Pathways to Impact Statement

The integration of 3D perception and reconstruction in Extended Reality (XR) stands as a transformative advancement in the digital domain. In addition to facilitating the cutting-edge research of XR and 3D vision technologies, the project will bring the virtual and real worlds closer together, contributing high practicality and accessibility to everyday life. The anticipated impacts of this work span various aspects, as outlined below:

Academic Impact:

- **Cross-Disciplinary Advancements.** Although the basic research of this project lies in XR and 3D vision, the methodologies and findings have the potential to influence and inspire advancements in other disciplines such as computational biology, digital humanities, design, psychology, clinical medicine, etc. Conducting interdisciplinary research and collaboration will also highly benefit the progress of this project.
- **Innovative Algorithms.** The emphasis on data-efficient learning and neural network interpretability will introduce novel algorithms that can be adopted by researchers investigating general artificial intelligence and machine learning problems.
- **Knowledge Dissemination.** In addition to publishing papers in XR related venues, the findings of this project will be promoted through interdisciplinary events including but not limited to conferences, workshops, seminars, etc. By presenting the research outcomes more broadly, this project can reach a wider range of academic audience and thus inspire cross-disciplinary innovations and collaborations.

Societal Impact:

- **Enhanced XR Experiences for All.** The proposed framework of this project will cater to the diverse population, where the intelligent and immersive XR experiences are accessible and beneficial to the children, young people, elderly, and other groups. For instance, children can benefit from XR's interactive educational modules, young people can remotely socialize with each other under XR environments, while elderly individuals can use XR applications for virtual travel. By leveraging the strong effectiveness and adaptability of the proposed framework, high-fidelity real-world context can be perceived and reconstructed to significantly enhance XR experiences.
- **Support for Disabled Individuals.** The integration of 3D vision technology can lead to the development of XR applications tailored for individuals with disabilities, such as virtual therapy sessions or interactive communication tools. This project can allow disabled individuals to feel more accurate spatial information that is hardly accessible to them in real world, improving their quality of life.
- **Cultural Preservation.** The rich cultural heritage can benefit from XR applications that digitize and preserve historical sites and traditions, making them available to future generations. Given the research outcomes of this project, cultural preservation applications in XR can digitize and edit 3D targets more efficiently and effectively.
- **Local Community Engagement.** We plan to collaborate with local communities, schools, and organizations in Hong Kong to gather feedback, understand their specific needs, and

further optimize our framework accordingly. Coupled with the supports for different groups of individuals and culture preservation for future generations, the research of this project has a direct positive impact on the local communities.

Educational Impact:

- **Enhanced Learning Experiences.** The integration of cutting-edge 3D vision and XR technologies in educational settings can provide students with immersive learning experiences, facilitating better understanding and absorption of knowledge.
- **Accessible Education.** Accurate 3D perception and reconstruction in XR can enable remote and virtual learning, making education more immersive and accessible to individuals across different ages, geographical locations, and financial situations.

Economic Impact:

- **Boost Local XR Industry.** By addressing the practical challenges in using state-of-the-art 3D vision techniques for XR applications, the proposed framework can boost the growth of the XR industry not only in Hong Kong but also in the Greater Bay Area, leading to job creation and economic development.
- **Promotion of Research and Development.** The modular design of our framework encourages future research, innovation, and development from both academic and industrial organizations. Given the objective that we will release the framework as an open-source repository, the R&D of relevant organizations can be highly benefited from this project.

Environmental and Health Impact:

- **Sustainable Development.** The project's focus on data-efficient algorithms aligns well with global sustainability goals, contributing to the reduction of environmental energy consumption.
- **Healthcare Innovations.** The adaptability of the framework can lead to XR applications that revolutionize medical training, patient care, and therapy in healthcare centers, assisting with both healthcare professionals and patients.

In the short term (1-5 years), this research project will benefit XR developers by providing them state-of-the-art 3D perception and reconstruction pipelines, models, APIs, etc. In addition, researchers from AI and XR communities can also leverage insights derived from the project, such as data-efficient learning methods, interpretable 3D deep models, etc. Looking ahead to a longer term (over 5 years), broader XR industry including emerging start-ups will gain from the project's deliverables of overall framework and key functional modules, enhancing the interactivity and immersion of XR applications for education, healthcare, entertainment, etc. In conclusion, this research project will leave lasting and positive impacts on academia, society, economy, environment, healthcare, and the broader XR community, both locally and globally.