

Effective Visualization Using ASP.NET AJAX

Technologies and Techniques for Effective
Visualization of a Longitudinal Health Record

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Presentation Summary

Achieving interoperability between islands of clinical data is a design imperative; however, more data does not necessarily imply better clinical decisions. Applications must use effective visualization technologies and techniques to present an integrated longitudinal health record in a manner that permits rapid synthesis of the relevant data that drive informed clinical decision making.

Objectives

1. Understand the use case for time-efficient clinical reasoning.
2. Create the expectation that a user interface should drive a clinical decision maker to synthesize and reason about the data.
3. Understand effective user interface design techniques that accommodate a human reviewer's poor visual memory and facilitate the synthesis of complex medical information.
4. Understand how the Microsoft ASP.NET AJAX software framework can be used to create effective user interfaces.



Demonstration Screens...

The demonstration screens used in this presentation will be accessed in real-time in order to demonstrate the dynamic nature of AJAX-enabled pages.

These screens are available at: www.careevolution.com

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Introduction

A physician with a different perspective...

" You people just don't get it... more data that I don't have time to review just increases my liability."

Frustrating to hear... Is it true?



Introduction

What is Broken?

- Clinical decision making mixes time efficiency with reasoning about data. Today, it can be faster to ask or do over than to find the result.
- Successful EMRs and RHIOs have tons of data. This requires more time... that docs don't have... to digest.
- Application design has favored screens that fragment data by source and emphasize "delivery" over "synthesis".



Introduction

What is the Fix?

- Software tools drive human decision support
- Emphasize clinical value =
better outcomes, less cost

In this presentation... web-based clients have traditionally been handicapped: Enter AJAX...

Truth: there are a lot of bad thick clients... so by itself, AJAX solves nothing



Visualization: The “Last Mile” of Interoperability

Design Imperative: Value is in the User Experience

- If we have done some really cool technical stuff (i.e. exchanging and aggregating data securely), but not changed the outcomes in the domain, we have not been successful. Create value for clinical decision makers.

We have work to do in the Last Mile

- Analogy to fast internet... We have information on hand, but it is not necessarily creating better outcomes or lowering costs.





Starting With The Answer

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Starting with the Answer

- Let's be concrete: Figure out what is going on with the following patients.
- Some of these user interfaces are better than others: let's make some observations about why this is the case.
 - ... Some techniques
 - Some technology...



Example 1 [Show The Demonstration Screen](#)

- Overview: VISTA-like Facesheet
- Observations
 - Given a fair amount of time there is a wealth of useful information to consider here
 - Individual fields, scroll bars and tabs fragment data
 - Comparisons are difficult to make, trends hard to spot
 - Correlations between data types take time to develop
 - All data seems equally important; key data does not jump out



Example 2 [Show The Demonstration Screen](#)

- Overview: Longitudinal Patient Summary
- Observations
 - Easier to see the “Big Picture”
 - Concentrations of data
 - In dx groups: chronic conditions
 - In time: acute episodes
 - The absence of data is data
 - Correlations and qualitative comparisons jump out
 - Popups provide access to details in context



Example 3 [Show The Demonstration Screen](#)

- Overview: Lab Results by Order Panel
- Observations
 - Difficult to make comparisons over time
 - Trends
 - Comparisons to a baseline
 - Difficult to find the results that I want
 - Type of result
 - Searching by date



Example 4 [Show The Demonstration Screen](#)

- Overview: Lab Results Viewer
- Observations
 - Facilitates comparison over time: trends and baselines
 - Collapse/expand makes it easier to seek out correlations
 - Easier to find the results I am looking for
 - “Interesting” data jumps out at me



Technology Enabler: ASP.NET AJAX

- This is a presentation about a technology... AJAX... and more specifically Microsoft's framework that makes it ridiculously easy to implement.
- However... we don't start with the technology. At the end of the day, AJAX provides technology solutions that make a web-based application more like a thick client.
- You can make really poor thick clients that don't solve our visualization problems.
- Our Approach: Design powerful visualization tools for web-based clients. Use AJAX to achieve these ends. Choose Microsoft's framework for ease of use.



Before AJAX

- Standard Web Browser Paradigm
 - Browser/Server communication defined as: the browser requests HTML from the server and displays it.
 - Getting data without refreshing the HTML
 - Java
 - Flash
 - Frames
- Implications
 - The submit button
 - Change settings; page refresh



Introducing AJAX...

- AJAX = Asynchronous Javascript And XML
- Client Javascript provides a resource (XMLHTTP) that can exchange data with a server (XML over HTTP) *asynchronously...* without refreshing the HTML being displayed
- Really, it's a technique, rather than a technology
- Supported by all mainstream browsers
- Modern frameworks... a la Microsoft ASP.NET AJAX
- Reminder... it is only making thin clients more like thick clients



Where's AJAX?

- Google Suggest
- Maps
- Email
- Others...



Example 2 [Show The Demonstration Screen](#)

- Longitudinal Patient Summary
- Where's AJAX?
 - Popups
 - Update Panel
 - Fetching more data without losing existing data for comparison



Example 4 [Show The Demonstration Screen](#)

- Lab Results Summary
- Where's AJAX?
 - Popup
 - Update Panel
 - Fetching more data without losing existing data for comparison
 - Collapse/ Expand



AJAX: Design Considerations

- Valuable in applications requiring complex interactions with one or more data sources
- Issues that AJAX creates
 - Web client users may not expect AJAX
 - Intense Javascript
- Presentation Caveats
 - We're talking about a sliver of AJAX: much of AJAX works well in a data entry application... we're mainly focused on data review
 - This is not a presentation about UI Design: colors, fonts, consistency, simplification, non-modal, etc.





Reasoning About Data

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Our Analysis

- **Themes for Reasoning About Data**
 - Tufte: Effective “Visual Explanations”
 - “Human-Readable” Data for Decision Support
 - Holes, not Drills
- **AJAX-Facilitated Visual Reasoning Principles**
 - Micro Macro Navigation: Data in Context
 - Data Composites Defeat Fragmentation
 - Enable Quantitative Comparisons
 - Speedy Screens Encourage Sifting



Theme: Visual Explanations

“If displays of data are to be truthful and revealing, the design logic of the display must reflect the intellectual logic of the analysis... Clear and precise seeing becomes one with clear and precise thinking.”

- Edward R. Tufte, Visual Explanations

- Reasoning about data requires:
 - Sifting, playing, comparing, correlating, etc.
 - Synthesis... putting the puzzle pieces together
- **Design Interactive Tools that relate to a physician’s decision-making process**



Theme: Human-Readable Data

- There is a great deal of literature distinguishing between machine-readable and human-readable data... that for decision support (implicitly understood to mean “done on a computer”) “computable” (discrete) data sets are required.
- Which implies that everything else is human readable... true, but only if given infinite time.
- Emphasize synthesis of data to make better decisions... trends, comparison over time; correlations across different data types; absence of data; determining what is relevant; etc.
- **Emphasize a design that ensures data is “computable” for humans... just like any DSS**



Theme: Holes, not Drills

- Canonical Principle of Sales: Don't give people what they want- Give them what they need: holes rather than drills
- Docs don't want labs; they want to know:
 - Does the patient have an infection? Is she clotting well? Too well? Is his diabetes well controlled? Is he going to tolerate the the treatment that is being considered?
- And often... they don't know what they want.
 - Chronic problems that could be relevant to the acute condition that you are treating them for.
 - Hypothesis generation: What is wrong?
- **Design tools that anticipate the questions that physicians are asking while reviewing the data**





AJAX-Facilitated Techniques for Reasoning about Clinical Data

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Reasoning About Data: Principles

Principles

- Micro Macro
- Composites
- Comparisons
- Speedy Sifting

AJAX-Facilitated Visualization Principles

- Micro Macro Navigation
 - Blink Impressions; Data Context; Data Hierarchy; Get The Details
- Data Composites Defeat Fragmentation
 - Multiple Data Sources; Correlations
- Enable Controlled Comparisons
 - Trends; Baseline; Qualitative Observations
- Speedy Screens Encourage Sifting
 - Minimizing Switching Costs with Async Loading

Techniques: How AJAX Delivers

Principles

- Micro Macro
- Composites
- Comparisons
- Speedy Sifting

What AJAX Enables in Web Clients

- Partial Page Updates
- Popups: Load detail on demand
- Collapse/Expand: Load detail on demand
- Load new data to expand a view without getting rid of the data that you had
- Load asynchronously
- **And More... relevant to data capture**

AJAX is NOT required... but, WOW!



Micro Macro Navigation: Principles

Principles

- **Micro Macro**
- Blink Impressions
- Data Context
- Data Hierarchy
- Get The Details
- Composites
- Comparisons
- Speedy Sifting

- Blink Impressions
 - What you know in 5 seconds
- Data Context
 - Timeline; event sequences; spacing
- Data Hierarchy
 - Navigation: Where did I come from?
How to return?
- Get The Details
 - Navigation: Sifting and Synthesis

Micro Macro Navigation: Principles

Principles

- **Micro Macro**
- Blink Impressions
- Data Context
- Data Hierarchy
- Get The Details
- Composites
- Comparisons
- Speedy Sifting

Know Your Givens

- Humans have a weak visual memory
- Manhattan/London/Tokyo...

High Price Screen Real Estate

- Minimize scrolling
- Minimize screen flips
- Avoid paging... pan if you can
- Avoid the “post paradigm” which results in the entire screen flashing

Micro Macro Navigation: Techniques

Principles

- **Micro Macro**
- Blink Impressions
- Data Context
- Data Hierarchy
- Get The Details
- Composites
- Comparisons
- Speedy Sifting

Non-AJAX

- Time Context/ Timelines
- Graphs
- Grouping... other spatial translations
- Color

AJAX

- Popup
- Collapse/Expand
- Partial page updates

Micro Macro Navigation: Examples

Principles

- **Micro Macro**
- Blink Impressions
- Data Context
- Data Hierarchy
- Get The Details
- Composites
- Comparisons
- Speedy Sifting

- Longitudinal Patient Summary
 - [Show The Demonstration Screen](#)
 - Timeline + total timeline
 - Dx grouping
 - Encounter popup
 - Collapse/ Expand; Panel Sequence
 - Drill down navigation for each type of data

Defeat Fragmentation: Principles

Techniques

- Micro Macro
 - **Composites**
- Many Data Sources
- Correlations
- Comparisons
- Speedy Sifting

- Multiple Data Sources
- Determining Correlations
 - Clinical: Correlating the impact of a treatment on the patient's condition
 - Workflow: I ordered this lab; here is the result

Defeat Fragmentation: Techniques

Techniques

- Micro Macro
- **Composites**
- Many Data Sources
- Correlations
- Comparisons
- Speedy Sifting

AJAX

- Collapse/ Expand
- Popup
- Loading asynchronously
- Aggregation: Loading from distinct data sources

Defeat Fragmentation: Examples

Techniques

- Micro Macro
- **Composites**
- Many Data Sources
- Correlations
- Comparisons
- Speedy Sifting

- Rounding/ Shift Report Summary
 - [Show The Demonstration Screen](#)
 - Many different data types
 - Correlations
 - Clinical
 - Workflow

Controlled Comparisons: Principles

Techniques

- Micro Macro
- Composites
- **Comparisons**
- Trends
- Baseline
- Qualitative
- Speedy Sifting

- Trends
 - More than graphs
- Baseline
- Qualitative
 - Concentration of Data; “Lots of Ink”
 - Absence of Data

Controlled Comparisons: Techniques

Techniques

- Micro Macro
- Composites
- **Comparisons**

Trends

Baseline

Qualitative

- Speedy Sifting

Non-AJAX

- Graphs
- Grids
- Tables

AJAX

- Collapse/ Expand
- Don't throw away existing data to get more

Controlled Comparisons: Examples

Techniques

- Micro Macro
- Composites
- **Comparisons**
- Trends
- Baseline
- Qualitative
- Speedy Sifting

- Lab Report Summary
[Show The Demonstration Screen](#)
 - Timeline + Total timeline
 - Collapse/ Expand
 - Time compression
 - Change date without losing existing data
- Longitudinal Patient Summary
[Show The Demonstration Screen](#)
 - Qualitative: Many Encounters;
No Encounters

Speedy Screens: Techniques

Techniques

- Micro Macro
- Composites
- Comparisons
- **Speedy Sifting**

Async Loading

- Asynchronous loading
 - Different sections of the screen load simultaneously
 - Multiple data sources
 - Pre-fetch

Speedy Screens: Examples

Techniques

- Micro Macro
- Composites
- Comparisons
- **Speedy Sifting**

Async Loading

- Longitudinal Patient Summary
 - [Show The Demonstration Screen](#)
 - Each panel loads asynchronously



Review of Techniques

Techniques

- Micro Macro
- Composites
- Comparisons
- Speedy Sifting

AJAX-Facilitated Visualization Techniques

- Micro Macro Navigation: Data in Context
 - “Blink” Impressions; Data Hierarchy
- Data Composites Defeat Fragmentation
 - Relationships to Peer Data
- Enable Quantitative Comparisons
 - Relationships Within a Type of Data
- Speedy Screens Encourage Sifting
 - Minimizing Switching Costs



MS ASP.NET AJAX Deep Dive

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Microsoft ASP.NET AJAX 1.0

- What it does
 - Asynchronous data via XMLHttpRequest
 - Client & Server-side data management resources
 - Javascript resources: Client tools and controls, Javascript classes and namespaces, additional resources
- Extends ASP.NET 2.0
- Implemented with System.Web.Extensions.dll



Microsoft ASP.NET AJAX 1.0

- Competitive Frameworks
 - Rich client side controls: grids, charts, toolbars, navigation
 - Javascript tools
 - Multi-platform; browser compatibility
- Playing together nicely
 - Struggles with browser eventing
- How it got to here
 - January 2007 release 1.0
- Where it is going...



Microsoft ASP.NET AJAX 1.0

- Coolest things...
 - UpdatePanels: AJAX with approximately ZERO new code... “AJAX for mortals”
 - Script Manager
 - Client Side Controls
 - Time Control
 - UpdateProgress Control
 - JSON Serialization: passing objects to Javascript



UpdatePanel Example

Instant AJAX [Show The Demonstration Screen](#)



Resources

- MS ASP.NET AJAX <http://ajax.asp.net>
- Visualizing Information <http://www.edwardtufte.com>





Questions



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