Immersive technology is the future, and this will make digital representations of reality as important as reality itself, if not more. It is therefore vitally important that these representations be accurate, to the greatest degree possible, creating a need for a new order of magnitude of information sending & receiving over long-distances — full-field communications. Why? Because a Better Connected World awaits.

By James "Bo" Begole, Global Head of Huawei Media Lab
Is what’s real what matters?

Long ago, the physicality of reality was what mattered most – to raise a building, plow a field, cross a river, make a widget, and trade that widget for gold. The material properties of physical objects mattered most when civilization was getting itself off the ground. We’re long past that era. In today’s information age, what matters most are things like the reliability, timeliness, completeness, and meaning of information. A classic example is a stock price. Does it matter whether the price actually matches the future earnings of a stock? No, what matters is that the price a trader sees is the correct and most up-to-date price that anyone has. Today, digital realities can matter as much as physical reality ever did, opening new territories for business value.

Digital realities

How many digital realities are there today? One category is virtual reality (VR), which consists solely of computer-generated information with little or no connection to the physical world. Another category of digital reality brings other real-world places closer, sending and receiving audio & video in real-time from remote places where we are unable to travel – remote reality. There are also realities that supplement our life’s experiences with information from the digital realm – augmented reality (AR).

While wearable hardware like Oculus Rift and Microsoft HoloLens capture much attention, one should not forget another technology making leapfrog advances – video telecommunication. The resolution of today’s cameras is astoundingly high (some image sensors are able to capture more than 120 million pixels), and such cameras will form the basis of many applications. Display sizes are expanding rapidly; the same amount consumers paid in 2004 for a 27-inch cathode ray tube (CRT) will now buy a 60-inch flat-panel display. We also see display resolutions increasing from HD (2MP) to 4K (8MP), and new screens are already available at 8K (32MP) resolution. Manufacturers are launching 110-inch products, and creating manufacturing lines for even more massive sizes in the future. And yes, ordinary people are finding spaces in their homes for...
such wall-consuming digital windows, enabling life-size display of what were once tiny, inaccurate representations of real-world objects through full-field communications equipment such as Huawei’s MirrorSys system.

Business realities

This kind of true-to-life visual detail will create, disrupt and revolutionize many businesses – medicine, maintenance, education, travel, real estate, and of course communication. People will soon be able to fly drones to tour exotic locations, shop at the most exclusive boutiques in the world from home, share the field with world-class athletes, and visit your great aunt in Kenosha, anytime. Let’s look ahead a few years.

Medicine

Dr. Jameela Jalal once travelled the world to see patients in remote corners. Her travels were cut short several years ago after being caught in a viral outbreak that decimated medical personnel treating the afflicted. Jalal was a rare survivor of the outbreak, but was left with her lower body paralyzed. Jalal now practices from one of the world’s most advanced medical hospitals, equipped with the latest full-field communication system.

Jalal now sees more patients per day than she previously could see in a month of travel, greatly expanding the reach of medicine in previously underserved communities while maintaining the highest quality of medical examination. Unlike the telemedicine systems of the past, which provided face-to-face communication, but not enough resolution for remote medical diagnosis or treatment, her full-field system today allows her to see the most miniscule detail on the patient’s skin; the shape, texture and color are perfectly captured and recreated, exactly as in real life. Anywhere a camera can go, patients can be seen. She doesn’t need to wear special equipment or head-mounted gear, which would be tiresome for a full day of work, because the immersive display covers an entire wall, providing a full digital reflection of remote reality.

Not only are patients shown in full visual and audio detail – Jalal can turn on computer vision systems that detect and track the physical movement of a
patient’s limbs. These systems compare the appearance and motion of the patient to previous visits, assessing the progress of recovery. Based on the rate of progress, the system can overlay a visual prediction of the patient’s condition in the future.

As she discusses the condition with the patient and interns, intelligent listening software identifies topics and automatically retrieves pertinent information (dosages, statistics, related conditions, recommended treatments and more), often before Jalal herself realizes she needs to look these up.

Even though Dr. Jalal can use a robot arm with haptic feedback to physically feel patient’s joints, muscles and body, she sometimes asks the interns to perform these physical tests, allowing her to train the next generation of physicians. When it comes to performing surgery, however, Jalal takes control, using the most advanced tele-robotic systems, which are capable of extending the precision of human surgeons through digital stabilization of hand tremors and amplification of surgical operation. It is during surgical procedures, with the medical students watching intently, that Jalal most fully appreciated the amount of detail that these immersive systems provide – life-size representation of the patient’s limbs, joints and skin allow her to function as if she were fully present in the remote space.

Jalal misses travel, but appreciates that after seeing patients from around the world every day, she gets to go home to her family and avoids what was once an occupational hazard of disease exposure.

Sports

Kelly Bennett has the best possible seat at the last match of the season for her favorite football squad. Along with thousands of other fans, Kelly is virtually standing right on the stadium sideline, watching the players in full visual detail and full-life size as they kick the ball up- and downfield. She is energized by the storm of sounds from chanting stadium fans, reproduced in full volume and spatial detail within her headset. Usually, she prefers to stay on the sidelines so she can get a full overview of the action, but sometimes she pops into a view from a player’s camera so she can feel the action as if she were a member of the team. Kelly plays football regularly on her school team, and she knows what options a player would consider, what strategy the opposing team might plot, and where to optimally thread the ball.

Whenever a player approaches the ball, an AR tracking system plots multiple trajectories and probable outcomes onto the ball, giving fans a sense of where the action is likely to go next, raising their anticipation & excitement as they watch players make decisions and drive toward goals. Fans can also comment and draw diagrams onto the field for others to debate.

Unfortunately, this time her team lost, and Kelly is very upset because her team’s star player messed up a promising shot. She thinks he should have passed it to a teammate who was more open. After the game, Kelly tries out this scenario in her game simulator, which indicates an 82% probability that the other teammate would have made the shot from his position. Kelly posts this scenario on her team’s social media page, which causes a firestorm of commentary, with many fans agreeing that the team’s star player is a selfish glory-hound who should have put the team ahead of himself. The result – a little girl learns about the importance of teamwork, and a selfish glory-hound misses out on USD1 million in endorsement deals because his reputation just took a hit.
Commerce

Habib Kenyatta is a building contractor in east Africa. He receives a message from the factory in China that his order of custom wall tiles is ready for inspection. These tiles will sheath the lobby in a new five-star hotel going up in Nairobi, so the quality has to be perfect. Habib slips on his VR headset and connects to the factory’s server, where an ultra-precise scan of a sample tile has just been uploaded. Because the system is using a light-field camera, surface details such as reflectivity and depth-of-texture are reproduced in exacting realism, with Habib’s digital glove able to remotely feel the “texture” through thousands of tactile sensors and actuators placed in the finger tips.

Using this sample as a base, his virtual construction simulator is then able to recreate how the finished lobby will look after the tiles are laid, and see how the light will reflect off their surfaces at different times of day. The effect is more beautiful than he imagined. Habib has used this system many times with this source in Foshan, so he has full confidence that the sample will be exactly as just seen. Thus, he gives the go ahead to start construction. Over the course of a thousand similar decisions he has had to make, this system has shaved months off of the construction time, not only saving money but also allowing the hotel to get rooms onto the market faster.

Whether the source is a set of cameras in the real world or a server containing all the information for an artificially-generated world, digital realities require enormous amounts of data to match human perceptual sensitivities, which can process over 500 gigabits per second of sound and light; that’s over a thousand times what the average home Internet connection today would allow. Even with advanced compression techniques capable of 300 to 1 reduction, and other optimizations further reducing the throughput to single-digit gigabits per second, it is still a certainty that tomorrow’s networks will need an order of magnitude improvement in data capacity.

Of course, it is not enough to simply send that much data from one place to another, it has to be scanned, sent, and recreated in real-time to qualify as immersive reality. Research has shown that systems must respond in less than a tenth of a second, or else users sense delay (latency), disrupting the sense of immersive reality, and contributing to the sense of motion sickness and dizziness that some people experience with virtual reality. With augmented reality, the need for real-time latency is perhaps even greater, as digital overlay will almost certainly disrupt a scene instead of enhancing it if it can’t react as quickly as a user moves or turns his head.

All of these are areas of concern for Huawei. Our R&D is developing technologies that can compress and transport all of the light and sound (and eventually movement, touch and other sensations) of a remote or virtual environment in real-time to be recreated in full, life-size and lifelike fidelity. We’re also working to make sure that there’s no lag in that sound and light. What will this mean? Not only will your car have the split-second reaction times necessary to drive itself, but you’ll be able to enjoy a seamless full-field VR conference with your co-workers while riding in it. Our technologies will let people exist in parallel realities with ease in tomorrow’s Better Connected World.

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About Full-field Communications

According to Huawei Media Lab Director James “Bo” Begole, “Full-field communication (FFC) is the next-generation leap in telecommunications where we’re transporting all of the data that your eyes and ears would see in the real world. We’re capturing those in super-high-resolution cameras and microphone arrays and transporting that in real time. So you get the full width of view, the full surround-sound audio, and the full field of light & sound.”

What does all this add up to? According to Huawei Media Lab Head of Strategy José Alvarez, “FFC is a way of looking and experiencing reality in a more immersive way. It’s the equivalent of looking out a small window and having a wide window – a 360-degree view of the world.”

Full-field comms is the key

All of these future realities have roots in what is already happening today, but they depend on something that is still rarely achieved – the precise scanning, transmission, and re-creation of information from one place to another. This is the essence of full-field communications (FFC) – but it’s not easy. The technology depends on complex & powerful cameras, microphones, speakers, displays, etc., but that’s just near the user. Whether the source is a set of cameras in the real world or a server containing all the information for an artificially-generated world, digital realities require enormous amounts of data to match human perceptual sensitivities, which can process over 500 gigabits per second of sound and light; that’s over a thousand times what the average home Internet connection today would allow. Even with advanced compression techniques capable of 300 to 1 reduction, and other optimizations further reducing the throughput to single-digit gigabits per second, it is still a certainty that tomorrow’s networks will need an order of magnitude improvement in data capacity.

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