Thesis Project Portfolio

FloodWatch: Building real-time geospatial visualizations for flood detection

(Technical Report)

Lapses in end-to-end accessibility of modern web applications

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

As technological growth has accelerated throughout the 21st century, reliance on digital platforms in day-to-day life continues to rise across the globe. My technical and STS research projects focus on the design and implementation of digital infrastructure, particularly within the context of web applications, as a means of effectively serving end users. While my capstone technical report specifically explores a tool for aiding flood-susceptible regions of Vietnam, my STS research project more broadly considers how web-based platforms can be built in an accessible manner for users with disabilities. Both projects provide unique examples of user groups, detailing both low-level implementation and high-level design processes for meaningfully serving their respective target audiences.

My capstone research project details my work on the FloodWatch research project, which aims to create a web-based platform for real-time flood detection and reporting. Specifically, our team is focused on serving users in Vietnam which are especially vulnerable to risks of coastal flooding. While there are existing efforts to address the flood crisis through means such as physical infrastructure, they are often costly and fail to address the short-term needs of Vietnam citizens. Instead, FloodWatch aims to address these limitations by both distributing historical, current and predicted data in addition to enabling citizens via a real-time reporting platform. Throughout the past year, we've focused on enhancing our reporting capabilities, increasing usage of ML-based flood predictions and supporting user-submitted weather collection through hardware sensors.

However, one of our most significant features has been the addition of region tilesets to our main map display of Vietnam. Previously, we've relied on individual markers in major cities to display real-time weather data. However, we found these to be both cumbersome to interact

with and relatively limiting in terms of effective users they serve. Instead, we wanted to provide a broader visualization of all regions in Vietnam while simultaneously maintaining the same degree of low-level granularity for particular sub-regions. Our implementation of region tilesets ultimately achieved this; when viewing all of Vietnam, region boundaries illustrate flood risk for large regions representing collections of cities. As users zoom into particular areas, region boundaries become narrower and visualize flood risk at a city or neighborhood level. My technical report details the implementation of region tilesets, from internal tooling created to automated jobs run for aggregating real-time data. In doing so, the report details alternate implementation strategies considered and their respective shortcomings in terms of effectively serving end-users.

My STS research paper explores the problem space of web accessibility through the lens of end-to-end implementation. Though the web has become increasingly accessible to many users through rising internet availability and more affordable devices, users with disabilities are often implicitly excluded by web applications. In this sense, the term accessibility can take on varying meanings depending on the particular user group considered. The ways in which users with disabilities interact with web applications can vary widely; for example, users may prefer keyboard-only navigation, non-visual browsing through a screen reader or mouse-only navigation. Due to this wide range of scope, building web applications without fully considering accessibility throughout the design process often results in an ineffective end-user experience for those with disabilities.

Specifically, my research paper utilizes Pinch and Bijker's Social Construction of Technology (or SCOT) framework to explore explicit and implicit interactions between relevant social groups. Rather than narrowing in on a particular root cause in this lapse of accessibility,

my research aims to more holistically explore relevant social groups which interact throughout the end-to-end implementation process. While engineers are often the first group considered, non-technical groups such as designers, managers and educators also contribute to building more equitable and inclusive web applications. While my research is not (and should not) be prescriptive towards a particular way accessibility should be handled, my findings ultimately uncovered several key relationships between social groups which may inform more specific recommendations for a particular design context. More broadly, the analysis serves as a holistic overview of the current web accessibility space, enabling technical and non-technical individuals to effectively champion for meaningfully accessible implementation.

Though my capstone technical report and STS research paper ultimately serve relatively disparate audiences, they are both fundamentally centered on the same principle of building effective platforms to meaningfully serve a target audience. While my work on the FloodWatch project was in many ways carried out as a technical research demo, simultaneously exploring the problem space of web accessibility reoriented my thinking towards end-users in Vietnam and how to most effectively deliver value to them. Likewise, working on a real-world project through FloodWatch helped ground my largely theoretical STS research and provide a practical example of software design and implementation. Working on these projects in parallel allowed me to more meaningfully internalize the value of digital infrastructure and how it can enable end users.