InvertNet: A New Paradigm for Digitization of Invertebrate Collections

Imaging Hardware for larger specimens

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InvertNet UIUC Team

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  - Systematic Entomologist
- John Hart – CoPI
  - Computer Science - Graphics
- Nahil Sobh – CoPI
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- Umberto Ravaioli – CoPI
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- David Raila – Senior Collaborator
  - Computer Science – Sr. Research Programmer

- Chris Taylor – CoPI
  - Systematic Astacologist






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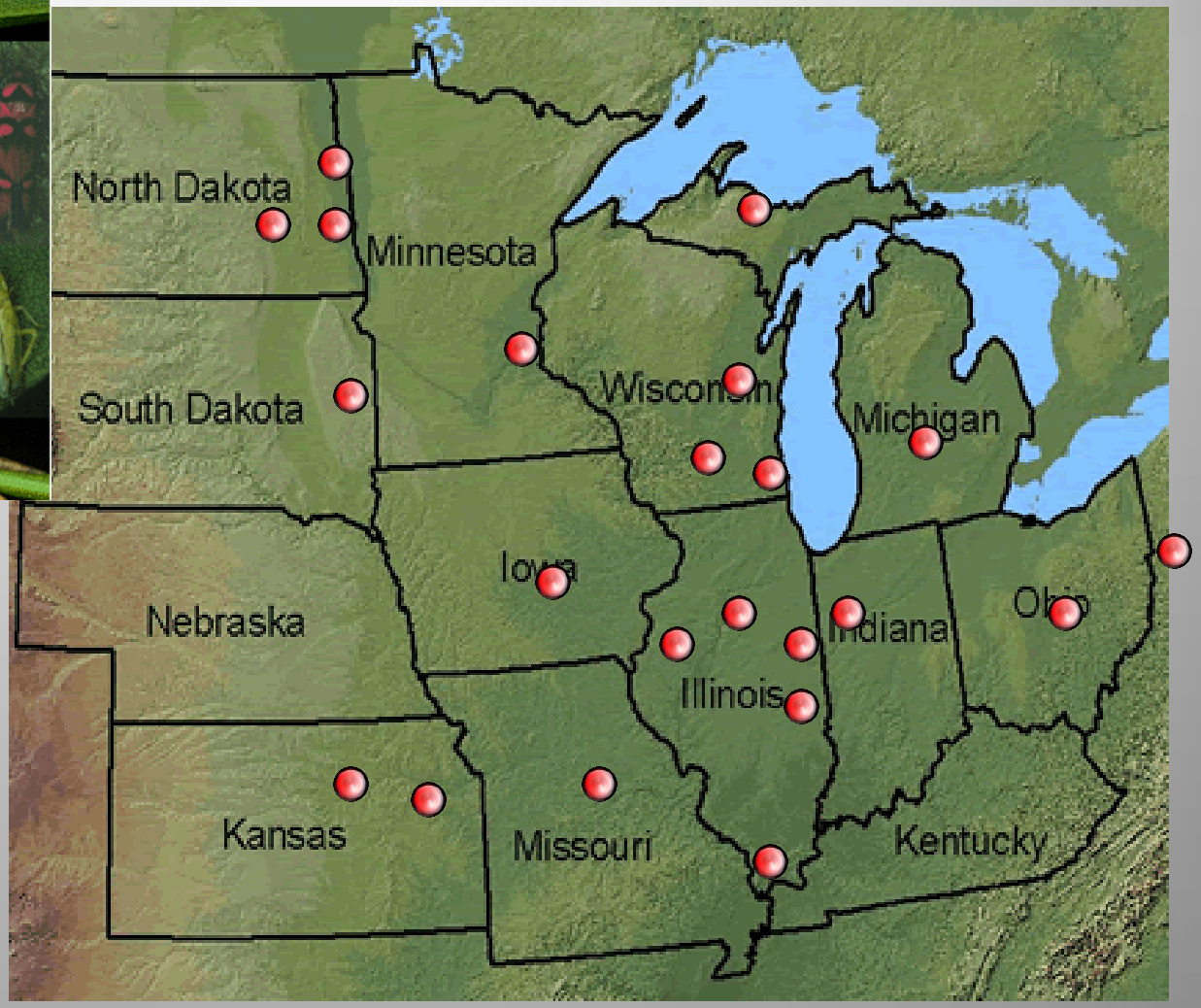
Scope



- 22 institutions
- 56 million specimens

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InvertNet Goals

- **Digitize all holdings of 22 arthropod collections (>50 million specimens)**
  - Specimen images and metadata (label info)
  - Drawers, vials, slides
  - Advanced imaging (including 3D)
  - Best quality at reasonable cost (~$0.10/specimen) and reasonable time investment

- **Provide access to images and other data via online virtual museum**
  - browsable/searchable/zoomable web interface
  - link to other data providers (GBIF,national ADBC HUB, etc.)

- **Provide platform for research and development of additional tools and resources**
  - Data mining and analysis
  - Community building, collaboration, and support
  - Education, outreach, and reference

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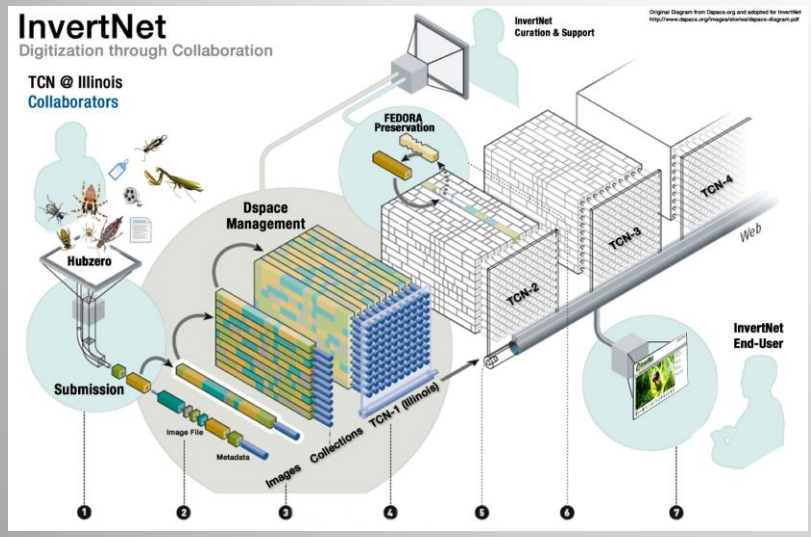
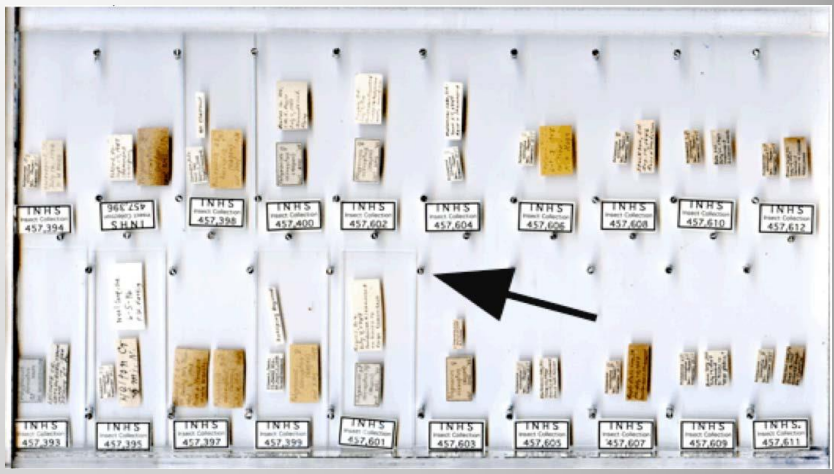
InvertNet Goals





- Digitization workflows
- Network architecture/data management
- Image capturing technology

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InvertNet Goals

- Image capturing technology

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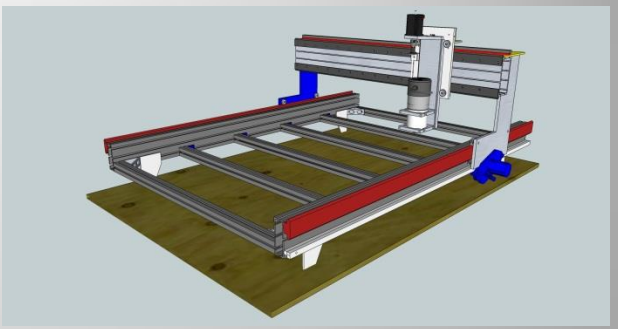
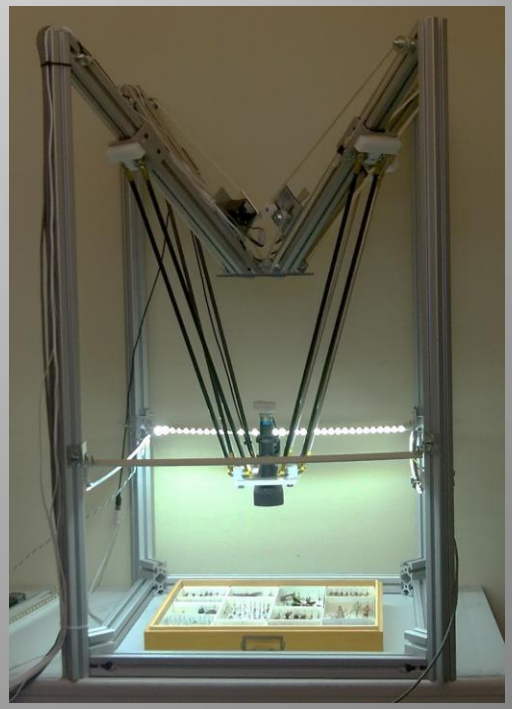
Digitization Workflows: Drawers

- tested 3 alternative systems for automated capture of high-res images of drawers
  - **GigaPan robot**
  - **CNC machine**
  - **Parallel robot**
- preferred system includes following hardware:
  - **custom assembled robot with aluminum frame and 4 pairs of carbon fiber arms controlled by precision stepper motors**
  - **high-res industrial camera**
  - **telecentric len**
  - **LED lighting array**
- software detects edges of drawer and moves camera over a grid capturing multiple images of drawer

GigaPan



CNC machine



parallel robot

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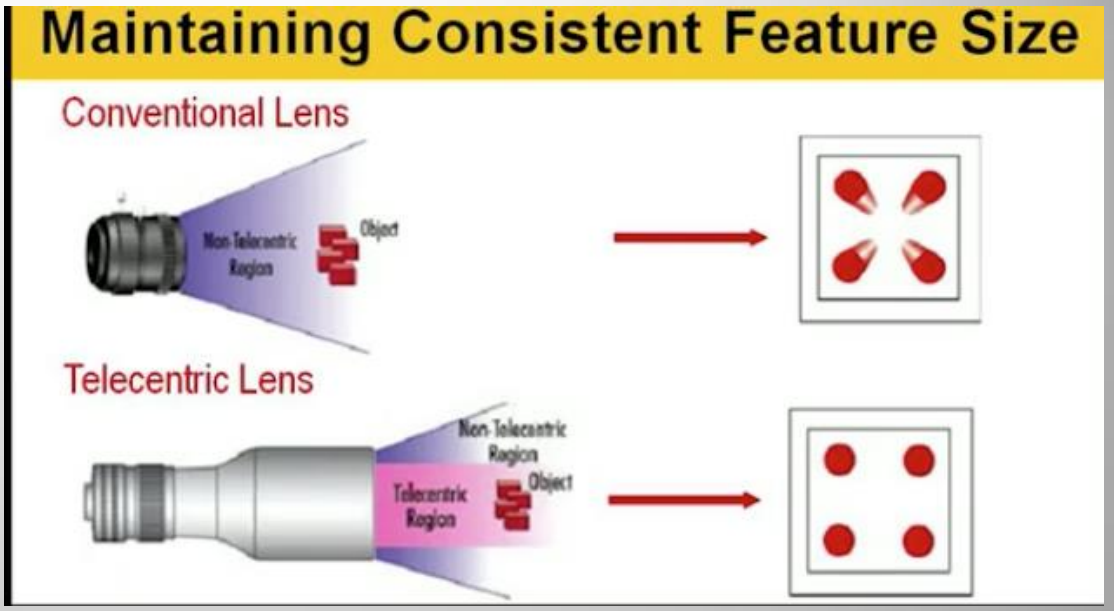
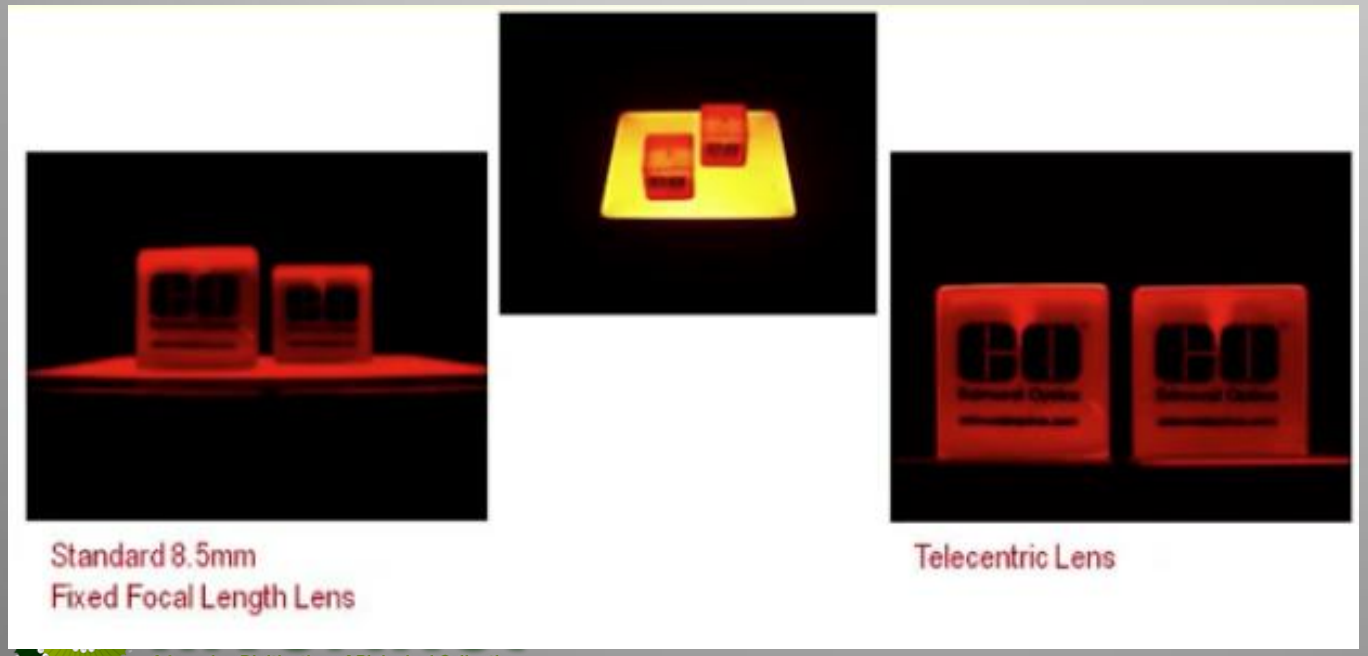
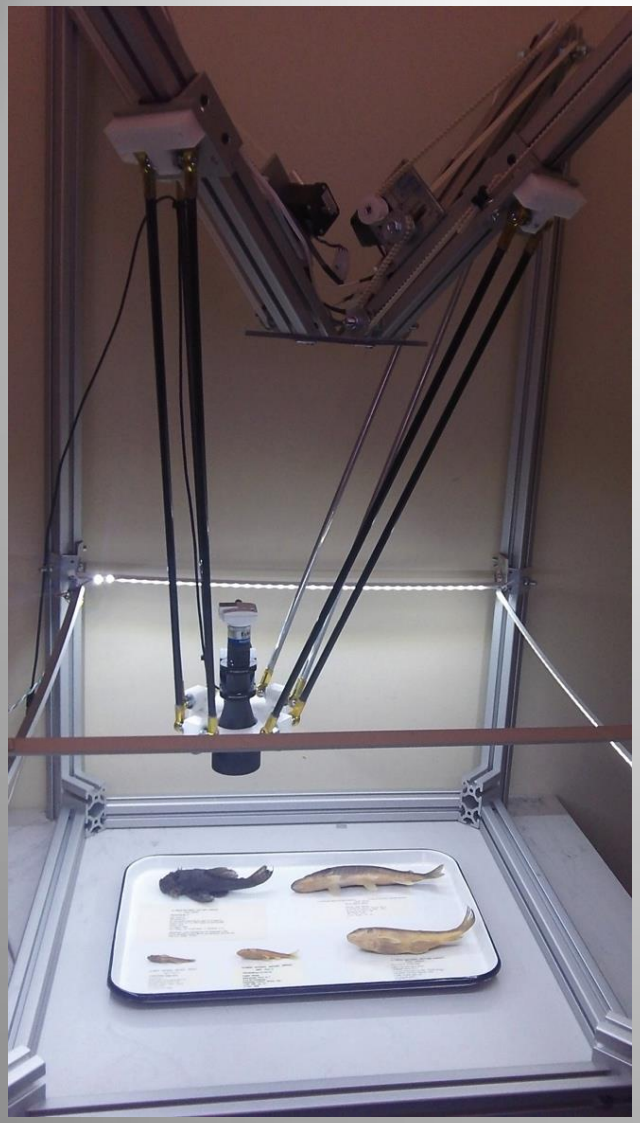
Maintaining Consistent Feature Size







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Imaging Setup

- Custom designed precision robotics system
- Precision machine hardware (“over the counter”) and machine control software
- High-res industrial camera with low-distortion telecentric lens (1.2X, 120mm working distance, 3 MP)
- 24”x 24” work platform
- State of the art computer vision system (OpenCV)
- Easy to use – automated
- Raw images stitched together to produce single very high resolution 2-D image

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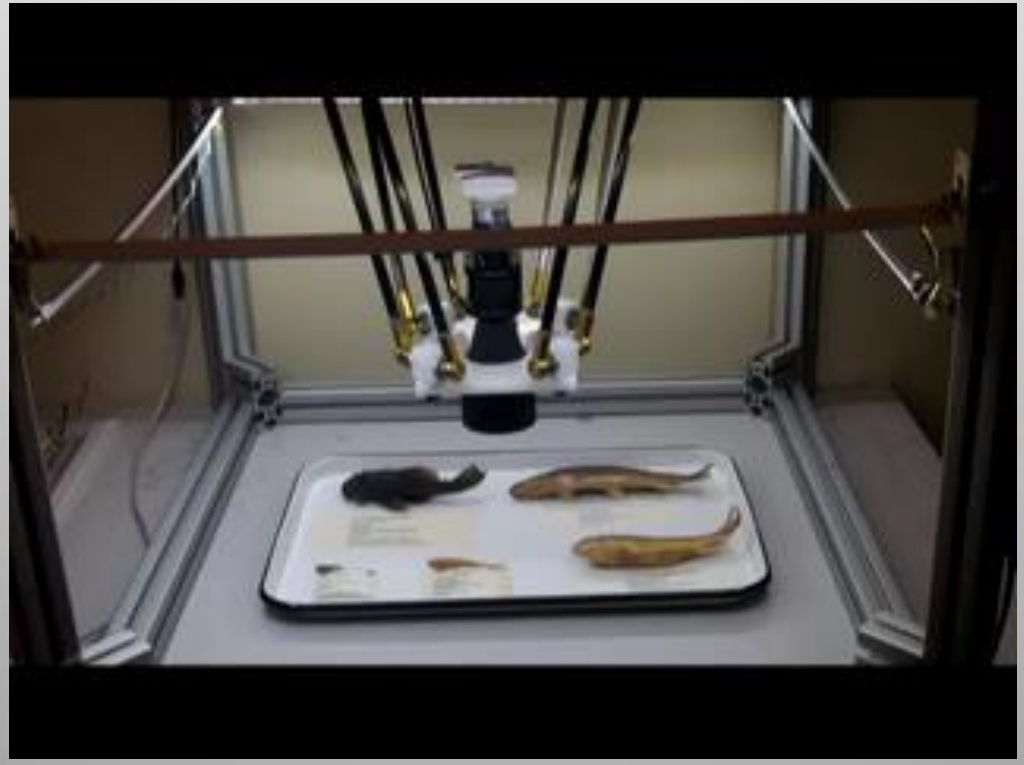

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Results

- **3 – 5 minutes per tray (size and speed are programmable)**
- **One stitched PNG image**

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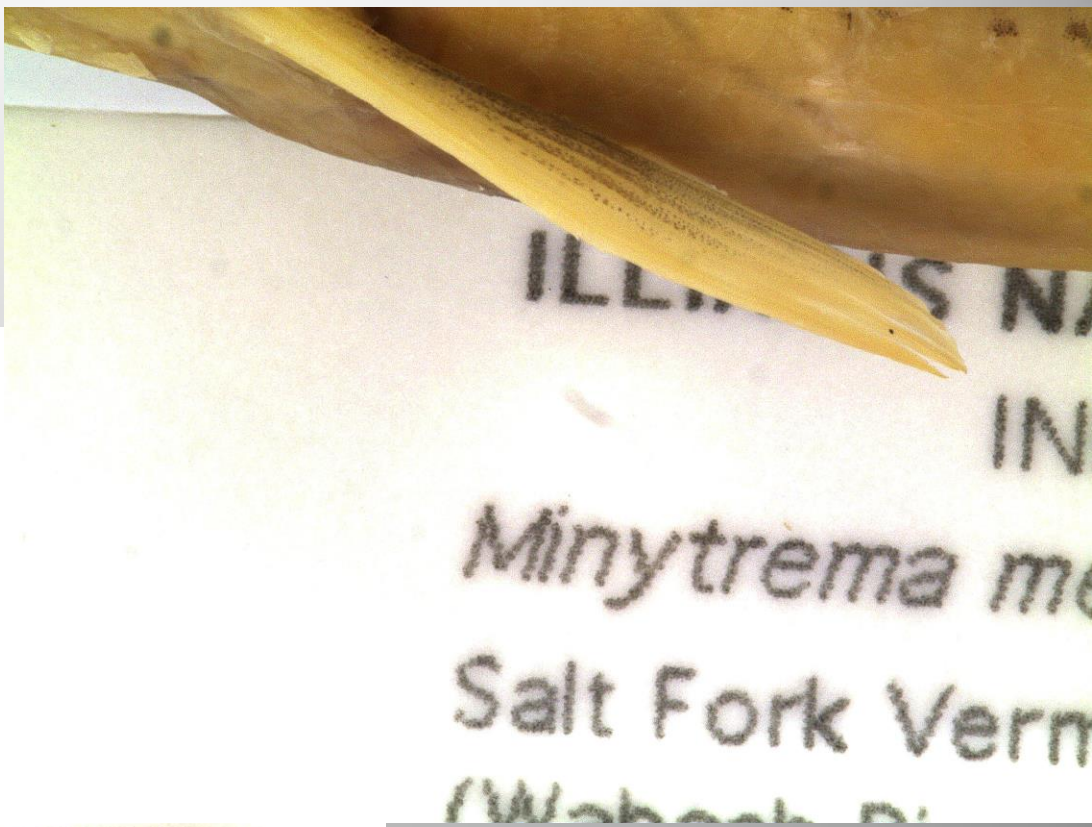
Results



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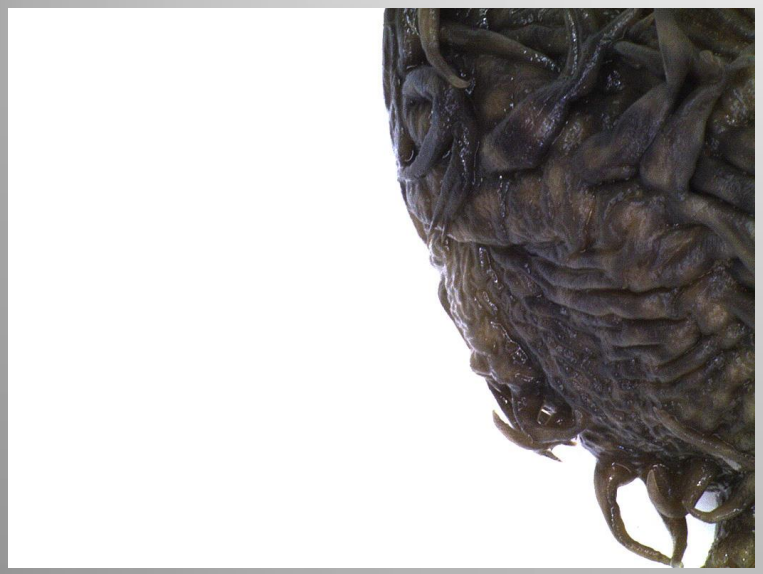
Results



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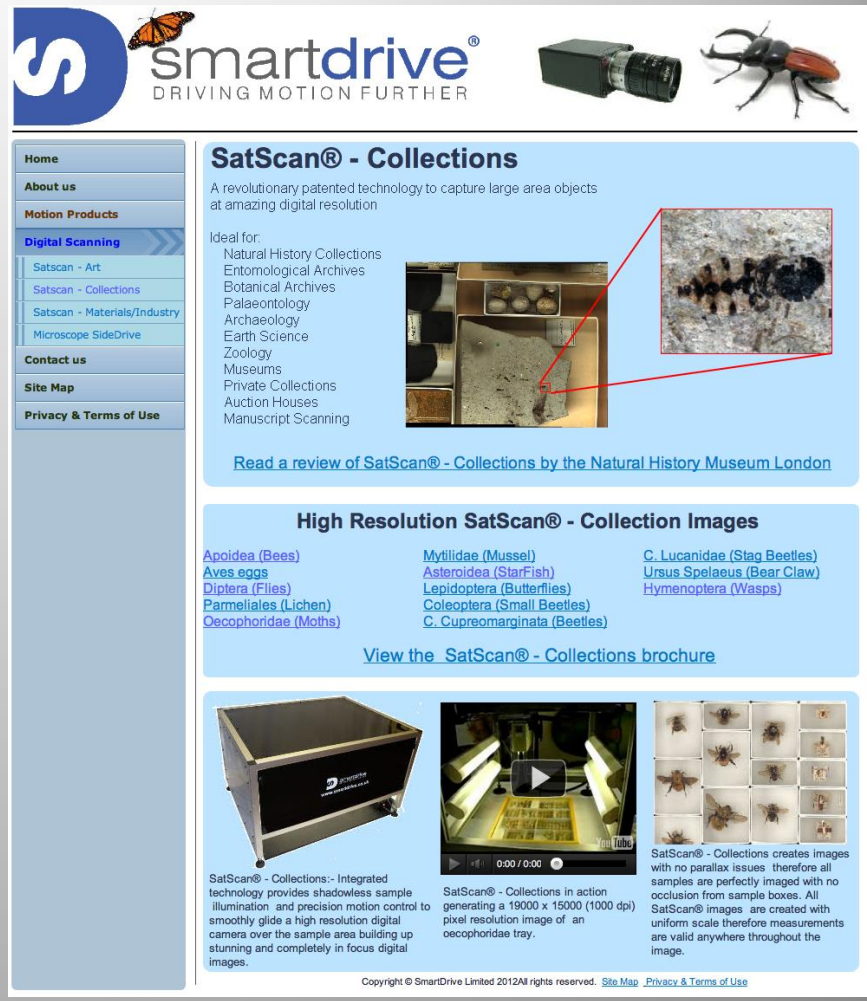
Hardware Cost

- Issues

  High end cameras/robots and lighting are prohibitive



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Hardware Cost

- Total cost of hardware and software (including computer) is around $5000

- Interface will be very user friendly

- Software needs to be pre-loaded by us

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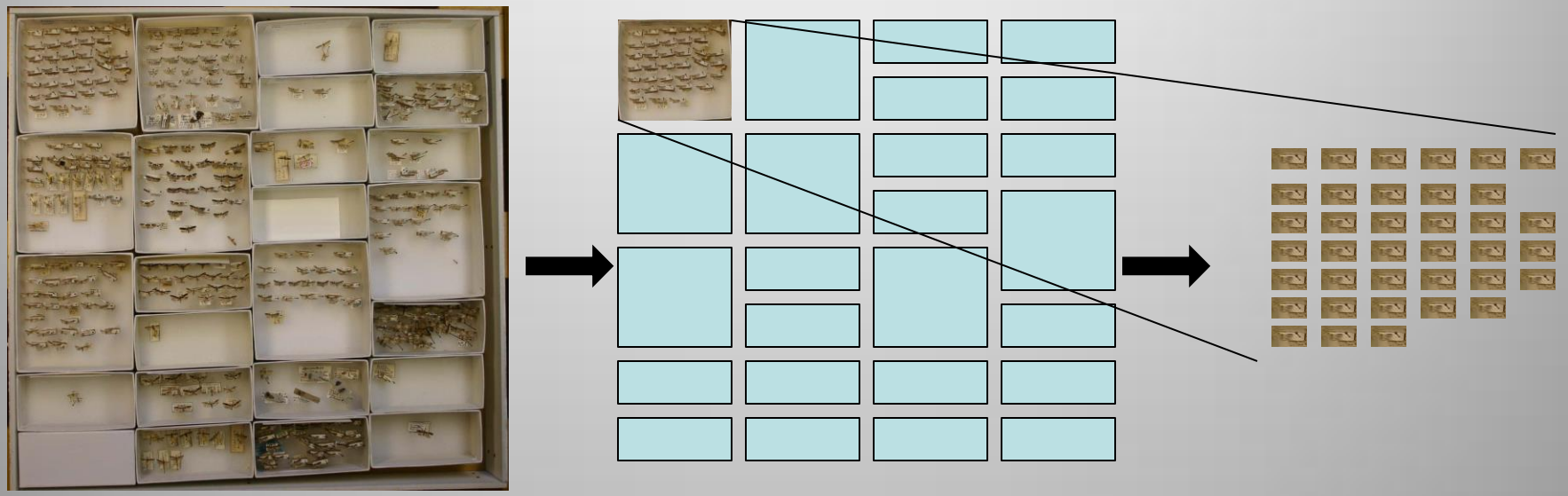
Stitched images post-processing



1. capture image of drawer + metadata (location, contents)
2. segment unit trays (image analysis software)
3. segment specimens
4. capture label data

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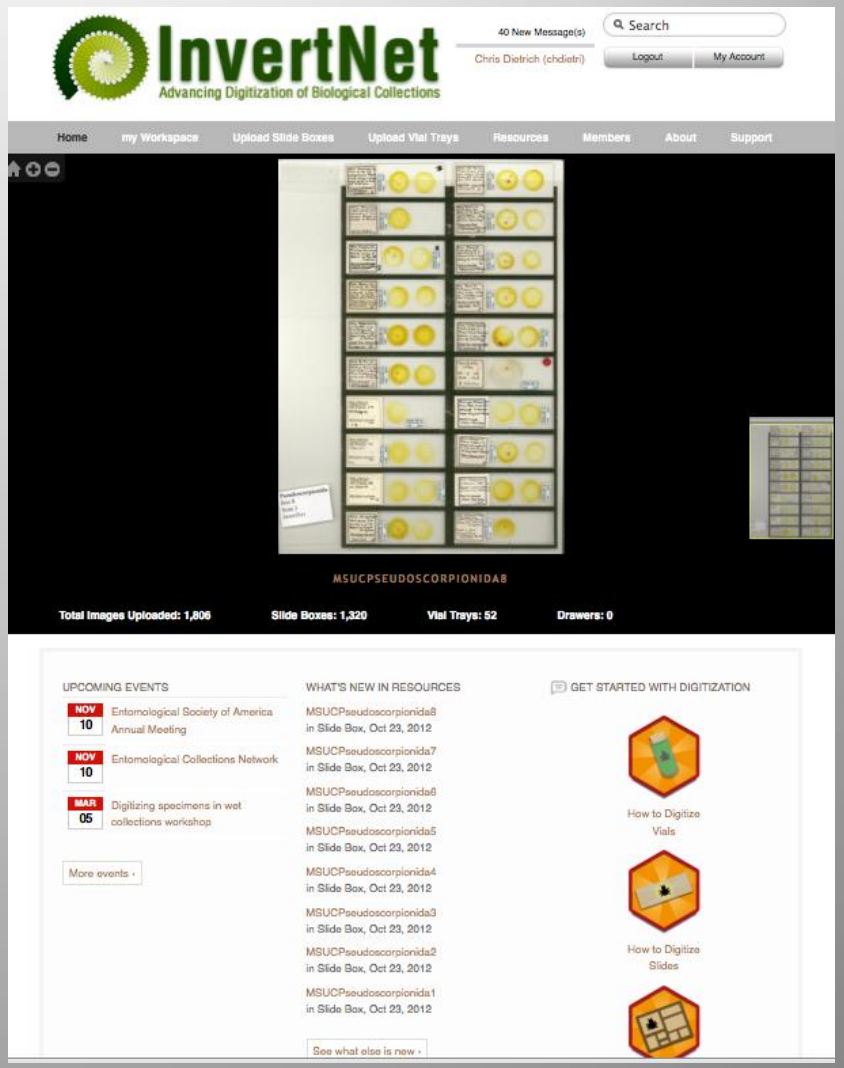
The Future

- continue to refine and further automate digitization workflows
- Incorporate pan tilt head on camera to allow for 3D reconstruction

Website – please visit

- InvertNet.org
- registration is open to all and available now



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Acknowledgements

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