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Recording the Use of Interactive Web Maps with ZoomTracker

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Abstract:

Interactive web multi-scale maps have become pervasive in our daily lives, much more than paper maps or static digital maps. But, our academic knowledge of the use of such maps is limited. How long and how often do people use these maps? How exactly do they browse these maps? Are there zoom levels that are more used than others? Are there differences in usage between a smartphone and a computer with a mouse? Are there regions that are never inspected? As cartographers and map designers, we must know the answers to these questions to improve our map design practices. One way to better understand the behaviour of the users is to record the details of their sessions of usage of such applications. There were recent attempts to achieve such recordings. The MapRecorder application can be installed on a smartphone and then records when a mapping application is used (Savino et al., 2021). Tappigraphy is a technique that records all *taps* on a smartphone and can be used to analyse mapping applications (Reichenbacher et al., 2022). These two propositions provide precious insights but do not record the details of the use, and we cannot answer our questions by using only these tools. At the same time, some techniques are developed to track specific details of the map use, such as mouse tracking (Krassanakis and Misthos, 2023). In this paper, we present ZoomTracker, a set of tools that can be used to precisely record the use of interactive web maps, to better understand the behaviour of the users.

The first side of ZoomTracker is to provide tools that can be integrated into a web map, tracking all the events occurring with the map. Though it may seem redundant as a zoom interaction throws at the same time an interaction event and a map-changing event, we decided to record both, as interaction events can be similar for different types of interaction. For instance, a simple pan where the user drags the map, and a pan with inertia, where the map still moves after the drag has been released, both throw similar drag events, and it is only by looking at the time the map stops moving that we can differentiate those two types of panning interaction. We record all these events in the log file that also contains attributes related to those events, such as a timestamp, the spatial coordinates of the centre of the screen or the current zoom level.

As there are many of those events during the use of a web interactive map, we decided to record the mouse tracking in a different file for mouse tracking. We similarly record mouse events and events related to touch screens and trackpads because they are handled similarly by web browsers. However, we record at the beginning of the session if browsing is mouse-based or touch-based.

Event	Time	Zoom level	Center
zoomstart	19.344	15	(55.8581,-4.2566)
movestart	19.344	15	(55.8581,-4.2566)
zoom	19.561	16	(55.8581,-4.2566)
zoomend	19.561	16	(55.8581,-4.2566)
moveend	19.561	16	(55.8581,-4.2566)
zoomstart	19.561	16	(55.8581,-4.2566)

Table 1. Extract of the raw data from ZoomTracker showing how *zoom* events come one after another during a large zoom.

ZoomTracker does not only record the raw events occurring during a session, but it also provides a set of tools to post-process the raw CSV output files. One example of the post-processing we developed is the identification of large zooms, i.e. a difference of more than one zoom level, due to a large pinch on the screen, or a long use of the mouse wheel. As shown in Table 1, such an interaction is not directly encoded into one event, but rather into several consecutive small zoom events, a small zoom starting at the same time as the end of the previous zoom. Identifying large zooms then consists of finding sequences of zooms immediately following each other. ZoomTracker can identify and characterise the following map interactions: small zoom, large zoom, linear pan (when the user simply drags the map towards one direction), *free pan* (i.e. when the user keeps the mouse pressed to observe the surrounding of the current map view; usually the drag ends

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on a location close to the start of the interaction), pan with inertia, and fly (when the user enters an address or coordinates, and the application centres and zooms to the desired location). We also characterise the static phases, i.e. when the user only looks at the map without changing it for a significant amount of time.

ZoomTracker was implemented as an extension of Leaflet, in Javascript, for the tracking part, and in Python for the post-processing functions, and the implementation is available on Github[1]. We designed a short experiment to verify that ZoomTracker properly records all the required events, and can be used to analyse the behaviour of users. We gave five participants the following task: "You are going to attend a scientific conference in Glasgow, Scotland, and you are searching for the best hotel between the central train station and the University where the conference occurs. Browse the map to choose your favourite hotel." The sessions of the participants lasted between 60 and 90 seconds. We also captured the screen during the session to check that all seeable interactions in the video were recorded by ZoomTracker, which was the case. Figure 1 shows how ZoomTracker can be used to understand how users browse the 20+ zoom levels they have access to in web maps. Figure 2 shows how mouse tracking can be used: in this case, the mouse mostly remains in the centre of the screen.

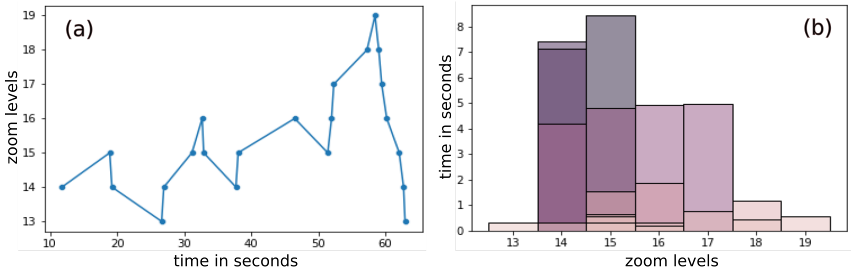

Figure 1. Two visualizations of the usage of the zoom levels during one session. (a) the sequence of zoom levels used during the session; (b) the cumulated time spent on each zoom level (the colour indicates the timestamp).

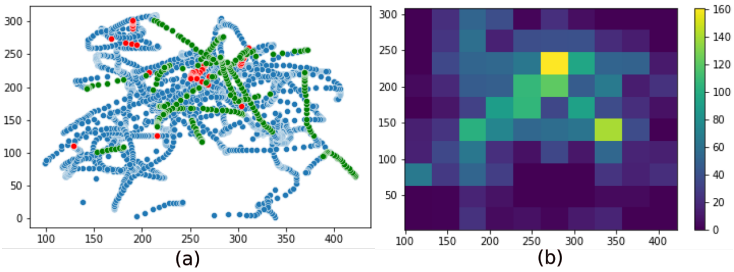

Figure 2. Two visualizations obtained from the mouse tracking of ZoomTracker: (a) the positions of the mouse during the recorded sessions (blue corresponds to static map phases, red corresponds to zoom phases, and green to pan phases); (b) heatmap of the mouse position for the same recorded session.

Over the next months, we plan to extend the tracker to OpenLayers and Google Maps APIs. But, most of all, we plan to run several user surveys with the tracker to understand better the behaviour of different types of users, with varying types of tasks with the map. Finally, we believe that ZoomTracker can be a useful tool to work on green cartography (Wu et al., 2024), i.e. to reduce the carbon footprint of these web interactive maps.

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[1] https://github.com/LostInZoom/ZoomTracker

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