Prospectus

Algorithm to Detect High-Interaction Hotspots
(Technical Topic)

Analyzing Lack of Community Participation through the Actor-Network Theory
(STS Topic)

By

Bhaskar Singhvi

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

Signed: _____Bhaskar Singhvi_____

Introduction

Managing the coronavirus pandemic has proven to be a challenge for the entire world where over 40 million cases have occurred globally. A New York Times article (2020) that tracks the pandemic in the U.S. notes that cities have been the primary driver of new cases, but more recently around August, rural communities have seen a quick rise in cases. The underlying commonality that exists between cities and the rural areas hardest hit by the virus is that both contain many locations with areas of high interaction. According to the New York Times (2020), “large numbers of people in close quarters have been a major driver of the pandemic”. Both the New York Times (2020) and D.J. Peters (2020) note that the locations that are driving the pandemic are ones such as prisons, nursing homes, colleges, food production facilities, and other places with high population density. It follows that if a country is to truly maximize efforts for public health and safety, each metropolitan or rural city must implement measures to identify and implement safety measures around high-risk areas.

My proposed solution is to develop a set of algorithms that can be used to predict population density of places in a city over time. In my technical project, I will propose an algorithmic solution that will use geolocation data spanning the course of many days to predict the time and place where a city has the likelihood of the most interactions. This solution will be primarily data driven and requires little input from users. It would allow cities to see trends and implement a more calculated approach rather than solely relying on individuals to stay safe.

However, the technical solution cannot be successful on its own since societal factors can inhibit the use of this solution. Ultimately, its success depends on the government's ability to convince a significant proportion of the population to disclose their location, even if anonymously. Analysis of community participation is significant because participation is noted

to be “an essential element for improving health” (Rifkin, 2009) so any external forces that might impact it should be carefully considered. Specifically, I will analyze how media and political agendas can undermine the public’s confidence in supporting a public health initiative. This is a significant phenomena that must be analyzed because if the public does not actively engage with a technology that depends on community participation, then it can fail as it did with the COVIDWISE contact tracing app launched in Virginia. More specifically, I will show through Actor-Network Theory how the creators of the app neglected the impact of rogue actors on the public which ultimately led to a lack of participation. Neglecting this social aspect could result in the failure of the technical solution since approval from communities to share location data is required in order to get significant and actionable results.

Effectively containing a virus is a sociotechnical problem by nature since there are technical and social dimensions that surround a public health initiative. In my paper, I will outline a technical solution, an algorithm, through which local officials can predict hotspots of high interaction. Then, I will use the Actor-Network Theory to analyze how a network of contact tracing can fail because of rogue actors, such as the media and political agendas, that undermine community participation. By considering both the technical and social issues, I hope to propose a holistic approach through which health officials can better mitigate the spread of a virus.

Algorithm to Detect High-Interaction Hotspots

In the time of the COVID-19 pandemic, it has become evident that it is imperative to develop efficient tools that help best prevent the spread of a virus. Since thousands of people can reside in a single city, it can become difficult to predict where a virus can spread the fastest. Technology can aid in this endeavor since algorithms can process a multitude of data to analyze

and deduce patterns that can help in deciphering where and when hotspots may arise. This would be particularly useful in figuring out what areas need more attention by the proper authorities.

Currently, a primary technology that attempts to predict hotspots is called “COVID Watch List” created by the company Urban Footprint. This technology uses fever and prior case data, movement data, and social vulnerability, economic stress, accessibility and health risk data to create predictions about which city, county, or state could become a major hotspot in the near future (Distefano, 2020). However, this is not very useful in examining intra-city trends. In particular, this tool does not show which parts of a city are at the highest risk of most transmissions since the movement data records how much people travel, but does not indicate where gatherings are likely to occur (Peters, A., 2020). As a result, this means that it can be quite difficult to pinpoint which parts of the city have higher density of people at what times. Furthermore, by ignoring micro-level trends, one loses the ability to deduce how the time of day influences where people tend to congregate. This means with the current approach, there can be gaps in figuring out which places need further restriction to contain the virus. On the other hand, by considering densities of common points of interest at particular times, engineers could produce more qualitative results about what parts of the city need more attention than others.

To address the issues raised earlier, the goal of the technical project will be to produce an algorithm that can continuously parse and process data in order to figure out what parts of a city are most densely populated at what times. To develop this solution, Python will be used since it is an effective programming language to process large amounts of data. Using the algorithm to aggregate geolocation data of users, and points of interest such as a hospital, restaurant, and other areas of high interaction, will yield the densities of different major locations of a city throughout the 24 hours of a day. This prediction algorithm will be tested by first using a set of data to create

the prediction model, then using a set of data from a later point in time and determine how closely the data matched. Via the use of Python plots, a clear visual representation of interaction hotspots can be created which can further corroborate the effectiveness of the algorithm in deciphering clear areas of high interaction.

Analyzing Lack of Community Participation through the Actor-Network Theory

Since the beginning of the coronavirus pandemic, the concept of flattening the curve has repeatedly been emphasized. In March, Siobhan Roberts wrote that flattening the curve is a method of mitigation that "is critical [since it] reduces the number of cases that are active at any given time, which in turn gives doctors, hospitals, police, schools and vaccine-manufacturers time to prepare and respond, without becoming overwhelmed." Flattening the curve relies on significant participation from the population since a significant majority of the population must cooperate with health initiatives to keep the total active cases low.

In helping with this endeavor, an app COVIDWISE was launched in Virginia which was a collaboration between Google and Apple, developers of the technology, and the Virginia government, who intended to better their ability to contact trace by freely distributing it to Virginians. Virginia's Governor Ralph Northam released a press release when the app launched where he stated users would be reminded of the ability to get the app freely, "its privacy protection features, and how it can be used to support public health and help reduce the spread of the virus" (Office of the Governor, Ralph Northam, 2020). A contact tracing app could pose "significant risks to citizens from the collection of sensitive data, including personal health, location, and contact data" (Tucille, 2020), which is why privacy protection features were significant to address. The app was also designed for simplicity since they had to target as many

people as they could which meant targeting a large assortment of demographics. Lastly, they needed an efficient means to contract trace, a method by which a virus can be further contained by finding and isolating those who came in contact with confirmed positive cases. These three features were important because as Governor Northam noted in the press release of the app, the success of the app is dependent on widespread use. Without a massive amount of people signing up and sharing their location, it would be extremely difficult to meet the 60% participation threshold set by health officials in order to be an effective tool (Algibes, 2020).

However, in making this a voluntary health initiative, the government of Virginia failed to consider other societal factors such as an individual's beliefs that impact their willingness to participate. If a person does not believe in the technology, or the pandemic itself, then they will not be inclined to use or even download the app. So even though this functioned correctly, this app essentially became impractical because of the lack of participation since only 11% of Virginians downloaded the app (Algibes, 2020). This meant that the original goal of contact tracing to reduce the spread of the virus was not achieved, and meant that the economic cost of producing the app was potentially wasted.

I will argue that the Government of Virginia overlooked the possibility of rogue actors, which in this case are the media and government officials with certain political agendas, that undermined the public health initiative by creating a lack of community participation. One example of this phenomena are people in Southwest Virginia whose "allegiance to a president who called virus warnings a 'hoax'" (Vozella, 2020) caused them to neglect health guidelines leading to a rise in cases. This example illustrates how political agendas can alter perceptions enough so that public safety is compromised.

My analysis of the failure of the COVIDWISE app will utilize the Actor-Network Theory framework, a theory formed by Michel Callon that details how a network builder can form and maintain a network composed of heterogeneous human and non-human actors to ultimately achieve specific technological goals. In the case of COVIDWISE, I intend to show how a network of "complex relationships that exist between governments, technologies, knowledge, … and people" (Cressman, 2009, p. 3) created by the government of Virginia, the network builder, can fail. Specifically, I will show how a network cannot succeed if during translation, the process by which a network builder creates a network, rogue actors are not carefully accounted for. So by examining polarization in Virginia described in the article by Barakat and specific examples detailed by Leonor and Vozella, I aim to show how the government of Virginia's lack of attention to the role of media and certain political agendas caused the app's failure.

Conclusion

The technical report will develop a new tool that can be used in order to contain the spread of a virus in areas with high interactions. This solution can analyze trends in population density of local areas over time which enables it to be an efficient way to parse substantive data about hotspot. The STS research paper will build upon how community participation can become a significant issue in health crises by analyzing the failure of the COVIDWISE app and showing how rogue actors can effectively alter community opinion enough to create suboptimal health outcomes.

Together, the technical and STS report aim to provide a comprehensive tool by which regulators and health experts can maximize their efforts in containing the coronavirus, while exploring societal factors surrounding community participation that perhaps were not as apparent

as before. By analyzing how society can respond to a tool like this, one can increase participation and yield more accurate results which can then be used to control the spread of the virus more effectively.

Word Count: 1966

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