

the company to keep users wedded to its software and dominate the next generation of hardware.

Apple has built a team combining its hardware and software veterans with talented outsiders. Run by a former executive from audiovisual pioneer **Dolby Laboratories**, the group includes engineers who worked on the Oculus VR and HoloLens virtual-reality headsets sold by **Facebook** and **Microsoft**, plus Hollywood digital effects wizards. Apple has also acquired several small companies with knowledge of AR hardware, 3D gaming, and VR software.

The company has been working on several AR products, including digital glasses that could connect wirelessly to an iPhone and project movies or maps on their lenses. While the glasses are a ways off, AR features could show up in iPhones sooner. Apple declined to comment for this story.

Except for novelties such as Snap Spectacles and disasters such as Google Glass, digital glasses aren't getting the attention of more immersive, gamer-focused VR headsets. Cook is gambling that, as he said last year, few people will want to be "enclosed in something" as they are with VR goggles, even once the leading VR companies improve their technology.

As *Pokémon Go* suggested, there's money to be had in AR. A roughly \$90 billion global market, it's set to rise 80 percent by 2024, according to researcher Global Market Insights Inc. And Apple has to pursue AR, because otherwise the growth of such devices will sap attention from its products, says Gene Munster, a founding partner at Loup Ventures who covered the company for many years as an analyst. "It's something they need to do to continue to grow," he says, "and defend against the shift in how people use hardware."

Adding AR features to the iPhone isn't a giant leap. Building slim, sturdy, adequately powerful glasses will be tougher. Like the Apple Watch, they'll probably be tethered to the iPhone. Beaming 3D images to the glasses will require a lot of power and therefore strong battery life, plus a new operating system and maybe a new chip. Apple will have to source the guts of the glasses cheaply enough to keep them affordable. Perhaps most

important will be apps, games, and other functions useful and cool enough to get people wearing the things.

Apple recruited Dolby veteran Mike Rockwell in 2015 to lead its AR division. Along with the Oculus VR and HoloLens veterans, his lieutenants include lead designers of the Apple Watch, developers hired from AR glasses maker **Meta**, 3D animators who worked on *Avatar*, and the creator of audio standard THX, say the people with knowledge of Apple's plans. "He's very seasoned," Oculus VR co-founder Jack McCauley says of Rockwell. "If they were to hire a guy for this job, they'd hire him."

Apple's acquisitions may also help Rockwell. It bought AR software maker Metaio in 2015 and AR camera software company FlyBy Media Inc. last year. Former Metaio CEO Thomas Alt now works on Apple's strategic deals team, which decides which technologies deserve investment. Last summer, Cook visited the offices of **Magic Leap Inc.**, a secretive AR startup valued at \$4.5 billion, and displayed interest in its technology, say those with knowledge of Apple's plans. Magic Leap declined to comment.

Hundreds of engineers are now on Rockwell's projects, including some on the iPhone camera team who are working on AR-related features for the phone, according to one of the folks with knowledge of Apple's plans. One feature Apple is developing would let users take a picture with their phones, then change the depth of the photo or

specific objects in it. Another would isolate an object in an image, such as a person's head, that could then be rotated 180 degrees. A third feature would use AR to place virtual effects and objects

on a person, as **Snapchat** does. The iPhone camera features would probably rely on a technology known as depth sensing and use algorithms created by PrimeSense Ltd., an Israeli company Apple acquired in 2013.

Apple's AR-enhanced glasses aren't expected to arrive before 2018 at the earliest. The company is conscious

◀ of how tough it is to make wearable gadgets seem like must-owns, since Google Glass became a laughingstock in 2014 and Apple's own watch failed to become a mainstream hit in 2015. Rockwell's developers will need to build a device that expands on the usefulness of iPhones and iOS without messing up the things people like about them. "To be successful in AR, there is the hardware piece, but you have to do other stuff too, from maps to social to payments," Loup's Munster says. Still, he adds, if history is any guide, "Apple is one of the only companies that will be able to pull it off." —*Mark Gurman, with Alex Webb and Mark Bergen*

**The bottom line** With the market set to rise 80 percent by 2024, Apple is tapping hundreds of engineers to develop AR hardware and software.

## Mobile

## Apple's Alternative to Virtual Reality



▶ **Tim Cook is investing heavily in augmented-reality systems**

▶ **"It's something they need to do to continue to grow"**

Tim Cook has talked up a lot of technologies since becoming **Apple Inc.**'s chief executive officer in 2011. Driverless cars. Artificial intelligence. Streaming TV. But no technology has fired him up quite like augmented reality, which overlays images, video, and games on the real world. (Think *Pokémon Go*, not Oculus Rift.) Cook has likened AR's potential to that of the smartphone. He predicted at a tech conference late last year that eventually we'll all "have AR experiences every day, almost like eating three meals a day. It will become that much a part of you."

He isn't just speculating. People with knowledge of the company's plans say Apple has begun an ambitious bid to bring AR to the masses, an effort Apple's leaders see as the best way for