

Future technology: 22 ideas about to change our world

Floating farms, brain wave passwords, and coffee-powered cars are just some of the incredible inventions and innovations that will shape our future.

Sweat powered smartwatches

Engineers at the University of Glasgow have developed a [new type of flexible supercapacitor](#), which stores energy, replacing the electrolytes found in conventional batteries with sweat.

It can be fully charged with as little as 20 microlitres of fluid and is robust enough to survive 4,000 cycles of the types of flexes and bends it might encounter in use.

The device works by coating polyester cellulose cloth in a thin layer of a polymer, which acts as the supercapacitor's electrode.

As the cloth absorbs its wearer's sweat, the positive and negative ions in the sweat interact with the polymer's surface, creating an electrochemical reaction which generates energy.

"Conventional batteries are cheaper and more plentiful than ever before but they are often built using unsustainable materials which are harmful to the environment," says [Professor Ravinder Dahiya](#), head of the Bendable Electronics and Sensing Technologies (Best) group, based at the University of Glasgow's James Watt School of Engineering.

"That makes them challenging to dispose of safely and potentially harmful in wearable devices, where a broken battery could spill toxic fluids on to skin.

"What we've been able to do for the first time is show that human sweat provides a real opportunity to do away with those toxic materials entirely, with excellent charging and discharging performance.

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Self-healing 'living concrete'

Scientists have developed what they call living concrete by using sand, gel and bacteria.

Researchers said this building material has structural load-bearing function, [is capable of self-healing](#) and is more environmentally friendly than concrete – which is the second most-consumed material on Earth after water.

The team from the University of Colorado Boulder believe their work paves the way for future building structures that could “heal their own cracks, suck up dangerous toxins from the air or even glow on command”.

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Living robots

Tiny hybrid robots made using stem cells from frog embryos could one day be used to swim around human bodies to specific areas requiring medicine, or to gather microplastic in the oceans.

“These are novel living machines,” said Joshua Bongard, a computer scientist and robotics expert at the University of Vermont, who co-developed the millimetre-wide bots, known as xenobots.

“They’re neither a traditional robot nor a known species of animal. It’s a new class of artefact: a living, programmable organism.

Tactile virtual reality

Researchers from Northwestern University have developed a prototype device which aims to put touch within VR’s reach, using a flexible material fitted with tiny vibrating components that can be attached to skin.

The system, known as epidermal VR, could be useful in other cases as well, from a child touching a display relaying the gesture to a family member located elsewhere, to helping people with amputations renew their sense of touch.

In gaming, it could alert players when a strike occurs on the corresponding body part of the game character.

The team’s design features 32 vibrating actuators on a thin 15cm by 15cm silicone polymer which sticks on to the skin without tape or straps and is free of large batteries and wires.

It uses near-field communication (NFC) technology – which is used in many smartphones for mobile payment today – to transfer the data.

“The result is a thin, lightweight system that can be worn and used without constraint indefinitely,” says Professor John A Rogers, who worked on the project.

Scientists hope that the technology could eventually find its way into clothing, allowing people with prosthetics to wear VR shirts that communicate touch through their fingertips.

Internet for everyone

We can't seem to live without the internet (how else would you read sciencefocus.com?), but still only around half the world's population is connected. There are many reasons for this, including economic and social reasons, but for some the internet just isn't accessible because they have no connection.

Google is slowly trying to solve the problem using [helium balloons](#) to beam the internet to inaccessible areas, while Facebook has [abandoned plans](#) to do the same using drones, which means companies like [Hiber](#) are stealing a march. They have taken a different approach by launching their own network of shoebox-sized microsatellites into low Earth orbit, which wake up a modem plugged into your computer or device when it flies over and delivers your data.

Their satellites orbit the Earth 16 times a day and are already being used by organisations like The British Antarctic Survey to provide internet access to very extreme of our planet.

6 760mph trains

Hate commuting? Imagine, instead, your train carriage hurtling down a tunnel at the same speed as a commercial jet airliner. That's the dream of PayPal, Tesla and SpaceX founder Elon Musk.

His [Hyperloop](#) system would see 'train' passengers travel at up to 760mph through a vacuum tube, propelled by compressed air and induction motors. A site has been chosen with the goal of starting test runs in two years. Once built, the loop will ferry passengers between San Francisco and LA in 35 minutes, compared to 7.5 hours by train.

Heart monitoring T-shirt

Wearable sports bands that measure your heart rate are nothing new, but as numerous studies have shown, the accuracy can vary wildly (especially if you rely on them to [count calories](#)). In general, that's fine if you just want an idea of how hard you're working out, but for professionals, accuracy is everything.

Using a single lead ECG printed into the fabric, this new t-shirt from smart materials company KYMIRA will accurately measure heart beats and upload them to the cloud via

Bluetooth. Once there, algorithms process the data to accurately detect irregular heartbeats such as arrhythmia heart beats, which could prove life saving.

And it's not just athletes who could benefit. "The possibilities this product offers both sportspeople and the general public is astonishing," says Tim Brownstone, CEO and founder of KYMIRA. "We envisage developing this product to be used for clinical applications to allow those who may already suffer with heart conditions enough warning of a heart attack."

Coffee power

London's coffee industry creates over 200,000 tonnes of waste every year, so what do we do with it? Entrepreneur Arthur Kay's big idea is to use his company, [bio-bean](#), to turn 85 per cent of coffee waste into biofuels for heating buildings and powering transport.

Drown forest fires in sound

Forest fires could one day be dealt with by drones that would direct loud noises at the trees below. Since sound is made up of pressure waves, it can be used to disrupt the air surrounding a fire, essentially cutting off the supply of oxygen to the fuel. At the right frequency, the fire simply dies out, as researchers at George Mason University in Virginia recently demonstrated with their sonic extinguisher. Apparently, bass frequencies work best.

The AI scientist

Cut off a flatworm's head, and it'll grow a new one. Cut it in half, and you'll have two new worms. Fire some radiation at it, and it'll repair itself. Scientists have wanted to work out the mechanisms involved for some time, but the secret has eluded them. Enter an AI coded at [Tufts University, Massachusetts](#). By analysing and simulating countless scenarios, the computer was able to solve the mystery of the flatworm's regeneration in just 42 hours. In the end it produced a comprehensive model of how the flatworm's genes allow it to regenerate.

Although humans still need to feed the AI with information, the machine in this experiment was able to create a new, abstract theory independently – a huge step towards the development of a conscious computer, and potentially a landmark step in the way we carry out research.

Space balloon

If you want to take a trip into space, your quickest bet might be to take a balloon. The company World View Enterprises wants to send tourists into the stratosphere, 32km above Earth, on hot air balloons.

Technically 'space' is defined as 100km above sea level, but 32km is high enough to witness the curvature of the Earth, just as [Felix Baumgartner](#) did on his space jump. The balloon flew its first successful test flight in June, and the company will start selling tickets in 2016 – at the bargain price of just £75,000 per person!

Cancer-detecting 'smart needles'

A "smart needle" has been developed by scientists in the UK which could speed up cancer detection and diagnosis times.

Researchers believe the technology could be particularly helpful in diagnosing lymphoma, reducing patient anxiety as they await their results. At present, people with suspected lymphoma often have to provide a sample of cells, followed by a biopsy of the node to be carried out for a full diagnosis, a process which can be time consuming.

The new device uses a technique known as Raman spectroscopy to shine a low-power laser into the part of the body being inspected, with the potential to spot concerns within seconds, scientists from the University of Exeter say.

"The Raman smart needle can measure the molecular changes associated with disease in tissues and cells at the end of the needle," said professor Nick Stone, project lead, from the University of Exeter. "Provided we can reach a lump or bump of interest with the needle tip, we should be able to assess if it is healthy or not."

Crowd-sourced antibiotics

Swallowing seawater is part of surfing. But now the scientists behind a new initiative called [Beach Bums](#) want to swab the rectums of surfers, to see if this water contains the key to developing new antibiotics. They're searching for antibiotic resistant bacteria known as superbugs: by studying the samples from the surfers, they hope to learn more about these potentially dangerous organisms in the hope of producing new drugs to combat them.

Car batteries that charge in 10 minutes

Fast-charging of electric vehicles is seen as key to their take-up, so motorists can stop at a service station and fully charge their car in the time it takes to get a coffee and use the toilet – taking no longer than a conventional break. But rapid charging of lithium-ion batteries can degrade the batteries, researchers at Penn State University in the US say. This is because the flow of lithium particles known as ions from one electrode to another to charge the unit and hold the energy ready for use does not happen smoothly with rapid charging at lower temperatures.

However, they have now found that if the batteries could heat to 60°C for just 10 minutes and then rapidly cool again to ambient temperatures, [lithium spikes would not](#)

[form](#) and heat damage would be avoided. The battery design they have come up with is self-heating, using a thin nickel foil which creates an electrical circuit that heats in less than 30 seconds to warm the inside of the battery. The rapid cooling that would be needed after the battery is charged would be done using the cooling system designed into the car.

Their study, published in the journal *Joule*, showed they could fully charge an electrical vehicle in 10 minutes.

Smart food labels

UK homes throw away 30 to 50 per cent of what we buy from supermarkets, says a 2013 report by the Institution of Mechanical Engineers. The report claimed we're guided by 'use by' and 'best before' dates on food packaging, which are kept conservative because they are driven by shops' desire to avoid legal action. An invention called 'Bump Mark' could change all that.

Originally developed for blind people, it's a label that starts out smooth to the touch but gets bumpier as food decays. And since it decays at the same rate as any protein-based food within, it's far more accurate than printed dates.

Self-driving trucks

We've almost got used to the idea of driverless cars before we've even seen one on the roads. The truth is, you might well see a lot more driverless trucks – after all, logistics make the world go round. They'll be cheaper to run than regular rigs, driving more smoothly and so using less fuel. Computers never get tired or need comfort breaks, so they'll run longer routes. And they could drive in convoys, nose-to-tail, to minimise wind resistance.

Companies like Mercedes and Peloton are already exploring these possibilities, and if the promised gains materialise, freight companies could upgrade entire fleets overnight. On the downside, it could put drivers instantly out of work, and even staff at the truck stops set up to service them, but many companies have said the trucks will still need a human passenger to ensure their cargo is safe.

£3 pain-free tattoo removal

Got a tattoo that you now regret? There may soon be a gentler, cheaper alternative to laser removal.

PhD student Alec Falkenham in the US has worked out how to harness a property of your body's own immune system. He's developed a cream that delivers drugs to white

blood cells called 'macrophages' (Greek for 'big eaters'), causing them to release the ink they took up in order to protect your skin during the tattooing process.

Artificial neurons on silicon chips

Scientists have found a way to attach artificial neurons onto silicon chips, mimicking the neurons in our nervous system and copying their electrical properties.

"Until now neurons have been like black boxes, but we have managed to open the black box and peer inside," said Professor Alain Nogaret, from the University of Bath, who led the project.

"Our work is paradigm-changing because it provides a robust method to reproduce the electrical properties of real neurons in minute detail.

"But it's wider than that, because our neurons only need 140 nanowatts of power. That's a billionth the power requirement of a microprocessor, which other attempts to make synthetic neurons have used.

Researchers hope their work could be used in medical implants to treat conditions such as heart failure and Alzheimer's as it requires so little power.

Floating farms

The UN predicts there will be two billion more people in the world by 2050, creating a demand for 70 per cent more food. By that time, 80 per cent of us will be living in cities, and most food we eat in urban areas is brought in. So farms moored on the sea or inland lakes close to cities would certainly reduce food miles. But how would they work? A new design by architect Javier Ponce of Forward Thinking Architecture shows a 24m-tall, three-tiered structure with solar panels on top to provide energy. The middle tier grows a variety of veg over an area of 51,000m², using not soil but nutrients in liquid. These nutrients and plant matter would drop into the bottom layer to feed fish, which are farmed in an enclosed space.

A single Smart Floating Farm measuring 350 x 200m would produce an estimated 8.1 tonnes of vegetables and 1.7 tonnes of fish a year. The units are designed to bolt together, which is handy since we'll need a lot of them: Dubai, for instance, imports 11,000 tonnes of fruit and veg every day.

The four-day working week

It turns out working less might mean [more work gets done](#). A raft of studies have shown that with less time to work, less time is wasted – there's less absenteeism and, in most cases, greater productivity.

A more compact working week has also been shown to encourage employees to stay with companies for longer, and works as a recruitment tool. A shorter working week could even reduce global carbon emissions, with fewer commuters clogging the roads on certain days.

Pleistocene Park

Russian scientist Sergey Zimov hopes to recreate a 12,000-year-old environment in a wildlife park for herbivores like wild horse and bison, with extinct megafauna like mammoths replaced by modern hybrids. Zimov will study the impact of the animals on environment and climate.

Near-perfect insulation

There are two things the majority of people in the Western world own: a refrigerator and a mobile phone. And aerogels could revolutionise the manufacture of both.

An aerogel is a material that's full of tiny holes. Made by extracting all the liquid from a gel, it can be up to 95 per cent pores. Those pores are so small – between 20 and 50 nanometres – that gas molecules can't squeeze through them. As a result, aerogels can't transport heat, making for a material with incredible insulating properties.

The unusual electrical properties of aerogels also make them suitable as lightweight antennae for mobile phones, satellites and aircraft.