Real and Virtual Continue to Merge in Manufacturing

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INTRODUCTION

As manufacturers increasingly seek to integrate cutting-edge digital technology into their existing production operations, the lines between the real and the virtual have blurred together. Manufacturers now have the ability to blend virtualized elements into real-world environments, offering the potential for improved training regimens, expedited or remote service and support, and the standardization and optimization of machining processes.

Three current forms of virtual technologies can be found in manufacturing today: virtual reality (VR), augmented reality (AR) and mixed reality (MR). The difference between the three is one of user experience. VR is completely immersive and replaces a real-world environment with a virtual one. AR alters a person's perception of the real world with enhanced computer-generated objects. And in MR, virtual objects are connected to real-world physical objects for a blended approach. While each virtual technology is different, all three provide the same benefits in terms of safety, convenience, cost effectiveness and practicality for those in the manufacturing world.

Pioneering companies within the manufacturing world, such as Mazak Corporation, continue to advance virtual technology with the development of new and innovative VR, AR and MR equipment. The applications of these systems vary from maintenance assistance and operator training to process standardization and sales demonstrations. This technology may be new to manufacturing, but it is quickly becoming commonplace as big automotive OEMs and various skilled trades groups implement forms of VR training for truly cutting-edge methodological approaches to education.

Mazak

VIRTUAL REALITY

Virtual reality (VR) technology uses a headset and software to transform ordinary video content into immersive, interactive experiences, letting the user join in the view. For machine tool manufacturers, this new technology offers two extremely important opportunities. First, it holds the promise of realistic training experiences without the need for access to an actual machine. Second, it generates immediate enthusiasm for the manufacturing world among younger people.

The ever-rising popularity of VR in the video game industry has driven the hardware aspect of the technology further than ever before, creating a boom in consumer VR technology development, which has reduced costs and increased functionality far beyond previous generations of VR equipment. Wi-Fi connectivity and more-compact headsets have allowed the platform to evolve toward greater flexibility and power. In the future, VR applications may even enable participants to go beyond learning the tasks involved in operating a single machine to running an entire virtual machine shop.

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AUGMENTED REALITY

AR is an interactive experience in the real, natural environment in which objects in that environment are enhanced via computer-generated perceptual information. This technology goes beyond typical QR codes and other previous attempts to merge reality with virtual information. With AR, the information previously shown on a screen appears to be part of the world around the user.

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This AR experience is so seamlessly interwoven with the physical world that it is often perceived as an immersive aspect of the real environment. While VR replaces the real world with a simulated one, AR alters a user's ongoing perception of a real-world environment. For consumers, this has resulted in products that offer novel ways to experience the night sky or see how a room in their home might look with different décor. For manufacturers, however, this technology can be deployed to enable everything from new methods for presenting maintenance information to the creation of novel human-machine interface paradigms.

MIXED REALITY

MR, so named for the manner in which it blends AR and VR technologies to maximize their individual capabilities, involves the placement of virtual objects in the real world and connecting them to existing physical objects. These virtual objects can range from informational brochures and 3D models to holistic training exercises and tutorials.

In the realm of virtual technologies, VR may be used to generate a full machine tool simulation, while AR would display the machine's internal base and other substructure components superimposed on the real-life machine tool. Conversely, MR can attach tutorial videos, brochures, 3D models and other information onto the features and aspects of the machine and allow users to connect with it. And when interacting with the virtual environment, users may even select options or make changes that are then reflected in the real systems to which the virtual objects have been attached.

VIRTUAL BENEFITS

In an industry that continues to face a significant skilled labor shortage, today's manufacturers welcome those developments that attract new generations to manufacturing careers while simplifying training to make it easier and faster. This has a simple and obvious benefit – on expensive equipment, pressing the wrong button can have equally expensive consequences. VR, for example, can make training sessions more accessible for students in remote locations or before machines are installed, all on a platform that shows promise in attracting new talent to the profession.

As beneficial as it is to training, virtual technology provides equally valuable benefits for customer service and support. Virtual service and support reduce the need for technicians to physically travel to customer facilities, saving manufacturers time and money. Those customers, in turn, can learn and perform their own repair and routine maintenance procedures to eliminate

interrupted production due to unplanned for machine downtime, all without requiring experimentation on an expensive machine platform.

Because VR is completely immersive, its main application benefit is training. Students can learn how to set up, program and run virtual machine tools prior to ever actually pushing the power button of a real machine. However, in the full virtual world, sessions often must be kept short, as even the best current technology is insufficiently realistic in terms of motion. Without precisely mimicking the action of the human eye, VR equipment frequently causes motion sickness and other symptoms.

AR is much more basic and portable. Unfortunately, users have limited ability to manipulate objects in AR and are locked into elements within the application. Few AR applications go beyond displaying images and video in situ, and those that do primarily allow users to control where said images are displayed. This works well for heads-up display (HUD) applications, particularly in environments where having hands-free access to maintenance or operational information is crucial, but its use cases are otherwise limited.

By providing the best of both of these technologies, MR lends itself well to remote service and support in addition to training applications. The smart glasses used are their own self-contained computers with hard drives that can house any necessary applications or allow users to access a VPN.

VIRTUALLY MAZAK

Recognizing the advantages of virtual technologies in the manufacturing industry, Mazak has developed its own Virtual Reality Training program. It requires nothing more than a headset, a pair of controllers and a laptop computer. In demonstrations, the system attracts instant interest among younger participants, who tend to quickly master the VR equipment tutorial. The program creates an environment in which participants may safely learn to repair, program, operate, disassemble and reassemble components, all in a world in which mistakes cause neither injuries nor damage.

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In its current form, Mazak Virtual Reality Training offers instructional modules that the company will eventually combine into multi-option scenarios. Participants will be able to log in to complete specific structured training opportunities, take an introductory or a refresher course and practice hands-on skills, all with graded feedback that helps them assess their progress. Mazak's VR development and beta testing processes take place at its National Technology Center on the campus of its Florence, Kentucky-based North American Manufacturing Headquarters.

The interactive aspects of VR make it an ideal platform for machine training, and Mazak has created VR scenarios that include material removal, part finishing, maintenance and other tasks. As hardware and graphics capabilities continue to improve, the sophistication of the system likewise increases, showing even more detail from the CAD files that drive the visual content.

Mazak is also working to expand its use of Virtual Reality Training as a way to invite current middle or high-school students to reevaluate their impressions of manufacturing careers and see firsthand how the field continues to advance. The technology holds immense promise as a means of increased training resources and attracting new talent to the industry.

MAZAK MIXED REALITY

In exploring the possibilities of MR technology, Mazak utilizes a Remote Assist system used for real-time customer support and training service technicians, as well as machinists, on machine operation and maintenance. The results are faster response times and shorter learning curves along with less unexpected machine downtime.

Within the MR Remote Assist system, Mazak anchors virtual elements to objects in the real-world. In doing so, they are able to, for instance, send documents to a service technician out in the field or to a customer. These individuals can then move and manipulate, open and scroll through those documents.

Additionally, Mazak is able to build 3D models into its MR world for users to manipulate and modify. With this capability, a service technician working on a machine in the field that needs to identify exactly where a particular part is installed could bring up an exploded assembly view of that particular component and its location within the machine. For customers, Mazak MR allows them to pull up service/maintenance tutorials that will eventually have part numbers listed on the 3D machine models so that customers can immediately order any necessary replacement parts.

Remote Assist allows a Mazak service tech at one location to connect with a customer at a different one wearing mixed reality smart glasses and provide support as if the technician were right there with them. Using state-of-the-art virtualized reality technology, the Mazak Remote Assist smart glasses let customers use hand gestures much like a computer mouse to open MR documents and applications – and allows remote support technicians to see everything the customer does.

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Without easy access to what a customer is seeing, talking that individual through a maintenance or repair procedure over the phone is often difficult and time consuming. With the glasses, the remote Mazak service person can make annotations in the customer's field of vision. For instance, they can point something out, or circle a particular part, to greatly improve and streamline the communication process. They can also send documents and files to the glasses and attach them to those real-world objects the customer is viewing.

Mazak loads detailed 3D CAD models of its machines into the Remote Assist smart glasses to allow users to separate the various machine components from the model and explode the view to see all of their constituent parts. This capability also assists in training new service technicians on disassembling and re-assembling various machine components, such as spindle housings. For what it refers to as its Multiple Machines project, Mazak will eventually have all its machine component models available through the glasses, as well as certain scenarios involving entire procedures.

CONCLUSION

As virtual technologies continue to evolve and merge with manufacturing, innovative companies such as Mazak are already leading the way and enhancing applications with technologies such as cloud storage, MTConnect® integration and object recognition. The possibilities are truly endless, and manufacturers will soon be able to leverage MR technology to gain greater access to training, faster and easier remote service and support, and further optimization of manufacturing operations.

About Mazak

Mazak Corporation is a leader in the design and manufacture of productive machine tool solutions. Committed to being a partner to customers with innovative technology, its world-class facility in Florence, Kentucky, produces over 100 models of turning centers, Multi-Tasking machines and vertical machining centers, including 5-axis models. Continuously investing in manufacturing technology allows the Mazak iSMART™ Factory in Kentucky to be the most advanced and efficient in the industry, providing high-quality and reliable products. Mazak maintains eight Technology Centers across North America to provide local hands-on applications, service and sales support to customers.