5 Technology Trends to Watch

A Special Supplement to It Is Innovation (i3) Magazine

- TECH MARCHES ON ....................................................1
- MAKING THE WORLD MORE ACCESSIBLE ..............2
- DIGITAL ASSISTANTS: HIRED HELP FOR THE SMART HOME .....................3
- AUGMENTED REALITY: CONVERGING WORLDS.... 6
- THE FUTURE OF TRANSPORTATION .......................10
- MEDICAL TECH AT A CROSSROADS .....................15
- ENHANCING SPORTS TECH .......................................21

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Welcome to the 2016 edition of Five Technology Trends to Watch. This annual Consumer Technology Association (CTA)™ publication looks at budding technologies that aim to refocus and improve our future. The outlook for the consumer technology industry is bright, with sales expected to reach $287 billion this year.

Countless technologies that promise to change our lives are on drawing boards, in development labs and in focus groups. Selecting the topics each year is challenging, but CTA analysts narrowed down five categories to take a deeper dive into for this issue: digital assistants, augmented reality, the future of transportation, digital health and sports tech. CTA also conducted a survey to get feedback on consumer awareness in these areas.

As the tech ecosystem continues to advance, our industry’s products are making a huge difference. Did you know that some universities are now bioprinting everything from blood cells to ears to cartilage? At Wake Forest University, for example, researchers were able to bioprint ear structures, as well as bone and muscles and then surgically implant them in animals. These structures eventually became functional tissue. This work could dramatically impact how we build, operate and interact with electronics.

Soon we will be living healthier, safer and richer lives. We will have fewer car accidents once driverless cars arrive on the scene. We will learn from the individual human genome how to cure once-deadly diseases. We will know what works and doesn’t in our healthcare. Many of today’s problems involving education, transportation and healthcare will be overcome. And that lesson will be taught using innovation and technology.

To learn more about the innovations enhancing our lives, I invite you to come to CES® 2017 on January 5-8, the world’s gathering place for all who thrive on the business of consumer technologies. At CES you will get a glimpse of a brilliant future. New products, services and technologies are solving real problems and improving the world for global citizens.

Make sure to visit the Innovations Design and Engineering Showcase at CES that recognizes excellence in product and engineering design, the CES Marketplaces that mirror new technology growth areas and Eureka Park where more than 600 entrepreneurs and startups introduce their visions to the world. For more information, visit CES.tech.

I hope you join us at CES 2017 in Las Vegas and help us celebrate the 50th anniversary of CES!

Gary Shapiro
CTA President and CEO
MAKING THE WORLD MORE ACCESSIBLE
By Steve Ewell

Accessible technology solutions are enabling the growing demographic of older adults to maintain their independence and quality of life. A joint CTA/CTA Foundation study on active aging found the market will grow from $24.4 billion in 2015 to $42.7 billion in 2020. This demographic, along with the nearly 56 million Americans with disabilities, provides an opportunity for technology to improve lives while also meeting a market demand.

Accessibility overlays all of the topics covered in this year’s Five Technology Trends to Watch. For example, take a look at the following.

• Voice assistants: regardless of your preferred assistant, these technologies are enabling control of your home and access to information through voice recognition. In addition to this benefit to the general public, these features can be crucial to people with mobility disabilities.

• Augmented reality: the ability to overlay information on the environment can provide helpful information to people with cognitive disabilities, audio cues to people with visual impairments or alerts for people with hearing loss.

• Transportation: ridesharing solutions open up new worlds of independence for people who are blind or low vision as well as older adults that have lost the ability to drive. Building on top of these available services, autonomous vehicles will further open up the world for these populations.

• Digital health: the ability to use sensors to track health data will enable consumers to take control of their health, while also providing alerts and warning signs for caregivers and medical professionals when needed.

• Sports technology: whether it’s a day as a spectator at the ballpark or competing at the local park or course, accessible sports technologies are opening up new opportunities for people to engage with recreational activities.

With these technologies, along with all of the product categories CTA tracks, it is clear that accessible technologies will open up new markets and provide greater independence to millions of consumers around the world. To learn more about what the CTA Foundation is doing with accessibility visit CTAFoundation.tech

At CES 2017, you’ll find the latest in accessibility technology:
► Health and Biotech
► Lifestyle Tech
► Smart Home
► Wearables
Prediction: You will never stop carrying a smartphone with you until the day you die. Smartphones are that important in our daily lives. But does it have to look like a smartphone? In 10 years, devices will include more enhanced computing and communications capabilities than today’s smartphones and come in form factors limited only by our imagination. Flexible sensors and advances in technology may enable our future mobile computing devices to be a plastic bracelet, necklace or even woven into our clothing. Because most people cannot name an item more important to their daily productivity, various lifestyle devices may emerge.

It is no surprise, then, that some of the best conveniences of the modern smartphone have started to leak their way into the home in the form of digital assistants. Currently, hardware-based digital assistants like Amazon’s Echo device are a physical manifestation of a nascent platform war among major online players aiming to be the focus of your digital life.

It Began with the Smartphone

Much ink has been spilled on the rise of the smartphone. Its importance cannot be overstated. But rather than focusing on the beginning of the adoption curve starting way back with the introduction of the iPhone in 2007 (yes, we know there were smartphones before the iPhone), fast forward a bit to the launch of Siri in late 2011 and Google Now in the middle of 2012.

These two digital assistants were for many their first meaningful interaction with a unique form of machine learning known broadly as “natural language processing” (NLP). NLP is the means through which computers can attempt to learn the subtleties of human speech including semantics (the meaning of individual words), syntax (the basic structure of sentences with subject, action, object, and so on) and context (the real world scenario denoted by the semantic and syntactic clues offered by the speaker). Siri and Google Now allowed the user to ask questions of the services in (more or less) the same way we would ask another human being. By contrast, users could issue commands to the cloud-based services by speaking in a pre-ordained syntax that would allow the language processor to correctly interpret requests such as “Play ‘Houses of the Holy’ by Led Zeppelin.”

Siri and Google Now were predicted to immediately and fundamentally change the way we interface with our devices and in some ways they have. Serendipitously, a national conversation about distracted driving was happening at the very same time that a smartphone’s ability to understand simple commands was being productized. So millions of smartphone owners had reason to fire up Siri or Google Now and attempt voice dictation of their first text message or voice dialing their first phone call. At times it was a frustrating experience, but once users understood that their commands had to fit within in a pre-programmed script with command words and clear enunciation, most were off to the races.

Since their introduction, use of and satisfaction with Siri and Google Now (and subsequent entries like Microsoft’s Cortana engine) have been mixed. Generally speaking, usage levels have been high if infrequent and the accuracy of results is all over the map from excellent to poor depending upon the task at hand. CTA recently polled nearly 800 smartphone owners about their experiences with smartphone-based voice assistants. Among that group, 72 percent reported ever having used a voice assistant on their phone and 56 percent of smartphone users reported using a voice assistant at least a couple of times a month.

More interestingly, the perceived accuracy of commands issued to voice assistants appears to be extremely high. Of those who ever used their smartphone’s voice assistant, 80 percent reported that it accurately interpreted their commands most or all of the time. Such high accuracy numbers are likely attributable to a couple of times a week
Everyday
A couple of times a week
A couple of times a month
Almost never
Never

Use of Smartphone-Based Digital Assistants

Source: CTA Market Research
focus on software development as a means of making products smarter since the hardware engineering had been thoroughly refined in the smartphone wars.

As more everyday items became smart—crock pots, door locks and car stereos to name a few—there was a new pain point introduced that affected consumers and device manufacturers alike: the lack of an integrated platform that allowed the technologies to not only be aware of one another’s existence but also to talk to one another in a seamless and organized way. As a beginning step towards solving this problem, Apple and Google each released software development kits (SDKs) called HomeKit and Brillo, respectively, to allow hardware developers to place programming hooks into their software to allow devices to interact with HomeKit or Brillo.

The Invasion Begins

Prior to 2011, give or take, most consumer technology products and, indeed, most consumers’ homes were not particularly “smart.” In what has come to be seen as an in-between era about four years after the introduction of the smartphone, the average smart home was still pretty dumb. There had for years been a version of the smart home that was functional but available only to the very wealthy. However the seeds of the democratization of smart things and their eventual invasion of the home were sown. Consumers could finally understand the value of having a formerly “dumb” box become connected to the broader internet, at first wired and then wirelessly. Blu-ray players connected to BDLive, thermostats talked to smartphone apps, power plug adapters allowed the user to turn devices on and off. Each device was connected, but ultimately segregated from one another both in the home and on the main command-and-control device, the smartphone. Each connected device required an app or a web-based interface to be used to its fullest potential. The smart home was smart, but not very strategic.

One of the greatest gifts the smartphone has given the electronics industry is the knock-on effects of such rapid innovation in a small form factor. For years some of the world’s best and smartest engineers have been working to figure out how to cram an unbelievable amount of computing power into the smallest system-on-a-chip (SoC) possible. In the race for thinner, smaller and faster, chip makers like Qualcomm, NVIDIA, Samsung and Apple refined the mobile SoC into a tiny and powerful unit of computing that, due to its small size and ubiquity, had uses in millions of devices at a fraction of its former price. Furthermore, engineering techniques and software design methods that allowed engineers and programmers to examine every trade-off between speed, power consumption and size known to man, allowed relative upstarts like Nest and Parrot to

How Often Does Your Voice Assistant do the Right Thing?

<table>
<thead>
<tr>
<th>All the time</th>
<th>Most of the time</th>
<th>Rarely</th>
<th>Never</th>
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<tr>
<td>13%</td>
<td>67</td>
<td>13</td>
<td>6</td>
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Source: CTA Market Research

The Assistant You Never Knew You Needed

While Apple and Google had SDKs in the market, Amazon appeared to be tackling the problem from a different angle. It all started with the Amazon Echo, a product introduced more or less out of the blue by Amazon. Fabled to have been a forthcoming feature in Amazon’s abortive attempt at building a smartphone (the Fire Phone), the Echo’s main feature is a voice control assistant named “Alexa.” Nominally, the Echo is a smart speaker. However, if you look a little closer, the Echo was the opening salvo in a burgeoning platform war for control of smart devices everywhere. For its part, Google has also announced the forthcoming Google Home device that will compete head-to-head with the Amazon Echo for smart home dominance.

Amazon Echo was hailed as a smart digital assistant but also as a mainlined IV drip for consumers addicted to a steady flow of deliveries from Amazon. The Echo was designed specifically to ease purchasing from Amazon with just the sound of your voice and a purchasing PIN code to protect you from errant purchases. Industry analysts were stunned at the overwhelmingly positive reaction to a product category that, at least from a hardware perspective did not exist in any meaningful sense until the Echo’s release in late 2014. Despite not knowing how to even categorize such a device upon its initial launch, analysts estimate that the Amazon has sold more than three million Echo units since launch.
In its twice-annual Consumer Technology Sales and Forecasts, CTA estimates that U.S.-based shipments of digital assistants will top 2.2 million units. Worldwide, CTA expects shipments of 2.8 million units. Strong double-digit growth rates are expected through 2020 when shipments of digital assistants are forecast to rise to nearly 15 million units worldwide.

**Why This? Why Now?**

The reason for the existence of the digital assistant depends heavily upon a person’s point of view. Considering the Amazon Echo, the obvious takeaway is that the device is a means through which to sell even more Amazon-sourced goods in a faster and more convenient way. However, an increase in sales might only be a positive side effect from what many believe is one of Amazon’s primary goals: to learn more about you and your daily habits in order to better monetize their customer relationship with you.

By existing in literal form in your kitchen or family room rather than just as an on-screen abstraction in your browser, perhaps Amazon hopes its goods and services will become even more ingrained in your daily habits and routines. It is perhaps no coincidence then that Amazon has recently been making moves in the grocery space with same-day delivery. Rather than just a place for relatively big-ticket items like laptops and smartphones, Amazon might prefer that you think of it when it is time to order paper towels, socks and shampoo as well.

A potential third strategy is at play as well. As IoT devices continue to proliferate, consumers are increasingly running up against devices that lack true and complete interoperability. Depending upon the brands and models purchased, your thermostat, for example, may be able to “see” your connected ceiling fan, but may not be able to “talk” to it. Or your connected thermostat may be completely blind to the other smart devices in the home. In the early years of the smart home, this lack of interoperability was a small price to pay for being among the vanguard of the smart home revolution. In 2016, the excuses are starting to ring hollow among consumers forced to bounce between a smart thermostat app, a connected light bulb app and a third app for their home security system.

The digital assistant could represent a potential rallying point for makers of smart devices and their apps through common application programming interfaces (APIs), minimum hardware requirements (e.g. all devices must support at least the 802.11n Wi-Fi standard at 5 GHz), and IoT reference platforms upon which engineers can build all sorts of amazing devices. What is required to bring all of this thought leadership and technology into one place is a strong market presence that has the engineering talent, R&D funding and patience to rally industry players under their flag. The hardware-based digital assistant, be it one from Amazon, Google (coming in 2016), Apple (rumored to be coming) or another company, could represent the best chance ever for companies to build comprehensive ecosystems of interoperable products united under one banner.

Aside from potentially winning the smart home war before it really begins, a company that can build a cohesive ecosystem of smart home devices stands to win in software and services too. In its U.S. Mobile App Report from 2014, comScore reported that the average smartphone user downloaded 0.68 apps in a given month. Understandably, as users become more set in their ways with respect to how they use their devices and what apps and services they use, the number of new apps they try should decline.

However, that decline in revenue from app sales needs to be offset somehow and recurring revenue from app subscriptions (e.g. pay a yearly fee of $3 for use of a given app) as well as in-app purchases like movie titles and emoji packs represent the brightest star on the horizon for those monitoring sales revenue from any of the major app stores. So what we are seeing from afar is a platform war to win the household that could ultimately have the direct and desired effect of asking users to pick a side (be it Apple, Google, Microsoft or some other) and further entrench their future purchasing in that platform to the exclusion of all others.

At the end of the day, the digital assistant may never really become more than it is today. Just as likely, however, is a future in which a handful of well-thought out, well-engineered and fully interoperable IoT platforms compete in the ultimate battle for the hearts and homes of smart device users everywhere. One thing is for certain, a better and smarter future for your home is on the horizon and it all began with the unassuming digital assistant.

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At CES 2017, see how technology advances are changing the future in:

- Communications Infrastructure
- Internet Services
- Personal Privacy and Cyber Security
- Robotics
- Sensors
- Smart Home
- Wireless Devices & Services
AUGMENTED REALITY: CONVERGING WORLDS
By Bill Belt

How do virtual reality (VR) and augmented reality (AR) differ? VR is a technology that combines images and sounds to produce a simulated, yet realistic, environment or an imaginary setting. VR users are made to feel as though they are present within this immersive environment. Users can interact with this artificial setting by “looking around” as images and sounds shift when software and hardware detect and track the users’ motions. Most well-known virtual reality technologies consist of a head-mounted device to produce an image through a display in front of the users’ eyes, combined with sounds produced through speakers or headphones.

Oculus VR is one manufacturer of VR technologies. The Oculus Rift virtual reality headset first attracted attention as a Kickstarter campaign in 2012, only two months after the company was founded. The dramatic potential of Oculus was highlighted when the privately held company was purchased by Facebook for just over $2 billion in a deal that closed in July 2014. Many other manufacturers have developed VR devices. Notable among them are HTC’s Vive, Samsung’s Gear VR and Sony’s PlayStation VR.

The intense interest in VR is beginning to be matched by attention to AR technologies. In contrast to VR, AR combines a view of the physical, real world environment with computer generated inputs such as sound, video, and graphics. In essence, AR modifies a view of reality through the use of software and hardware. AR is most often used in real-time, allowing the surrounding real world to become interactive and digitally influenced by the user through computer vision and object recognition.

With AR, digitally generated information is overlaid on the real world environment. Hardware components for augmented reality include processors, displays, sensors and input devices. Smartphones and tablets contain these elements since they typically include a camera and sensors such as an accelerometer, GPS tracking and compass. So, unlike typical VR which requires specialized equipment to generate a simulated environment, AR relies on devices many consumers already own to combine the real world environment with augmented information.

For example, the Pokémon GO game sensation combines real-time, real world video images from smartphone and tablet cameras with digitally rendered Pokémon, providing the illusion that Pokémon were standing, running and fighting in our surroundings. Other AR technologies incorporate head-mounted gear, such as Google’s Glass, which superimpose information on the user’s field of view.

In short, with virtual reality the real world is blocked out and the user can only see the virtual world and virtual objects. With augmented reality, the real world is not blocked out and the user can still see the real world along with virtual objects.

Birth of a New Vision of Reality
In one form or another AR has been around for decades. In fact, the term ‘augmented reality’ was coined by Boeing researcher Tom Caudell in 1990. Not surprisingly, many of the first applications of AR were related to military research. The first use of AR for entertainment was as part of a theater production in 1994.

NFL football fans are likely to remember the 1998 introduction of the computer generated “1st & Ten” yellow lines rendered on the playing field. In 2000, Hirokazu Kato created the ARToolKit, an open-source software library that uses video tracking to overlay computer graphics on a video camera. In fact, the ARToolKit is still widely used in many AR applications. By 2009 ARToolkit was bringing AR to web-browsers.

Since 2013, augmented reality hardware and software has been gaining traction in the consumer technology marketplace. In 2014 Google announced the shipment of Google Glass, ushering in a period of intense interest in “wearable” AR. Microsoft’s HoloLens, a wearable AR headset still in development, displays holographic images that are the user’s real world field of view. Exciting predictions about the HoloLens’ potential as a revolutionary gaming device abound.

More and more smartphone and tablet apps are employing AR such as Pokémon GO and Star Walk. You can fight zombies and escape man-eating dinosaurs in AR-based games. In addition to consumer applications, AR has been making inroads in “commercial” uses, such as Volkswagen’s Mobile Augmented Reality Technical Assistance app, which provides virtual step-by-step repair instructions to service technicians.

Caterpillar Inc. is testing an AR solution from Vuforia Studio Enterprise that will help workers operate and maintain the company’s XQ3S generator, which is used to provide portable power at construction sites and concert events. Viewed through a mobile device such as a smartphone or tablet, Vuforia’s AR shows the XQ3S’s operating data and instructions on how to operate it and how to perform maintenance, such as replacing filters and changing the oil. Microsoft’s HoloLens could also serve as a practical tool to address industrial problems.
**From Gimmick to Useful Solution**

While consumers’ initial exposure to AR is likely to come from sci-fi movies and gaming apps, the technology is indeed moving into the mainstream as a tool to address real challenges.

Most construction projects are very time consuming. Buildings may be designed and modeled with advanced 3D tools, but it eventually ends up as old-school blueprints. Working off of those blueprints is time consuming, since builders have to refer to them constantly throughout construction, slowing things down. Bentley Systems is developing wearable AR technology that allows workers to see the blueprints overlaid on the construction site right in front of their eyes.

Another interesting application also involves new construction. According to the U.S. Department of Transportation, 33 percent of all pipeline damage occurs because excavation crews are unaware of existing pipelines and incidentally damage them during new construction projects. Discovering the location of existing pipelines is a manual process that must be done by each crew and isn’t always performed properly. Bentley Systems is developing a heads-up display showing existing underground pipelines as a proactive means of alerting workers to potential dangers where they are digging.

In an analogous scenario, AccuVein makes a handheld scanner that projects the location of veins over a patient’s skin, allowing medical personnel to quickly and accurately locate veins when drawing blood or injecting medications. The device is in use in hospitals across the U.S. and AccuVein estimates that it’s been used on more than 10 million patients.

Inglobe Technologies released a demo to assist drivers in identifying where automotive parts are located within their cars and how those parts are interconnected. One day soon, even a novice might be able to perform basic car repairs like checking fluid levels and replacing filters.

And Mishor 3D is developing a GPS 3D navigation aid to project driving directions and other safety information right onto a car driver’s field-of-view through the car windshield. This system would save drivers from having to take their eyes off the road to look at and read traditional GPS displays.

And AR could also help the visually impaired. VA-ST is developing computer vision technologies to aid people with vision loss. The majority of people who are legally blind have some remaining, but impaired, vision. For many people with impaired vision, recognizing faces, driving, reading and avoiding objects in their path are difficult tasks. For example, the VA-ST visor can create a stencil outline around a person’s face to help with recognition and can also help improve situations with poor contrast.

From devices that bring gaming to a new level, to technologies that save time and money, the potential market for AR solutions is only limited by our imaginations. Industries as diverse as construction, infrastructure development and maintenance, medical care, transportation and education could all be revolutionized by widespread use of augmented reality technologies.

**Another Gold Rush?**

Almost all large tech companies have shown interest in augmented reality, including industry leaders Apple, Facebook, Google and Microsoft. In May 2015 Apple acquired Metaio, an augmented reality startup founded in 2003 as a spinoff of a Volkswagen project. The acquisition could help bolster Apple’s AR efforts. Apple is rumored to be developing an AR feature for its Maps app that allows users to point their phone at a street to see what businesses are nearby, or a restaurant’s exterior to see the menu or specials.

Apple’s CEO Tim Cook recently said, “AR can be really great. We continue to invest a lot in this. We are high on AR for the long run. We think there are great things for customers and a great commercial opportunity.”

Facebook’s CEO Mark Zuckerberg recently confirmed that in addition to their interest in virtual reality, as demonstrated by the purchase of Oculus, Facebook is also researching augmented reality solutions. Zuckerberg predicts that virtual reality will merge with augmented reality and become part of everyday life.

Google and others have invested nearly $1.4 billion in Magic Leap, a secretive startup that is developing what some call next gen AR. Google and others have invested nearly $1.4 billion in Magic Leap, a secretive startup that is developing what some call next gen AR. Magic Leap is using the term “mixed reality” to signify that their technology combines AR and VR and places 3D virtual elements in real environments.

With such influential tech companies backing augmented reality, there’s plenty of market research attempting to predict future revenue. However, a pure quantitative analysis of the AR market today is challenging, because there’s not much of a track record to analyze yet.

Digi-Capital’s Augmented/Virtual Reality Report 2016 forecasts that AR could reach $90 billion in revenue by 2020. Digi-Capital predicts that AR software and services could have similar economics to today’s mobile market. A large AR user base would be a major revenue source for TV/film, enterprise, advertising and consumer apps.

Online retailers would also have an entirely new platform for selling to a mass audience. Together with innovative applications not yet imagined, AR hardware and software could prove to be a major use of mobile carriers’ voice and data networks, increasing revenue
for carriers. However, AR could also disrupt mobile markets if AR hardware, such as wearable headsets, begins to replace smartphones and tablets as the consumer’s “device of choice” for internet connectivity.

According to a recent marketsandmarkets.com report, *Augmented Reality and Virtual Reality Market by Device Type*, the global augmented reality market is expected to reach $117.40 billion in revenue by 2022.

While many other sources exist for prediction of revenue, nearly all analysts combine the VR and AR technologies into one market to produce combined revenue predictions. For example, Goldman Sachs Group believes the combined VR/AR market will reach $80 billion in revenue by 2025.

**If We Build It, Will They Come?**

While there is no doubt about the high tech industry’s enthusiasm for augmented reality, what do consumers think? Landfills and recycling centers are littered with consumer technologies that failed to gain market acceptance in spite of promising predictions for their appeal, or technologies with short lifespans. Do consumers know anything about AR? Do they realize the Pokémon Go app employs something called “augmented reality”? Do they even care? How will consumers react to purchasing yet another high tech gadget, especially when some head mounted displays will cost at least $3000? Moreover, many consumers may be reluctant to wear computers on their faces. And, as demonstrated by Google Glass, consumers have a heightened sense of concern for privacy and security.

CTA surveyed 1011 adults in August 2016 to learn more about their awareness and sentiment of this new technology.

The chart above shows a reasonably high amount of awareness of various augmented reality use cases, especially considering the lack of commercial and consumer hardware and software for AR applications. Not surprisingly, the most well-known use cases for AR are apps on smartphones, such as Pokémon Go. Equally

<table>
<thead>
<tr>
<th>Consumer Awareness of Augmented Reality (AR)</th>
<th>Select Use Cases</th>
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<tbody>
<tr>
<td>Apps on smartphones for AR gaming</td>
<td>38%</td>
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<tr>
<td>Educational use of AR to help teach students</td>
<td>21</td>
</tr>
<tr>
<td>Medical use of AR to enhance or assist in surgical procedures</td>
<td>18</td>
</tr>
<tr>
<td>Smart shopping at retail, such as AR dressing rooms</td>
<td>14</td>
</tr>
</tbody>
</table>

Source: CTA Market Research

The chart above shows a reasonably high amount of awareness of various augmented reality use cases, especially considering the lack of commercial and consumer hardware and software for AR applications. Not surprisingly, the most well-known use cases for AR are apps on smartphones, such as Pokémon Go. Equally

understandable, 67 percent of younger respondents, ages 18-24, were very or somewhat familiar with AR use in smartphone gaming apps, while only 30 percent of older respondents, ages 45-54, indicated they were very or somewhat familiar with this use case. As with many other nascent technologies, awareness is highest among younger survey respondents across all use cases studied.

The chart above confirms that consumers maintain strong concerns about the privacy and security of their personal information. Manufacturers must address these apprehensions by ensuring AR devices and technologies incorporate high levels of security. Consumers will need to be educated about these protections to adequately address their fears.

Only 36 percent of respondents strongly or somewhat agreed that they have enjoyed their use of AR. Many AR solutions are in early-stage beta mode and will require significant enhancements before consumer satisfaction improves. More research and development, focused on the early problems identified by testers, will be required. Technical hurdles such as processing power and battery life will also require improved performance for AR to reach its full potential.

For now it appears that the high costs, especially for head mounted devices, will keep some consumers from early adoption. But analysts predict that prices will fall quickly, as is often the case for new technologies.

**What Lies Beyond**

Many people have predicted that virtual reality will merge with augmented reality and become part of everyday life. Augmented and virtual reality headsets will combine into a single piece of hardware that people carry around or wear like a pair of glasses. Unifying these two technologies will be technically complex. Today, virtual and augmented reality headsets use fundamentally different visual technology, and it’s difficult for a pair of small glasses to block out the outside world the way a VR headset can. The next generation of AR faces major technical hurdles. The technology requires multiple sensors and substantial computing power to constantly interpret its surroundings. That has made early versions of head mounted displays hot, heavy, inefficient and expensive.
Yet, it’s hard not to be excited about the potential of augmented reality to fundamentally change the way we live and interact with each other and the internet. Commercial acceptance and use of the technology will likely drive a slower evolving consumer market. But, once those markets begin emerging, augmented reality is likely to be the next computing platform, disrupting the mobile phone markets and other established tech markets. The consumer technology industry has thrived on the chaos that often accompanies innovation. Augmented reality devices and applications have that potential, and from that chaos new possibilities emerge.

At CES 2017, see new advances in augmented and virtual reality products:
- Accessories
- Augmented & Virtual Reality
- Computer Hardware/Software/Services
- Content Creation & Distribution
- Electronic Gaming
- Wearables

AR at CES

At CES 2016, the first Augmented Reality Marketplace debuted and covered about 3,000 net square feet of space and included exhibitors like ASRC Federal for NASA, Marxent and Occipital. They showed the latest AR tech including headsets, structure sensors and software. AR is also being incorporated into products across the show floor like auto technology, retail applications and even vacuum cleaners. The tremendous growth of the AR category at CES shows the advancement of this still nascent technology. Look for new AR advances at CES 2017.
THE FUTURE OF TRANSPORTATION
By Brian Markwalter

It would be a disservice to write about the future of transportation without a deep dive on driverless vehicles. The changes are just too profound to ignore. The only questions are how will driving be different and how soon will it happen? But, it’s not all about driverless cars. The way we transport goods and the role of electric vehicles are also big factors in the future of transportation.

The auto industry is where the smartphone industry was just before the iPhone – on the verge of a revolution in technology. Driverless car technology has the power to transform our transportation networks. And perhaps even more importantly, a national shift to driverless technology could eliminate about 90 percent of 32,000 vehicular deaths in the U.S. each year.

First, driverless cars are going to happen and sooner than you believe possible. Imagine it’s the year 2020, just four years from now, and your son or daughter is about to get his or her license. Will they be driving themselves around the old fashioned way with no self-driving features? Consider this: according to the Centers for Disease Control, motor vehicle fatality is the leading cause of death for teenagers, representing over one-third of all deaths. It simply does not make sense to say no to driverless features as they become available. Cars are reaching their limits in terms of protecting occupants from crashes. The big safety gains will come from avoiding accidents altogether.

As it turns out, young people are considerably more likely to envision a not-too-distant future in which cars do some or all of the driving. When CTA asked consumers how they believe road trips will be different in the next five years, the 18-34 year old group was almost twice as likely (48 percent) as those 45 years and older (28 percent) to agree that the car will drive autonomously on the highway while you drive the rest of the time. The older age group is far more likely to agree (61 percent) that we will still be doing the driving, except in emergencies when the car might intercede to apply brakes, a feature which is already available today.

Take the Wheel and Drive

CTA research shows that while people are highly satisfied with current advanced technologies to enhance driving, they love the benefits of driverless cars and want to buy them. This may seem at odds with reports that consumers don’t want driverless cars. But those reports come from research in which consumers are asked about driverless cars in a manner that highlights the “who is in control” aspect.

For instance, numerous media reports cited a 2015 study from the University of Michigan Transportation Research Institute that showed a slight majority of respondents indicated they preferred “No self-driving” over “Partially self-driving” or “Completely self-driving” vehicles. Yet the full Michigan research is actually similar to CTA’s. Drivers below the age of 45 preferred “Partially self-driving” over “None” or “Completely self-driving.” That means consumer research on driverless cars is consistent. People say they are excited about everything the technology offers, but still want the ability to manually control a driverless car.

Additional CTA research shows that consumer satisfaction with advanced driving features is astonishingly high. Among users of lane departure warning systems, automatic parking, collision avoidance and adaptive cruise control, satisfaction is almost unilateral at 93 percent or higher. People who have used these features now expect them to be included in future cars, and will be receptive to additional safety and convenience automation systems.

<table>
<thead>
<tr>
<th>INTEREST IN DRIVERLESS CARS BY AGE</th>
<th>Valid</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
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<td>100.0</td>
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<tr>
<td>Total</td>
<td>1248</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Of the 62 percent who are very interested or moderately interested in replacing current vehicle with a completely self-driving vehicle.

Source: CTA Market Research
Consumers also embrace the fundamental safety proposition that driverless cars offer. When asked to rank favorability among a set of benefits offered by driverless cars, consumers rated, “Reducing accidents from aggressive driving or driving under the influence of drugs or alcohol” highest with 82 percent rating the benefit favorable or very favorable. Consumers also appreciate the cost benefit that driverless cars will offer.

A close second among the most favorable benefits, at 80 percent, was the anticipated reduction in car insurance. But consumers weren’t nearly as impressed by the fact that driverless cars can free up land currently used for parking lots. The idea of completely driverless cars that pick us up when beckoned may be a bit beyond our grasp right now.

**Interest in Self-Driving Vehicles**

The most direct evidence that consumers have an appetite for driverless cars comes from asking them specifically about test driving or owning a driverless car. In CTA’s research, 70 percent of drivers expressed interest in test driving a driverless car. And more than 60 percent expressed interest in replacing their cars or trucks with a driverless vehicle. Consumers are willing to adopt driverless features, provided they are asked about the technology in a neutral way – though that acceptance declines with age. That’s surprising – and ironic – given that seniors will benefit greatly from driverless cars, enjoying newfound freedom and independence when they can no longer safely drive.

**But When?**

Until two years ago, forecasts for the introduction and adoption of driverless cars varied widely. But in the last two years, statements from manufacturers have coalesced around the widespread availability of fully driverless cars around 2020. In January of 2014, Dr. Dieter Zetsche, chairman of Daimler, predicted that fully driverless vehicles could be on the market by 2025. To be fair, he was referring to the longer term vision of a car that can operate without human intervention and may not have a steering wheel. We know that more conventional driverless cars will be on the road before then.

Nissan has been consistently bullish on driverless cars. In January 2013 Nissan CEO Carlos Ghosn said he expects driverless cars to be available by 2020. Later that year, Nissan reinforced its commitment with specifics, saying it would be ready with multiple commercially-viable autonomous drive vehicles by 2020. Nissan also announced it was working with leading universities and was participating in an autonomous driving proving ground in Japan.

Earlier this year, GM executive Richard Holman confirmed the accelerated timetable for driverless cars, while noting the influence of Silicon Valley in the process. GM is investing to make sure it stays competitive in the fast changing world of mobility, putting $500 million into ride-hailing service Lyft and purchasing Cruise Automation for $1 billion.

Ford’s product development Chief, Raj Nair, said he expects, “SAE Level 4” automation to hit the market by 2020. SAE Level 4 is just one step short of fully autonomous driving under all conditions that can be managed by a human driver. Level 4 anticipates that the car must continue to drive itself in the event the human driver does not respond to a request to intervene. And this summer, Ford made an especially bold announcement – CEO Mark Fields said the company will deploy a fleet of driverless vehicles by 2021.

Audi is also widely recognized as a leader in self-driving vehicles, or “piloted driving” to use the company’s term. Audi showed its e-tron Quattro concept car at CES 2016 and has been demonstrating a piloted A7, nicknamed Jack, for almost two years. Audi has not provided a firm date for when it will ship cars with Jack’s level of autonomy, but it has continued to promote and invest in the technology. Significantly, Audi, BMW Group and Daimler AG partnered last year to buy Nokia’s digital mapping business, a crucial technology for the introduction of driverless cars.

“Ford will be mass-producing vehicles with full autonomy within five years. And that means there will be no steering wheel, no gas pedals and no brake pedals. A driver is not going to be required,” announced Ford’s President and CEO Mark Fields on August 16, 2016. It was a definitive statement of Ford’s timetable and target market. The release went on to say Ford intends to have

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**Interest in Replacing Current Vehicles with a Driverless Vehicle**

<table>
<thead>
<tr>
<th>Very Interested</th>
<th>Moderately Interested</th>
<th>Slightly Interested</th>
<th>Not at all Interested</th>
</tr>
</thead>
<tbody>
<tr>
<td>34%</td>
<td>28%</td>
<td>17%</td>
<td>21%</td>
</tr>
</tbody>
</table>

Source: CTA Market Research

**Interest in a Driverless Test Ride**

<table>
<thead>
<tr>
<th>Very Interested</th>
<th>Moderately Interested</th>
<th>Slightly Interested</th>
<th>Not at all Interested</th>
</tr>
</thead>
<tbody>
<tr>
<td>44%</td>
<td>26%</td>
<td>16%</td>
<td>14%</td>
</tr>
</tbody>
</table>

Source: CTA Market Research
“a high-volume, fully autonomous SAE level 4-capable vehicle in commercial operation in 2021 in a ride-hailing or ridesharing service.”

This level of automation is just one step short of fully autonomous driving under all environment and road conditions that can be managed by a human driver. Level 4 anticipates that the car must continue to drive itself, in the event the human driver does not respond to a request to intervene. In effect, Ford is getting to autonomy faster by targeting a controlled market and application.

Do I Have to Draw You a Map?

Another telling part of Ford’s announcement is the reference to investments and collaborations with leading companies that provide advanced vision and machine learning algorithms, 3D mapping, LiDAR, and radar and camera sensors. It is now clear that cars will drive themselves without the assistance of special infrastructure or roads.

Back in 2004, the prognosis for self-driving was not so bright. Every team failed the DARPA Grand Challenge requiring automated vehicles to navigate a course in the Mojave Desert. In fact, no vehicle completed more than five percent of the course. To be fair, terrain was the biggest killer. However, just three years later, six teams completed the 2007 DARPA Urban Challenge requiring autonomous vehicles to drive in traffic, merge, park, pass and negotiate intersections with manned and unmanned vehicles.

Starting with GM’s Futurama exhibit at the 1939 World’s Fair through RCA demonstrations in the 1950s, the vision of driverless cars involved automating both the road and the car. Cars were either in partitioned lanes or followed embedded wires. Through the progress of Moore’s Law, companies like Mobileye changed that thinking with the introduction of machine vision systems that could reliably interpret all the visual clutter streaming past while we are driving.

Now the path is obvious. Driverless cars will happen initially through advanced sensors like LiDAR and cameras with machine vision, incredible data fusion and machine learning, and highly accurate 3D maps. Cars will be able to do the things humans do well today, for example figuring out whether it is safe to turn or spotting pedestrians, without getting distracted. Our brains are amazing things when they stay on task, but according to the National Highway Transportation Administration’s National Motor Vehicle Crash Causation Survey (NMVCCS), we don’t stay on task very well. In cases where researchers could attribute a reason for a crash to a driver, 41 percent were “recognition errors,” such as inattention, internal or external distraction or inadequately looking for traffic.

Besides staying focused, driverless cars will have another huge advantage over people. They will include maps with incredible detail — centimeter accuracy rather than the tens of meters we use today. Cars will know the curvature and hilliness of roads. There will not be any blind intersections. And connectivity to the cloud will add dynamic information about traffic, potholes and lane closures. The importance of high-resolution 3D maps is underscored by Ford’s recent investment in California startup Civil Maps, German car companies’ purchase of Nokia’s mapping business called Here, and of course, Google’s long term commitment to mapping.

In time, driverless cars will augment their sensors and not-quite-real-time maps with local, instantaneous vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications. According to the NVMCCS report, the single most prevalent pre-crash event is turning or crossing at intersections. With V2I, the intersection itself could warn cars and prevent collisions. Cars will communicate with each other at intersections and relay information, like sudden braking, to cars behind them.

Sharing the Road

“The reason Uber could be expensive is because you’re not just paying for the car — you’re paying for the other dude in the car,” Uber CEO Travis Kalanick said at the Code Conference in 2014. The statement seemed bold at the time. Was he indicating that Uber will replace its drivers with driverless cars? In reality, it was just a frank assessment that the service that people desire is to get from point A to point B. Kalanick’s point was that by removing the cost of the driver, it becomes cheaper to take Uber than to own a car. Car ownership can go away.

The synergy between ridesharing and autonomous vehicles identified by Kalanick was proven when GM announced its $500 million investment in ride-hailing company Lyft in January. The companies characterized the move as an alliance in which they will work together to develop a network of driverless cars. The floodgates opened. In May Volkswagen announced a $300 million investment in Gett, a taxi-hailing startup from Israel operating in many European cities. That same day, Toyota announced an investment in Uber combined with a partnership to lease vehicles to Uber drivers. And just two weeks prior, Apple announced a $1 billion investment in Didi Chuxing, the best-known ride-hailing service in China.

Traditional car companies and a host of startups and technology icons are partnering to bring about a new future in low-cost mobility.

“Ford will be mass-producing vehicles with full autonomy within five years. And that means there will be no steering wheel, no gas pedals and no brake pedals.”

-Mark Fields, Ford president and CEO
Delivering the Goods

Certainly as our own transportation will change dramatically, the movement and delivery of goods will change in the near future. Some of the underlying factors will be the same. There will be driverless long haul trucks just like there will be driverless cars. Companies are already experimenting with sharing economy approaches to package delivery. And online purchasing is altering both the retail landscape and the package delivery business.

Amazon put a spotlight on last-mile package delivery when it said that it planned to deliver packages by drone. That comment by Jeff Bezos on 60 Minutes reflected a strategic imperative for what was rapidly becoming a tactical need. Amazon Prime, with its two-day delivery model, and Prime Now with two-hour delivery (or one hour for a fee), has fed consumers’ desire for instant gratification. It is not surprising that Amazon now has more than 100 fulfillment centers and is experimenting with many ways to deliver packages.

Package delivery is an expensive proposition. Delivery fees cost Amazon more than $4 per package by some estimates. Amazon’s net shipping cost (gross shipping cost minus shipping revenue) exceeded $5 billion last year. Reducing delivery costs contributes directly to Amazon’s financial health, which explains recent investments in its own truck trailers and leased planes. Amazon is even experimenting with crowd-sourced, or gig-economy, package delivery through its Amazon Flex program, an Uber-like app in which drivers sign up to deliver Prime Now packages from mini-warehouses to customers.

Despite all this, Amazon is not looking to replace third-party shippers, like UPS, FedEx and the U.S. Postal Service (USPS). These companies provide the vast majority of package delivery and will continue to do so. While it is fun to write about the instant gratification of orange juice delivered in less than an hour, businesses and consumers rely on low-cost, reliable package delivery.

UPS has invested heavily in this area through its Orion software. UPS drivers make an average of 120 stops per day. Orion figures out the best route in terms of cost, while considering special delivery times, private roads and a host of other factors. According to estimates, UPS can save $50 million per year just by reducing the average daily travel of its drivers by one mile. Orion provides those savings to stay competitive in low-margin consumer deliveries while maintaining the backbone of business delivery.

Before that list mile delivery, goods often travel by large trucks on long highway trips. Will these packages be riding in driverless trucks? What about job prospects for those drivers? Although much of the commentary about automated trucks predicts dire outcomes for truck drivers, the reality is that life may get better for drivers as a result of automation. Turnover in the trucking industry is notoriously high – 100 percent by some accounts. The introduction of driverless features will improve safety and allow drivers to be more productive during stretches of highway motoring.

Is package delivery by drone a gimmick? No, it will happen.

The introduction of driverless trucks will not be as disruptively fast as with personal cars. Last year Freightliner was given a license to test drive its autonomous tractor trailer rig in Nevada. Meanwhile, the Google Self-Driving Car has driven 1.5 million miles, learning every minute of the way. The economics and physics of large trucks make it hard to introduce driverless features quickly. Trucks are expensive, have much lower sales volume and are professionally driven, which creates a different set of incentives from passenger cars. Truck designers also have to factor in longer stopping distances, slower acceleration and less maneuverability. As a result, IHS predicts that by 2035 driverless trucks will account for 15 percent of heavy duty truck sales, a much slower pace than current predictions for cars.

Is package delivery by drone a gimmick? No, it will happen. That is, assuming the Federal Aviation Administration gets regulations in place and integrates commercial drones into the airspace. Consider that in 2014 USPS delivered around four billion packages, the average weight of which was 1.6 pounds. Even if only one percent of these were viable for drone delivery due to business, weather and other reasons, there will be 40 million drone deliveries per year. And that is just for USPS.

Drones for Human Travel

CES 2016 showcased innovative ideas on drones for human travel. EHang 184, known as the “passenger drone” developed by Chinese UAV company, is about 4.5 feet tall, 440 pounds and can carry a single passenger for 23 minutes at a speed of 60 mph. All the passenger has to do is input a destination, sit back and let the drone do the rest. Even though there is still a lot of work to be done, an automated commercial drone may soon be in our future.

Where many get the drone package delivery picture wrong is in conjuring up images of drones flying around New York City. Dense urban areas, despite the traffic, have a robust infrastructure for getting packages to businesses and into multi-dwelling units. Drone delivery will emerge first in the mid-density suburban areas where demand is high and distances put pressure on the cost of delivery by car or truck.

Electric Slide

Back in 2008, President Obama set a goal of getting one million electric vehicles (EVs) on the road by 2015. One year after the deadline, only 400,000 plug-in EVs have been sold. Worse, sales of EVs actually fell six percent in 2015 compared to 2014. What seemed like a reasonable goal when gas was around $4 per gallon has proven to be unattainable with gas in the $2 range. Despite billions of dollars in federal and state subsidies, consumers have been slow to adopt EVs.
Unlike driverless cars, EVs have not benefited much from Moore’s Law and cannot avoid the “infrastructure problem” associated with charging stations. Batteries, electric motors and control systems have gotten much better, but not twice as good every 18 months as we see with semiconductors. Tesla is the only car company that has broken the 200 mile range for an all-electric vehicle. As one GM executive said, “Today’s drivers of 100 mile electric cars always need to look for the next charge.”

To the extent range anxiety has been conquered, it is through plug-in hybrids that have both an electric motor and a gas engine to provide conventional driving distances. Manufacturers can use bigger batteries and a small gas engine to augment range or a conventional gas engine and small electric motor to improve city mileage. The Chevy Volt has an electric range of 53 miles but a total range of 420 miles. Clean vehicle advocates initially bashed Chevy for the robust gasoline capability, but subsequent reports indicate that the average Volt travels nearly as much in all-electric mode as the EV-only Nissan Leaf.

Due to zero emissions targets, subsidies and prestige, car companies will continue to improve EVs and introduce new models. There is one other factor that may significantly improve the market for EVs, and that is the nexus with ridesharing services, and ultimately, self-driving capability. As part of their new partnership, GM and Lyft established a short-term rental program for Lyft drivers, and Lyft drivers will be among the first to get access to GM’s all-electric Chevy Bolt.

Ford’s August announcement of mass produced autonomous vehicles proved the synergy between ridesharing and autonomy. Some of that synergy spills over to electric vehicles. The cars are sold to a business intermediary with enough scale to manage a robust charging infrastructure, especially in urban areas with the largest customer base. It is easy to see a large ride-sharing company establishing fast charging stations in select locations and using their cloud services to scheduling charging.

Here’s to a cleaner, safer future as the future of transportation unfolds.

Driverless Advances at CES

The driverless car is now a reality. Here are some of the advances that were announced in driverless technology at CES 2016.

- BMW’s i3 smartwatch controlled, self-parking feature.
- GM’s Mary Barra announced a strategic alliance with Lyft to create a network of on-demand driverless vehicles, with a goal to have 12 million connected vehicles on the road this year.
- Volkswagen introduced its BUDD-e concept, which features gesture recognition, zero-emissions, and self-driving technologies.
- Kia announced its Drive Wise technology in its Soul EV, which include a human machine interface, V2X (vehicle to everything) systems and autonomous driving systems.

At CES 2017, you’ll see innovation in automotive technology:
- Communications Infrastructure
- Internet Services
- Vehicle Technology
- Wireless Devices & Services
MEDICAL TECH AT A CROSSROADS

By Mark Chisholm

The intersection of the medical and technology sectors is nothing new, with electrocardiograms, pacemakers and other technologies shaping the medical industry and far predating the fitness trackers, smartwatches and health and fitness apps of today. Though current, consumer-facing devices have been available on the market for years, we are approaching a crossroad, where in the years to come consumers are poised to wrest even more control over their health and personal information from the traditional gatekeepers.

More distant on the horizon, the emergence of biometrics, bioprinting and embedded or implanted technology promise to revolutionize the medical and consumer technology industries. Meanwhile, health tracking, remote monitoring and other technologies – facilitated by connectivity and the ubiquitous nature of today’s sensors – threaten to upset traditional healthcare models.

Awareness and Perception

Consumer awareness of health and fitness devices varies, with consumers eager to adopt fitness trackers and smartwatches, while adoption of such technologies as health monitoring devices and biometrics is lagging behind.

To compare consumer acceptance of fitness devices to their health monitoring counterparts, looking at consumer adoption of the former is a good start. Fitness activity bands will account for the bulk of shipments of tech wearables through the rest of the decade, according to CTA’s U.S. Consumer Technology Sales and Forecasts 2012-2017, reaching nearly 28.1 million units shipped to dealers this year. More, CTA found that 74 percent of online American adults are likely to buy some kind of health and fitness technology product this year.

On the other wrist, a recent CTA survey found that while consumers are willing to share fitness data, they are less willing to share personal health data, with the exception of sharing such data with a primary care physician, where respondents feel more comfortable. Barriers still remain, however. In a survey conducted in August for Five Technology Trends to Watch, CTA found that just 33 percent of respondents said they would own or use a health monitoring device because “It’s an easy way to help keep track of your health and provide information for your doctor.” This was the number one reason respondents indicated they would make use of such a device, with survey responses such as “To monitor health and/or track a medical condition” (26 percent), “Accessibility and connectivity to medical professionals in the event of an emergency” (15 percent), and “To save money that would otherwise be spent on traditional health care, such as hiring a caretaker or nurse” (11 percent) trailing behind.

Such responses related to health monitoring and medical-oriented devices indicate a hesitance to adopt or use these technologies – 74 percent of respondents indicated they do not use a health monitoring device to observe their own health. The reason behind this may be two-fold, centered around privacy and perceived benefits.

The Privacy Question

As consumers continue to adopt health and fitness devices that collect myriad data – from steps taken, to user location, to heart rate and various other health information – it’s necessary to be cognizant of the risks. Few would disagree that this new age has presented us with the reality of compromised privacy. In 2015 alone, federal records show that more than 100 million health records were compromised. A staggering 78.8 million of those records were “lost” when Anthem Inc. was attacked in February 2015. While such data was not collected via fitness or health
Recognizing how important the disclosure of data collection practices is, and how important it will become in the future, in late 2015 CTA released the Guiding Principles on the Privacy and Security of Personal Wellness Data, a set of voluntary guidelines for private sector organizations that handle personal wellness data. CTA’s Health and Fitness Technology Division – made up of companies including Fitbit, Google, Humetrax, Jawbone, MC10, Misfit, Under Armour and Qualcomm – is responsible for the development of these principles. The Guiding Principles recommend that, among other precautions, companies:

- Provide robust security measures;
- Provide clear, concise and transparent information on the use of data collection, storing and sharing, especially when transferring data to unaffiliated third parties;
- Allow consumers the ability to control and review their personal wellness data;
- Offer users the ability to opt out of advertising; and
- Disclose their protocol for law enforcement requests.

“The industry itself created and approved these Guiding Principles, recognizing that we need to evolve with common purpose to build and maintain consumers’ trust,” said Gary Shapiro, president and CEO, CTA.

The consequences of such security breaches exist for patients and companies alike. In mid-August, the Federal Trade Commission ruled on a 20-year privacy practice order with electronic health record vendor Practice Fusion, after the company was found to have solicited reviews from patients and companies alike. In mid-August, the Federal Trade Commission ruled on a 20-year privacy practice order with electronic health record vendor Practice Fusion, after the company was found to have solicited reviews from patients posting them online without concealing personal identification information.

“Companies that collect personal health information must be clear about how they will use it – especially before posting such information publicly on the internet,” Jessica Rich, director of the FTC’s Bureau of Consumer Protection, said in a statement.

As our devices become a bigger and bigger part of our lives, monitoring our health and activities (sometimes from underneath our skin), both consumers and vendors alike will need to pay close attention to the possibilities that are inherent to such connectivity and data collection living side by side. If consumers are to adopt such technologies, they will need to feel confident that their personal information is secure.

The Benefits of Accessibility

In addition to helping create the Guiding Principles, the Health and Fitness Technology Division has worked with the CTA Foundation and CTA’s market research department to produce a number of recent studies on health and fitness devices, as well as active monitoring devices, including CTA’s Active Aging Study, released in March.

The U.S. Census Bureau projects that by 2050 the U.S. population aged 65 and over will double to nearly 84 million. As active technology becomes more sophisticated and adoption increases, cost benefits are expected to emerge not only for the aging demographic – such as those provided by “aging at home” – but also for the healthcare industry, through the convenience such technologies provide.

In the Active Aging Study, CTA attempts to define and differentiate the varying health and fitness technology used by consumers, and such technologies find their way into everything from smart home devices, fitness trackers and mobile apps. Such health-focused devices can address needs including declining eyesight, declining hearing, weight loss and remote monitoring.

Despite the benefits provided by health monitoring devices, CTA’s recent Five Techs survey found that in most cases, seniors were less likely to use such a device compared to younger demographics. In only one case scenario – “Accessibility and connectivity to medical professionals in the event of an emergency” – did respondents aged 55 and older lead other age groups.

### DIVISIONS OF HEALTH AND WELLNESS

<table>
<thead>
<tr>
<th>Products, applications and services that...</th>
<th>Safety and Smart Living</th>
<th>Health and Remote Care</th>
<th>Wellness and Fitness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety monitoring</td>
<td>Prevent seniors from home hazards and getting lost</td>
<td>Personal health devices</td>
<td>Track health vital signs and manage conditions on their own</td>
</tr>
<tr>
<td>Emergency response</td>
<td>Alert family and service providers when emergency occurs</td>
<td>Remote diagnosis &amp; monitoring</td>
<td>Diagnose/manage patient conditions virtually by care workers</td>
</tr>
<tr>
<td>Smart living</td>
<td>Improve living comfort through smart sensors &amp; home controls</td>
<td>Virtual consultation</td>
<td>Connect with an online doctor for non-acute health issues</td>
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<tr>
<td>Home living support</td>
<td>Address home chores and inconvenience with ease</td>
<td>Fitness tracking devices</td>
<td>Track/measure fitness progress against goals</td>
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<tr>
<td></td>
<td></td>
<td>Diet/weight loss tools</td>
<td>Track/measure diet and weight for self improvement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wellness monitoring devices &amp; apps</td>
<td>Address other wellness needs such as brain health, stress, etc.</td>
</tr>
</tbody>
</table>

Source: CTA, Parks Associates, Active Aging Study
Given the willingness of younger age groups to embrace new technologies, this may not be a complete surprise, but the results suggest there may be an opportunity for consumer outreach to demonstrate the benefits of these technologies. According to CTA's Active Aging Study, “Although seniors’ unfamiliarity with technology sometimes leads them to an illusion about price-feature trade-offs, many vendors also make the mistake of focusing too much on being ‘feature-rich’ and unilaterally believe that seniors can be convinced of paying more for ‘feature-rich’ products.”

Therefore, education may be needed on both sides of the fence. The CTA Foundation, launched in 2012 with a mission to link seniors and people with disabilities with technology to enhance their lives, also works to connect industry, consumers, government, advocacy groups and other key stakeholders to make sure everyone is on the same page.

### Biometrics and Bioprinting

A number of other health-focused technologies, whether currently being built into devices such as smartphones or looming on the horizon, promise to mold the healthcare industry of tomorrow.

One area that is already here is biometrics, though many consumers may not yet take advantage of these technologies despite how widespread they have become. Biometrics refers to technologies that measure and analyze unique human body identifiers, such as DNA, fingerprints, eye retinas/ irises, voice patterns, facial patterns and hand measurements.

Features such as the fingerprint scanners used to unlock smartphones or automatic image tagging on Facebook made possible through facial recognition are all based on biometrics, but CTA found in a recent study that less than half of U.S. adults have adopted or used some type of biometric technology. The good news in Biometric Technologies: Understanding Consumer Sentiments, CTA found that while less than half of U.S. adults (43 percent) have used them, a larger portion is aware of, and comfortable with biometric technologies.

According to the study, consumers are most familiar with DNA testing, likely due to science disciplines and the criminal justice system, not to mention crime dramas, with three quarters of respondents indicating awareness. Unsurprisingly, the most commonly used type of biometric technology among respondents was digital fingerprinting, with 29 percent of respondents claiming to have used such a technology in the past.

While the study focused on consumer comfort levels with biometrics across a number of use cases including security screening, surveillance, personal convenience, personal transactions and commercial uses, it’s encouraging that CTA found that respondents were most comfortable with biometric technologies being used in medical situations, with 63 percent of respondents indicating they were either “comfortable” or “very comfortable” with biometric technologies being used in such a scenario.

The benefits of biometrics in medical scenarios are numerous, and respondent comfort levels varied by use case. Respondents were most comfortable using assistive technologies, with 70 percent of those surveyed comfortable with using biometrics.
to help people who are blind or have low vision identify other people through voice or facial recognitions technologies. Sixty five percent are comfortable using assistive technologies to help people with Alzheimer’s identify others. When using biometrics for health assessment, comfort levels fell slightly, with 63 percent comfortable using them to self-assess their health, and 57 percent comfortable allowing medical doctors to assess their health.

Interestingly, while respondents indicated that they were more comfortable using biometric technologies to self-assess their health versus allowing a medical doctor to do so, when examining the level of trust in managing biometric information, the opposite is true. Respondents indicated they were most comfortable with healthcare organizations managing biometric information (67 percent), followed by insurance providers (38 percent), smartphone manufacturers (26 percent) and cloud storage services (23 percent). Biometrics holds the potential to shake up the healthcare industry, while presenting challenges related to the collection and storage of consumers’ personal information.

One technology on the horizon that does not immediately raise privacy concerns is bioprinting, or using additive manufacturing – better known as 3D printing – to manufacture tissue and organs. In the 2013 edition of Five Technology Trends to Watch, the medical applications of 3D printing were discussed, from available applications such as 3D-printed prosthetics to possible future applications such as 3D-printed organs. In the years since, 3D printing has become more commonplace (though perhaps not as consumer-focused as once predicted), and with it, bioprinting has emerged as a more viable (and less hypothetical) option for the medical community.

A number of universities made bioprinting breakthroughs in 2016, ranging from bioprinted blood cells to ears and cartilage. At Wake Forest University, for example, researchers were able to bioprint ear structures, as well as bone and muscles. These structures were implanted in animals and the implants survived, eventually becoming functional tissue. The findings were detailed in Nature Biotechnology. Meanwhile at Pennsylvania State University, researchers broke fat tissue down into stem cells in an attempt to manufacture cartilage.

Bioprinting is easily years off, and no bioprinting trials have been approved by the FDA for use in humans, but such university research may provide a glimpse into the future of medicine.

**Business to Business Implications**

By empowering the user as well as disrupting traditional channels, many believe that advances in health and medical technology will create major business to business opportunities in the coming years.

An upcoming CTA study being conducted by CTA’s market research department and the Health and Fitness Technology Division will focus on the implications of health and fitness tech in the medical community, primarily among physicians, providers and insurance entities. Areas examined will include potential rewards on the consumer side for sharing health information and incentives on the provider or pharmaceutical level, and whether these align.

As large-scale carriers attempt to consolidate (and in many cases are rebuked, such as the DOJ’s rejection of the proposed Anthem-Cigna bid and Aetna’s rejected Humana merger), so-called “narrow channels” are putting pressure on carriers’
Margins. As the healthcare landscape shifts from factors including but not limited to health and fitness devices and the Affordable Care Act, shifts in business models will be an area to watch.

With an eye on the potential business impact of health and fitness devices, in July Fitbit created the Fitbit Group Health business unit, to oversee four services: corporate wellness, weight management, insurance and health research. Then, in early August the company hired Adam Pellegrini, former vice president of digital health at Walgreens, as Fitbit’s new vice president of digital health, further solidifying the relationship to the healthcare and pharma industries.

Companies across the health and wellness industry are looking forward like Fitbit. The health care industry stands at a crossroads, with ubiquitous connectivity and the spread of embedded sensors promising to shake up everything from wearables to the traditional visit to the doctor’s office. Enabling trends like self-reporting and biometrics, along with emerging technologies like bioprinting, show a vision of a new, connected health channel of tomorrow.

### Percent of Consumers Who Have Used Biometric Technology

- **None**, 57%
- **Any**, 43%

### Biometric Technologies Used

<table>
<thead>
<tr>
<th>Biometric Technology</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital fingerprinting</td>
<td>29%</td>
</tr>
<tr>
<td>Voice recognition</td>
<td>13%</td>
</tr>
<tr>
<td>DNA</td>
<td>11%</td>
</tr>
<tr>
<td>Facial recognition</td>
<td>9%</td>
</tr>
<tr>
<td>Eye retina/iris recognition</td>
<td>4%</td>
</tr>
<tr>
<td>Hand measurements</td>
<td>3%</td>
</tr>
<tr>
<td>Ear biometrics</td>
<td>1%</td>
</tr>
</tbody>
</table>

Source: CTA Market Research

At CES 2017, find the most recent health advances in:

- Fitness and Sports
- Health and Biotech
- Lifestyle Tech
- Personal Privacy and Cyber Security
- Sensors
- Smart Home
- Wearables
- Wireless Devices & Services

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PSAPs

In June, the Committee on Accessible and Affordable Hearing Health Care for Adults for the National Academies of Sciences, Engineering and Medicine recommended that the Food and Drug Administration (FDA) establish a new category of over-the-counter wearable hearing devices. Separate from traditional hearing aids, non-prescription personal sound amplification products (PSAPs) can offer an affordable solution to the 98 million Americans experiencing some level of hearing loss. While both hearing aids and non-prescription devices can improve hearing, a pair of hearing aids can range in price from $1,000 to $6,000. Non-prescription devices are one-tenth that cost, ranging from $100 to $600.

According to CTA’s Personal Sound Amplification Products: A Study of Consumer Attitudes and Behavior, price is a major barrier to individuals seeking help for a hearing deficiency. CTA is encouraged by the committee’s recognition that a new market for hearing aids is warranted. CTA also filed comments responding to the Federal Trade Commission’s reopened docket on PSAPs, explaining that FDA should permit PSAP manufacturers to market their products for many kinds of use cases.

CTA Foundation 2016 Grant Update

The Consumer Technology Association Foundation was founded in 2012 to improve the lives of the growing yet underserved communities of older adults and people with disabilities. The 2016 grants build on the successful programs designed to highlight how technologies can enable healthier, longer, more independent lives for people across the U.S.

Benetech – benetech.org
BridgingApps – bridgingapps.org
Jewish Council for the Aging of Greater Washington – va-seniortech.org
Lighthouse Guild – lighthouseguild.org
Meritan – meritan.org
Oasis Institute – oasisnet.org
Older Adults Technology Services (OATS) – oats.org
San Diego Futures Foundation – sdfutures.org
Selfhelp Community Services – vscm.selfhelp.net
American Foundation for the Blind – afb.org

To learn more about the CTA Foundation visit CTAFoundation.tech.

Tricorder X

In the Star Trek movies, a tricorder is a multifunction handheld device that is used for sensor scanning, data analysis, and recording data. Qualcomm’s Tricorder X PRIZE contest, first launched at CES 2012, offers a $10 million grand prize to a company that can create a portable, wireless non-invasive health diagnostic device. The mobile device must be able to diagnose and interpret a set of 15 medical conditions as well as capture five vital health metrics. The final teams will compete in late 2016 with the winners announced in early 2017.

- Aezon
- CloudDX
- Danvantri
- DMI
- Dynamical Biomarkers Group
- Final Frontier Medical Devices
- Scanadu/Intelese

For more information, visit tricorder.xprize.org.

Transient Electronics

For years, DARPA has been working on developing “transient electronics”, or electronics that dissolve after a specific amount of time. In addition to being environmentally friendly by adding no hazardous materials to the waste stream, transient electronics are well suited to be used as implants in the human body as a diagnostic tool, to aid in healing and preventing infections, assisting with pain mitigation through nerve stimulation, or countless other applications, all without the need for removal surgery.

“If you make silicon thin enough, it becomes degradable,” Dr. Marvin Slepian, cardiologist and professor of medicine at the University of Arizona, told It Is Innovation (i3) magazine. “Once the medical need for them has passed, biodegradable devices will disappear, without the permanent burden for the body.”
The sporting world is rapidly changing, following the technology landscape while taking athlete training, performance, safety and recovery into consideration. Not only is this having a positive effect on athletes, this is also improving the viewing experience for spectators watching the game live or at home. What athletes and spectators are experiencing now is only a taste of what’s to come in the future.

The definition of athlete may confuse some, but in this context an athlete is any person who plays a sport. This can be recreationally or professionally, in grade school or college, for a work league or just with friends. Thankfully, the technologies being used to monitor athlete performance are not only reserved for the professionals. Today, we are seeing the first signs of what is to come in the world of sport technology.

At the basic level, there are wearable devices that monitor sleep, steps, heart rate and more. What isn’t provided is an in-depth analysis on the specific activity being performed, which is where integrated technology comes in. Integrated technology in sports can be an assortment of equipment, hardware, software and connectivity options.

According to a 2016 CTA survey, 91 percent of respondents believe that there is some sort of benefit to integrated sports technology. The survey also showed that 48 percent of the respondents thought that integrated technology would benefit professional athletes the most, while 35 percent thought it would benefit those who play in recreational leagues, or participate in physical activity at least once a week.

Training Technology

With the Rio Olympics just wrapped up, a slew of records were broken, inspiring performances and athletes at the top of their game. According to Denver Post’s John Meyer, the United States Olympic Training Center in Colorado Springs used some of this cutting-edge technology to train Olympians for the games. Meyer described how the training center could simulate altitudes up to 24,000 feet. In addition, the training facility included underwater cameras to analyze swimmers, technology to count the number and power of boxers’ punches, a “Noraxon instrumented treadmill” to collect data from runners and many more to improve performance.

Much of this technology is straightforward and many recreational athletes have used something similar to help improve their own performance. For example, many have visited a sports store to have foot-strides recorded to choose the right running shoe. Others have gone to the driving range and recorded a golf swing in slow-motion in order to play it back later to analyze and improve performance. These types of training technologies have opened the door for much more.

The USA volleyball team uses a product called VERT to aid in training. VERT is the most advanced wearable jump technology that allows users to see real-time analytics, manage jump load and prevent injuries. The monitor worn near the waist of the user counts jumps, measures vertical height and records jump rate. What sets VERT apart is its durability and “coaching” capability. This monitor can be worn in-game or at practice. It also comes with an app called “VERTcoach” that sends real-time updates to the app-user (in this case the trainer), allowing the coach to manage the workload and monitor the performance of his or her players as it is happening.

Similar to VERT, SwingSmart is changing the way golf is played. Instead of recording multiple golf swings, SwingSmart attaches to the underside of the shaft of any golf club. All the user needs to do is play golf. The complete swing motion is analyzed instantly and is sent to the accompanying app immediately, providing the user with stats including tempo, swing speed, face angle, club path, shaft lean, angle of attack, and a 3D view of the path and plane of the golf swing. Again, the SwingSmart shows how integrated technology is being used to improve performance, but more importantly it shows another example of how real-time/in-game performances are being tracked instead of practice performances.

The adidas miCoach Smart Ball is another product that is helping shape the future of integrated technology. Its integrated sensor detects speed, spin, strike and flight path, which is relayed to the miCoach app on the user’s phone. The ball is regulation weight and offers challenges to the user while also tracking progress.

Cisco’s “Connected Athlete” demonstration allows people, processes and data to work together and interact with Wireless Body Area Networks (WBAN) and Medical Body Area Networks (MBAN) to monitor an athlete’s biometric performance, including heart and respiratory rates, blood oxygen and carbon dioxide levels, glucose and lactate concentrations in the blood, and use this data to accurately
assess the athlete's in-position physical condition and energy expenditure.

Real-time tracking provides a better sense of what needs to be worked on when compared to practice. There are certain factors that only arise in game situations that a lot of athletes can’t simulate in practice. According to Cisco, the Internet of Everything uses data from these analytics in multiple ways. The players wear small sensors during games to measure the intensity of their activity. The sensors transmit data wirelessly back to the analytics system. The sports science team records information on every event involving a player including collisions, leaps, kicks and sprints. The team can then anticipate when players will become fatigued, which is a good indication of potential injury risk.

Stadium Technology

Professional athletes are not the only ones benefiting from the advancement of integrated technology. Fans attending the game are beginning to notice a change in the stadium experience.

Setting the standard for all new stadiums is Levi’s Stadium in Santa Clara, CA, home of the San Francisco 49ers. It comes with all the bells and whistles that a sports fan could ask for while enjoying a sporting event. With more than 1,000 Wi-Fi access points, every seat is within 10 feet of one, allowing all the fans to check scores, email, fantasy leagues and social media accounts.

Levi’s Stadium also introduced its own app to enable people to order food right from their seat. In addition, the app helps locate the nearest restroom without a line. This gives fans the maximum amount of time to actually enjoy the game instead of waiting in food or restroom lines. Other features at the stadium include Bluetooth beacons to help guide fans to their seats, more than 2,000 Sony TVs inside the venue and 200 phone charging stations.

Also located in California, the Golden 1 Center will house the Sacramento Kings and is set to be totally functional by October 4, 2016. Taking notes from Levi’s Stadium, the Golden 1 Center is running 650 miles of fiber-optic cable, more than 300 miles of copper throughout the arena, hundreds of Wi-Fi access points around the building and a 6,000-square-foot data center in the stadium. The stadium’s app allows fans to buy tickets and parking passes. Other cool features of the app include the capability to inform fans of the easiest lot to park in as they approach the stadium, being smartwatch friendly and providing replays and stats for latecomers. According to an interview with WIRED, Kings CTO Ryan Montoya is fine if people would rather just watch the game instead of take advantage of the technology. Montoya just wants to provide the capability to connect to the internet and interact with the stadium. “That’s our philosophy,” Montoya said in the interview. “The fans would only be limited by their own devices.”

The same WIRED article, by David Pierce, explained that almost every object in the stadium was connected to each other. “Around Golden 1 Center, nearly every object is connected in some way, feeding streams of data back into the system. From a centralized command center in the bowels of the arena, a group of employees will sit at a bank of 20 or so screens and watch everything that’s happening everywhere,” Pierce said. “They’ll be able to redirect people to shorter concession lines, stream live video to fans’ phones, and run sales on merchandise when t-shirts just aren’t flying off the shelves. Eventually, a sufficiently fast network could even make Golden 1 Center an ideal home for new kinds of events.”

As more stadiums and venues adopt this type of integrated technology, sports fans everywhere are in store for a totally connected and optimized live-viewing experience.

What the Future Holds

The sci-fi future seems to grow closer every day. New products hitting the market will completely change how athletes train, play and recover. For example, MC10’s BioStampRC is one of the most durable, flexible sensors out right now. It is the size of a large bandage and can conform to any part of the body, so the user can put it anywhere he or she likes. It includes access to raw kinematic and electrophysiologic data, six degrees of freedom inertial sensing with 3-axis accelerometer and gyroscope and electric biopotential. This type of technology allows athletes to monitor and improve their performance without a big, bulky sensor getting in the way.

Technology like this will give way to a more seamless textile technology where clothes will have non-intrusive sensors woven into the fabric to monitor performance during play and health at home. At that rate, health and activity can be monitored 24/7, in the least intrusive way possible. Wearables are some of the trendiest, most popular technology products. But think about not having to wear a smartwatch or Fitbit. Instead, the clothes you wear everyday will have built-in sensors that give you the same information, and even more in-depth data. The owner of the Golden State Warriors, Joe Lacob, recently invested in this “smart fitness” clothing with Athos, a fitness apparel maker that uses electromyography technology to track muscle performance in real time.

In a piece written for Quartz, Daniel Cho, CEO of HaloNeuroscience explains how top athletes are looking forward to the next best training technology to help in performance and recovery. Cho analyzes NBA superstar Stephen Curry and his training regimen, some which are a little off-the-wall. “To make it even harder, he uses military-grade goggles with strobing effects that produce blanks in the visual space, requiring him to react based on partial information. The result? He’s cognitively and physically prepared for virtually anything his defender throws at him,” Cho writes. Similarly, Cho says that Arizona Cardinals quarterback Carson Palmer is one of many pro football players to adopt StriVR, a VR company that creates 360-degree training videos shot from a player’s point-of-view.

Cho also explored Nike’s new “smart basketball court” that features both motion-tracking and LED visualization technology built directly into the floor. He also writes about how athletes are using new technology in the recovery process. NBA superstar LeBron James is one of many athletes who uses cryotherapy, a chamber
cooled below -250 degrees Fahrenheit to reduce muscle fatigue. What the future holds for athletes and spectators is exciting. Maybe at the next Summer Olympics in Tokyo we’ll see even more records broken. Who will the next Michael Phelps be? Who will run faster than Usain Bolt? Will Katie Ledecky’s impressive wins be the start of a new trend for athletes everywhere?

Integrated technology is improving athletes’ performance and recovery, making competition more intense and recovery faster. On the other side, with technologies like 4K Ultra HD, spectators may feel like they have the ultimate viewing experience already, but this is just the tip of the iceberg. It will be fascinating to see how integrated technology will advance from here. In the grand scheme of things, the future holds so much potential. Sports and spectating are about to be taken to the next level and we are waiting to experience what is about to come.

Student Athletes

Another aspect of integrated technology is the implementation of it in public schools to monitor performance and, more importantly, increase safety. Whether it is installing sensors in football players’ helmets for concussion safety or monitoring heart rates to make sure an athlete is not being pushed too far, integrated technology is a serious topic of discussion for administrators.

According to a 2016 CTA survey, 77 percent of respondents said they agreed that integrated technology should be required in public schools to monitor safety and reduce injuries, while 53 percent agreed that integrated technology should be used to enhance a student athlete’s performance.

San Diego-based startup InjureFree is getting the ball rolling by introducing an app that informs the local youth sports community with data-supported statistics while providing an out-of-the-box concussion education platform for youth sports administrators. According to sporttechie.com, InjureFree “digitally tracks individual training completion in real-time, easing administrative burden, which means no more printing and filing paper completion certificates. Custom education materials can be uploaded to address any area of concern, such as CPR, first aid, or ACL injury prevention training.”

From the Couch

Fans at the stadium are not the only ones who are noticing an improvement in the viewing experience. Technology has extended beyond stadium walls and given all fans, at the stadium and at home, the ultimate viewing experience.

The rise of league-specific apps has made it easier for users to watch the game from any screen they want. Not to mention that the quality of the viewing experience is now increased to 4K Ultra HD. But the future holds far more for that immersive viewing experience.

According to Alex Hunting of beyond.com, “Movement tracking cameras are creating types of in-game data that have never been at the disposal of coaches and players before.” This is a benefit to not only the coaches and players, but to the television viewers who now have access to almost every angle of the game. Drones have also broken into the scene, giving spectacular views only available through these popular devices.

Sports Tech at CES

Last year at CES 2016, the Sports Business Forum was launched and explored attendee experience, the investment landscape, venues’ use of technology and the future of sports content distribution. In addition, major league executives from many professional leagues attended the show to learn more about opportunities in technology and participate in the forum. The forum and executives’ visits were so successful that at CES 2017 there will be an expanded presence of sports tech. For more information visit CES.tech.
wha.

Yep, the impossible just happened.

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