A Different Web Analytics Perspective Through Copy to Clipboard Heatmaps

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Abstract. Heatmaps are widely used in web analytics to visualize certain user activities within web pages, including mouse clicks, mouse moves and page scrolling. We propose Copy to Clipboard Heatmaps (CTCHs), to visualize what users copy from web pages. We present an implementation of CTCHs, demonstrate various types of useful information that CTCHs expose in technical-educational web pages, and discuss several possible uses.

Keywords: Web Analytics · Web Visualization · Clipboard · Copy · Text Analysis · Heatmap · Educational Technology · E-Learning

1 Introduction

Heatmaps can be very effective in visualizing accumulated data graphically. In the context of web analytics, heatmaps are widely used to visualize the frequency of visitor actions in areas of web pages. A web page can be presented to web analyzers with a varying background color. Areas of high user activity are displayed with "warm" background colors (e.g. red and orange shades), and areas with low user activity with "cold" background colors (e.g. blue and green shades). Different shades of warm and cold colors represent different levels of frequency. Website maintainers can use the visualized information to improve and optimize web page structure, navigation and content.

Špakov and Miniotas [5] proposed using heatmaps to visualize accumulated data of user eye gaze. Eye gaze data of website visitors is normally unavailable, but heatmaps can be used to visualize in-page user activity that can be tracked by modern browsers, such as mouse and scroll actions [3] [2].

Three main types of heatmaps are currently available in commercial web analytics. The most common are click heatmaps, showing the distribution of mouse clicks on page elements (mainly links). The second type is cursor move heatmaps, showing frequency of mouse cursor moves in areas of the page. Cursor moves are considered to be correlated with eye gaze and user attention [1]. The third type is scroll or viewport heatmaps, visualizing the time or the number of visits in which page parts are visible to users.

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Table 1. Heatmaps in 15 Commercial Web Analytics Tools

Service	Click	Move	Scroll	Service	Click	Move	Scroll
clicktale.com	✓	✓	✓	mouseflow.com	✓	✓	✓
crazyegg.com	✓		✓	plerdy.com	✓	✓	✓
cux.io	✓			sessioncam.com	✓	✓	✓
freshworks.com	✓		✓	smartlook.com	✓	✓	✓
heatmap.com	✓	✓	✓	uxcam.com	✓		
hotjar.com	✓	✓	✓	vwo.com	✓		✓
inspectlet.com	✓	✓	✓	zoho.com	✓		✓
luckyorange.com	✓	✓	✓				

Table 1 summarizes support of heatmaps in 15 popular commercial web analytics tools. We found only these three main types of heatmaps in an extensive review of commercial web analytics, with no other types of heatmaps.

Mouse clicks, mouse cursor moves and viewport scroll positions are certainly important, but modern browsers expose additional in-page user actions information [4], which may also be useful in web analytics, including copying to the clipboard. To the best of our knowledge, this paper is the first to propose and demonstrate heatmaps that visualize what users copy from web pages to their clipboards.

2 Implementation

Figure 1 shows the architecture of a CTCHs implementation. For simplicity we describe a standalone implementation, although in practice it would probably be integrated with other functions in a complete web analytics service.

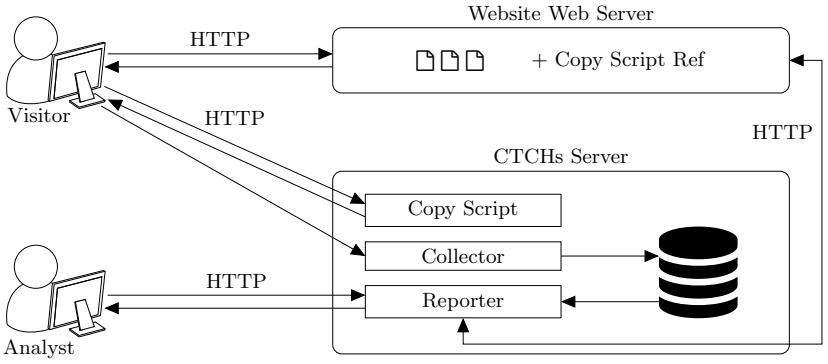

Fig. 1. High-Level Architecture of a CTCHs Implementation

To enable CTCHs support for a website, a reference to a *Copy Script* is embedded in all the website pages. This is a common technique in web analytics and usually requires only a minor amendment to the website templates. As a result, every request for a page from the website returns a revised page that triggers an additional request to load the *Copy Script* from the *CTCHs Server*. The script tracks JavaScript Clipboard Copy events and reports back to the *Collector* component in the *CTCHs Server*, which stores the data in a dedicated database. Web analysts visit the website through the *Reporter* component of the *CTCHs Server*, which integrates aggregated copy statistical data from the database, with original web pages to form pages with heatmap background. HTTP is used for communication between the clients (the visitor and the analyst) and the servers, and between the two servers.

3 Results

We examined the CTCHs implementation on technical-educational web pages, at www.objectdb.com. The pages contain learning materials on Java Persistence API (JPA). JPA users often use the website as a reference. They copy sample code from the website and paste it later in their IDEs. Figures 2-5 demonstrate several meaningful sections of CTCHs from the website (from February 2020).

Figure 2 shows sample code from instructions on how to enable cascading detach (A JPA term). The line that starts with the *@OneToOne* annotation is the key, and in that line the core is the *cascade* parameter, and particularly the *DETACH* value. The background colors show very well the levels of importance based on user's copy frequency. This is positive visual feedback, indicating that users understand and use the sample code correctly.

Figure 3 demonstrates user preferences. The sample code lists different callback methods, and the heatmap shows which callback the users find more useful (green is considered to be warmer than blue), so we can learn about user preferences from this heatmap section.

```
@Entity
class Employee {
    :
    @OneToOne(cascade=CascadeType.DETACH)
    private Address address;
    :
}
```

Fig. 2. Importance and Centrality

```
@PrePersist void onPrePersist() {}
@PostPersist void onPostPersist() {}
@PostLoad void onPostLoad() {}
@PreUpdate void onPreUpdate() {}
@PostUpdate void onPostUpdate() {}
@PreRemove void onPreRemove() {}
@PostRemove void onPostRemove() {}
```

Fig. 3. User Preferences

Figure 4 shows instructions on how to create a new project in a tutorial. We can see that the suggested project name is often copied by users, probably to be pasted in the IDE. Such indications throughout a tutorial can provide valuable

feedback on user progress, and may help in identifying breaking points in which users tend to abandon the tutorial (indicating that improvement of the tutorial content might be needed at these breaking points).

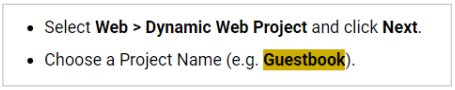

Fig. 4. Progressing in a Tutorial

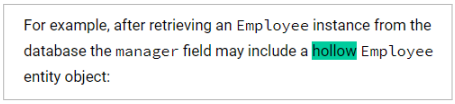

Fig. 5. Unclear Terminology

Figure 5 shows text with a JPA term, *Hollow*, which is painted as warm in the heatmap. It probably indicates that many readers are unfamiliar with the term (which is explained on that web page), and they copy it into the clipboard in order to search for it (on the page, website, or externally in a search engine). A content editor may want to clarify the content in such cases, by adding a reminder, a link or a tooltip, to explain the term.

4 Conclusions

CTCHs can highlight various valuable information about web usage, particularly in technical-educational websites. This may include, user code preferences, how users understand and use sample code, how users follow tutorials, and which terms and concepts in the text users find unclear. We focused on visualization using heatmaps. Future work may explore quantitative methods that can utilize copy to clipboard data to improve websites and online learning materials.

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Further Reading

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