Investigating the Effects of Cultural Differences on Climate Solutions in Vietnam

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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

In 2022, extensive flooding ravaged across Vietnam, with entire homes, cars, and livelihoods swept away by the current. People escaped on rafts from the tops of wooden houses, and families were separated for days at a time. Communities dependent on riversides and coastlines for economic stability collapsed and were forced to migrate to cities, uprooting thousands from their homes (Miller, 2020). In just October alone, a shocking number of 436,868 people were affected, with 19 deaths and 110 injuries, and over 89,450 houses inundated (ReliefWeb, 2023). By the end of the season, the 2022 wet season was one of the heaviest flooding seasons ever encountered in Vietnam. And yet, throughout the decades, flooding has only trended worse, with UN reports stating that while it is difficult to pin everything on climate change, natural disasters across the Earth have doubled in the last twenty years (Earth.org, 2020). Unfortunately, while flooding has always been accepted as the norm, recent trends suggest that greater catastrophic floods will occur and sea levels will continue to rise, destroying more than just the infrastructure of these communities, but the cultures, traditions, and livelihoods.

Vietnam is not alone in the rise of climate change-related disasters, but it is a region most vulnerable to climate change – it is among the top 5 countries most vulnerable according to USAID. As flooding continues to ravage the populations of Vietnam, communities that have lived along riversides and coastlines for generations are forced to move to urban areas. With the importance of a community's sense of place, the forced migration of communities to new lands is a great injustice, and one that should not be taken lightly (Miller, 2020). Especially in Vietnam, it has been shocking to note that over 1.7 million people have migrated from the Mekong Delta in the past ten years, a major region with an abundance of riversides and wetlands (Chapman, 2018). Lifestyles and livelihoods are completely stripped away from families who

have lived and worked the land they have lived upon. In addition, lower income communities are more vulnerable to floods – within a localized region, they are more likely to be settled in most dangerous areas for flooding, and are least able to prepare and recover from floods due to lack of income (Bangalore, 2019; McElwee et. al., 2017). Even more moving has been the fact that the countries most affected by climate change are those contributing the least to carbon emissions (Miller, 2020; European Environment Agency, 2023; PBS, 2022). This has led many engineers from multi-disciplinary fields to enter the fight against climate change risks, from computer scientists to urban planners to civil engineers. This paper will explore the extent to which traditional cultural values may affect a person's perception of the risks of flooding, towards climate change, and towards current and future technical solutions to fight climate change and its effects.

Case Context

Vietnam is a country of approximately 97 million people in Southeast Asia, immediately south of China and east of Cambodia and Laos. The country has over two thousand miles of coastline mostly along its eastern shore, and many major rivers such as the Red River. A country with an abundance of water, the concept of water in Vietnam is an extremely complex relationship, and discussions must be multifaceted. Faced with an annual wet season, flooding is embedded into the culture of Vietnam, and is always expected during the rainy season. Rainfall is almost a daily occurrence during these times, with a heavy but short downpour typically appearing in the afternoon hours. As such, the increased rainfall contributes to fluvial flooding, or floods caused by the overflowing of rivers. However, as counter-intuitive as it may seem, this flooding is beneficial to the local communities – water from floods creates land suitable for rice

cultivation, an economic pillar of Vietnam. Yet, floods are still only beneficial in moderation since major floods can still wipe out homes and rice fields. Most importantly, with the looming threat of climate change, rice yields are expected to reduce by 71% by 2100 due to increased flooding disasters (Vien et. al., 2011). The water that enables such widespread agricultural production may very well also be the water that levels farmland and rice fields, revealing the complexity of the problem faced by these local communities and engineers.

Within Vietnamese tradition, water has also been widely embraced, and Vietnamese lifestyles have been greatly influenced or dependent upon water. In addition to the dependence on flooding for rice farming production, vulnerable regions such as the Mekong and Red River Delta are the two most densely populated regions in Vietnam, with around half of the country's population living in these deltas, and where huge communities have settled for much of Vietnam's history (Ngoc et. al, 2022; Nguyen, 2023; Delta Alliance, 2009). Deltas are wetlands created when a major river deposits sediment into another slower moving body of water, and as such, these communities are completely surrounded by water bodies (National Geographic, 2023). Because of this, these communities traditionally depend on fishing, shrimp farming, and other lifestyles dependent on water. Vietnam even has an art form called *water puppetry*, a folk tradition telling stories, performed in water (Vietnamese Immigration Services, 2023). This shows the great intertwining between daily life and entertainment with the surrounding water and environment.

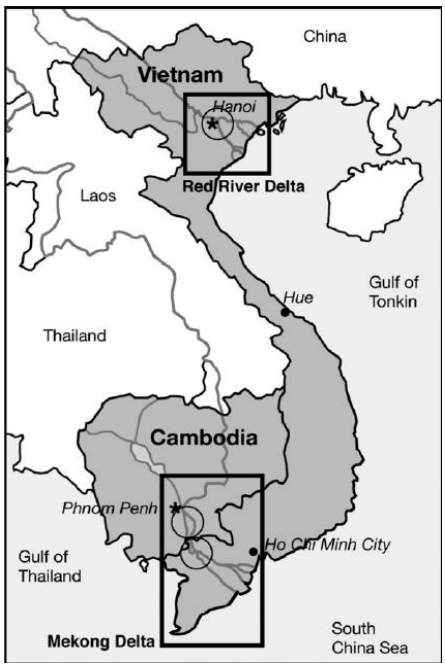

Figure 1. A map of the Mekong and Red River Deltas, the two most populated and vulnerable regions in Vietnam for flooding (Source: Berg et. al., 2007).

With such a complex relationship, there are many different dimensions to consider in building solutions to deadly flood risk mitigation. The first must be the consideration that simply blocking water flow or passage into a community such as through levees could positively protect a community from destruction of homes, but also affect one negatively through the partial rerouting of water from creating the necessary marshes for rice farming. Without the ability to farm rice, these communities are now instead harmed economically. In addition, rerouting a river permanently such as through dams will also disable the ability to fish or farm shrimp, another source of food and income for many communities along these riversides, completely changing the lifestyles and landscape of these communities that have been unchanged for generations. As such, the creation of any solution must strongly consider the social dimensions of the communities they are attempting to serve, and must consider that solutions that may work in

certain environments may not similarly benefit another environment. Without providing the local community a say in these solutions, engineers fail to understand a full image of the scope and effects of their creations, and in turn may harm a community they meant to benefit.

To address these types of situations, this capstone project aims to create a tool that can be utilized by the local communities at their own discretion and to serve in local government planning and preparation for natural disasters such as flooding. The project aims to avoid directly impacting the local community directly to avoid unintended effects, as well as to avoid any disruption of the daily human interactions and lifestyles of these communities. With the importance of the local community's input on the creation of these engineering solutions, the *Social Construction of Technology* framework, a framework analyzing technology from which societal standards, values, and human actions shape technologies and their "successes," may be used to analyze the complex relationships between solutions and this unique problem, and especially the cultural values that shape any posed solutions. A greater understanding of these values will enable engineers as well as this capstone project to avoid destroying communities, and create long-lasting effective solutions to save lives.

STS Theory

The *social construction of technology* provides a lens through which one can view this unique nuance of Vietnamese heritage and culture, and how it can play a major impact on the solutions to be employed to fight flood risks. In this framework, technologies have an *interpretive flexibility*, where social values can change how technologies are perceived or used, especially in the environment in which they are deployed or released to the public to solve specific issues that they were designed to address. Such social forces can coerce redesigns and

further iterations upon the engineering solution until the technology reaches *closure*, a successful design that has addressed the concerns of each stakeholder group (Pinch, et. al., 1984). Using SCOT, analyzing Vietnam's cultural values reveals that flood mitigation techniques Americans may see as intuitive or useful in American use cases can be ineffective or damaging in Vietnam, and often rejected, an example of the interpretive flexibility of these solutions due to culture. For example, levees and dams reroute water away from rice fields that communities depend upon for food and income, and cause another community to bear the flood downstream (Hoa et. al., 2008). This phenomenon is apparent in Vietnam due to the described unique cultural values leading to communities densely clustering in these most agriculturally productive deltas. Western strategies for possible infrastructural changes only make the issue more complex in Vietnam. As Hoa shows through modeled flooding simulations in Vietnam, physical barriers are ineffective long term in overall flood mitigation of the entire region, and even in the short term, cause unanticipated damage to other surrounding communities without the necessary proper planning. As shown in this study, even when already socially rejected as many communities have pushed back on these solutions, these solutions can also prove to be technically and physically faulty as well due to spatial distributions of population clusters and the difference in landscape of Vietnam versus the West.

Instead, the use of early warning systems like this capstone project have arisen to address this. As technological solutions themselves, these face interpretive flexibility as well. As part of my research, it is required to have hardware sensors that can collect real-time rainfall data to send to our early warning system as part of flood risk detection. However, Vietnamese partners of our research project had provided concerns about how social groups and locals would react to the deployment of the first iteration of the sensor design in cities, pointing to the sensor's

requirement of having to be deployed on a level surface such as the ground or a rooftop to catch and measure rainfall. With the need to deploy on busy streets in inner cities, the ability to deploy sensors on the ground was infeasible. Deployment on the ground would have led to an interference of daily human activities, especially being physically in the way of foot and vehicle traffic, and a lack of safety or integrity for the sensor readings due to possible damage resulting from accidents or purposeful adverse actions, easily made possible due to proximity to human traffic. This pushed the project to move towards LiDAR-based sensors, enabling the deployment of devices on the undersides of bridges and lampposts instead, outside of the reach of daily human activities and possible interference both by the device and with the device. In addition, the avoidance of a direct physical solution to the prevention of flood risks and instead the creation of a *tool* to monitor and warn of flood risks also steers clear of any major interference to human activity and local cultural values that earlier engineering solutions had encountered (such as by levees and dams). Early warning systems like ours place the focus on preparation and evacuation, providing time for communities to plan and choose to protect themselves in ways that better serve their values, and giving a voice to those most affected in the decision-making process.

Yet, closure upon this problem has not been met – while the use of early warning systems can serve immediate flooding impacts and save countless lives by evacuation, they still fail to address the impending future of rising sea levels in the long term. The reversal of climate change is still unachieved, of which the worsening effects of climate change will soon cause entire regions to soon be underwater. It has been found that at least a third of the Mekong Delta will be submerged with a three foot rise in sea level, and in its result will cause the displacement of an enormous number of people, being the most populated region in Vietnam (Miller, 2015). Further

dimensions of this problem must therefore be explored, with larger-scale efforts required from the greater world community towards this collective fight against climate change, a much larger-scale problem.

Research Method

I pose the following question to consider as we develop further solutions: What are the key values that shape Vietnamese cultural perceptions towards climate change and its technical solutions? To investigate, I searched for the most trusted and widely used news sites based in Vietnam, and found that *vnexpress.net* was the most visited news and media publisher site in Vietnam (SimilarWeb, 2024). As the leading media publisher in Vietnam, *vnexpress.net* offers a less biased and more illustrative representation of the sentiments of the general Vietnamese public. As such, it is a good gauge for the general perceptions of the people of Vietnam. Using the Python library *BeautifulSoup*, I scraped the news site for all articles containing the keywords of "floods", "climate", "typhoon", and "monsoon", and performed thematic coding on all the words contained in all of these articles, as well as their titles. These words were originally in Vietnamese, so each word was translated to its English equivalent phrase using Python's *DeepTranslator* library. Since I speak Vietnamese, I am able to verify the translation. Then, a count was compiled for each unique word across all of these articles, which was then filtered, removing all articles, prepositions, and irrelevant words (such as words pertaining to pronouns, the keywords themselves, and names). Finally, I aggregated these words into categories through prompting a large language model, GPT3, to perform a k-means clustering upon the 102 most observed words, leveraging the state-of-the-art word embeddings made available by OpenAI's API and natural language capabilities to perform classification. These were a major improvement

upon my first attempt, using *NLTK*, a Python library, to train my own natural language word embedding model upon all words in my dataset, which was much less accurate and created less cohesive clusters.

In addition, for some words that were not placed in a category, such as *America* or *hell*, or for words that may have multiple meanings, such as *mandarin* and *bar*, I sampled articles that mentioned these words, and read them to determine the true usages for these words. If these fit into a category that it was not placed in before, I added them into the corresponding category, or switched it into the category that best fit the usage.

By observing which words are most often used in articles related to climate change, one can gauge the sentiments of the general population of Vietnam towards climate change, and reveal and aggregate the values that are most important to the demographic. These values will be the main drivers of social influence upon any engineering solutions deployed into Vietnamese communities. They will determine social interpretations of the technology, limit the effectiveness of such solutions, and determine whether or not these solutions will become widespread or will be forced into further changes until closure. Knowing what these values are can help engineers anticipate potential problems ahead of development and deployment, and allow plans and designs to be modified with these values in mind, ensuring a smoother deployment process with less pushback from social pressures.

Results

An analysis of the top 102 relevant words revealed many surprising and unexpected results. Firstly, I have found a growing shift of the general public's focus with regards to flooding solutions, shifting from infrastructure to digital technologies such as apps. It also

revealed the major driving concerns and values of the Vietnamese public regarding climate change and related natural disasters – there are clear concerns about access to food, sources of energy, business profits, livelihoods, and the economy.

Table 1. The Top 102 Most Commonly Occurring Words in Related VNExpress Articles. Note: Colors indicate the category that each word was clustered into by K-Means Clustering.

"GAS": 12651
"WATER": 11202
"DEGREE": 10322
"LIVE": 9125
"YEAR": 7990
"CHANGE": 7852
"ENTER": 7796
"AREA": 7282
"SEA": 7235
"ABOVE": 7233,
"CENTRAL": 7150,
"HIGH”: 6971
"HEAT": 6906
"NORTH": 6841,
"DYNAMIC": 6724,
"NATIONAL": 6691,
"HOME": 6568,
"LABOUR": 6465
"WIND": 6394
"STORM": 6370,
"FAMILY": 6362,
"POWER": 6027,
"DIRECTION": 5532,
"WINTER": 5329,
"QUANTITY": 5133,
"GRANT": 5029
"RAIN": 4920
"WORK": 4734
"LAND": 4644
"STRONG": 4613
"TIME": 4583
"REGION": 4518
"NEED": 4454,
"MANDARIN": 4318,
"COPPER": 4157,
"TRANSFER": 4050
"FIT": 4024,
"NEWSPAPER": 3974,
"HEART": 3886,
"GRAND": 3835
"GO UP": 3466,
"SEASON": 3451,
"MONTH": 3333,
"EXPORT": 3212,
"MUSCLE": 3186
"APP": 3165,
"CONSTRUCTION": 3130,
"CHIEF": 3129,
"GENERATION": 3113,
"TERRIBLE": 3092,
"CREATE": 3087,
"REDUCE": 3082,
"RIVER": 3008
"COLD": 2710,
"FESTIVAL": 2645
"SKY": 2603
"LOVE": 2565
"RESCUE": 2497,
"PRICE": 2356,
"AMERICA": 2326,
"RECEIVE": 2319,
"RESEARCH": 2315,
"BRIDGE": 2287,
"DESIGN": 2272,
"PEPPER": 2253,
"WASTE": 2180
"FISH": 2153
"LONG": 2122,
"LITERATURE": 2085,
"TUNNEL": 2083
"JOB": 2073
"FORCE": 2039,
"CHEMISTRY": 1990,
"CARBON": 1986,
"SERVICE": 1896,
"SYSTEM": 1878,
"ACTIVE": 1775
"WEAK": 1677,
"POSITIVE": 1665
"GOD": 1663
"FRUIT": 1656,
"TURMERIC": 1605,
"ELECTRICITY": 1552,
"BAN": 1487
"SCHOOL": 1455,
"MANAGEMENT": 1399,
"SPEED": 1372
"ON ONE'S OWN": 1364,
"DEAN": 1311,
"BUSINESS": 1309,
"COMPUTATION": 1303,
"SQUID": 1296
"RISK": 1275
"NET": 1266
"MACHINE": 1232
"BAR": 1149
”PROFIT": 1100
"IDEA": 1097
"SELL": 1081,

"COMMUNE": 1042, "FUND": 879 "HELL": 855,

KEY: NO CATEGORY BUSINESS/ECONOMY RESOURCES
PREVIOUS SOLUTIONS TECHNOLOGICAL SOLUTIONS
NEW RESEARCH FOOD TIME & DURATION
WEATHER & NATURAL PHENOMENA GEOGRAPHICAL FEATURES
EMOTIONS & RELATIONSHIPS GOVERNMENT & POLITICS
DIRECTION & LOCATION CAUSING CHANGE

Figure 2. A list of the top 102 most occurring relevant words across all articles containing relevant climate key words, with their number of occurrences and category, if applicable.

To begin, 18 of the top 102 words (17.6%) are related to possible solutions that may be implemented, and ways that the population believe can help solve the flooding disasters facing the nation. 6 words are classified in support of new research and education (NEW RESEARCH), suggesting the investment of great funding into new innovations through research in schools and universities in Vietnam and around the world. There are 8 words concerned with previously implemented or current solutions that are used to fight against floods (PREVIOUS SOLUTIONS), or to fight risks associated with floods, including words like “construction” (such as of levees and other infrastructure). There are, however, also 4 words such as “app,” “computation,” and “machine” that align towards the development and rise of computing technology (TECHNOLOGICAL SOLUTIONS), especially in the context of smart city systems, classified under technological solutions. This suggests that in addition to the use of infrastructure to fight these disasters, the public is starting to also consider technological advances in computer engineering and science as possible sources of innovations for solutions. In addition, as “app” has more observations than “construction”, this may signal a shifting focus from infrastructure to digital technology such as in the development of early warning systems.

Next, 7 of the top 102 words (6.9%) have to do with food (FOOD), indicating that a major concern of the population when faced with these dangers is the access to food and

resources. Though *mandarin* was not initially classified into the food category, through reviewing the articles containing unclassified words I found that a majority of these articles were talking about the mandarin orange fruit, a popularly grown fruit in Vietnam. As such, the most mentioned food is the mandarin orange, surprisingly. In addition, the second most mentioned food is pepper. This reveals that the most highly affected crops under highest concern due to climate change and flooding in Vietnam are actually mandarin oranges and pepper, contrary to the expectation of the dominance of rice farming and the dependency on rice in Vietnam. Rice is surprisingly only at 233 occurrences, almost ten times less appearances than pepper, and almost twenty times less than mandarin. Pepper is in fact referring to black pepper, which is another major crop of Vietnam. However, unlike rice, which is dependent upon water from floods creating marshes for the rice to grow, black pepper does not have the same benefits from floods, suggesting that the increase in floods could prove to be even more devastating for black pepper production. However, fish is the next highest word, with 2153 occurrences, two positions below pepper. This also reveals and illustrates the importance of fishing in Vietnamese culture, and warns of the potential great harm to the fishing industry of Vietnam with the impending dangers of increased flooding, killing sea life (squid is also on the list of the top 102 most occurring words, found near the end of the list at 1296 occurrences). With these words listed high on the most occurring words, this reveals that these food sources are likely the most vulnerable to and most damaged by floods. As these are major exports of the country as well, damage to these crops may cause more than just hunger and famine, but also great economic impacts as well to vulnerable farming communities.

Two other major concerns were realized through this process: energy and business. It was found that 7 of the top 102 words (6.9%) have to do with natural resources or sources of energy

(RESOURCES), which may be greatly affected by the storms and monsoons brought about by these disasters, and are important for sustaining daily activities. In addition, 10 of the top 102 words (9.8%) have to do with businesses, profits, and the prices of goods and exports (BUSINESS/ECONOMY). As shown by this, a major concern of the population when considering the dangers of these disasters and looming danger of climate change will be the lowered income and potential loss of businesses and exports from Vietnam, greatly damaging the economy. As such, the economy and business profits of the people's livelihoods are a major factor that motivates the public in this fight as well. When considering the impacts of flooding and the creation of possible solutions or plans to protect communities with an impending flood event, it will be important to protect the energy resources and businesses of the people, as these will be the most impactful and highly valued by the people.

Finally, it must be noted that the Vietnamese public wants change. Even though flooding has always been a part of daily life, the public understands that such threats will only become worse every year as climate change fails to be addressed successfully. With 10 out of the top 102 words (9.8%) related to a call to action for change, public pressure is clear for further developments in technology, and faster.

Discussion

The most immediate insight coming as a result of this analysis is that it supports the claim that many in Vietnam shifted support from infrastructural solutions towards computing technology. This claim was argued by many related works to our research, suggesting that many infrastructure-based methods have been relatively ineffective or unsuccessful in accounting for regional and cultural differences, and that creating a tool instead for use by the local community

under their discretion would be the most effective way to involve the main stakeholders in solutions that directly affect their lives. With the multiple words related to computing technology in the top 102 most occurring words, this reveals that there is a major focus in the eyes of the Vietnamese public on the use of computing technology to protect against these disasters, compared to the mentions of infrastructure. Since my capstone research work also pushes for this change, with the development of an early warning system tool, the analysis suggests that the Vietnamese public would also be in support of the research output of my team. It also suggests that the public is more interested in these emerging technologies in computation in general, which when used as solutions may be more likely to spread or be adopted. The shift in public focus, in the lens of the social construction of technology, will play a major role and have a major effect in both the development of new technological solutions towards flooding, as well as in controlling the effectiveness of the solutions already in deployment. In the context of SCOT, a shift in public opinion towards the growing field of computation from physical solutions corresponds directly with already growing trends in smart city research, and is very likely the driving force that has accelerated the rapid rise of smart city platform development. As societal approval for such research focus continues, these new platforms leveraging *cyber-physical systems*, or the integration of computer science with physical systems and infrastructure, will continue to expand in their reach and innovation. Funding has also greatly increased for use in computer science research, compared to other disciplines, driving even more interest and focus into the field. And as research continues, as a result, new research groups will now focus more on the leveraging of computational power, rather than the physical power of physical infrastructure solutions, outputting new ideas more aligned towards computer science. This will therefore affect researchers and universities who are studying similar problems in science and

technology, pushing them to look first at digital or cyber-physical solutions before other possibilities. As more digital solutions are built and deployed, the hardware that is required to be deployed will be directly embedded into the city infrastructure such that it will become a part of the city, by the ideals of a *smart city*. They will blend into the environment, and collect, transmit, and analyze data while outside the reach of human activity hidden into the city. This will greatly contrast that of the physical solutions used before, which made a direct and distinct impact on the landscape of a city. As such, the transition towards digital solutions will be nearly invisible to the communities.

This analysis also revealed three main concerns regarding flood risks. Firstly, the Vietnamese public are concerned about the lack of access to food and damage to food production. They are also very concerned about damage to natural resources and sources of energy and electricity. Most concerning to the public would be harm to the economy, to their businesses, profits, and especially the livelihoods that sustain family living expenses. When developing new solutions in the face of flood prevention and flood risk mitigation, researchers and engineers must consider these concerns, and to develop solutions that significantly address and protect these major concerns of the people. Solutions that do not successfully address these concerns will likely be rejected in deployment or on release, in which governments and communities will either refuse to adopt them, or integrate them into their communities and lives. As already previously discovered in my research work, any technology causing any disruption of the daily activities and livelihoods of the communities will be pressured into redesign, either by key stakeholders in the government, or by the community itself. This happened with my research's first iteration of an early warning data collection sensor, our rain gauge design, with key stakeholders refusing to deploy them in certain locations or requesting changes in design.

SCOT makes clear why this may occur – when a technology does not serve the purpose of the society it is meant to serve, it will be pressured to change or become obsolete. In the most extreme cases especially in the context of flood mitigation, it becomes especially understandable when the biggest concerns of the people are those that will directly harm the communities the most if failed to be protected – in this case, damage to food sources would cause famine and widespread hunger, loss in natural resources and energy will bring daily activities to a halt and the ability to complete most tasks and business operations, and the loss of business and income would result in extreme poverty for communities. Solutions that do not protect the community from these horrible consequences lack any kind of effectiveness on a social scale for the people they are meant to serve.

With a focus on protecting these three facets of daily life, researchers and engineers can better serve the community that they are implementing major solutions for, and better address the values that are most important to these communities, allowing for a much more effective and successful solution, and especially, a much less harmful implementation.

Limitations

Though this analytical approach through the thematic coding of all articles from news sites in Vietnam as a single entity allows one to elicit the major themes and uncover the major concerns of the Vietnamese population at large, it is limited in its ability to reason as to why certain concerns exist. It may face ambiguity in word occurrences due to some words having multiple meanings, which may be lost either in translation into a different word, or result in different meanings of a word simply grouped into the same word. In addition, the inability to reason stems from the scraping of all articles' words into a single file of words, removing the

semantic differences between articles. This means that it may lack a personal connection to the ideas and themes elicited by the writers of the articles, and the sentiments of the articles may have also been lost when merged into the single file. In addition, I had only scraped the articles on vnexpress.net. While the leading media publisher representing Vietnam, the scraping of additional news publishing companies in Vietnam could provide a larger number of perspectives that a single publisher may not focus upon, and avoid any implicit biases that may lie in a single publisher's writing styles and perspectives.

Future Research

To avoid these generalizations that may have occurred in this research method, another method that will have also been very useful is in the conducting of interviews with samples of people from different parts of Vietnam, representing different regions of the country, and allowing a more personal and deeper understanding of the true sentiments of the population from people directly within these communities. Rather than an aggregation of the general public's values based on news articles, an analysis of sentiments from the communities themselves will allow for a more nuanced understanding, where different trends may be analyzed or revealed depending on the regions, occupations, and demographics of those interviewed.

Incorporation into Future Research

In further consideration of the results of this analysis, there are many more changes that can be brought into our platform such that we can address. We can address not just the development of an early warning detection system for floods, but also incorporate other facets of daily life to be monitored as part of a fully all-encompassing smart city application, the overall

goal for our platform. Especially with the evidence suggesting a strong concern for food accessibility and energy accessibility in the event of flood disasters, our platform hopes to become multi-modal as well as multifaceted, to take in data from many different sources such as soil and air, and to detect changes in conditions that may indicate a risk in agricultural production or lead to harmful air quality. These can protect the population's main concerns that were revealed by the research study: protecting food and resources of the people. Both contribute to the development of a smart city system that can improve the quality of life and protect its communities through the use of computing technology. Especially with the indication that the general public will be in full support of the development of such technological advancements in smart city platforms from the results of this study, this signals that our capstone research work may be very valuable and beneficial to the communities in Vietnam, and that researchers like our own group should continue to push further into wider applications of Internet of Things (IoT) capabilities for the improvement of quality of life and risk mitigation of natural disasters.

Conclusion

Even after a study of the general overarching sentiments of the Vietnamese public, there is much to be gained in further analyses. However, this study reveals major areas of focus with which to orient research efforts to address, to be mindful of, and to avoid harm when developing our solutions. In following these areas of focus, technological solutions will be the most successful, and move closer to a closure of the technology within the domain it is serving. Where engineers in the past have developed solutions without enough consideration of the values of these communities, leading to great harm and damage at worst to the region, and ineffectiveness at best, this study enables researchers to have greater clarity in the facets of daily life that must

be protected in these communities. And furthermore, solutions that manage to support all of these concerns and values of the people while simultaneously protecting these communities from harm will be those that are the most effective and widely embraced solutions, and will likely be adopted by the people they are aiming to serve.

Not only should researchers focus on these main concerns of the public, but also policymakers and government officials concerned with the well-being of the Vietnamese people. These shared concerns regarding food, energy, and businesses, and especially the words themselves that represented these categories – such as protecting mandarin and black pepper farming, fishing, electricity, exports, and profits – can be applied across all issues that affect the nation, not just in the context of climate change and flooding. In addition, these were found to be some of the most important values and concerns of the people. Every decision that is made may affect these activities and resources, and as such, all must consider the consequences of their decisions with respect to these values of the community when creating new policies.

Moving forwards, while these emerging cyber-physical technologies still fail to physically reverse the entire looming threat of climate change, they will mitigate damage and save lives when these events occur. As solutions become more globally-scaled towards the mitigation of climate change itself, researchers must continue to consider the same concerns and values, just like those revealed in this paper for smart city applications and other engineering solutions in Vietnam.

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