

# Virtually Reality Collaborative Re-Design Environment

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Our project investigates the development of a collaborative design and re-design environment for mechanical parts within an immersive, virtual reality environment. This emerging environment will allow remote collaborators to annotate and modify a shared virtual model in real time, giving each participant a sense of presence of the part as it is acted upon.

The design of engineering parts frequently starts from a previously existing part to which changes and/or improvements need to be made. The re-use of existing part designs not only saves time during the design phase, but also saves a great deal of money during downstream manufacturing because existing fixtures, tooling, and inspection devices often can be retrieved from storage and reused. In the past, for each major part modification, the members of the design and manufacturing teams would gather around the existing physical part, inspect it from all sides, point to it, make sketch marks on it, tack post-it notes on it, and – to the degree possible – make physical changes to it. In large organization today, however, the various parties are often scattered around the country or the world, making such meetings impractical. They can send faxes and make telephone calls – hardly a substitute for face-to-face meetings in one location. At best, distributed designers can share a window on a computer screen, on which they can point and click with a mouse. We are developing a remotely sharable design work space that offers a more natural interface for sketching and for marking up pre-existing designs.

We want to reintroduce into this networked, tele-shared, collaborative environment some of the immediacy of the traditional re-design environment where every participant had an opportunity to manipulate and annotate the physical part to be re-designed. We hope to achieve this through an appropriate combination of traditional sketching paradigms, computer graphics, and virtual reality technologies that give each participant a sense of presence of the part under discussion and an immediate front-row seat to the actions and explanations by all other remote participants. Typically, the part to be discussed and modified exists in virtual form only as a computer model

in the shared data base. The goal is to port those aspects of the traditional design environment that are most crucial to a rapid and successful re-design to the new networked worldwide work environment.



Figure 1: *Two students working at the VR workstation*

The environment that we are investigating is based on commercially available virtual reality technology. The user wears stereo glasses and sits in front of large-screen display. A virtual working space of several cubic feet is established between the user's eyes and the display screen (see Figure 1). A virtual image of the part under discussion appears in this workspace, within easy reach to the users hands. It can be re-oriented by any one of the collaborators, and each participant with access to an appropriate pointing device or "stylus" can make annotations on this part. In preparation for such a remote collaborative session, a pre-existing physical object can be captured by a 3D scanner, and the corresponding computer model entered into a shared database. All designers can now interact with this model through real or virtual pointing devices. Through a 3D mouse or a mechanical arm with force-feedback, the designers can mark up the surface of the model and/or make changes to its current geometry. These changes are instantly visible to all other participants in the current design session.