

Case study

AR-training-for-metal-additive-manufacturing

Problem

Metal AM has developed rapidly over the last few decades and is capable of producing parts with intricate geometries and detail unobtainable by CNC machining and die casting. Major industries are investing in metal 3D printers but are facing difficulties in finding trained/skilled operators. Training can cost weeks of time and thousands of dollars. Lack of skilled operators can also be attributed to lagging educational systems compared to AM technology. In light of this, it was necessary to find a solution to reduce the costs involved in terms of time and money to train new AM operators more quickly and efficiently.

Solution

A system was created that was capable of standardizing the metal AM workflow in a comprehensive format to quickly and efficiently train new operators. This was accomplished by implementing an AI-powered AR training simulation for metal AM that:

- Utilized an AI system for text recognition and object detection
- Used an innovative, immersive training environment using an AR headset
- Supported the delivery of just-in-time guidance
- Provided contextual and personalized feedback
- Capable of working with any AR headset and for any metal 3D printer

An AI algorithm was developed to simulate the same.

Development

CAD software was used to create the Renishaw AM400 digital twin; Solidworks was used for its full configuration and Fusion 360 was utilized for its RBV configuration.

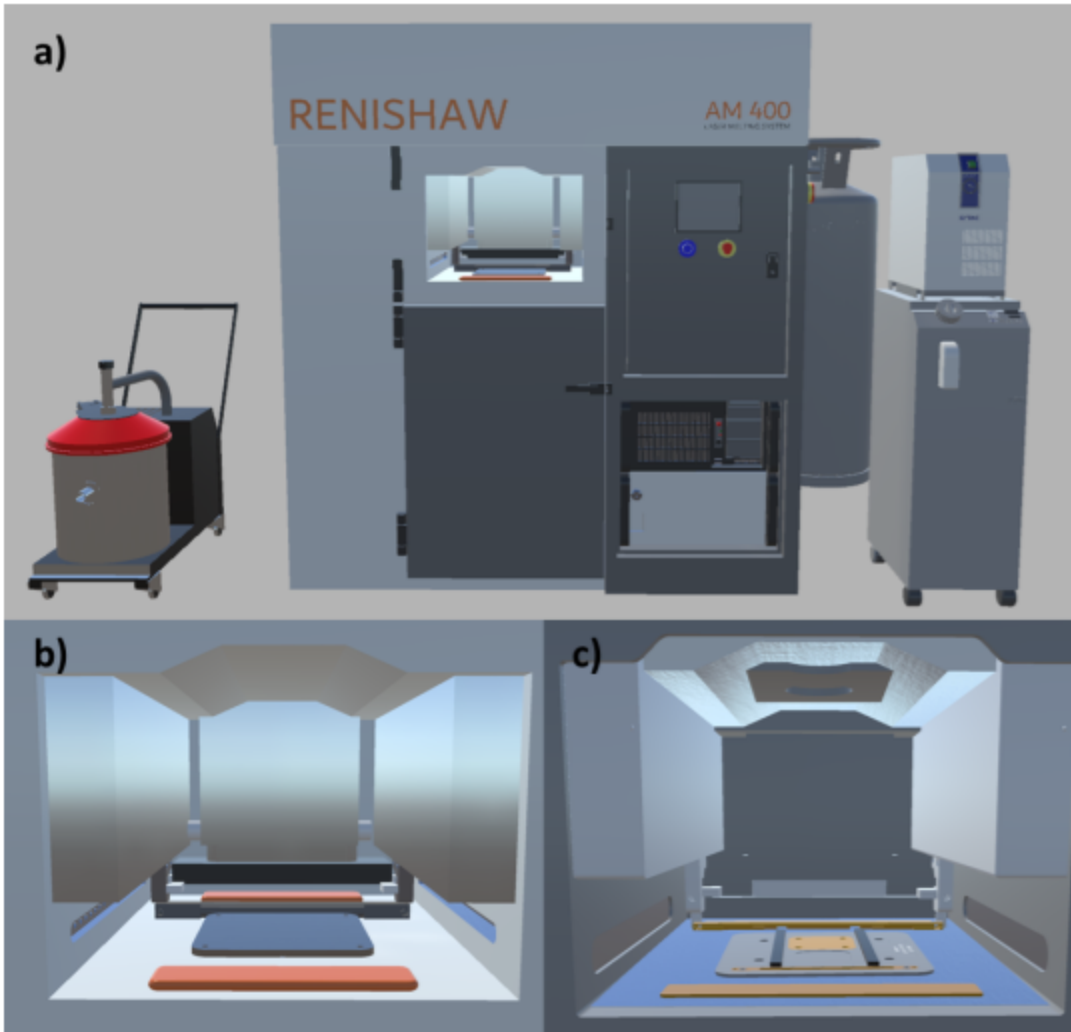
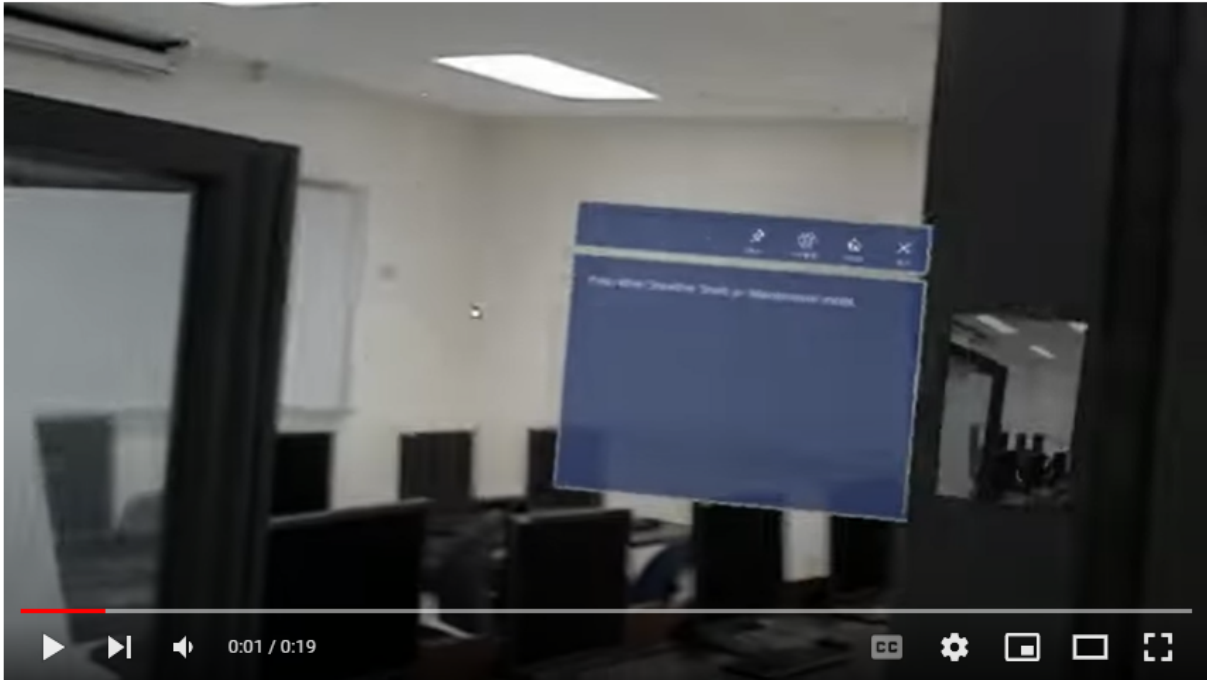


Figure 1: Digital Twin of the Renishaw AM400 using CAD

Precise measurements of the most commonly interactive parts were taken like doors, buttons and build areas. External equipment like chiller, dryer and argon tank were modeled as well. Here is the [link](#) to the video clip of the training process.

Implementation & Integration

The digital twin was uploaded into the virtual environment of HyperSkill and a step-by-step training procedure was created which was capable of including pictures/videos to facilitate the learning process. Computer Vision was used to detect the button pressed by the user.



<https://youtu.be/d4fdFMzIV5c>

For the AR visualization, Hololens 2 was used and HyperSkill was downloaded into the headset, which allowed the trainee to experience the simulation. The aim was for the trainee to first scale and fix the Renishaw AM400 digital twin to the room and this was done using Hololens 2 finger and hand gestures.

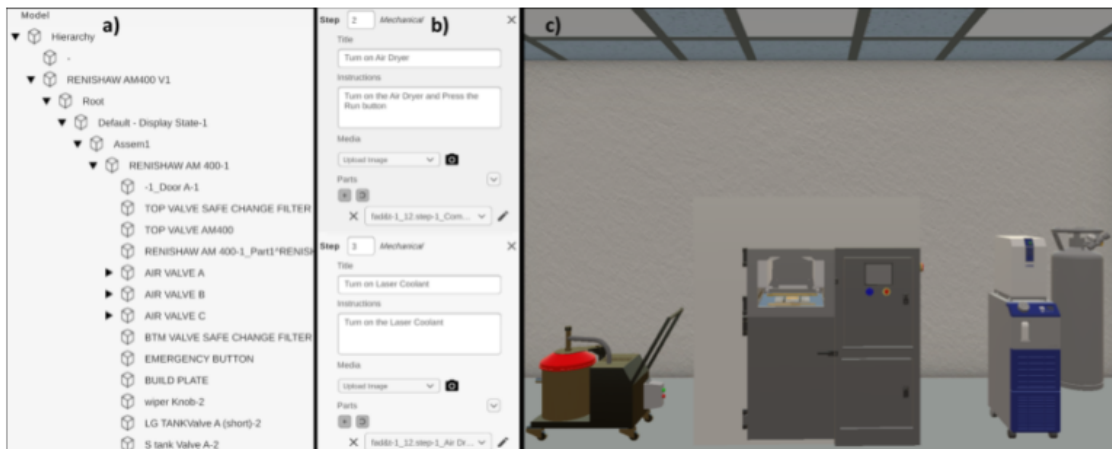
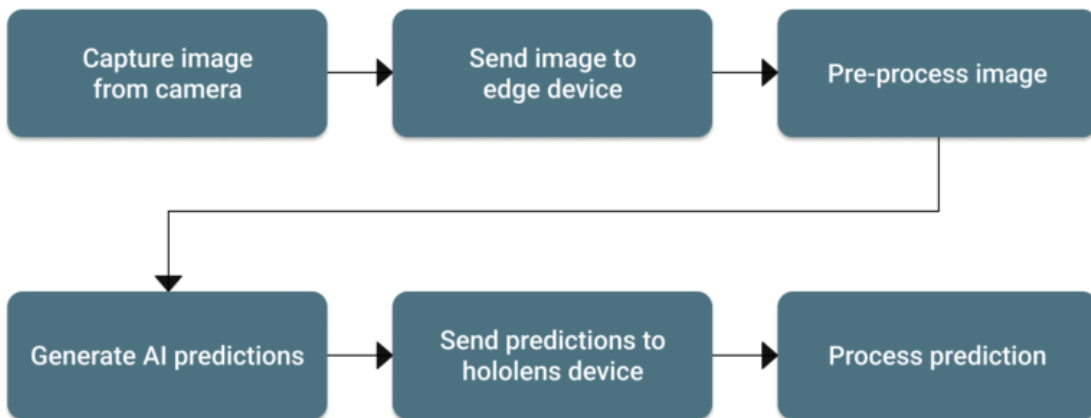


Figure 2: Training procedure simulation in HyperSkill



Figure 3: AR visualization of the Renishaw AM400

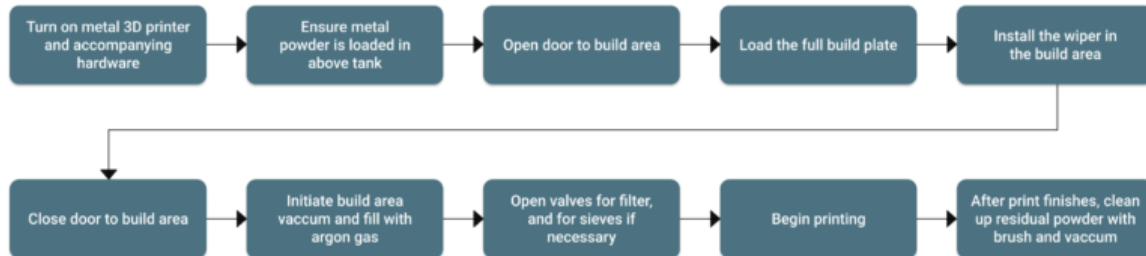
The Computer Vision AI system interfaced with the HyperSkill app to provide immediate user feedback. At a given prompt, the Hololens captured an image from the Hololens camera which was sent to the web app for AI processing. The AI prediction result was then sent back to Hololens for user feedback.



Flowchart 1: Process flow of AI system

Training Procedure

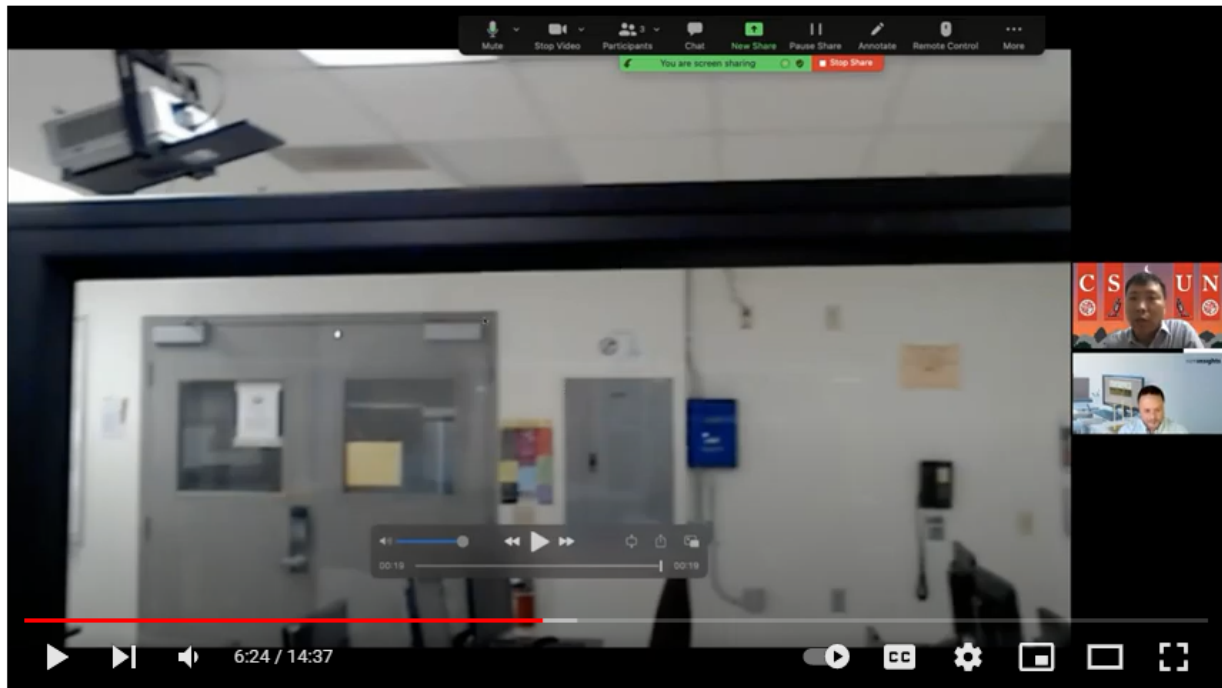
A high-level flowchart of the standardized process was developed for the full and RBV configuration. This was reviewed by an experienced operator to ensure that all steps are correct and in order. A detailed, low-level flowchart was also developed for implementation into HyperSkill.



Flowchart 2: Training instructions for new trainee

Testimonials

Professor Bingbing Li, Department of Manufacturing Systems Engineering & Management, California State University Northridge, said *"We received excellent support from the SimInsights Team! The CEO Raj, and his engineering team members Erick and Chris helped us a lot in developing the AR system. We used HyperSkill to create the workflows and integrated our machine learning models for finger detection and text recognition. SimInsights provided support and training to our students and also visited our lab to test the overall system on the 3D printers in our lab. Thank you!"*.



HyperSkill at Cal State Northridge (CSUN) and UCI CallIT2

California State University Professor Bingbing Li shares his collaboration with SimInsights on AR and AI based workforce training using HyperSkill.

<https://www.youtube.com/watch?v=DM-uMkEfgxo&t=383s>