

Flood Warning Systems for the Local Community
(Technical Report)

Climate Change Unconcern in Rural Pennsylvania
(STS Research Paper)

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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

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Introduction

The watershed area of Greenbriar in Charlottesville surrounded by Meadow Creek is prone to damaging floods during intense storms and periods of consistent rainfall. Our objective is to create systems and strategies to overcome this zoned watershed in Charlottesville that is experiencing flooding issues. The team's plan is to connect black boxed electronic sensors to networks compatible with feeding live information and create push warning notifications and dynamic informative visualizations via a refined database.

Developing flood warning systems in this area provides residents in this at-risk area notifications so that they can take precautions and prevent damages to their homes; it has no actual effect, though, in augmenting the efforts to reverse the ominous issue that is causing increased flooding globally. Flooding is explicitly surging as with direct correlation to increased temperatures, increased temperatures are influenced by directly by several anthropogenic factors that have come to fruition through industrialization and the expanding human population.

From an STS perspective, my prospectus is focused on examining the lives lived by those in rural Pennsylvania and how we can learn about climate change unconcern through the experiences of these people. Through a framework of experiential development, I intend to investigate the spaces where knowledge forms about climate change among this population, and investigate what the next steps could be to heighten levels of concern without affecting or offending lives lived by these people.

Technical Topic

Flooding is confidently expected to increase exponentially in the coming decades, as from 2016 to 2099, the intensity and prevalence of extreme participation events are forecasted

to soar. Southeastern Virginia, in particular, extreme participation magnitude may increase up to three times current levels (Sridhar et al., 2019). The damages caused by flooding to residential homes is a remarkably high expense vulnerability, as an average sized home of 2,500 square feet with \$50,000 worth of possessions has a loss potential of over \$26,000 with only one inch of rainfall. An accumulation of half a foot of water can result in over \$52,000, which is a large fraction of what these homes are oftentimes worth (FEMA, 2017). With the dense assortment of houses in the Greenbrier neighborhood, with the watershed posing a constant threat, increased frequency of intense flooding will be devastating to the landowners and perspective investors of the zone.

With the modern human frequency of dependency on smart phones and internet access, simple yet informative systems can be built on the internet of things using affordable devices and easily accessible software. The cost benefit ratio of incorporating simple notifications flood warning systems has been evaluated in some instances to be a valuable \$110, providing people who are not proactively aware of a potential flood the ability to prepare (Silva Souza et al., 2017). Scaling and efficiency regarding these systems is not a subject of concern, with cooperative communication networks optimizing the resource allocation through optimal relay selection (Ansere et al., 2020).

Our team of Abdullah Mahmood, Kwadwo Tenkorang, Loza Asmare, and I are currently developing a flood warning system for usage by residents in the designated watershed and by Albemarle County infrastructure teams, with the help of Dr. Jonathan Goodall and graduate student Ruchir Shah. The system will use an assortment of black box sensors acquired from The Things Network, which will be placed in several flooding prone locations throughout the watershed (SenseCAP LoRaWAN Barometric Pressure Sensor - Marketplace - The Things

Network, n.d.). The data from these sensors are pulled using python code, which is imported by lambda functions calibrated with AWS to conditionally and periodically pull data from these sensors. Using readings of pressure and temperature, a current water depth is derived, a time series variable which is crucial to predict flooding. This data is written to an SQL database, in which a visualization software will use to portray the current state of the watershed. Establishing a push notification system is an element of the system that we have not developed a method for.

Measuring the effectiveness of the flood warning system can be separated into two categories. First, the system must provide timely and accurate warning to its users. This will be measured by the time it takes between when the parameters for a potentially dangerous rainfall are met in the physical world and when users are notified; the accuracy will be measured by contrasting the actual water depth and what our sensors calculated water depth is. The second indicator of performance for this system is the ability for future capstone groups to inherit the system and improve upon it. Our judgement to measure this is the quantity of documentation for the developed script and the assessment of scalability of the system.

STS Topic

Climate change perceptions are currently in a state of halted progress. Despite 97% of scientists agreeing that Earth has been warmed due to human causes, only 46% of people globally believe climate change is a serious issue (Scientific Consensus, 2020; Stokes et al., 2015). The results of climate change has formed trends of global temperature rise, shrinking ice sheets, increased sea level, and increased ocean acidification which have and will continue to cause and worsen extreme weather events and loss of life, yet the United States in Donald Trump's presidential term has dismissed at least 70 environmental regulations and 30 more are in progress to be reversed as of July 2020 (Popovich et al., 2020). In the rural areas of

Pennsylvania, the heavy industrial presence of power plants, natural gas drilling, and farming operations contribute the fourth most greenhouse gas emissions of all states in the United States; projections predict that temperatures will rise by 5.4% and rainfall will increase by 8% on average in the state (Muschick, 2019). Outside of the six main urban sections of Pennsylvania, only 33% of residents were polled to strongly support a Pennsylvania specific carbon reduction plan (Metz et al., 2015). My objective is to analyze the unconcern or denial of climate change in rural Pennsylvania using the framework of lived lives and the specificities of human experience.

Explanations for climate change unconcern oftentimes use the argument of knowledge deficits, that those who do not recognize the severe dangers of climate change is a challenge that should be overcome by instilling a scientific consensus that should be recognized as an absolute truth. This model assumes that greater levels of scientific understanding and concern about climate change is ultimately superior, which when framed negatively can create polarization around policies and subject communication. The framework for applying climate change unconcern as an experiential development through the context of a person's life places value on the social systems that combine values and facts (Lucas & Davison, 2019).

The experiential framework outlines five main experiences for unconcern around climate change. The first is ideological unconcern, which is the set of beliefs about a society's proper order and the ways to achieve it. Oftentimes ideological unconcern is manifested in politics, and the polarization of climate change is often a product of western English-speaking democracies; in the US, conservatives are more likely to be climate change skeptics, and rural Pennsylvania is becoming more conservative as unease around support for coal industry increases (Dunlap & McCright, 2008; Nark, 2020). Pennsylvania also did not require climate change education in the school curriculums until 2020, lacking pushback to skeptical ideals (Kubis,

2019). Secondly, group-based lack of concern occurs when a stance forms based on a societal group one exists in, and many times is a method to mitigate exclusion or rejection. While ideological unconcern is associated with those stances formed by ideals, group-based unconcern is shaped by the interactions of those around them. In rural Pennsylvania, small communities and acceptance of partial media narrows the scope of groups with alternative viewpoints, and those who express concern about climate change could be ostracized. Religious influences of climate change views involve the doctrine and religious practices that shape one's perspective on the legitimacy or concern of climate change, which can manifest in viewing research on the subject a threat to divine understanding or interference with an inevitable judgment day. As Pennsylvanian adults are 73% Christian, and a direct association is found between conservative Christian faiths and climate change unconcern, religion may be a strong source of skepticism in rural Pennsylvania ("Adults in Pennsylvania", n.d.; Morrison et al., 2015). Self-enhancing sources of climate change unconcern stem from an individualistic mindset, where one prioritizes current concerns over drawn out and ambiguous issues. As rural Pennsylvania is not yet susceptible to extreme weather events or rising sea levels, the threat of climate change may not seem ominous enough to change daily lifestyles. Perceptions on subjects like how low enough gas prices justify driving an inefficient vehicle or that big corporations and cities are responsible for driving change may shift the responsibility away from rural Pennsylvanians and drive unconcern. Lastly, self-protective sources of unconcern develop by way of uncomfortable knowledge, as denying and opposing the imminent threat of climate change aids the overwhelming helplessness an individual feels from the ominous environmental threat. This can be tied into the atmospherically harmful industries of rural Pennsylvania, and how unconcern shelters from the thoughts of dissolving economic foundations in these areas.

Examining the lived lives of those in rural Pennsylvania and framing it to shape a qualitative analysis of climate change unconcern will create a scenography that allows for open minded dialogue. Treating climate change unconcern as a knowledge deficit or unconscious acceptance of biases is unproductive. My intention is to investigate the area's interaction with climate change science and technologies that form knowledge while considering factors like values, economic status, and demographic to form a dialogue of climate change perspectives.

Next Steps

The research regarding climate change unconcern is vast, but frequently it assumes high level factors and lacks to consider what tangibly demotivates people from believing in climate change. Narrowing the scope to just those in rural Pennsylvania, I intend to generate some anecdotal text about individual experiences in dealing with climate change. Through this anecdotal investigation, I want to focus on the technological factors of how this population forms their knowledge, especially in the educational spaces of this area. The objective of completing this research is to generate an understanding of climate change unconcern in this selected area deep enough to tailor an approach that could shift perspectives in the population without ignoring experiences lived.

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