

# The NCN/A3R (“NA3”)

## Native Application Development Framework



Linguistic Technology Systems (LTS)

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# Team Members

## Lead Software Architect

Nathaniel Christen, Doctoral Candidate, University of Ottawa. Specializations: C++, Programming Language Implementation, Cognitive and Computational Linguistics, Scientific Computing, Philosophy of Science, Digital Humanities.

## Quality Assurance and User Acceptance Director

Ara Mehetarian, former head of Quality Assurance at Random House and AIG.

## Medical Imaging and Data Communications Consultant

Alan H. Rowberg, M.D., formerly RIS/PACS Manager at Northwest Hospital; Co-Developer of DICOM protocol formerly Co-Chair of DICOM Standards Committee.

## Company Founder and CEO

Amy Neustein, Ph.D., Editor-in-Chief of the *International Journal of Speech Technology*; Editor of De Gruyter Series in Text Mining in Medicine and Health Care; Editor of SpringerBriefs in Speech Technology; Author/Editor of 12 academic books on natural language processing, speech recognition, text mining, speech and automata, forensic speaker recognition, mobile speech, and cyber-physical systems and smart homes.

# Capital Raising for Round A, ROI, and Exit Plan

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

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<sup>1</sup> See Slide 13 for development stages and exit strategy.

<sup>2</sup> See Slides 11 and 12 for details.

# Vertical Markets

- ◆ **Scientific Computing** NCN can provide a canonical framework for implementing cloud back-ends to augment the capabilities of technical/scientific desktop software.
- ◆ **Bioinformatics and Pharmacology** With a software-development environment combining powerful GUI development with rigorous data modeling, NA3 streamlines the implementation of complex applications managing multi-faceted data structures at both the analytic and User Interface level. For example, biomedical/bio-pharmaceutical software typically integrates clinical, chemical, demographic, epidemiological, and imaging/radiological data into a unified platform.
- ◆ **Civil and Industrial Engineering and Educational Software** NA3 can augment engineering, educational, and industrial-design applications with cloud back-end services, with inter-application networking/workflow capabilities; and with multi-media publication viewers, for a richer reading experience of documents describing engineering or industrial designs and artifacts, as well as of instructional and test-preparation materials in an educational context (see slides 16-20 and 28-31).
- ◆ **Cyber-Physical Systems** NA3 can be used to implement rich-client monitoring software paired to cloud services hosting realtime IoT data.
- ◆ **E-Commerce/Real Estate** NA3 can help developers implement rich-client front-ends (as alternatives to web applications) for sectors such as e-commerce and real estate (see slides 21-27 for capabilities uniquely available to native front-ends).

# 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

## Cloud/Native Components as Back-Ends for Native Software

- Our “Native Cloud/Native” service is a protocol, which refers to 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 and A3R technology (collectively referred to as NA3) can be ported to other (non-Qt) application frameworks (wxWidgets, XCode, MFC, etc.).
  - Note: This presentation will focus on NA3’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

# How 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<sup>A</sup>T<sub>E</sub>X, and XCONCUR).

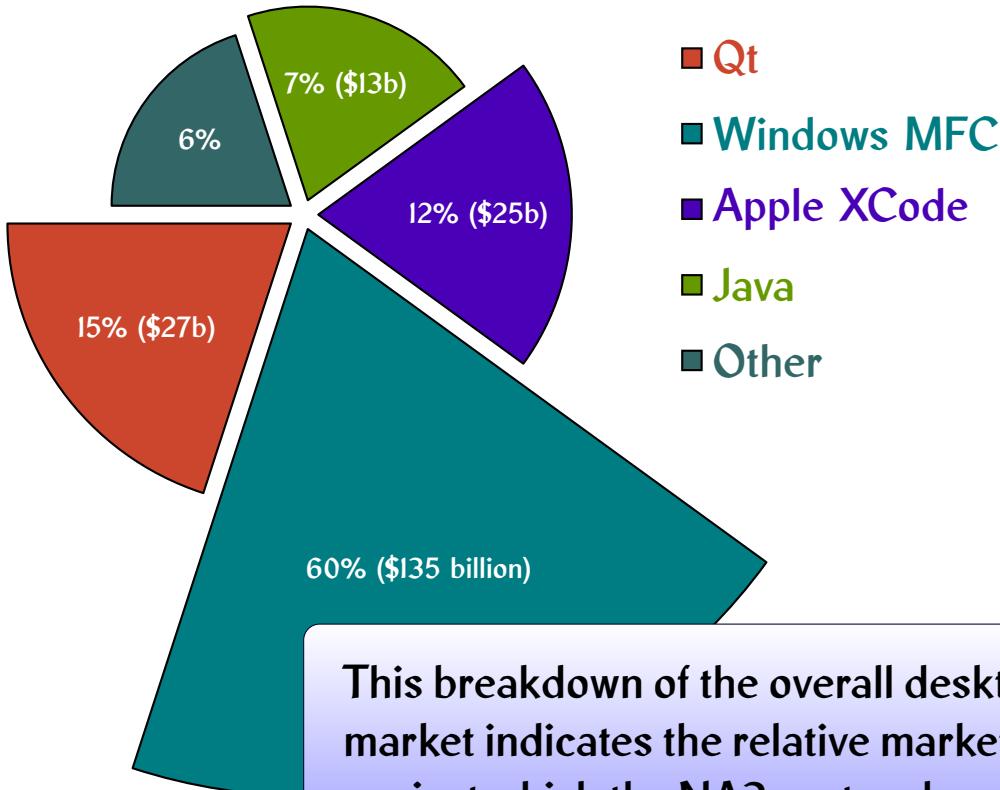
## Multiscale, Requirements-Focused Resource Description

- NA3 incorporates Semantic Web alternatives with greater Requirements Engineering and 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

NA3  
Team  
Capital  
Vertical Markets  
Comparables  
NCN  
Qt  
Semantic Web  
Software Development Market  
Business Strategy  
NCN Revenue  
Customization  
Development Phases  
Potential NA3 Markets  
Examples

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.



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.

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).

# 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.

# Customization and Monetization

All development and licensing figures quoted below are per-client

- ◆ **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)

# ROI and Development Phases

NA3  
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- 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

NA3  
Team  
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Business Strategy  
NCN Revenue  
Customization  
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Potential N Markets  
Examples

## 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

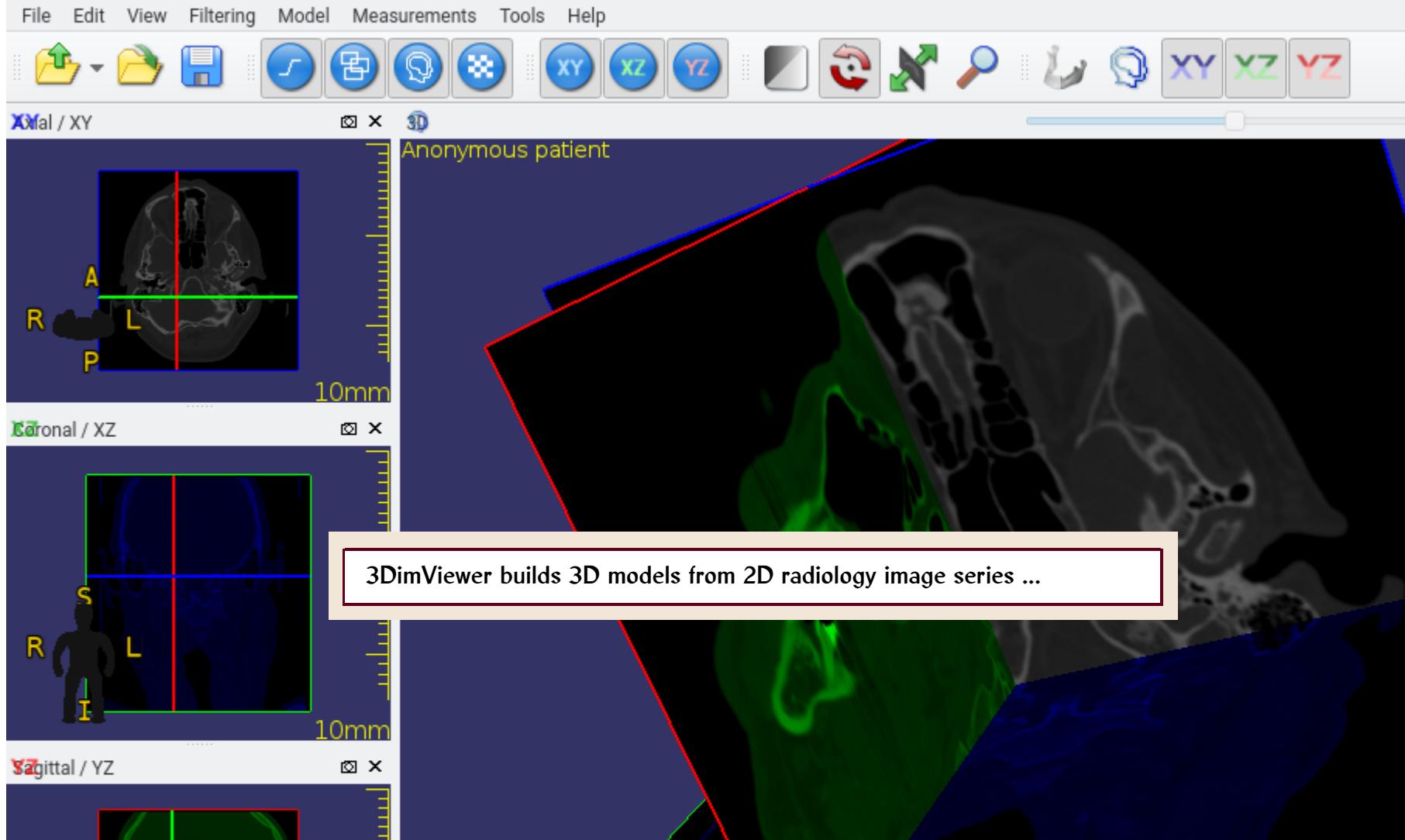
*Native applications offer superior User Experience, leveraging distinct interactive features of desktop GUIs: context menus, dialog boxes, tool tips, Multiple Window Display, dock windows, and so on:*

- Compelling front-ends for e-commerce (Note: “46% of global online retail orders happen on desktop”, source: leftronic.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

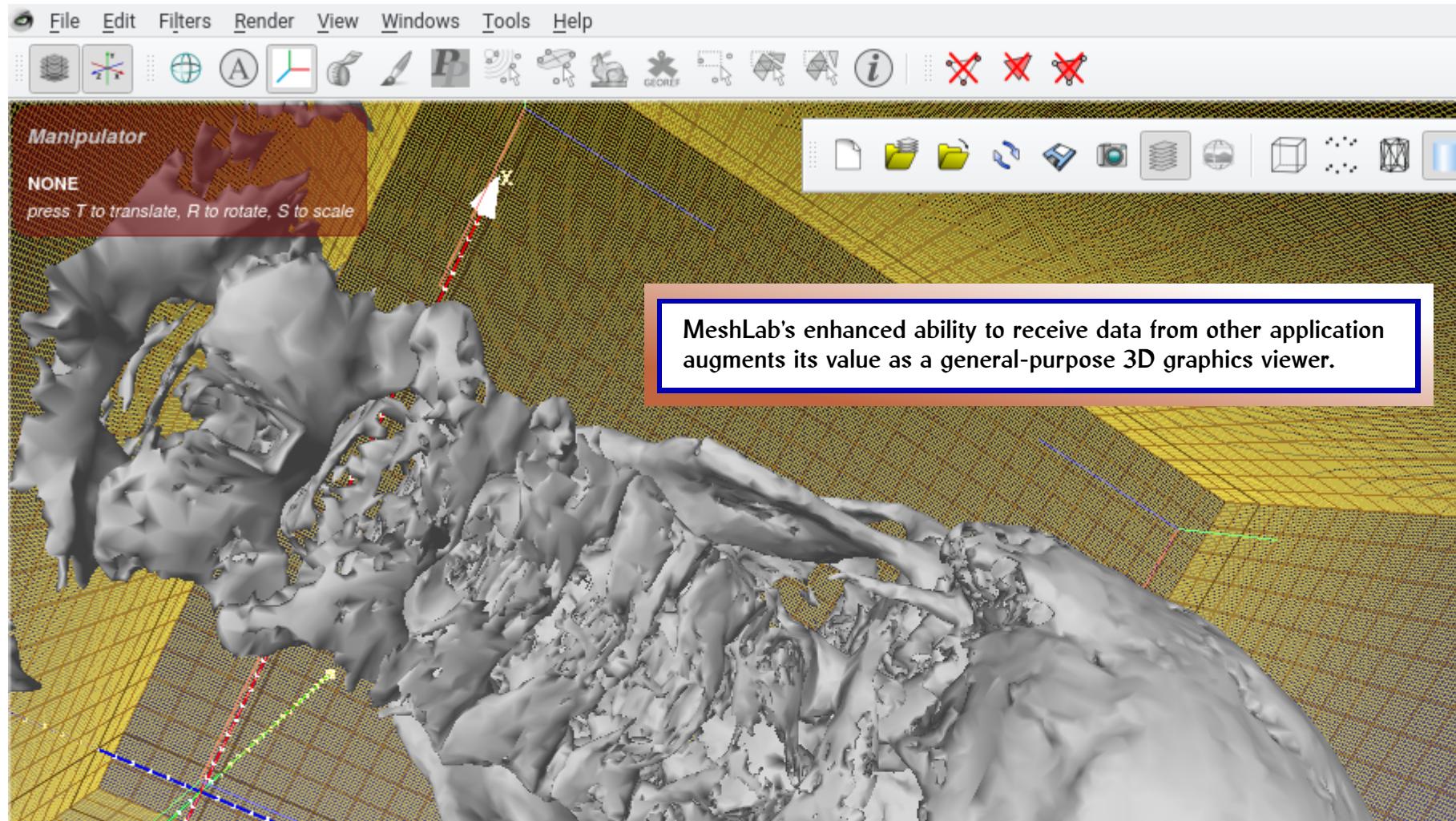
Research S  
Research Slide 2  
Research Slide 3  
Research Slide 4  
Research Slide 5

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

Research S  
Research Side 2  
Research S  
Research Side 4  
Research Side 5

Forms Web Language Help About

Save Form Open Form Cloud Save Cloud Open Submit Form

Page: 0 Search for: Forwards

Welcome Web

X ? ^ × Form Outline

Click on a subheading to continue

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

ndp-main-outline <5> ? ^ ×

Referring Doctor: Dr. New Test

Referred By (Choose One): Clinical Specialist

Date of Visit: 1/9/16

Please List your Previous Stays

Sun	Mon	Tue	Wed	Thu	Fri	Sat
31	1					
7	8					6
14	15					13
21	22					20
28	29					27
4	5					3

OK Print

January 2018

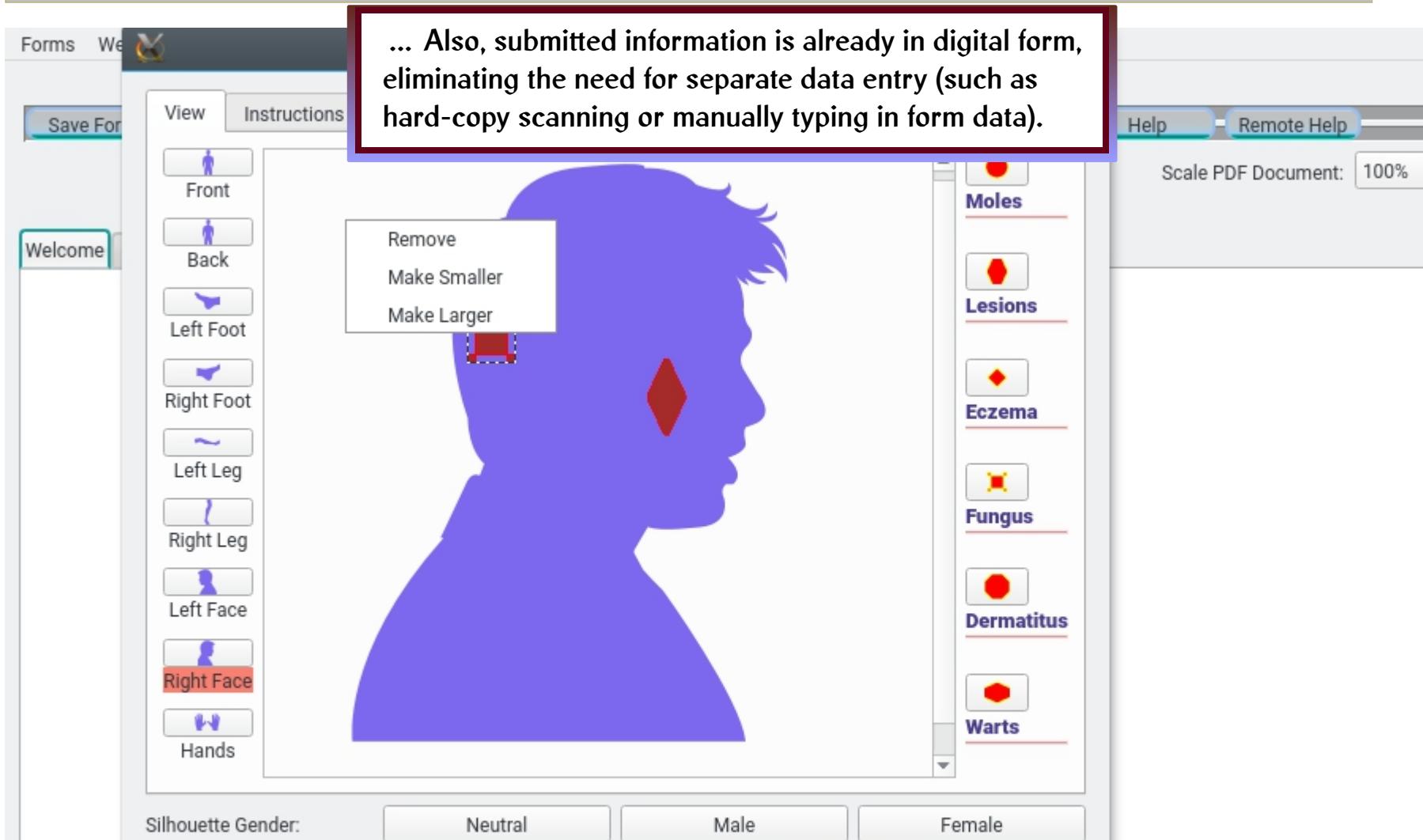
February 6  
March 13  
April 20  
May 27  
June 3  
July 10  
August  
September  
October

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

# Qt-Based Interactive Forms

Research S  
Research Side 2  
Research Slide 3  
Research S  
Research Side 5

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

Data-Set Applications are “Research Object Bundles” — combinations of code and data, providing access to data sets without the need for external software dependencies.



Silhouette Zoom:  Clear

Image Transforms ... Annotations Transforms ...

Pan Zoom Slide Pan Rotate Zoom

# Native Applications as Interactive Catalogs

E-Commerce  
Slide 1

E-Commerce  
Slide 2

E-Commerce  
Slide 3

E-Commerce  
Slide 4

E-Commerce  
Slide 5

E-Commerce  
Slide 6

E-Commerce  
Slide 7

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 interface for a product catalog. In the center is a large image of two brown leather sneakers with white soles, displayed against a blue background. A context menu is open over the right shoe, listing options: Detach Image, Detach Noteboook, Detach Description, **Detach Everything** (which is highlighted with a blue bar), Merge Windows, Explore Color Matches ..., View 3D Model ..., Take Screenshot, View Item List, and View Shopping Cart. To the left of the main image is a vertical sidebar containing three smaller thumbnail images of different shoes. At the bottom of the screen, there are navigation controls: a double-up arrow icon, a double-down arrow icon, an item number 'Item: 3', an 'Image Zoom' slider, and zoom-in/out arrows. Below these controls is a horizontal ellipsis (...). At the very bottom of the interface, there are tabs for 'Overview', 'Features', 'Specs', and 'Reviews', with 'Overview' currently selected. To the right of the main content area, there is a sidebar with the title 'Grand Crosscourt II Sneaker' followed by a descriptive 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!'. Below this text is a section titled 'Actions:' with two bullet points: 'Add to Cart' and 'Explore Colors'. There are also two small circular icons, one orange and one black, next to these actions. The overall layout is clean and modern, designed for a mobile or tablet device.

Grand Crosscourt II Sneaker

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](#)

Item: 3    Image Zoom:

.....

Overview Features Specs Reviews

- 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.

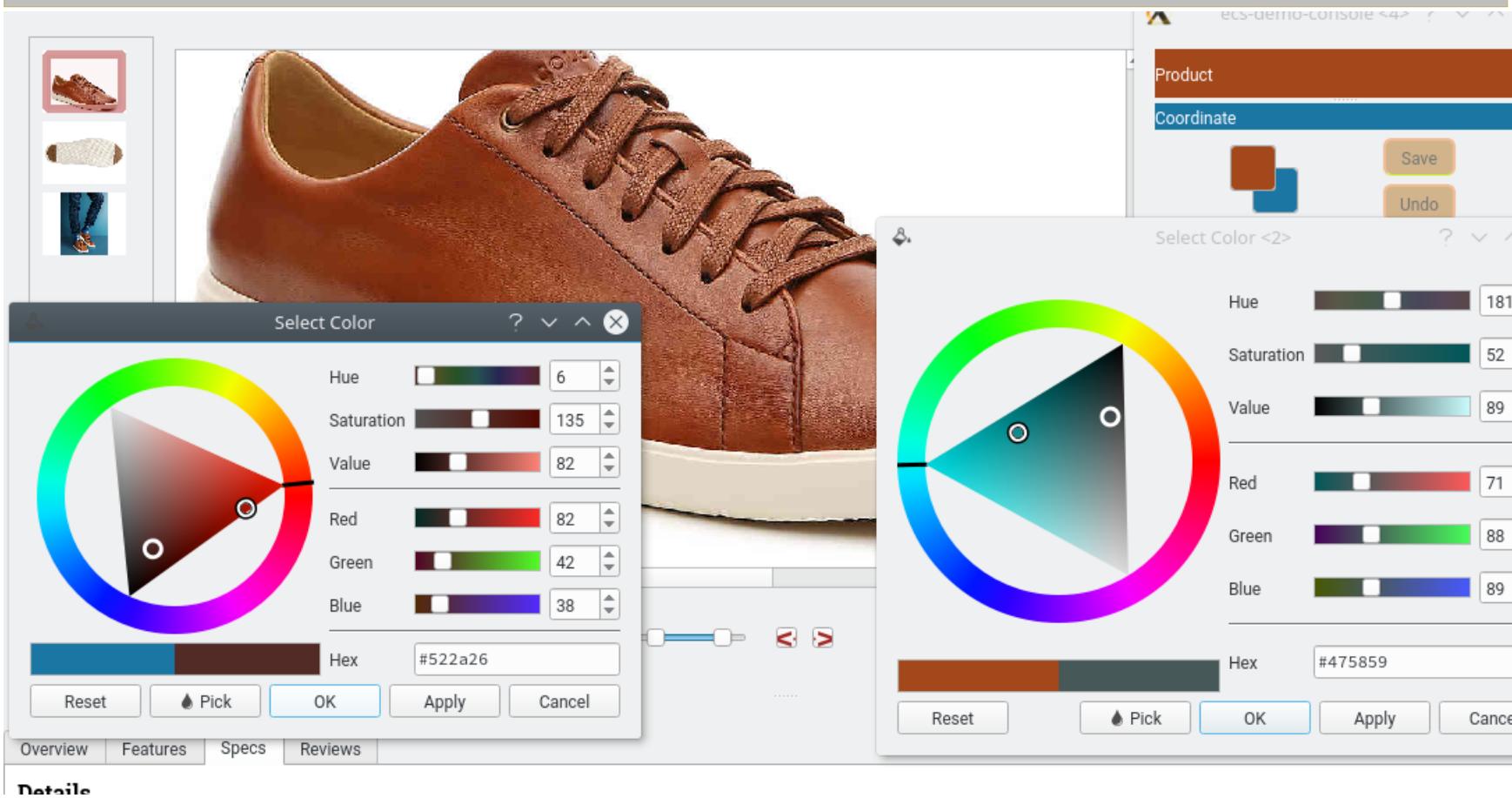
The screenshot illustrates a multi-dimensional shopping cart interface. At the top, a navigation bar includes File, Email, Events, APIs, Web, and Broadleaf. Below it are search and filter controls: Page: 0, Search for:, and a zoom setting at 100%. The main area features two overlapping windows, each titled "tecs-db-main <2>" and "tecs-db-main <3>".

- Window <2> (Left):** Displays a purple peony bouquet. The description on the left reads: "Lily Garden Silk Peony Bouquet Home Decoration, Lilac, 18 Inches High". The window has tabs for Overview, Specs, Reviews, and Q & A, with "Overview" selected. Buttons for OK and Cancel are at the bottom.
- Window <3> (Right):** Displays a large hydrangea bouquet. The description on the right reads: "Frosted Hydrangea, Mauve, 32 Inches High, 12 Floral Sprays". This window also has tabs for Overview, Specs, Reviews, and Q & A, with "Overview" selected. Buttons for OK and Cancel are at the bottom.

# Explore Products with Native Software

E-Commerce  
Slide 1  
  
E-Commerce  
Slide 2  
  
E-Commerce  
Slide 3  
  
E-Commerce  
Slide 4  
  
E-Commerce  
Slide 5  
  
E-Commerce  
Slide 6  
  
E-Commerce  
Slide 7

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

E-Commerce  
Slide 1  
E-Commerce  
Slide 2  
E-Commerce  
Slide 3  
E-Commerce  
Slide 4  
E-Commerce  
Slide 5  
E-Commerce  
Slide 6  
E-Commerce  
Slide 7

A3R programming can also bring enhanced UX to Real Estate presentations: instead of just groups of photos, properties can be displayed via interactive, multi-dimensionally organized, color-coded photo viewers.

The screenshot shows a software interface titled "rpdf-emb-console". On the left, there is a grid of thumbnail images representing different rooms or properties. A specific thumbnail in the fourth row, third column is highlighted with a red border and has an arrow pointing to it from a callout box. This callout box contains the text "Color-Coded Groups" and lists eight room categories, each associated with a colored bar: Entrance/Foyer/Hall (teal), Kitchen/Dining Room (yellow-green), Living Room/Den (purple), Bath/Powder Room (blue-gray), Bedroom/Closet (teal), Master Bedroom/Spa (light green), and Basement/Game Room (gray). To the right of the grid is a large image of a well-furnished bedroom with wooden floors, a large bed, and a chaise lounge. A callout box over this image contains the text "Current Photo". At the bottom of the interface, there are navigation buttons (left and right arrows), an item counter (Item: 19), an image zoom slider, and standard window controls (OK, Cancel).

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).

The screenshot shows a photo viewer interface with a grid of thumbnail images. A large, detailed image of a living room is displayed on the right side of the screen. On the left, there is a sidebar with a list of 'Groupings' and a navigation bar at the bottom.

- Already Viewed (vertical color band):** A callout points to a thumbnail in the second row, third column, which has a thick vertical purple border around it.
- Not Yet Viewed (horizontal color band):** Another callout points to a thumbnail in the fourth row, fifth column, which has a thin horizontal purple border around it.
- Current Photo (viewed for the second time):** A callout points to the thumbnail in the second row, first column, which has a thick horizontal purple border around it. This thumbnail also has a thick purple border around the entire image area.

**Groupings:**

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

**Navigation:**

- Left arrow: <
- Right arrow: >
- Item: 10
- Image Zoom: [Slider]

# 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 of thumbnail images and a main view showing a living room. The sidebar includes a 'Groupings' section with several filter options.

**Visible Groups:** Entrance/Foyer/Hall (checked), Living Room/Den (checked), Bedroom/Closet (checked), Master Bedroom/Spa (checked). These are highlighted with a green oval.

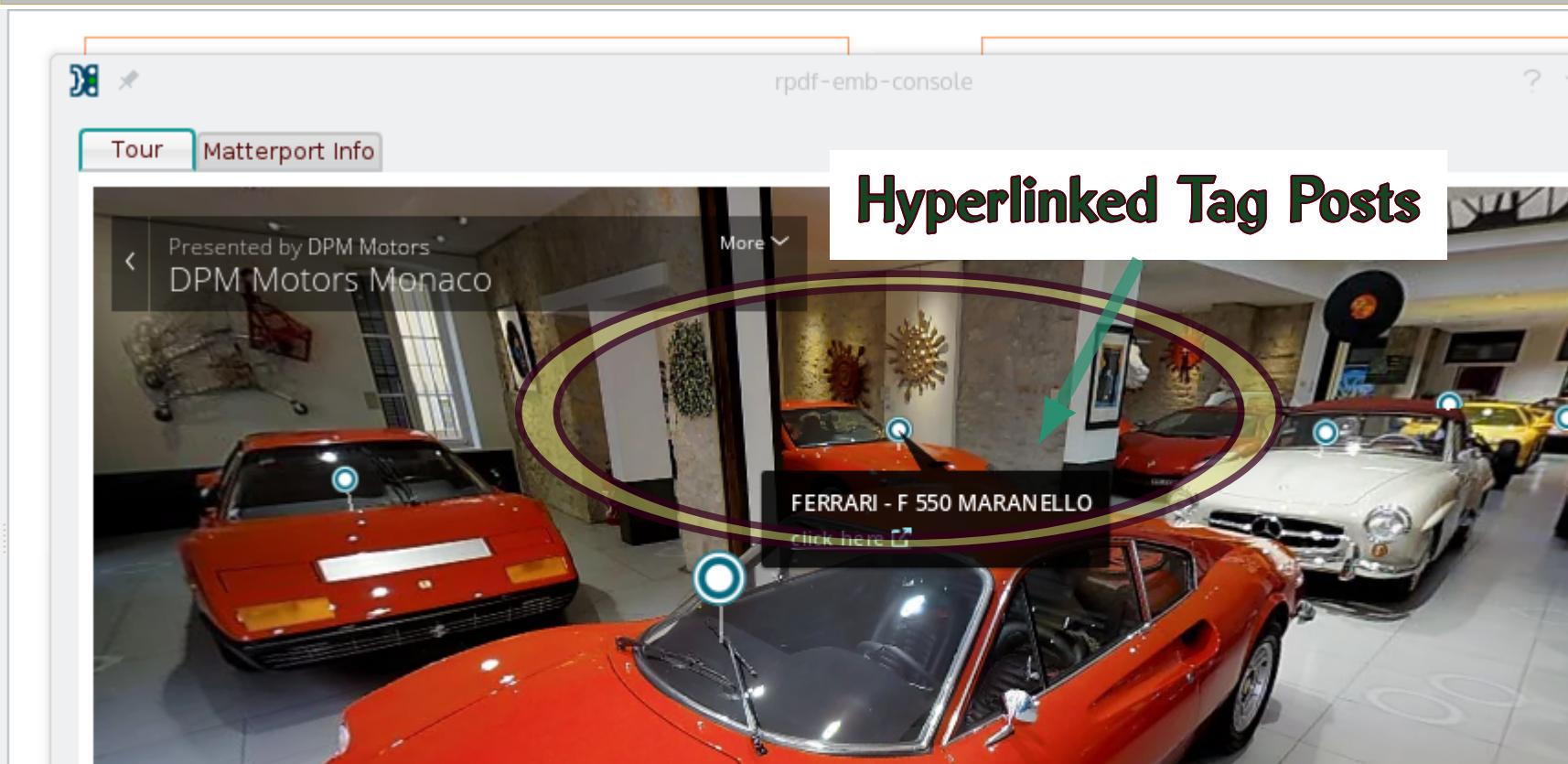
**Check Boxes:** Kitchen/Dining Room, Bath/Powder Room, Basement/Game Room. The 'Bath/Powder Room' checkbox has a red arrow pointing to it.

**Hidden Groups:** Kitchen/Dining Room, Bath/Powder Room, Basement/Game Room. The 'Basement/Game Room' checkbox has a red oval around it.

Below the sidebar, there are navigation arrows, an 'Item: 3' indicator, an 'Image Zoom:' slider, and 'OK' and 'Cancel' buttons.

# 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 (Preferences), a book (Library), and a magnifying glass over a book (Reading). Below these are tabs for 'HTML Source', 'Lisp', 'CSS', and 'XML'. A large red rectangular area covers the main content area. Below this, the text 'Read article view' is visible. At the bottom, there is a navigation bar with a left arrow, a central orange square icon, and a right arrow.

## ANTHROPOLOGY AND HUMANISM

[Explore this journal >](#)

### Ethnographer as Apprentice: Embodying omusical Knowledge in South India

da Weidman

Published: 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 this area is a vertical scroll bar and a small decorative icon. Below the pattern area, the word 'Patterns' is followed by a horizontal slider with two endpoints labeled 'Pattern 1 (3-4-3-4)' and 'Pattern 2 ('. Underneath the slider is a 'File' field containing the path '/extension/ScignSeer/articles/svg/tala.svg'. At the bottom right, there is a 'Proceed' button with a checkmark and a small circular icon.

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 a chemistry application interface. At the top is a menu bar with options: Display, Build, Calculation, SONIC, and Help. Below the menu is a toolbar with various icons. On the left, there's a sidebar with a "Springer" logo and a search bar showing "Showing 157 results." Below the search bar are filters for "ENT" (157 results), "CS", and "JRCemi" (37 results). A detailed search result is displayed for the book "Cysteine Proteases of Pathogenic Organisms" by M.W. Robinson and J.P. Dalton (Eds.) from 2011, published by Springer. The book cover is shown. In the center-right of the screen is a large 3D ball-and-stick model of the cysteine molecule, with carbon atoms in grey, hydrogen atoms in white, oxygen atoms in red, and sulfur atoms in yellow. A context menu is open over the molecule, with "SONIC" selected. The menu options include Configure, Select All, Reperceive Bonds, Duplicate Geometry, Atomic Charges, Remove, and a separator line followed by "SONIC". A sub-menu for "SONIC" is open, showing "Springer Keyword Search: Cysteine", "Springer Web Search Home", and "Search Saved Articles". At the bottom right, there are standard window control buttons (minimize, maximize, close).

# Document Viewers Augmented With APIs

Publishing  
1  
Publishing Slide  
2  
Publishing  
3  
Publishing Slide  
4

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.



**MEDAL**

 Click the icon to save

This is a **Medal**. We acquired it in 1920. It is a part of the **Product Development** department.

Cite this object as

Medal; bronze; 1920-3

Row:

0

Column:

0

# Embedded Multimedia

Publishing  
1  
Publishing Slide  
2  
Publishing Slide  
3  
Publishing  
4

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

Mo  
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## 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 territoriality, red pandas tend to have overlapping home ranges with other. This means that they search for the best food sources patchily distributed across their range.

[ark.org/red\\_panda/about-the-red-panda/](http://ark.org/red_panda/about-the-red-panda/)

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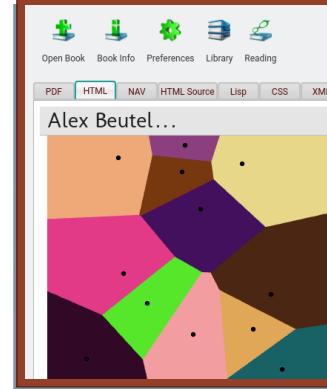
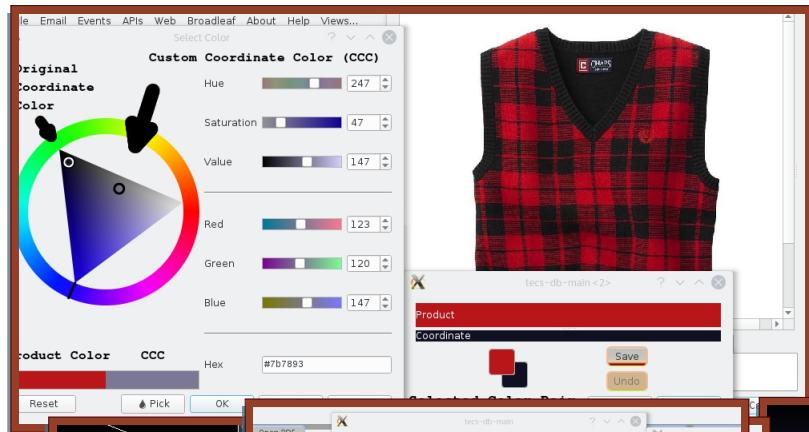


Figure 2 The Voronoi Diagram of the set of Melbourne's inner city train stations

It should also be noted that this account aims to represent space partitioning at a cognitive rather than at a physical level. What this means is that *at* will not be

