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3D reconstruction
of barley kernels

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Barley quality assessment

Color, texture and shape characteristics derived from 2D images can be used to assess barley quality and to identify barley varieties.

1. **How to produce 3D models of kernels?**

2. Does the analysis of 3D models improve quality assessment results?

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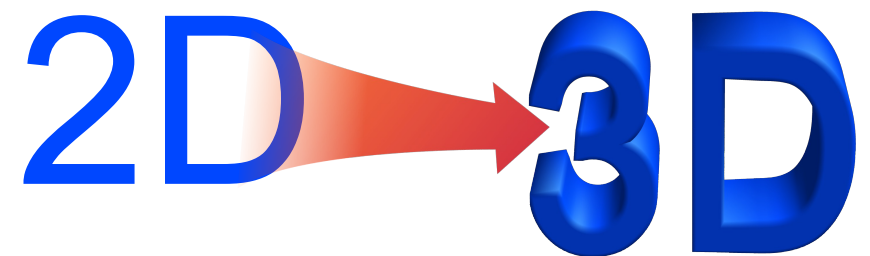
Goal

Compare techniques for 3D scanning able to produce models of barley objects.

- Single camera or stereoscopic camera system?

- Is a structured light required?

- Hand-held or stationary scanner?

- Simple and inexpensive scanner – possible?

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Approach 1

Inspection structured light 3D scanner Inspecvision Opti-Scan 3D

Cost: € 16000 and more

Way of acquisition: automatic by means of rotating table and structured light.

Source: http://www.messtechnik-inspecvision.de/

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Approach 1: result

👍 Object can be easily placed in front of the scanner,

👍 The resulting mesh is dense and encloses the whole volume,

👎 The surface is smothed with no sharp edges and no details,

👎 Creas is barely noticeable,

👎 Texture overlay is not available.
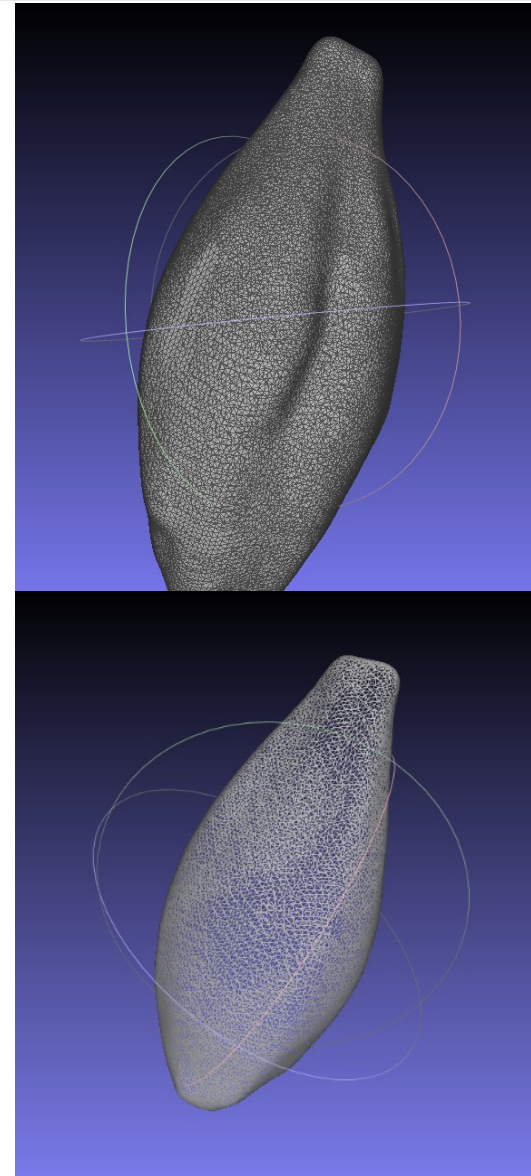
Rendered by Meshlab software

Approach 2

Handheld 3D scanner
Artec Spider 1.3MP,
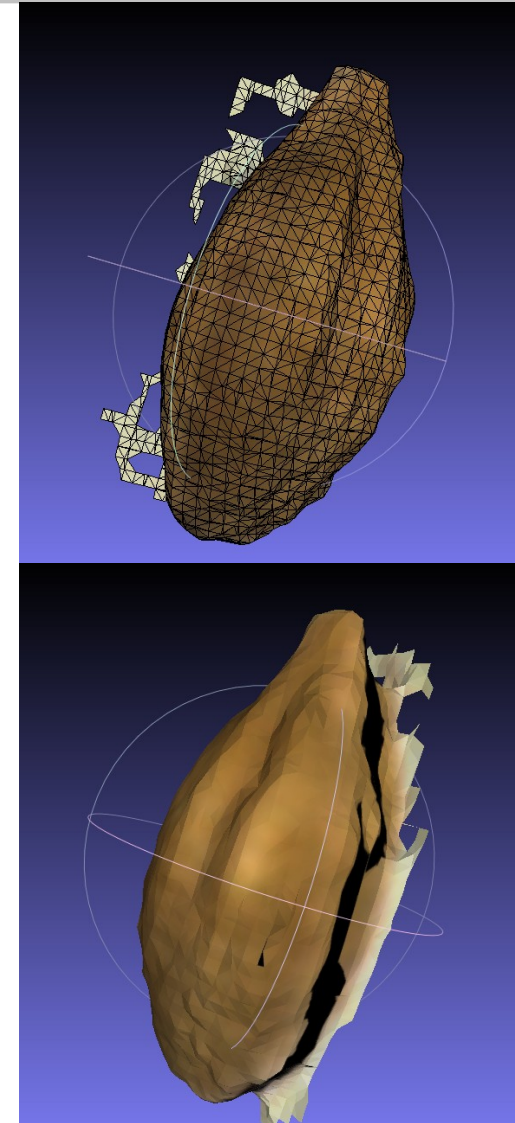
Cost: € 15700,

Way of acquisition: semiautomatic

User scans the object of interest
manually from different angles.
The reconstruction is automatic.

Source: http://objexunlimited.com/

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Approach 2: result

👍 Texture overlay is available,

👍 The resulting mesh is dense and encloses the whole volume,

👎 Ventral and dorsal sides have to be scanned and reconstructed separatly,

👎 Low spatial resolution,

👎 Background is not accurately removed from the model.

Rendered by Meshlab software

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Approach 3

Desktop structured light 3D scanner with a stand, for dental and jewelery applications — Solutionix Rexcan DS2

Cost: € 20000,

Way of acquisition: fully automatic by means of tilted and rotating table.

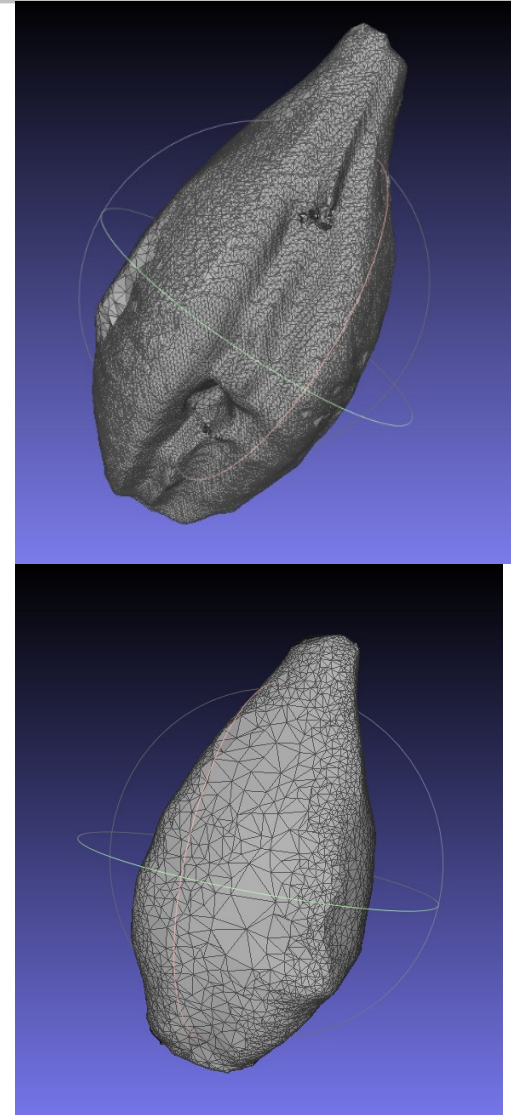Scanner is designed for digitizing very small and detail rich objects.

Source: htp://www.114shuibeng.com

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Approach 3: result

👍 Clearly visible crease, sharp and clear shape with visible details,

👍 Very good spatial resolution of upper side of the object,

👎 Worse spatial resolution of the bottom side,

👎 Inaccuracies and discontinuities,

👎 Texture overlay is not available.

Rendered by Meshlab software

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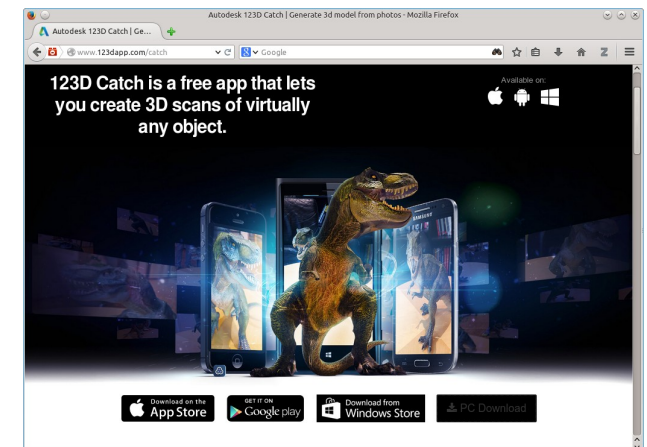Institute of Electronics

Approach 4

USB digital microscope
Delta Optical Smart 2MP
Cost: € 80

Autodesk 123D Catch
Web service
Cost: free

Way of acquisition: manually taken photos from a dozen of different angles. Photos are stitched into a 3D model on a web service.


Source: http://deltaoptical.pl/

Source: http://123dapp.com

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Approach 4: result

👍 Clearly visible crease, sharp with visible details,

👍 Good spatial resolution,

👍 Good quality texture overlay,

👍 Inexpensive device for scanning,

👎 Requires image preprocessing,

👎 Takes long to complete reconstruction,

👎 Incorrect reconstruction of brush side.

Rendered by Meshlab software

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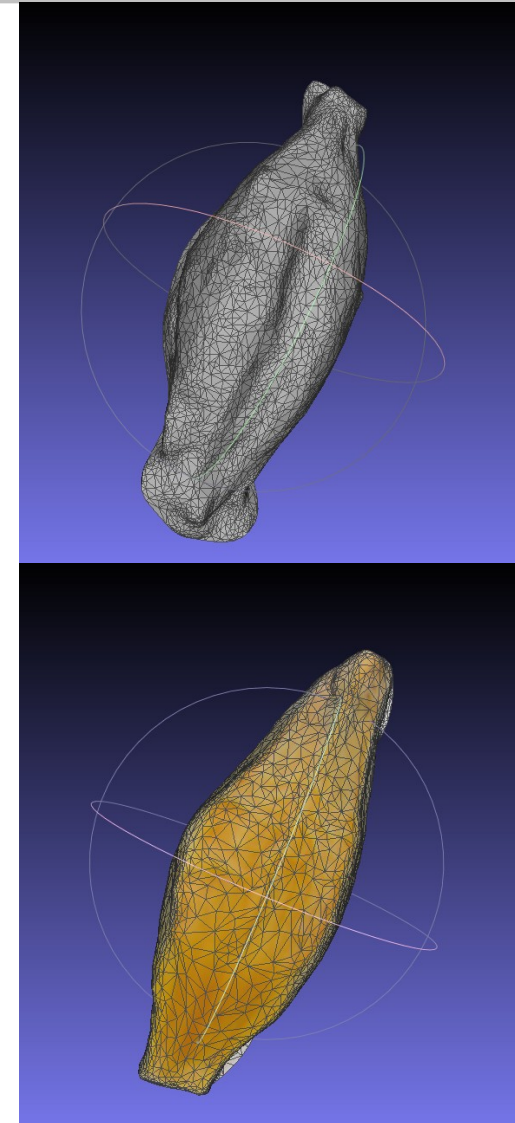
Conclusions

- Accurate 3D reconstruction of a barley kernel can be successfully performed at low cost

- The model can be scanned by means of single camera, there is no need to use structured light

- It is difficult to scan small objects by means of hand-held scanner

- Textured 3D model can be used for comprehensive characterization of color and shape of barley kernels

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