

Project Title

Overview

Intellectual Merit

Broader Impacts

We propose to investigate xx

1 Overview

Vannevar Bush (the author of [1]) founded NSF.

1.1 Long-term vision and this project's focus on xx

1.2 Overview of specific research activities

1.3 Intellectual Merit

1.4 Research team qualifications

2 Background & Related Work

3 Thrust 1: ...

4 Thrust 2: ...

5 Thrust 3: ...

6 Broader Impacts

7 Results From Prior NSF Support

PI Chen is the PI for NSF: CRII: CHS titled “Techniques for Helping Domain Experts Understand and Improve Models Underlying Intelligent Systems” (\$200,460, 2019-2021) and NSF: CAREER titled “Expanding the Interaction Bandwidth between Physicians and AI” (\$548,111, 2021-2026). Intellectual merit: publications on user-centered designs of AI systems for radiology [5] and pathology [2, 3, 4]. Broader impacts: Integration into UCLA undergraduate curriculum “Interactive & Applied Machine Learning” that introduces EE/CS students to human-centered design.

References Cited

- [1] BUSH, V., ET AL. As we may think. *The atlantic monthly* 176, 1 (1945), 101–108.
- [2] GU, H., HUANG, J., HUNG, L., AND CHEN, X. A. Lessons learned from designing an ai-enabled diagnosis tool for pathologists. *Proceedings of the ACM on Human-Computer Interaction* 5, CSCW1 (2021), 1–25.
- [3] GU, H., LIANG, Y., XU, Y., WILLIAMS, C. K., MAGAKI, S., KHANLOU, N., VINTERS, H., CHEN, Z., NI, S., YANG, C., ET AL. Improving workflow integration with xpath: Design and evaluation of a human-ai diagnosis system in pathology. *ACM Transactions on Computer-Human Interaction* 30, 2 (2023), 1–37.
- [4] GU, H., YANG, C., HAERI, M., WANG, J., TANG, S., YAN, W., HE, S., WILLIAMS, C. K., MAGAKI, S., AND CHEN, X. A. Augmenting pathologists with navipath: Design and evaluation of a human-ai collaborative navigation system. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (2023), pp. 1–19.
- [5] XIE, Y., CHEN, M., KAO, D., GAO, G., AND CHEN, X. A. Chexplain: enabling physicians to explore and understand data-driven, ai-enabled medical imaging analysis. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (2020), pp. 1–13.

Facilities, Equipments, & Other Resources

PI Chen's Lab at UCLA

The UCLA Human-Computer Interaction Laboratory (HCIL) maintains access to ample lab space (about 1000 sq ft) for the PI and graduate students for the expected duration of the project. There will be multiple Windows and Linux workstations available for student use for various computing needs (*e.g.*, developing AI models and system prototypes). Laboratory space for the proposed infrastructure will also be provided by the department for the extended lifespan of the equipment, beyond the duration of this proposal. It is equipped with the necessary power and ethernet necessary for the operation of the various equipment as well as for use by researchers working in the space. There is access to multiple quiet rooms available for conducting human subject studies, such as usability testing and interview. HCIL also has access to the support from the Henry Samueli School of Engineering and Applied Science at UCLA on education and research activities through a variety of shared computing resources for both research and teaching activities. The School provides networking, disk storage and backup, general-purpose timesharing access to multi-user systems, email and workstation support. The School's central facility is for the support of research, and is open to undergraduate and graduate students, faculty and staff. The Department network is connected to the UCLA campus backbone via a gigabit connection. An 802.11n wireless network is available throughout the Department. The Department network is also linked to the School's network that includes IBM servers and workstations and PC-based labs, supporting classes and giving access to undergraduate students.

Data Management Plan

We expect to produce the following kinds of artifacts: (1) software, (2) data and analysis results, (3) publications, and (4) educational materials.

Software Sharing Plan

Our project team believes strongly in open-source software development and supporting open data access as far as is feasible given ethical, privacy, security, and intellectual property concerns.

The team has a great track record of developing open-source software that is used across a range of application domains, ranging from **xx** Recent examples include **xx** All software that we develop for the current proposal will also be made publicly available.

Specifically, this research will produce **xx**

Our tools for end users will use simple, easy-to-use, and learnable interfaces and abstractions, as well as cleanly designed APIs to make them broadly accessible. We will also publish user-friendly documentation and offer tutorials that will complement the technical descriptions that we will publish in academic papers. We will establish a publicly-available project web page to serve as a common portal for all publicly-released data stemming from this work, along with access to the infrastructure itself. The project web page will be easily discoverable from the PIs' home page. No fees will be charged for access to data or software. The PIs will make sure the software is freely available to science and engineering researchers and educators in the non-profit sector. The PIs will also support other individuals or teams to develop new research tools or systems by using or extending our software.

Implementations of the new tools developed in this proposed work will be added to the project website as they are ready for use. If applicable, we will also distribute them via other distribution channels—e.g., Python's package installer `pip` or the Chrome Web Store. We have already used both `pip` and the Chrome Web Store successfully for existing projects. All open-source software, tutorials, papers, data, and other information will be hosted on the project website, backed up by hosting services such as `github.com`.

Data and Analysis Results

Our team will perform human subject studies of our prototype under the oversight of an Institutional Review Board. Data collected in these studies may include details of user interactions—mouse clicks and keyboard interactions—and survey or interview responses. These will be used to understand how participants use the prototype. We may also make screen recordings of participants interacting with the prototype. We may collect email addresses in order to compensate participants. Email addresses will be the only identifiers collected. There will be no link between the email addresses and the anonymous tool usage data. All data will be secured on password-protected computers. Student investigators will have access to the data. We will destroy the list of

participant email addresses within a prescribed time period after each study session. We will not destroy anonymous system usage data. Retained datasets will not contain identifiable information. We will make retained datasets available to the research community via `github.com`. Likewise, we will make the materials we develop for running these human subjects studies available to the research community via `github.com`.

The team has access to servers that can ensure the long-term preservation of the public data and open-source software, and we do not envision any obstacle to making this data accessible to all. All the PIs will be jointly responsible for managing and disseminating data and software generated by the project. For the public data and open-source software, since it will be broadly available, we do not anticipate any problems with the dissemination if any of the PIs were to leave their current institution.

Publications

We plan to publish our findings in top venues and conferences, including technical reports, articles in conferences, journals, and workshops, describing significant findings from work conducted under this grant.

Educational materials

We plan to disseminate our findings in the research community by giving workshops and tutorials as well as writing survey articles. We also plan to incorporate findings in graduate-level courses. All material resulting from this activity will be made available online, including lecture notes, slides, and homework exercises.

As described in the Software Sharing Plan, we will also develop educational materials specifically for teaching the use of our prototype, with the aim of supporting users from related community. Additionally, we will make all resultant educational materials available via our project webpage. Materials may include tutorials, documentation, and lectures.