Accessibility in Digital Maps - Position Paper

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Introduction

It is critical that any mapping solution that is created for the web present the spatial information inherent in maps to blind and visually impaired users. The current web content accessibility (WCAG) standard of providing map information is through a text description (Logan, 2018b, 2018a; "Web Content Accessibility Guidelines (WCAG) overview," 2018). This may have been the most effective method ten years ago, but since the creation of the web vibration API, web audio API, and web speech API, it is now possible to create much more advanced nonvisual maps on the web. Several studies have evaluated the effectiveness of text descriptions for representing data sets, and the evidence is very strong showing text descriptions are not nearly as effective as other representations (Coppin, 2015; Papadopoulos, Koustriava, & Koukourikos, 2018).

There are currently two evaluated methods for browsers to show map data nonvisually, digital auditory maps, and vibro-audio maps (VAMs). Both map types require every feature in the data set to have a name attribute that tells the user what that feature is, along with the geometry of each feature. Neither raster maps, nor maps that label extended features with a single point, fit this definition, and are extremely difficult to make accessible. Digital auditory maps have been used to show heatmaps, such as in Zhao, Plaisant, Shneiderman, & Lazar (2008), in city maps Feng, Stockman, Bryan-Kinns, & Al-Thani (2015), and enclosed space maps (like buildings) in Biggs, Coughlan, & Coppin (2019). VAMs have been used for building maps in Giudice, Guenther, Jensen, & Haase (2020) and city maps in Poppinga, Magnusson, Pielot, & Rassmus-Gröhn (2011). Future XR devices, such as ("HaptX | haptic gloves for vr training, simulation, and design," 2019), will soon allow even more nonvisual representations of map data. Although the above maps could technically be reproduced in the browser, the only maps that have been done in the browser are the heatmaps from ("SAS graphics accelerator," 2020) and our enclosed space maps from Biggs et al. (2019), offered through XR Navigation. Whatever tools the browser ends up providing need to address the nonvisual usage that blind users, in particular, will need.

Accessibility has been a core part of the HTML platform since the beginning, and section 508 requires governments to make their sites accessible (Hoffmann, 2018). Currently many mapping tools, such as Mapbox (2020) and Agafonkin (2020), have no accessibility features, and other tools, such as ESRI (2018), Google (2019), and ("SAS graphics accelerator," 2020) are very rudimentary, and only show data points. If the HTML map component has a viewer similar to one of the above tools, the nonvisual viewer needs to be performant enough to show basic points, polygons, and lines. If accessibility is considered at the beginning of the planning process, then costs and future effort will be significantly minimized (Holmes, 2018; W3C Web Accessibility Initiative, 2019). One of the most important, and costly, features to retroactively fix will be a name requirement for every feature in a dataset. The way all accessible maps work is by utilizing spatial collision detection with a feature. When the user collides with the feature, that feature's name attribute is read. It is difficult for nonvisual users to make sense of unnamed features, as the user is required to build up an image from an egocentric point of view, rather than an allocentric point of view (like a visual user would do). A dataset without name attributes is virtually useless in a digital nonvisual display.

Other attributes, such as hierarchical relationships, or layer relationships, are also important. For example, how can a computer identify an office in a building on a college campus? The office needs to be in the building, and the building needs to be on the campus. One option for this is to have conventions for layers, where the layers are indexed by hierarchy, with campus on the bottom, and room on the top. Another important consideration is representing walls in building maps. For instance, a single room may need to be represented by three shapes: a wall type line polyline that traces the border of the room, leaving an opening for a door, so the line does not connect with itself (this could look like a "C"), a door type line that will go in the opening between either end of the wall line, and a room type polygon that has the name and floor shape of the room. The problem with this method is there are three shapes for a simple room, rather than one. However, this method does allow a standard collision detection algorithm to function without modification. A second option is to represent the edges of room-type polygons as solid walls, and have a door polygon overlap the two polygons it bridges. The problem with this approach is that doors all need to have enough coverage in both polygons so the collision detection algorithm can hit a door, and change behavior to allow an exit from the room polygon. The collision detection algorithm will need to be modified to stipulate that room type polygons can not be exited unless they are covered by a door type polygon. These are several considerations critical to XR map exploration, and in particular nonvisual map exploration. Without conventions and requirements for data underlying these maps, there will be no point in building an HTML map component, as the types of maps it can show will be incredibly limited.

Considering nonvisual usage of these maps is extremely important, and it is our goal to highlight and discuss solutions and usage patterns that may not be apparent to designers and builders of the HTML map solution.

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