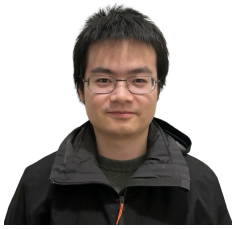
BeSAFE v2

Mixed Reality Project Proposal
Supervised by: Zuria Bauer, René Zurbrüg, Hermann Blum
October 6, 2024

GROUP MEMBERS

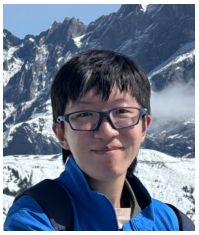
Haonan Chen

Shenghao Zhang



Tianhao Chen

Yingzhe Liu



I. DESCRIPTION OF THE PROJECT

In this project, we aim to address the limitations of synthetic environments used to train robots, which often lack realism or are overly simplistic, such as those in NVIDIA Isaac Sim. Leveraging Habitat 3.0's [1] features, particularly its capability to navigate through an environment using a VR headset, we will integrate it with a photo-realistic environment in Unreal Engine to create a more immersive and realistic simulation.

II. WORK PACKAGES AND TIMELINE

The work packages include the Habitat 3.0 platform which will be used for embodied AI training. Specifically, it serves as the server side of the project, instructing robots on how to navigate in the home environment. Meanwhile, we adopt Unreal Engine to create a more realistic environment. Namely, the UE application will serve as the client side that receives the instruction from Habitat 3.0 and send back the feedback. The photo-realistic scene will be built with Blender using PBR materials to achieve a sense of reality.

- Oct. 14: Explore Habitat 3.0; get familiar with the platform and its APIs.
- Oct. 20: Deploy the template VR project on the Quest3.
- Nov. 11: Migrate the photorealistic environment to the Unreal Engine; connect Habitat 3.0 to the engine so that we can use VR to navigate through the environment.
- Dec. 16: Try the different extensions of the Habitat 3.0 function with the UE environment, such as social navigation and social rearrangement. Train the robot in the scene using the recorded data from the environment.

The platform of our front end application is Meta Quest 3, and we will build the back-end server (Habitat) on Linux since there is no Windows version. The programming languages that we are going to use include C++ and Python.

The key challenge will be to build the connection between the Unreal Quest 3 application and Habitat 3.0. We need to extend the codebase to support the communication without harming forward compatibility.

III. OUTCOMES AND DEMONSTRATION

The desired outcome of our project entails realistic scenes created in Unreal Engine that users can explore through the Meta Quest 3 headset by controlling a humanoid character and interacting with the robot manipulated by Habitat 3.0 with its existing features. Furthermore, optional outcome includes the trained robot that can perform social navigation and social rearrangement fluently.

To test our project, we plan to invite multiple interested participants to wear the headset and navigate through the environments while performing the two tasks. In particular, we set to collect their opinions on how realistic, intuitive, and interactive our result is as well as the robot's performance. Finally, we present an offline demo that users can deploy on their own computers, showcasing all of our work, i.e., with all functionalities available to try out.

REFERENCES

[1] Xavi Puig, Eric Undersander, Andrew Szot, Mikael Dallaire Cote, Ruslan Partsey, Jimmy Yang, Ruta Desai, Alexander William Clegg, Michal Hlavac, Tiffany Min, Theo Gervet, Vladimir Vondrus, Vincent-Pierre Berges, John Turner, Oleksandr Maksymets, Zsolt Kira, Mrinal Kalakrishnan, Jitendra Malik, Devendra Singh Chaplot, Unnat Jain, Dhruv Batra, Akshara Rai, and Roozbeh Mottaghi. Habitat 3.0: A co-habitat for humans, avatars and robots, 2023.