

Technology Scan

Focus: Fourth Industrial Revolution technologies for inclusive and sustainable development

AFRICA

SOUTH AFRICA

Cloud, AI to improve food security

Startup, Omniolytics, has turned to IBM to help transform poultry farming through digital platforms that use sensors and IBM Watson running in the IBM Cloud. Omniolytics develops smart farming solutions for emerging and commercial poultry farmers. The local poultry industry today has a number of challenges ranging from the quality and origins of feeds, high feed prices, and the recurrence of avian influenza and disease outbreaks such as listeriosis and salmonellosis.

Working with IBM, Omniolytics has developed a new approach that uses Internet of Things (IoT) technologies to collect data on the environmental conditions of production facilities and day-to-day management activities and processes of poultry to improve animal health, mitigate losses, and assist producers in improving production efficiency, helping address food security concerns. The suite of solutions uses IBM Watson and machine learning capabilities to identify and learn the typical behaviour of birds—and leads to improved management practices. Farmers are then able to receive a more complete picture of the well-being of their flocks delivered on IBM Cloud identifying processes and environmental deviations which could point to a potential problem.

<https://it-online.co.za>

ASIA-PACIFIC

AUSTRALIA

IoT turns agri waste into renewable energy

Melbourne-based renewable energy company, AgBioEn, is using a combination of IoT devices, drones, and telemetry as part of an AUD 2 billion initiative to turn agricultural waste into renewable fuels. The company plans to take waste from high-yielding, sustainably grown crops and then process it to produce renewable

diesel, bio-jet fuel, LPG, heat (for on-farm glasshouses), food-grade liquefied CO₂, and a soil nutrient that can be plowed back to grow more crops.

Working with La Trobe University and Microsoft partner LAB3, AgBioEn is running a series of on-farm trials, growing different crops under different conditions. It has used IoT sensors and devices to monitor the health and growth of the crops with telemetry and drone data held in an Azure Cloud Edge Computing Platform. Data analytics tools and dashboards are available for La Trobe researchers and farmers that partner with the company. Crop trials will continue for the next 3–4 years, while AgBioEn will complete its fuel manufacturing facility design this year, with construction scheduled to start early next year with fuel produced from 2023.

LAB3 has helped design the crop testing system, which sees data from farm-based sensors and drones uploaded via LoRaWAN networks into an Azure IoT Hub. Stream analytics performs an initial analysis of the stored data in an Azure Data Lake and available for analysis through Azure Cosmos DB.

<https://www.cdottrends.com>

Recycling robot for soft plastic waste

Working alongside industry partners as part of a federal government Cooperative Research Centre Project grant, researchers from the Centre for IoT and Telecommunications at the University of Sydney are developing a unique method to increase recycling of soft plastics—by creating a smart, automated robotic system that uses robotics and Artificial Intelligence (AI) to sort recyclable waste.

The researchers are working with waste management companies, IQRenew and CurbCycle, technology developers Licella, Mike Ritchie and Associates, and Resource Recovery Design to develop the system. It will be integrated into IQ Renew's material recovery facility as part of CurbCycle's soft plastic recovery program, an Australian initiative that involves the household collection of recyclables that are segregated into bags prior to placing them into their kerbside recycling bin.

After being separated from other waste, the soft plastics will be used for various purposes, including advanced recycling into oils and other valuable chemicals using patented Catalytic Hydrothermal Reactor technology (Cat-HTR™) created by Licella Holdings.

<https://www.eurekalert.org>

CHINA

AI-powered drug discovery framework

Ping An Insurance (Group) Company of China has reported that its researchers have come up with a deep-learning framework for drug discovery. The researchers created a new AI-driven framework for drug discovery called MPG that learns molecular representations from large volumes of unlabeled molecules. They also made their own graph neural networks (GNN) model called MolGNet for modeling molecular graphs.

Ping An said drug discovery can take between 10 and 15 years. AI technologies have been employed to speed up the process, particularly in molecule drug design, drug–drug interaction and drug–target interaction predictions. Yet, molecular designing remained a challenge given the dearth of labeled data for training datasets. To this end, the research team worked with GNN technology, a model that can be pre-trained with unlabeled data instead of relying on labeled data. In their research, the team crafted a self-supervised pre-training strategy named Pairwise Half-graph Discrimination. It found that after pre-training the MolGNet on 11 million unlabeled molecules, it captured “meaningful” patterns of molecules to produce an interpretable representation.

“The pre-trained MolGNet can be fine-tuned with just one additional output layer to create state-of-the-art models for a wide range of drug discovery tasks, including molecular properties prediction, drug–drug interaction and drug–target interaction, on 14 benchmark datasets,” the researchers said in their study's abstract. They also said their own GNN model has the potential to become an “advanced

molecular encoder in the drug discovery pipeline.”

<https://www.mobihealthnews.com>

Multi-modal AI

When Open AI's GPT-3 model made its debut in May of 2020, its performance was widely considered to be the literal state of the art. Capable of generating text indiscernible from human-crafted prose, GPT-3 set a new standard in deep learning. But oh what a difference a year makes. Researchers from the Beijing Academy of Artificial Intelligence recently announced the release of their own generative deep-learning model, Wu Dao, a mammoth AI seemingly capable of doing everything GPT-3 can do, and more.

First off, Wu Dao is flat out enormous. It's been trained on 1.75 trillion parameters (essentially, the model's self-selected coefficients) which is a full 10 times larger than the 175 billion GPT-3 was trained on and 150 billion parameters larger than Google's Switch Transformers. In order to train a model on this many parameters and do so quickly—Wu Dao 2.0 arrived just 3 months after version 1.0's release in March—the BAAI researchers first developed an open-source learning system akin to Google's Mixture of Experts, dubbed FastMoE. This system, which is operable on PyTorch, enabled the model to be trained both on clusters of supercomputers and conventional GPUs. This gave FastMoE more flexibility than Google's system since FastMoE doesn't require proprietary hardware like Google's TPUs and can therefore run on off-the-shelf hardware—supercomputing clusters notwithstanding.

With all that computing power comes a whole bunch of capabilities. Unlike most deep-learning models which perform a single task—write copy, generate deep fakes, recognize faces, win at Go—Wu Dao is multi-modal, similar in theory to Facebook's anti-hatespeech AI or Google's recently released MUM. BAAI researchers demonstrated Wu Dao's abilities to perform natural language processing, text generation, image recognition, and image generation tasks during the lab's annual

conference. The model can not only write essays, poems, and couplets in traditional Chinese, it can both generate alt text based off of a static image and generate nearly photorealistic images based on natural language descriptions. Wu Dao also showed off its ability to power virtual idols (with a little help from Microsoft-spinoff Xiaolce) and predict the 3D structures of proteins like AlphaFold.

<https://www.engadget.com>

AI platform to sort garbage

A team of researchers participating in Huawei's Cloud Garbage Classification Challenge created the aptly named GarbageNet, an AI platform for sorting different types of refuse.

As per the research team's paper:

“We present a novel incremental learning framework, GarbageNet, to address the aforementioned challenges. Firstly, weakly-supervised transfer learning guarantees the capacity of feature extractor. Secondly, for new categories of garbages, GarbageNet embeds them as anchors for reference and classifies the test samples by finding their nearest neighbors in the latent space. Thirdly, an attentive mixup of training data is utilized for suppressing the negative effect of mislabeled data.”

GarbageNet can't work alone; it's a brain looking for a body. If the team can either develop their own robots or pair with a company that specializes in mechanical sorting equipment, this could go a long way toward solving our trash problems.

<https://thenextweb.com>

INDIA

IoT-based device for silk supply chain

Karnataka-based silk agritech startup ReshaMandi is helping to bring different strands of the industry together through IoT and other app-based services. “The silk supply chain always had a problem of not knowing exactly what they are producing in terms of quality. Silk [mulberry] farmers cannot understand the price fluctuations for their cocoons, while reelers who function like

cartels, using arbitrary testing methods, can be biased against a product from certain regions. We are trying to change this by using quality as the benchmark for not just pricing, but also production,” says Mayank Tiwari, founder and CEO of the silk agritech startup ReshaMandi, based in Bengaluru.

Tiwari co-founded ReshaMandi with Saubh Agarwal and Utkarsh Apoorva in April last year to digitize sericulture production from farming, thread processing (reeler units) to fabric weavers, and business organizations with platforms based on AI and IoT.

The startup initially helped to solve the logistics problems faced by sericulture farmers and reelers due to the lockdown's transport restrictions. Over the past year, its app-based services have grown to include cocoon sourcing and grading, farmer advisories on mulberry cultivation, disease detection in *chawki* (young silkworms), and fair price marketing. It has also tied up with Bengaluru-based agritech startup Fasal, in an innovative precision farming project that aims to save water resources while increasing the mulberry leaf yield. To speed up the process, ReshaMandi ensures that cocoon grading results are available within a day. By removing the geographical details, the startup tags the cocoon lots by their tested quality scores, which guarantees a fair price.

At the farming level, ReshaMandi offers two IoT devices, one to monitor the soil's carbon and moisture content, and the other to maintain ideal air quality, temperature, and humidity levels in the rearing shed. While the app is free to use, the devices are available on monthly subscription.

The devices are connected with an app installed on a farmer's smartphone (for Android 5.0 and up). The in-house developed app is available on Google Play Store as “ReshaMandi, The New Silk Route.” Sensors installed in the field and rearing sheds enable ReshaMandi to send textual advice through the phone, with follow-up calls if required.

<https://www.thehindu.com>

Automated rainwater harvesting system

Students of the National Institute of Technology Andhra Pradesh (NIT-AP) have devised a unique solution with innovation and technology. Calling themselves Team LinkLer, the group has developed a “Wi-Fi mounted Microcontroller” that integrates sensors for smart harvesting of rainwater and creates a system which does the job without human intervention. This system can automate the process of water storage, reduction in water-borne diseases, and efficient storage. Team LinkLer aims to address the problem of water shortage in Indian cities by deploying DeepTech such as IoT and machine learning.

The team has developed an end-to-end Software Stack that provides an easy interface to manage and control in-house water resources. The system monitors wastewater and supply systems such as rainfall recorded, water remaining in the storage tank, water quality index, and water supply in a given area. The students have also designed an underground storage tank with a material capable of holding the water on a long-term basis. The treatment process is monitored on a feedback IoT system.

The system strives to bring autonomy in the entire rainwater harvesting process and overall water utility in one’s home. They integrate tank depth sensors for available water quantity in the main and secondary tank, and use weather patterns for rainfall estimates using machine learning. Further, estimation of storage from rainwater in the additional tank is done in coordination with the main water supply source as well.

There are two versions of this system. One comes with a mechanical tank setup, while the other integrates the microcontroller and flow meter/sensor into the existing supply. The product’s concern is to make users aware of their water usage pattern and make the management process hassle-free. The fact of more “information-based water usage” can drive our concern toward proper addressal of the rising water crisis, the team says.

<https://www.thebetterindia.com>

IoT device to record real-time ambient temperature

Indian Institute of Technology in Punjab’s Ropar has developed a first-of-its-kind IoT device—AmbiTag. The institute stated that the device records real-time ambient temperature during the transportation of perishable products, body organs, and blood, vaccines, etc. AmbiTag is a USB-shaped device that continuously records the temperature of its immediate surroundings from -40°C to 80°C in any time zone for a full 90 days on a single charge.

Most of the similar devices available in the international market record data only for a duration of 30–60 days. AmbiTag has a range of inbuilt features to customize logging intervals, time zone, and alarms, said Dr. Suman Kumar, the coordinator of the IoT Systems Domain at the Agriculture and Water Technology Development Hub (AWaDH). He said AmbiTag is a certified device priced below ₹1,000 to ensure the broader use of the device in different applications. “It generates an alert when the temperature goes beyond a pre-set limit. The recorded data can be retrieved in user-defined format by connecting the USB with any computer.”

“The AmbiTag temperature data log advises the user whether the transported item is usable or the cold chain has been compromised during the transportation. This information is particularly critical for vaccines, organs, and blood transportation in the Indian scenario.”

“AmbiTag in India is developed by the researchers at the IIT Ropar Technology Innovation Hub - AWaDH and its startup ScratchNest. The ScratchNest is an IoT technology startup founded by four IIT Ropar students. AmbiTag is waterproof and monitors ambient temperature during the transportation of vaccines, including Covid-19, medicines, blood samples, food and dairy products, meat products, and animal semen. So far, such devices are being imported by India in a massive quantity from other countries, such as; Singapore, Hong Kong, Ireland, and China.”

<https://www.thehindu.com>

Blockchain-based healthcare systems

Indian Institute of Technology Madras researchers have developed “BlockTrack,” a first-of-its-kind blockchain-based secure medical data and information exchange system for a mobile phone-based application, which is currently being field-tested at the institute’s hospital. A release said BlockTrack aims to securely digitize healthcare information systems while ensuring protection of sensitive personal information and medical records by decentralizing the control and ownership of patient data, through a blockchain-based innovation. The BlockTrack innovation is now protected through a provisional IP filed with the Indian Patent Office.

The Android version has been developed separately for patients and doctors. It opens up universal and transferable healthcare information management with a strong emphasis on data privacy and tracking the spread of infectious diseases across geographies. It allows the interoperability of systems from multiple hospitals, institutes, and healthcare organizations. The patient can choose to visit any healthcare facility which is on BlockTrack’s blockchain network without any concerns about duplication of records or re-registrations, said the release.

BlockTrack is developed by a team led by Prabhu Rajagopal, Lead Faculty for Remote Diagnostics, Center for Nondestructive Evaluation (CNDE), Department of Mechanical Engineering, IIT Madras. This is one of the first implementations of blockchain technology for securing Healthcare Data Management Systems and we see immense impact this approach can make in securely digitizing and maintaining unique patient records across the country and indeed across the world eventually.

<https://www.newindianexpress.com>

REPUBLIC OF KOREA

Cardiovascular event prediction model

The Korea Institute of Machinery and Materials (KIMM), said its researchers have

developed a cardiovascular event prediction model that enhances the speed and accuracy of disease diagnosis. Researchers led by Dr. Jong-won Park, head of the institute's Department of Reliability Assessment, collaborated with the cardiology research group at Daejeon St. Mary's Hospital. KIMM said in a statement the research team integrated the big data deep-learning technology used in checking the reliability of mechanical parts and equipment into ultrasound imaging equipment.

According to KIMM, the new technology utilizes a graphics processing unit to achieve a diagnosis time of 30 minutes with 80% accuracy. Using AI deep learning, the researchers came up with the model through automated analysis of aortic atherosclerotic plaque. The research institute said they were "successful in confirming the effectiveness of such methods."

In their study, the research team adopted a fresh approach toward creating a deep-learning model that can be deployed to classify aortic plaque and measure plaque thickness. They applied standard machine learning techniques, such as autoencoder and U-Net models, to differentiate ultrasound images of the aortic wall, which was identified to confirm the conditions of any aortic atherosclerotic plaque—a risk factor for stroke. KIMM noted that the researchers plan to modify the deep-learning model to improve the accuracy of aortic plaque analysis. They also intend to expand the technology to be used along with imaging data for spotting faults and failures in building virtual engineering platforms for manufacturing future transportation equipment parts.

<https://www.mobihealthnews.com>

AI technology to visualize location and size of sound source

Researchers have developed AI technology that can accurately and quickly visualize the location and size of sound sources. It is useful in tracking the location of disaster survivors, gas spills, and leaks. An empirical test will be conducted in 2022 to search for missing people with a drone equipped with high-performance microphones.

The technology developed by researchers from the Korea Research Institute of Standards and Science (KRISS) and Pohang University of Science and Technology (POSTECH) is 10 times more accurate than previous technologies and the time of arithmetic operation is about one-tenth.

"We will carry out continuous research so that technology can be commercialized and bring innovation to existing markets," Chang Ji-ho, a KRISS researcher, said in a statement released by POSTECH. In defense, the technology can be used to find the location of enemy firearms. POSTECH said that deep-learning algorithms can accurately distinguish the location and size of individual sound sources even under unfavorable conditions where many sounds are mixed and visualize them like a map for easy location.

Tracking the location of sound sources through unmanned aerial vehicles such as drones is not so precise and performance degradation is inevitable due to noise. Because tracking technology developed by the joint research team provides more than 10 times more accurate information than before, it can be used in adverse conditions with noise. Researchers installed 56 speakers in a spherical form in a laboratory to implement various acoustic data. POSTECH said the new technology would contribute to the success of various drone missions such as reconnaissance, transportation, and rescue.

<https://www.ajudaily.com>

VIET NAM

IoT solutions for rural areas

Kerlink is teaming up with Vietnamese IoT startup Cloud Energy in building new solutions to meet demand for IoT services in rural areas around Ho Chi Minh City (HCMC), expanding on their earlier collaboration on smart-building and energy-management projects in the city of nearly 9 million people. The two companies recently developed and deployed a fully wireless LoRaWAN network to monitor and manage a 900-kWp solar-power installation on a mushroom farm 80 km from the city. The installation of the wire-

less solar-power system was chosen by NG Investment for its superior advantages: stability of data reading, ability to connect to different inverter brands, and the cost savings on investment and maintenance.

The IoT upgrade included Kerlink's long-range, low-power Wirnet iStation gateways and its Wanesy Management Center to operate and manage the new system, and Cloud Energy's advanced LoRaWAN-based meter and devices for data management, optimized to meet the rigorous requirements of utility scaling. The system is expected to reduce the owners' operation and maintenance costs by 30% annually compared to the previous system. New installations are expected to shave 30% off the cost of a new wired monitoring system.

Cloud Energy uses advanced technologies and developing tailored IoT solutions for its markets in smart utilities management, smart buildings, and smart cities. Based in HCMC, the company provides advanced wireless solutions, including wireless mobile routers and cloud management platforms, optimized to meet the rigorous requirements of utility scaling to provide a best-in-class solar monitoring for energy efficient solutions.

<https://futureiot.tech>

EUROPE

BELGIUM

Stroke care with AI

Clinicians are using AI to help triage patients they suspect may have had a stroke. Aidoc, a provider of AI-powered tools for medical imaging, and icometrix, a Belgian imaging firm, have teamed up to provide an advanced end-to-end AI stroke package for patients.

The package includes icometrix's FDA-cleared CT analysis tool and Aidoc's FDA-cleared AI stroke solution which detect bleeding inside the skull and if a stroke has happened. Aidoc's algorithms analyze medical images directly after the patient is scanned, before notifying physicians within the imaging workflow. It is customizable and provides cutting-edge AI-

powered care coordination with real-time sharing, viewing, and chatting.

“Aidoc’s care coordination suite facilitates rapid triage and communication of patients with suspected stroke, alerting physicians and speeding up access to lifesaving treatment” explains Ariella Shoham, Vice President of Marketing at Aidoc. “The solution is always-on, always running behind the scenes without requiring physician activation. Suspected stroke patients are automatically flagged directly after the scan is performed and a notification is sent simultaneously to team members including neurosurgeons, stroke teams, radiologists and emergency department physicians” she adds.

<https://healthcareglobal.com>

POLAND

Smart city blockchain solution

Orange and technology company Smartkey, are partnering to deliver blockchain technology that will manage access control, smart bikes, utilities, and other elements of smart cities. Firstly, the two will extend Smartkey’s “Rescue without Barriers” pilot, which enables rescue services in Olsztyn, Poland use Smartkey to gain immediate access to every secure district and building in the area, using blockchain, reducing response times.

“Smart devices are not a new idea. Already over 2 million M2M cards from Orange work, among others, in such devices throughout Poland,” said Sebastian Grabowski, director of IoT and advanced technologies at Orange. “However, even a wide range of such devices does not create a network in itself, just as a collection of houses does not create a city. We also need an infrastructure that connects IoT technology with the end user, and this is what blockchain provides.”

Together, this will be deployed to more than 80 cities across Poland which uses Orange’s IoT solutions integrated with the Live Objects IoT platform. The Live Objects platform is already being used to manage a number of city services, including remote reading of water meters or street lighting control. The integration of the Live

Objects platform enables the ability to register devices with an Orange SIM card in the blockchain network and to generate and distribute Smart NFT access keys in the SmartKey blockchain network. The specificity of blockchain technology based on decentralized applications (dApps) and Orange network security standards prevent unauthorized use of the “virtual key.”

<https://www.capacitymedia.com>

UK

AI to monitor water quality

AI that enhances remote monitoring of water bodies—highlighting quality shifts due to climate change or pollution—has been developed by researchers at the University of Stirling. A new algorithm—known as the “meta-learning” method—analyzes data directly from satellite sensors, making it easier for coastal zone, environmental and industry managers to monitor issues such as harmful algal blooms (HABs) and possible toxicity in shellfish and finfish.

Lead author Mortimer Werther, a PhD Researcher in Biological and Environmental Sciences at Stirling’s Faculty of Natural Sciences, said: “Currently, satellite-mounted sensors, such as the Ocean and Land Instrument (OLCI), measure phytoplankton concentrations using an optical pigment called chlorophyll-a. However, retrieving chlorophyll-a across the diverse nature of global waters is methodologically challenging. “We have developed a method that bypasses the chlorophyll-a retrieval and enables us to estimate water health status directly from the signal measured at the remote sensor.”

“This research, funded by the European Union’s Horizon 2020 programme, is the first demonstration that trophic status of complex inland and nearshore waters can be learnt directly by machine learning algorithms from OLCI reflectance measurements. Our algorithm can produce estimates for all trophic states on imagery acquired by OLCI over global water bodies.

“Our method outperforms a comparable state-of-the-art approach by 5-12% on average across the entire spectrum of trophic states, as it also eliminates the need to

choose the right algorithm for water observation. It estimates trophic status with over 90% accuracy for highly affected eutrophic and hypereutrophic waters.”

<https://eurekaalert.org>

NORTH AMERICA

USA

AI-powered dermatology tool

At Google’s recent I/O event, Google announced its new AI-powered dermatology tool for consumers. The app allows consumers to use their phone’s camera to capture images of their skin, hair, or nail concern from different angles. The app will then guide the user through a series of questions to better understand the users’ skin type, how long they have had the issue, and if any other symptoms are present.

Google’s AI dermatologist tool will help address key barriers in access to care for consumers and help them take an empowered role in their care. This tool may help:

1. Lower the cost of care for consumers. On average, a dermatologist visit costs consumers \$150. Google’s AI dermatologist tool offers a starting point for consumers and makes skin-care advice more accessible for people who cannot afford traditional options.
2. Increase access to dermatological care. Over 2 billion people globally suffer from dermatologic issues, but there is a shortage of specialists. Although dermatologist density has increased from an estimated 1.9 specialists per 100,000 individuals in 1970 to 3.4 in 2017, the recommended density of 4.0 specialists per 100,000 people for adequate dermatologic care has not been met, and the gap between access in rural and urban areas is growing.
3. Improve care outcomes with earlier diagnosis. Through the tool, users can collect data that may lead to an earlier diagnosis by prompting users to see a clinician. Google’s AI dermatologist tool allows users to capture their condition in real time, which is key when patients face an average wait time

of 18 to 33 days. As Dr. John Maitland told Forrester in an interview, “We often use the photographs that people have on their phones. The rashes may have changed or gone away. [If] they can show us photos when they first got it, we can see the progression.”

4. Enable consumers to make informed decisions about their healthcare. Google’s tool can give users the information they need to make an informed decision about the next steps—whether that is more research or making an appointment. The AI model analyzes the data and pictures you provide against its knowledge of 288 conditions to give a list of possible matching conditions that users can research further.

<https://www.cdotrends.com>

AI to monitor remote seabird colonies

Scientists at Duke University and the Wildlife Conservation Society (WCS) used a deep-learning algorithm—a form of AI—to analyze more than 10,000 drone images of mixed colonies of seabirds in the Falkland Islands off Argentina’s coast.

The deep-learning algorithm correctly identified and counted the albatrosses with 97% accuracy and the penguins with 87%. All told, the automated counts were within 5% of human counts about 90% of the time. “Using drone surveys and deep learning gives us an alternative that is remarkably accurate, less disruptive and significantly easier. One person, or a small team, can do it, and the equipment you need to do it isn’t all that costly or complicated,” said Madeline C. Hayes, a remote sensing analyst at the Duke University Marine Lab, who led the study.

To conduct the new surveys, WCS scientists used an off-the-shelf consumer drone to collect more than 10,000 individual photos, which Hayes converted into a large-scale composite visual using image-processing software. She then analyzed the image using a convolutional neural network (CNN), a type of AI that employs a deep-learning algorithm to analyze an image and differentiate and count the objects it “sees” in it—in this case, two different species of sea birds. These counts were added together to create compre-

hensive estimates of the total number of birds found in colonies.

<https://www.sciencedaily.com>

IoT communicators at 5G speeds

Researchers at the Georgia Institute of Technology, Nokia Bell Labs, and Heriot-Watt University have found a low-cost way for backscatter radios to support high-throughput communication and 5G-speed Gb/sec data transfer using only a single transistor when previously it required expensive and multiple stacked transistors.

Employing a unique modulation approach in the 5G 24/28 Gigahertz (GHz) bandwidth, the researchers have shown that these passive devices can transfer data safely and robustly from virtually any environment. The findings were reported earlier this month in the journal *Nature Electronics*.

Traditionally, mmWave communications, called the extremely high-frequency band, is considered “the last mile” for broadband, with directive point-to-point and point-to-multipoint wireless links. This spectrum band offers many advantages, including wide available GHz bandwidth, which enables very large communication rates, and the ability to implement electrically large antenna arrays, enabling on-demand beamforming capabilities. However, such mmWave systems depend on high-cost components and systems.

The researchers are the first to use a backscatter radio for gigabit-data rate mmWave communications, while minimizing the front-end complexity to a single high-frequency transistor. Their breakthrough included the modulation as well as adding more intelligence to the signal that is driving the device.

The technology opens up a host of IoT 5G applications, including energy harvesting, which Georgia Tech researchers recently demonstrated using a specialized Rotman lens that collects 5G electromagnetic energy from all directions.

<https://www.eurekalert.org>

AI strategy enables robots to adapt to real world environments

Artificial intelligence algorithms developed by a team of researchers from UC

Berkeley, Facebook and Carnegie Mellon University are equipping legged robots with an enhanced ability to adapt to and navigate unfamiliar terrain in real time.

Their test robot successfully traversed sand, mud, hiking trails, tall grass and dirt piles without falling. It also outperformed alternative systems in adapting to a weighted backpack thrown onto its top or to slippery, oily slopes. When walking down steps and scrambling over piles of cement and pebbles, it achieved 70% and 80% success rates, respectively, still an impressive feat given the lack of simulation calibrations or prior experience with the unstable environments. Not only could the robot adjust to novel circumstances, but it could also do so in fractions of a second rather than in minutes or more. This is critical for practical deployment in the real world.

The RMA system combines a base policy—the algorithm by which the robot determines how to move—with an adaptation module. The base policy uses reinforcement learning to develop controls for sets of extrinsic variables in the environment. This is learned in simulation, but that alone is not enough to prepare the legged robot for the real world because the robot’s onboard sensors cannot directly measure all possible variables in the environment. To solve this, the adaptation module directs the robot to teach itself about its surroundings using information based on its own body movements. For example, if a robot senses that its feet are extending farther, it may surmise that the surface it is on is soft and will adapt its next movements accordingly.

The base policy and adaptation module are run asynchronously and at different frequencies, which allows RMA to operate robustly with only a small onboard computer. The RMA project is part of an industry-academic collaboration with the FAIR group and the Berkeley AI Research (BAIR) lab. Before joining the CMU faculty, Pathak was a researcher at FAIR and a visiting researcher at UC Berkeley. Pathak also received his Ph.D. degree in electrical engineering and computer sciences from UC Berkeley.

<https://engineering.berkeley.edu>