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Six-Time Top 100 Global Innovator

ITRI has been recognized as a Top 100 Global Innovator for the sixth time and fifth consecutive year, making it the most awarded research institution ever in Asia. "Being named as a Top 100 Global Innovator illustrates ITRI's consistent high performance and scale in innovativeness," said ITRI President Edwin Liu.



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ITRI Named a Top 100 Global Innovator for the **Sixth Time**

ITRI has been named a Top 100 Global Innovator[™] for the sixth time and fifth consecutive year, making it the most awarded research institution ever in Asia. The annual list from Clarivate[™], a global leader in providing trusted information and insights to accelerate the pace of innovation, recognizes organizations with the capabilities, consistency and creativity that delivers new value and ingenuity for the world. ITRI, the French Alternative Energies and Atomic Energy Commission (CEA), and National Centre for Scientific Research (CNRS) are the only three government-sponsored research organizations to make the 2022 list.

Top 100 Global Innovator 2022

Clarivate"

"Being named as a Top 100 Global Innovator illustrates

ITRI's consistent high performance and scale in innovativeness. ITRI's patents feature three main characteristics: High Innovation: 98% of its patents are invention patents; International Deployment: The number of foreign patent applications is nearly double that of domestic applications; High Patent Quality: ITRI has received a large number of citations in its US patents, suggesting its strong patent influence," said ITRI President Edwin Liu.

In recent years, ITRI has been working on maximizing the impact of intellectual property (IP), identifying untapped niche opportunities, and creating new value for R&D results. "We are actively facilitating connections between the capital and technology markets to build an IP Bank and national-level patent pool for Taiwan. So far, we have supported more than 50 startups and small & medium enterprises to enhance technological innovation and acquire financing," added Dr. Liu.

"ITRI is one of the three national state-funded research organizations that make the list this year. We congratulate ITRI on its inclusion for the 6th time, 5 years in a row. ITRI truly exemplifies above-the-bar excellence in innovation, with its novel ideas and international





ambition. We hope ITRI can continue to drive industrial development and deploy its many R&D results into the economy," said Ed White, Chief Analyst and Vice President of IP and Innovation Research, Clarivate.

According to Clarivate, the methodology for the Top 100 Global Innovators model of excellence calculation has been refreshed for 2022. This year's report introduced a new twin track approach to evaluation: The first track identified organizations that passed the qualification criteria based on volume of inventive activity, while the second track evaluated all inventions in the Derwent World Patents Index[™], scoring them on influence, success, globalization, and technical distinctiveness.

The Top 100 program uses informatic techniques targeting innovation excellence to compare over 50 million ideas, across thousands of baselines, through billions of calculations, to discover the 100 innovators at the pinnacle. This year is the 11th edition of the Clarivate Top 100 Global Innovators report, which includes honorees from 12 countries and regions. Besides ITRI, renowned companies such as 3M, Intel, Qualcomm, and TSMC are also on the list. See the full Top 100 list <u>here</u>.



» Spotlight

CES 2022 Review: A Hybrid Exhibition Experience



Best moments and scenes of ITRI at CES 2022.

The world's largest tech trade show CES 2022 has finished its exhibition, with more than 2,300 exhibitors participating at the event. This year, ITRI took a dual approach to create a "physical x virtual" exhibition experience, hosting both a physical booth in Las Vegas and a digital pavilion, allowing visitors from around the world to explore innovations wherever they are.

ITRI's innovations at the physical exhibition caught the attention of many visitors with several interactive experiences, such as PoseFit and the Interactive Time Machine, while ITRI staff in Taiwan also held online video conferences with booth visitors to respond to their inquiries regarding technological design and applications.

"We are very excited to join CES 2022 in this challenging yet exuberant time. On this global stage for innovation, we exhibit 13 of ITRI's innovations with the confluence of AI, robotics, ICT, health and other technologies to seek for international technology transfers and business collaboration opportunities," said Dr. Sean S.H. Wang, President of ITRI International Inc., a subsidiary of ITRI based in the US. "In the exhibition hall and via online, we have been energetically engaging interactive, intelligent and productive discussions with potential partners around the world," he added.

Brian Moon, Vice President of Sales and Business Development, Consumer Technology Association (CTA), noted that this year CES has so much innovation to show, including automotive, audio/video, NFT, and space techs. He was impressed by ITRI's pandemic-related innovations in digital health and virtual entertainment such as the Interactive Time Machine, and congratulated ITRI on winning three CES Innovation Awards for its excellent technology design and engineering. "We certainly appreciate ITRI being at CES and supporting us for so many years, and it is exciting to see the exhibit space and the innovation continuing to grow," he said.

ITRI's exhibition this year has garnered much attention from the tech community. iPetweaR, for instance, was praised as one of "the most interesting and innovative products to watch out for at CES 2022" by the UK-based tech review site TechRadar, and named among "the top 5 cool products to be unveiled at the event" by BGR, a leading tech media outlet in India.

Learn more about ITRI's CES 2022 innovations below:

 Novel Applications in AI, Robotics, and ICT	>
Health Techs to Improve Quality of Life	>

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» Spotlight

Novel Applications in AI, Robotics, and ICT

AI, Robotics, and ICT are always a spotlight of CES, and this year ITRI presented the RGB-D AI Robot, the first collaborative robot that integrates smart 3D vision as a standard; the Autonomous Selfie Drone, which flies itself to take the best selfie picture using AI; and the Interactive Time Machine, which creates a 3D interactive avatar from the user's full body with AI and forms a metaverse for avatars to interact with players in real time.



ITRI's highlight technologies in AI, robotics, and ICT included the RGB-D AI Robot, the Autonomous Selfie Drone, and Interactive Time Machine.

RGB-D AI Robot

The RGB-D AI Robot, a CES 2022 Innovation Awards honoree, is the world's first collaborative robot featuring 3D vision as a built-in standard. The smart sensing technology functions as a pair of sharp eyes on a robotic arm, and it reduces the size of the sensor by 168 times compared with other robots, while increasing the sensing speed by 38.6 times.

The Robot includes self-learning technology to enable fast, high-precision 3D object retrieval, eliminating the need for revising control programs to teach robots to identify objects, which often takes one to two weeks. Whenever a production line is changed or new materials are introduced, the Robot can automatically scan tens of



thousands of training materials, quickly learning the best handling strategy in less than 12 hours. Consequently, engineering costs are greatly reduced, and production efficiency is boosted.

Possible applications include sorting and packaging objects for smart automation in the manufacturing and logistics industries. The Robot also has potential use in retail or service businesses and healthcare to directly serve customers.



Video of RGB-D AI Robot.

Autonomous Selfie Drone

The Autonomous Selfie Drone frees the user from photography courses-it does all the hard

composition, angle, and lighting preparation, flying itself into position to take the best selfie picture based on AI algorithms and data acquired from essential photography techniques.

Users who know photography also can follow their individual preferences to set up different close-up angles, photography body ratio, and compositions. The drone can analyze posture and head orientation to automatically adjust its own position and the angle of depression to achieve the best composition. Its relative portrait mode uses smart framing technology to analyze the user and background, creating a natural and unobtrusive match between the subject and the surroundings.

Compared with other selfie drones, ITRI's innovation distinguishes itself with fully automated photography, smart aesthetic composition, and the direct use of the phone camera, which grants superior resolution and removes the need to convert image formats.



Video of Autonomous Selfie Drone.

Interactive Time Machine

ITRI's Interactive Time Machine is the first and only system that creates with AI a 3D interactive avatar from the user's full body rather than from the face only, automatically generates a younger-looking avatar including the user's surroundings, and forms a metaverse for avatars to interact with players in real time.

The user can move freely in front of the system, and the 3D model shown on the display creates the corresponding movements simultaneously. The user can also interact with a virtual self that looks younger or older, which creates a unique experience that intertwines the real world with the virtual one. Use cases include VR/AR/MR gaming, personal entertainment,

teleconferences where people meet and interact with their 3D models, and exhibitions for interactive activities to attract visitors.



Video of Interactive Time Machine.

Other AI, robotics, and ICT technologies that ITRI showcased for CES 2022 included the DNN Video Analysis OS, the Ultra Low Power AI Accelerator, Virtualization-based Fault Tolerance for Critical Online Services, and the 5G O-RAN RIC.



» Spotlight

Health Techs to Improve Quality of Life

Due to the ongoing global pandemic, innovations in e-health wearables, smart monitoring, and health management have received much attention at CES. ITRI's highlight health technologies include PoseFit, a muscular functional screening mirror that can provide personalized exercise plans, and iPetWeaR, a health monitoring wearable device for pets.



ITRI's highlight health technologies featured PoseFit and iPetWeaR.

PoseFit

The PoseFit muscular functional screening mirror measures muscular strength, flexibility, and imbalances, and provides a personalized and actionable exercise plan. PoseFit captures a user's specific movement and posture through a lens and uses a skeletal recognition system to determine muscular function. By analyzing the strength of specific muscle groups, posture, flexibility, endurance, and sense of balance, it indicates which muscle groups are too tight or are not strong enough. This innovation provides customized exercise suggestions to strengthen muscles or point to places that should be massaged or relaxed. It requires no wearable devices to operate. The examinee is required to complete five sets of exercises, each of which is demonstrated with an instructional video.

PoseFit is suitable for two types of users: those trying to improve fitness and frail older adults. For those wanting to enhance body shape, performance and muscles, PoseFit provides a clear assessment of postures potentially harmful to health. For older adults who may experience age-related physiological decline, the system identifies weak muscle areas and posture issues, and recommends workout plans for improvement to minimize the risk of falls associated with poor posture or low muscle mass.



Video of PoseFit muscular functional screening mirror.

iPetWeaR

This CES 2022 Innovation Awards honoree is a wearable device that tracks a pet's health data including heart rate, respiration, and activity, and alerts the pet guardian of abnormalities. The low-power physiological detection radar technology is completely harmless and does not require skin contact with the pet.

The device is attached to a pet's collar to be near the pet's neck/chest or can be integrated into pet mattresses. The collected physiological data is sent by Bluetooth to the pet guardian's mobile device, where they can instantly view the data in an app and learn whether the pet is asleep or awake. In the case of irregular heartbeat or breathing the pet guardian will immediately receive a warning notification. The long-term history is also logged in a database for easy viewing.



iPetWeaR can help early detection of a pet's underlying health condition to lower the risks of its sudden passing caused by heart attack, heat stroke or adverse vaccine reactions. Besides its application at home, iPetWeaR can assist staff in animal shelters and hospitals to provide improved animal care services.



Video of iPetWeaR.

Other health tech exhibits included the <u>All-in-One Thermal Sensing System</u> (another ITRI's CES 2022 Innovation Awards Honoree), the <u>Full-Body Strideway Analysis System</u>, the <u>EPiTRI</u> bionic full-thickness skin tissue printing system, and the <u>Automatic Cell Production System</u>.

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» Spotlight

5G O-RAN Energy-Saving Private Network Solution Exhibited at MWC

The 5G industry is welcoming new business opportunities associated with the move towards net zero carbon emissions. ITRI and Pegatron Corp. are jointly participating online in this year's Mobile World Congress (MWC) by unveiling the 5G base station that they developed together. The debut of the 5G Open RAN (O-RAN) energy-saving private network solution demonstrates how smart algorithms in conjunction with network traffic monitoring and traffic steering technology allow 5G base stations to provide smart, energy-saving, and uninterrupted services. This carbon-reduction solution is also poised to promote broader usage of 5G base stations and generate new business opportunities.

Open architecture offers enormous opportunities in the 5G era and can overcome barriers created by traditional telecommunications equipment makers. ITRI's 5G O-RAN energysaving private network solution facilitates base station equipment and systems integration firms in effectively controlling the private network costs of 5G base stations, and even more importantly is providing hardware and software integration solutions for 5G base station products.



The 5G Open RAN (O-RAN) energy-saving private network solution developed by ITRI and Pegatron intelligently manages energy consumption for 5G base station systems to reduce carbon emissions.

Dr. Pang-An Ting, General Director of ITRI's Information and Communications Research Laboratories, remarked that the MWC is the most influential conference in the communications sector, and the 5G O-RAN trend has attracted participation by major firms such as AT&T, Intel, Rakuten, Nvidia, Qualcomm, and NTT DOCOMO. ITRI has worked on private network management technology for many years, and it has won the Small Cell Forum Award (SCF Award) twice. This highlights that Taiwan's 5G base station smart management technology is every bit as advanced as that of world-leading firms. IEEE research shows that among cellular networks, base station power consumption accounts for up to 50-60%, which is higher than that of core and transport networks. ITRI and Pegatron are jointly exhibiting online the 5G O-RAN end-to-end energy-saving control system, which is based on Taiwan's first smart base station network management system. The solution provides rapid deployment and efficient management of private networks and can be used in smart factories, hospitals, and entertainment venues.

CY Feng, General Manager of BU6 at Pegatron Corporation, reiterated that via gNB Energy Savings capabilities with ITRI, Pegatron aims to lower operating and administrative costs for smart manufacturing, hospitals, warehousing, and shipping ports. Pegatron will continue improving the performance of 5G O-RAN products and build vertical applications for private networks. At the same time, Pegatron will cooperate with partners to drive Taiwan's 5G private network industries forward on a global scale.

The 5G energy-saving private network solution is a software that intelligently manages energy consumption for 5G base station systems. Smart algorithms redirect terminal devices to specific base stations, and in tandem with the regular monitoring of traffic in the base station network and terminal devices (such as machines in smart factories) ensure uninterrupted connection services. This frees up more base stations to hibernate, reducing power consumption and costs. Monthly power savings in a smart factory private network with 100 5G base stations would be 12,750 kWh, which is equivalent to the usage of about 37.5 households, and which translates to a reduction of about 7,060 kilograms of carbon emissions.



»R&D Focus

Bi-Swivel Laser Cutting Module Technology

ITRI has collaborated with leading robotic arm manufacturer HIWIN Technology and Taiwan's largest laser tube cutting equipment maker SOCO Machinery on the development of Bi-Swivel Laser Cutting Module Technology. This module, the only of its kind made in Taiwan, is able to cut precise patterns on metal or other materials and can be used in manufacturing applications such as metal processing, tube cutting, or engraving. The technology made its debut at TIMTOS x TMTS 2022 in Taipei in late February, attracting the interest of many users and vendors.



ITRI, SOCO Machinery, and HIWIN together debuted high-performance but costcompetitive laser cutting technology at TIMTOS x TMTS 2022.

Bi-Swivel Laser Cutting Module Technology involves adding two oscillating shafts to the laser cutting module. The optical mirrors of the oscillating shafts, in conjunction with HIWIN's Torque Motor Rotary Table, guide a high-power laser source of over 2,000 W in carrying out

multi-degree-of-freedom oscillating cutting. The rotation axis does not have any angle limitation, and repeatability precision reaches +/- 0.0028 degrees.

Dr. Fang-Hei Tsau, General Director of ITRI Southern Region Campus, reiterated the importance of precision in laser processing as there is often a need to cut various irregular geometric patterns on composite materials. Just as there is a significant difference between writing using one's arm or wrist, the laser cutting machine also needs to rely on the oscillating laser processing head to function like a wrist that can move at all angles, thus enhancing cutting efficiency and quality.

SOCO Machinery Executive Assistant Joseph Lin states that most imported oscillating laser processing heads are cost-prohibitive. ITRI's laser optical module in combination with the torque motor rotary table of HIWIN's Bi-Swivel Laser Cutting Module Technology can cut costs in half by using domestically made components, thereby increasing the added value of products. He adds that this technology will be introduced to SOCO's laser 3D tube cutting machines and five-axis laser cutting machines, providing cutting technology to the highest specifications but at lower prices to laser equipment and machine tool manufacturers.

According to market research agency Mordor Intelligence, compound growth of about 13.76% is anticipated in the global market for lasers from 2022 to 2027. The Asia-Pacific market accounts for the largest and fastest growing segment of this market. Introducing this laser cutting module into the production process can greatly boost competitiveness for laser equipment and machine tool manufacturers. ITRI will continue to employ innovative technologies to assist industries in upgrading and transforming, while realizing the goals of smart manufacturing, energy conservation, and carbon reduction.

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»R&D Focus

Tracing the Pollutant Emission Source via Inorganic Isotope Ratio Analysis

By Chun-Ting Kuo



The Multiple Collector Inductively Coupled Mass Spectrometer (MC-ICP-MS) traces the pollutant source via inorganic isotope ratio analysis.

Tracing the source of emission for pollutants is often a complicated issue yet a critical step for eliminating pollution. Although traditional analysis methods can provide precise quantitative information, these results reveal little about the origin of pollutants. To remedy this situation, ITRI has developed a novel forensic method by improving on isotope ratio analysis technology.

ITRI's inorganic isotope ratio analysis system has been built upon a Multiple Collector

Inductively Coupled Mass Spectrometer (MC-ICP-MS). Internally, the isotopes in the sample solution are introduced into the instrument and ionized by ~60000C Ar plasma. With the control of an electric and magnetic field, ionized isotopes are emitted with different emergence angles in terms of their molar mass and can be collected by multiple collectors. An isotope ratio is considered a useful index representing local climate change and environmental evolution, and therefore can act as a fingerprint for pollutants. With the development of mass spectrometry over the recent decades, a high-precision inorganic isotope analysis can now be realized and put to use in tracking pollution sources from ground water.



The internal structure shows that the isotopes that pass through the Ar Plasma, electric field, and magnetic field are finally collected by multiple collectors. (Figure adapted from Thermo Fisher MC-ICP-MS Manual)

In contrast to common inductively coupled plasma mass spectrometry (ICP-MS), which utilizes only a single collector and relies on a scanning mode to collect various isotopes sequentially, the multiple collectors in ITRI's MC-ICP-MS achieve simultaneous multi-isotope measurements so that a more precise isotope ratio result can be obtained.

This system was initially built to realize the SI unit – mole (Avogadro constant), in which silicon isotopes are precisely determined with an extremely low measurement uncertainty with the help of isotope dilution mass spectrometry (ID-MS). The extremely low measurement uncertainty is highly useful to distinguish the subtle discrepancies of isotope ratios between different sample sources, allowing the system to trace the source of emission pollutants.

In a recent real case, several underground water samples from chromium (Cr) contaminated areas and nearby effluent sewage in Central Taiwan were collected for the determination of Cr isotope ratios. With a superior mass resolution, the signal of interferences can be separated from the signal of target elements. Through the comparison of obtained Cr isotope ratios in different areas, a regional consistency was found that shows the feasibility of tracing the source of real pollution events via the isotope ratio analysis.



The signal of Cr isotopes measured by MC-ICP-MS.

Efforts have been made to continuously improve the analysis performance, expand the service range to common metal pollutants such as lead (Pb), and build up the database for more efficient tracing of the pollutant source. Comparing to isotope measurement technology worldwide, simultaneous measurement of multiple isotopes and the introduction of ID-MS enables lower measurement uncertainly for ITRI's technology, greatly assisting in distinguishing the source of pollutants.

In the future, this system will also be able to trace emission pollutants in the air (such as PM2.5 and PM10) via a comprehensive sample pretreatment, widening potential applications of this technology.

Acknowledgments

The author gratefully acknowledges the contribution of the Green Energy and Environment Research Laboratories at ITRI for evaluating the feasibility of this technology for application in real pollution events, especially in the design of field experiments and data interpretation.

About the Author



Dr. Chun-Ting Kuo is a senior scientist at the Center for Measurement Standards at ITRI. He received his PhD degree in the Department of Chemistry from National Taiwan University, and worked as a postdoctoral researcher and senior scientist respectively at the University of Washington and Lamprogen Inc. in the United States. His current research focuses on the determination of inorganic trace elements and isotopes.

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»Collaboration

iPMx Molecular Rapid Test System for COVID-19 Launched in Japan

In cooperation with BizLink Group and Japan Biotechno Pharma (JBP), ITRI has successfully launched its iPMx Molecular Rapid Test System in the Japan market. The testing kit has received a sales and manufacturing license from Japan's Ministry of Health, Labour and Welfare. In the future, iPMx is expected to further expand its applications and become available for more hospitals and medical facilities overseas. ITRI will also work with JBP to introduce it to the US, Europe, and South-East Asia regions.



iPMx features a compact design, high accuracy and high efficiency that can provide rapid test results in one hour.

The iPMx Molecular Rapid Test System has four key features: (1) High Precision: Accuracy is over 90%; (2) High Sensitivity: Virus can be detected in the early stage of infection; (3)

Lightweight: The canister weighs only 600 grams—57 times lighter than traditional testing devices—and is easy to carry around; (4) High Efficiency: Only one hour is needed to complete the test, which is 1/4 the time needed by existing PCR tests. In July 2020, it participated in the COVID-19 Proficiency Test of the Quality Control for Molecular Diagnostics (QCMD), obtaining 100% accurate results for all samples.

ITRI Executive Vice President Alex Y.M. Peng commented that ITRI has actively sought international cooperation on epidemic prevention technology since the pandemic began. It contracted with JBP in October 2020 for clinical trials and distribution for iPMx. JBP completed the trials in June 2021, and has recently obtained a sales and manufacturing license to officially begin sales in the Japanese market. "The compact design of iPMx makes it easy to be sent to locations throughout Japan for first-line infection prevention, boosting Japan's capacities in preventing the spread of COVID-19," he said.



Representatives from Japan and Taiwan announced the launch of the iPMx Molecular Rapid Test System in the Japan market.

JBP CEO Naoki Shinohara stated that JBP is committed to the development of antibody and antigen testing. Upon learning about the iPMx Molecular Rapid Test System developed by ITRI in 2020, he was deeply impressed and was confident in the enormous potential of the PCR detection reagent market. After overcoming stringent review hurdles by Japan's Ministry of Health, Labour and Welfare, the product is now finally ready to be sold in Japan. Plans are being made to sell the product to nations in need and hospitals overseas, with the hope of creating greater public wellbeing. BizLink CEO Felix Chien-Hua Teng commented that while participating in this In Vitro Diagnostic (IVD) Devices technology transfer, BizLink examined the existing prototype technology, and then together with ITRI resolved the issue of excessive cooling time. BizLink also assisted in optimizing the design of the kit for mass production, helping to move this product from prototype to commercial production.

Hoshino Mitsuaki, Deputy Representative of the Taipei Office of the Japan-Taiwan Exchange Association, commented that Taiwan and Japan have long maintained extremely close industrial cooperation. ITRI has abundant advanced technology capacities, while JBP has experience in clinical trials and submitting applications to regulatory authorities to bring products to the market. The two sides have added more depth to their cooperation via the successful introduction of the iPMx Molecular Rapid Test System to the Japanese market. "We are very pleased to see these achievements based on interaction between Taiwan and Japan, and we look forward to these efforts helping to quell the pandemic at an early date," he added.



» Collaboration

ITRI and UCLA to Collaborate on World-Leading Memory Technology Development



ITRI and UCLA will pursue a VC-MRAM cooperation project aiming to accelerate the R&D of next-generation memory.

As chip sizes continue to shrink, high-performance Magnetic Random Access Memory (MRAM) technology has become the mainstream. To advance the development of nextgeneration MRAM, ITRI and UCLA have signed an agreement to jointly undertake a Voltage Control Magnetic RAM (VC-MRAM) cooperation project. With support from Taiwan's Department of Industrial Technology (DoIT), Ministry of Economic Affairs (MOEA) and the US Defense Advanced Research Projects Agency (DARPA), this collaboration aims to leverage the technical expertise and innovative capacity from both parties to apply material components to memory chips for computing and storage.

Dr. Chih-I Wu, ITRI's Vice President and General Director of Electronic and Optoelectronic System Research Laboratories, emphasized that the advantages of VC-MRAM such as fast reading/writing and low power consumption make it suitable for energy-saving and lowcarbon emissions applications, presenting a golden opportunity for ITRI's collaboration with UCLA. "This is the first time that ITRI has received actual funding from DARPA in a cooperation initiative. We believe our strengths can be combined to add greater depth to the development of VC-MRAM technology," he said.

Dr. Kang Wang, Distinguished Professor and Raytheon Chair in Electrical Engineering at UCLA, remarked that ITRI, as an internationally renowned applied research institution, has unique formidable expertise and technical capacities. It has a solid foundation and R&D strengths in MRAM technology, and the two sides should be able to leverage their respective foundations through their cooperation, yielding even more groundbreaking achievements.

UCLA Professor and Circuits & Embedded Systems Area Director Dr. Sudhakar Pamarti said that ITRI has platforms and experience in the development of components and manufacturing verification. By realizing the innovative ideas of UCLA in process development, the development of material components will be promoted to related applications. He expects that by the beginning of 2023, the advanced technology developed through this cooperation will create a whole new paradigm in next-generation memory.

ITRI began cultivating MRAM technology years ago, including component innovation, breakthroughs in materials, and circuit optimization, and is poised to address the demands for rapid processing of big data in the AI and 5G era. This is one of the examples that demonstrate ITRI's commitment to promoting Intelligentization Enabling Technologies and fostering innovative applications. ITRI will continue to join hands with industrial, academic, and research organizations in helping industries to upgrade their technology, explore novel solutions and create new possibilities.

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»Collaboration

Next-Generation Semiconductor Cooperation Between ITRI and USC

ITRI announced the commencement of its collaboration with University of Southern California (USC) on IC design and development, IP support, and silicon shuttle services. By enhancing heterogeneous integration, computing, and memory technologies, the cooperation is expected to integrate multidisciplinary R&D results and advance chip manufacturing to boost nextgeneration semiconductor development.

This cooperation will combine the strengths from ITRI and USC to drive advancements in the global semiconductor industry. USC's Metal Oxide Semiconductor Implementation Service (The MOSIS Service) has long provided silicon prototyping and low volume production services and has worked with global leading semiconductor foundries such as TSMC, while ITRI has been dedicated to developing advanced semiconductor technologies and assisting Taiwan's semiconductor supply chain players to optimize and upgrade their products. It is expected that this joint work can connect key chip partners in the US and address the global trends in AI computing applications.



ITRI and USC announced the collaboration on next-gen semiconductors.

ITRI President Edwin Liu remarked that ITRI and USC signed a memorandum of cooperation in November, 2021 that focuses on chip design and development, IP authorization, shared wafer trial production, and next-generation semiconductor R&D. With the official announcement of the collaboration with USC, he expressed his excitement to see how the partnership will bring new opportunities, using ITRI's multidisciplinary R&D platforms and MOSIS' prototyping capacities. "ITRI and USC will collaborate via an institution-to-institution mechanism and build a customer service business model that provides Taiwan's companies with chip packaging and related downstream services following trial production," he said.

"We are excited that the research teams at USC's Electrical and Computer Engineering Department (ECE) and Information Sciences Institute (ISI) with strong profiles in artificial intelligence, radio-frequency and millimeter-wave IC designs, analog and mixed-signal circuits, quantum computing, and optoelectronics can extend their global collaborations with ITRI's outstanding teams. We look forward to seeing the R&D coworking that advance the microelectronic technologies going into applications of great innovations," said Dr. Yannis Yortsos, Dean of USC Viterbi School of Engineering.

Dr. Anthony Bailey, USC Vice President for Strategic and Global Initiatives, remarked that the joint efforts between USC and ITRI laid out a new arena of USC's global research and development, being a marriage of USC's first-tier, fundamental electronic and optoelectronic research record and capabilities and ITRI's research and development with a unique focus on

industry application and commercialization.

Dr. Craig Knoblock, Executive Director of USC ISI, added that The MOSIS Service has the leading-edge capabilities to support semiconductor design and manufacturing, and looked forward to seeing the fruition of semiconductor projects that will benefit innovative start-up companies in the US and Taiwan.

ITRI is committed to promoting technological innovation to assist in industrial upgrading and transformation. In its 2030 Technology Strategy and Roadmap, ITRI is strengthening R&D in semiconductors and intelligentization enabling technology to support multiple applications in 5G, big data, IoT, and AI. It is hoped that the expertise of ITRI and USC will create a win-win situation for all parties and solidify the foundation for next-generation semiconductor development.



» Activity

5G Applications in MR Drone Contest



The mixed reality drone utilizes 5G network technology to allow ultra-low latency image transmissions.

ITRI and Compal Electronics have jointly developed a new generation of 5G drone technology. The unique characteristics of the dedicated 5G network technology were put on display in a drone racing competition at the Asia New Bay Area in Kaohsiung. The technology highlighted includes high-speed positioning of drones, 5G low-latency transmission video streaming, and mixed reality (MR) computing, along with commercialization verification.

Drone racing competitions have become an increasingly popular activity throughout the world in recent years. While the majority of these drone competitions currently only have physical obstacles, the competition held in Kaohsiung had drones fly at high speeds through both physical and virtual obstacles. In this MR drone competition, the pilot can see video streams sent back by the drone camera that is synchronized with the VR head-mounted device. This allows for a First Person View (FPV) while flying at high speeds, creating an even more exciting sensory experience via VR integration.



A drone flying through the LED-lit racetrack.

Dr. Pang-An Ting, General Director of ITRI's Information and Communications Research Laboratories, stated that the technology developed has two key features. First, development of a lightweight 5G camera and ultra-low latency digital image transmission technology compares favorably against traditional analog competitive drones. Image quality of the latter is only 300,000 pixels, whereas the new technology boosts image pixels to over two million, while transmission only takes 0.05 seconds. This creates a sensory experience with zero time lag. Second, the development of the 5G MR system's high speed drone positioning allows for stacking virtual objects in mixed reality, creating a flight course for drones to race through. This may even lead to the creation of new types of gameplay, such as player versus player shooting competitions.

The innovative applications developed for these 5G racing drones are expected to allow such competitions to imitate F1 racing, which sparked the thriving development of the auto industry, and thus promote the growth of drone software, manufacturing, subsystems, components, and peripheral industries. This will also generate business opportunities in live broadcasting, smart interactive entertainment, and simulation training. Given the future of 5G IoT, ITRI formulated the 2030 Technology Strategy & Roadmap that is funneling investment in the development of drone technology, and is creating a diversified array of applications in the field of Smart Living.

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» Activity

Golden Asia Fund III Set to Fuel Semiconductors, **Green Economy, and Healthcare Startups**

Industrial Technology Investment Corporation (ITIC), the fully-owned subsidiary of ITRI, and Mitsubishi UFJ Capital (MUCAP), the venture capital arm of the Mitsubishi UFJ Financial Group (MUFG), have jointly announced their 3rd cooperation in the establishment of a venture fund, Golden Asia Fund III, L.P. (GAF III), which has already successfully raised US\$49.5 million.



Representatives of limited partners from Japan and Taiwan celebrated the establishment of Golden Asia Fund III.

"Since its inception in 2011, Golden Asia Fund has validated the mode of bilateral collaboration built on a strong foundation of proven trust between ITIC and MUCAP. This proven investment platform has been continuously backed by reputable limited partners, and GAF III possesses and embodies the same virtues developed in GAF and GAF II. Our investment goes beyond capital to active company building at every stage, from seed to growth and beyond. Given the vast network of professional contacts, expertise, and extensive business connections of MUFG/MUCAP and ITRI/ITIC, GAF has the ability to grow equity investments through not only financial investment, but also strategic and operational support and to foster technological, marketing, production, and investment collaborations between Taiwanese and Japanese companies for global wins," said ITRI President and ITIC Chairman Dr. Edwin Liu.

As of today, GAF and GAF II have made investments in 22 firms in Taiwan and 20 in Japan. GAF believes that cross-border collaboration can nurture innovative spirit and increase the chances that startups will succeed. Among its inspirational stories of success, GAF facilitated a Taiwanese company that provides BLDC motor driver solutions and modules to cooperate with a world-class motor company based in Japan for the China/ASEAN markets; assisted an automobile OEM company providing aluminum forging components for vehicle chassis suspension systems to collaborate with a Japanese tier-1 automotive manufacturer; and supported a Japanese food tech startup that develops and produces plant-based meat ingredients to collaborate with a well-known food brand in Taiwan for the Taiwan and European markets.

Mitsubishi UFJ Capital President Shinsuke Sakamoto remarked that Taiwan and Japan are old friends and the bonds of friendship already forged should be carried forward for success. "Since the beginning of GAF III formation, I firmly believe that for a better future of Taiwan and Japan, the persistent efforts made by the Golden Asia Fund family must continue," he said.

While not constraining itself to specific sectors for investments, GAF III will explore three trends which it believes investors should prepare for in the next few years, including semiconductors, green energy, and healthcare, as well as other fields such as electric vehicles and precision machinery.

About the Golden Asia Fund

The Golden Asia Fund (GAF) is a vehicle established jointly by ITIC and MUCAP and managed by Golden Asia Fund Ventures Ltd., a Cayman Islands exempted limited company. GAF was initiated in 2011 to exploit the considerable industrial synergies between Taiwan and Japan, and to facilitate entry into fast-growing emerging markets. The GAF invests in and supports startups in a wide range of industrial fields and at various growth stages, acting as a bridge to link Taiwan and Japan.

»About Us



Industrial Technology Research Institute (ITRI) is one of the world's leading technology R&D institutions aiming to innovate a better future for society. Founded in 1973, ITRI has played a vital role in transforming Taiwan's industries from labor-intensive into innovation-driven. To address market needs and global trends, it has launched its 2030 Technology Strategy & Roadmap and focuses on innovation development in Smart Living, Quality Health, and Sustainable Environment. It also strives to strengthen Intelligentization Enabling Technology to support diversified applications.

Over the years, ITRI has been dedicated to incubating startups and spinoffs, including wellknown names such as UMC and TSMC. In addition to its headquarters in Taiwan, ITRI has branch offices in the U.S., Europe, and Japan in an effort to extend its R&D scope and promote international cooperation across the globe. For more information, please visit https://www.itri.org/eng.

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