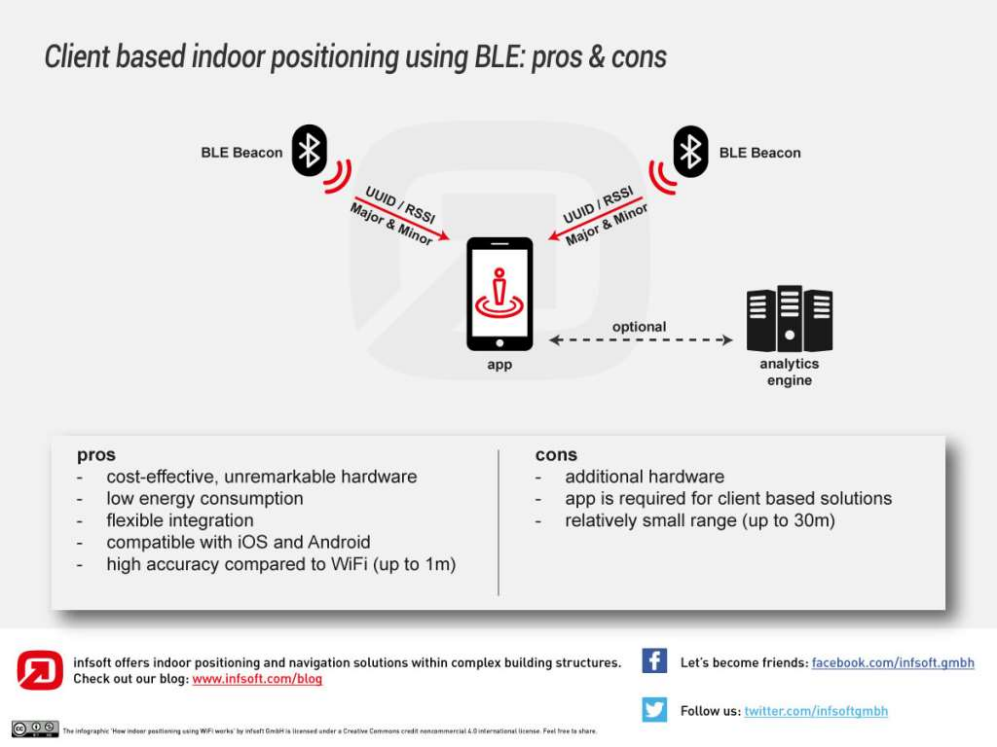
http://blog.match-app.de/beacons-kurz-erklaert/

Internet of Things/ Indoor GPS und WLAN or Bloetooth Beacons



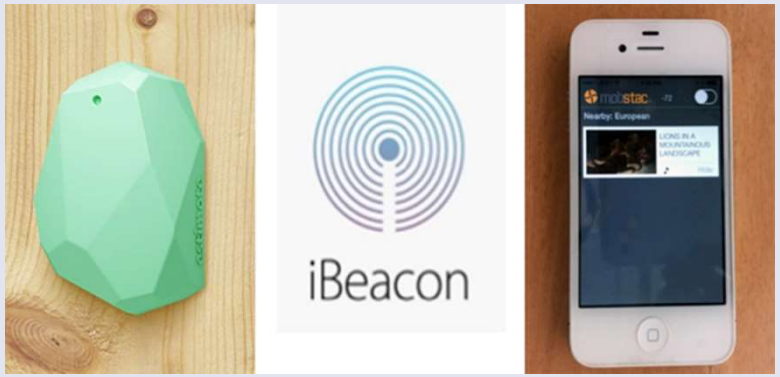
https://www.industry-of-things.de/indoor-positionsbestimmung-funktionsweise-und-technische-informationen-a-561397/

Internet of Things/ Indoor GPS und WLAN or Bloetooth Beacons

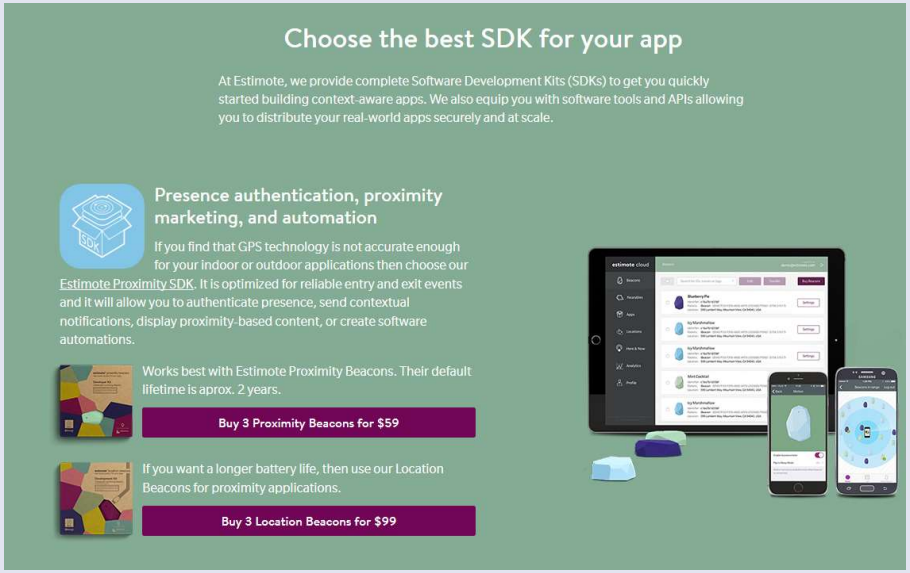


https://www.industry-of-things.de/indoor-positionsbestimmung-funktionsweise-und-technische-informationen-a-561397/

Wie sehen Beacons aus?



- https://estimote.com/press-kit/



Beacons im Museum

- https://www.metmuseum.org/blogs/digital-underground/2015/beacons
- https://www.metmuseum.org/visit/met-app
- Design an app http://www.beacondo.com/
-

Software

To compare the variety of tools that are available to use with beacons, two solutions were employed: an app developed by Mobstac, and a free app, SDK, by Beacondo. The Beacondo app alone was used for the subsequent follow-up testing in the galleries and other demos in the Museum (fig. 6).

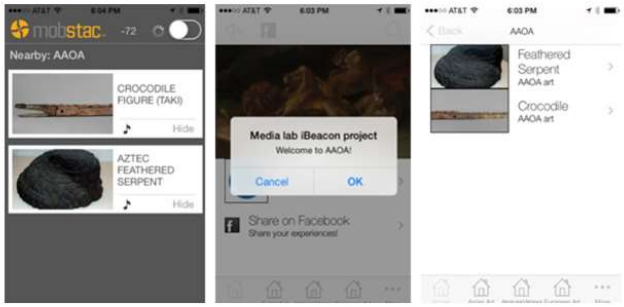
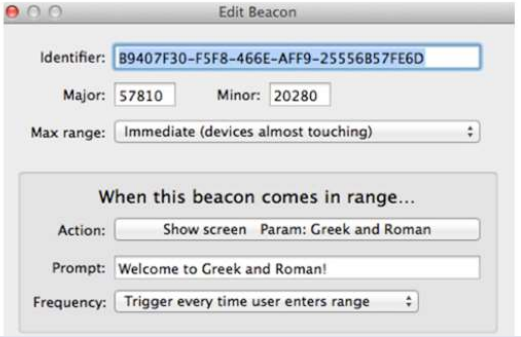


Fig. 6. To compare the variety of tools to use with beacons, two technology solutions were employed: an app developed by Mobstac (left), and a free app, SDK, by Beacondo (center and right).

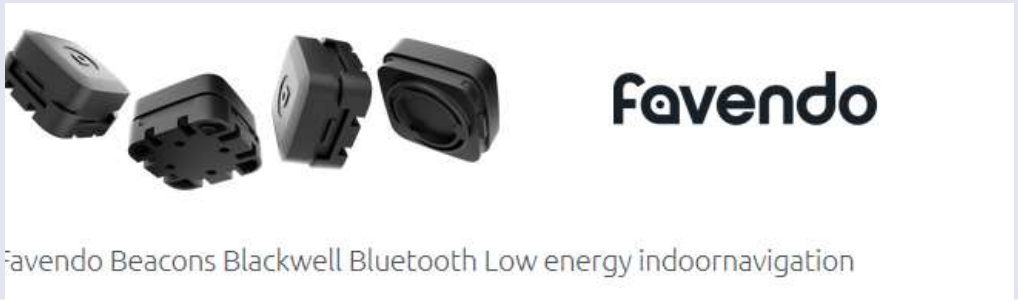
Beacon Setup in Beacondo

Each beacon's unique information (UUID, major and minor values) was added in the beacons section of the Beacondo editor (fig. 7).



Favendo Bamberg

- Bamberger Firma (auf der ERBA)
  - https://www.favendo.com/indoornavi/
  - https://www.favendo.com/modules/beacons/
  - *Lichttechnologie/Visual Light Communication (VLC) und das auf ihr basierende Indoor Positionierungssystem (IPS) erlauben eine noch genauere Positionierung und Navigation. Die Positionierungsgenauigkeit liegt bei ca. 30 Zentimetern und entspricht den Anforderungen einer produktgenauen Navigation im Lebensmitteleinzelhandel. Erkauft wird diese Genauigkeit mit dem Nachteil, dass das Smartphone ständig „Sichtkontakt“ zur Lichtquelle haben muss. Durch eine Kombination mit Beacon-Technologie kann dieser Nachteil aufgehoben und die Positionierungs-Genauigkeit beibehalten werden.*

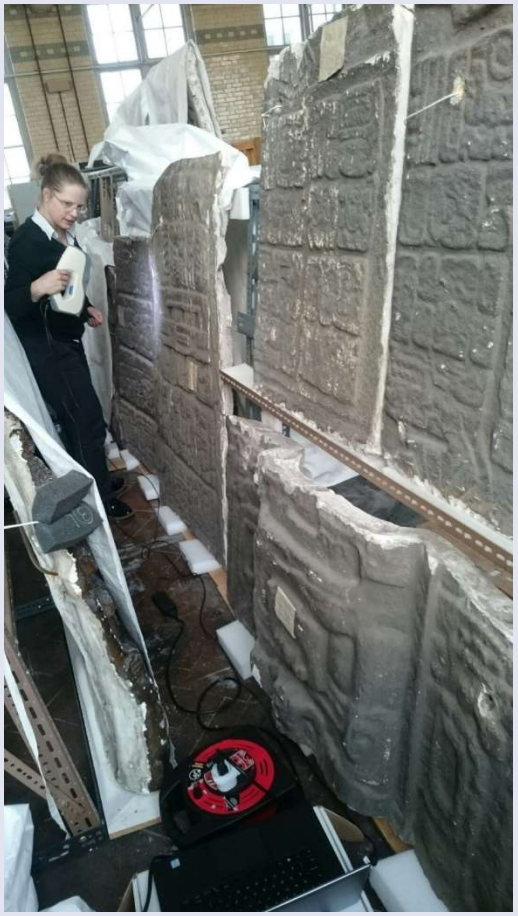


Weiterführende Links

- http://blog.match-app.de/beacons-kurz-erklaert/
- https://www.industry-of-things.de/indoor-positionsbestimmung-funktionsweise-und-technische-informationen-a-561397/
- Sehr ausführliche Technische Arbeit : Bachelorarbeit, anton Anders, März 2016, Indoor-Positionsbestimmung mit Hilfe von Bluetooth-Low-Energy-Beacons und Pedestrian Dead Reckoning
- https://cse.cs.ovgu.de/cse-wordpress/wp-content/uploads/2016/08/BA_Anton_Anders.pdf

Anwendungsbeispiel

Virtuelle Rekonstruktion



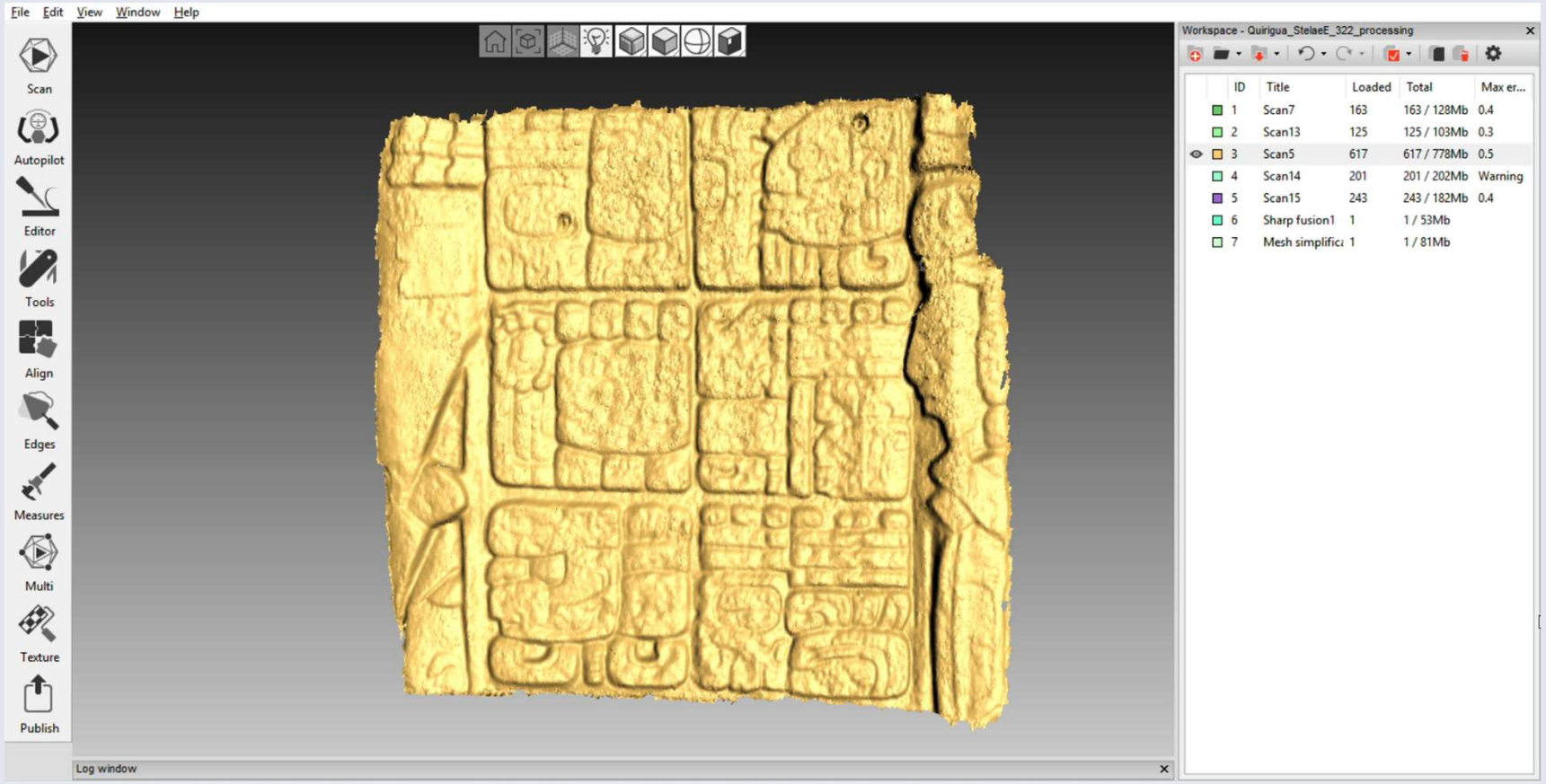
Film 1 Processing

Film 2 Virtual reconstruction

Film 3 Length of reconstruction

The British Museum

Google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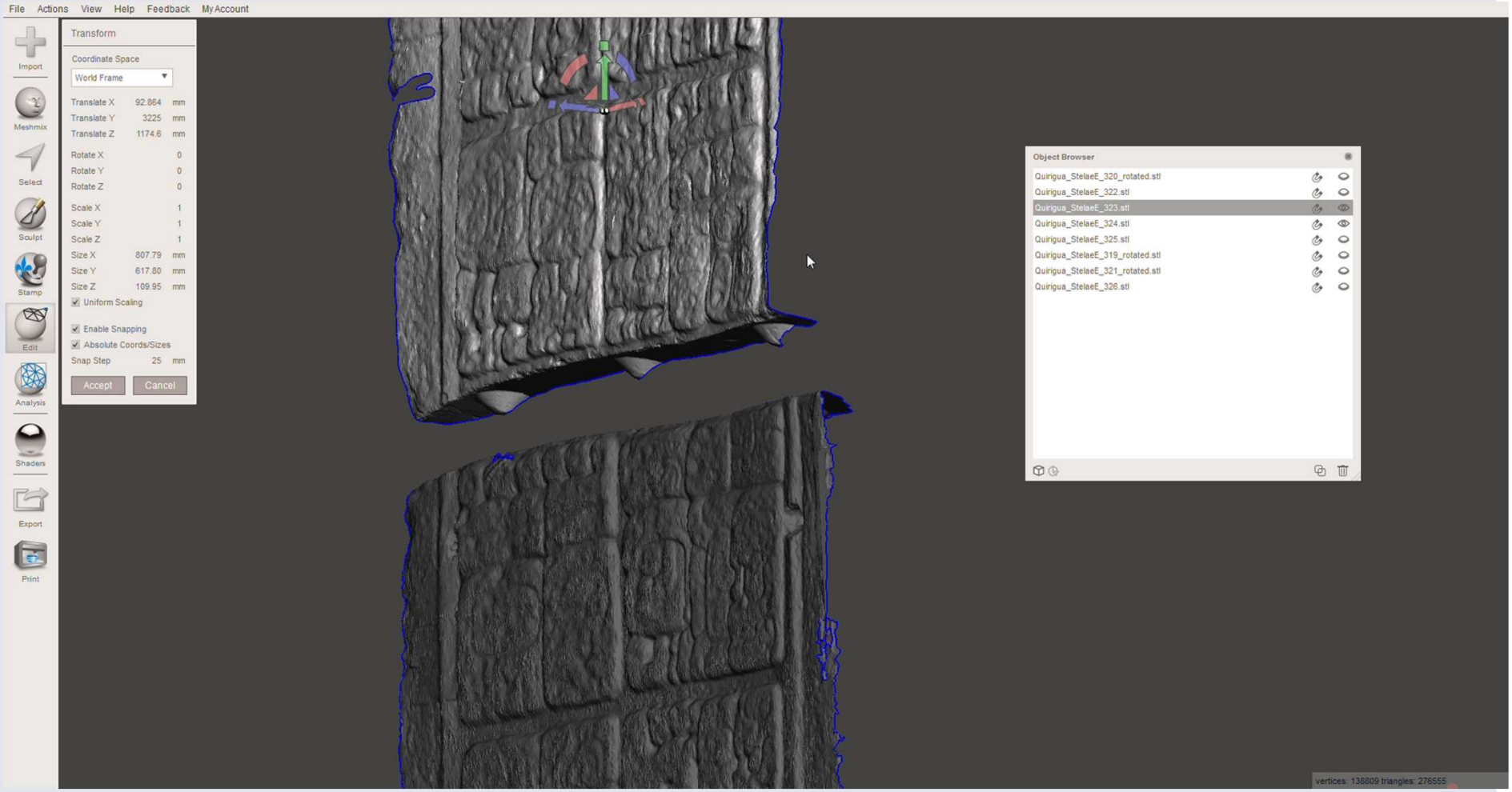
Scan
Autopilot
Editor
Tools
Align
Edges
Measures
Multi
Texture
Publish
Log window
Workspace - Quirigua_StelaeE_322_processing
ID Title Loaded Total Max er...
1 Scan7 163 163 / 128Mb 0.4
2 Scan13 125 125 / 103Mb 0.3
3 Scan5 617 617 / 778Mb 0.5
4 Scan14 201 201 / 202Mb Warning
5 Scan15 243 243 / 182Mb 0.4
6 Sharp fusion1 1 1 / 53Mb
7 Mesh simplifica 1 1 / 81Mb


File
Actions
View
Help
Feedback
My Account
Import
Meshmix
Select
Sculpt
Stamp
Edit
Analysis
Shaders
Export
Print
Transform
Coordinate Space
World Frame
Translate X 92.864 mm
Translate Y 3225 mm
Translate Z 1174.6 mm
Rotate X 0
Rotate Y 0
Rotate Z 0
Scale X 1
Scale Y 1
Scale Z 1
Size X 807.79 mm
Size Y 617.80 mm
Size Z 109.95 mm
Uniform Scaling
Enable Snapping
Absolute Coords/Sizes
Snap Step 25 mm
Accept
Cancel
Object Browser
Quirigua_StelaeE_320_rotated.stl
Quirigua_StelaeE_322.stl
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Quirigua_StelaeE_326.stl
vertices: 138809 triangles: 276555

Literatur

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- Boehm, J. “Natural User Interface Sensors for Human Body Measurement.” *ISPRS - International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* XXXIX-B3 (August 1, 2012): 531–36. https://doi.org/10.5194/isprsarchives-XXXIX-B3-531-2012 .

- Luhmann T. Nahbereichsphotogrammetrie: Grundlagen, Methoden und Anwendungen. 3 edition. Berlin: Wichmann, H; 2010. 668 p.
  - Kapitel 6.8 Low-Cost-3D-Sensoren, S.594-596

- Stylianidis, Efstratios; Remondino, Fabio (2016): 3D recording, documentation and management of cultural heritage. Caithness: Whittles Publishing. Available online at https://ebookcentral.proquest.com/lib/ub-bamberg/detail.action?docID=4710342