Finding Presentation Failures Using Image Comparison Techniques

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Web Applications

It takes users only 50 ms to form opinion about your website (Google research - 2012)

Online music service
Motivation

• Presentation of a website
  – Crucial to make first impression
  – Capture users’ interest

• What is a presentation failure?
  – Web page rendering ≠ expected appearance
Example

Web page rendering ≠ Expected appearance (oracle)
Example

Web page rendering ≠ Expected appearance (oracle)

Difference 1: Alignment problem
Example

Difference 2: Color problem

Web page rendering ≠ Expected appearance (oracle)
Example

Web page rendering ≠ Expected appearance (oracle)

Difference 3: Style problem
Motivation

• Presentation of a website
  – Crucial to make first impression
  – Capture users' interest

End user – no penalty to move to another website
Business – loses out on valuable customers

• Impact of presentation failures
  – Gives negative impression of your business
    • Affects branding efforts
  – Reduces usability
Limitations of Related Techniques

• **Manual**
  – Labor-intensive and error-prone

• **Invariant specification techniques**
  – Selenium, Sikuli, Cucumber, Crawljax
  – Required to exhaustively specify correctness invariants

• **Tree-based comparison techniques**
  – XBT, GUI differencing, automated oracle comparators
  – Cannot be used if DOM has changed significantly

• **Fighting Layout Bugs**
  – Application independent correctness checker
Goal – Automatically detect and localize presentation failures in web pages
Our Approach

1. **Detection**: determine whether a presentation failure has occurred

   - Use image comparison to find visual differences between test web page and oracle
Visual differences

Difference pixels
Our Approach

2. **Localization**: identify the faulty HTML element

*Use rendering maps to find faulty HTML elements corresponding to visual differences*

- Use R-tree to map pixel visual differences to HTML elements
- “**R**”ectangle-**tree**: height-balanced tree, popular to store multidimensional data
Sub-tree of R-tree
Map pixel visual differences to HTML elements
### Case Study

<table>
<thead>
<tr>
<th>Subject Application</th>
<th>Size</th>
<th>#T</th>
<th>Localization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gmail</td>
<td>161</td>
<td>53</td>
<td>79%</td>
</tr>
<tr>
<td>Craigslist Autos</td>
<td>70</td>
<td>41</td>
<td>66%</td>
</tr>
<tr>
<td>Virgin America</td>
<td>1,016</td>
<td>41</td>
<td>78%</td>
</tr>
<tr>
<td>PayPal</td>
<td>317</td>
<td>51</td>
<td>84%</td>
</tr>
</tbody>
</table>

- **Detection accuracy**: % of test cases in which our approach could detect that a presentation failure had occurred.
- **Localization accuracy**: % of test cases in which the expected faulty element was reported in the result set.

**Average detection = 100%**
**Average localization = 77%**
Future Work

• **Problem 1:** Handle only static pages
  – Dynamic regions e.g.: advertisements, user account information, text from database
  – Check visual properties, not content

• **Problem 2:** Oracle image == test web page rendering
  – Pixel-perfect match not always needed
  – Allow for a “close enough” match with tolerance level

• **Problem 3:** Large result sets
  – Provide ranked result set to the user
  – Heuristics based on parent-child relationships
Summary

• Technique for automatically detecting and localizing presentation failures

• Use image processing techniques for detection

• Use rendering maps for localization

• Preliminary results validate feasibility of the approach
Thank you

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Need to Debug Presentation Failures

SDLC
Software Development Life Cycle

Requirements Gathering
Design
Development
Testing And Maintenance
Need to Debug Presentation Failures

SDLC
Software Development Life Cycle

Requirements Gathering

Testing And Maintenance

Development

Presentation Development Testing

Design
1. Presentation Development Testing

• Front-end developers
  – Convert oracle images to “pixel-perfect” HTML template pages

• Back-end developers
  – Change templates by adding dynamic content

• Both continuously test if the implemented page is consistent with the oracle
Need to Debug Presentation Failures

SDLC
Software Development Life Cycle

Requirements Gathering
Design
Development
Testing And Maintenance
Refactoring Debugging
2. Refactoring Debugging

- Applicable during regression testing
- Changes to code after initial implementation
  - E.g.: Refactoring page from `<table>` based layout to `<div>` based layout
- Changes not intended to change appearance
- Change may have direct or indirect impact

- Test for presentation failures and debug to find responsible HTML elements
Need to Debug Presentation Failures

Standard Debugging

SDLC
Software Development Life Cycle

Testing And Maintenance
3. Standard Debugging

• Make corrective code changes based on bug reports
  – E.g.: Resolve user-reported failures

• Reproduce the failure in-house and debug
Mockup Driven Development

- Mockups generated by graphic designers
- Front-end developers must create “pixel-perfect” template pages
- Cursory search for front-end developer job postings shows this is very common
Key Responsibilities / Performance Requirements:

- Generate pixel-perfect web pages from high fidelity mock ups created in Photoshop and Fireworks.
Front End Developer
Horizontal Integration  Hopkins, MN

Job Description
To continue to support its growing client needs and demands, Horizontal Integration is currently looking for a Front End Web Developer that has a passion for developing award-winning websites and applications.

- Expert at coding semantic HTML markup
- Ability to develop pixel perfect sites that meet the design requirements
- Experience building responsive websites

About Horizontal Integration
Horizontal Integration, a 3-time winner of “Best Places to Work” in Minnesota, is looking for talented Web development professionals to join its in-house development & integration team. With an increasing client roster that includes some of the leading brands in the US and a portfolio of services that delivers business value across disciplines and business units, Horizontal Integration employees continue to work on cutting-edge technologies and innovative projects for our clients in the web development, custom application development, mobile, web content management and digital marketing design and execution. For more information on some of the work we do and team more about the company vision, please visit us at www.horizontalintegration.com.

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Job Duties

- Gathering, interpreting requirements from clients and designers and translating them into CMS based websites with pixel-perfect fidelity to Photoshop comps.
Drupal Front End Developer
Promet Solutions Corporation - Chicago, IL

Responsibilities:
- Work in teams to help build and develop the front end of websites
- Participate in daily and weekly status meetings

- Proficient in converting PSD compositions into HTML and CSS markup
- Must have high attention to detail, capable of pixel-perfect page construction that performs well across browsers.
Front-end Developer
for Guidance Solutions, Inc in Marina del Rey, CA

- Interpret existing site design and style guides by creating pixel perfect web pages from Photoshop files.
• Code pixel-perfect, cross-browser compatible templates using HTML 5 and CSS, from designs provided by our internal design team or external agencies
Be able to create pixel perfect sites/pages from approved creative designs, and also be able to offer feedback to the team when UI/UX elements need to be altered in order to adhere to development best practices.
Responsible for creating pixel perfect templates based on designer mock-ups, using HTML, CSS, and JavaScript
The Front-end Web Development Team for Sony Electronics in San Diego, CA, is currently looking for creative and talented Web Developer’s that will be responsible for translating visual designs into pixel perfect, standards-compliant web pages for the Sony Store Online e-commerce website.
Ability to develop pixel perfect implementations of Photoshop comps
Our new web developer will work closely with our Ecommerce UX, Design, and Development Teams to transform mock-ups into cross-platform pixel-perfect web interfaces--achieving well executed, high-performing, scalable, and easily maintained results.
Careers at Toaster: Front End Developer

Toaster Ltd is a specialist digital creative agency based in London. We are currently working on some amazing digital projects for clients such as Google, YouTube and Google News. We are looking for a Front End Developer to help us craft, design and execute pixel perfect sites for projects such as Chromecast, Sync Sports, Life in a Day, YouTube SpaceLab, Google Science Fair and WeDayUK to name just a few.

We are looking for experienced HTML5 front end developers, full-time or part-time, to work closely with designers, producers and project managers to bring the vision of our clients to life.

Interns
We are accepting applications from new graduates or undergraduates seeking experience. email: job@toasterLtd.com to apply

- Excellent eye for layout and ability to translate PSD files into pixel perfect HTML/CSS code

- Experience with Sass / Less
- Knowledge of experience with CSS, JavaScript
- Experience with HTML5 and CSS3
- JS libraries knowledge (especially Google Closure Library)

How to apply
We offer a competitive salary rate and the possibility to work remotely.
Please submit your application to job@toasterLtd.com with "Front End Developer - London" in the subject line, along with a cover letter and any sample URLs that show off your code and your skills. You'll be able to start the current season.

About Toaster Ltd
Toaster Ltd is a specialist digital creative agency with offices in London, Singapore and Tokyo. We're a team of designers, developers, project managers, writers and technology gurus. Together, we help our clients bring real-world digital ideas to life.

We work with Google Creative Lab, and directly for other brands like Toyota, Honda and Google. As well as helping other advertising agencies produce good stuff. Our work has been honoured at Cannes with a Gold Lion, by effie for the World's Best Creative Advertising Agency, and The Rainford Awards and The Cannes Lion Awards.

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