

Thesis Project Portfolio

A Cloud-Based Flood Monitoring and Alerting System

(Technical Report)

An Examination of Cultural and Political Relationships with Flood Management in Bangladesh

(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

Abdullah Mahmood

Spring 2021

Department of Engineering Systems and Environment

Table of Contents

Sociotechnical Synthesis

A Cloud-Based Flood Monitoring and Alerting System

An Examination of Cultural and Political Relationships with Flood Management in Bangladesh

Prospectus

Sociotechnical Synthesis

Climate change is drastically reshaping the world around us. One significant consequence of climate change is global warming. With global warming comes an increase in damaging flooding events, caused by rising sea levels and more frequent and intense storms. These floods impact different parts of the world in different ways. In Charlottesville, VA, flooding can cause disruption to the local economy by interrupting the workflow of residents. In Bangladesh, flooding causes even more economic damage to the agricultural sector and loss of lives. To combat the harm caused by flooding, it is important to design solutions to proactively guide the development of flood management systems while also considering the ethical implications of building solutions in affected communities which may hesitate to adopt new strategies.

The technical project's goal was to start development of a cloud-based flood monitoring and alerting system for use in the county of Albemarle, VA. The system collects environmental data from the surrounding watershed using Internet of Things sensors. The measurements recorded by the sensors are then reported to The Things Network and then pulled into the cloud part of the system built on tools provisioned from Amazon Web Services. With the collected data, visualization and alert dashboards have been made for the county. The data can also be pulled for use in analysis and modeling in Jupyter notebooks and SWMM modeling using a REST API created by the team.

The STS research concerns an area in a very different part of the world – Bangladesh. Flooding is deeply ingrained in the core of the country. With a rapidly growing population in an already population-dense country, flooding causes increased damage as time goes on. Government policy concerning flood management strategies have been lacking and the role of non-governmental organizations has been sounding alarm for some. Citizens have taken on

autonomous adaptation strategies, good in the short term but likely harmful in the long term. The research sheds some light on the entanglement of these three groups and provides some possible strategies to be used to implement for use in the future using the Principles of Community-Responsive Adaptation as proposed by authors in another research paper.

Main goals of the cloud-based flood monitoring and alerting system include scalability, maintainability, and resource efficiency. By creating a system that works for Charlottesville, VA, it is likely that such a system should be able to scale for use in other regions based on the needs of the clients. For instance, in Bangladesh, scalability and low resource cost are important to create a nation-wide flood management and monitoring strategies.

I would like to thank Professor Sean Ferguson for his impactful guidance in navigating the responsibilities engineers need to consider when designing and implementing solutions in the real world and for his assistance this past year with my research. I would also like to recognize my technical capstone team members Loza Asmare, Glen Mitchell, Kwadwo Tenkorang, and Conor Todd for a wonderful collaboration on the cloud-based flood monitoring and alerting system project. Finally, I would like to thank Professor Jonathan L. Goodall, Ruchir Shah, and Jacob Nelson in their continued assistance on the technical project.