

The Top 10 Technological Inventions of 2016

When it comes to technology, there is the kind you can buy soon after it's invented. Then, there is the kind that is so breakthrough that it has just recently emerged in research. Rather than only considering gadgets with the latest technology, the ten on this list consider which emerging technologies of 2016 are also providing new opportunities or solving huge problems. Some are already on the market or very close to being there, but some of the most fascinating are the ones still in the hands of researchers and scientists. All of these technologies are changing the way we consider what is possible, and that's pretty impressive.

Ambient Backscatter: Power Harvested from Air

As the world increasingly communicates using mobile devices, the need for access to power sources has increased. Charging laptops and mobile phones has been either challenging or impossible in remote locations, leaving owners of these devices the problem of finding portable solutions for charging. But replacement batteries and recharging solutions are often bulky and expensive. As computing and communication devices are rapidly decreasing in size, the wires that recharge them can seem awkward in comparison to slim and sleek devices. Remote locations simply do not have accessible charging sources.

But University of Washington students Vamsi Talla, Vincent Liu and Aaron Parks, with researchers Shyam Gollakota, David Wetherall, and Joshua R. Smith, have developed a device which allows for wireless communications by leveraging the existing ambient RF signals absorbed from the air. Existing sources of power are enabled by ambient backscatter tags. Tiny ambient backscatter devices require no batteries, last forever, and require zero maintenance. They can be imbedded into concrete walls, floors or roofs. Keys wallets and sunglasses could be imbedded with the ambient backscatter cells. When lost, they could communicate with cellphones to let owners know where their items are located. It is estimated that Ambient Backscatter devices will be available within two to three years.

Jeeva Wireless, the spin-off company which will market the devices, is the recipient of a Phase I SBIR National Science Foundation grant. The company will provide communication solutions using 10,000 times less power than current technologies, allowing Wi-Fi, ZigBee and Bluetooth transmissions using power gleaned by selectively reflecting incoming radio waves which will build new signals.

Interscatter Communication

University of Washington engineers have developed a way to convert Bluetooth signals into WiFi signals so that contact lenses and brain implants can send signals to smartphones. The

initial use for this technology could be providing medical information to patients. Researcher Vikram Iyer stated that a contact lens connected with interscatter communication could use the contact lens wearers' tears to track blood sugar levels, sending notifications to the person's cell phone when the levels dropped. Diabetics could have immediate notice that they needed treatment. Brain implants could be used to transmit data which might be helpful with people regain movement.

Immune Engineering

The controversial aspects of engineering genes by changing its essential genetic instructions is become easier as scientists create new technologies to do so. Scientists have spent decades researching how T cells within the human body can recognize dangerous invaders and then kill them off. When T cells are seen using a microscope, they actually are able to crawl toward other cells, probe them, and then shoot invader cells with toxic granules to kill them. They are animalistic in behavior and autonomous. They are able to converse with and poison other cells, they are able to make more of themselves, and they are to change what happens within their microenvironment.

Synthetic biologists such as Wendell-Lim of Cell Design Labs, are producing the T cells of the future. His T cells are able to target cells which are enemies, and can be programmed so that they only kill when a specific drug is added and only if there are two different markers on an enemy cell. These types of T cells have already been used in trials to provide immune therapy for tumors of the brain, lungs and liver, and so far, some patients were killed during these trials. But tech firms, immune therapy start-ups and the largest drug companies in the world are working with T cells to try to find cures for the major diseases plaguing humans.

There is money to be had as T-cells are rapidly becoming the focal point for cure:

- Boston-based AbVitro sequences DNA inside individual T Cells and Juno buys the company for \$125 million in 2016
- Start-up Seres develops bacteria pills which ward off immune disorders and infection and Nestle pays \$120 million to the company in 2016
- Collectis develops first T cell treatment for leukemia and Pfizer and Servier pay \$40 million for the rights to the product in 2015
- Juno develops a T cell treatment portfolio and biotech firm Celgene pays \$1 billion for a percentage of it in 2015

Electronic Tattoos

Electrical engineer Yael Hanein, professor at Tel Aviv University, Israel, developed a flexible electrode which can be applied like a tattoo. The technology was designed so that persons needing long term recordings of muscle activity could wear the thin electrode without inconvenience. Hanein noted that the researchers were tasked with the key innovation of making very thin electrodes. Their successful result can do anything regular electrodes can do.

New High Efficiency Solar Panels

Buffalo, New York is the site of the new SolarCity factory where the company will be able to produce 10,000 solar panels each day. It will be one of the biggest in the world, and will transform the way solar panels are currently made. Using new technology, the solar panels will be high-efficiency. It is a risky move for the company because China currently produces conventional silicon-based solar panels very cheaply.

But Peter Rive, chief technology officer of SolarCity expects that the new panels will cost less and be so highly efficient that the residential market will embrace their product. In the past, the company has simply installed commercial use panels, but the opening of the Buffalo facility will create a vertically integrated new company, with manufacturing, providing and installing all within the same company.

Residential solar should become more popular as installed costs drop. The key technology making all these changes possible came from Silveo, which SolarCity purchased in 2014. The small company's expertise uses elements of a thin-film cell, a layer of semiconductor oxide, and a standard crystalline-silicon solar cell. This design was originated by Martin Green, a 1970s solar power pioneer from Australia.

Reusable Rockets

The first rocket to return from a space flight came home to a landing pad in November, 2015. Up until this moment, thousands had flown into space, only to fly a few moments and then burn up during free falls down through Earth's atmosphere. The rocket that landed first was Blue Origin, the project of tech billionaire Jeff Bezos. The second, SpaceX, the project of Tesla CEO billionaire Elon Musk, succeeded in December, 2015.

SpaceX company is already in the business of launching space station supply missions and satellites. Blue Origin is planning to take tourists on four-minute rides into space. Though the companies differ in focus, they both share the need for reusable rockets. It is an economic reality that spending many millions of dollars per rocket is not feasible. Both developed onboard software which allows their rockets to use flaps and thrusters which slow their rockets and allow them to be manipulated precisely as they return toward Earth. If both companies can sustain the process of regularly returning rockets safely so that they can be refueled and flown many times, then spaceflight should be much less costly and may become far more accessible to human passengers.

Artificial Intelligence Which Automatically Detects Alzheimer's

Researchers from VU University Medical Center in Amsterdam have applied artificial intelligence algorithms to MRI brain scans, automatically classifying which form of dementia patients have. The results were published in the journal *Radiology* on July 6, 2016. The new system produces accuracy of up to 90 percent. Alle Meije Wink, senior investigator in the radiology and nuclear medicine department at the center said that there is potential for screening people at risk to intercept with treatment before the disease has advanced.

The system specifically distinguishes between two forms of dementia and Alzheimer's which have previously been so similar in terms of declining function that medical professionals have had difficulty knowing which form the patient had. This made treatment dependent upon tracking functional changes rather than being able to prevent structural changes before they begin. Firm conclusions cannot be drawn yet, but researchers believe the early results are encouraging for the future of Alzheimer's diagnosis and treatment.

Tesla Autopilot

Thousands of people around the world die each day from human error car crashes. Because cars are the most common-place mode of transportation in many countries, their ubiquitous presence belies the fact that they can be extremely safe, yet extremely dangerous. Tesla electric car company began placing ultrasonic sensors placed along the sides and bumpers of sedans in October, 2014. At the time, this technology upgrade was made available to their customers for \$4,250 in addition to vehicle's purchase price.

The sensors were paired with digitally controlled brakes, a front radar and a camera, with the entire package designed to let the car take over to avoid crashes. But the packages went unused, yet collecting data. In October, 2015, a software update was sent by Tesla to its 60,000 cars including the sensor technology. The software was given the name Tesla Version 7.0, but its nickname, Autopilot, was the one customers claimed.

Autopilot included automatic parallel parking, which General Motors, BMW and Mercedes already offered. It also gave cars the ability to manage speed, park itself, steer within lanes, and even change lanes. But its ability to provide self-steering put it at the forefront of car transportation. Autonomous driving was a thing of science fiction future, and the future had arrived, at least partially.

The Tesla test fleet of partially autonomous sedans is capable of doing many things on the road, but it cannot start automatically, requires a series of steps to launch, and can shut itself off when road conditions warrant it. The company will add increasing autonomy to the software, using upgrades in cautious increments. However, Elon Musk, Tesla CEO, believes completely autonomous cars are technically possible as soon as two years from now.

CRISPR: Precise Plant Gene Editing

In Sainsbury Lab in Norwich, England, research scientist Sophien Kamoun is using CRISPR technology to fight fungal diseases in crops. Kamoun and his colleagues are fighting against

microbes which evolve and change constantly, which makes the battle a million dollar effort against these pathogens. The CRISPR technology allows for specific gene editing using bits of genetic material from bacteria as target editing, and doesn't necessitate inserting foreign genes into the plants.

This breakthrough technology allows scientist to edit plant genomes at significantly less cost than in the past. The precise editing process leaves no foreign DNA behind. The process is easy and plants produced using this method may be able to avoid the expensive and long regulatory process used for GMOs. Research labs around the world are using this new technology, working to increase agricultural productivity. By 2050, the world's population is projected to reach 10 billion, and the importance of creating reliable yields and quality in food sources such as wheat, rice, barley, potatoes, tomatoes and other crops.

Key laboratory greenhouses already growing plants with precisely edited genes include the John Innes Centre in Norwich, UK; the University of Minnesota, Seoul National University and the Institute of Genetics and Developmental Biology in Beijing.

Companies such as DuPont Pioneer are already investing in the technology. Jennifer Doudna, who is one of the technology's inventors, has created Caribou Biosciences, which is a CRISPR startup. The company is already experimenting with corn, wheat, soybeans and rice and hopes to sell its seeds within five years. The U.S. Department of Agriculture and the European Union are reviewing regulations for GMOs to determine whether or not CRISPR crops should be governed similarly. Though several labs in China have used the technology to try to boost rice yields and in the successful creation of wheat resistant to fungus, Chinese authorities have yet to determine whether or not planting CRISPR crops will be allowed.

Snowfactory

TechnoAlpin, an Italian company, has developing Snowfactory so that ski resorts will be able to extend their seasons into the summer. The technology produces a different kind of manufactured snow which is denser than the kind currently made by conventional snowmakers. This new kind of artificial snow is made in the absence of air, and melts much more slowly than traditional forms of man-made snow. While current forms of artificial snow last up to ten times longer than real snow, Snowfactory can make snow that lasts two to three times longer than even artificial snow. It can survive in 75 to 80 degrees for quite some time. It also has the advantage of having no temperature threshold for making snow, while traditional snowmaking techniques at ski resorts require that temperatures be approximately 28 degrees for successful results.

In July, 2016, Boreal Mountain Resort in California became the first site in North America to use the new technology, successfully making snow in the Sierra Nevada mountain range at 91 degrees Fahrenheit. The location close to Lake Tahoe typically experiences that kind of heat during the summer months, but the Snowfactory allowed it to conduct a ski and snowboard camp until August 8. Robin Smith, the North American director of business development and strategy for the technology said that though Snowfactory has been used to make Nordic ski routes in the early season, this is the first time ever for testing the technology in the summertime. While Snowfactory requires about the same energy used by four traditional

snow blowing guns, the cost is higher, but Smith believes that the company will do well with ski resorts used to profitable ski seasons, and it may create its own niche within the typically expensive ski and snowboard camps.