Thesis Portfolio

Optimization of VDOT Safety Service Patrols to Improve VDOT Response to Incidents

(Technical Report)

Social Responsibility to Investigate Radicalized Posts in Online Chat Forums

(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

Elizabeth Campbell
Spring, 2020

Department of Systems and Information Engineering

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Sociotechnical Synthesis

Both projects in this portfolio are tied to data driven efficiency and optimization, which is arguably the heart of Systems Engineering. Both the STS Research project, which emphasizes understanding and minimizing mass shootings, and the technical work, which focuses on minimizing traffic and accidents, aim to cut down on something, whether it be hateful posts or wait time of stranded vehicles, which in turn keep the United States a safer place for the public. Though neither hateful posts or a stranded vehicle, no matter how upsetting they are, are inherently dangerous, their repercussions (extremely radicalized views and traffic backup and accident) are dangerous and can lead to deaths through shootings or car accidents.

The Capstone Project focuses on the Virginia Department of Transportation (VDOT) and the routing of their Safety Service Patrol Vehicles (SSPs). SSPs are a fleet of cars that travel on major highways in the state of Virginia aiming to detect incidents and help in their clearance to minimize traffic costs and congestion. The first semester, the team focused on data cleaning and evaluating the ability of the SSP vehicles including gaps in detection. Additionally, the team focused on detection and clearance time of the vehicles, disparities between detection in different regions in the state of Virginia, evaluation of different detection methods (SSPs, traffic cameras, police cars, etc) and off route detection (detection not on the major highway routes). As the SSP program stands, the SSP vehicles are placed on the highways, changing overtime to better fit the incidents, by word from the patrollers and not by statistical analysis of the most optimal locations. The second phase of the project focused on building an algorithm that would optimally place the SSP vehicles throughout the highway system to increase SSP performance and minimize total response time. A genetic algorithm, an algorithm that is based on natural selection to find the most optimal result, was implemented, looping through possible routes SSPs may take

to ultimately be as close to an incident before it happens. This algorithm took data from previous roots combined with incident data to optimize the SSP routes.

The STS Research Paper discusses possible solutions to minimize the number of mass shootings and investigate the radicalization on online chat forums that leads to physical behavior. The mass shootings in this paper are tied to white supremacist linked attacks and their posts on online radicalized forums. The attackers are radicalized quickly online because of the echo-chamber effect that the Internet has (Wood, 2019). Researchers suggest that one of the best ways to stop the radicalization that leads to attacks is to drive the radicalized online forums underground further from mainstream media so that new users will be less likely to join. Additionally, administrators of the radicalized sites should take these pages offline, and internet service providers should stop providing services to these users. Also, public officials should ensure that they are not using inflammatory language that can easily be mimicked and translated into the hateful rhetoric that attackers use online.

Though the Capstone Project and the STS Research Paper were not closely tied together, there are benefits from conducting a technical and research paper in unison. The Capstone project has a large emphasis on creating a deliverable for the client, VDOT, at the end of the year. The creation of a code that could be implemented by VDOT as deliverable was something that guided the group throughout the project, and kept the team on track. On the other hand, the STS Research paper oftentimes felt like a paper that would have no results or "deliverable" section. How would one research paper create a solution to mass shootings in the United States if the government and top researchers in the field have not been able to do it? By doing the STS Research while doing the Capstone, I was pushed to think of concrete solutions that could be formed into a deliverable, even if they were not physical (a code). I would turn again to my

computer, this time not for code, but rather encrypting the most radicalized forums and cutting off security services to the hate-filled sites. These internet and code based solutions to something so physical as mass shootings was something that I may not have come across had I not done these projects simultaneously.

On the contrary, the STS Research paper showed the emphasis for background in the Capstone project. The STS Research paper was largely based on gathering a story and facts to better understand why and how mass shootings are happening in the United States. This background of why and how was something that a code for an algorithm could largely ignore up to a point because we had direction for a physical solution. The Capstone seemed more solution driven – if the total clearance time improved, why did there need to be background on why and how. That was until it came time for choosing an exact algorithm to fit the problem. The team had to work through different types of algorithms that would best fit the problem of cars moving between two exits. The team looked to other groups that had implemented similar solutions and how they had done it until finally landing on police cars traversing through patrol routes as a similar process. Had the STS Research not been done at the same time, the background component may have been lost on the Capstone and the algorithm chosen would not have fit the solution as well.

References

Wood, M. (Host). (2019, March 20). Marketplace Tech Blogs [Audio Podcast]. https://www.marketplace.org/2019/03/20/how-internet-echo-chambers-lead-to-faster-radicalization/