Thesis Project Portfolio

FloodWatch: A Mobile Application for Real Time Flood Response and Analysis

(Technical Report)

Understanding the Non-Technical Challenges of Gray Flooding Solutions in Coastal Cities

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Spring, 2022

Department of Computer Science

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Sociotechnical Synthesis
(Executive Summary)

A Distributed Data Infrastructure for Flood Response and Prediction

> *The government tells us we need flood control and comes to straighten the creek in our pasture. The engineer on the job tells us the creek is now able to carry off more flood water, but in the process we have lost our old willows where the owl hooted on a winter night and under which the cows switched flies in the noon shade. We lost the little marshy spot where our fringed gentians bloomed.*
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> —Aldo Leopold, "Round River"

Coastal flooding in cities is on the rise due to factors such as climate change, changes in precipitation, and land subsidence. Ho Chi Minh City, among the top flood-prone cities, is predicted to be submerged along with most of southern Vietnam by 2050. A critical step to addressing this problem is through collecting flood data. My capstone project, FloodWatch, fills in this step by serving as a platform for collecting user-generated flood data. At the same time, the application provides immediate benefits by enabling residents of Ho Chi Minh City to respond to local flooding in real-time. My STS research topic discusses the consequences of existing or proposed solutions to flooding such as sea dikes or physical flood barriers. It delves into a variety of factors, particularly environmental and societal, which can impact the effectiveness of flooding solutions. My STS research primarily serves as inspiration for the FloodWatch project by exposing the non-technical factors involved in addressing flooding. It is important for engineers to consider the broader context of their technical solutions. This can influence their technical decisions or change their approach entirely. In the long-term, we intend FloodWatch to inform decision-makers and engineers about the many factors involved in flooding in order to help them derive the most effective solutions.

In my STS research, I expose the challenges and harms of implementing gray infrastructure flooding solutions in various coastal cities. Here, gray infrastructure refers to man-made structures such as concrete barriers or pipes. Specifically, I use Ho Chi Minh City and Venice as case studies for discussing the impact of gray flooding solutions. From this research, I found that gray infrastructure, although effective at preventing flooding, can have negative environmental and societal effects. Some of these include diminishing marine life or disrupting economic activity. An alternative to the gray infrastructure I discuss in my research is green-blue-gray infrastructure. This approach involves considering environmental benefits as a secondary goal with the primary goal being flood mitigation or prevention. Regardless of what approach is used, I've found that one must look at flooding as a sociotechnical system involving not just engineering challenges but also environmental and societal ones.

FloodWatch, my technical project, aids engineers or city officials in sociotechnical systems thinking by providing the flood data they need to implement the most comprehensive flooding solution. FloodWatch is a mobile application that allows city residents to upload and view real-time reports on flooding in their area. Residents can use this app to quickly and safely navigate streets or prepare for incoming flooding. The app could also provide a wealth of data for researchers. They can use this data to analyze flooding patterns or train machine learning models to predict these patterns. City officials or engineers can then use insights or predictions to inform their decisions on what flooding solutions to implement.

My technical project was the primary inspiration for my STS research paper. As I was developing the FloodWatch application, I questioned its purpose and its effectiveness in addressing flooding. The STS research paper was an opportunity to explore this question and develop a stronger motivation for the technical project. From the paper, I realized the main value

my technical project provided was flood data. Although this data would not address flooding directly, it would help researchers and engineers to determine optimal flooding solutions. Completing both the technical project and STS research paper has given me a practical understanding of how STS fits into engineering practice. The technical project allowed me to dive deep into solving technical problems and allowed me to develop my software development skills. The STS research paper allowed me to understand the broader picture and purpose of my technical project. I was able to gain domain knowledge of coastal flooding, and more importantly, realize the multifaceted nature of tackling flooding. This project as a whole has allowed me to realize that engineering and STS are not separable; rather, engineers must take both technical and non-technical considerations to arrive at an ethical, sustainable, and effective solution.

This project has been funded by grants won by Professor Nguyen, Department of Computer Science. He has helped with defining the vision of the project, gaining support from collaborators, and overseeing the project's progress.