SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

Weekly Discovery

We SHARE to inspire and ignite ideas!

3 June – 7 June 2024

AI

New Techniques Emerge to Stop Audio Deepfakes

"Voice cloning—in which AI is used to create fake yet realistic-sounding speech—has its benefits, such as generating synthetic voices for people with speech impairments. But the technology also has plenty of malicious uses: Scammers can use AI to clone voices to impersonate someone and swindle individuals or companies out of millions of dollars. Voice cloning can also be used to generate audio deepfakes that spread election disinformation.

To combat the increasing dangers posed by audio deepfakes, the U.S. Federal Trade Commission (FTC) launched its Voice Cloning Challenge. Contestants from both academia and industry were tasked with developing ideas to prevent, monitor, and evaluate voice cloning used for nefarious purposes. The agency announced the contest's three winners in April. These three teams all approached the problem differently, demonstrating that a multipronged, multidisciplinary approach is required to address the challenging and evolving harms posed by audio deepfakes."

Source: IEEE Spectrum (30 May 2024)

ARCHITECTURE

Pavilions In Cities: 14 Structures That Foster Human Interactions

"As dwellers of big cities, we tend to be dragged into a very fast-paced lifestyle. Surrounded by monumental buildings and infrastructure, we can easily lose sight of key spaces that connect us with our neighborhood and provide us with rare moments of peace and enjoyment. Appropriation of the environment we inhabit becomes an uncommon circumstance.

The need for human-scale structures is fundamental in cities where public spaces are sometimes overlooked or misused. To foster civic participation, recreation, socialization, and overall, making the city more livable and enjoyable for its citizens, relatively small public landmarks generate opportunities for users to interact with the surrounding space in various ways. To create these discoveries, one common and easy resource used has been the creation of simple pavilions or installations, seizing the attention of passersby, on their scale.

Whether it is a performance stage, an artistic interactive installation, or a pavilion with a social purpose, all of these projects selected are an invitation to open up the space for users, creating outdoor encounters and fostering human interactions."

Source: Archdaily (31 May 2024)

AUTOMOTIVE DESIGN

Roth Architecture Creates Electric Car for Navigating Narrow Tulum Roads

"Tulum-based design studio Roth Architecture has created an electric car accented with local materials to offer a "tranquil journey amidst nature" along the local roads. The EK car was designed to reduce the environmental impact of fossil fuel transportation, in line with what the studio calls its commitment to the "urgent demands of the Earth".

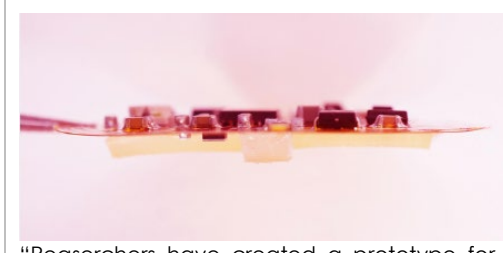
The EK, which means 'star' in the Mayan language, fits three people and reaches speeds up to 22 miles per hour (36 kilometres per hour). It is approximately 13 feet long, seven feet wide and seven feet high (four x two x two metres).

It consists of a fibreglass body covered in silver automotive paint on a three-wheel chassis. Two large, open-air windows were placed on either side of the car, while its front and rear windshields are protected with transparent acrylic."

Source: Dezeen (29 May 2024)

BIOELECTRONICS

Uchicago Scientists Invent "Living Bioelectronics" That Can Sense and Heal Skin



"Reaserchers have created a prototype for what they call 'living bioelectronics': a combination of living cells, gel, and electronics that can integrate with living tissue. Tests in mice found that the devices could continuously monitor and improve psoriasis-like symptoms, without irritating skin. The researchers hope the principles can also be applied to other parts of the body, such as cardiological or neural stimulation.

In this study, the researchers took a new approach. Typically, bioelectronics consist of the electronics themselves, plus a soft layer to make them less irritating to the body. But Tian's group wondered if they could add new capabilities by integrating a third component: living cells themselves. The group was intrigued with the healing properties of certain bacteria such as S. epidermidis, a microbe that naturally lives on human skin and has been shown to reduce inflammation. They created a device with three components. The framework is a thin, flexible electronic circuit with sensors. It is overlaid with a gel created from tapioca starch and gelatin, which is ultrasoft and mimics the makeup of tissue itself. Lastly, S. epidermidis microbes are tucked into the gel.

When the device is placed on skin, the bacteria secrete compounds that reduce inflammation, and the sensor monitors the skin for signals like skin temperature and humidity. In tests with mice prone to psoriasis-like skin conditions, there was a significant reduction in symptoms."

Source: UChicago News (31 May 2024)

DESIGN

Nine Unique Product Designs That Improve Health and Wellbeing

"Assistive devices empower individuals with disabilities or limitations to perform tasks independently, fostering self-sufficiency and confidence. Meanwhile, health technology enables users to track and manage their health conditions more effectively, acting as a prevention tool.

Inclusive designs ensure that everyone, regardless of ability or identity, can access and enjoy products, promoting a more equitable society, while products designed with accessibility in mind break down barriers, making essential services and amenities more available to a wider range of people.

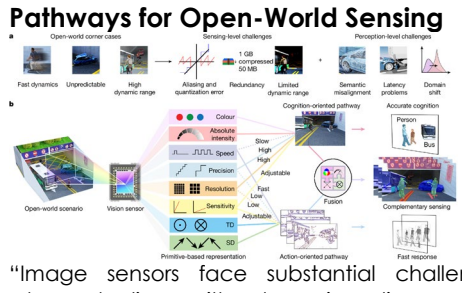
Sports and exercise equipment, alongside personal health products, promote physical activity and encourage healthier lifestyles.

Whether it's adaptive clothing or user-friendly technology, these products prioritise comfort and ease of use, enhancing user experience."

Source: Dezeen (28 May 2024)

IMAGE SENSORS

A Vision Chip with Complementary Pathways for Open-World Sensing



"Image sensors face substantial challenges when dealing with dynamic, diverse and unpredictable scenes in open-world applications. However, the development of image sensors towards high speed, high resolution, large dynamic range and high precision is limited by power and bandwidth. Here we present a complementary sensing paradigm inspired by the human visual system that involves parsing visual information into primitive-based representations and assembling these primitives to form two complementary vision pathways: a cognition-oriented pathway for accurate cognition and an action-oriented pathway for rapid response. To realize this paradigm, a vision chip called Tianmouc is developed, incorporating a hybrid pixel array and a parallel-and-heterogeneous readout architecture. Leveraging the characteristics of the complementary vision pathway, Tianmouc achieves high-speed sensing of up to 10,000 fps, a dynamic range of 130 dB and an advanced figure of merit in terms of spatial resolution, speed and dynamic range. Furthermore, it adaptively reduces bandwidth by 90%. We demonstrate the integration of a Tianmouc chip into an autonomous driving system, showcasing its abilities to enable accurate, fast and robust perception, even in challenging corner cases on open roads. The primitive-based complementary sensing paradigm helps in overcoming fundamental limitations in developing vision systems for diverse open-world applications."

Source: Nature (29 May 2024)

MEDICAL IMAGING

This Self-Powered Sensor Could Make MRIs More Efficient

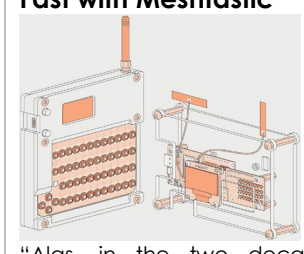
"MRI scans are commonly used to diagnose a variety of conditions, anything from liver disease to brain tumors. But, as anyone who has been through one knows, patients must remain completely still to avoid blurring the images and requiring a new scan. A prototype device could change that. The self-powered sensor detects movement and shuts down an MRI scan in real time, improving the process for patients and technicians.

This sensor was incorporated into an MRI table designed to lay under a patient's head. In tests, when a person turned their head from side to side or raised it off the table, the sensor detected these movements and transmitted a signal to a computer. Then, an audible alert played, a pop-up window on the technician's computer appeared and the MRI scan ceased. The researchers say that this work could help make MRI scans more efficient and less frustrating for patients and technicians alike by producing better images during a single procedure."

Source: ACS (31 May 2024)

MESH RADIO

Build Long-Range IoT Applications Fast with Meshtastic



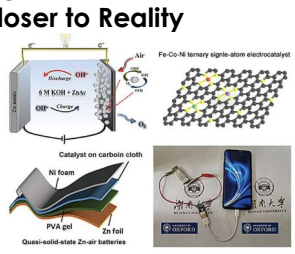
"Alas, in the two decades since, mesh networking has been slow to displace conventional radio systems. It's popped up on a small scale in things like theZigbee wireless protocol for the Internet of Things, and in recent years it's become common to see Wi-Fi networks extended using mesh-based products such as the Eero. But it's still a technology that I think has yet to fulfill its potential. So I've been excited to see the emergence of the open-source Meshtastic protocol, and the proliferation of maker-friendly hardware around it. I had to try it out myself.

Meshtastic is built on top of the increasingly popular LoRa (long-range) technology, which relies on spread-spectrum methods to send low-power, low-bandwidth signals over distances up to about 16 kilometers (in perfect conditions) using unlicensed radio bands. Precise frequencies vary by region, but they're in the 863- to 928-megahertz range. You're not going to use a Meshtastic network for 1.5-Mb/s downloads, or even voice communications. But you can use it to exchange text messages, location data, and the like in the absence of any other communications infrastructure."

Source: IEEE Spectrum (29 May 2024)

NANOMATERIALS

New Catalyst Brings Commercial High-Efficiency Zinc-Air Batteries Closer to Reality

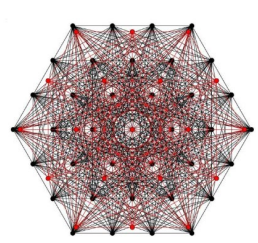


"The non-noble metal (Fe, Co, Ni, etc.) catalysts possess promising potential to replace noble metals (e.g., Pt, Ru, Ir, etc.) as catalysts for oxygen electrocatalysis. Up to now, various mono- and dual-single-atom catalysts have been fabricated, though it is still challenging to synthesise ternary single-atom catalysts due to the difference of interaction

Source: Dezeen (28 May 2024)

QUANTUM PHYSICS

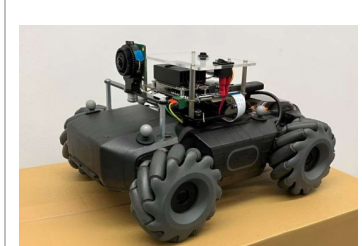
A Framework to Construct Quantum Spherical Codes



"Researchers at NIST/University of Maryland recently introduced a new framework to construct quantum codes that could also apply to bosonic quantum systems. Their framework, outlined in a paper published in Nature Physics, specifically proposes the construction of quantum codes that are defined on spheres.

ROBOTICS

Research Team Introduces an Agile Multi-Robot Research Platform

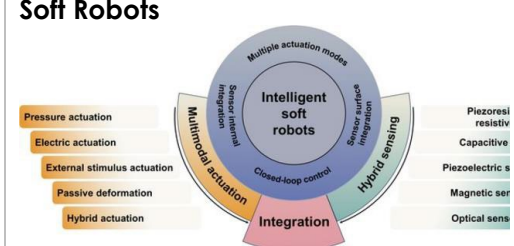


"Researchers at the University of Cambridge recently introduced the Cambridge RoboMaster, a promising platform for multi-robot research.

This platform, outlined in a paper pre-published on arXiv, includes the design of a fleet of customized Robomaster wheeled robots,

ROBOTICS

Revolutionizing Robotics: Integrating Actuation and Sensing for Smarter Soft Robots



"The world of robotics is witnessing a transformative shift with the rise of soft robotics, which offers unparalleled flexibility and adaptability in various applications, from medical interventions to intricate rescue operations. A groundbreaking review article by Zhou et al. published in Cyborg Bionic Systems in 2024, sheds light on this evolution,

forces between different metal ions (Fe, Co, Ni, etc.) and ligands. Here, we report a Fe-Co-Ni ternary single-atom catalyst (FeCoNi-Nx) derived from a zeolitic imidazolate frameworks (ZIF) precursor as an efficient oxygen electrocatalyst, and an optimised flexible casting-drying polyvinyl alcohol (CD-PVA) film as a quasi-solid electrolyte host, for high-efficiency solid-state Zn-air batteries. The aberration-corrected HAADF-STEM and EELS spectrum confirm the co-existence of Fe, Co and Ni single atoms in the FeCoNi-Nx catalyst, and the electrochemical, mechanical, and durability tests prove the superiority of the CD-PVA film. As a result, the FeCoNi-Nx-based rechargeable Zn-air battery delivers superior specific capacity (846.8 mAh·gZn–1) and power density (135 mW·cm–2) in aqueous electrolyte, as well as an over 60 mW·cm–2 power density in quasi-solid electrolyte. As a result, the quasi-solid-state Zn-air battery with a small area of only 2 cm2 is able to charge a mobile phone, which outperforms all the reported devices to date.

Read full article here."

Source: Phys.Org (3 Jun 2024)

As with classical computers, quantum computers require error-correction schemes to reliably perform useful large-scale calculations. The nature and frequency of errors depends on the quantum computing platform, and although there is a large literature on qubit-based coding, these are often not directly applicable to devices that store information in bosonic systems such as photonic resonators. Here, we introduce a framework for constructing quantum codes defined on spheres by recasting such codes as quantum analogues of the classical spherical codes.

The team applied this framework to bosonic coding, and obtained multimode extensions of the cat codes that can outperform previous constructions but require a similar type of overhead. Their polytope-based cat codes consist of sets of points with large separation that, at the same time, form averaging sets known as spherical designs. They also recast concatenations of Calderbank–Shor–Steane codes with cat codes as quantum spherical codes, which establishes a method to autonomously protect against dephasing noise."

Source: Phys.Org (3 Jun 2024)

along with software to simulate and train the robots on specific tasks.

The Cambridge RobotMaster has so far proved to be a highly versatile, reliable and accessible testbed for multi-robot research."

Source: TechXplore (1 Jun 2024)

highlighting the crucial integration of actuation and sensing technologies that pave the way for truly intelligent soft robots.

Soft robots, unlike their rigid counterparts, are made from materials that mimic the mechanical properties of living tissues, allowing them to move and adapt with a life-like grace. This capability makes them ideal for operating in unstructured and unpredictable environments where traditional robots might falter. The innovative research spearheaded by the team from Southeast University in Nanjing, China, focuses on merging actuation—the ability to move and interact with surroundings—with sensing, which involves collecting data about the environment. This integration is essential for developing soft robots that can react and adapt to their surroundings autonomously."

Source: Eurekalert! (2 Jun 2024)