Telling the Story of Climate, Sustainability, and Modern Computing to the General Public

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1 INTRODUCTION

As the SIGEnergy Workshop solicitation aptly notes, climate change is a risk to our entire planet and mitigating its effects is one of the most urgent challenges we face as a society. In the field of computer science, researchers and the industry have increasingly recognized climate change as an important problem that they will need to solve. The National Science Foundation (NSF)'s March 15, 2022 "Dear Colleague Letter: Design for Sustainability in Computing" [4] implores researchers to do more in this area. Major companies like Apple, Google, Meta, and Microsoft have made commitments to sustainability efforts [2, 7, 8, 12]. These are laudable but top down strategies. Increasingly developers and researchers have focused on integrating sustainability into the design and implementation of the systems they build. However, all too often, there remains a disconnect between those aspirations, the users of these systems, and the developers and researchers that day to day build and maintain these systems. How, therefore, might we better connect the aims with action?

We argue that any planet-scale collaboration must directly involve the general public [9, 10]. Voting based on particular environmental issues can help to shape public policy. Public sentiment plays a critical role in influencing the direction of companies through consumer demand. Furthermore, research funding stemming from the federal government through organizations such as the NSF are largely driven by public opinion. By creating a demand for these kinds of efforts, you are creating the opportunities for NSF to increasingly fund this kind of research work. As an example, NSF funds big research projects on telescopes [5] because the public generally supports the idea that we should learn about the universe, an understanding that has been facilitated through public outreach efforts by astrophysicists such as Carl Sagan and Neil deGrasse Tyson as well as by popular series such as *NOVA*, *How the Universe Works*, and *Through the Wormhole with Morgan Freeman.*

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The most visible spokespersons for modern computing are currently Bill Gates, Elon Musk, and Mark Zuckerberg. Bill Gates has made concerted efforts to address climate change [3] and to raise the issue with the general public through a book and a series of explainer videos [6]. Elon Musk's efforts in the arena of electric cars and solar panels has certainly contributed to addressing environmental issues but he does not put a lot of energy towards messaging the public about climate change. Facebook as a corporation does have a robust commitment towards addressing climate issues and Zuckerberg has personally donated money to the Breakthrough Energy initiative led by Gates, but reaching the public has not been a priority for him either. This has resulted in the lack of a cohesive message about the role that modern computing plays in relation to climate change. Finally, the spokespersons are representatives of industry rather than the research community. Modern computing touches more than half of the world's population so a more diverse representation of the participants, concerns, and contributions are warranted.

As a practitioner or researcher, anyone who designs, builds, or implements computing technology has to balance things like CPU for memory or scalability for performance. To make those decisions, you have to have a deep knowledge and understanding of the fundamentals of the relevant subfield. Likewise, when you want to bring sustainable design into the equation, you rely upon that knowledge to balance those competing concerns with an aim towards sustainability. In order to pursue these endeavors, however, you are reliant upon support from industry and the federal government which is driven by public sentiment. This is why outreach is vitally important. We propose that interdisciplinary collaborations that connect computer science practitioners and researchers to the public will help to bring environmental-based action in modern computing to center stage.

2 A SOLUTIONS-BASED APPROACH

Institutions such as The Alan Alda Center for Communicating Science [11], The Climate Change Communication Program at Yale [13], and the American Association for the Advancement of Science [1] offer excellent resources that assist scientists in honing their communication skills. In recent years, it has become clear that certain methods of communicating about climate issues can cause people to feel despair and hopelessness [16]. This has been increasingly referred to as climate grief. Presenting climate challenges can spur action to solve the problem [18] but presented alone the result can be a belief that efforts towards addressing climate change are futile, that the problem is too big, and that solutions are impossible. The field of Science Communication details best practices, the principle being a solution-based approach [14]. Coupling information

about environmental issues with suggestions for direct action helps to counter climate grief by focusing on hope rather than despair. When developing your connections to the public, remember that this is an essential component for effective work.

3 PROJECT METHODOLOGY

In this section, we will describe an example of a Summer 2021 collaborative outreach project with a particular focus on our process in order to provide a potential template for how you might go about doing similar kinds of work. Our research team consisted of a computer science professor who focuses on cloud computing and data center systems, a community-based theater practitioner, three undergraduate theater students and a theater professor who served as the PI. The funding for the project was drawn from several sources. The computer scientist used corporate gift money to fund two of the undergraduate students, one of the undergraduate was funded through a Summer Undergraduate Research Grant supervised by the theater professor who redirected the grant's faculty stipend to the community-based theater practitioner. The total budget for the project was $18,839.

We all had different but compatible motivations for this work. The computer scientist had been working for years on building and designing cloud and data center systems, and had recognized that the effect on the environment of those systems was large and was getting bigger [15]. The theater professor had seen increasing concerns about the environment among students which had led to an enhanced sense of urgency for finding ways to address this problem. The community-based theater practitioner had several opportunities to work with scientists from a variety of fields and observed struggles to communicate messaging to general audiences and had witnessed how theater was an effective way to bridge that gap. The undergraduate students all expressed their interest in creating work about this important topic and bringing their various skill sets to the project, from writing to performing and from videography to music.

We started with the computer scientist giving us a presentation geared towards those without field-specific knowledge that helped to put into context the environmental impacts of modern computing. The undergraduate students found points of inspiration within the material and each created a pitch for a potential story. They gave the pitches to the computer scientist and got feedback about their ideas. Translating the science-based material did take some simplification or stream-lining, so it was vital to have the computer scientist's active involvement throughout the whole process.

The community-based theater practitioner was a particularly vital guiding force for our project. Their expertise from over ten years of engaging in collaborative theater making with various communities had refined their approach to help facilitate adapting the messaging into creative formats that were informative, engaging, and could reach general audiences. For this project, they worked with the computer scientist to assist the students in making narrative-driven choices that accurately reflected the science. We specifically had to find ways to navigate simplifying things enough to make sense for the general public and serve the story while maintaining the integrity and accuracy of some pretty complex, technically-based concepts. From using popular culture touchpoints and character development techniques to strategic plot structure choices and leveraging where our audience members would likely have personal connections to the subject matter, we found ways for the expertise of all research group members to contribute to our process.

4 "THE CLOSET OF DOOM" AND "APPLICATION IDOL"

We eventually narrowed our focus to developing two different creative stories (See Figure 1). "The Closet of Doom" features a Veruca Salt type character who always wants the latest device and gets pulled into an alternate reality where she interacts with outdated phones. We focused on how our personal usage of devices such as cellphones contributes to E-waste with the potential for product life-time extension as a mitigating factor. "Application Idol" focuses more on the role of corporations in relation to energy used to support cloud computing, with the potential for directing consumer demand accordingly. Two apps compete against each other based on their environmental impact, including their cloud resource demands and device requirements. We also highlighted how using #greenapp could bring visibility to more sustainable apps. An excerpt from the script is as follows:

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        APPLICATION IDOL HOST
Thank you both for joining us this evening.
Now, I would like to invite you (points at camera)
–the audience to vote for who you think
should win the App Idol Season 55 Finale.

                GINA
I didn't realize that Songify uses renewable
energy to run their data centers and Noise Cloud
doesn't. I'm definitely voting for Songify.

        APPLICATION IDOL HOST
And the winner is...SONGIFY!!!

(Gina cheers while SONGIFY curtsies/bows.)

                GINA
Well I guess I should delete NoiseCloud now
that I know they care more about making money
than protecting our environment. Bye Felicia!
(she deletes the app) Ah that felt good. I wonder
which of my other apps should be deleted.
Because I am all about that #GreenApp!

                (The End)
```

The development process took approximately a month, as shown in Figure 2. "The Closet of Doom," initially named "Phonin' Down the Rabbit Hole," went through several revisions before resulting in a ten-page script. "Application Idol" was intended to be a shorter piece that similarly went through multiple revisions and involved the writing of two original songs. When we had final versions of the scripts, we assigned performance roles among the research group, recruited an additional performer, and scheduled the video shoots over a two week period. The videographer edited the videos,

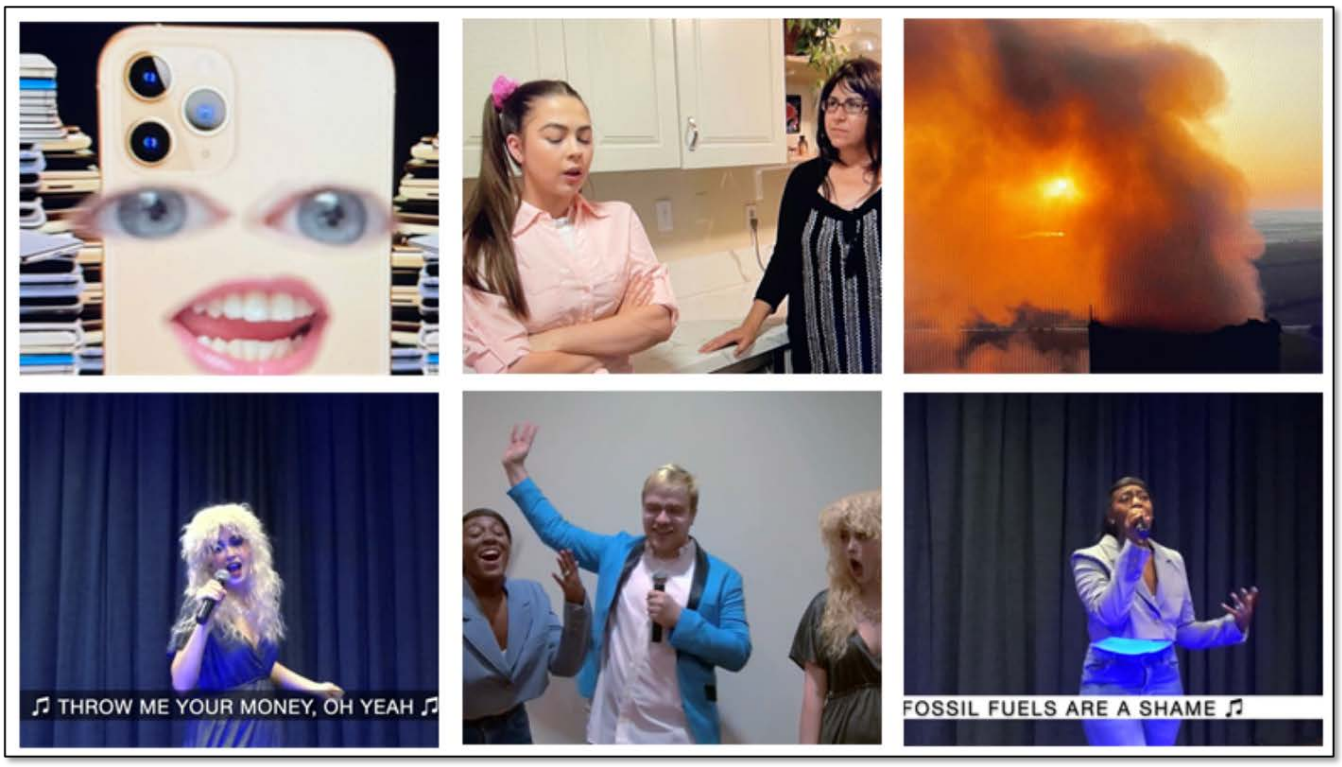

Figure 1: Images from "Closet of Doom" (top row) and images from "Application Idol" (bottom row).

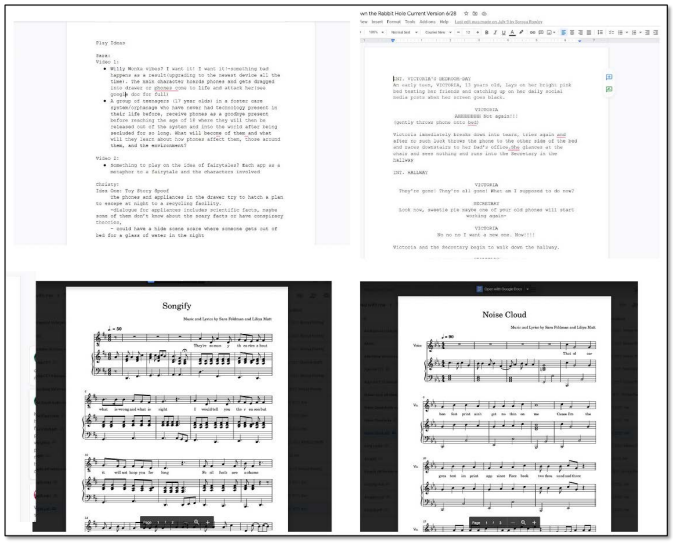

Figure 2: Script excerpts from play drafts (top row) and sheet music from "Application Idol" (bottom row).

incorporating several rounds of feedback from all members of the research team before publishing the final products on the Education and Outreach page for C3-Lab at https://c3lab.net/.

Figure 3: Images from *Spotlight on Science* series.

5 SHINING A *SPOTLIGHT ON SCIENCE*

We also made two supporting educational videos featuring our computer scientist, one on cloud computing and the other on E-waste that work alongside the creative pieces to help give the general public insights into the environmental impact of modern computing (See Figure 3). While covered more broadly in the initial educational session, the production of these videos began with the computer scientist more specifically outlining the major contributions of environmental impact from cloud computing platforms. Using these effects as a starting point, the Theatre professor developed those points into a coherent story. It took several passes of revision for

the stakes of these impacts to be clear, and each time the theater professor had to push back on the more technical explanations to get at the underlying details of "why it matters" to the general audience. Here storytelling was critical–simply listing statistics or facts about how many tons of Co2 are emitted for a particular datacenter does not convey to the audience the scale or dimensions of the problem. After approximately half a dozen revision passes, the scripts for each of these approximately three-minute videos were completed.

Next, the script had to be performed, and here again the theater professor gave the computer scientist a "crash course" in basic acting for the camera. It was not enough to read the script as developed; to create a compelling video that connects with the audience, the script had to be brought to life. This required physical training including posture, eye contact with the camera, and hand gestures. Next, each line or part of a line in the script had to have the right emphasis, focus, and appropriate pauses were necessary to ensure that the message was not only clear but also engaging. Finally, vocal "fillers" such as *ummm* had to be removed. In today's world of social media, viral videos, and short programming, each aspect of the message, script, delivery, and production are critical for ensuring that the intended audience will take the time to watch the final product.

The computer scientist attended at least one of the shooting days for each of the creative pieces, so we filmed the companion *Spotlight on Science* video in the same location used for the creative piece, thus further helping to link the material. You also can find the *Spotlight on Science* videos on the Outreach and Education page of our research group, C3-Lab: https://c3lab.net/education/.

6 HOW TO SAVE THE WORLD: A GUIDEBOOK

And, because we are particularly committed to facilitating this work more broadly in the field of computer science, we also created a companion guidebook which details our process and shares some resources for translating science-based material into creative pieces. A PDF copy of this guidebook is located at https://c3lab.net/education/.

7 CONCLUSIONS

In this paper we have described the motivations for applying science communication practices to the field of computer science, with a particular emphasis on creative and interdisciplinary approaches. We outlined a method for that process that is not limited to the participants in our project, but instead could be applied to collaborations broadly speaking. With funding agencies increasingly emphasizing broader impact activities, this is especially timely.

Stories have the power to shape our understanding of the world and spur action [17]. In this regard, other fields are in many ways ahead of CS. We call for collaboratively creating new stories about climate and sustainability in regards to modern computing with participants both inside and outside the field. Doing so could help to inspire the next generation of research and developments in modern computing, infusing sustainability into every aspect, from how we teach our students to our research priorities and beyond in ways that include dynamic outreach efforts to the general public.

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