Deloitte.

IoT Innovation Report

2018

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IoT

Innovation Report 2018

Introduction

In 2015, Amtrack had a problem. It's Northeast Corridor railway was the busiest in America – but one in five of its trains ran late. To find a solution, Amtrak turned to Siemens. The German company installed more than 900 connected sensors to monitor equipment along the line and on the locomotives. Armed with the sensor data, Amtrak was able to spot potential problems before they developed. By the following year, delays were down by one-third. Siemens' work for Amtrak is just one example of how the Internet of Things (IoT) is creating a revolution in connectedness.

According to the Boston Consulting Group, by 2020, companies will be spending around 310 billion USD a year on the Internet of Things, with much of this spent in the manufacturing, energy and transportation industries. Increasingly, the IoT will be used for tasks such as predicting when machines will need maintenance; micromanaging energy usage in real-time; directing smart irrigation systems to water crops only when needed; and tracking the exact location of individual items in a large warehouse. All with the goal of increasing business efficiency and productivity.

In addition to these areas, the IoT could also have a big impact on our everyday lives. Already many home devices, such as coffee makers, refrigerators and even juicers, are connected. These innovations could someday allow your alarm clock to notify your coffee maker to start brewing coffee when you wake up; your refrigerator to automatically re-ordered milk when you run out; and your car to text your boss when heavy traffic will make you late for work. It could also allow police to detect when a crime has occurred and respond much faster, or allow remote detection of when an elderly person falls and needs help.

All of this connectedness has potentially huge consequences for how we live and work. Not least for security. Too few IoT devices have robust security protocols, such as encrypting data. Many IoT devices contain back doors and software flaws that make them easy to hack, creating the potential for using our home appliances to spy on us. Another issue that many companies will be faced with is storing and managing the massive amounts of data that all of these devices are going to produce. Companies need to figure out a way to store, track, analyze and make sense of the vast amounts of data that will be generated.

The reality is that the growth of IoT will require a host of innovative solutions to meet these challenges and take advantage of the coming opportunities. Here at Springwise, we have been following the development of these solutions. In this report, we highlight some of those with the greatest potential in the areas of smart cities, logistics, agriculture, sustainability and security.

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The IoT and smart cities

Most cities already generate large amounts of data (from sources such as security cameras and environmental sensors) and contain big infrastructure networks (such as those controlling traffic lights, electricity grids, and public transportation). Now, IoT innovations allow data and infrastructure elements to be combined with sensors and AI to add greater intelligence to the urban architecture.

Last year, Spain's Balearic Islands announced plans to turn the archipelago into a globally-recognized lab for IoT projects. Around half a million sensors will be added to the islands' existing digital terrestrial television infrastructure. The sensors, combined with an open-source platform, will then be used to trial projects such as triggering alarms if someone has accidentally left a pot to boil dry, helping visitors who get lost, or identify if a beach has become too crowded and offer alternatives to swimmers.

At the same time, Bill Gates has purchased 25,000 acres of land in Arizona for use in building a new smart city from the ground up. The community, to be called Belmont, will include a communication and infrastructure spine designed to support high-speed digital networks, data centres, and autonomous vehicles and logistics hubs. The city will act as a test case for the viability of smart city technology.

Despite the increased interest, most so-called smart cities are just cities which contain a few smart projects. This is because developing city-wide smart projects is incredibly expensive and requires developers and city planners to work through a number of issues in areas such as security, privacy and the impact on housing and affordability. In the meantime, cities and tech companies see smart cities projects as a huge future growth area, and many are positioning themselves to get involved. At Springwise, we have covered a number of these IoT innovations that are already making cities smarter.

One of these is **Crosswalk**, hardware that works with an app that can adjust the time that lights remain green (page 11). The traffic light contains a sensor that scans the pavements for someone using the Crosswalk app, and then it automatically adjusts the time that the lights remain green. The app allows pedestrians with restricted mobility more time to cross the road, while limiting delays to traffic. The app is being trialled in cities in Holland, along with another app that uses speed cameras to tell cyclists when they need to speed up to make the green light.

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In London, insurer Direct Line and urban design specialists **Umbrellium** have developed a crosswalk that uses AI, cameras and computer-controlled LEDs to alter the patterns, layout, and configuration of pedestrian crossings (page 12). The Starling Crossing can distinguish between pedestrians, cyclists and vehicles, and calculate the precise location, trajectory and velocity of each road user - anticipating where they may move to in the next moment. If the system spots, for example, a child running heedless into the road, it can alter the crossing to make their trajectory clear to any nearby drivers or cyclists. Similar systems could one day be connected to self-driving vehicles to prevent accidents at crossings, for example, by automatically braking all vehicles in the event that a child runs into the road.

Traffic is not the only area in which the IoT is already working to improve the lives of urban residents. In Germany, clean-tech start-up **Green City Solutions** has developed a modular plant wall that filters urban air (page 13). The CityTree is a freestanding plant filter which scrubs particulate matter and CO2 from the air. The 12-foot-high unit has the same cleansing effect as 275 urban trees but at just 5 percent of the cost and in just 1 percent of the space. CityTree can be monitored and regulated remotely, and could pay for itself by selling advertising space on the unit's built-in displays.

Logistics – measuring freshness

Another area in which the IoT is already working to increase productivity is in logistics and supply chain management. In a business where speed is everything, the IoT is rapidly becoming the industry standard. Connectivity allows better tracking of materials across all parts of the logistics chain, better fleet management, and more accurate monitoring of sensitive and perishable goods. One example of this is a new temperature sensor for fruit being developed by Switzerland's **Federal Laboratories for Materials Science and Technology** (EMPA) (page 14). The sensors are embedded in 3D-printed fruit which has been designed to duplicate the exact composition of real fruit such as mangos, bananas, and apples. During shipping, the replica is packed in with the real fruit and sends back data on temperature – allowing cooling to be adjusted in real time to keep food in peak condition.

One reason why the EMPA sensors are embedded in fake fruit is because many sensors contain heavy metals, which are harmful to human health. This limits the usefulness of sensors and RFID chips in tracking food and medicines. Recently, however, engineers at **ETH Zurich University** have developed

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biodegradable temperature micro-sensors which may be safe enough to use with food (page 15). The micro-sensors enclose a superfine electrical filament made of magnesium, silicon dioxide and nitride inside a polymer made from corn and potato starch. The sensor is not only safe for human ingestion, but it is thinner than a human hair and weighs just a fraction of a milligram. It can be connected to an external micro-battery and is capable of sending data via Bluetooth. The sensors are currently too expensive for mass production, but the researchers hope that they will be able to decrease the costs enough to make them practical for incorporating into food products, and perhaps other products as well.

Improving farm yields

Agriculture has always been a distinctly offline business, with decision making largely resting on the grower's skills and expertise. Yet, knowing more about precise soil conditions could allow farmers to greatly improve crop yields. At Springwise we have noticed a number of companies combining sensors with smart irrigation systems and drones to turn farming from educated guesswork into a precision business.

Israel-based **Viridix** is one such company, which is hoping to disrupt farming with a platform for farmers (page 16). Their soil sensors replace the traditional sensors used in farming, such as tensiometers, which are not precise enough to use in scale. Viridix deploys networks of proprietary sensors throughout fields to collect soil analytics. The company's proprietary soil moisture sensor measures the water potential available to the roots of the plant, which is considered the gold standard of measurement in irrigation. The sensor can be mounted on different platforms, with no electricity or network needed for operation. The data is then placed onto a platform for app developers to build tools on top of. One company, i-Dipper, has already used the Viridix data to develop a smart irrigation system, designed to run without electricity, that can water or feed each plant separately, according to its needs.

Smart sensors also hold out the hope of helping ranchers to improve their yields cheaply and efficiently. The founders of **Cowlar**, a start-up based in Islamabad, Pakistan, believe that connected sensors could increase the efficiency of the country's livestock rearing (page 17). The start-up has created a wearable for cows that tracks their temperature, activity, health and fertility. The collar sends data to farmers via a solar powered base and cellular service towers, giving farmers a cost-effective way to make better-informed

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decisions about their herd. Cowlar are not the only company to bring the IoT to the farmyard. JMB North America is also working on a monitoring solution that tells ranchers exactly when a heifer is about to give birth – allowing them to maximise the time they spend with each heifer in the crucial moments.

Improvements in sustainability

Increasingly, IoT projects are focusing on human-centered and outcome-based approach, where the potential for sustainability is built in from inception. Recent projects centered on development sustainability include using sensors to remotely monitor the temperature of vaccines during transport to rural clinics in India; to monitor water quality in Bangladesh; and to monitor water usage at water pumps in Kenya. In Nairobi and Cape Town, the Red Cross is also experimenting with low-cost, solar-powered fire alarm systems in urban slums, which sounds alarms and sends text messages to the residents and authorities when a fire breaks out.

One factor slowing the spread of such sustainable IoT technology can be a lack of Internet access. Around the world, an estimated four billion people do not have regular Internet access, and about one billion do not have reliable electricity. **Kumbaya** is approaching this problem by using the IoT to help those without reliable access to electricity to connect to the Internet (page 18). It's ZeroXess connectivity platform uses solar panels to run a touch-screen connectivity hub. The hub allows direct communication, radio and television broadcasts and internet access. By providing a way to connect to the internet without relying on local electricity infrastructure, Kumbaya could help small, local businesses to thrive and create more sustainable cities and communities.

The IoT is also helping to protect wildlife. The **Zoological Society of London** (ZSL) and non-profit tech company **Digital Catapult** have teamed up to develop anti-poaching technology (page 19). They are creating a sensor and a satellite-enabled network to monitor wildlife in remote national parks. The sensors will detect possible poaching activity and immediately alert those monitoring the area.

Recycling has become an important element of the drive to reduce waste and improve sanitation and sustainable consumption. Springwise has covered several innovations looking at creative ways to repurpose waste, such as a British company that recycles chewing gum into plastics. Polish company

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Bin-e is taking a more connected approach (page 20). They realised that, although many people have good intentions when it comes to recycling, they can be confused by the need to segregate different types of waste into different containers. In response, Bin-e have developed a fully-automated recycling bin. The bin is capable of determining what kind of material has been dropped in, and direct it into a specific compartment for compression and storage. The bin then alerts the waste disposal company when it is time to pick up the trash, and the type and amount of recyclable materials it contains. The data collected and shared in the IoT cloud can also be used to improve a company's waste management by monitoring recycling rates.

Improving efficiency

In addition to logistics and farming, the IoT also offers the opportunity to improve efficiency in a number of areas that are often overlooked. One of these is buildings maintenance. Some of the highest maintenance areas in any building are the restrooms. These require frequent cleaning and restocking – often by an on-site cleaner available around the clock. Germany's **Fraunhofer Institute for Integrated Circuits** and CWS-boco International have developed an intelligent washroom information service that uses IoT technology to track conditions and supply levels in restrooms (page 21). Information gathered by sensors is sent to a central control unit, which can then alert individual cleaning teams. The system allows management to develop greater efficiency in scheduling cleaners and ordering supplies.

Energy usage is another area where more information can lead to efficiency savings. IoT technology has already been used to balance supply and demand, to create peer-to-peer energy exchanges and even to create a self-healing grid which can automatically reconfigure itself to keep power flowing in the event of an outage. Now, smart-glass manufacturer **View** has created tinted windows that can be controlled remotely (page 22). The system uses sensors to track the location of the sun and increase or decrease the level of tinting to prevent glare. By reducing glare, the system prevents the loss of heat and reduces air conditioning use and energy consumption by up to 20 percent.

Keeping cars running smoothly is another area with great potential for efficiency savings, especially in large fleets. It is not always easy to tell when something is wrong with a vehicle – and even harder to tell when something is about to go wrong. So, start-up **OtoSense** is developing the AudioHound, which

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they hope to license to car manufacturers shortly (page 23). The AudioHound will use sensors to listen in on the inner workings of vehicles to determine when parts are about to wear out, allowing problems to be fixed before they lead to more expensive breakdowns. The Hound can also listen to what's going on outside the vehicle, which may have applications in self-driving vehicles.

Greater safety at work

One oft-touted goal for the Internet of Things is to make life not only simpler, but also safer. Springwise has already covered innovations and devices that monitor everything from the traffic hazards to air quality and whether the stove has been left on. But IoT is also being used to create devices to improve workplace safety, particularly in industrial sectors, such as mining and transportation. One example is the SafeCap prototype created by Ford Motor Company in Brazil. The smart cap can monitor brain waves to detect "micro-sleeps" in truck drivers and other operators of heavy machinery. These micro-sleeps are an indicator of fatigue and the caps can help alert drivers that it is time to take a rest, before they fall asleep at the wheel.

French company **Intellinium** is also working to improve workplace safety with a variety of connected wearables (page 24). Products include a safety shoe that lets wearers send and receive messages without using their hands. Workers can receive messages through vibrations and send messages through by exerting pressure with their big toe (or with their hands if their toes are immobile). The system allows workers to be alerted instantly to the need vacate an area, or to request immediate help if they are incapacitated and cannot move. The company has also created bio-sensing wearables which can track environmental hazards and send remote alerts if workers are at risk of injury.

NASA's Jet Propulsion Lab and the US Department of Homeland Security have developed a system to coordinate different kinds of wearables to gather data and direct responders. The system, called **Assistant for Understanding Data through Reasoning, Extraction and sYnthesis** (AUDREY) can gather data from a wide variety of sensors, including those worn in uniforms and GPS systems (page 25). In an emergency, the system collates the data from these different sources and guides responders to avoid areas with high risk of danger, such as a floor that is about to collapse.

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The impact of the IoT and future challenges

According to research group Gartner, by 2020 there will be more than 26 billion connected devices in use by businesses and individuals. With such a proliferation of devices, there will be tremendous opportunity, but also tremendous challenges. Many of these challenges involve security. In 2013, hackers used internet-enabled heating, ventilation and air-conditioning systems set up in Target stores to steal 40 million credit card numbers from the U.S. retailer, and many companies have not improved their IoT security in the years since. The 2016 Mirai attack used IoT devices to cause Internet shutdowns across Europe and North America, resulting in an estimated USD 110 million in economic damage.

Securing multiple points of vulnerability is a major challenge for organisations and requires a comprehensive, end-to-end approach. Such approaches are difficult to develop, however, most hackers concentrate on breaching one specific element within the technology stack while system operators must provide protection against all possible areas of attack. In addition, while everyone agrees that security is vital, many companies are not willing to pay higher prices for greater security. This could prevent the growth of many IoT applications.

The lack of standards presents another challenge to IoT growth. There are currently no overarching standards for how the different parts of the IoT technology stack should interact. Instead, different industries and organizations use their own standards. These can be incompatible, even among players in the same industry. This lack of standards may slow IoT adoption or discourage manufacturers from developing new technology, since they do not know whether their innovations will meet whatever guidelines are eventually adopted.

Another challenge will come from the need to develop infrastructure capable of connecting billions of IoT devices. Current centralized systems will require huge investments in order to handle such large amounts of information. It will likely be necessary to decentralise IoT networks and make greater use of edge computing solutions. Peer-to-peer networks, where devices identify and authenticate each other directly, could also help to create more flexible ways of handling the vast amounts of data.

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Amidst these challenges will come vast opportunities to develop not only new IoT products, but also new ways of analysing and making use of the data that will be generated. To prevent IoT from becoming a bubble – full of expensive devices no one needs, it will be important for IoT companies to address some of these challenges with innovative solutions.

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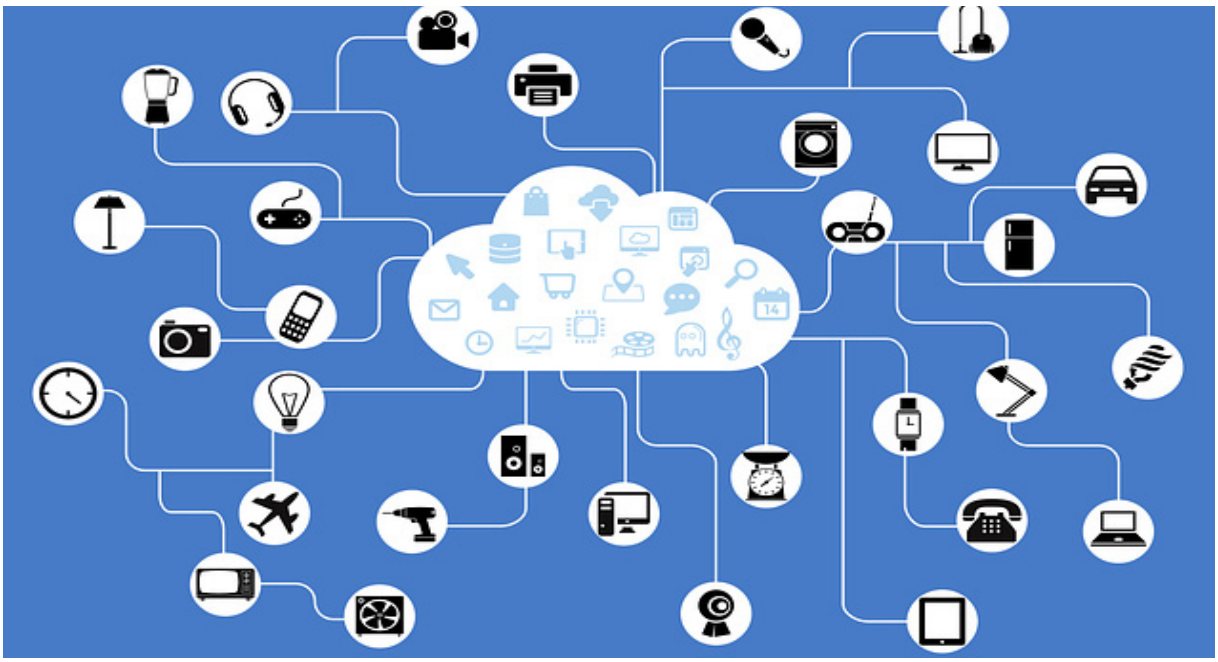
EDITORIAL TEAM



At a Glance

SECTOR
Smart Cities

WHAT
The Crosswalk app gives less-able pedestrians more time to cross the road safely.

WHO
Dynniq

WHERE
Netherlands

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dynniq.com
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App modifies traffic lights for slower pedestrians

The Crosswalk app gives less-able pedestrians more time to cross the road safely.

Launched in April this year, Crosswalk is an app that gives pedestrians with restricted mobility more time to cross the road. Currently the system is being trialled with 10 subjects in the Dutch city of Tilburg. The adapted traffic lights house a sensor that scans the pavements on both sides of the road. If it locates someone using the Crosswalk app then it automatically adjusts the time that the lights remain green. The app has four varied time settings, and the light's sensor will pick the one suitable for the pedestrian's level of mobility to ensure that they have more than enough time to cross the road, but also that it doesn't overly delay the traffic.

The system is the brainchild of Dutch company, Dynniq. Known for their work in intelligent traffic systems, they say the app works with both GPS and the software that's already installed in the traffic light, meaning that the whole system could be rolled out across the country quickly and without any need to add costly software or hardware.

The scheme is all part of the city's 25-year plan to make their network of roads safer for pedestrians and cyclists. Dynniq are also working on a variation of the app that will work for cyclists, notifying the lights when a cyclist is approaching, and also one for the visually impaired that activates a sound pattern to let them know if the light is green or red.

We are slowly beginning to see the future of city design, and there are plenty of companies hard at work on future tech. London, for example, has just opened its first smart street with streetlights powered by footsteps. In the Dutch city of Utrecht, cyclists are trialling a new system that detects their speeds and recommends adjustments to make the green lights. What would you like to see in the cities of the future?

At a Glance

SECTOR
Smart Cities

WHAT
New technology reacts in real-time to make pedestrians, cyclists and drivers safer and more aware of each other.

WHO
Umbrellium

WHERE
United Kingdom

CONTACT
www.umbrellium.co.uk
www.umbrellium.co.uk/contact

Interactive pedestrian crossing provides alerts for drivers

New technology reacts in real-time to make pedestrians, cyclists and drivers safer and more aware of each other.

An aspect of life that is taught to children from an early age, crossing the road safely is something everyone has to do on a daily basis. Although lesson learnt as a child will always be useful, new technology created by insurer Direct Line and built by urban design specialists Umbrellium hopes to encapsulate drivers into the safe crossing experience. The Starling Crossing – or Stigmergic Adaptive Responsive Learning Crossing – uses familiar and understandable road markings and colours to react to different conditions in real-time. The crossing is able to modify the patterns, layout, configuration, size and orientation of pedestrian crossings in order to prioritise pedestrian safety. The entire road surface at the crossing area is monitored by cameras and embedded with computer-controlled LEDs that can be seen from all angles during both day and night.

Acting upon research by the Transport Research Laboratory, the full-scale prototype has been temporarily installed in South London, England, and is designed to support the weight of vehicles, remain slip-free in pouring rain and to display markings bright enough to be seen during daytime. Using a neural network framework, cameras track objects that are moving across the road surface, distinguishing between pedestrians, cyclists and vehicles, calculating their precise locations, trajectories and velocities and anticipating where they may move to in the next moment. If a person is distracted, looking down at their mobile, and veers too close to the road surface when a car is nearby, a warning pattern lights around them to fill their field of vision. If a child runs into the road unexpectedly, a large buffer zone is created around them to make their trajectory clear to any nearby drivers or cyclists.

Roads are not simply just tarmac in the modern day, with developments in technology making them smarter than ever before. In Tel Aviv, wireless technology has been installed within the roads so electric cars can charge as they drive, and sensors are helping drivers in India navigate round the most dangerous hairpin bends. How could smart roads boost efficiency in your business operations?

At a Glance

SECTOR
Smart Cities

WHAT
A German startup has devised an Internet of Things green space that is monitored electronically and removes pollution from the urban environment.

WHO
Green City Solutions

WHERE
Germany

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Compact IoT green wall cleans urban air

A German startup has devised an Internet of Things green space that is monitored electronically and removes pollution from the urban environment.

We have already seen modular plant pots that create vertical home gardens, and a plant wall that can purify indoor air. Now, a German company is taking things a step further with an innovation they hope will be an answer to creating low-cost, low-maintenance outdoor urban greenscapes. The company has developed a freestanding plant filter, the CityTree, that can clean the surrounding air of particulate matter while offsetting 240 tons of CO2 equivalents per year. The 12-foot-high unit combines a vertically-installed moss culture with vascular plants for a green wall that can ingest particulate matter, nitrogen dioxide and ozone, and has the same cleansing effect as 275 urban trees but at 5 percent of the cost and just 1 percent of the space. Thanks to solar panels and a fully automated provision of water and nutrients using a built-in tank, the CityTree requires only a few hours of maintenance each year, and has a production footprint of just four tons of CO2.

On top of its environmental benefits, the CityTree contains sensors which collect and analyze environmental and climatic data, which is used to regulate and control the unit from a distance, and ensure that the plants thrive as the weather changes. CityTree also contains room for visual or digital information displays that allow advertisers to rent space on the unit, and for advertisers who prefer non-digital advertising, messages can be spelled out by using plants of different colors. The units can also include benches, wi-fi hotspots and e-bike charging stations.

CityTree is the brainchild of clean tech start up Green City Solutions , which was founded in 2015 to develop innovative ways to fight air pollution. The CityTree has already won numerous green awards in Germany and Europe, and the company hopes to, “create living conditions that allow all people around the world to permanently have clean and cool air to breathe ... linking the natural abilities of plants with cutting-edge Internet of Things technology in a unique way,” in order to contribute to intelligent city design. What other city landscapes might benefit from thinking vertically, rather than horizontally?

At a Glance

SECTOR
Logistics / Export

WHAT
A Swiss research institute has created replica fruits with embedded temperature sensors that send real-time monitoring data to suppliers and exporters.

WHO
Swiss Federal Laboratories for Materials Science and Technology

WHERE
Switzerland

CONTACT
www.empa.ch
twitter.com/Empa_CH

Embedded temperature sensors keep fruit fresh in transit

A Swiss research institute has created replica fruits with embedded temperature sensors that send real-time monitoring data to suppliers and exporters.

Switzerland's Federal Laboratories for Materials Science and Technology (EMPA) is currently testing a new temperature sensor for fruit being shipped from producer to consumer. With much of the food consumed around the world shipped hundreds of thousands of miles from its place of production, cooling is an essential part of the cargo shipping process. Should anything go wrong during the journey, entire containers of fruit could end up wasted if state food agencies order the destruction of the goods.

The new sensors are contained within replica pieces of fruit - currently available in mango, banana, apple or orange form. Researchers x-rayed each type of fruit and simulated its composition with a mix of polystyrene, water and carbohydrates. The mixture was then printed with a 3D printer to create the copy containing the smart sensor. Now, while in transit, the replica sits directly with the fruit, allowing suppliers and exporters to much more closely monitor temperature data throughout the entire journey.

Other recent innovations in delivery processes range in size from using blockchain to track the movement of international, trans-Atlantic cargo to making sample size products available on-demand within minutes. How else could shipping and delivery be smartened up through technology?

At a Glance

SECTOR
Food safety

WHAT
Engineers have developed biocompatible microsensors that can be attached to food to measure temperature and check freshness.

WHO
ETH Zurich University

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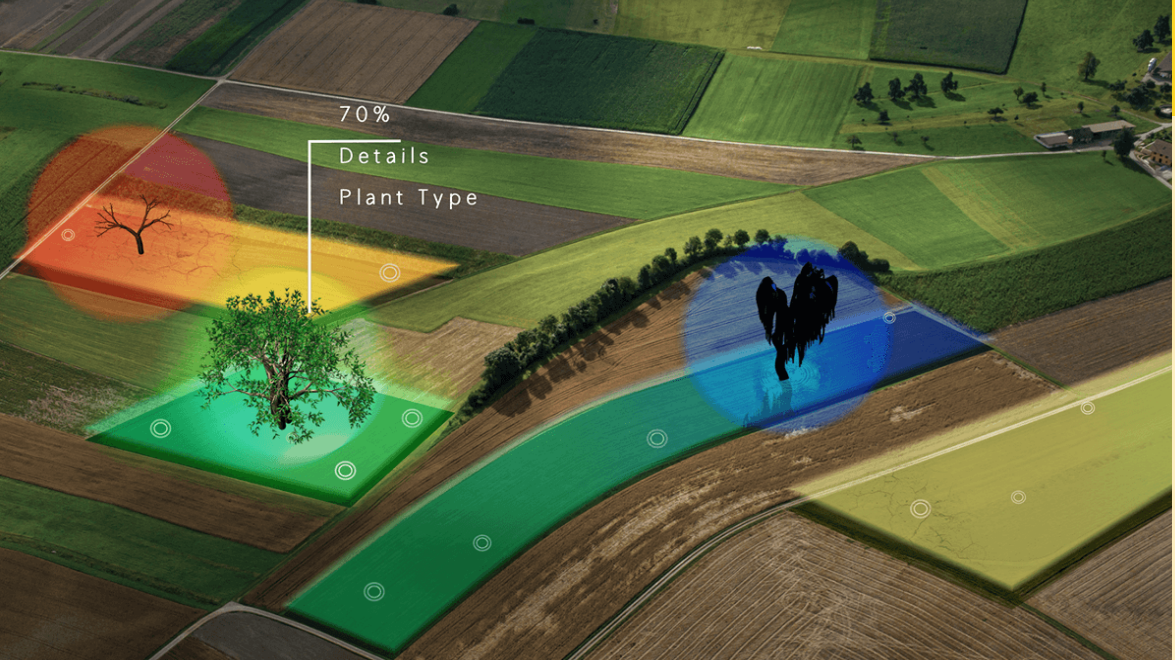
Ultra-thin temperature sensor is biodegradable and biocompatible

Engineers have developed biocompatible microsensors that can be attached to food to measure temperature and check freshness.

Microsensors are already being used for many everyday applications, and are being integrated into RFID chips for innovative uses such as tracking luggage or stopping bike theft. However, as the sensors usually contain heavy metals, which are harmful to human health, they cannot currently be used for applications that involve food or internal medicine. Recently, however, engineers at ETH Zurich University have developed biodegradable temperature microsensors which may one day be safe enough to be used with food.

The new microsensors are created by enclosing a superfine electrical filament made of magnesium, silicon dioxide and nitride inside a compostable polymer made from corn and potato starch - all materials that are safe for human ingestion. The sensor is thinner than a human hair and weighs just a fraction of a milligram. Researchers connected the sensor to an external micro-battery using ultra-thin, biodegradable zinc cables. In addition to a microprocessor, the sensor contains a transmitter capable of sending temperature data via Bluetooth. This makes it possible to monitor the temperature of a product over a range of 10 to 20 meters (30-60 feet).

Although producing the sensors is currently an expensive and time-consuming process, lead researcher Giovanni Salvatore believes that it will soon be possible to mass produce the sensors. He envisions them being used to incorporate food products into the Internet of Things; for example, by fitting individual fish with sensors to monitor temperature fluctuations during shipment. Although more research is required before the biodegradable sensors are deemed safe for human use, and the team is still searching for a biocompatible energy source to power the sensors, Salvatore predicts that within ten years they will be part of our everyday lives. What uses will there be for a tiny, biocompatible sensor?



At a Glance

SECTOR
Agriculture / Farming

WHAT
Israeli startup hopes the data collated from soil-embedded sensors will strengthen and evolve the agriculture industry.

WHO
Viridix

WHERE
Israel

CONTACT
www.viridix.com
info@i-dripper.com

Analytics from soil sensors could revolutionise agriculture

Israeli startup hopes the data collated from soil-embedded sensors will strengthen and evolve the agriculture industry.

While many industries have adapted to the digital age and all it has to offer, agriculture has continued with its offline approach to business. Israel-based Viridix hopes to change this with its network of sensors distributed in land and fields that collect soil analytics. Data collated will be available to app developers to build tools that could help those in the industry boost their efficiency and explore new approaches to their work.

The sensors monitor ground moisture levels and act as real-life root collecting crucial data to allow farmers and growers to optimize decision making and automatization. The "RootTens" technology measures every important parameter in the soil and transmits it to the cloud. Partner technology i-Dripper supports this solution, acting as an accurate irrigation system that feeds each plant separately according to its needs. The system does not need electricity to operate, requiring just minimal water resources to assess the needs of the plants in its ecosystem. This ensures plants are watered just enough and water isn't wasted.

Expanding the agriculture industry and assisting it digitally is a sector that has much room for improvement and exploration. A recent deal to create an 'agricultural city' spanning over 311,000 acres shows the scope for industry expansion, while a land restoration project to install water reservoirs in dry areas to boost vegetation growth is another innovation approach to helping growth in all senses. How else can technology support crop growth in the most desperate areas?

At a Glance

SECTOR
Agriculture / Animal farming

WHAT
Cowlar is a wearable for cows that is designed to help farmers more easily track the health, fertility, location and general activity of their cattle.

WHO
Cowlar

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Pakistan

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Fitbit for cows helps Pakistan farmers keep herds healthy

Cowlar is a wearable for cows that is designed to help farmers more easily track the health, fertility, location and general activity of their cattle.

Despite being one of the world's major milk-producing countries, Pakistan's average milk yield per cow is far below that of other nations. The founders of Cowlar, a startup based in Islamabad, Pakistan, believe that by increasing the efficiency of each farmer's herd by even five percent, more than USD 1 billion could be added to the country's economy. Using Cowlar - a wearable for cows that tracks their temperature, activity, health and fertility - could help accomplish that increase in productivity.

An easy to fit collar, the Cowlar is waterproof and has a six month battery life. Using motion sensors, the collars wirelessly send data to farmers via a solar powered base and cellular service towers. Depending on their personal preference, farmers can access their herd's information via text, automatic phone call and through an online dashboard. Interest in the collar has been widespread, and Cowlar says that it will expand globally after doing more local development work. Currently the collar costs USD 69 with a USD 3 monthly subscription fee after the first three months.

With such disparity between the food wasted in some countries and starvation in others, farming has the potential to significantly redress the imbalance. A connected farm-in-a-box is now available to help communities become more self-sufficient, and apps are being used by a variety of agencies to help farmers better prepare for potential natural disasters. How could farming communities in different countries use technology to help support each other?

At a Glance

SECTOR
Energy

WHAT
The solar-powered platform provides affordable energy and connectivity in emergency situations and for daily activities.

WHO
Kumbaya

WHERE
United States

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New solar-powered communications hub connects off-grid communities

The solar-powered platform provides affordable energy and connectivity in emergency situations and for daily activities.

Kumbaya's goal for its zeroXess connectivity platform is to reach a billion or more of the residents around the world who are not yet online. Currently, four billion people globally are not connected to the internet. More than one billion people do not have regular, reliable access to electricity. By solving the electricity challenge with a sustainable smart solution, Kumbaya will make a significant impact on the United Nations' number one sustainable development goal. Furthermore, increasing access to technology, education and infrastructure should mean that poverty will be on the decline.

Sustainability is, of course, a key component of the company's zeroXess product and platform. The home energy system uses 120 watt solar panels to run the touch-screen connectivity hub. The hub has six USB ports, four LED fixtures and built in health sensors. This allows for direct one and two-way communication. Local radio and television stations are broadcast by the hub, as well as internet access. It endeavours to provide educational and entertaining content for all. The content library contains lessons on topics as diverse as entrepreneurship, literacy, nutrition and agriculture. Moreover, the company is always looking for material with which to expand.

The system also makes available the ability to send and receive money securely. This opens up an entire new world to small businesses and local entrepreneurs. Making the zeroXess system affordable is crucial to its success. It is something the company is continuously working on with a number of partners to help make the system as widely available as possible.

Other projects using mobility and renewable energy as the means to bring resources to remote communities include a portable sterilizer and a traveling recycling plant. The sterilizer makes surgery accessible and safe for communities without reliable sources of water and electricity. And the mobile recycling machine turns plastics into indoor/outdoor tiles. What type of information and support could be particularly useful for citizens immediately after they gain regular access to the internet?

At a Glance

SECTOR
Nature conservation

WHAT
The Zoological Society of London is collaborating with a non-profit to develop a sensor and satellite network.

WHO
ZSL

WHERE
United Kingdom

CONTACT
www.zsl.org
www.zsl.org/contact-us

Internet of Things tackles global animal poaching

The Zoological Society of London is collaborating with a non-profit to develop a sensor and satellite network.

ZSL (Zoological Society of London), one of the most famous zoos in Europe, has teamed up with non-profit technology company Digital Catapult to support the development of anti-poaching technology. The partnership will use the Internet of Things (IoT) and Low Power Wide Area Network (LPWAN) technologies to create a sensor and satellite-enabled network that will be able to help conservationists monitor wildlife and respond to poaching threats on land and sea in some of the world's most remote national parks.

Up to 35,000 African elephants were killed by poachers in 2016, and black rhino and mountain gorilla populations continue to be at high risk. LPWAN could help prevent poaching in game reserves by enabling remote sensors to communicate with one another over long distance while using only a small amount of power. These connected sensors are able to detect activities nearby and determine whether these originate from wildlife or poachers, creating immediate alerts for those monitoring the area.

Digital Catapult has installed a LPWAN base station at the ZSL headquarters at London Zoo, which will enable prototypes to be tested on site. This technology will build on the revolutionary work already underway in areas including Kenya, Nepal, Australia, the Chagos Archipelago, and Antarctica.

The practise of poaching has been the target of many technology companies, with a similar project using artificial intelligence to monitor poachers recently coming to light. One of the many devastating impacts of poaching is the potential to cause extinction of some animals, and one startup has tackled this potential catastrophe with rhinos by producing a 3D printed horn that could help the species avoid being a target. As more innovations of this nature continue to astound Springwise, how else could technology help wild animals facing threat?

At a Glance

SECTOR
Waste management / Sustainability

WHAT
Poland-based firm has created an intelligent waste bin capable of separating recyclables on site, as well as storing data in the cloud.

WHO
Bin-e

WHERE
Poland

CONTACT
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IoT garbage bin automatically sorts waste and collects data

Poland-based firm has created an intelligent waste bin capable of separating recyclables on site, as well as storing data in the cloud.

While we've seen plenty of innovations looking at creative ways to repurpose waste plastic (as fine kitchenware, for instance), there's also a movement towards creatively increasing the amount of successful recycling that takes place, such as this gamified waste disposal campaign in a Dutch campus, and now here's a bin that does the recycling for users.

Poland based Bin-e has developed a futility automated garbage bin that's small enough to fit discreetly into office spaces. Bin-e was borne out of the realization that office employees, though well intentioned, are often confused by segregated recycling recepticles, placing objects in the wrong units, resulting in both increased garbage (due to contamination) and/or increased labor costs of sorting. While details of exactly how Bin-e will process different items remain elusive, users basically drop a piece of waste into a top compartment that's capable of figuring out exactly what kind of material that waste is, be it a glass bottle or a plastic container. After deciding what category the object belongs to, the waste will be processed into that specific compartment and consequently compressed, thereby increasing storage capacity. Moreover, Bin-e is connected to an IoT cloud, sending and storing data and waste usage that can then be shared with a waste disposal company, the idea being that waste only has to be collected when storage is full, saving time and labor costs. While a working pilot version is almost ready, office and other contextual bins will be available in 2018, with Bin-e predicting that a switch to its bins could improve recycling rates for businesses up to 80-percent.

We've seen how trash collection is being automated using an aqua drone — what other ways can technology help humans to help themselves when it comes to waste?

At a Glance

SECTOR
Hygiene / Sustainability

WHAT
Germany's Fraunhofer Institute for Integrated Circuits worked with CWS-boco International GmbH to create a smart washroom sensor system for quicker cleaning.

WHO
Fraunhofer Institute for Integrated Circuits

WHERE
Germany

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Intelligent sensors improve washroom maintenance efficiency

Germany's Fraunhofer Institute for Integrated Circuits worked with CWS-boco International GmbH to create a smart washroom sensor system for quicker cleaning.

Bathrooms, washrooms, restrooms, loos... whatever the spaces are called, they are companies' highest maintenance rooms. Soap, toilet paper and hand towels constantly need refilling, making the washrooms in large buildings extremely time consuming to clean and maintain. With the intelligent sensor CWS Washroom Information Service created by Germany's Fraunhofer Institute for Integrated Circuits and CWS-boco International GmbH, cleaners can now better plan for and respond to the requirements of each building's washrooms.

Battery operated sensors measure the levels of materials in each dispenser and, using wireless Bluetooth technology, transmits the data to a central Washroom Control Unit. Using the Fraunhofer Institute's proprietary technology, the central unit then sends the information and alerts to the companies' cleaning team. Individual cleaners can use the app to make real-time adjustments to the scheduled rota, as needed. Using the data dashboard, management teams can review short and long term patterns of consumption for better overall administration of a company's resources.

Creating stronger, more intelligent connections helps many aspects and types of business, from trackable herds to smart beer taps, run more efficiently. What analog areas of work could be linked up for new methods of use?

At a Glance

SECTOR
Glass windows / Sustainability

WHAT
View's windows tint automatically according to the weather conditions and can be controlled by a smartphone app.

WHO
View

WHERE
United States

CONTACT
viewglass.com
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Now windows have entered the Internet of Things

View's windows tint automatically according to the weather conditions and can be controlled by a smartphone app.

Window glare is something that have been solved for decades with simple blinds, but now a glass company is making windows smarter and more energy efficient, bringing in auto-tinting that can be controlled by a mobile phone. View's Dynamic Glass offers connected windows that can be programmed to darken or brighten depending on outdoor conditions, and prevent glare in doing so.

The system tracks the location of the sun using a sensor, and gathers information on light conditions from the internet. View offers a smartphone app that connects to the window's IP address, connecting them to the network of IoTs and enabling them to be controlled independently.

The tint is controlled by a very low electrical current that allows it to change the pattern of electrons to make the windows appear clear or opaque. View says their technology, by helping to prevent the loss of heat or reduce air conditioning usage, can actually cut energy consumption by up to 20 percent. The company has installed its windows at buildings across the US, including the Levi's Stadium of the San Francisco 49ers football team.

Could View's Dynamic Glass be combined with these stained glass windows that doubles as solar panels, to create the ultimate eco-friendly, new generation window?

At a Glance

SECTOR
Automotive

WHAT
AudioHound sound recognition software can be used to monitor a car's mechanical health and environmental surroundings.

WHO
OtoSense

WHERE
United States

CONTACT
www.otosense.com
twitter.com/otosense

Start-up develops app which gives cars ears

AudioHound sound recognition software can be used to monitor a car's mechanical health and environmental surroundings.

Car owners who aren't in tune with their vehicle's clunks and squeaks will eventually be able to install software that listens to mechanical sound for them. A new start-up OtoSense is developing the AudioHound app, which currently runs in prototype-form on tablets but the company hopes to license to car manufacturers with a means of building it into the car's internal technology.

The idea is that it will be able to hear every distinct sound a car makes, from engine revs to clutch shifts, and will know if something's not right. Often getting defective parts fixed early can be much cheaper (and safer) for the customer, plus the software is said to be so advanced it can even detect general wear and tear over time by tiny subtle audio changes.

The other main use for AudioHound is listening to what's going on outside the vehicle. Microphones would be placed to listen to the exterior, so it could detect emergency services vehicles, listen to the road surface noise - it could contribute significantly towards advances in self-drive cars.

It's not the only automobile feedback innovation we've seen lately, with Pirelli's smart tires informing users of tire condition. And driverless cars are starting to get closer to a pragmatic reality, with Adrian Flux offering insurance specifically for the mode of transport. The applications for such advanced artificially hearing are endless - what other areas of day-to-day life could be improved with such tech?

At a Glance

SECTOR
Safety at work

WHAT
France-based startup patents technology for smart shoes that reduce the need for other wearables and helps industrial workers keep in touch via toe-tapped codes.

WHO
Intellinium

WHERE
France

CONTACT
intellinium.io
twitter.com/intellinium

Smart shoe sends and receives hands-free morse code messages

France-based startup patents technology for smart shoes that reduce the need for other wearables and helps industrial workers keep in touch via toe-tapped codes.

With thousands of workers dying in work-related accidents every year, French company Intellinium was founded to help increase personal safety. The startup hopes that their new patented technology will help predict accidents and reduce emergency response time for injured workers.

Intellinium's new design aims to transform a passive work equipment into an active wearable. Ideally, the connected shoe will help reduce electronic and other hardware use and waste, as well as the number of different wearables required for full protection. The smart system uses a pressure point inside the shoe that the wearer pushes with his or her big toe. Messages are sent and received via a series of long and short alphabet symbols, like Morse code. Should the wearer be unable to use foot pressure to communicate, an external membrane allows for messaging by hand.

As cities become increasingly connected, workplace safety is of growing concern, particularly in industries of heavy manual labor. On-site health and safety monitoring is often easier than providing enough and appropriate wearables and is a good first step for increased worker safety. Connected to the cloud, this startup's safety monitoring tool checks environmental hazards such as noise, pollutants and UV levels and issues on-site and remote alerts if safe levels of any are exceeded. As technology and materials advance, wearables are becoming increasingly strong and flexible. Designed specifically for industrial workers, this small device tracks a wearer's actions to provide suggestions for reducing the risk of back injury.

Safety shoes and boots are the single piece of personal protective equipment worn by all manual laborers. What other industries have a similarly ubiquitous piece of machinery, equipment or clothing that could be connected for increased efficiency and safety?

At a Glance

SECTOR
Public safety

WHAT
US innovation equips firefighters with real time information to help them respond to emergencies.

WHO
NASA's Jet Propulsion Lab and the US Department of Homeland

WHERE
United States

CONTACT
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The Internet of Things meets firefighting

US innovation equips firefighters with real time information to help them respond to emergencies.

NASA's Jet Propulsion Lab and the US Department of Homeland Security are developing a machine learning system to help feed relevant information and recommendations to firefighting teams in real time. The Assistant for Understanding Data through Reasoning, Extraction and sYnthesis, or AUDREY, is an AI system that gathers data on emergency situations and guides responders, enabling them to better deal with situations.

Equipment to help first responders safely and effectively save lives and minimize damage is constantly evolving — such as devices designed to improve navigation in smoke-filled buildings through vibrations or thermal imaging. The new system was designed to be part of the IoT and to coordinate those kinds of wearable technologies. For example, the whereabouts of each responder can be tracked through GPS, and sensors in the uniforms could track the concentration of dangerous chemicals or gases in the air, and the temperature in different parts of the building. "When first responders are connected to all these sensors, the AUDREY agent becomes their guardian angel," says Edward Chow, the research's program manager. "Because of all this data the sensor sees, firefighters won't run into the next room where the floor will collapse."

Springwise has previously covered an innovation that helps those in an emergency receive advice on how to deal with the situation. How else could AI be used to manage IoT devices to help save lives?

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