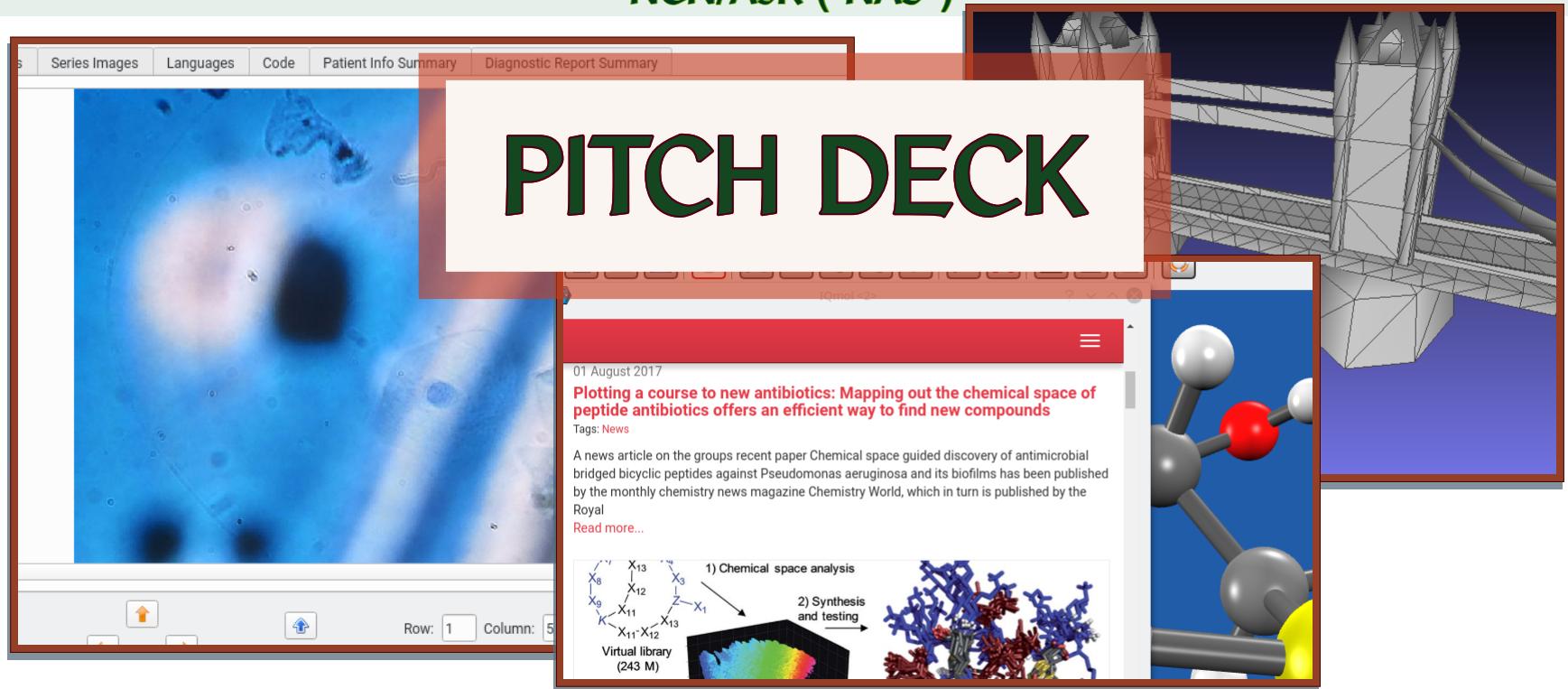


An Advanced Native Application Development Framework Integrated with Cloud Back-Ends

NCN/A3R (“NA3”)



Linguistic Technology Systems (LTS)
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LTS Team Members

Principal Investigator

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Capital Raising for Seed, ROI, and Exit Plan

- ◆ New Jersey-based home-grown female-headed software development company for native applications launching “Seed” between \$1.5 and \$2 million.
- ◆ Conservative burn with 5 year exit plan.
- ◆ Company valuation at \$100 Million at exit.¹
- ◆ Business model: customization, hosting, and licensing.²

¹ See Slide 13 for development stages and exit strategy.

² See Slides 11 and 12 for details.

Vertical Markets

- ◆ **Scientific Computing:** Providing a canonical framework for implementing cloud back-ends to augment the features of technical/scientific desktop software.
- ◆ **Bioinformatics and Pharmacology:** Streamlining the implementation of complex applications that manage multi-faceted data structures — integrating clinical, chemical, demographic, epidemiological, and imaging/radiological data — at both the analytic and User Interface levels.
- ◆ **Civil and Industrial Engineering and Educational Software:** Augmenting the engineering, educational, and industrial-design applications with cloud back-end services which have inter-application networking/workflow capabilities. Similarly, augmenting multi-media publication viewers in order to enable a richer reading experience of documents that describe engineering or industrial designs and artifacts.
- ◆ **Cyber-Physical Systems:** Implementing rich-client monitoring software paired to cloud services hosting realtime IoT data.
- ◆ **E-Commerce/Real Estate:** Assisting developers in the implementation of rich-client front-ends (as alternatives to web applications) for sectors such as e-commerce and real estate.

Baselines For Projecting LTS Growth

This slide considers sample Qt-based or innovative GUI-focused companies to establish a baseline for assessing the future growth of LTS.

- ◆ **The Qt Group Plc** *€45.6 Million annual revenue* (source: Qt) Financial records released by The Qt Group suggest that commercial “Developer” and “Distribution” licenses are Qt’s largest revenues source: The Qt Group aims for 60% revenue from licenses, 20% from consulting, and 20% for “support and maintenance” — total net revenue across these sources was the equivalent of US \$57 Million.
- ◆ **ICS (Integrated Computer Solutions)** *US \$25-50 Million annual revenue* (source: Glassdoor) ICS specializes in custom software development for companies in the military, aeronautics, and biomedical sectors. ICS exemplifies a Qt company whose revenue derives mostly from customization and consultation.
- ◆ **Toradex** *US \$16.2 Million annual revenue* (source: owler.com) Toradex specializes in microprocessors and embedded systems, one of the largest of several Qt partners focusing on embedded systems with Qt front-ends for touchscreens and/or desktop consoles.
- ◆ **Galois, Inc.** *US \$43.80 Million annual revenue* (source: RocketReach) Galois is not a Qt partner, but they have published sophisticated research on UI implementation and Functional Programming, helping to lay the scientific foundation for next-generation rich-client software, as well as cyber-security and software trustworthiness.

Our NCN (Native Cloud/Native) Protocol for Cloud Back-Ends

Cloud/Native Components as Back-Ends for Native Software

- Our “Native Cloud/Native” service is also a protocol, which governs native application front-ends paired with Cloud/Native (back-end) container instances.
- Code libraries and data representation may be shared across both endpoints.
- Common representation on both server- and client-side streamlines network communications (no need to marshal data between different formats).
- Our NCN technology can be ported to other (non-Qt) application frameworks (wxWidgets, XCode, MFC, etc.).
 - Note: This presentation will focus on NCN’s default Qt implementation.

How Cloud Back-Ends Enhance Native Front Ends

- Cloud Backup ● Share Data between Users ● Collaborative Editing
- Maintain users’ application state across different computers (home/school/office)
- Upgrade running applications without needing to re-compile

NCN Addresses Limitations of Qt in the Cloud

Qt is the most popular native, cross-platform application-development framework.

- ◆ ~1 million active developers ◆ Over 5,000 client companies ◆ Worldwide “Qt Partners” Ecosystem ◆ ~US \$25 billion overall market

However, there is Limited Qt Cloud Integration Support

- “Qt Cloud Services” Discontinued in 2016.
- Currently there is no standard model for accessing Cloud services from Qt applications.
- Nor is there a standard Qt-based Cloud/Native container architecture.

How NCN Addresses Limitations of the Semantic Web

Many experts have critiqued the Semantic Web for lacking conceptual rigor, adequate modeling for multi-scale information, and intrinsic representations for Quality Assurance Requirements. To address these limitations, NCN introduces new Semantic Web technologies with the following features:

The Application-as-a-Resource (A3R) Model

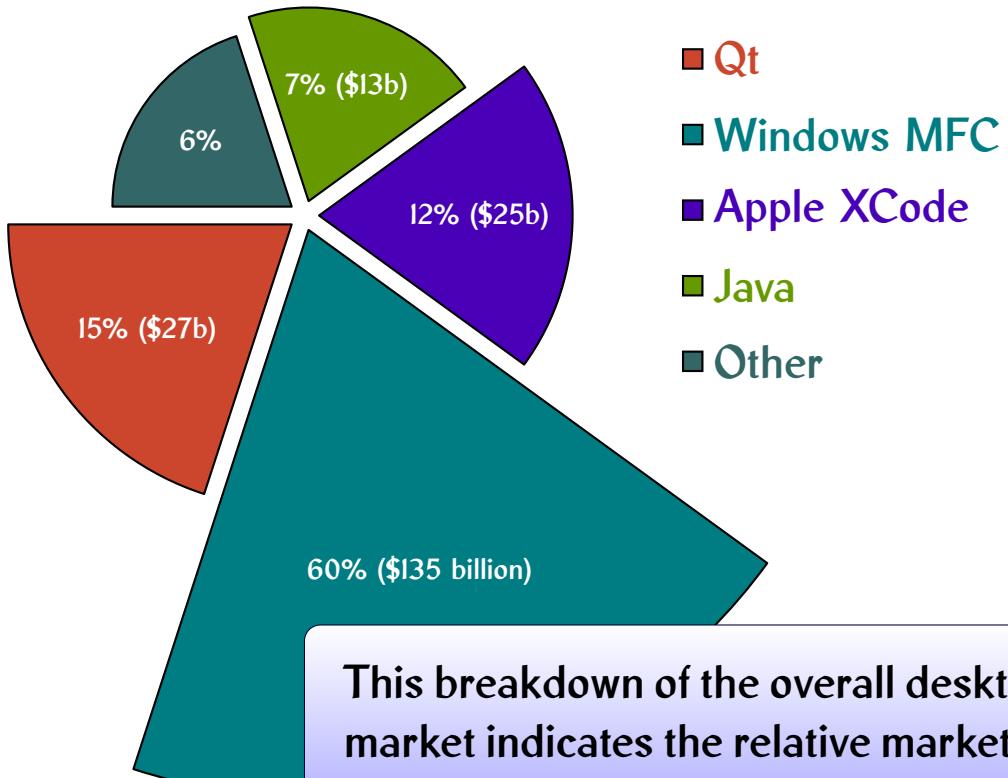
- A3R Applications are self-contained, citable resources and tools which can conform to modern resource documentation standards, such as the Research Object protocol.
- A3R includes a representation for natural language publications (e.g., books and articles) that unifies different manuscript formats (such as XML, L^AT_EX, and XCONCUR).

Multiscale, Requirements-Focused Resource Description

- NCN/A3R (combinatorially called “NA3”) incorporates Semantic Web alternatives with greater Quality Assurance precision, such as Conceptual Space Markup Language.
- Hypergraph-based Resource Framework to intrinsically support multi-scale data structures.
- Workflow-oriented “Meta-Procedure” Interface Definition framework to enforce procedural alignment among applications.

Overview of the Software Development Market

This slide offers a rough breakdown of the software development market, (estimated at \$350 Billion), restricted to desktop software (roughly one-half the total market), including both cross-platform and single-platform solutions.



Taking the Qt implementations of the NCN and A3R protocols as a prototype, analogous versions may be built targeting other popular software-development platforms (see next slide for a more detailed outline).

This breakdown of the overall desktop application-development market indicates the relative market share of different platforms against which the NA3 protocols may be implemented.

Our NCN Business Strategy

Within the Qt Market

- Promote NCN as a standard solution for Qt/Cloud Integration.
- Promote NCN developer tools for custom Qt scripting/markup languages.
- Promote NCN's Semantic Web protocol as a standard model for inter-application networking, describing applications, and serializing application-specific data structures.
- On the basis of these enhancements to the Qt ecosystem, LTS hopes to join the **Qt partners** program, which would expose NCN's unique features to a worldwide developer community.

Outside of Qt (see slide 14)

- Port the NCN Protocol implementations, C++ reflection model, and hypergraph libraries to standard (non-Qt) C++ and other languages.
- Implement language-agnostic hypergraph serialization to allow NCN networking between applications written for different operating systems and/or programming languages.

NCN Revenue Sources

- ◆ **Customization** Custom-implemented applications using project-specific versions of NCN and/or A3R (see next slide).
- ◆ **Licensing** Commercial licenses required for any deployment of NCN outside LTS-controlled servers and/or any commercial deployment of A3R applications.
- ◆ **Hosting** Running proprietary containers via a Cloud-Native service such as OpenShift, LTS can offer integrated hosting and consulting wherein LTS fully implements and maintains a back-end paired to any desktop/native client software. (Because the expertise involved in building native desktop applications is very different from the techniques required to deploy a Cloud-Native container image, the option of delegating all backend responsibilities to LTS may appeal to Qt-oriented development teams.)
- ◆ **Sponsorship** Running a data-sharing platform which would be a publicly-visible introduction to NCN. This “demo” container would host research data sets (and would therefore be a resource in the public interest) allowing LTS to receive compensation from companies financially supporting the portal because it is a technology which benefits science and research.

Monthly Customization Revenue Procured Per Client

Figures refer to initial client-development fees, followed by monthly hosting/license fees.

- ◆ **Custom NCN Servers** LTS builds special versions of NCN which natively recognize client's application-specific data types, preferred serialization formats, and client/server interface definitions.
(dev: \$75K; licensing: \$10K/month)
- ◆ **Custom Markup and Scripting Languages** LTS builds scripting and/or markup languages customized for clients' unique data and interface requirements. These custom languages may be used for data serialization, testing, prototyping, and runtime fine-tuning of application behavior.
(dev: \$250K; licensing: \$10K/month)
- ◆ **Custom GUI Components** LTS builds GUI classes on client's behalf, which natively support NCN integration. (dev: \$50K; licensing: \$5K/month)
- ◆ **Workflow Management** LTS customizes networking protocols so that multiple applications may be unified into distributed workflows.
(dev: \$50K; licensing: \$15K/month)

Development Phases and Exit

- I (9-12 mos) Establish a hosting platform (projected to take the form of a RedHat Enterprise Service or Kamatera Partner affiliation) within which LTS can license individual cloud back-ends on a per-client basis, paired with clients' desktop front-ends. We will make tools available to help developers create applications that leverage NCN back-ends, including those hosted by our company.
- II (1-2 yrs) LTS will prioritize marketing its development libraries and cloud service, with an emphasis on explaining to Qt-based companies that the LTS hosting option provides functionality similar to the discontinued Qt Cloud Services.
- III (2-4 yrs) Generalize NA3 to standard C++ (eliminating Qt dependencies), implement NA3 in an Apple-specific version targeting XCode, port NA3 to Java, and build a Windows-specific implementation via MFC.
- IV (5th yr exit) With NA3 now realized in Qt, Windows, Mac, and Java versions, consolidate each of these implementations into canonical container prototypes, such as RedHat "Cartridges". This collection then becomes a comprehensive, multi-platform desktop/cloud integration technology valued at \$100M, potentially sold as a product suite to cloud and/or desktop-software vendors such as RedHat, Autodesk, Amazon (via Amazon Web Services) or Adobe.

NA3 In Different Software Ecosystems

Potential NA3 Markets (see Slide 9 for overview)

Windows MFC (~\$135b market size) NA3 components can be implemented in MFC (Microsoft Foundation Classes) and C++/CLI, building off of a generic-C++ version using the C++ Standard Library in place of Qt-specific data structures.

Apple XCode (~\$25b market size) Apple Operating Systems are based on Linux, so Linux-oriented A3R implementations can form the basis of an XCode version. This XCode implementation would also be built around the C++ Standard Library.

JavaFX (~\$12.5b market size) The Java programming language provides the most widely used cross-platform application development framework outside of Qt. It is feasible to port C++ NA3 implementations to Java. The core of this re-implementation would involve designing a Java Hypergraph Library compatible with the A3R serialization and Interface Definition protocol.

Workflow Management (~\$10b market size – source: MarketsandMarkets) NA3 plugins can be added to new or existing applications to support inter-application networking, unifying multiple applications into workflow-management systems.

Example Use-Cases

Inter-Application Networking and Workflow Management

- Export data and instructions between Qt-based applications (slides 16-17).
- Embed document or multi-media viewers inside scientific or dataset applications (slides 28-31).

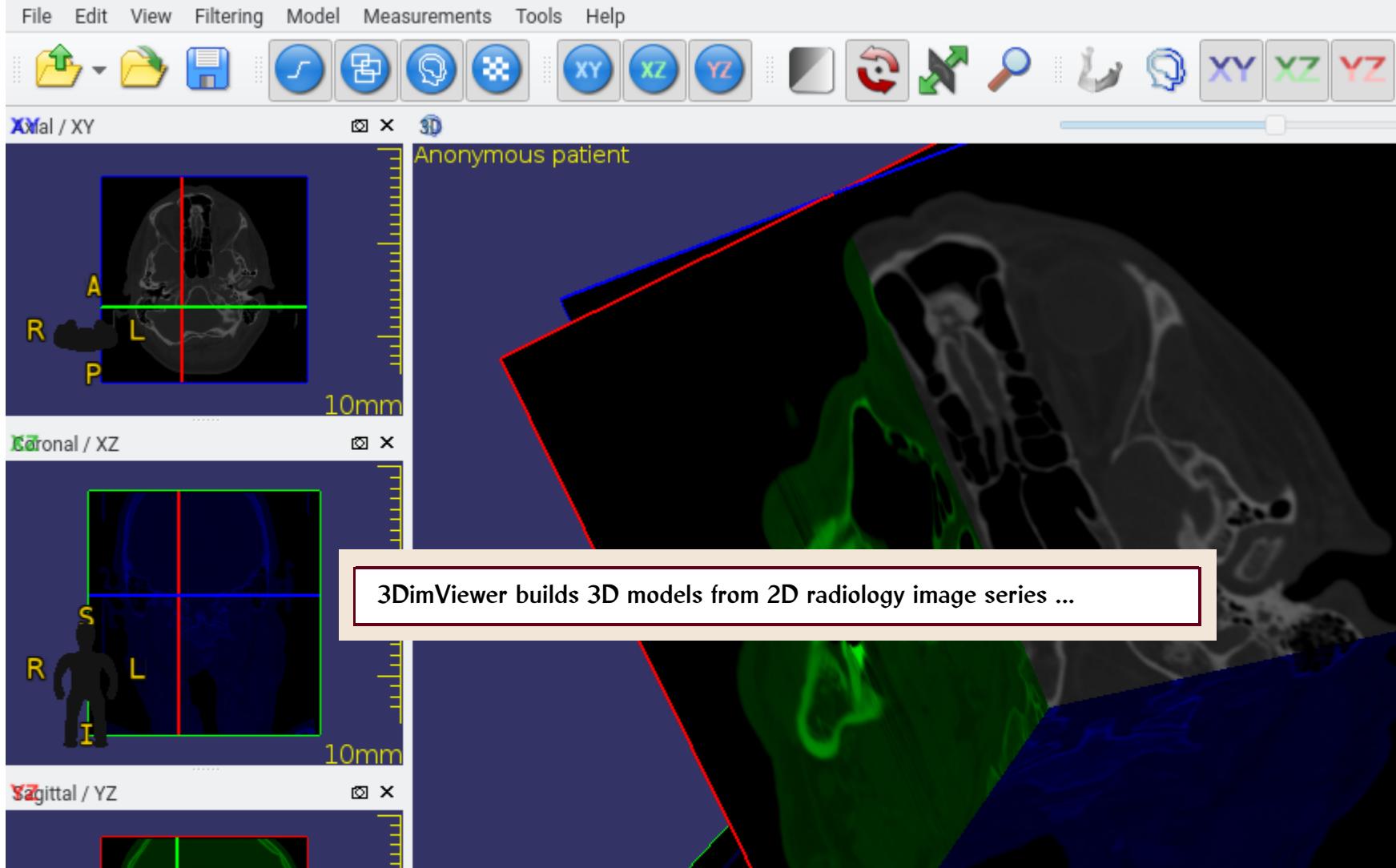
Responsive desktop-style applications for enhanced UX

Native applications offer superior User Experience, leveraging distinct interactive features of desktop GUIs: context menus, dialog boxes, tool tips, Multiple Window Display, dock windows, and so on:

- Compelling front-ends for e-commerce (Note: “46% of global online retail orders happen on desktop”, source: lefronic.com), Real Estate, VR, etc. (slides 21-27).
- For scientists and researchers, build innovative data-collection instruments as well as interactive Research Object applications (slides 18-20).

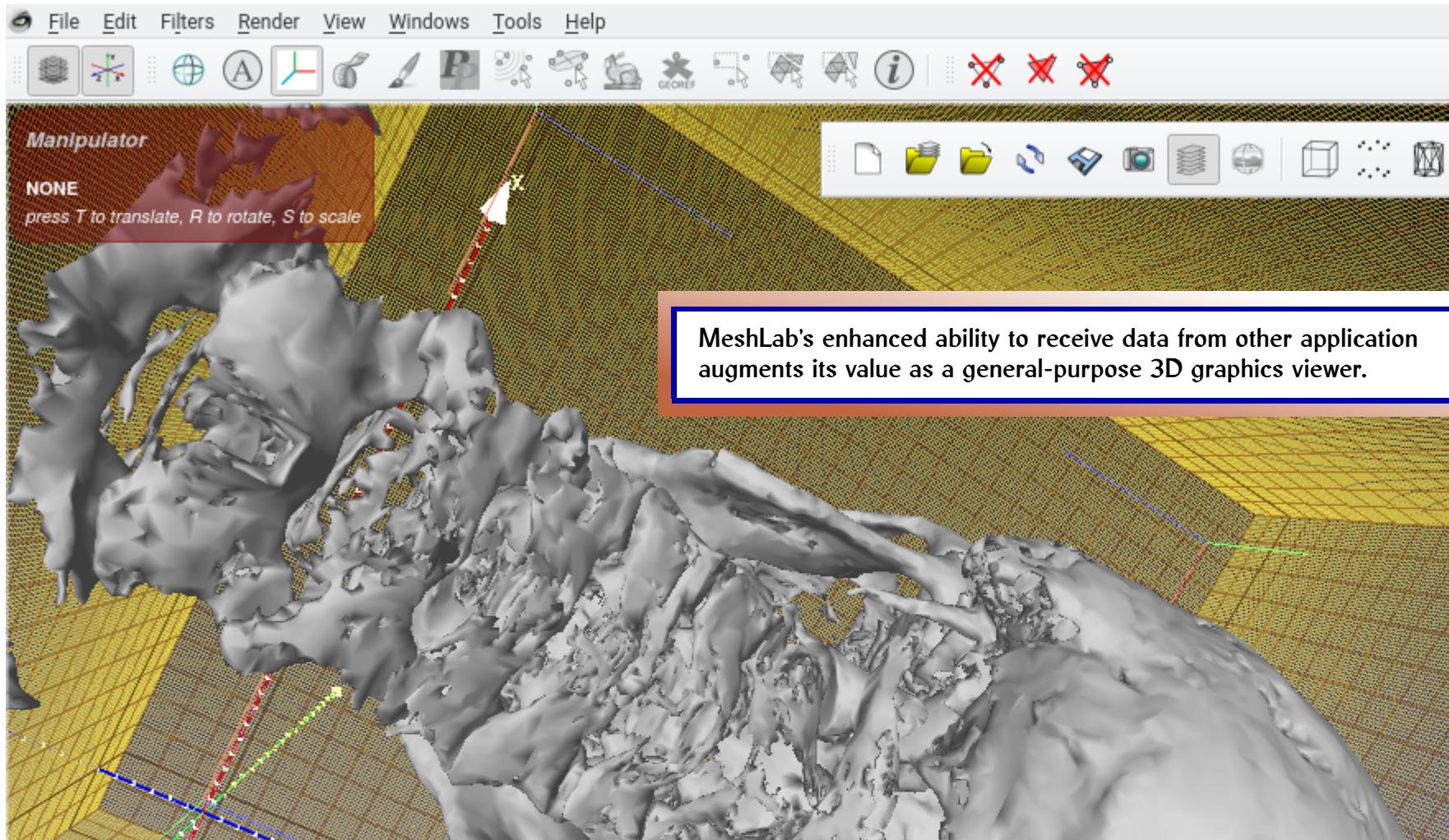
An Example of Inter-Application Networking

This slide and the next demonstrate a case-study where inter-application data sharing enhances the capabilities of two applications: 3DimViewer (a radiology tool) and MeshLab (a 3D graphics engine).



3D Graphics Sent to MeshLab

... Once the 3D tissue sample is constructed by 3DimViewer's algorithms, an A3R inter-application networking protocol (implemented as an extension to both applications) allows 3DimViewer to export the model to MeshLab so that it may be studied in a more comprehensive 3D viewing environment.



A3R Applications as Data Collection Instruments

Forms Web Language Help About

Save Form Open Form Cloud Save Cloud Open Submit Form

Page: 0 Search for: Forwards

ndp-main-outline <5> ? ^ X

Welcome Web Form Outline

Click on a subheading to continue

Patient Information
Chief Complaint
Review of Symptoms
Treatment History
Medical History
Current Medications
Family History

Referring Doctor: Dr. New Test

Referred By (Choose One): Clinical Specialist

Date of Visit: 1/9/16

Please List your Previous Surgeries

Sun	Mon	Tue	Wed	Thu	Fri	Sat
31	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

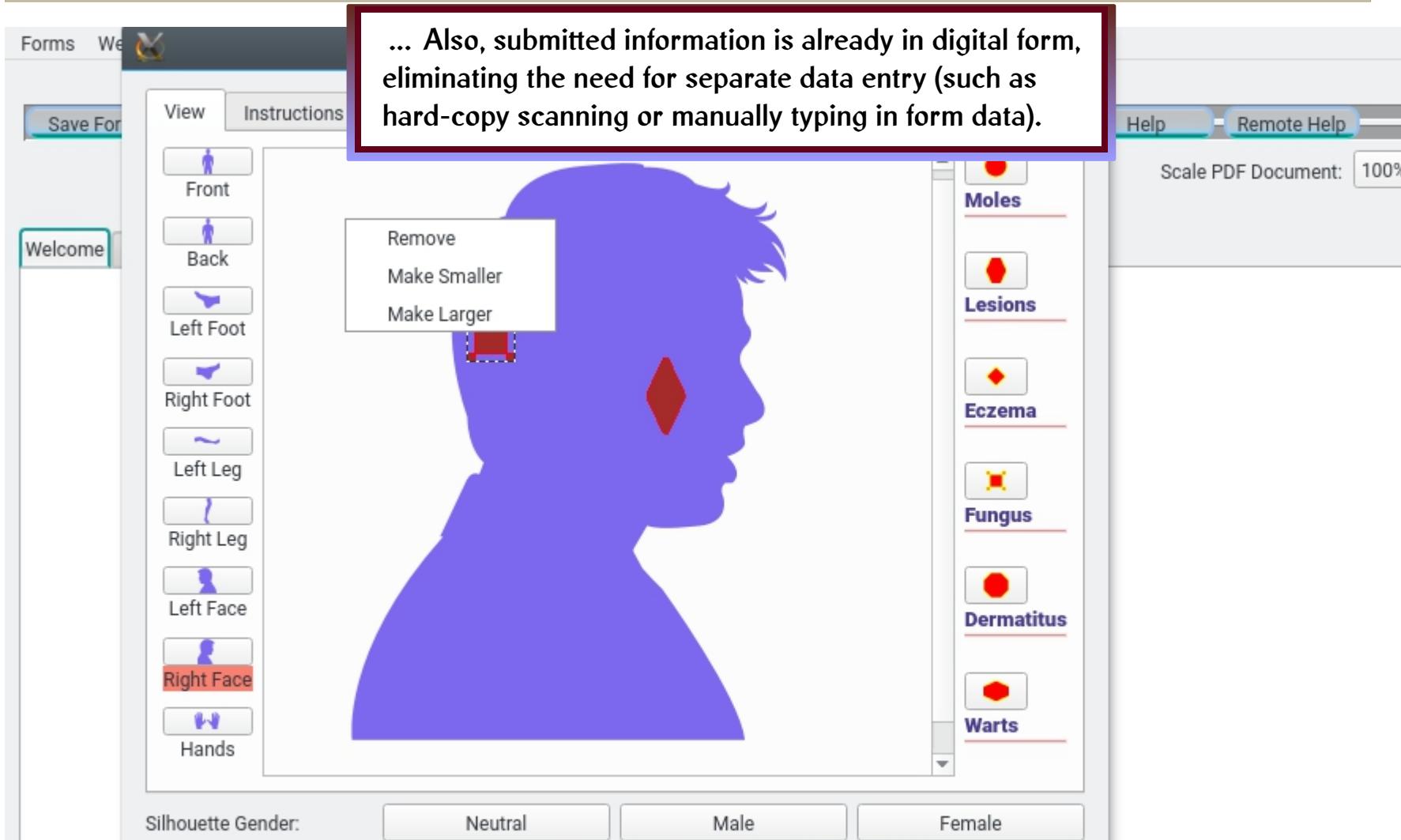
OK

In the screenshot, a modal dialog box titled "ndp-main-outline <5>" is displayed. It contains fields for "Referring Doctor" (set to "Dr. New Test") and "Referred By (Choose One)" (set to "Clinical Specialist"). Below these is a date picker set to "1/9/16". A sub-dialog titled "Please List your Previous Surgeries" shows a grid of dates from January 1 to January 31, with two entries: "Test 2" on Jan 1 and "Test 1" on Jan 21. The "OK" button at the bottom left of the sub-dialog is highlighted.

In medicine and social science, “data collection instruments” (DCIs) refer to surveys, questionnaires, and other tools to obtain human feedback.

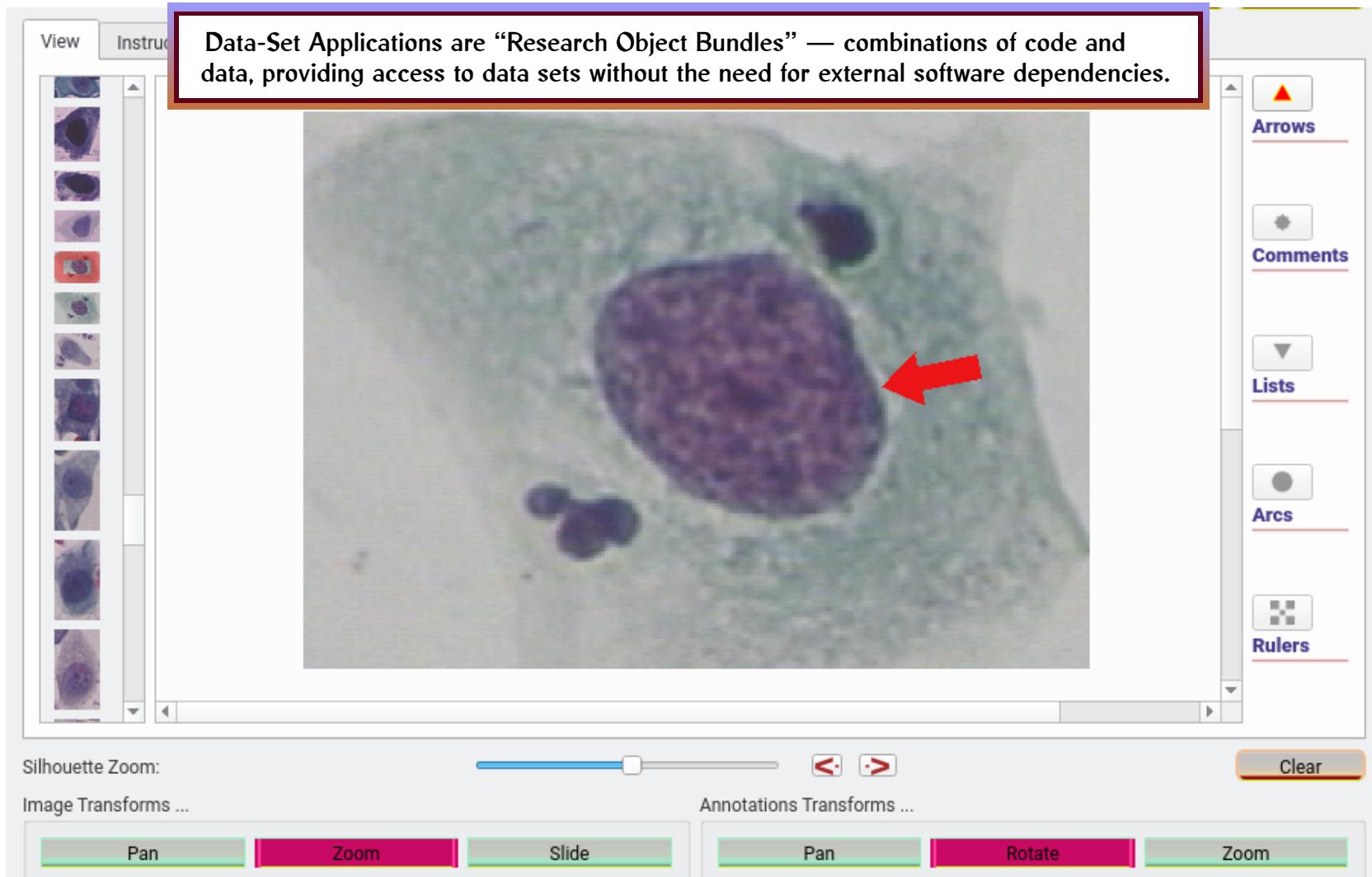
Qt-Based Interactive Forms

Data Collection Instruments implemented as native desktop applications can have easily navigable, interactive forms that make it simpler for physicians to provide information ...



A3R Applications as Research Objects

Complementary to A3R components which facilitate *obtaining* research or experimental data, A3R “Data-Set Applications” are also powerful tools for visualizing and analyzing research findings.



Native Applications as Interactive Catalogs

As a case-study in enhanced User Experience afforded by native applications, consider how static PDF catalogs and brochures can be turbo-charged into engaging, interactive software-based presentations.

The screenshot shows a native application window with a dark blue header bar. The main content area displays a pair of brown leather sneakers with white soles, resting on a dark surface. To the left of the main image is a vertical sidebar containing three small thumbnail images: a brown leather shoe, a white lace-up shoe, and a person wearing blue jeans and brown shoes. At the bottom of the sidebar are two navigation icons: an upward arrow and a downward arrow. Below the sidebar is a horizontal navigation bar with tabs: 'Overview' (selected), 'Features', 'Specs', and 'Reviews'. At the bottom of the main content area are zoom controls: 'Item: 3' (with a dropdown menu), 'Image Zoom' (with a slider and arrows), and a horizontal scroll bar.

A context menu is open over the sneakers, listing the following options:

- Detach Image
- Detach Noteboook
- Detach Description
- Detach Everything** (highlighted in blue)
- Merge Windows
- Explore Color Matches ...
- View 3D Model ...
- Take Screenshot
- View Item List
- View Shopping Cart

To the right of the main content area, there is a sidebar with the title "Grand Crosscourt II Sneaker". The sidebar contains the following text:
Sleek and simple, the Grand Crosscourt II sneaker from Cole Haan is the perfect way to add some tailored casual style to your every day look!

Actions:

- [Add to Cart](#)
- [Explore Colors](#)

Below the sidebar are two circular color swatches: one orange/brown and one black.

- Leather upper
- Lace-up
- Round toe

Interactive Shopping Carts

Instead of static lists, shopping carts can be made into multi-dimensional, multiple-window interactive displays.

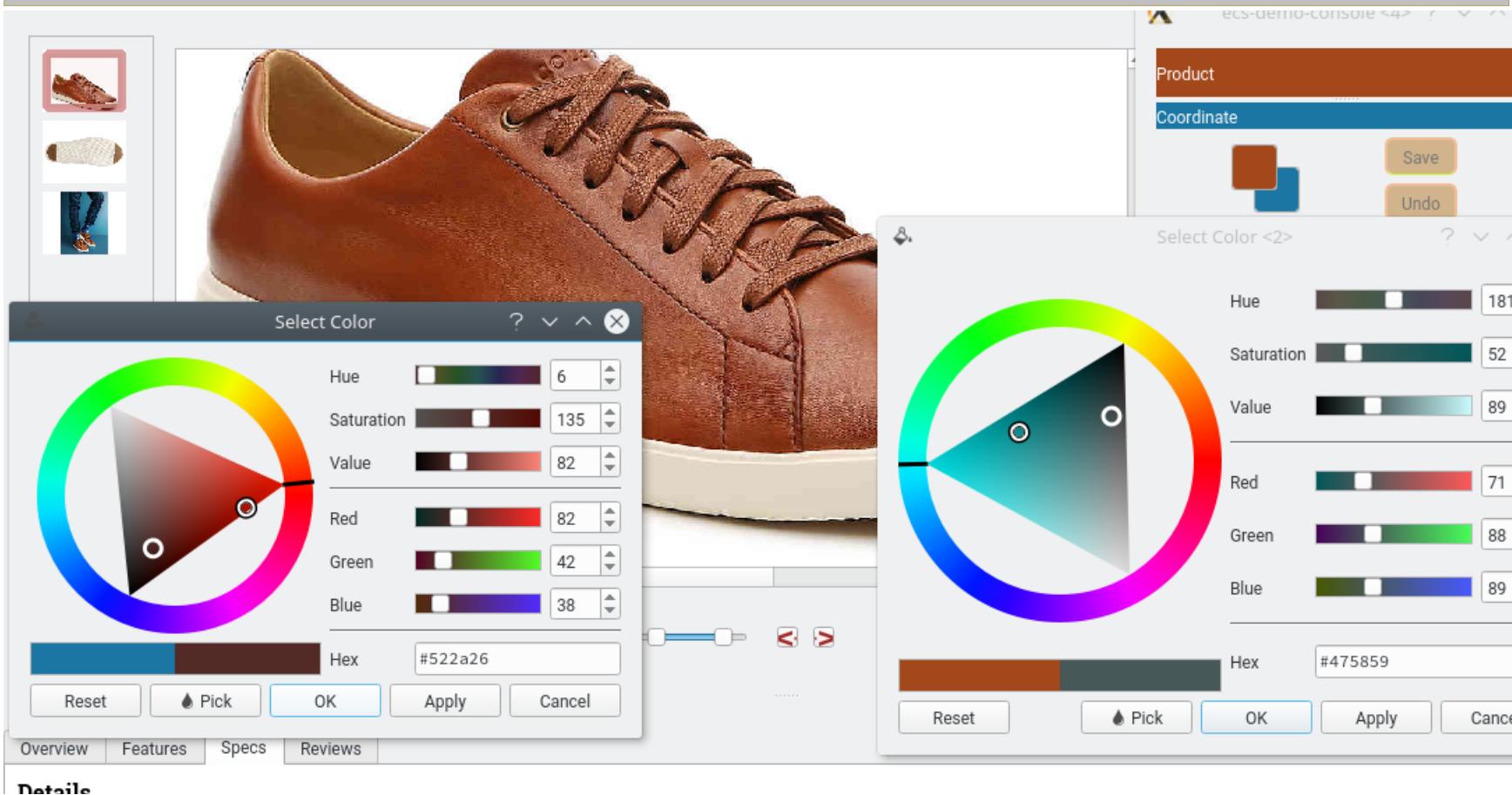
The screenshot illustrates a multi-dimensional, multi-window interactive display for a shopping cart. At the top, a navigation bar includes File, Email, Events, APIs, Web, and Broadleaf. Below it, a toolbar shows Page: 0, Search for:, and a zoom level of 100%. A grid of thumbnail images for various floral arrangements is visible.

Two main product details windows are open:

- Window 1 (Left):** Product ID tecs-db-main <2>. It displays a bouquet of purple peonies and greenery. The description on the left reads: "Lily Garden Silk Peony Bouquet Home Decoration, Lilac, 18 Inches High". Navigation buttons for Overview, Specs, Reviews, and Q & A are at the bottom, along with OK and Cancel buttons.
- Window 2 (Right):** Product ID tecs-db-main <3>. It displays a large cluster of pink hydrangea flowers. The description on the right reads: "Frosted Hydrangea, Mauve, 32 Inches High, 12 Floral Sprays". Navigation buttons for Overview, Specs, Reviews, and Q & A are at the bottom, along with OK and Cancel buttons.

Explore Products with Native Software

Interactive catalogs allow designers to incorporate many unique features and capabilities of desktop applications, such as using HSV color-wheel controls to explore color coordination while shopping.



Interactive Real Estate

A3R programming can also bring enhanced UX to Real Estate presentations: e.g. instead of just assembling a series of photos, properties can be alternatively displayed via interactive color-coded photo viewers wherein each color would correspond to a cluster of photos associated with different parts of the property, such as living quarters, sleeping quarters, work space, etc.

rpdf-emb-console

The screenshot shows a software interface titled "rpdf-emb-console". On the left, there is a grid of thumbnail images representing various rooms and exterior views of a property. To the right of the grid is a large image of a bedroom. Below the grid is a list titled "Groupings" containing the following items:

- Entrance/Foyer/Hall
- Kitchen/Dining Room
- Living Room/Den
- Bath/Powder Room
- Bedroom/Closet
- Master Bedroom/Spa
- Basement/Game Room

Each item in the list is preceded by a colored square corresponding to its group. A callout arrow points from the "Current Photo" text to the bedroom thumbnail in the grid. Another callout arrow points from the "Color-Coded Groups" text to the "Groupings" list. The bottom of the screen features navigation buttons (left/right arrows), an item counter (Item: 19), an image zoom slider, and standard "OK" and "Cancel" buttons.

Groupings

- Entrance/Foyer/Hall
- Kitchen/Dining Room
- Living Room/Den
- Bath/Powder Room
- Bedroom/Closet
- Master Bedroom/Spa
- Basement/Game Room

Current Photo

Color-Coded Groups

Item: 19

Image Zoom:

OK Cancel

Photo Viewer Interactive Cues

These slides demonstrate visual cues aiding photo navigation, such as color bands (overlays) that switch from horizontal to vertical indicating which photos have been viewed so far; and the thumbnail of the current viewed photo marked with a thick colored border (surrounding the thumbnail photo and its overlays).

Already Viewed (vertical color band)

Not Yet Viewed (horizontal color band)

Current Photo (viewed for the second time)

The screenshot shows a photo viewer interface. On the left is a grid of small thumbnail images. A black arrow points from the text "Already Viewed (vertical color band)" to a thumbnail in the top row where a vertical blue bar is overlaid. Another black arrow points from the text "Not Yet Viewed (horizontal color band)" to a thumbnail in the middle row where a horizontal blue bar is overlaid. A third black arrow points from the text "Current Photo (viewed for the second time)" to a large, detailed image of a living room and kitchen area on the right side of the screen. At the bottom, there is a list of photo groupings with colored bars underneath them: Entrance/Foyer/Hall (blue), Kitchen/Dining Room (green), Living Room/Den (purple), Bath/Powder Room (dark blue), Bedroom/Closet (light blue), Master Bedroom/Spa (light green), and Basement/Game Room (grey). Navigation controls at the bottom include arrows for previous/next, item number 10, and image zoom sliders.

Filtering Photos

Another feature which may be conveniently implemented in A3R-style photo viewers is a filtering option, which — given a collection of pictures classified into several groups — allows users to show or hide photos based on the group they belong to (note the check-box buttons on the group listing).

The screenshot shows a photo viewer interface with a sidebar for filtering. On the left, there's a grid of thumbnail images representing different rooms. To the right is a large image of a living room with a sofa, coffee table, and a view of the ocean through arched windows.

Visible Groups (highlighted with a green oval):

- Entrance/Foyer/Hall
- Kitchen/Dining Room
- Living Room/Den
- Bath/Powder Room
- Bedroom/Closet
- Master Bedroom/Spa
- Basement/Game Room

Check Boxes (highlighted with a red oval):

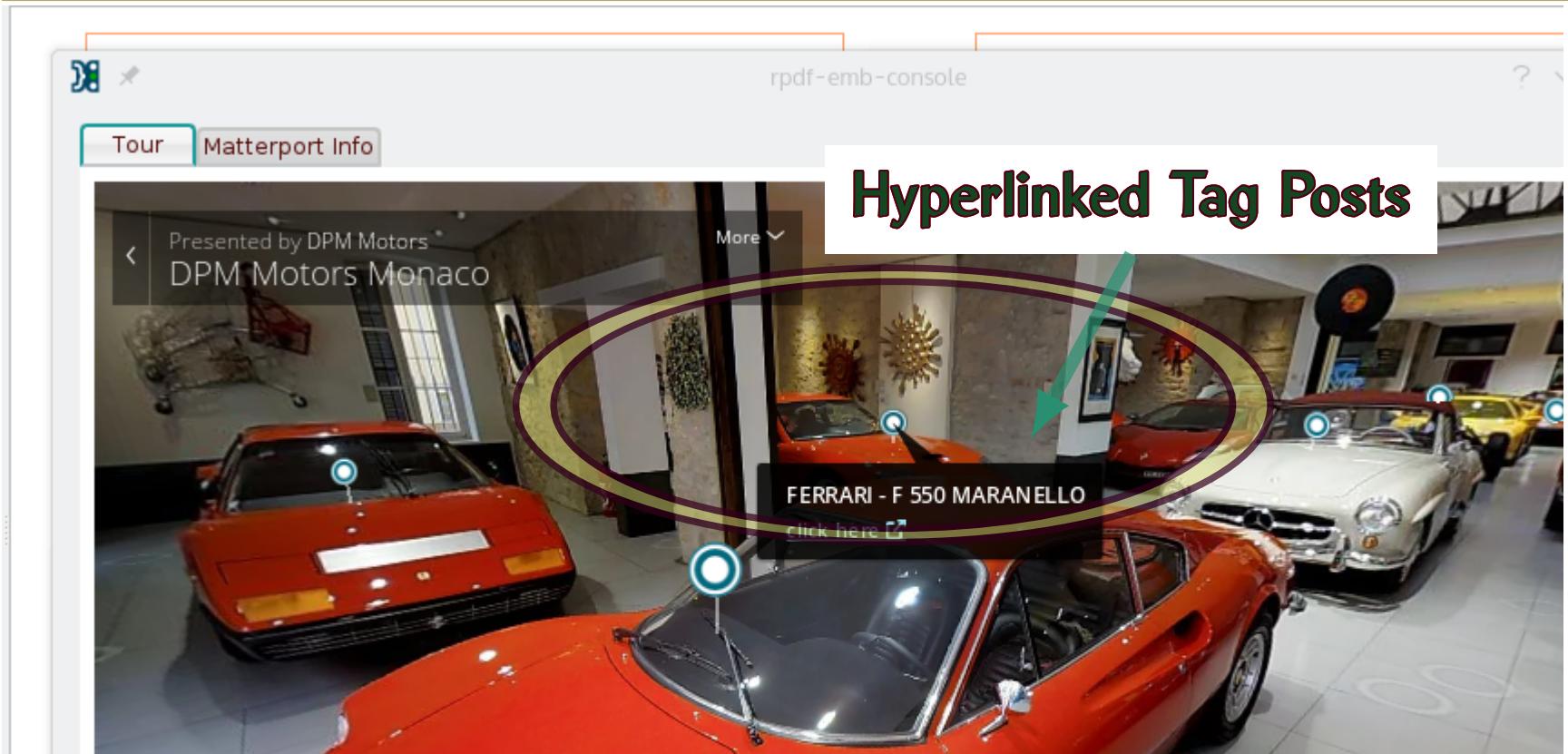
Hidden Groups (highlighted with a red oval):

Item: 3 Image Zoom:

OK

Interactive VR: Hyperlinked Tag Posts

Another emerging technology, relevant to both e-Commerce and Real Estate, is the use of Panoramic Photography to create immersive Virtual Reality scenes. Panorama-Photography-based VR engines, like Matterport, allow “tag posts” with embedded hyperlinks, which in a native-application context become channels of communication between the VR renderer and the host application. The full capabilities of this interactive modality — combining VR with clickable links and text “bubbles” — can only be fully realized via Virtual Reality engines (such as WebGL) embedded in native software.



A3R Document Viewers

A3R applications may embed viewers for document formats such as e-Pub, HTML, and PDF; then supplement conventional publications with special components customized for individual manuscripts: e.g. (as in this case), a widget allowing readers to visually explore patterns in classical Indian music.

The screenshot shows a digital journal interface. At the top, there are three icons: a gear, a stack of books, and a magnifying glass over a book. Below the icons are tabs for 'References', 'Library', and 'Reading'. A horizontal menu bar includes 'HTML Source', 'Lisp', 'CSS', and 'XML'. A large red rectangular area covers the main content area. Below this, the text 'd article view' is visible. On the left side, there is a sidebar with a small orange icon.

ANTHROPOLOGY AND HUMANISM

[Explore this journal >](#)

Ethnographer as Apprentice: Embodying
omusical Knowledge in South India

da Weidman

ublished: 26 December 2012 [Full publication history](#)

The screenshot shows a specialized viewer window. At the top, it says 'Display Tala Types: Jhoomra/Dhamar (14 beats)'. Below this is a large rectangular area containing a grid of colored rectangles (red, purple, green) representing a musical pattern. To the right of the pattern are vertical scroll bars. Below the pattern, the word 'Patterns' is followed by a slider labeled 'Pattern 1 (3-4-3-4)' and 'Pattern 2 ('). Further down, there is a 'File' field containing the path '/extension/ScignSeer/articles/svg/tala.svg'. At the bottom right are 'OK' and 'Proceed' buttons.

Volume 37, Issue 2
December 2012
Pages 214-235



A3R Document Viewers as Embedded Components

Document Viewers may also be embedded in host applications which provide domain-specific visualization capabilities. For example, chemistry papers might be viewed within IQmol (a Qt-based program for molecular visualization and physical/chemical analysis) via an A3R document-viewer plugin.

The screenshot shows the IQmol application interface. At the top is a menu bar with 'Display', 'Build', 'Calculation', 'SONIC', and 'Help'. Below the menu is a toolbar with various icons. On the left, there's a 'Configure' context menu open over a molecule. In the center, a 3D ball-and-stick model of the amino acid cysteine is displayed against a blue background. To the left of the molecule, a search interface from Springer is embedded. It shows a search bar with 'Search' and 'Showing 157 results.', a sidebar with 'ENT' (157 results), and a main area listing a book titled 'Cysteine Proteases of Pathogenic Organisms' by M.W. Robinson and J.P. Dalton (2011). The book cover is shown next to the title. At the bottom of the search interface is the URL 'www.springer.com/gp/search?query=cysteine&submit=Submit'. The overall interface is designed to integrate scientific visualization with document search and retrieval.

Document Viewers Augmented With APIs

Another strategy for interactive publications is linking documents with APIs maintained by publishers, or by cultural or educational institutions.

View Instructions

As an example, documents mentioning artifacts held in a museum can provide features to view more information about those museum-pieces through the host institution's API.



This is a **MEDAL**. We acc...
is a part of the **Product**
department.

Cite this object as

Medal; bronze; 1920

Row: 0 Column:

Embedded Multimedia

Custom-built A3R document viewers can provide convenient access to multimedia content embedded in or linked to texts — including audio files, videos, and 3D graphics scenes or models.

Ailurus fulgens swinhonis (also known as *a. f. fulgens*). Only found in China (in the Hengduan

Mo
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The
ab

In this case a video player is launched in a dialog box, floating above the article text. For those reading digital books or articles, videos and other multimedia content can be presented through secondary windows launched via context menus; text and multimedia may thereby be viewed side-by-side.



Behavior

Red pandas are generally solitary, but there are a couple of cases where they develop extended associations with their mothers that last beyond the breeding season.



In terms of t
tend to have
other. This n
search for th
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ark.org/red_panda/about-the-red-panda/

ScignSeer Video Player

ARKIVE
www.arkive.org

Moving images copyright
© BBC Natural History Unit

Sound recordings copyright
© BBC Natural History Unit
© Natural FX

Restart Pause Play

URL file:///ext_root/videos/a.mp4

Proceed Cancel

Thank You!

Please contact Linguistic Technology Systems for more information about NA3 and/or other Software Development and Software Language Engineering Solutions: (917) 817-2184.

