Computational Design & Synthesis to Facilitate Science Communication

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Abstract: Experts often deliver poster presentations at scientific conferences. These posters are filled with text, charts, and graphs to illustrate their latest research findings. However, the typical scientific poster may not be optimized in terms of universal design, or even general readability. When scientists from around the globe congregate to discuss research in this way, it is important that they are able to communicate information easily and effectively—but to design an effective poster is a time-consuming and intricate task. This issue may also present difficulties for students at research institutions, as creating scientific posters to be easily read and understood by a wide audience is challenging and not broadly taught. As a result, both students and scientists may not be able to disseminate their latest findings easily. My project provides a solution to this problem by automatically providing suggestions for improving poster design (from text placement habits to color usage) and fixing common issues in display, organization, and overall readability. These adjustments made on research posters can then be used to further improve scientific communication. Thus, the ultimate goal of my research project was to create an online interface that helps users enhance the clarity, organization, and accessibility of their scientific research posters to facilitate scientific discussion and communication among students and scientists.

Project Objectives: The objective for this research project was twofold. First, I aimed to create an openly-available resource for Bowdoin students so they can submit their own posters and receive suggestions based on readability formats and graphic design standards. The means to achieve this end-goal was to establish a website that they could easily navigate to and use for their own convenience. Second, I strived to improve on the underlying system to advance the use of computational creativity techniques to make more accurate suggestions. This involved collaborating in a specialized partner-pair by using code to express more ways to make research posters presentable and accessible. Some goals we began with included adjusting the background color and determining if the font color and size were appropriate, as well as incorporating a way to detect jargon in posters. Overall, my primary research objective revolved around how computers could be used to help generate organized and readable poster designs and how to improve the accompanying interface to make this process more effective, efficient, and interactive for users. To support the overall objective of the project, I explored how to improve and incorporate effective human-computer interaction techniques by offering feedback to users for enhancements in scientific communication, thus starting the conversation between human designer and computational assistant. Therefore, it was crucial that the website incorporated both proper AI (artificial intelligence) and UX (user experience design) methods. The current implementation allows users to input their own PowerPoint poster (pptx file) and generates design suggestions to the user in a way that helps them improve their poster's effectiveness in addition to giving personalized feedback. The current program also allows the user to download and save a new and improved version of the poster.

Methodology: The first step of creating a poster-generating program included examining and creating an accurate grading scale based on research on universal standards to determine what a "good" poster entails. To do so, I generated a list that described the details of how to improve the quality of research posters, its information, and its overall organization. This included anything from text placement habits and font usage to analyzing positioning for more ideal arrangement of graphs, charts, and text to reduce data clutter. Second, I designed an easily-accessible website and resource for students and others to use to submit their current posters to generate more readable and clear

scientific research posters afterward. To carry out these functions, I integrated HTML, CSS, and JavaScript to make a website that was both organized and accessible for users to navigate. Using HTML, I carefully designed a home page that gives a glimpse of the program's function and overall goals, an about page that explains the mission and purpose of the website, a create page that outlines exactly what the program can do (remedying font inconsistencies, creating readable color contrasts, adjusting size, etc.), a gallery page of posters that have been generated from the site, and a help page for frequently asked questions. The create page was then linked to a design-upload webpage where the user can input their file for feedback on their research poster. On top of the website's basic functions and utilities, I also added CSS style by selecting complementary colors to highlight each webpage. The purpose of this design was to make the website easy to navigate without being too overwhelming or straining the viewers' ability to see clearly. To make the website more dynamic, I used JavaScript code to allow background images to zoom in and out and provided confirmation prompts for the file-upload system so the user has a chance to edit their file before uploading it onto the website. I then combined my knowledge of the Python coding language with HTML to be able to extract information from uploaded poster files on the website. I utilized the Flask framework to integrate the Python code that my partner created with my website interface as well, which enabled me to expand the prototype's clarity and functionality. The python-pptx package was used to extract information from the poster uploaded by the user, and thus start the process for generating one or more new posters for the user. At first, this included simply retrieving text data from an uploaded file and displaying it on a webpage. However, I expanded my work to gather more than just text data, and fully combined my code with my peer's Python code for analyzing and editing posters to integrate the functions for displaying feedback and changes as needed to the current poster.

Results Obtained: The end result of this research project was a polished website that could generate feedback for the user, as well as create a new poster based on that feedback. From these results, I concluded that it is possible to use computational design and data analysis techniques to enhance scientific research posters. These results suggest that design, science, computer science, and other research fields could be increasingly interconnected to further improve the presentation of research in the future. More broadly, these results can also be applied to improve science communication amongst researchers, professors, scientists, and students.

Significance and Interpretation of the Results: The versatility of this website can prove to be useful in many circumstances—while users lack the time and ability to format their own research posters, the website can be used as a quick and easy resource to create posters that are more presentable. This could further disseminate information in an organized manner beyond the world of academia and reach larger audiences to improve scientific communication for many scientists and students. The next steps for the website would be to make it more personalized for the user—an example being the creation of a user login account for users to save their work in their account to be able to download, email, share, or print their poster later.

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