Magic Leap 2 Optics Breakthroughs Empower Enterprise AR

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To create our next-generation augmented reality (AR) headset, Magic Leap 2, we had to solve four of the toughest challenges in AR optics.

Taking into account customer feedback and our better understanding of the current limitations of AR and its applications, we built Magic Leap 2 based on what we learned from our first-generation device.

What we discovered led us to four major optics advances for Magic Leap 2:

- Doubled the field of view in a smaller device
- Added dynamic dimming to bring AR into bright conditions
- Simplified the optical system to offer more comfortable viewing and extended wear

- Enhanced our manufacturing capabilities to ensure precision at scale and enable high performance from a diffractive eyepiece

Optical improvements to Magic Leap 2 and the benefits for enterprise

Twice the field of view, half the size

We heard you. Customers told us that field of view (FOV) was critical to their use cases, especially for cooperative work, so expanding the FOV was a design priority for Magic Leap 2. But we also wanted to decrease the size of the projector by half -- leading to a major optics challenge.

Through years of rigorous research, we found that the currently available projector options (uLED arrays, laser-scan-based systems, LCoS panels) were either too large, consumed too much power, or led to challenges with image artifacts. Adapting the eyepiece for a larger FOV also presented a design hurdle. If we simply enlarged the eyepiece of Magic Leap 1, its surface area would have to increase by over 50% -- or, as big as your hand, making the headset too big for practical use.

To solve the challenges around FOV and the size of the device, we invented a new projector architecture and eyepiece design. The advanced architecture of Magic Leap 2 enables more immersive AR solutions. It offers twice the FOV (up to 70°) in a smaller form factor, with 2x image quality, 2-3x color uniformity, and 100x reduction in front rainbows, compared to our first-generation device.

The larger FOV, especially its larger vertical direction, will provide direct benefits to businesses. Two or more colleagues could comfortably view and collaborate on virtual content from different viewing angles, an engineer could see and modify a full-scale CAD model, and an analyst could visualize data at room-scale. Doubling the FOV in a smaller device could enable physicians to visualize a full person for health applications, and with excellent image quality. And a contractor, architect, or property developer could simply walk through a building site and see plumbing, electrical, and other construction elements.

Dynamic dimming improves the enterprise AR experience

Solid digital content in brighter conditions, even outdoors

Virtual content tends to get washed out in bright environments, which has limited where and how you can use AR devices. We designed Magic Leap 2 to work across a huge range of ambient light conditions -- including bright areas like outdoors or operating rooms. Magic Leap 2 can reach up to 2,000 nits of brightness, but this still isn't enough to compete with direct sunlight. And making the display even brighter would have required consuming more power, in a bigger form factor.

So we turned to a unique solution: dynamic dimming. Magic Leap 2 is the first general purpose AR device to feature dimmers integrated into the optical stack, which enables two types of dimming capabilities:

- **Global dimming,** which automatically dims the environment to ensure clear, solid, and vibrant digital content in brightly lit areas; and
- **Segmented dimming**, which enables applications to dim specific regions of the display, and make specific content areas, such as text, videos, or instruction sets, easier to see.

Magic Leap 2 can reduce ambient light in the entire area for use in brighter environments and adjust the dimming feature based on the brightness of the area and the brightness of the projector. You can also use dimming selectively, so that only the part of the display with the virtual content is brighter or in a lighter view than the surrounding area. This segmented dimmer results in excellent virtual image quality, as background light is eliminated. The segmented dimmer also enables the rendering of black, which is actually impossible without a dimmer, and also allows for a minimum amount of virtual light leakage into the real world environment.

Dynamic dimming will improve your AR experience and work in more environments, as there are several possible applications for this technology. For example, workers could see solid virtual content outdoors, like construction sites, emergency locations, or outdoor facilities, and surgeons could bring immersive AR solutions with dynamic dimming into brightly lit operating rooms, where it could help with surgery and related medical scenarios. Global and segmented dimming capabilities will provide a better AR experience if you're next to windows, in a brightly lit conference room, or in a bright industrial space, and could even ensure easy text and image legibility for stationary blocks of content, such as menus, interfaces, and instructions.

Magic Leap 2 focuses on comfort for extended wear

Comfortable viewing, extended wear with a simplified optical system

When viewing virtual content, several issues can cause visual discomfort. For example, vergence-accommodation conflict occurs when your visual system senses that your eyes' focus and rotation don't match. And, incorrect render perspective can occur when the AR device misperceives the location of your eyes and renders incorrectly. Additionally, bionicle misalignment can occur when the virtual image in your right eye doesn't match your left eye.

Our first-generation Magic Leap device addressed the vergence-accommodation conflict by using two focal planes, but this required larger, more complex hardware. To still enable a smaller form factor and a larger viewing volume for Magic Leap 2, we needed to ensure comfortable viewing of near and far objects on a single focal plane.

So we developed a suite of solutions that addresses these common causes of discomfort, allowing you to view content at near (37cm) and far (infinite) distances. This suite includes combining robust eye-tracking with a smart choice of focal plane, as well as automatic display calibration. Magic Leap 2 tracks each eye with two unobstructed cameras, together with 6 LEDs to illuminate and generate eye "glints," thereby improving rendering, image quality, and comfort. Having a smarter choice for focal plane minimizes discomfort and the 37cm clip plane is just the right distance to avoid negative effects. Magic Leap 2 also calibrates the display automatically to correct for any bionicle misalignment or color separation. You can also run a diagnostic test to make corrections for a better immersive experience.

Magic Leap devices are fully customizable, distribute weight evenly around the head, and are designed for thermal comfort. You can even insert or swap out prescription lenses into your device to make it even more customized.

Comfort is essential for real-world application. Together with the smaller, lighter form factor, solutions for near and far viewing will make Magic Leap 2 a practical tool for all types of people in all types of roles. For example, you could comfortably view virtual content for extended periods, allowing you to use enterprise AR applications for longer, throughout the day. You can see both close up and at a distance on Magic Leap 2 for extended periods while minimizing eye strain, and the Magic Leap 2 clip plane will prevent discomfort, nausea, or headaches from content that appears too close.

Magic Leap 2 benefits from unmatched, in-house manufacturing capabilities

Precision at scale and high performance from a diffractive eyepiece

Optics technologies are only viable if they can be produced with high quality at scale. To provide an AR platform that businesses can rely on to get work done, we needed to reproduce our optics advances at industrial scale, while always maintaining image quality -- fabricating tens of thousands of eyepieces, quickly, reliably, and without defects.

Magic Leap, with our unmatched in-house optics manufacturing capability, controls 100% of the eyepiece fabrication process, imprint, and manufacturing and metrology equipment, which lets us achieve an impressive yield rate (currently >90%).

With our unique jet and flash imprint lithography, Magic Leap owns every aspect of this nano-patterning technology -- a key enabler of display performance. By precisely controlling the volume of resin across the waveguide, this nano-imprint process achieves higher uniformity and efficiency performance. Our nano-imprint process opens many options for the structure of waveguides. We can develop 1D, 2D, and 3D nanostructures and combine different types of structures within a single waveguide element. Our team of experts at Magic Leap has also developed innovative solutions to detect defects and ensure quality. These include machine-vision-based inspection of transparent substrates, a stack and layer inspection system, and automated, in-line stack metrology.

Such manufacturing expertise and IP adds value to our products and positions Magic Leap to meet growing demand. We estimate the capacity to produce more than 100,000 units each year, with the space, best practices, and machinery for further growth. This enables immersive AR solutions and an incredible user experience. It also means reliable products for large enterprise deployments, based on our 37 critical-to-quality parameters, including dimensional and optical KPIs. And, we can provide ongoing scaling and innovation by tapping our expert in-house teams and proprietary equipment to move quickly from R&D to manufacturing at scale.

Looking ahead

Solving the numerous challenges and customizing the platform to support enterprise use cases has poised Magic Leap 2 to become the leading enterprise AR platform. We look forward to collaborating with developers, enterprises, and the ecosystem to deliver on that potential.

- For more information about Magic Leap 2, visit https://www.magicleap.com.
- Visit Insight to order Magic Leap 2 today.
- To get started with Magic Leap 2, visit our Developer Portal for the resources and tools needed to learn, build, and publish innovative AR solutions.

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#MagicLeap2 solves some of the toughest challenges in AR optics: achieving a larger field of view in a smaller device, dynamic dimming for bright conditions, and comfortable viewing for extended wear. #AugmentedReality #TechNews

Read more at: https://lnkd.in/gqER4HN4

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