My graduate studies and research endeavors in leading artificial intelligence (AI) community at CMU, as well as internships in some of the biggest tech companies, revealed to me the limitless potential of AI when integrated into the field of engineering. I saw that advances in deep learning-based computer vision and reinforcement learning have ushered in a new generation of autonomous systems and human-machine interaction. However, we are still facing significant challenges that are preventing AI from mastering many practical applications. Whether in engineering design, autonomous systems, or industrial applications, the increasingly complex data sets from the real world require a joint interdisciplinary effort bringing the human-in-control and to foster ethical, accountability, retractability, explainability, causability, safety and security[1].

Thus, I would like to apply for a PhD position to make my contribution to your world-leading research. As an ambitious researcher with the future in mind, I stand at the intersection of AI and engineering, eager to drive the field of AI in areas of human-machine interaction and autonomous systems. As such, I believe that I can not only be an asset to your team but hopefully to the future of AI as well. Thus, I believe that this doctoral path will enable me to become a leader capable of integrating AI and computer vision in order to apply innovative solutions and propose intelligent systems for advancing the future of humanity. Therefore, please allow me to outline my academic and research journey thus far, as well as the particular path I would like to take in my doctoral studies.

I discovered my passion and started making a unique contribution to the field of engineering during my undergraduate studies at the University of Cincinnati and Chongqing University. During my studies, I interned at top tech companies such as Siemens, where I observed the applications of the latest technology in real-world situations. Like an increasingly complex engineering problem, I watched the world being constructed with the joint contribution of various disciplines that combined provided optimal and intelligent solutions to drive us into a better world. This fascination and an analytical perspective drove me to overcome many challenges at school and work and make the Dean's List while graduating Magna Cum Laude.

Along the way, I learned that AI was widely regarded as the one technology capable of outperforming human intelligence, which made me determined to pursue innovations in this field in order to take part in this joint effort of constructing a better world. With the firm belief that scientific research must be founded on solid fundamental knowledge, I came to CMU for graduate studies, where I learned data science and programming through projects in *Data Structure & Algorithms* and *Engineering Computation*. Furthermore, *Machine Learning*, *Computer Vision, Deep Learning*, and *Reinforcement Learning* provided me with knowledge of AI fundamentals and cutting-edge applications. As with all increasingly complex and rapidly emerging technology challenges, I have had to develop an adaptable mind and sharpen my analytical perspective to pass all these courses and maintain a GPA of 3.9+/4.0. In fact, I am currently passing this knowledge onto 150 students as a Teaching Assistant in *Artificial Intelligence* and *Machine Learning* courses.

During the Fall semester of 2021 at CMU, I worked at the Robotics Institute with Prof. Matthew Travers on the "Recycling Paper Data Collection and Classification" project. We collaborated with a local recycling facility to develop a fully automated recycling paper classification and

[1] Holzinger, A. (2020). *Machine Learning and Knowledge Extraction*. Springer.

sorting system. In addition, we aimed to generalize the deep learning models to the next level. Our research focused on domain differences in appearances and light reflections, and we successfully created domain adaptation algorithms by introducing adversarial learning methods to ensure robustness under any working scenario. As a result, this work has been successfully deployed in real-world manufacturing and entered a new scope of lifelong learning.

With my solid training in AI theory and internship experience, during my second year at CMU, I was selected as an intern at Professor Kenji Shimada's CERLAB. The goal of the project was to create AR applications for editing realistic 3D scenes based on the "Meta-world" concept. This was a terrific opportunity to broaden my expertise of computer vision while also learning about new cutting-edge applications. This challenge was made more difficult by the fact that 3D representations are often sparse and computationally costly. I resolved these challenges by modeling the problem in 2D leveraging unsupervised plane segmentation and 3D to 2D projections. Despite the intricacy of the 3D structures, our proposed method was able to accurately rebuild the scene using our designed efficient 3D to 2D transformation.

My internship experience in CERLAB led me to my master's thesis. My current research aims to develop the previously discussed project into "3D scene editing and inpainting via semantic segmentation." Having our 3D scene world be editable means that the reconstructed properties are semantically meaningful – a user should manipulate a chair rather than a triangle in a mesh, or turn off a particular light in a room rather than edit a set of light probes[2]. We proposed to use semantic segmentation for dimension reduction, and then search with 3D patch match algorithm in the nearest semantic neighbors to complete the inpainting process. Once developed, our proposed method will allow users to directly edit and manipulate any object in a 3D scene, benefiting both interior design and other application areas such as human-machine interaction and inspection robotics.

In multiple application areas of AI, I intend to concentrate on computer vision-based research to extend the capabilities of humans and robots in both real and virtual worlds. Computer vision could provide humans and robotics with multi-level instructions and accurate feedback for the control systems. With this robust tool, I defined my ultimate research objective to enable safe and dependable autonomy for a wide variety of high-integrity robotics accessibility applications by designing tractable and provably correct algorithms, developing fast implementations, and validating them on real autonomous systems.

I am certain your university's dedication to changing the world through its leading research will help me achieve my goal of entering academia and continuing my lifelong study with the objective of transforming the future. This future that I envision is much more autonomous and full of new possibilities for human-machine interaction, enabling humanity to evolve in a whole new way.

[2] Zhang, E., & Curless, B. (n.d.). Realistically editing indoor scenes (dissertation).