

Designing with Holograms –

A Preliminary Study On Improving Design Visualisation Through Holographic Display

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I. BACKGROUND

An intuitive ability to realistically visualize and manipulate a 3D model of an engineering assembly prior to physical prototyping is key to an efficient design process[1]. The current project aims to assess the feasibility of using an internally developed mixed reality (MR) application to improve design visualization through holographic representation of engineering components. In this way, design engineers may move through the design process more efficiently and effectively[2].

II. DESCRIPTION

A. Methods

An internal preliminary user study was conducted for our internally developed MR application – deployed on Microsoft HoloLens2 (HL2), that allows design engineers to manipulate, scale and position holographic CAD components onto each other to test assembly feasibility. A large-scale assembly project, specifically, a bomb loader, was chosen for the test case. The loader has an approximate footprint of 3.5 by 1.5m, and reaches a height of 2m with a total weight of 4 tons.

Three senior design engineers from an engineering design firm were asked to participate. Participants were first given a brief explanation of the background of the project, and an orientation to HL2 gestures and the MR application. They were then asked to utilize the application to test its usefulness in design visualization for 15 minutes. Following the study, participants were then asked for their views on how the application would help their process.

B. Main findings

Based on participants' comments, the preliminary study revealed key areas in which the application could improve the design process and visualization:

- (i) Creation of a safe and cost-effective mock-up of large-scale projects through holographic manipulation (Fig.1), in what would otherwise be a dangerous and expensive physical prototyping process;
- (ii) Observation of collision detection during assembly of holographic parts (Fig.2) to allow for greater physical assembly feasibility later on; and
- (iii) Effective placement of wiring and other small components by being able to walk-through the holographic assembly to observe previously inaccessible areas.



Figure 1: Holographic display of large-scale bomb loader model



Figure 2: Collision detection between holographic parts, where the active part turns red to signal to the user that collision is occurring

In addition, the participants highlighted the need for greater intuitiveness in the guided user interface (GUI) of the application and improved accuracy during holographic part selection and manipulation.

III. CONCLUSIONS

The use of MR within an engineering design process shows great potential to improve the efficiency of the design process. Engineers may test initial concepts, realistically determine assembly feasibility and effectively evaluate designs using MR. While further improvements in both hardware and software development are necessary, the present study demonstrates that with the use of MR, companies would be afforded the opportunity to save cost and time on physical prototyping through improved visualization via holographic display.

IV. REFERENCES

- [1] Connacher HI, Jayaram S. Virtual Assembly Using Virtual Reality Techniques. *CAD Comput Aided Des* 1997;29:575–84.
- [2] Wolfartsberger J. Analyzing the potential of Virtual Reality for engineering design review. *Autom Constr* 2019;104:27–37. <https://doi.org/https://doi.org/10.1016/j.autcon.2019.03.018>.