



Weekly Newsletter
TECHNOLOGY
SURVEILLANCE

N° 17-2023

APRIL 28TH, 2023





OBJECTIVE: To provide weekly information about the latest global scientific and technological advancements, as well as the most innovative products and services entering the international market.

I. NEWS

1.1 Research Links Common Insecticide to Neurodevelopmental Disorders

A new study from The University of Toledo (UToledo) suggests early exposure to a common class of insecticides called pyrethroids may increase the risk of autism and other developmental disorders, even at levels currently recognized as safe by federal regulators. Pyrethroids are some of the most widely used insecticides in the country, appearing in both consumer products and industrial preparations. Interest in a possible link between autism and pyrethroids has grown after several epidemiological studies documented higher rates of neurodevelopmental disorders in areas where the pesticides were used.

Research sought to build on those population-based studies by analyzing the specific behavioral changes attributable to low-level exposure to pyrethroids. Working with a team that included scientists from Columbia, Emory and the University of Southern California, Burkett examined the offspring of female mice who were exposed to small doses of the pyrethroid insecticide deltamethrin before, during and immediately after pregnancy. The researchers found those mice exhibited increased hyperactivity and repetitive behaviors, less vocalization and were more likely to fail basic learning tests compared to controls.

For more information, visit the following link:

https://news.utoledo.edu/index.php/04_25_2023/utoledo-research-links-common-insecticide-to-neurodevelopmental-disorders

Reference

Linkhorn, T. (April 25, 2023). UToledo research links common insecticide to neurodevelopmental disorders. Recovered April 27, 2023, The University of Toledo: https://news.utoledo.edu/index.php/04_25_2023/utoledo-research-links-common-insecticide-to-neurodevelopmental-disorders

Information source: (The University of Toledo, 2023)



1.2 Artificial Intelligence system can generate novel proteins that meet structural design targets

Tunable proteins could be used to create new materials with specific mechanical properties, like toughness or flexibility. Massachusetts Institute of Technology (MIT) researchers are using Artificial Intelligence (AI) to design new proteins that go beyond those found in nature.



A new machine-learning system can generate protein designs with certain structural features, and which do not exist in nature. These proteins could be utilized to make materials that have similar mechanical properties to existing materials, like polymers, but which would have a much smaller carbon footprint.

Credit: Jose-Luis Olivares, Massachusetts Institute of Technology

Researchers developed machine-learning algorithms that can generate proteins with specific structural features, which could be used to make materials that have certain mechanical properties, like stiffness or elasticity. Such biologically inspired materials could potentially replace materials made from petroleum or ceramics, but with a much smaller carbon footprint. The researchers from MIT, the MIT-IBM Watson AI Lab, and Tufts University employed a generative model, which is the same type of machine-learning model architecture used in AI systems like DALL-E 2. But instead of using it to generate realistic images from natural language prompts, like DALL-E 2 does, they adapted the model architecture so it could predict amino acid sequences of proteins that achieve specific structural objectives.

For more information, visit the following link:

<https://news.mit.edu/2023/ai-system-can-generate-novel-proteins-structural-design-0420>

Reference

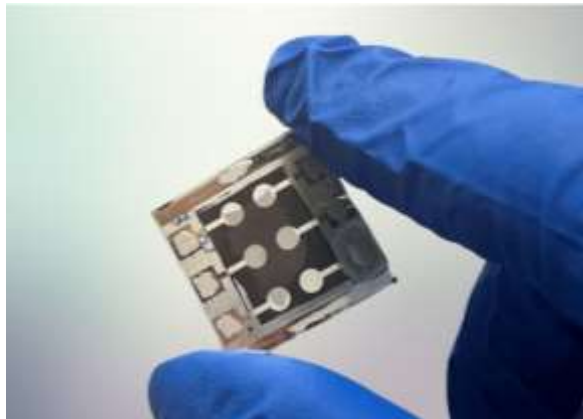
Zewe, A. (April 20, 2023). AI system can generate novel proteins that meet structural design targets. Recovered April 21, 2023, Massachusetts Institute of Technology: <https://news.mit.edu/2023/ai-system-can-generate-novel-proteins-structural-design-0420>

Information source: (Massachusetts Institute of Technology, 2023)



1.3 Coating method in the manufacture and marketing of perovskite solar cells

Perovskite solar cells (PSCs) are considered a promising candidate for next-generation photovoltaic technology with high efficiency and low production cost, potentially revolutionizing the renewable energy industry. Researchers from City University of Hong Kong (CityU) and the National Renewable Energy Laboratory (NREL) in the US jointly developed an innovative one-step solution-coating approach that simplifies the manufacturing process and lowers the commercialisation barriers for PSCs. To improve the manufacturability of PSCs, Dr Zhu collaborated with Dr Joseph M. Luther, from NREL, to jointly invent a new approach for fabricating efficient inverted perovskite solar cells in which the hole-selective contact and perovskite light absorber can spontaneously form in a single solution-coating procedure.



*Perovskite solar cells fabricated by the one-step solution spin-coating method.
Credit: Dr Zhu Zonglong's, City University of Hong Kong*

The collaborative team also showed that the new approach is compatible with various self-assembled monolayer molecular systems, perovskite compositions, solvents and scalable processing methods, such as spin-coating and blade-coating techniques. And the PSC fabricated with the new approach have comparable performance with those produced from other methods.

For more information, visit the following link:

<https://www.cityu.edu.hk/research/stories/2023/04/20/one-step-solution-coating-method-advance-perovskite-solar-cell-manufacturing-and-commercialisation>

Reference

City University of Hong Kong. (April 20, 2023). One-step solution-coating method to advance perovskite solar cell manufacturing and commercialisation. Recovered April 21, 2023, City University of Hong Kong:

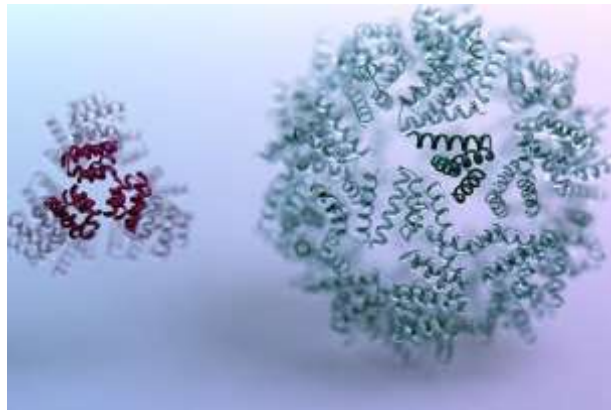
<https://www.cityu.edu.hk/research/stories/2023/04/20/one-step-solution-coating-method-advance-perovskite-solar-cell-manufacturing-and-commercialisation>

Information source: (City University of Hong Kong, 2023)



1.4 Reinforcement Learning: from board games to protein design

Raising a child with autism is no easy task, no matter where they fall on the spectrum. In fact, it's a long-distance marathon of sorts with no finish line. It can be exhausting and frustrating. Scientists have successfully applied reinforcement learning to a challenge in molecular biology. A team led by University of Washington (UW) Medicine researchers developed powerful new protein design software adapted from a strategy proven adept at board games like chess. In one experiment, proteins made with the new approach were found to be effective at generating useful antibodies in mice.



Examples of computer-designed protein molecules created by a reinforcement learning software program.

Credit: Ian C. Haydon/Institute for Protein Design

Reinforcement learning is a type of Machine Learning in which a computer program learns to make decisions by trying different actions and receiving feedback. Such an algorithm can learn to play chess, for example, by testing millions of different moves that lead to victory or defeat on the board. The program is designed to learn from these experiences and become better at making decisions over time. To make a reinforcement learning program for protein design, the scientists gave the computer millions of simple starting molecules. The software then made ten thousand attempts at randomly improving each toward a predefined goal. The computer lengthened the proteins or bent them in specific ways until it learned how to contort them into desired shapes.

For more information, visit the following link:

<https://newsroom.uw.edu/news/reinforcement-learning-board-games-protein-design>

Reference

Gray, L. (April 20, 2023). Reinforcement learning: from board games to protein design.

Recovered April 21, 2023, University of Washington:

<https://newsroom.uw.edu/news/reinforcement-learning-board-games-protein-design>

Information source: (University of Washington, 2023)



1.5 Design *"artificial muscles"*

Robots of the future: They are soft and flexible enough to bounce off walls or squeeze into tight spaces. And when you are done with them, you can toss these machines into a compost bin to decompose. That is the vision of a team of engineers, including University of Colorado Boulder (CU Boulder) graduate student Ellen Rumley. In a paper published last month in the journal *Science Advances*, the researchers described their designs for a new kind of robotic actuators, or *"artificial muscles."* The group's actuators, which work by shifting fluid around in squishy sacs, can power robotic arms and legs with life-like movements. They also dissolve naturally in soil over a period of a few months, making them much more sustainable than previous models. *"You could dispose of them in an industrial compost bin,"* said Rumley, co-first author of the new study and researcher in the Paul M. Rady Department of Mechanical Engineering at CU Boulder. *"We hope the project will inspire other engineers to develop robotics with sustainability in mind."*



*An "artificial muscle" made, in part, from material designed for biodegradable grocery bags.
Credit: Max Planck Institute for Intelligent Systems*

In the new study, this team developed a series of soft robotic actuators entirely made of sustainable ingredients. The muscles are about as versatile as traditional actuators Hydraulically Amplified, Self-Healing, Electrostatic (HASEL) and, in some cases, can flex for 100,000 cycles or more without breaking.

For more information, visit the following link:

<https://www.colorado.edu/today/2023/04/20/grad-student-helps-design-artificial-muscles-you-can-toss-compost-bin>

Reference

Strain, D. (April 20, 2023). Grad student helps design 'artificial muscles' you can toss in the compost bin. Recovered April 21, 2023, University of Colorado Boulder: <https://www.colorado.edu/today/2023/04/20/grad-student-helps-design-artificial-muscles-you-can-toss-compost-bin>

Information source: (University of Colorado Boulder, 2023)



1.6 Multifunctional tendon mimetic hydrogels developed

Natural tendons are water-rich tissues exhibiting outstanding mechanical strength and durability. Their mechanical properties originate from sophisticated microscale structures involving stiff collagen fibrils aligned in parallel and interlaced with soft water-retaining biopolymers. Over the past decades, researchers have been trying to use synthetic hydrogels, a class of water-rich materials involving polymer networks, to replicate the structures and properties of natural tendons. It remains difficult since synthetic hydrogels are usually weak and brittle. Resolving this mismatch would enable critical applications in tissue repair, biomedical robots, implantable devices, and many other technologies. A research team led by Dr Lizhi Xu of the Department of Mechanical Engineering in the Faculty of Engineering at the University of Hong Kong (HKU) has developed a new type of tendon-mimetic hydrogel with outstanding mechanical properties matching those of natural tendons combined with multifunctionalities for biomedical applications.

In this study, aramid nanofibers derived from Kevlar, a polymer material used in bullet-proof vests and helmets, were mixed with polyvinyl alcohol, another synthetic polymer, for the construction of tendon-mimetic hydrogels. With tensile stress applied during the fabrication process, aramid nanofibers aligned with each other according to the direction of stretching, leading to an anisotropic network mimicking the structural features of natural tendons.

For more information, visit the following link:
https://hku.hk/press/news_detail_26045.html

Reference

Strain, D. (April 20, 2023). HKU Mechanical Engineering team develops multifunctional tendon-mimetic hydrogels. Recovered April 21, 2023, The University of Hong Kong: https://hku.hk/press/news_detail_26045.html

Information source: (The University of Hong Kong, 2023)



1.7 Digital tools and techniques against cybercrime

Irfan Ahmed, Ph.D., leads computer scientists working to protect nuclear plants and other critical infrastructure — and aiming to apply the methods to other crime. In the never-ending cybersecurity war, Irfan Ahmed, Ph.D., provides the good guys with digital forensic tools — and the knowledge to use them. Ahmed is an associate professor of computer science and director of the Security and Forensics Engineering Lab within Virginia Commonwealth University (VCU) Engineering's Department of Computer Science. In the Security and Forensics Engineering (SAFE) Lab, he leads a pair of projects funded by the U.S. Department of Homeland Security — aimed at keeping industrial systems safe from the bad guys, and showing how the same tools crafted for investigating cyberattacks can be used to probe other crimes.

Cyberattacks often target a portion of software architecture known as the control logic, which receives instructions from the user and hands them off to be executed by a programmable logic controller. For instance, the control logic monitoring a natural gas pipeline might be programmed to open a valve if the system detects pressure getting too high. Programmers can modify the control logic — but so can attackers. One of Ahmed's DHS-supported projects, called *"Digital Forensic Tools and Techniques for Investigating Control Logic Attacks in Industrial Control Systems,"* allows him to craft devices and techniques that cyberdetectives can use in their investigations. He noted that investigation capabilities are an under-researched area, as most emphasis has been on prevention and detection of cyberattacks.

For more information, visit the following link:

<https://www.news.vcu.edu/article/2023/04/vcu-researchers-fight-cybercrime-with-new-digital-tools-and-techniques>

Reference

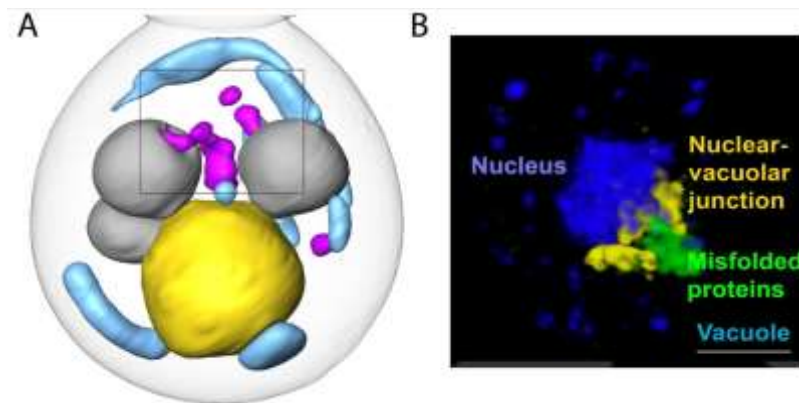
McClain, J. (April 20, 2023). VCU researchers fight cybercrime with new digital tools and techniques. Recovered April 21, 2023, Virginia Commonwealth University: <https://www.news.vcu.edu/article/2023/04/vcu-researchers-fight-cybercrime-with-new-digital-tools-and-techniques>

Information source: (Virginia Commonwealth University, 2023)



1.8 New pathway for clearing misfolded proteins

Stanford researchers defined a novel cellular pathway – including a “*dump site*” – for clearing misfolded proteins from cells. The pathway is a potential therapy target for age-related diseases like Alzheimer’s, Huntington’s, and Parkinson’s diseases. To find the new pathway, researchers in the lab of Judith Frydman, the Donald Kennedy Chair in the School of Humanities and Sciences, integrated several genetic, imaging, and biochemical approaches to understand how yeast cells dealt with misfolded proteins. For the experiments, the team restricted misfolded proteins to either the nucleus or the cytoplasm – the area inside the cell but outside the nucleus. This team visually followed the fate of the misfolded proteins through live-cell imaging and super-resolution microscopy.



A) A 3D reconstruction of a yeast cell engulfing cytoplasmic misfolded proteins (purple) inside of the degradation cellular machinery, or vacuole (gray).

B) Super-resolution reconstructions showing nuclear misfolded proteins (green) being targeted to the degradation cellular machinery through the nuclear-vacuolar junction (yellow).

Credit: Fabián Morales-Polanco, Stanford University

Also, this team identified the “*garbage dump*” site as the intersection of the nucleus and the vacuole (an organelle full of enzymes for degrading proteins) and showed that misfolded proteins in this “*garbage dump*” site are moved into the inside of the vacuole for degradation. They also showed that the pathway depends on a class of proteins used to create small vesicles for transporting molecules around cells.

For more information, visit the following link:

<https://news.stanford.edu/2023/04/20/study-finds-new-pathway-clearing-misfolded-proteins/>

Reference

Overgaard, E. (April 20, 2023). Study finds new pathway for clearing misfolded proteins. Recovered April 21, 2023, Stanford University:

<https://news.stanford.edu/2023/04/20/study-finds-new-pathway-clearing-misfolded-proteins/>



Information source: (Stanford University, 2023)



1.9 Development plant genetic traits that enable plants to “talk”

Plant genetic innovation indicates if crops have been exposed to disease, insect pests or fertility loss. Insignum AgTech develops plant genetic traits that enable plants to “talk” and signal to farmers when specific plant stresses begin. *“With this trait, a corn plant generates purple pigment, indicating that a fungal infection has started but is not yet apparent. Additional traits will utilize other natural pigments, such as red or blue, that give an early indication of yield-limiting factors such as insect pests or fertility loss,”* said Insignum Ag Tech Chief Executive Officer (CEO) Kyle Mohler, a Purdue University alumnus. *“Farmers will gain the ability to sustainably and precisely treat when and where needed, ultimately increasing yields without arbitrarily increasing costly inputs.”*



*Insignum AgTech develops plant genetic traits that give farmers an early indication of yield-limiting factors like disease, insect pests or fertility loss.
Credit: Insignum AgTech, Purdue University*

“Insignum’s genetic traits are well aligned with that mission. Farmers can see what their plants need and then respond to improve crop health and yields. We were encouraged by Insignum’s results we saw in field trials last year, and we are hopeful about this collaboration.” said Tom Koch, research manager at Beck’s.

For more information, visit the following link:

<https://www.purdue.edu/newsroom/releases/2023/Q2/insignum-agtech-and-becks-collaborate-to-help-corn-talk.html>

Reference

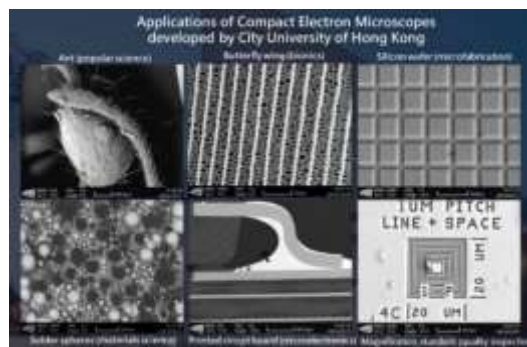
Mohler, K. (April 21, 2023). Insignum AgTech and Beck’s collaborate to help corn ‘talk.’ Recovered April 24, 2023, Purdue University:
<https://www.purdue.edu/newsroom/releases/2023/Q2/insignum-agtech-and-becks-collaborate-to-help-corn-talk.html>

Information source: (Purdue University, 2023)



1.10 Next-generation, self-designed compact electron microscopes

An electron microscopes (EM) system composed of a pulsed electron source, a fast camera, a staged pumping vacuum system, and an aberration corrector has been developed by a team led by Professor Chen Fu-rong, Chair Professor in the Department of Materials Science and Engineering. It is the first time-resolved electron microscope integrated with both scanning and transmission electron microscope modes in a compact format developed by a university-based research team. The team's ultimate goal is to develop a miniature high space-time resolved "quantum" EM that can be used to study atom dynamics of beam-sensitive materials.



Desktop electron microscopes, self-designed by CityU can be applied in various research industry fields.

Credit: stock.adobe.com, City University of Hong Kong

The team also designed pulsed electron sources and the fast camera that can be used with a desktop EM. By equipping the fast camera with a deflector, the speed of imaging is not limited to the readout time. Besides, this team designed an aberration corrector, which can further improve imaging resolution. With innovative designs mentioned above, the novel EM can generate an image of a sample in five minutes, achieving nanoscale spatial resolution and a magnification of over 10^5 time for observation and analysis in nanoscale.

For more information, visit the following link:

<https://www.cityu.edu.hk/research/stories/2023/04/21/cityu-worlds-first-university-manufacture-next-generation-self-designed-compact-electron-microscopes>

Reference

City University of Hong Kong. (April 21, 2023). CityU: world's first university to manufacture next-generation, self-designed compact electron microscopes. Recovered April 24, 2023, City University of Hong Kong:

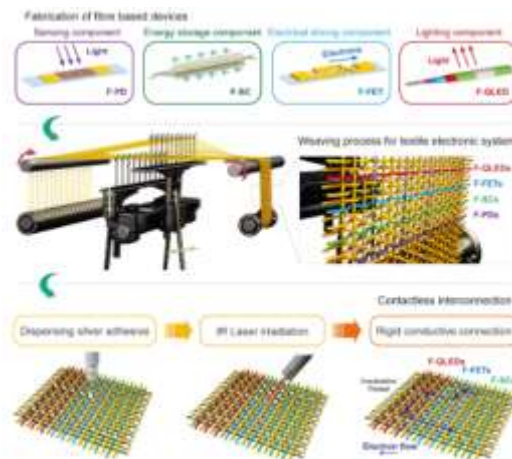
<https://www.cityu.edu.hk/research/stories/2023/04/21/cityu-worlds-first-university-manufacture-next-generation-self-designed-compact-electron-microscopes>

Information source: (City University of Hong Kong, 2023)



1.11 Cheaper method for making woven displays and smart fabrics – of any size or shape

Researchers have developed next-generation smart textiles – incorporating LEDs, sensors, energy harvesting, and storage – that can be produced inexpensively, in any shape or size, using the same machines used to make the clothing we wear every day. The international team, led by the University of Cambridge, have previously demonstrated that woven displays can be made at large sizes, but these earlier examples were made using specialised manual laboratory equipment. Other smart textiles can be manufactured in specialised microelectronic fabrication facilities, but these are highly expensive and produce large volumes of waste.



Credit: Sarah Collins, University of Cambridge

Now, the researchers have shown that smart textiles can be made using automated processes, with no limits on their size or shape. Multiple types of fibre devices, including energy storage devices, light-emitting diodes, and transistors were fabricated, encapsulated, and mixed with conventional fibres, either synthetic or natural, to build smart textiles by automated weaving. These fibre devices were interconnected by an automated laser welding method with electrically conductive adhesive. The research team, working in partnership with textile manufacturers, were able to produce test patches of smart textiles of roughly 50x50 centimetres, although this can be scaled up to larger dimensions and produced in large volumes.

For more information, visit the following link:

<https://www.cam.ac.uk/stories/smart-textiles>

Reference

Collins, S. (April 21, 2023). Cheaper method for making woven displays and smart fabrics – of any size or shape. Recovered April 24, 2023, University of Cambridge: <https://www.cam.ac.uk/stories/smart-textiles>

Information source: (University of Cambridge, 2023)



1.12 Grasping the future with a robotic arm-hand combo

Robot manipulation today generally focuses on motions either with a robot arm or a dexterous hand, but rarely both. Roboticians Daniel Rakita, who works frequently on robotic arms, and Aaron Dollar, a specialist in robotic grasping, recently teamed up for a project that combines their areas of expertise.



Credit: School of Engineering & Applied Science | Yale University

Combining the arm and hand movements has long been a priority for the robotics community, but it is a goal that comes with some significant challenges. The parts of a robotic system that you can control are known as the degrees of freedom. The greater the degrees of freedom, the more you can do with a robot — however, it also increases the system's complexity. It is, Rakita says, “*kind of a trade-off.*” For their robotic arm/hand, Rakita and Dollar developed algorithms that can grapple with such a high-dimensional system to get the optimal amount of freedom and control. One of the benefits of having extra degrees of freedom at the hand level as well as at the arm level is that the robot could have smoother motions and can better navigate within its environment.

For more information, visit the following link:

<https://seas.yale.edu/news-events/news/grasping-future-robotic-arm-hand-combo>

Reference

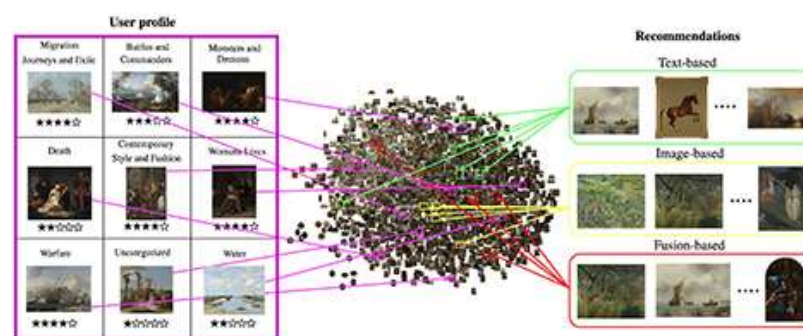
Yale University. (April 21, 2023). Grasping the future with a robotic arm-hand combo. Recovered April 24, 2023, Yale University: <https://seas.yale.edu/news-events/news/grasping-future-robotic-arm-hand-combo>

Information source: (Yale University, 2023)



1.13 State-of-the-art Artificial Intelligence to design visual art recommender systems

Computer scientists from the University of Luxembourg have studied the potential of advanced Artificial Intelligence (AI) and cutting-edge deep learning techniques in the domain of cultural heritage. Their research aims to solve the challenge of recommending artwork in environments such as museums, art galleries, and exhibitions, where subjective content, intricate concepts, and emotional reflections come into play.



Credit: University of Luxembourg

The research, led by Dr. Bereket Yilma and Prof. Luis Leiva from the Faculty of Science, Technology and Medicine of the University of Luxembourg, uses state-of-the-art AI to design visual art recommender systems to deliver highly personalised content that caters to the user's unique interests and preferences. The algorithms, leveraging the combined power of textual and visual data of the artworks, are able to effectively capture the underlying meanings and themes in visual art through the fusion of visual and textual data. The techniques developed in this work can also be leveraged to empower various digital assistants to offer personalised recommendations considering each user's unique preferences and anticipating dynamic reflections that can be triggered as users interact with visual content such as photos, videos, illustrations and infographics.

For more information, visit the following link:

https://www.wen.uni.lu/fstm/news/when_ai_recommends_artworks_you_ll_love

Reference

University of Luxembourg. (April 21, 2023). When AI recommends artworks you'll love. Recovered April 24, 2023, University of Luxembourg:

https://www.wen.uni.lu/fstm/news/when_ai_recommends_artworks_you_ll_love

Information source: (University of Luxembourg, 2023)



1.14 Voice assistant devices provide better information access for older adults

Older adults use voice assistant devices more often with training and flyers with instructions to complement their daily routine, according to a new University of Michigan study that looked at long-term usage. Voice assistants, such as Amazon's Alexa and Google Nest, are low-cost computing devices that use voice and conversation as the primary interaction modality. In recent years, they have become increasingly popular with hands-free methods to retrieve information or to listen to music. These devices also provide better information access for older adults, who may not use computers and mobile devices due to late-life vision or motor disability.



*Studying Exploration & Long-Term Use of Voice Assistants by Older Adults
Credit: Jared Wadley, University of Michigan*

Previous research has examined how older adults have used voice assistants on a short-term basis. The U-M study involved older adults in a long-term care community who used Alexa devices for at least one year. Participants learned to use Alexa through a training program that encouraged exploration. Training flyers were placed near the participants' devices, which gave them time to explore new skills relevant to their daily lives. All participants used Alexa at least twice a day.

For more information, visit the following link:

<https://news.umich.edu/alexa-set-the-alarm-for-me-to-take-my-medication/>

Reference

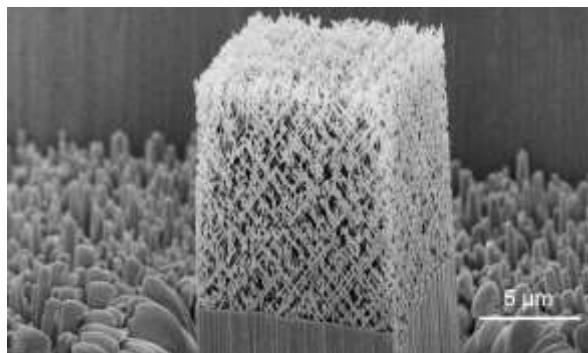
Wadley, J. (April 21, 2023). 'Alexa, set the alarm for me to take my medication.' Recovered April 24, 2023, University of Michigan: <https://news.umich.edu/alexa-set-the-alarm-for-me-to-take-my-medication/>

Information source: (University of Michigan, 2023)



1.15 Researchers fabricate mechanical metamaterials with ultra-high energy absorption capacity

Chinese researchers have successfully fabricated mechanical metamaterials with ultra-high energy absorption capacity using the ion track technology. The study was conducted by the researchers from the Materials Research Center of the Institute of Modern Physics (IMP) of the Chinese Academy of Sciences (CAS) and their collaborators from Chongqing University. Mechanical metamaterials refer to a class of composite materials with artificially designed structures, which exhibit extraordinary mechanical properties that traditional materials do not have.



*The SEM image of a FIB-milled quasi-BCC beam nanolattice.
Credit: IMP. Chinese Academy of University*

Nanolattice is a new class of mechanical metamaterials with characteristic sizes on the nanoscale. Due to size effects, geometrical configuration, and material selection, the mechanical properties of this type of porous materials are very different from those of bulk materials. Given its even better mechanical properties with lighter weight, nanolattice is expected to bring revolutionary applications in the field of high-performance functional materials in the future. In this work, based on the Heavy Ion Research Facility at Lanzhou (HIRFL), the researchers fabricated a new type of quasi-body centered cubic (quasi-BCC) beam nanolattice mechanical metamaterial with the ion track technology.

For more information, visit the following link:

https://english.cas.cn/newsroom/research_news/phys/202304/t20230421_329685.shtml

Reference

Liu, J. (April 21, 2023). Researchers fabricate mechanical metamaterials with ultra-high energy absorption capacity. Recovered April 24, 2023, Chinese Academy of Sciences: https://english.cas.cn/newsroom/research_news/phys/202304/t20230421_329685.shtml

Information source: (Chinese Academy of University, 2023)



1.16 The VDES technology for potential maritime applications

The microsatellite will test the Very High Frequency (VHF) Data Exchange System (VDES) technology for potential maritime applications, such as real-time maritime traffic and asset tracking for better predictive analysis, as well as secured and reliable ship-to-ship or ship-to-port communication.



*Students from NUS College of Design and Engineering worked closely with research staff at STAR to develop Lumelite-4.
Credit: National University of Singapore*

The Satellite Technology and Research Centre (STAR), National University of Singapore (NUS) designed and built the Lumelite-4 microsatellite using the university's patented modular and scalable satellite's bus system with fault tolerant features, while A*STAR's I2R developed the experimental satellite-based communication hardware. This collaboration between NUS and A*STAR signifies the pioneering effort by Singapore researchers to develop a satellite-based high-performance VHF (VDES), which will significantly improve maritime communications as well as traffic management and analytics. Currently, international voyaging ships are fitted with the Automatic Identification System (AIS), which is an automatic tracking system that uses transceivers on ships for collision avoidance by allowing the maritime authorities to track and monitor vessel movements using broadcast information on identification, location, course and speed.

For more information, visit the following link:

<https://news.nus.edu.sg/successful-launch-of-lumelite-4-to-enhance-maritime-communications/>

Reference

Liu, J. (April 22, 2023). Another giant leap into space: successful launch of Lumelite-4 to enhance maritime communications. Recovered April 24, 2023, National University of Singapore: <https://news.nus.edu.sg/successful-launch-of-lumelite-4-to-enhance-maritime-communications/>

Information source: (National University of Singapore, 2023)



1.17 Cryo-imaging lifts the lid on fuel cell catalyst layers

Thanks to a novel combination of cryogenic transmission electron tomography and deep learning, École Polytechnique Fédérale de Lausanne (EPFL) researchers have provided a first look at the nanostructure of platinum catalyst layers, revealing how they could be optimized for fuel cell efficiency. Proton-exchange membrane fuel cells (PEMFC), which are being developed for use in electric vehicles, rely on nanoparticles called catalysts to trigger electricity-producing reactions between hydrogen and oxygen. Most PEMFC catalysts contain platinum – a scarce and precious metal. There is therefore a pressing global need to develop catalysts that can generate the most power while minimizing platinum content.

Vasiliki Tileli, head of the Laboratory for in-situ nanomaterials characterization with electrons in the School of Engineering, has found a way around this challenge. By imaging catalysts and their environment at below-freezing temperatures using cryogenic transmission electron tomography and processing the images with deep learning, she and her colleagues have succeeded in revealing, for the first time, the nanoscale structure of catalyst layers. *“I think this advanced technique will therefore be useful not just for facilitating the mass manufacturing of PEMFCs through optimized platinum use, but also for many different materials science and energy applications – for example, battery storage, water electrolysis, and energy conversion systems in general.”*

For more information, visit the following link:

<https://actu.epfl.ch/news/cryo-imaging-lifts-the-lid-on-fuel-cell-catalyst-2/>

Reference

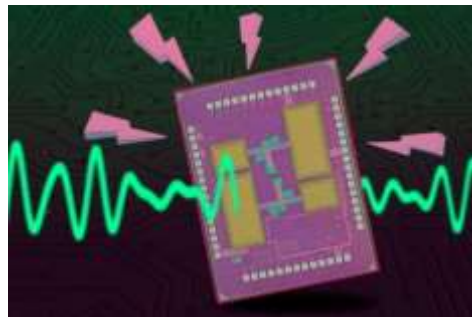
Luterbacher, C. (April 24, 2023). Cryo-imaging lifts the lid on fuel cell catalyst layers. Recovered April 24, 2023, Ecole Polytechnique Fédérale de Lausanne: <https://actu.epfl.ch/news/cryo-imaging-lifts-the-lid-on-fuel-cell-catalyst-2/>

Information source: (École Polytechnique Fédérale de Lausanne, 2023)



1.18 Miniscule device could help preserve the battery life of tiny sensors

Scientists are striving to develop ever-smaller internet-of-things devices, like sensors tinier than a fingertip that could make nearly any object trackable. These diminutive sensors have miniscule batteries which are often nearly impossible to replace, so engineers incorporate wake-up receivers that keep devices in low-power “sleep” mode when not in use, preserving battery life. Researchers at Massachusetts Institute of Technology (MIT) have developed a new wake-up receiver that is less than one-tenth the size of previous devices and consumes only a few microwatts of power. Their receiver also incorporates a low-power, built-in authentication system, which protects the device from a certain type of attack that could quickly drain its battery.



Credit: Jose-Luis Olivares, Massachusetts Institute of Technology

The MIT team built a receiver that utilizes terahertz waves, which are about one-tenth the length of radio waves. Their chip is barely more than 1 square millimeter in size. They used their wake-up receiver to demonstrate effective, wireless communication with a signal source that was several meters away, showcasing a range that would enable their chip to be used in miniaturized sensors. For instance, the wake-up receiver could be incorporated into microrobots that monitor environmental changes in areas that are either too small or hazardous for other robots to reach. Also, since the device uses terahertz waves, it could be utilized in emerging applications, such as field-deployable radio networks that work as swarms to collect localized data.

For more information, visit the following link:

<https://news.mit.edu/2023/miniscule-device-could-help-preserve-battery-life-0424>

Reference

Zewe, A. (April 24, 2023). Miniscule device could help preserve the battery life of tiny sensors. Recovered April 25, 2023, Massachusetts Institute of Technology: <https://news.mit.edu/2023/miniscule-device-could-help-preserve-battery-life-0424>

Information source: (Massachusetts Institute of Technology, 2023)



1.19 Using superconductors to move people, cargo and energy through one combined system

The promise of superconductivity for electrical power transmission and transportation has long been held back by high costs. Now researchers from the University of Houston and Germany have demonstrated a way to cut the cost and upend both the transit and energy transport sectors by using superconductors to move people, cargo and energy along existing highway infrastructure. The combined system would not only lower the cost of operating each system but would also provide a way to store and transport liquified hydrogen, an important future source of clean energy. The liquified hydrogen would be used to cool the superconductor guideway as it is stored and transported, reducing the need for a separate specialized pipeline system capable of cooling the fuel to 20 degrees Kelvin, or minus 424 Fahrenheit.



Schematic illustration showing the cross-sectional view of the superconducting highway for energy transport and storage and superconductor levitation for the transport of people and goods in the future.

Credit: University of Houston

Researchers built a model to demonstrate the key technical aspect of the concept – levitating a magnet above a superconductor guideway. Liquified nitrogen was used to cool the superconductors in the model and future models will use hydrogen. Vehicles with magnetized undercarriages – trains, cargo trucks, even personal vehicles – would enter the superconductor guideway, levitating and moving at high speed to reach their destinations. After leaving the guideway, vehicles would continue their trips powered by traditional electric or internal combustion motors.

For more information, visit the following link:

<https://uh.edu/news-events/stories/2023/april-2023/04242023-super-conductor-hwy-ren.php>

Reference

Kever, J. (April 24, 2023). Using superconductors to move people, cargo and energy through one combined system. Recovered April 25, 2023, University of Houston:



<https://uh.edu/news-events/stories/2023/april-2023/04242023-super-conductor-hwy-ren.php>

Information source: (University of Houston, 2023)



1.20 Progress in alternative battery technology

Researchers have now optimised the electrolyte fluid for zinc batteries: they used benign salts, and in smaller quantities. Water-based Zinc batteries offer a promising alternative to these lithium-ion batteries. An international team of researchers led by Eidgenössische Technische Hochschule Zürich (ETH Zurich) has now devised a strategy that brings key advances to the development of such zinc batteries, making them more powerful, safer and more environmentally friendly.



*Zinc batteries are considered promising alternatives to lithium-ion batteries.
Credit: Xin Zou, Escuela Politécnica Federal de Zürich*

If only there weren't challenges that engineers must face with when developing these batteries: when zinc batteries are charged at high voltage, the water in electrolyte fluid reacts on one of the electrodes to form hydrogen gas. When this happens, the electrolyte fluid dwindles and battery performance decreases. Furthermore, this reaction causes excess pressure to build up in the battery that can be dangerous. Another issue is formation of spikey deposits of Zinc during charging of the battery, known as dendrites, that can pierce through the battery and in the worst case even cause short circuit and render the battery unusable. In recent years, engineers have pursued the strategy of enriching the aqueous liquid electrolyte with salts in order to keep the water content as low as possible. But there are also disadvantages to this: It makes the electrolyte fluid viscous, which slows down the charging and discharging processes considerably. In addition, many of the salts used contain fluorine, making them toxic and harmful to the environment.

For more information, visit the following link:

<https://ethz.ch/en/news-and-events/eth-news/news/2023/04/progress-in-alternative-battery-technology.html>

Reference

Bergamin, F. (April 24, 2023). Progress in alternative battery technology. Recovered April 25, 2023, Eidgenössische Technische Hochschule Zürich: <https://ethz.ch/en/news-and-events/eth-news/news/2023/04/progress-in-alternative-battery-technology.html>

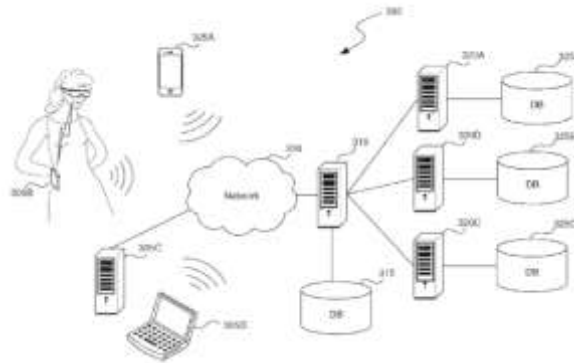
Information source: (Eidgenössische Technische Hochschule Zürich, 2023)



2 PATENTS

2.1 Automated avatars

An automatic avatar system can build a custom avatar with features extracted from one or more sources. The automatic avatar system can identify such features in a source image of a user, from an online context source of the user (e.g., shopping activity, social media activity, messaging activity, etc.), and/or from a user-provided textual description source describing one or more avatar features.



*Is a block diagram illustrating an overview of an environment in which some implementations of the present technology can operate.
Credit: ARUNACHALA, A., WIPO IP Portal*

The automatic avatar system can query an avatar library for the identified avatar features. In some cases, the automatic avatar system may identify multiple options for the same avatar feature from the various sources and the automatic avatar system can select which of the features to use based on a priority order specified among the sources or by providing the multiple options to the user for selection. Once the avatar features are obtained, the automatic avatar system can combine them to build the custom avatar.

For more information, visit the following link:

https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2023064224&_cid=P20-LGVAJJ-58331-1

Reference

Arunachala, A. (April 20, 2023). Automated avatars. Recovered April 20, 2023, WIPO IP Portal:

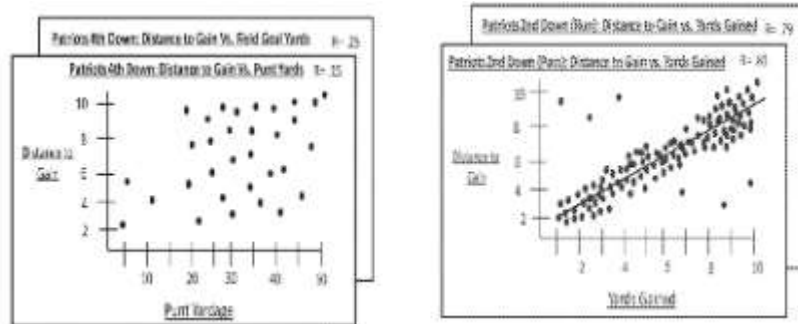
https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2023064224&_cid=P20-LGVAJJ-58331-1

Information source: (WIPO IP Portal, 2023)



2.2 Methods, systems, and apparatuses for processing sports-related data

A method, system, and apparatus for collecting, manipulating, transmitting, and interpreting data.



Illustrates an example of an odds module, according to an embodiment.
Credit: Huke, C., Beyers, J., Cronin, J., D'andrea, M., Grant, H., and Bodkin, J., WIPO IP Portal

In one embodiment, a plurality of sensors configured to capture real-time sensor data from a live event including a plurality of actions; one or more sport gaming platforms, and a user device, where the one or more sports gaming platforms are configured to: receive and store the captured sensor data, filter a historical sensor database on similar event data matching an unique identifier (ID) for an upcoming action, wherein the ID identifies odds on upcoming plays, determine, based on Artificial Intelligence and/or Machine Learning and before occurrence of the upcoming action, that there is a high correlation between the captured sensor data and the similar event data, determine a probability of occurrence of the upcoming play associated with the wager ID, and update odds offered by the exchange system.

For more information, visit the following link:

https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2023064563&_cid=P20-LGVA3N-53707-3

Reference

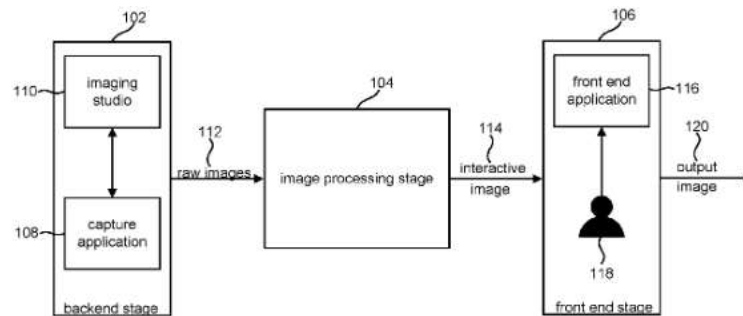
Huke, C.; Beyers, J.; Cronin, J.; D'andrea, M.; Grant, H. & Bodkin, J. (April 20, 2023). Methods, systems, and apparatuses for processing sports-related data. Recovered April 20, 2023, WIPO IP Portal:

https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2023064563&_cid=P20-LGVA3N-53707-3

Information source: (WIPO IP Portal, 2023)

2.3 Interactive image generation

A content generation platform is generally described herein. More specifically, interactive image generation and techniques and features thereof are disclosed herein. In some embodiments, one or more sets of images of a scene are captured in an imaging studio.



is a high level block diagram illustrating an embodiment of the disclosed content generation platform.

Credit: Chui, C., Parmar, M., Mignard, M., Uppuluri, A., Chahal, J., Chaudhry, A., Jain, H., Pang, A., Sharma, L., Le, J., and Seaton, B., Mackey, A., WIPO IP Portal

The captured one or more sets of images of the scene are processed using one or more Machine Learning based networks to generate an interactive image of the scene comprising a plurality of interactive features. One or more of the plurality of interactive features of the generated interactive image may be modified or edited according to user preferences. In some embodiments, an arbitrary input image captured in an unknown environment is processed using one or more Machine Learning based networks to generate an interactive reconstruction or floorplan of the input image.

For more information, visit the following link:

https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2023064549&_cid=P20-LGVD6T-86993-3

Reference

Chui, C.; Parmar, M.; Mignard, M.; Uppuluri, A.; Chahal, J.; Chaudhry, A.; Jain, H.; Pang, A.; Sharma, L.; Le, J.; Seaton, B. & Mackey, A. (April 20, 2023). Interactive image generation. Recovered April 20, 2023, WIPO IP Portal: https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2023064549&_cid=P20-LGVD6T-86993-3

Information source: (WIPO IP Portal, 2023)



2.4 System and method for detecting purchased or tampered containers

A system and method which permits tracking of the state of the container for a product, including with regard to whether the container has been opened and/or tampered with.



Show a non-limiting, exemplary set of screenshots of an application for interaction with a user who is changing the state of the container of the product.

Credit: MERHEBY, W., WIPO IP Portal

The user views at least a portion of the container with a camera, such as for example the camera of a smartphone or other mobile communication device. Upon scanning that portion of the container, a web page or other user interface appears on a communication device that is in communication with the camera, such as the previously described smartphone or other mobile communication device. An image of the portion of the container is also preferably sent to a server for analysis. Upon receipt of such state information for the container, optionally and preferably the state information is written to a Distributed Ledger Technology (DLT) such as for example the Blockchain.

For more information, visit the following link:

https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2023062524&_cid=P20-LGVAD2-56569-1

Reference

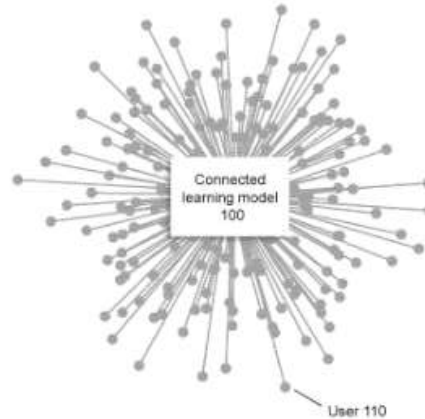
Merheby, W. (April 20, 2023). System and method for detecting purchased or tampered containers. Recovered April 20, 2023, WIPO IP Portal: https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2023062524&_cid=P20-LGVAD2-56569-1

Information source: (WIPO IP Portal, 2023)



2.5 Vehicle assembly having a capacitive sensor

A virtual assistant platform implemented by a computer system comprising:



*Displays a representation of a connected learning model for a virtual assistant.
Credit: Neale, M., and Bayjou, R., WIPO IP PORTAL*

One or more hardware processors configured to execute computer readable instructions; one or more memory storing the instructions; a mapping data structure stored in the one or more memory, the mapping data structure mapping a plurality of intents to respective client specific actions; a network interface configured to receive a query from a user device operating in a client specific communication session with a virtual assistant in a first context, the instructions when executed providing: an Artificial Intelligence (AI) language model comprising a client specific language model, the client specific language model having been trained on client specific data, and a mesh language model, the mesh language model having been trained on mesh specific data, the mesh specific data having been received by operating multiple virtual assistants in the first context, the AI language model being responsive to the query to generate an intent; a mapping function to apply the intent to the mapping data structure and access a corresponding client specific action for delivery of a response to the user device; and a transmission function to transmit the response to the user device.

For more information, visit the following link:

https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2023061614&_cid=P20-LGVCV8-83586-1

Reference

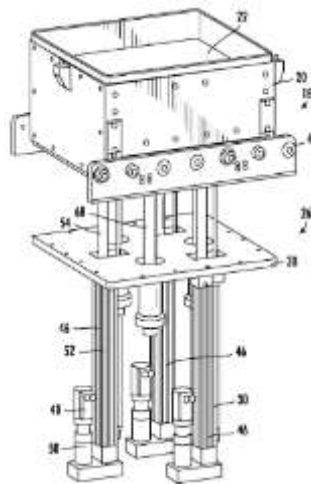
Neale, M. & Bayjou, R. (April 20, 2023). Machine Learning systems for virtual assistants. Recovered April 20, 2023, WIPO IP Portal:
https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2023061614&_cid=P20-LGVCV8-83586-1

Information source: (WIPO IP Portal, 2023)



2.6 Three-dimensional printer with precision vertical positioner for very heavy articles

A three-dimensional (3D) printing system includes a print engine chassis, a build box, a vertical movement mechanism, a powder dispensing module, a consolidation module, and a controller.



is an isometric drawing illustrating portions of an embodiment of a three-dimensional (3D) print engine with focus upon a vertical movement mechanism and a high capacity build box.

Credit: Cathey T., Espacenet Patent Search

The print engine chassis defines a build chamber configured to receive and support the build box. The build box includes a build plate upon which the 3D article is fabricated. The vertical movement mechanism includes a plurality of actuators configured to collectively provide precise positioning of the build plate. The controller is configured to: (1) operate the vertical movement mechanism including operating the plurality of actuators to position an upper surface of the 3D article generally proximate and parallel to a build plane, (2) operate the powder dispensing module to dispense a new layer of powder over the upper surface, and (3) operate the consolidation module to selectively consolidate the new layer of powder.

For more information, visit the following link:

<https://worldwide.espacenet.com/patent/search/family/085982165/publication/US2023120908A1?q=3d>

Reference

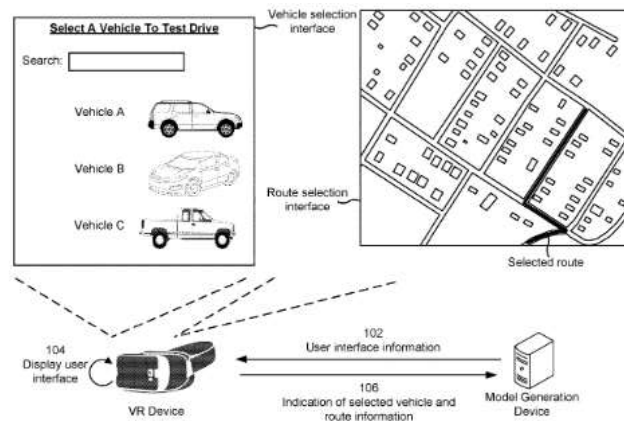
Turner, C. (April 20, 2023). Three-dimensional printer with precision vertical positioner for very heavy articles. Recovered April 20, 2023, Espacenet Patent Search: <https://worldwide.espacenet.com/patent/search/family/085982165/publication/US2023120908A1?q=3d>

Information source: (Espacenet Patent Search, 2023)



2.7 Dynamically generating scenery for a Virtual Reality driving session based on route information

In some implementations, a device may identify objects associated with the route based on one or more images associated with a selected route.



*Are diagrams of an example implementation relating to dynamically generating scenery for a virtual reality driving session based on route information.
Credit: Chow, C., Chouman, A., Espacenet Patent Search*

The device may generate a model associated with the route including the scenery, wherein the scenery includes models of the objects based on geographic locations of the objects and three-dimensional spatial information of the objects. The device may determine a visual reference point for the virtual reality driving session based on at least one of vehicle information associated with the vehicle or user information. The device may provide, to a virtual reality device, presentation information that causes the virtual reality driving session to be displayed by the virtual reality device from a perspective of the visual reference point within a vehicle model associated with a selected vehicle placed in the model of the route with the scenery.

For more information, visit the following link:

<https://worldwide.espacenet.com/patent/search/family/085982957/publication/US2023119620A1?q=REALITY%20VIRTUAL>

Reference

Chow, C.; & Chouman, A. (April 20, 2023). Dynamically generating scenery for a virtual reality driving session based on route information. Recovered April 20, 2023, Espacenet Patent Search:

<https://worldwide.espacenet.com/patent/search/family/085982957/publication/US2023119620A1?q=reality%20virtual>

Information source: (Espacenet Patent Search, 2023)



2.8 Systems and methods for monitoring, analyzing and regulating Blockchain transactions

Systems and methods for generating a metric based on Blockchain data for use in controlling, evaluating, or otherwise regulating a transaction. The metric may be used to control the release of assets, to trigger an event, or as a measure of the satisfaction of contractual conditions based on whether the characteristics of a transaction or of a party engaging in a transaction are associated with a score that satisfies a threshold value. In some embodiments, a state-change derived score or metric allows the creation of a layer of trust or reliability that a Blockchain network can reference in situations where a greater degree of trust is desired.

Blockchain-based smart contracts are proposed contracts that can be partially or fully executed or enforced without human interaction. One of the objectives of a smart contract is automated escrow. A key feature of smart contracts is that they do not need a trusted third party (such as a trustee) to act as an intermediary between contracting entities. Instead, the Blockchain network executes the contract on its own. This may reduce friction between entities when transferring value and could subsequently open the door to a higher level of transaction automation.

For more information, visit the following link:

<https://worldwide.espacenet.com/patent/search/family/085982763/publication/US2023118380A1?q=blockchain>

Reference

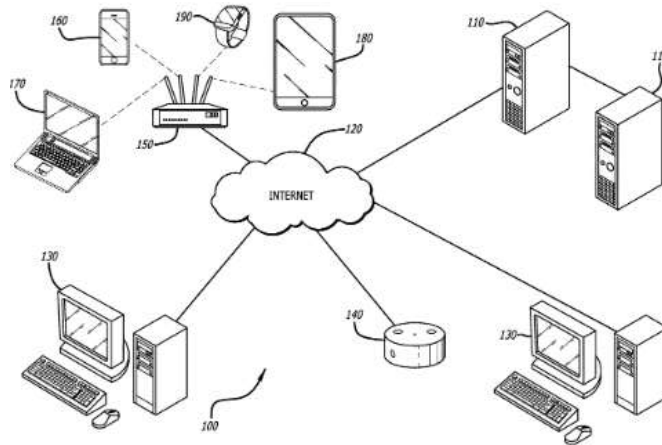
Krosinski, J. (April 20, 2023). Systems and methods for monitoring, analyzing and regulating blockchain transactions. Recovered April 20, 2023, Espacenet Patent Search: <https://worldwide.espacenet.com/patent/search/family/085982763/publication/US2023118380A1?q=blockchain>

Information source: (Espacenet Patent Search, 2023)



2.9 Artificial Intelligence assisted real time quotations

Systems and methods are described to utilize Artificial Intelligence to customize insurance rate quotes to customers. A computing device with an Artificial Intelligence logic is utilized.



A schematic block diagram of a computer network in accordance with an embodiment of the disclosure.

Credit: Hobby D., Espacenet Patent Search

The computing device can be configured for receiving a request to generate a quote from a user such as a customer. In response, the systems and methods can access historical data about the customer from a plurality of sources. Data may also be further configured for retrieving third-party data about the customer and then analyzing the historical and third-party data in real time to determine and generate the quote, which may then be returned to the customer. Often, the third-party data may include telematic data and psychographic data personalized to the customer, among other data

For more information, visit the following link:

<https://worldwide.espacenet.com/patent/search/family/085980931/publication/US2023119102A1?q=ARTIFICIAL%20INTELLIGENCE>

Reference

Hobby, D. (April 20, 2023). Artificial Intelligence assisted real time quotations. Recovered April 20, 2023, Espacenet Patent Search:

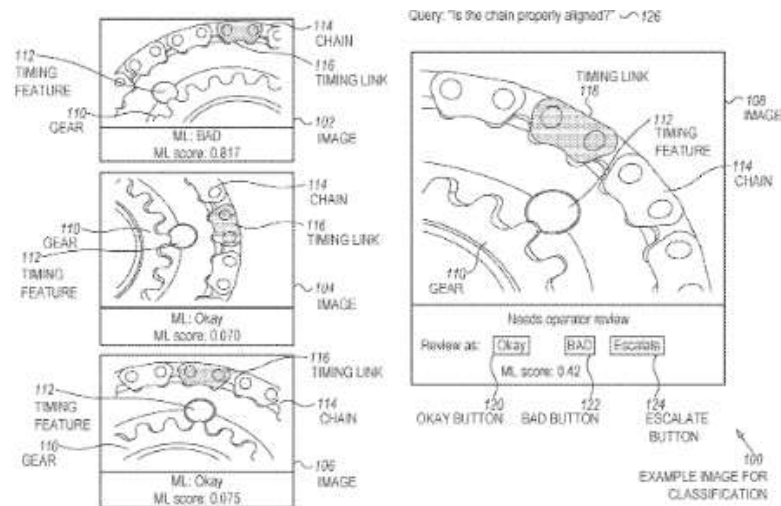
<https://worldwide.espacenet.com/patent/search/family/085980931/publication/US2023119102A1?q=artificial%20intelligence>

Information source: (Espacenet Patent Search, 2023)



2.10 Rapid deployment Machine Learning system

A Machine Learning system may be deployed with a less-than-optimal classification system, but may include a human in the loop system to rapidly assist in classification and deployment.



Is a diagram illustration of an embodiment showing an example set of images and queries.

Credit: Geiger, A., Dirac, L., Espacenet Patent Search

The human's input may be returned as a response to a query and may also be stored for re-training the Machine Learning system. With a rapid human response, a Machine Learning system may be deployed and may "learn" over time. A multi-stage human intervention system may have a rapid response human interface, and if the first human encounters ambiguity, the request may be elevated to a second stage human expert for resolution. Such a system may be deployed using a generic or semi-generic classification system, and as the human responses are accumulated, the Machine Learning system may be repeatedly re-trained to reach a desired performance level.

For more information, visit the following link:

<https://worldwide.espacenet.com/patent/search/family/085982600/publication/US2023117932A1?q=machine%20learning>

Reference

Geiger, A. & Dirac, L. (April 20, 2023). Rapid deployment Machine Learning system. Recovered April 21, 2023, Espacenet Patent Search:

<https://worldwide.espacenet.com/patent/search/family/085982600/publication/US2023117932A1?q=machine%20learning>

Information source: (Espacenet Patent Search, 2023)