

DANIEL BURRUS'

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THE BIG IDEAS THAT ARE
CHANGING EVERYTHING

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3D Printed Shoes are a Step in the Right Direction

By Daniel Burrus, CEO of Burrus Research

Having new shoes that you need to “break in” because they hurt your feet (or dealing with shoes that always feel uncomfortable no matter how long you wear them) will soon be a thing of the past thanks to 3D Printing. Several shoe companies, including Nike, Feetz, and United Nude, are now using 3D Printing technology to give customers shoes that are custom made for them—in the store, on the spot.

I have been covering 3D Printing for over 20 years in my Technotrends Newsletter, and at first the technology was used for rapid prototyping. Over the past few years, however, rapid advances in what I call ‘The Three Digital Accelerators’ —processing power, storage, and bandwidth, have catapulted this technology into a tool for manufacturing finished products that include not only shoes, but also jewelry, dresses, car dashboards, parts for jet engines, jawbones for humans, replacement parts for synthesizers, and much more.

What Is 3D Printing?

When people first hear that you can manufacture something by printing it, they have a hard time visualizing it. Think of it this way: 3D printers build things by depositing material, typically plastic or metal, layer by layer, until the prototype or final product is finished. When the design is downloaded into the printer, a laser creates a layer of material and fuses it. Then it adds another layer and fuses it...and then another and another...until the object is completed.

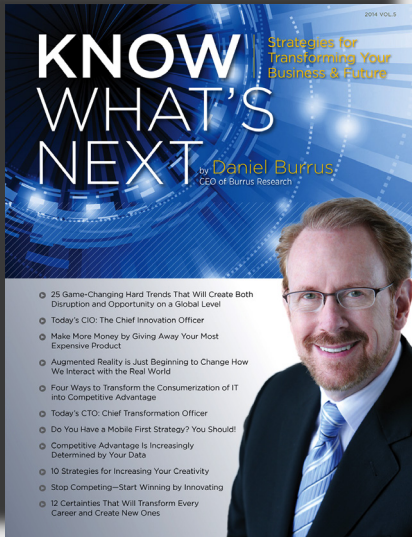
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TECHNOLOGY NEWS HIGHLIGHTS

Sensor Detects Stress & Energy Levels

A small, flexible sensor has been developed that can analyze perspiration to assess a person's level of stress and overall energy. Using a combination of nanotechnology and expertise developed through



jet engine research, the wireless device – which resembles a nicotine patch – is designed to detect early signs of anxiety and fatigue non-invasively and continuously.

Receptors inside the sensor are responsive to two target biomarkers. Orexin-A, a hormone released by the hypothalamus, is a key indicator of alertness, while cortisol provides a dynamic indicator of how the body responds to stress. When these compounds come into contact with the nano-sensors, they are converted into electrical signals that can be transmitted to a smartphone or other wireless device.

Sweat is directed precisely to the sensors using microfluidics technology that was developed to improve the efficiency and airflow of airplane engines. This results in greater control and more accurate measurements.

The new technology will have broad applications for civilian and military use including monitoring of physical and mental fatigue in pilots, air traffic controllers, fire fighters and heavy equipment operators. The sensors could also eventually be adapted to measure other electrolytes and metabolites associated with specific diseases.

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Energy-Storing Cigarette Butts

More than five trillion used cigarette butts end up in the environment every year. But researchers recently found a way to transform



an environmental problem into an eco-friendly energy solution by turning the filter material into a high-performance coating for supercapacitors that boosts their capacity to store large amounts of energy.

In the quest to improve the characteristics of supercapacitors, increased power density is an important property for speeding up charge-discharge cycles. That means the supercapacitor material must have a large surface area with a combination of different sized pores to adsorb and release electrolyte ions.

The researchers found that using a simple burning technique (called pyrolysis), the cellulose acetate fibers in the cigarette filters could be transformed into a carbon-based material with a number of tiny pores. The result is a material that performs better than graphene or carbon nanotubes currently used to coat the electrodes of supercapacitors, and is less expensive to produce. The coating could be used in everything from computers and mobile devices to electric vehicles and wind turbines to meet the growing demand for more efficient energy storage.

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3D Printed Spine

A 12-year old cancer patient is the recipient of the world's first prosthetic vertebrae to be fabricated using 3D printing. During surgery to remove a malignant tumor from his spinal cord, several of the boy's vertebrae needed to be removed. So doctors created a design based on his actual bone structure to produce a customized spinal implant that will integrate more naturally with the rest of his spine.



The artificial bones are made with titanium powder for superior strength, and contain tiny pores that enable bones to grow into them. This alleviates the need to use cement and screws to hold them in place, and makes the entire implant more secure.

Although this is the first vertebral implant to be fabricated in this manner, other successful orthopedic transplants using 3D printing have included a jawbone and an artificial hip.

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Delivery Drone in Australia



Google recently began testing a new proof-of-concept robot in Australia that's aimed at getting autonomous delivery drones off-the-ground once and for all. Part of Google X Project Wing, the working drone is a first step in launching a fully functioning service – something that has been delayed in the U.S. by the need to have a regulatory framework that addresses privacy and safety concerns that govern the use of unmanned aerial vehicles (UAVs).

The new drone uses a vertical takeoff or landing (VTOL) system which allows it to fly fast but also to hover. Packages are delivered by means of a winch, a spool of high grade fishing line, and a gadget that goes down with the package (dubbed the “egg”). When the egg detects that it has reached the ground, it releases the package and sends a signal to the UAV hovering above to crank it back up. An emergency release allows the UAV to cut the line in the event of a problem.

Drawing on experience with their driverless car program, Google's next step will be developing an infrastructure that will allow drones to fly safely. But, unlike cars that move in two dimensions, UAVs need to operate in three dimensions, and over much wider areas.

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Bicycle Radar

The number one cause of bicycling deaths in the U.S. is being hit from behind. But a device called Backtracker is designed to make cycling safer by detecting vehicles up to 400 feet away and warning cyclists of their presence. In addition, it alerts oncoming drivers of a bicycle in their path.



The two-piece device uses military grade radar to sense vehicles approaching from behind. The front unit mounts on the handlebars and displays intuitive data about the distance and speed of advancing vehicles on a series of red LEDs. The back unit, which clips onto the seat post, houses the radar unit and also gives motorists a sense of closing distance by flickering faster and brighter as they get closer. In heavy traffic, when cars are always close, Backtracker helps cyclists identify breaks in the traffic so they know that it's safe to change lanes without looking over their shoulder.

Pre-orders are being accepted through Dragon Innovation's crowdfunding site at a price of \$149.

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Preventing Information Overload



In an increasingly data-driven society, the human brain is often being presented with more data than it can possibly analyze. This may end up causing fatigue and anxiety as people are continually bombarded with “too much information.” So researchers are working on ways to help our minds deal with large, complex datasets more effectively by changing the way data is presented based on an individual’s subconscious reactions.

The Collective Experience of Empathic Data Systems (CEEDS) Project has developed a multi-modal, virtual reality environment that measures a user’s responses (such as gestures, eye movements, heart rate) to large amounts of information. When a participant starts to exhibit signs of “overload” the system automatically adjusts the way in which the data is presented, either by simplifying the visual images or by guiding the observer to more relevant areas through the use of subliminal clues like flashing arrows.

We are only aware of about 10 percent of our brain activity, and this technology is aimed at increasing

that percentage to help us perform better by assimilating increasingly complex datasets more quickly. Applications include virtual classrooms in which presentations are adapted to individual attention levels as well as museums, libraries, airports and retail stores.

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3D Photo Editor Can Change Object in the Photo



Imagine being able to manipulate objects in a digital image and expose areas that were never even captured in the original photograph. That’s precisely what a new open source editing tool is capable of doing. It allows for a full range of control – scaling, rotation, translation and deformation – in three dimensions. Models are used to complete the geometry and appearance, and reveal those parts that are hidden from view. The program also estimates the illumination, color and texture, while matching pixels to the original image to create a realistic representation of the object when it’s moved.

For example, the editing tool can be used to change the orientation of a chair in a still photo of a room, or to create an animation of a car flipping

over from a single image.

The source code is available under GPLv2 license at:
<http://www.cs.cmu.edu/~om3d/sourcecodeversions.html>

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Pure Lithium Battery



A recent breakthrough in battery technology could triple energy density while reducing weight and cost. The key is lithium – not only in the electrolyte (like today's batteries) but in the anode as well. The problem is preventing

the lithium anode from expanding during charging and using up the electrolyte over time.

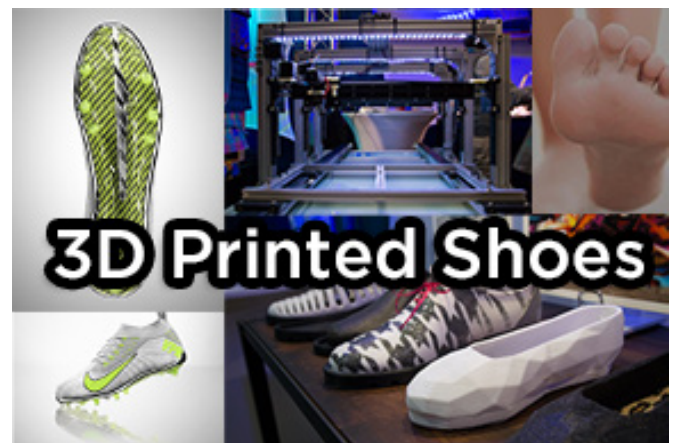
The solution appears to be a microscopic layer of nanospheres built like a honeycomb. When placed over the unstable lithium, the flexible, non-reactive film protects the anode and improves efficiency. While unprotected lithium anodes exhibit about 96 percent efficiency, the version with the new film approaches 99.6 percent. However, the goal, in order to become commercially viable, is 99.9 percent, which the developers expect will be achievable in about two years.

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3D Printed Shoes

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3D printers can range from the size of a microwave oven to the size of a car. A printer that can print a house by depositing cement, layer upon layer using a printer the size of a tractor-trailer, is already in development. Prices for 3D printers range from hobbyist kits for under \$1,000 to over \$100,000 for industrial versions.



The Perfect Fit

What makes 3D printed shoes so enticing for consumers is that the shoes are tailored for each person's unique feet. Few people have feet that are identical. In other words, your left foot might be slightly wider or smaller than your right foot. Because of this, finding shoes that fit both feet perfectly is rare. Additionally, because the current shoe sizing system is limited to half-integer measurements (6, 6.5, 7, 7.5, etc.), it's only taking into account how long someone's feet are. Finding shoes for wide or thick feet is difficult. 3D Printing solves all this.

With 3D Printing of shoes, rather than try on box after box of pre-made shoes in standard sizes, customers get photographs taken of their feet from various angles. This allows the computer

to create an accurate 3D model of the person's feet. This information is then combined with details about the customer's height, weight, and activities they engage in. After inputting all the data, customers receive a personalized pair of shoes tailored exactly for them.

In some cases, such as with Feetz, the shoes are printed and then shipped to the customer. In other cases, like with United Nude, the shoes are printed in the store, right before the customers' eyes.



Taking it a Step Further

Of course, this technology is not just for fashion-forward people seeking the latest trends in shoes. It also has a therapeutic application. SOLS Systems, the maker of custom, corrective orthotics, is using 3D shoe printing to make orthotic shoes that alleviate a patient's foot pain and improve comfort. In the process, they are taking the orthotic scanning and prescription process from archaic and sterile to tech-savvy and fashionable. And because the shoes are custom made, patients experience a high level of engagement with the product, while podiatrists enjoy a higher conversion rate at the point-of-sale.

Additionally, athletic shoemaker Nike has introduced its new Nike Vapor Ultimate Cleat American football boot, which combines 3D knitting (what Nike calls its proprietary flat knitted Flyknit technology) and 3D shoe printing to give players an athletic shoe that delivers both lightweight speed and strength. By integrating 3D knitting with 3D shoe printing, Nike is giving athletes shoes that have a second-skin, sock-like fit that adapt to each individual player's foot as well as to his style of play, helping athletes perform at their highest level. For athletics, 3D shoe printing is definitely a game changer.

Running Strong

While the majority of shoes sold today are still made the traditional way, you can be sure that 3D printed shoes will become more commonplace in the future, along with many other 3D printed products you'll use every day. 3D Printing is advancing quickly on a global level and offers something that up until recently was impossible: On-demand, anytime, anywhere, by anyone manufacturing.



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