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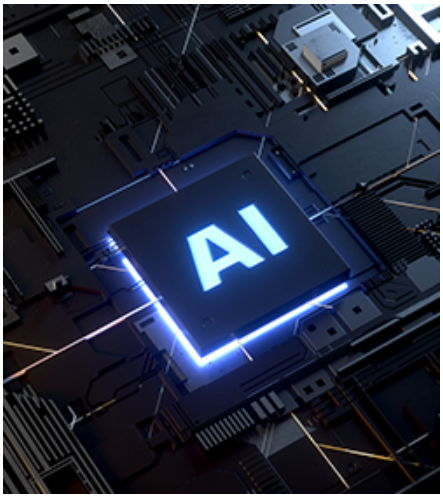
Merging 3D Artificial Intelligence with AR and VR Technology

By: Dijam Panigrahi



We don't know which of the world's largest tech-forward companies will power the best future tools, technologies, and resources for manufacturing, healthcare, construction, and more. Because of this, organizations have been working extremely hard to ensure they are creating changes that will greatly impact humanity. This begins as recent technological advances with artificial intelligence (AI) and immersive mixed reality technologies such as augmented reality (AR), and virtual reality (VR) have been made.

Although these technologies differ from each other, they are currently working together in advanced three-dimensional (3D) applications and environments, as it benefits companies and their customers.

Immersive mixed reality utilization

In virtual reality, a user wears a headset that enables entry into a new world, one that may even imitate the real world. Virtual reality allows for users to be given both a visual and audible experience that will duplicate a real-world setting in a manufacturing environment.

Augmented reality is conceptually similar to virtual reality. However, augmented reality displays digital content in the real world. This allows for manufacturers of power, utility, or industrial

equipment involved in the creation of new machinery to see virtual specs of the design. In turn, they also see how it could function in a real utility or power generation environment.

Challenges for enterprises

Certainly, these technologies offer promise. The challenge, though, is that they require heavy doses of data, the ability to process large amounts of data at remarkable speeds, and the ability to scale projects in a technological environment that is infrequently allowed in typical office environments.

Immersive mixed reality calls for a precise and persistent fusion of both the real and virtual worlds. Therefore, rendering complex models and scenes in photorealistic detail, rendered at the correct physical location with the correct scale and precise pose is required. To leverage AR/VR to design, build, or repair components, persistent accuracy and precise nature are needed.

This is currently achieved by using discrete GPUs from servers and delivering the rendered frames wirelessly to the head-mounted displays (HMDs) such as the Microsoft HoloLens and the Oculus Quest.

The need for 3D & AI in immersive mixed reality

One of the main requirements for mixed reality applications is to precisely overlay on an object its model or the digital twin. This way, work instructions can be provided for assembly and training, and possible errors in manufacturing can be caught as well. This allows the user to also track the object and modify the rendering while the work advances.

The majority of on-device object tracking systems use 2D image and/or marker-based tracking. This severely limits overlay accuracy in 3D, as 2D tracking is unable to estimate depth with high accuracy, and therefore, the scale and the pose. Although users may receive what appears to be a good match when looking from one angle or position, the overlay loses alignment as the user moves around in 6DOF.

Also, object registration, which is the object detection, identification and its scale and orientation estimation, is achieved. In most cases, this is achieved computationally or by using simple computer vision methods with standard training libraries (examples: Google MediaPipe, VisionLib). This may work well for regular, smaller, and simpler objects such as hands, faces, cups, tables, chairs, wheels, regular geometry structures, and so on. For large, more complex objects in enterprise use cases, however, labeled training data (more so in 3D) is not available easily. As a result, using the 2D image-based tracking to align, overlay, and persistently track the object and fuse the rendered model with it in 3D is extremely difficult, if not impossible. Enterprise-level users are defeating these obstacles by leveraging 3D environments and AI technology into their immersive mixed reality design-build projects.

Deep learning-based 3D AI allows users to identify 3D objects of arbitrary shape and size in various orientations with high accuracy in the 3D space. This approach is scalable with any arbitrary shape and is amenable to use in enterprise use cases requiring rendering overlay of complex 3Dmodels and digital twins with their real-world counterparts.

This can also be scaled to register with partially completed structures with the complete 3D models, allowing for ongoing construction and assembly. With this platform approach, users can achieve an accuracy of 1mm to 10mm in the object registration and rendering. The rendering accuracy is mainly limited by the device capability. This approach to 3D object tracking will allow users to fuse the real and virtual worlds in enterprise applications. In turn, this will open many uses including but not limited to training with work instructions, error detection in construction and assembly, and 3D design and engineering with life-size 3D rendering and overlay.

Working in a cloud-based environment

To be safe, manufacturers should be careful in how they design and deploy these technologies, as there is a significant difference in the platform they are built on and how they are maximized for use.

Although technologies such as AR/VR have been in use for many years, manufacturers have utilized virtual solutions that are built upon an on-premise environment, where all the technology data is stored locally.

On-premise AR/VR infrastructures limit the speed and scalability required for current virtual designs. This limits the ability to manage knowledge-sharing between organizations, which can be crucial when designing new products and understanding the best approach for virtual buildouts.

Manufacturers are overcoming these limitations by leveraging cloud-based (or remote-server-based) AR/VR platforms powered by distributed cloud architecture and 3D vision-based AI. These cloud platforms provide the desired performance and scalability to drive innovation in the industry at speed and scale.

Enterprise-grade high-quality AR/VR platforms require both performance and scale. However, existing systems such as MS HoloLens and others are severely limited in both aspects. Most enterprises have a rich repository of existing complex 3D CAD/CAM models created over the years. These 3D models may vary in their complexity (such as poly count, hierarchy, details, and more), making it difficult to run and excel within on-premise virtual platform environments restricted by device limitations. This forces developers to decimate the contents (3D models/scenes) to fit to different mobile devices, spending months in the process and sacrificing on the overall quality of the experience.

As these virtual environments become richer and larger, the problem continues to compound. This cycle is repeated for each of the different AR/VR hardware platforms, making it difficult for

any enterprise to move from experiments and pilots to full-scale deployable solutions, thus stunting the speed of innovation and effectiveness.

The device limitations also severely restrict the capability of existing AR/VR systems to generate and work with very fine mesh with large polygon count models and point clouds, which is essential to collocate and precisely fuse the virtual objects on top of physical objects in the real world with complex surfaces, and varied lighting and environment.

Manufacturers are overcoming this great challenge by partnering with providers of cloud-based (or remote-server-based) AR/VR platforms powered by distributed cloud architecture and 3D vision-based AI. These AR/VR cloud platforms provide the desired performance and scalability.

Manufacturers today are experiencing the next wave of technology innovation that will fundamentally alter the way they operate. This transformation is primarily driven by merging the digital and physical world to create a better, smarter, and more efficient way of operating. Immersive technologies such as AR/VR technologies are playing a pivotal role in this transformation. The organizations that take a leadership role will be the ones that not only leverage these technologies but also will partner with the right technology provider to help scale appropriately without having to stunt technological growth.

Today, manufacturers are defeating these obstacles by leveraging cloud-based AR/VR platforms powered by distributed cloud architecture and 3D vision-based AI. These cloud platforms provide the desired performance and scalability to drive innovation in the industry at speed and scale.