

# Virtual Reality System with Haptic/Auditory Devices for Assembly and Maintenance Training

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## **Problem Statement:**

The lead-time for the development of a model for performing a virtual reality system is usually high. When an expensive VR system is purchased, the justification requires a high level of productivity increase. Conventional modeling of VR systems with high lead-times reduces the productivity of VR systems. Restricting the study to a single industry can help in developing methods for lead-time reduction. As the first step in allowing more prevalent use of virtual reality systems, training in the use of virtual reality systems is a must. Another area of concern is for aircraft manufacturers to analyze the ease of assembly and disassembly, which can reduce the turn around time in maintenance. A third major area of concern is the training of maintenance crew to identify defects. Most of the defects that occur are rare and hence difficult to train for when using real aircraft. However, with VR systems, it is possible to train maintenance crew in the identification of defects. The training system can also be used for certification of maintenance personnel. Additions of devices that enhance the VR experience are useful in increasing the level of training. The use of VR systems that are limited to visual feedback may not provide an authentic system for training. Hence, haptic devices that provide force feedback and auditory systems that will provide a more realistic environment can be used to enhance the system

## **Statement of Work:**

This proposal aims at developing a training and certification system for aircraft assembly, manufacture, and maintenance personnel. The training system will focus on developing two types of virtual reality systems:

- System for training aircraft manufacturers
- System for training aircraft maintenance personnel

The proposed research will be developed in the following phases: a) Development of Training System for use of VR, b) training system for aircraft manufacturers, c) training system for aircraft maintenance, d) certification system for aircraft maintenance.

## **Project Objectives:**

This project envisages the use of virtual reality systems in the training of manufacturing and maintenance personnel. The following tasks as described below will be used to implement this project.

## **Development of VR Models:**

The first task in this project is the development of VR models. Components to be used in the development of VR models will be first identified with the help of participating industries. There are 4 levels of models planned. Based on discussions with the aircraft manufacturers,

Level 0 - 3D VR Simulation of the work cell and tasks to be performed

Level 1 - VR model with humanoid inserted

Level 2 - Allow trainee to interact with the VR model thru Head mounted display and Cyber gloves

Level 3 - Enhance the experience with haptic devices and auditory feedback

**Benefits from the proposed research**

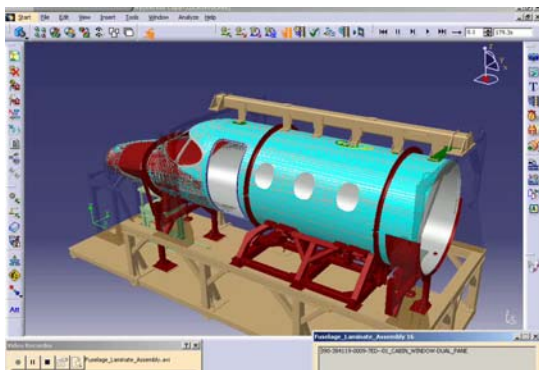
- Reduced lead-time for the development of new VR models
- Analysis of assembly and maintenance tasks
- Training system for aircraft manufacturers
- Training system for maintenance crew
- Use of haptic and auditory devices to enhance the VR experience

**Development of Training System for use of VR:**

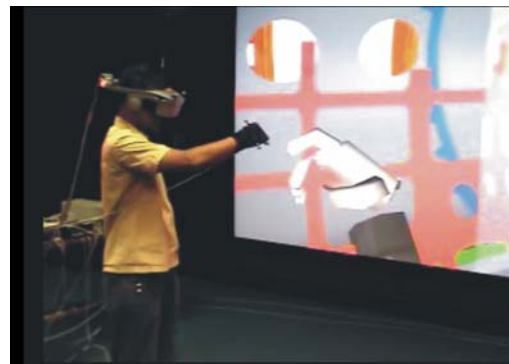
The training system to be developed will focus on the use of immersive virtual reality systems in combination with haptic (force feedback) devices. Manufacturing and maintenance personnel identified by participating industries will be trained on the VR system. Once the users are trained in the use of the system, the second phase of training will focus on the application of the system to the training of assembly, disassembly, and maintenance procedures.

**Implementation of VR systems:**

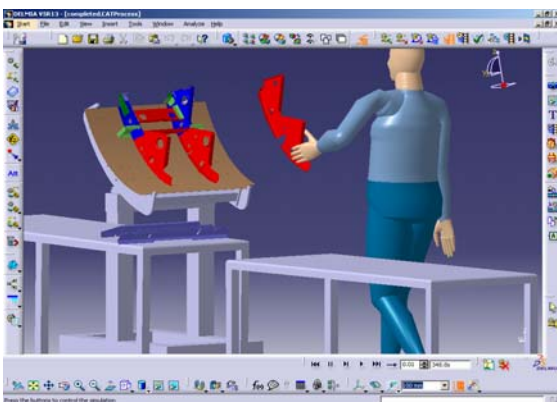
Among the four models specified, we have already accomplished up to Level 2 for Cessna, Level 1 for Learjet and Level 0 for Raytheon. The software used for accomplishing these tasks were Delmia V5R15, Pro-e Mockup, 3ds Max. These models have been implemented in the companies and it is found that it is an effective tool in a training system.



LEVEL 0-3D VR Simulation of the work cell and tasks to be performed



Level 2 - VR model thru Head mounted display and Cyber gloves



Level 1 - VR model with humanoid inserted