

# Statement of Purpose

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Program: Computer Science, Ph.D.

December 1, 20xx

**Communication** is the major research topic that has piqued my interest. I have observed communication challenges between humans and computers due to inappropriate algorithms and system designs. Also, I have noticed communication issues among humans, stemming from a lack of expertise to comprehend the language and background knowledge of others effectively. I have conducted the following work as a human-computer interaction (HCI) researcher in both academia and industry to address these problems: (A) devising a progressive algorithm for UMAP to support real-time data exploration [1], (B) suggesting the design guidelines of user interface when integrating Large-scale Text-to-image Generation Models (LTGMs) into the creative processes of visual artists [2], (C) employing GANs for an efficient communication between webtoon<sup>1</sup> authors with different skill sets [3], (D) moderating customer inquiries to alleviate the stress and emotional dissonance experienced by customer service representatives [4]. As a Ph.D. student, I plan to develop **intelligent systems that optimize communication not only between humans and computers but also among humans by inventing sophisticated algorithms and groundbreaking interaction techniques.**

**Enhancing human-computer communication.** (A) UMAP, one of the famous dimensionality reduction methods, was known to face limitations especially when dealing with large-scale data, requiring tens of seconds for obtaining the results. In response, I introduced a progressive algorithm to reduce its computation time significantly [1]. This innovation has increased the usability of UMAP by decreasing the communication cost between the system and users, ultimately making it more efficient to be deployed for interactive data analysis. (B) Upon completing the UMAP project, I noticed that the rapid technological advancement left many visual artists disoriented in leveraging LTGMs more actively in their creative works. Moreover, there were no established guidelines for crafting interactive systems to use LTGMs effectively. Through an interview study with 28 visual artists as well as a systematic literature review of 72 relevant papers, I delineated the versatile roles of LTGMs: automating the creation process, expanding their ideas, and facilitating communications. I also outlined key design principles for those creating interfaces using LTGMs [2].

**Improving human-human communication.** (C) Many webtoons are made in cooperation between a writer who writes a script and an artist who illustrates the story. They are often confronted with miscommunication owing to the writers' insufficient drawing skills. Grounded in a formative study, I developed a GAN-based interactive system that can generate diverse reference images and synthesize them locally on any user-provided image [3]. A study with 24 professional webtoon authors demonstrated that our system enhances communication and increases author satisfaction compared to traditional methods. (D) In my subsequent research, I recognized the stress that customer service representatives (CSRs) face when dealing with disrespectful inquiries and proposed a system that uses Large Language Models (LLMs) to modify the tone while preserving their original content [4]. I plan to examine whether the system can actually help CSRs alleviate their stress and emotional dissonance by conducting a user study.

**Future research agenda.** I hope to enable individuals with diverse levels of knowledge and abilities to communicate with AI systems effectively. This aims to mitigate any potential discrimination arising from the need for additional skills. Specifically, I recently published a dataset of Vega-Lite specifications, which encompasses the largest and most diverse human-generated charts to date [5, 6]. I will leverage this dataset to streamline developing

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<sup>1</sup>comics published on the web

Natural Language Interfaces (NLIs) for data visualization [5, 6]. My goal is to make chart creation accessible to all, removing the barriers of programming and charting know-how, ensuring everyone can harness the power of modern technology. Also, my passion lies in facilitating communication between people using AI. As a visual arts enthusiast, I observed conflicts between visual artists and clients when working on commissioned work [2]. I aspire to improve the visual communication using LTGMs with a novel user interface. I am convinced that achieving this can encourage a thriving and cohesive society where empathy flourishes.

**Ph.D. program and potential advisors.** I am particularly interested in XYZ University's emphasis on practical values through product-oriented research. At XYZ, I will increase my research competency as well as entrepreneurship by performing research with renowned faculty members and experiencing well-established innovative programs for startups. I am keenly interested in collaborating with **Dr. Sam Altman**, who recognizes the potential of integrating AI into interactive systems, spanning from enhancing human capabilities to simulating social behaviors. Similarly, I am also captivated by the research of **Dr. Elon Musk**, who has made significant contributions to tools and methodologies emphasizing ethical considerations, responsible design practices, and human values within areas such as data visualization, Human-AI design, and education. The work of **Dr. Steve Jobs** is also intriguing, as he strives to uncover design principles and implement them in both interactive and automated design tools. As I embark on this academic journey, I eagerly anticipate immersing myself in their cutting-edge research, actively contributing to ongoing projects, and engaging in the vibrant intellectual community they cultivate. My objective is not only to glean insights from these esteemed faculty members but also to collaboratively push the boundaries of knowledge at the intersection of HCI and AI.

**Career after graduation.** After completing my Ph.D., I hope to continue doing research in academia as a professor. This aspiration stems from my desire to impart the knowledge and wisdom I have gained from my esteemed colleagues and senior professors to future generations. In this role, I will focus on creating user interfaces that are both intuitive and inclusive, thereby ensuring equitable access to AI technology for everyone. This endeavor aims to eliminate the disparity in technology usage, making AI a tool for empowerment rather than exclusion. Furthermore, my research will improve communication between diverse groups, thereby cultivating a more humane and harmonious society. The skills I will acquire through my Ph.D. studies will serve as a solid foundation for my future career, driving innovation and catalyzing positive transformation within our community.

[1] **Ko, H.-K.**, Jo, J., Seo, J. (2020). Progressive Uniform Manifold Approximation and Projection. *EG/VGTC Conference on Visualization (EuroVis '20)*, 133–137.

[2] **Ko, H.-K.**, Park, G., Jeon, H., Jo, J., Kim, J., Seo, J. (2023). Large-scale Text-to-Image Generation Models for Visual Artists' Creative Works. *ACM Conference on Intelligent User Interfaces (IUI '23)*, 1–15.

[3] **Ko, H.-K.\***, An, S.\*, Park, G., Kim, S. K., Kim, D., Kim, B., Seo, J. (2022). We-toon: A Communication Support System between Writers and Artists in Collaborative Webtoon Sketch Revision. *ACM Symposium on User Interface Software and Technology (UIST '22)*, 1–14.

[4] **Ko, H.-K.**, Son, K., Jin, H., Choi, Y., Chen, X. (2023). Moderating Customer Inquiries and Responses to Alleviate Stress and Reduce Emotional Dissonance of Customer Service Representatives. *CHI 2023 Workshop on Generative AI and HCI*, 1–4.

[5] **Ko, H.-K.**, Jeon, H., Park, G., Kim, D. H., Kim, N. W., Kim, J., Seo, J. (2023). A Vega-Lite Dataset and Natural Language Generation Pipeline with Large Language Models. *VIS 2023 NLVIZ Workshop: Exploring Research Opportunities for NL, Text, and Data Visualization*, 1–7.

[6] **Ko, H.-K.**, Jeon, H., Park, G., Kim, D. H., Kim, N. W., Kim, J., Seo, J. (2023). Natural Language Dataset Generation Framework for Visualizations Powered by Large Language Models. *Arxiv Preprint (Under Review)*, 1–18.

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