Thesis Project Portfolio

FloodWatch: Devising an Autonomous Cyber Physical System for Real Time Flood Intelligence in an Operational Framework

Considerations of Co-Creation in Devising an Autonomous Cyber Physical System for Real Time Flood Intelligence in an Operational Framework - Development and Adoption

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Smart city technology can be described as systems that utilize a combination of sensors, data analytics, and modeling to provide insights, decision making, and prediction abilities. Such technologies have applications in security, traffic management, storm impact prediction and prevention, flood intelligence and more. My STS research project dives into the reasoning behind various levels of adoption of smart city technologies throughout the world. I utilize Actor-Network Theory and various primary discourses to analyze the actions, perceptions, and sentiments of citizens, municipalities, and private businesses in the adoption of smart city systems. Concurrently, my technical project involves developing a smart city system with flood intelligence by employing machine learning at various stages for features such as, crowdsource image verification, sensor anomaly detection, water level monitoring, and flood susceptibility prediction. The capabilities of the system that I am working on are being displayed at *floodwatch.io*, which serves as the progressive web app for viewing location specific flood susceptibility and submitting flood reports. There is certainly an intersection between my technical work and STS research and it is important to take into account citizen and user perspective in development as it will ultimately drive or hinder adoption.

In my STS research on smart cities, I arrived at the insight that a more balanced involvement of stakeholders can work towards a better adoption. The level of collaboration between the three major actors – municipalities, private businesses, and citizens – seems to be what dictates the difference in adoption among major cities. I analyze Professor Weibe Bijker's work in comparing American and Dutch coastal engineering practices and attitudes. I extend this analysis to the comparison of Copenhagen, Denmark and Toronto, Canada: the first, a city that has flourished with a fully integrated smart city system versus, the second, a city that has argued and pushed for a halt in rolling out such technologies. My analysis revealed that actively

engaging citizens in decision-making, co-creation, and information retrieval could work towards fostering a sense of ownership and self-efficacy, ultimately aiding in adoption efforts.

With my technical work, I am currently working to integrate the various capabilities that I mentioned above, into the FloodWatch service as a whole. Of these, producing flood susceptibility scores for any particular location is perhaps the most unique task due to previous hurdles of scalability and the need to create accurate predictions from a model that is generalized to work everywhere. The idea behind this functionality is that upon developing a physical sensor network in provinces, cities, and districts, we are able to produce flood susceptibility forecasts at an extremely granular level, which fuels better insights on infrastructure allocation and disaster preparedness and response. The project aims to incorporate citizens as well through crowdsourcing of flood reports with pictures. With user submitted images and the use of deep learning vision techniques, a verification and validation pipeline is in place to ensure that the submitted images are accurate and appropriate. This work is being used directly by Vietnamese municipalities and works to incorporate citizen input to garner trust, which will hopefully result in successful adoption of the FloodWatch system throughout the country. Furthermore, this system is designed to be extended to the global scale.

The STS course content really emphasized the importance of analyzing the technical, organizational, and cultural elements of a particular situation simultaneously in order to have an appropriate contextual understanding. When this principle was used in the STS research for adoption of smart city systems it provided a holistic perspective of reasoning behind disparities. Similarly, considerations from the technical, organizational, and cultural perspectives are used in development decisions in the intelligence behind the FloodWatch system. Utilizing the integrated approach of analyzing the technical, organizational, and cultural facets has the potential to not

only cultivate a robust understanding of complex situations but also to play a pivotal role in shaping informed decision-making processes.