

# ROBOT INTENT SIGNALING USING AUGMENTED REALITY

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Research Question: Advantages of robot intent signaling in tightly spaced Human-Robot collaborative environment

## Introduction

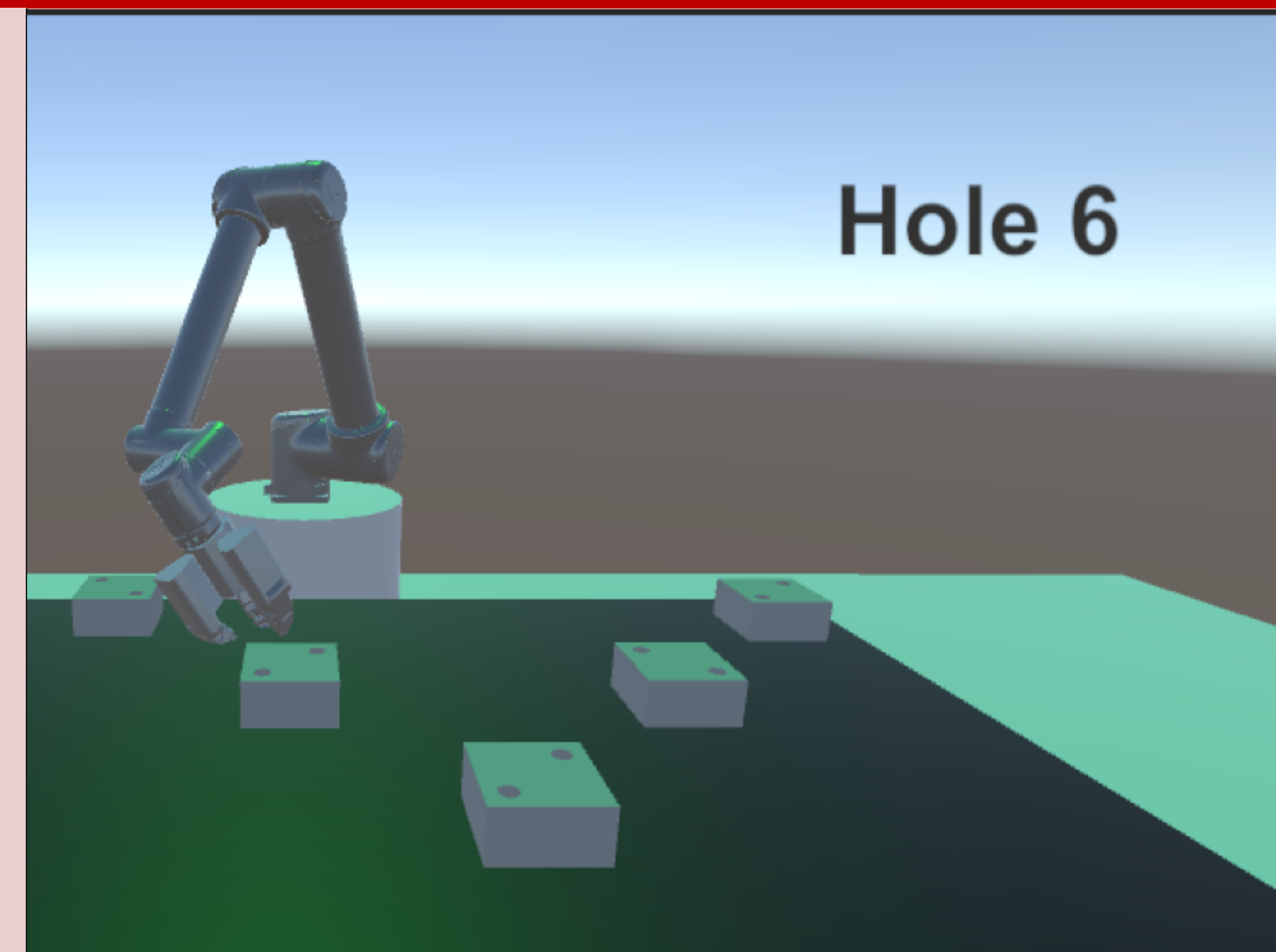
Human-robot collaborations are ubiquitous ranging from assembly line, autonomous vehicles, medical procedure. Successful implementation of such systems depend on each contributor's ability to predict the future action of other collaborators. The goal is to design an Augmented Reality environment that would help signal the robot's intent to human collaborators in real-time to improve the trustworthiness and the efficiency of the system.



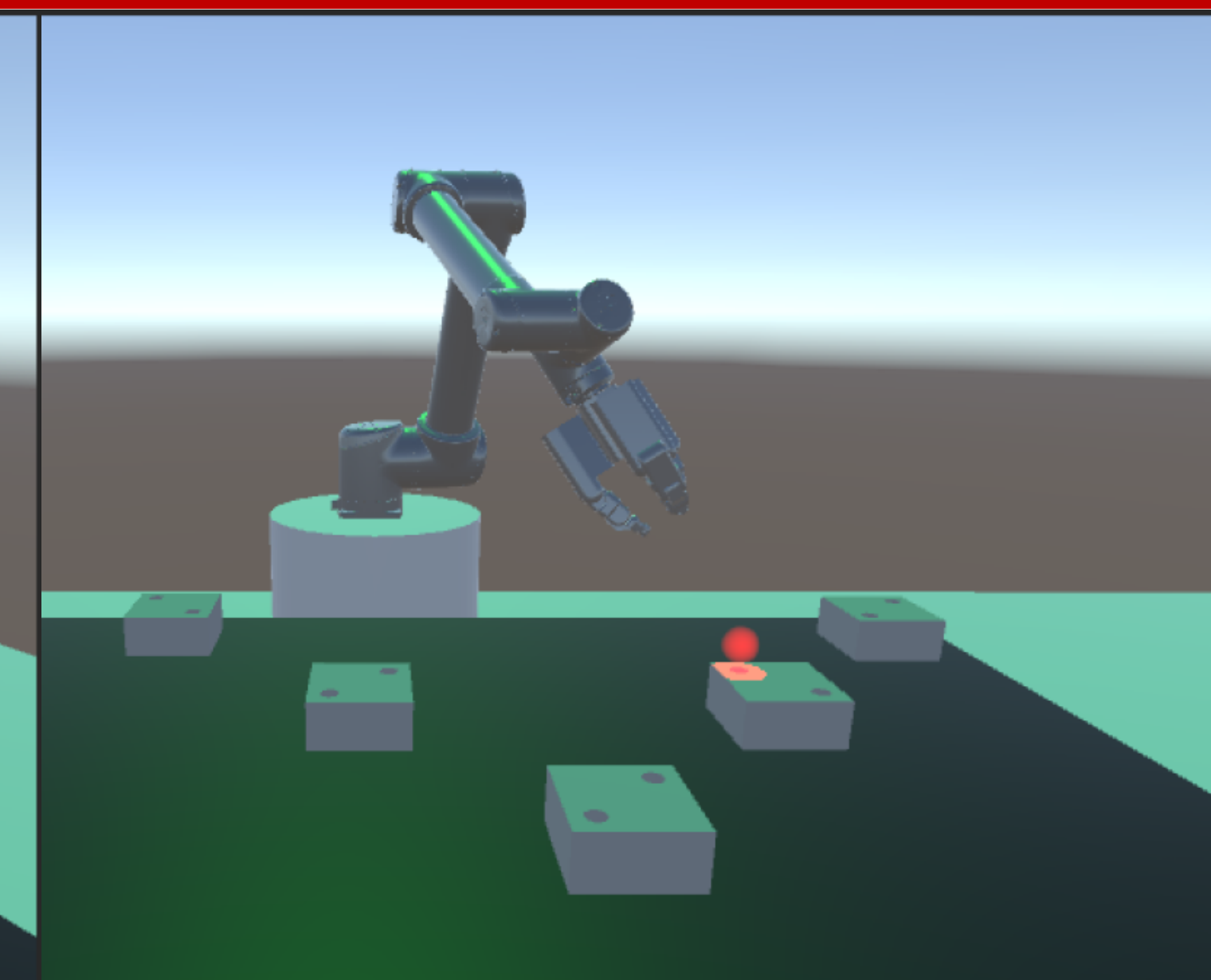
**Fig-1:** Collaborative screw assembly.

Retrieved from:  
<https://www.youtube.com/watch?v=tPZQSKHbyq8>

## Unity VR Environment



**Fig-2:** Unity application with robot intent signaling by displaying the hole number which the robot is moving to on the headset screen.



**Fig-3:** Unity application with robot intent signaling by highlighting the hole that the robot intends to move to.

## Discussion

- Successfully implemented the virtual reality application in Unity.
- The application replicates an assembly line where human & robot collaborate to screw in various parts.
- The human member places the screws in the designated holes and the robot collaborator tightens the screws, while signaling its next screw location to the human collaborator.
- Applications include training new workers before assigning them to assembly line, or training medical servers with new procedures virtually, etc.

## Future Work

- Accommodating multiple human collaborators to view the robot's intent signals at the same time can allow usefulness in a wide number of scenarios.
- Signal timing and signal content also affect the effectiveness of such systems. A study that focuses on different signal timings and different types of signals can be helpful for improving the system.
- The current iteration of the project includes only Virtual Reality (VR) capabilities due to hardware limitations. Implementation in Augmented Reality environment could open more applications.

## References

- F. Cini, T. Banfi, G. Ciuti, L. Craighero, and M. Controzzi. The relevance of signal timing in human-robot collaborative manipulation. *Science Robotics*, 6(58):eabg1308, 2021
- M Daily, Youngkwan Cho, K Martin, and D Payton. World embedded interfaces for human-robot interaction. In 36th Annual Hawaii International Conference on System Sciences, 2003. Proceedings of the. IEEE, 2003

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