



Technical evaluation of the update classification system

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WEL— Accessibility Catch-Up Technical Report 2, January
2012

Technical evaluation of the update classification system

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An update classification system has been developed[1] that injects JavaScript code into a Web page. This code monitors the page for updates, then classifies and presents the changes. This report describes a technical evaluation of the code, which was injected using a Google Chrome extension. 20 of the Alexa top 25 Web pages were tested, resulting in interaction with 100 different instances of dynamic content. Classification was found to be correct in all cases, although the update aggregation system did not always perform as expected.

WEL

Web Ergonomics Lab

Accessibility Catch-Up

This Google-funded project is a follow on from the SASWAT project (<http://hwc.cs.manchester.ac.uk/research/saswat/>). The aim is to make the findings of that project immediately beneficial to screen reader users, and to explore ways of speeding up the dissemination of accessibility research findings.

Accessibility Catch-Up Reports

This report is in the series of WEL Accessibility Catch-Up technical reports. Other reports in this series may be found in our data repository, at <http://hwc-eprints.cs.man.ac.uk/view/subjects/saswat.html>. Reports from other Web Ergonomics Lab projects are also available at <http://wel-eprints.cs.manchester.ac.uk/>.

Acknowledgements

This report forms the second technical report for the “Accessibility Catch-Up” project.

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1 Introduction

2 Method

2.1 Implementation

The system described in [1] was implemented as an extension for the Google Chrome browser¹. Information from the classification process was output to the JavaScript console.

2.2 Test sites

Twenty sites were used for the evaluation. They were selected from the Alexa top 100 sites for the UK, as reported on XX Nov 2011². A handful of the most popular sites were not suitable for the evaluation (e.g., because a login was required); the top 25 sites are listed below; 5 were omitted for the reasons given. Note that several of the sites present different pages depending on whether the user is logged in or not, and on the identity of the user. For those sites where the researcher had a login, that was used, for others, the login page was only used if it contained dynamic content.

1. Google UK `google.co.uk`
Facebook (login required)
2. YouTube `youtube.com`
3. BBC Online `bbc.co.uk`
4. eBay UK `ebay.co.uk`
5. Yahoo! `yahoo.com`
6. Wikipedia `wikipedia.org`
Windows Live `live.com` (login required)
7. Amazon.co.uk `amazon.co.uk`
8. Twitter `twitter.com`
LinkedIn `linkedin.com` (login required)
9. Blogger.com `blogspot.com`
PayPal `paypal.com` (https protocol)
10. The Daily Mail `dailymail.co.uk`

¹details, build, OS, etc.

²Alexa.com...

t.co *t.co* (twitter URL shortener)

11. The Guardian *guardian.co.uk*

12. MSN *msn.com*

13. WordPress.com *wordpress.com*

Amazon.com *amazon.com* (duplicate of 7)

14. Apple Inc. *apple.com*

15. The Internet Movie Database *imdb.com*

16. Telegraph.co.uk *telegraph.co.uk*

17. Flickr *flickr.com*

18. HSBC *hsbc.co.uk*

19. Microsoft *microsoft.com*

Tumblr *tumblr.com* (login required)

LiveJasmin.com *livejasmin.com* (adult content)

20. Bing *bing.com*

A brief examination of the 20 selected sites indicated that all sites contained some dynamic content (see table 1). The precise nature of this content is given in section 3.

2.3 Procedure

The sites were viewed in Google Chrome in the order shown above. A tab was opened in the Chrome browser and the JavaScript console opened for that tab. The dynamic content was viewed/interacted with in the manner and order described in section 3. The console output was examined during and after browsing to determine how the system had chunked and classified the updates.

3 Results

For simplicity, the nature of the dynamic content, and how it was classified, are described together. This section organises the results initially by site, then summarises them according to the type of dynamic content.

The URL of each page is given as it was displayed in the browser location bar. Page content and design change frequently, however, so a direct replication of this experiment is not possible.

Site	ASL	Tabs	Slide show	Replace	Insert	Remove
Google	1				1	
Youtube	1	1			1	1
BBC				1	1	1
eBay	1					
Yahoo!	1	1	1			
Wikipedia	1					
Amazon	1		1			
Twitter				3	2	1
Blogspot		1				
Daily Mail		1	2			
Guardian		1	1	1		
MSN	1	1	1			
Wordpress			1			
Apple	1					
IMDB	1	1		1		
Telegraph		1	1			
Flickr	1	1		1	1	1
HSBC		1				
Microsoft	1	3	1			
Bing	1		1			

Table 1: Summary of the dynamic content found on the test sites. The number of each type of dynamic content that was tested is shown in this table.

3.1 Google

`www.google.co.uk`

The results page for a Google search was used as the test page, as it contains more interactive content than the main page. The following two types of dynamic content were found:

ASL

Typing into the search box causes a list of suggestions to appear below the input field . The list (acutally a `<table>` element) appears after the first character is typed, and is updated for each change to the text.

Chunking The list is grouped into a single chunk. 3 additional updates are also (erroneously) placed in the queue, caused by changes to the current search term.

Classification Updates are correctly classified as user-initiated insertion/replacement.

Insert region (page preview)

Hovering the mouse over one of the search results causes a graphic to appear to the right; hovering on this causes a visual preview of the result page to appear in its right. This preview appears as the title, URL, then an image with some text highlighted .

Chunking The appearance of the preview is grouped into 2 or more chunks. One contains the upper text (page title and URL), the remainder are 1 for each section of highlighted text. Changing the preview to another search result has the same effect, but the updates are replacements.

Classification Updates are classified as automatic insertion/replacement.

3.2 YouTube

<http://www.youtube.com/>

ASL

An auto-suggest list accompanies the search box, initiated after the first character has been typed.

Chunking The suggestions were grouped into a single chunk, although ordering of the removed text was not as it had appeared on the screen.

Classification The updates were correctly classified as user-initiated insertion then replacement.

Tabs

A menu on the left gives the user control of the central area of the page. Clicking a link updates the content in the central area, acting as tabs.

Chunking Three chunks were created, 1 for each of the insertion then removal of a 'loading...' message, and 1 for insertion of the tab content. No DOMMutationEvents were detected for removal of the previous content.

Classification Updates were correctly classified as user-initiated insertion.

Remove area

The 'tab' headings can be removed by clicking a cross icon that appears when the heading is hovered over.

Chunking A single chunk is detected for the element removed.

Classification The update is correctly classified as user-initiated removal.

Insert area

Hovering over a suggested channel brings up a ‘tool-tip’ like element containing a link to subscribe to that channel. It disappears when the mouse moves away.

Chunking A single chunk is detected for the element inserted/removed.

Classification The update is correctly classified as automatic insertion/removal.

3.3 BBC

<http://www.bbc.co.uk/>

Automatic replace (clock)

An analogue clock appears on the page, with the date and time appearing next to it as text. Every minute, the text is updated to show the new time.

Chunking Update events were grouped into a single replacement update.

Classification Updates were correctly classified as automatic replacement.

Remove area

The BBC home page is composed of sections. These may be removed by clicking an X graphic on the top right.

Chunking A single chunk was created for the removal.

Classification The update was classified as user-initiated removal.

Show more

Most sections contain lists of links (e.g., news stories). The number of links displayed can be adjusted (within limits) by clicking plus and minus icons. No DOMMutationEvents were detected for these changes.

3.4 eBay

<http://www.ebay.co.uk/>

ASL

An auto-suggest list appears when the search box is used. It appears after the first character has been typed, and updates on every subsequent change.

Chunking The first appearance of the list is grouped into a single chunk; subsequent changes are chunked as a set of replacements (i.e., each suggestion is replaced with a new one).

Classification Updates are correctly classified as user-initiated insertion, then replacements.

3.5 Yahoo!

<http://uk.yahoo.com/?p=us>

ASL

An auto suggest list appears when 3 or more characters have been typed in the search box, and is updated on every keystroke.

Chunking The suggestions list is grouped as a single list. On the first appearance, a second chunk represents the insertion of some text: ‘Search suggestions are available. Use the up and down arrow keys to review them.’.

Classification The updates are correctly classified as being user-initiated insertion (first appearance) or replacement (subsequent changes).

Tabs

The news is organised in to 4 tabs (News, Sport, Entertainment and Finance). Clicking on the tab heading changes the content of the area below to display links to relevant news articles.

Chunking Three chunks are created for the update: one for the insertion of a ‘loading’ message, another for its removal, and the third for the insertion of the tab content.

Classification The updates are correctly classified as being user-initiated, but are classified as insertions. Subsequent visits to previously loaded tabs do not result in DOMMutationEvents, suggesting the content is inserted on viewing, then hidden from the user when not being viewed.

Slideshow

An area of the page displays a photo or video and a little detail about a news story. Below this is a horizontal list of 4 stories; hovering the pointer over one of these updates the story area. The list of 4 stories is part of a longer list of 32; arrow buttons allow you to move between these in groups of 4. Clicking the arrow to change the group also causes the main story display to change, displaying the first story of the new 4. These also change automatically.

Chunking Hover-initiated and automatic changes are inconsistently chunked either into a single update representing the replacement of the whole slide or as two chunks — one for the removal, one for the insertion. Clicking the control to show the next set of 4 slides results in 3 or 4 chunks: one the removal of content of the main slide, one for the insertion of the new main slide content (or these two as one replacement chunk), one the change of the list of 4 stories, another giving the location (e.g., ‘11-15 of 50’ to ‘16-20 of 50’).

Classification Updates are classified correctly as insertion, removal or replacement. Hover and automatic updates are classified as automatic. Clicking the control to change the set is incorrectly classified as automatic initiation.

3.6 Wikipedia

http://en.wikipedia.org/wiki/Main_Page

ASL

The search box has an associated auto-suggest list, triggered after 1 character.

Chunking Chunking does not work correctly. There appears to be a series of changes made, inserting the list, then formatting it, and the current algorithms do not handle this correctly.

Classification The updates are correctly classified as user-initiated.

3.7 Amazon

<http://www.amazon.co.uk/>

ASL

The search box has an associated auto-suggest list, triggered after 1 character.

Chunking The list is grouped as a single chunk.

Classification The updates are correctly classified as user-initiated insertion or replacement. An automatic removal update is detected when focus leaves the window and the list disappears.

Slideshow

A region at the bottom of the page presents a slide show of products. 3 items are displayed, while arrow controls on the left and right can be clicked to change the items (i.e., clicking the right arrow shows a new set of 3 items; following this by clicking the left would replace these with the original 3). Text in the top area gives the page (i.e., set) being viewed and the total number of pages.

Chunking 4 chunks are created for each change: 1 for replacement of each item and 1 for the replacement of the page index.

Classification Classification of effect is correct (replacement), as is initiation (automatic). This section of the page is not loaded until it comes into view — an update that is classified as automatic.

3.8 Twitter

<http://twitter.com/#!/>

Automatic Insert (new tweets notification)

When new tweets are available, the page title changes, and an area is inserted into the page, informing the user of the number of new tweets available.

Chunking The update is a single chunk.

Classification The update is correctly classified as automatic insertion.

Manual Insert (display new tweets)

Clicking on the new tweet notification refreshes the main content to display the unread tweets at the top of the list.

Chunking The update is grouped into two chunks, one for the insertion of the new content, one for removal of the new tweet notification area.

Classification The first chunk is classified as user-initiated insertion, the second as automatic removal.

Manual Insert (view tweet)

Clicking on a tweet displays its content on the right of the page.

Chunking The update is grouped into four chunks. Two are for insertion and removal of the ‘close’ control, the other two are for insertion of the tweet content, and the insertion of ancillary information (‘Mentioned in this tweet...’). Clicking ‘close’ to remove this area results in a single chunk.

Classification All chunks are classified as user-initiated insertion or removal. Removal is classified as user-initiated removal.

Automatic replace (trends)

An area, which is visible on the right of the page if no tweets are being viewed, gives a list of trending topics. This is automatically, periodically updated.

Chunking The updates are grouped into two chunks - the removed content and the inserted content.

Classification The updates are correctly classified as automatic removal and insertion.

Automatic replace (time since tweet)

Below each tweet is an indication of how much time has elapsed since it was written (e.g., “2 minutes ago” or “1 hour ago”), or the date for older tweets. These are automatically updated when necessary (i.e., every minute for those less than an hour old, every hour for older tweets, etc.)

Chunking The update is grouped into a single chunk representing the replacement of the sentence.

Classification The update is correctly classified as automatic replacement.

Manual replace (who to follow)

An area of the page suggests people to ‘follow’. This list can be refreshed by clicking a link.

Chunking The update is grouped into a single chunk.

Classification The update is correctly classified as user-initiated replacement.

3.9 Blogspot

<http://www.blogger.com/home>

Tabs

A set of 3 tabs organise information on the page, but changing them does not generate any DOMMutationEvents.

3.10 The Daily Mail

<http://www.dailymail.co.uk/home/index.html>

Tabs

The site contains a tabbed area to show ‘Today’s headlines’ or ‘Most Read’ stories. No DOMMutationEvents were generated when using this content.

Slideshow

A slideshow (‘Fancy that’) shows 5 pictures with links to stories. Controls on the right and left move the items 1 to the right/left, revealing 1 new story.

Chunking When clicking the left arrow control, 2 DOMMutationEvents are generated: one is the insertion of a new item now at location 0 (if 1-5 are visible), the other is removal of the item now at location 2. Clicking the right arrow results in removal of the item that was at 0, and insertion of the item that was at 2. It is not clear how these mutations match the visual appearance, but the chunking and filtering system handles them as expected.

Classification Updates are correctly classified as user-initiated.

Slideshow

A section (‘Today in pictures’) displays a photo and brief text relating to a news story. Below are 3 small photos with names (including the one on display). Hovering over a photo changes the main display. Controls allow the user to change the main display; which also causes the 3 small photos to ‘revolve’ (e.g., item 1 becomes 3, 2 becomes 1, and 3 becomes 2), although no new items are revealed.

Chunking Hover-initiated changes are chunked as a single replacement. Clicking the control arrows results in three chunks: one for the content replacement, and two for insertion and removal of the photos below.

Classification When initiated by hovering, the updates are classified as automatic replacement; updates initiated by clicking the controls are classified as user-initiated replacement (or insertion/removal).

3.11 The Guardian

<http://www.guardian.co.uk/>

Ticker

A ticker gives news headlines. Controls allow it to be paused, or played in either direction. No DOMMutationEvents were generated when using this content.

Tabs

3 tabs show stories from the site ('Most viewed', 'Latest', and 'Zeitgeist'). No DOMMutationEvents were generated when using this content.

Slideshow

A slideshow displays 4 offers. Left and right controls move these offers 1 item to the left or right, revealing 1 new item. No DOMMutationEvents were generated when using this content.

3.12 MSN

<http://www.msn.com/?st=1>

ASL

An auto-suggest list accompanies the search box. Focusing the field brings a list of currently popular searches, while typing replaces these with a more conventional list of matching suggestions.

Chunking The list is grouped as a single chunk.

Classification The initial appearance of a default list is classified correctly as automatic insertion, subsequent updates are classified correctly as user-initiated replacement.

Slideshow

A slideshow of 7 slides appears in the centre of the page. The slides change automatically, and controls allow pause, play and manual changing.

Chunking Two chunks are created for each change; one for the insertion of the slide content, another for the change in index information (e.g., ‘6 of 7’). Once the slides have been viewed once, DOMMutationEvents are only generated for the index changes.

Classification Automatic updates are classified as such. When the controls are used manually, updates are also classified as user-initiated.

Tabs

4 tabs (‘local’, ‘movies’, ‘jobs’ and ‘travel’) have the content below changed by hovering.

Chunking Updates are grouped into 3 chunks: the main content, a section below, and the title. Once all 4 areas have been viewed once, no DOMMutationEvents are generated by changing tab.

Classification Updates are classified as automatic insertion.

3.13 WordPress

<http://wordpress.com>

Slideshow

The main content of the page is a 3 column, 4 row table of selected WordPress blogs. A control at the bottom (labelled ‘earlier’) causes the content of this table to be replaced, and another button (labelled ‘later’) to appear. The ‘earlier’ and ‘later’ buttons can move between sets (the ‘later’ button does not appear on the latest set — the initial slide).

Chunking The whole section is grouped into a single chunk. Insertion occurs before removal so the two changes are presented as such, not collected into a single replacement update.

Classification Updates are correctly classified as user-initiated.

3.14 Apple

<http://www.apple.com>

ASL

An auto-suggest list accompanies the search box, with results including graphics and text.

Chunking The list is grouped into a single chunk.

Classification The Update is correctly classified as user-initiated insertion/replacement. The list is removed when focus changes; this is classified as automatic removal.

3.15 The Internet Movie Database

<http://www.imdb.com>

ASL

An auto-suggest list accompanies the search box, initiated after the first character has been typed.

Chunking The suggestions are chunked into a single group.

Classification Updates are correctly classified as user-initiated inserted (first appearance of list) or replacements (subsequent list changes).

Slideshow

The 'Box Office' region gives details about the current top films at the UK Box office. 'Previous' and 'Next' links allow users to move between the films. Information displayed includes a graphic, the title, and box office takings.

Chunking 4 chunks are created, 1 contains the rank and title, 1 for the weekend takings, 1 for the weekly takings and 1 for the number of weeks the film has been in the rankings. The first chunk is a grouping of the updates for the rank and the title, but order of the updates does not match the order in the visual presentation. The chunking mechanism recognises the two updates as being neighbours, but does not re-order them. The change would therefore be presented in the order title, rank, rather than rank, title, as shown visually.

Classification All changes are correctly classified as user-initiated replacements.

Tabs

The news section has tabs organising the news into 3 categories. The tab content is changed by clicking the title. No DOMMutationEvents were generated when using this content.

3.16 Telegraph

<http://www.telegraph.co.uk>

Tabs

A tabbed area organises links to the most viewed stories into 3 groups (today, past week, and past month). These are activated by clicking. No DOMMutationEvents were generated when using this content.

Slideshow

A slideshow of 'pictures of the day' is controlled by mouse clicks on arrow icons on the left and right of the image. No DOMMutationEvents were generated when using this content.

3.17 Flickr

<http://www.flickr.com>

ASL

An auto-suggest list accompanies the search box, initiated after the first character has been typed.

Chunking The suggestions list was chunked into a single unit, although changes to the list remained as removal and insertion, rather than being grouped into replacements.

Classification Updates were classified as user-initiated, insertion or removal.

Expand/collapse

Various regions on the page may be expanded or collapsed. No `DOMMutationEvents` were generated when the triangle icon to expand/collapse regions in the centre of the page. Using the 'hide' or 'show' links for regions on the right, no `DOMMutationEvents` were generated when a region was hidden, but events were generated when shown.

Chunking Two updates were generated, for the insertion then removal of the revealed content. It is not clear how these updates relate to the visual changes, but the system handled the original `DOMMutationEvents` as expected.

Classification Updates were classified as user-initiated, insertion and removal.

Manual replace

Two regions can have their content refreshed by clicking on an icon.

Chunking Three chunks are presented: initially the title is replaced with 'thinking' (chunk 1), then this is replaced with the new title (chunk 2), and the content is replaced (chunk 3).

Classification The updates are classified as user-initiated replacements.

Remove region

The 'People you may know' region of the page has a list of suggested users. Each one may be removed from the list by clicking a cross to its right.

Chunking The change is chunked as a single update containing the removed element.

Classification The update is correctly classified as user-initiated removal.

Tabs

The 'Your contacts' section allows users to select between showing pictures of their contacts or pictures by their contacts. Although not styled like a typical tab, the functionality is identical. No DOMMutationEvents were generated when using this content.

3.18 HSBC

<http://www.hsbc.co.uk/1/2/>

Tabs

An area that behaves like tabs is found on the right of the page. 4 sections headings are present in a vertical stack, with content for one displayed directly below the title. Clicking another heading hides the previously displayed content and reveals the content for the selected heading. The styling and heading positions makes this appear like an expanding/collapsing region, but functionality is exactly as tabs. No DOMMutationEvents were generated when using this content.

3.19 Microsoft

<http://www.microsoft.com/en-us/default.aspx>

ASL

An auto-suggest list accompanies the search box, initiated after the first character has been typed.

Chunking The suggestions list was grouped into a single chunk.

Classification The updates were classified as user-initiated; the first as insertion, subsequent as replacement.

Tabs

The 'top products' region displays 3 products; those on display can be changed by selecting between tabs ('windows', 'xbox', etc.).

Chunking Replacing the tab content was chunked into 2. First was the insertion of the new content (all 3 products as a single chunk), second was the removal of the previous 3 products (as a single chunk).

Classification The changes were correctly classified as user-initiated removal or insertion.

Slideshow

The most prominent part of the page is a slideshow with 3 slides; this can be played (default), paused, and slides changed in either direction by clicking on controls on the top right of the slide. No DOMMutationEvents were generated when using this content, either automatically or manually.

Tabs

Expand/collapse style tabs (as with HSBC) are present to the right of the main slideshow. No DOMMutationEvents were generated when using this content.

Tabs

The whole of the main content area can be changed between 4 views (for home, for work, for IT pros and for developers); the tab controls are to the right of the page. No DOMMutationEvents were generated when using this content.

3.20 Bing

<http://www.bing.com/>

ASL

An auto-suggest list accompanies the search box, initiated after the first character has been typed.

Chunking Updates are grouped into a single event, representing the insertion or replacement of the entire list.

Classification The update events are identified as user-initiated. The initial suggestion list is classified as insertion, subsequent lists as replacement.

Slideshow

The background to the search area displays a photograph. When the mouse hovers over the page, 4 small boxes appear over parts of the image; when the mouse hovers over a box, some text appears. Also on the image are left and right icons ; clicking these changes the image and some text below.

Chunking The changes are grouped into 5 events: replacement of the text below the image, and replacement of the text in each of the 4 hover areas.

Classification The changes are identified as user-initiated replacement.

Site	ASL	Tabs	Slide show	Replace	Insert	Remove
Google	ok				✓	
Youtube	✓	✓			✓	✓
BBC				✓	n/a	✓
eBay	✓					
Yahoo!	✓	✓	✓			
Wikipedia	x					
Amazon	✓		✓			
Twitter				✓	✓	✓
Blogspot		n/a				
Daily Mail		n/a	x			
Guardian		n/a	n/a	n/a		
MSN	✓	✓	✓			
Wordpress			✓			
Apple	✓					
IMDB	✓	n/a		ok		
Telegraph		n/a	n/a			
Flickr	✓	n/a		✓	x	✓
HSBC		n/a				
Microsoft	✓	✓	n/a			
Bing	✓		✓			

Table 2: Summary of the evaluation results by site and content type. Classification of initiation type was always correct, but performance of the update aggregation (chunking) was variable. A ‘✓’ indicates that the system gave a good result, ‘ok’ indicates that there were problems, but the updates should still be understood when presented; an ‘x’ indicates that there were significant problems understanding the changes from the updates, and; ‘n/a’ indicates that no DOM mutation events were detected.

3.21 Summary

In summary (see table 2), classification on the initiation axis of the taxonomy was always correct, but the chunking of changes was occasionally poor. This occasionally led to replacement updates being presented as a removal then insertion rather than as a replacement; classification by effect was otherwise correct. In 2 cases, the update events generated by the DOM mutations were processed as expected, but did not reflect the apparent visual changes well. The five errors were as follows:

- Two problems on auto-suggest lists (Google and Wikipedia). In these cases, the updates were not limited to a single replacement of a list or table, or even replacement of each suggestion, but involved multiple updates, e.g., adding a replacement, then modifying its structure to highlight the match. The system did not manage to collect these updates together and present them as a coherent update.
- In two cases (Daily Mail and Flickr), the DOMMutationEvents were handled

in the expected way, but did not match the visual changes to the page. This is thought to be due to a combination of changes to the DOM and to the style of elements already present, with the system not adequately handling the latter. Another potential cause of this problem is where content is inserted into the DOM before it is required ('pre-loaded', e.g., so that any lag in the loading process is not perceived by the user).

- Finally, the IMDB content replacement was handled broadly correctly, but the changes were grouped in the order in which they changed, which did not match the visual layout (or indeed the DOM).

In addition to the poor handling of the content described above, in many cases (12 content instances on 9 sites), but most commonly with tabs, changes to the content did not result in insertion, removal, or modification to the DOM. This suggests that any new content was already present, and the apparent changes were modifications to the style of sections of the page, e.g, revealing some content and hiding other. This hypothesis was not tested in detail, but was certainly the case in some of the sites (e.g., the BBC). A similar issue arose where the content was loaded on its first view, then styling was used to hide/reveal. For example, for the tabs on the Yahoo! page, only the content of the visible tab was in the DOM when the page was loaded; visiting the other tabs caused their content to be inserted into the DOM, but the content of other tabs was only hidden from view, not removed. As a consequence, DOMMutationEvents were only generated for the first view of each tab.

4 Conclusions

Although the classification system has less input data than the system used in the SASWAT evaluation, it classified 85% of the dynamic content correctly. The user model [2] showed that initiation type was the most significant factor in determining whether a user was likely to attend to an update; all updates were classified correctly on this axis. When problems arose, they were generally a result of updates being formed from a series of smaller changes, including situations where an element may change twice in rapid succession; the system as it currently stands was unable to collate these changes and correctly identify the net result, as would be perceived by a user.

The problems encountered by the chunking mechanism can, theoretically, be overcome. The original SASWAT implementation achieved this by taking snapshots of the DOM, and comparing the page before and after updates, using the DOMMutationEvents only as a trigger to indicate change. This, however, was an intensive process and did not give acceptable performance. Performance of the current system has not yet been measured, but running the classifier did not cause any discernable effects on the page behaviour. It is likely that further refinement of the current chunking system could improve the output without the performance problems of the original system.

It is also necessary to consider those changes that were not detected (that are assumed to result from changes in style). It is clearly important to let the user know

that their action has had an effect, and give them feedback about what happened; after all, the user experience should not depend upon the background technology. Implementing rules that monitor and evaluate the style of elements should allow this to be achieved, while resolving problems such as pre-loading of slides.

Considering the results of this evaluation, the following improvements need to be made:

- Investigate handling of non-mutation changes: how can they be detected, and how can their handling be integrated with mutation events?
- Take styling of elements into account when handling changes.
- Improve the chunking mechanism to cope better with multiple changes within a region and retain the logical order of elements rather than events.

References

- [1] Andy Brown. Presenting the saswat interfaces through wai-aria. Technical Report, University of Manchester, <http://hew-eprints.cs.man.ac.uk/153/>, December 2011. The code.zip file contains the code described in the technical report.
- [2] C. Jay and A.J. Brown. User review document: Results of initial sighted and visually disabled user investigations. Technical Report, University of Manchester, <http://hew-eprints.cs.man.ac.uk/49/>, 2008.