Design and Creation of a Virtual Reality Station for Passive Observation of Additive Manufacturing Technology

Overview
Institutions currently do not have an effective way to educate students who may be taking classes remotely, about the different types of additive manufacturing equipment. Penn State University researchers have begun testing different types of learning mechanisms to help provide a solution to this problem. The Capstone group, PSU Made By Design Lab 2, was tasked with utilizing Virtual Reality to allow students to be able to successfully learn and interact with different types of additive manufacturing machinery in a virtual setting; wherever they may be located, in real-time.

Objectives
The first is to design and manufacture a rig to house various sensors and computers. The second is to design and create a software package which allows real time video streaming, worldwide, in real time.

Approach
• The team gathered the customer needs directly from the sponsors through weekly meetings and limitations of the Kinect sensors were identified through consideration of the rig’s intended operation.
• The rig team performed patent searches on various camera-stand technologies before constructing their own solution. The software team found an open source (MIT Licensed) project that handles most of the Kinect scanning synchronization and streaming.
• Prototypes and ideas were designed based on customer needs and design constraints (such as the Kinect sensor’s viewing angle).
• Preliminary ideas were constructed, with alpha and beta prototypes of the rig constructed midway and towards the end of the semester. Basic SolidWorks Simulations were conducted to understand the strength of prototyped parts of the rig.
• Iterations of each part that make up the rig were performed and improvements were made in areas where shortcomings were identified.
• Mechanical rig testing was performed by the members of the rig design team. This process included verifying the rig structure was conducive to optimal Kinect sensor performance and the integrity of each part that made up the rig structure.
• The performance of the mechanical rig was validated by members of the rig design team towards the end of the semester and software testing was done on both a live print on the Taz 6 printer as well as inanimate objects.
• The software performance was validated by observation (i.e. is the scanned object visible in VR) and also through the Frames Per Second metric (quality VR experiences aim for a minimum of 90 fps).

Outcomes
• The primary result of the project is a mechanical rig allowing Microsoft Kinect sensors to scan a 3D printer in real time with the ability to export the scanned mesh into Unity to be viewed by a user in virtual reality.
• The project verified the feasibility of the initial idea, specifically implementing a live camera feed of a 3D printer into a virtual reality environment.
• The sponsor saved $800 in raw materials and ~$3000 in labor (assuming 3 hours/week at $10/hour with 7 workers)
• The project reduced setup time, assembly time, tool wear, etc.
• The project identified the design parameters that must be met in order to fully change the rig into a end-use consumer product.