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TECHNOTRENDS® NEWSLETTER

The biggest ideas that are changing everything

IN THIS ISSUE

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Will Your City Be a Smart City Soon?

By Daniel Burrus, CEO of Burrus Research

Despite the apparent trade-off between privacy and efficiency, authorities across the globe are intent on becoming known for achieving smart city status and for the right reasons. Politicians are seeing the real benefits and cost savings that smart city initiatives can provide, and as citizens we need to get used to the idea of our towns collecting and making use of more and more data to reshape the world around us for the greater good.

As the number of connected sensors, machines and devices rapidly grows in crowded cities, the data generated will provide the ubiquitous big data that we often hear about. But we are only just beginning to realize the value in a network that increasingly consists of everyday objects. Everything from buildings, energy, traffic flow, education, healthcare and even elevators contains information that represents both the daily grind and natural flow of every city.

This increasing volume of data that is generated every second of every day should and will be put to great use in the months and years ahead. Now that we have fully embraced the concept of smart devices with our phones, and we are beginning to experience it in our cars and homes, it's only natural that we now look to make our cities much smarter too.

Although we are slowly obtaining a greater understanding of the data that surrounds us, the good news is that positive results are already happening. Authorities are faced with a double-edged sword in which almost every choice comes with a compromise. For example, video surveillance in high crime areas has proven to reduce crime rates from 5% to 20%, but as a society, are we willing to reduce crime by introducing cameras watching our every move? This is the kind of trade-off we will have to face if we want to dramatically lower crime rates.

> *Traffic Signal Optimization can reduce travel times by as much as 20%*

The traffic in every major city across the world is probably our biggest concern, given we have all experienced gridlock. Once again, technology comes to the rescue. Traffic signal optimization has shown to reduce travel times by up to 20%. And let's not forget the joy of trying to find a place to park. The average person spends 18 minutes per day trying to find a place to park. Smart parking systems can reduce up to 30% of congestion without authorities even needing to build new lanes and roads.

There is already a wealth of statistics available now that major technology research in cities has revealed the scope of the cost savings. For example, 40% of municipal energy costs comes from street lighting. Intelligent lighting can reduce energy costs by up to 20%. Lansing,

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TECHNOLOGY NEWS HIGHLIGHTS

Reef Robot

The crown-of-thorns starfish (COTS) has become the scourge of the Great Barrier Reef. Infestations of the coral-eating predators are responsible for an estimated 40 percent of the decline in the reef's coral cover, and they've proven to be difficult to eradicate, due to their ability to regenerate, even when cut in half.

Recently, Australian researchers launched a trial of a new robot designed to hunt down and kill COTS autonomously. Known as COTSbot, the underwater droid uses advanced image recognition and machine learning to identify its target and deliver a lethal (only to the starfish) dose of bile salts via injection.

The robot is designed to operate for 8-hour runs and can deliver up to 200 shots in a single mission. An acoustic sensor enables it to navigate within a meter of the sea floor, and a vision-guided articulating arm injects the poison as the bot hovers above.

The plan is to deploy COTSbots throughout the reef as a type of "first responder" to eliminate the bulk of the menacing creatures, followed by divers a few days later.

Given that underwater visibility is highly variable with depth and changes in water clarity, COTSbot had to "learn" how to think for itself by capturing images of suspected COTS, which were verified by a human.

The feedback was then incorporated into the robot's memory to create a robust recognition system that boasts 99 percent accuracy.

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"Magic" Beans

A new legume-shaped sensor pod is designed to monitor stored grains, helping farmers better manage and preserve their crops.

The plastic "beans" measure about 45 mm (1-3/4 inches) long and 18 mm (3/4 inch) wide, and are 3-D-printed to encapsulate a circuit board containing sensors that measure temperature, humidity, air pressure motion and orientation, as well as concentrations of various gases such as carbon dioxide and carbon monoxide.

On-board Bluetooth communications and a wirelessly rechargeable battery allow them to be controlled and programmed remotely via a smartphone app. As nodes in a wireless network, multiple beans placed in and around a grain pile can provide a continuous, three-dimensional analysis of storage conditions and alert a farmer of potential environmental problems or insect infestation.

But beyond farming, the beans could have other applications for the Internet of Things. For example, they could record whether a parcel has been mishandled during transport, or alert a caregiver when an elderly individual takes a fall.

The sensor-filled beans are targeted to become commercially available within two years.

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Shape Shifter

A new material that's capable of changing its own size, volume and shape could have dramatic implications for dynamic architecture.

Inspired by the ancient technique of origami, the material is made up of individual cells that have 24 sides and 36 edges.

Each cell can be folded along any one of its edges to change its shape, and, networked together, the cells can create a variety of structures with a range of elasticities and strengths.

Pneumatic actuators embedded into the structure can be programmed to "deform" the structures to attain the desired shape, and the process is completely reversible.

The research team has demonstrated the viability of the material by connecting 64 cells into a 4x4x4 cube that can fold completely flat, shrink, grow, or totally change shape.

Potential applications for a material like this are vast, including portable shelters, adaptive facades

and retractable roofs. The technology is also totally scalable from the meter-scale level to nano-scale devices, such as surgical implants.

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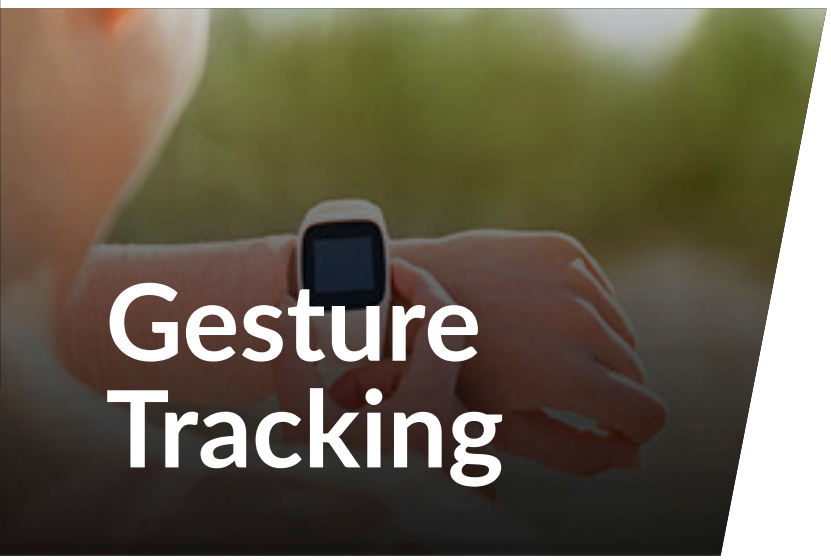

Gesture Tracking

Smartwatches may be all the rage, but they're limited in terms of how users can interact with them. (It's difficult to type on a smartwatch display!)

So computer scientists and electrical engineers have teamed up to develop a technology that can accurately track finger movements to within about 8 millimeters using sonar.

Dubbed FingerIO, the system uses the microphones and speakers already built into a smartphone or smartwatch. As the speaker sends an inaudible signal that bounces off the finger, the microphone records the "echo" to calculate the location of the finger in space.

The result is an ability to interact with mobile devices by merely writing or gesturing on a tabletop, a piece of paper, or even in mid-air.

The use of sonar has several advantages over cameras. First of all, sound waves do not require a line of sight in order to transmit information, so users can interact with their device through the fabric of a shirt, for example. Secondly, sound waves travel slower than radio waves or light, so processing bandwidth is greatly reduced.

And finally, the capability can be achieved without any special hardware, as most devices already have a speaker and a microphone built in.

In tests on a typical Android device, where users were asked to draw a variety of shapes, the average difference as tracked by FingerIO was 8 millimeters for a smartphone and 12 millimeters for a smartwatch – more than adequate for tracking finger movements, given the fact that a finger is about 10 millimeters thick.

The researchers plan to expand the tracking abilities to multiple fingers moving simultaneously, and extend the technology to three dimensions by adding additional microphones.

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Anti-Aging Breakthrough

A significant breakthrough in understanding the makeup of human skin cells has given

researchers a specific biomarker for developing powerful new anti-aging treatments as well as drugs that can address other age-related diseases, including cancer.

The discovery was made by taking skin samples from 72 donors, ranging in age from 6 to 72.

Samples of the upper layer (epidermis) and lower layer (dermis) were taken from a sun-protected area and analyzed to measure key enzyme activity in the mitochondria.

It was found that mitochondrial complex II significantly decreases with age in dermal cells, an observation that had not previously been reported.

The study is important because it shows for the first time that aging can be linked to a specific metabolic enzyme.

Over time, decreases in these enzyme levels lead to decreased bio-energy in the skin, causing fine lines, wrinkles and sagging.

Armed with this information, it may now be possible to find a treatment, tailored to different ages and skin pigments, to combat the decline and counteract the signs of aging.

Additionally, the researchers believe that these results could help address aging processes elsewhere in the body that can lead to any number of age-related disorders.

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Expanding the Boundaries of 3-D Printing

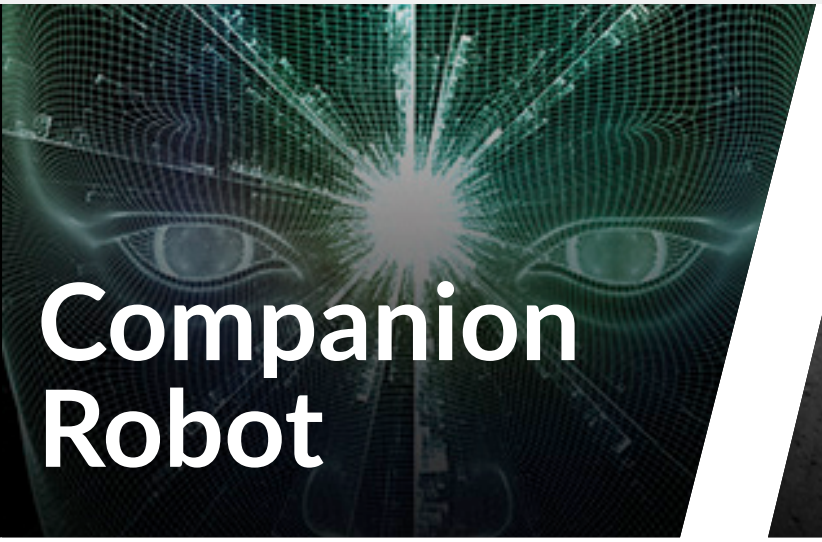
Leave it to the creators of AutoCAD to come up with the next generation of 3-D printers. The latest addition to their line of 3-D software solutions is knows as Project Escher, a control technology that pushes the boundaries of 3-D printing to new levels.

Although conventional 3-D printing is fine for small, relatively simple projects, its speed is greatly reduced with increased size and/or complexity. Project Escher works around this bottleneck by running multiple tool paths on collaborating machines to generate much larger prototypes in a short period of time.

The whole system is designed to be modular so that printheads can be changed out with other types of tools to perform specific tasks. For example, some could be printing while a milling head cuts away those portions of the structure that are only needed during printing and a robotic arm adjusts the positioning of the part. The bottom line is that by distributing tasks among independent tools linked together by parallel-processing systems, larger prototypes can be created in less time than ever before.

Although it's still under development, a commercial version of the platform may be available as early as 2017.

For information: Autodesk, Inc., 111 McInnis Parkway, San Rafael, CA 94903; phone: 415-507-5000; fax: 415-507-5100; website: http://projectescher.com/



Companion Robot

The science of robotics is making a giant leap from virtual humans (VH) to truly social robots, the first of which is named Nadine. At the core of Nadine's development is an artificial intelligence (AI) system that includes a range of emotions and a short-term memory linked to a language database (including English, French, German, and, soon, Chinese and Italian), along with gesture and facial recognition.

The result is a humanoid that can look you in the eye, greet you, remember your face, alter her facial expressions, have a chat with you, play games, read stories, and answer questions based on previous conversations. Soon, she'll even be able to talk on Skype.

Nadine was developed specifically for individuals with special mental health needs, such as people with autism and those who suffer from severe loneliness or depression, but her functionality can be adapted to address a variety of other specific needs. The developers are also working on robotic companions for children to act as a playmate and to monitor their behavior, as well as train them to be bilingual by speaking to them in another language.

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Concrete from CO_2

This is "upcycling" at its best – capturing carbon dioxide (CO_2) emissions from smokestacks and turning them into a useful building material. That's the concept behind CO_2NCRETE, a new construction material that was recently unveiled by UCLA researchers. In addition to tackling the problem of what to do with all the greenhouse gases being generated by power plants, the new material will reduce the use of traditional concrete, which in itself contributes about 5 percent of carbon dioxide emissions globally.

The researchers have demonstrated a process in which CO_2 is mixed with lime to produce a cement-like material that can be shaped using a 3-D printer. But it's not quite ready for mass distribution yet. Taking CO_2NCRETE from proof-of-concept to production will require scaling up the process to produce much larger quantities than can be done in the lab.

However, this technology could turn the tables on the economics of power production by turning a major waste by-product into a valuable resource that can be used to expand building and extend road systems, particularly in countries like China, the largest greenhouse gas producer in the world.

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Will Your City Be a Smart City Soon?

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Michigan, put in smart street lighting and was able to reduce costs by 70%, a big win for the mayor who championed the initiative.

As a word of caution, it appears that we are still very naive when it comes to security and our responsibility in this digital age. With so much of our lives and infrastructure getting connected, we all need to step up our game and appreciate the implications of ignoring security warnings.

For example, a recent report revealed how vulnerable our hospitals are to cyber-attacks and hackers. Maybe it's our self-awareness that is in need of a 21st-century upgrade. Recently, 18 USB sticks were dropped purposely on multiple floors of a hospital. Within 24 hours, one of them had been plugged into a nurse's station, infecting the network with malware, which gave the hackers access to the entire network.

With the majority of public-serving institutions at risk from hackers intent on causing chaos and disruption, it's more important than ever to re-evaluate your level of security and threat prevention. Threats can appear in many different forms, such as ransomware that will lock all files and demand payment to unlock your data. The only positive aspect of ransomware is that it informs the user instantly of an infection.

However, there is also much stealthier malicious software that can be secretly stealing data or compromising systems completely under the radar of the establishment. Eliminating these risks by upgrading old systems is key, but so is educating users about understanding the vulnerabilities in the workplace and how to prevent them. The creation of closed systems with hardware-embedded security will make it easier to predict and prevent cybercrime. Crime will continue to be a risk, but new advanced intelligent systems can help predict an attack and prevent it before it happens.

These security challenges should not damage the level of excitement and energy around the future possibilities. In this digital transition, we are merely taking another brave step forward, and there is no doubting how cash-strapped local and state agencies can become more efficient by better using data and implementing new technology.

Many large companies are involved in making cities smart, including Cisco, IBM, and Siemens. Cisco will happily advise governments that a smart city can save energy by 20%, reduce water consumption by 50%, crime by 20%, traffic by 30%, and so on. These facts, backed up by data, will be tough for those in control of budgets to resist.

Businesses, local and state agencies, committees, etc., will always be cost and data driven. Our evolving digital economy will ensure that smart cities, IoT, and local services will all become a natural part of our lives. Yes, there will be security and even privacy challenges, but this is a hard trend that will happen, so the time to start solving predictable problems is before they happen.

Many of our fears of a technology-fueled dystopian future are based on fictional literature and Hollywood movies. But we seldom stop to think that our future reality could be quite different from 1984 or the rise of machines that the Terminator franchise warned us about.

Real life is not always as interesting as art. The implementation of computerized sensors for nearly everything we know and love to drive down costs and improve efficiency could be as exciting as it gets. Is it such a bad thing? Eliminating waste, intelligent traffic management and vast improvements to public transport during peak periods are mouthwatering prospects on their own. The belated arrival of e-government services, allowing faster access at a lower operating expense for taxpayers, should also be enough to convince even the biggest cynics.

I don't believe this is an either-or situation. Technology should be able to improve every aspect of our lives in our homes, cities and world. We now interact with each other more than ever before, not less—contrary to popular opinion. The rise of the global community is enabling a greater understanding that shapes our world view and challenges age-old stereotypes.

As citizens of a global community, we expect our smartphones to provide us answers to any questions as they pop into our heads. We have developed an insatiable thirst for real-time information. Reliability and simplicity are expected to be standard, meaning this is how cities will soon be judged by both their inhabitants and visitors.

We now connect and interact in many different ways, which illustrates how technology is bringing us closer together. The real spirit and character that live inside every city across the world do not need to be sacrificed and will continue to thrive as long as we work to keep the best of our past and present, as we build a better future together.

Concentrating on resisting change or fearing the unknown is counterproductive. I have advised major businesses and governments for decades that the best way to improve planning is by learning to separate hard trends, the trends that will happen, from soft trends, the trends that might happen, and use this knowledge to shape the best future possible. Whether we want to admit it or not, the cities in which we all reside are falling behind our modern expectations. Reducing costs and increasing efficiency will fuel growth much more than control-crazed conspiracy theories.

If you look at the cities that have already moved forward to make themselves smart, Barcelona is one that stands out. By 2014, Barcelona was saving $58 million (U.S.) a year through smarter water systems and $37 million from intelligent street lighting. In addition, it gained $50 million annually from smart parking technology and reduced parking times and congestion at the same time. And between 2014 and 2015, theft, which accounts for over half of all crime, was reduced by 30.2% thanks to video surveillance systems in high crime areas. Best of all, the smart city initiatives (over 80 so far) have helped create more than 45,000 new jobs.

With this and many other success stories from both large and small cities all over the world, it's time to create a framework that includes the responsibilities around implementation, connectivity, privacy, security, data management and the wealth of analytics that will be required. There are many talking points, but these conversations need to begin sooner rather than later.

Ultimately, these networked sensors and machines talking to other machines, making decisions based on parameters, will save both time and money. The use of technology to deliver safer and more energy-efficient cities is something to be celebrated rather than feared.

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