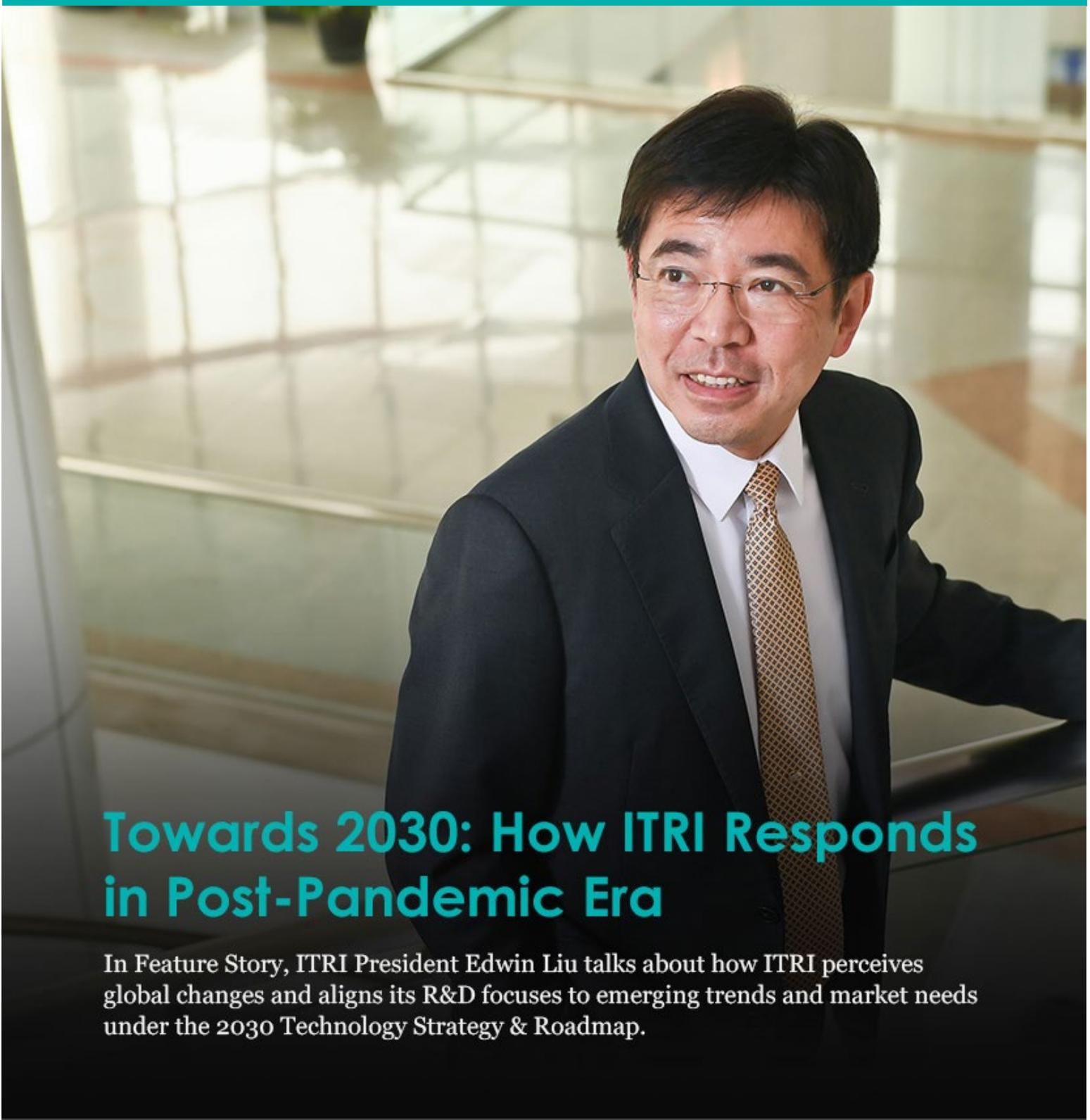


ITRI TODAY

102

Fall Issue 2020



Towards 2030: How ITRI Responds in Post-Pandemic Era

In Feature Story, ITRI President Edwin Liu talks about how ITRI perceives global changes and aligns its R&D focuses to emerging trends and market needs under the 2030 Technology Strategy & Roadmap.

☰

» Contents



FEATURE

ITRI 2030 and Post-Pandemic Trends

SPOTLIGHT

One-Step Autologous Cartilage Repair System



R&D FOCUS

Smart Lighting in Hospitals

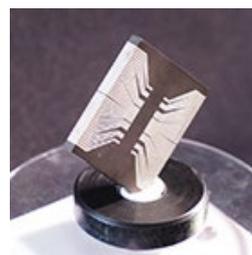
Comprehensive Elder Care Solutions to Promote Fitness & Healthcare for Seniors

COLLABORATION

Joining Hands with Quanta Computer to Develop Multi-Antenna Laptops

Collaboration with Excelsius Medical Provides High-Precision Assistance for Eye Surgery

ITRI and Bucheon City Sign MoU on Environmental IoT



ACTIVITY

Celebrating Our 47th Year and Meeting Future Prospects

ITRI Tech Showcase at BIO Asia-Taiwan 2020

Smart Robotics Technologies Exhibited at TAIROS 2020

ITRI and Czech Republic Embark on New Chapter in Technology



» Feature

ITRI 2030 and Post-Pandemic Trends

Edwin Liu

President of ITRI



ITRI 2030 and its anti-pandemic innovations.

The world is facing challenges such as global economic restructuring, digital transformation, population aging, urbanization, environmental sustainability, and AI revolution. To join the forces of the industry to co-create innovation in response to the emerging trends and market demands, ITRI developed the 2030 Technology Strategy & Roadmap. With a human-oriented approach, we have examined major macro-environmental factors and envisioned future life scenarios in the next ten years to determine directional statements for our R&D.

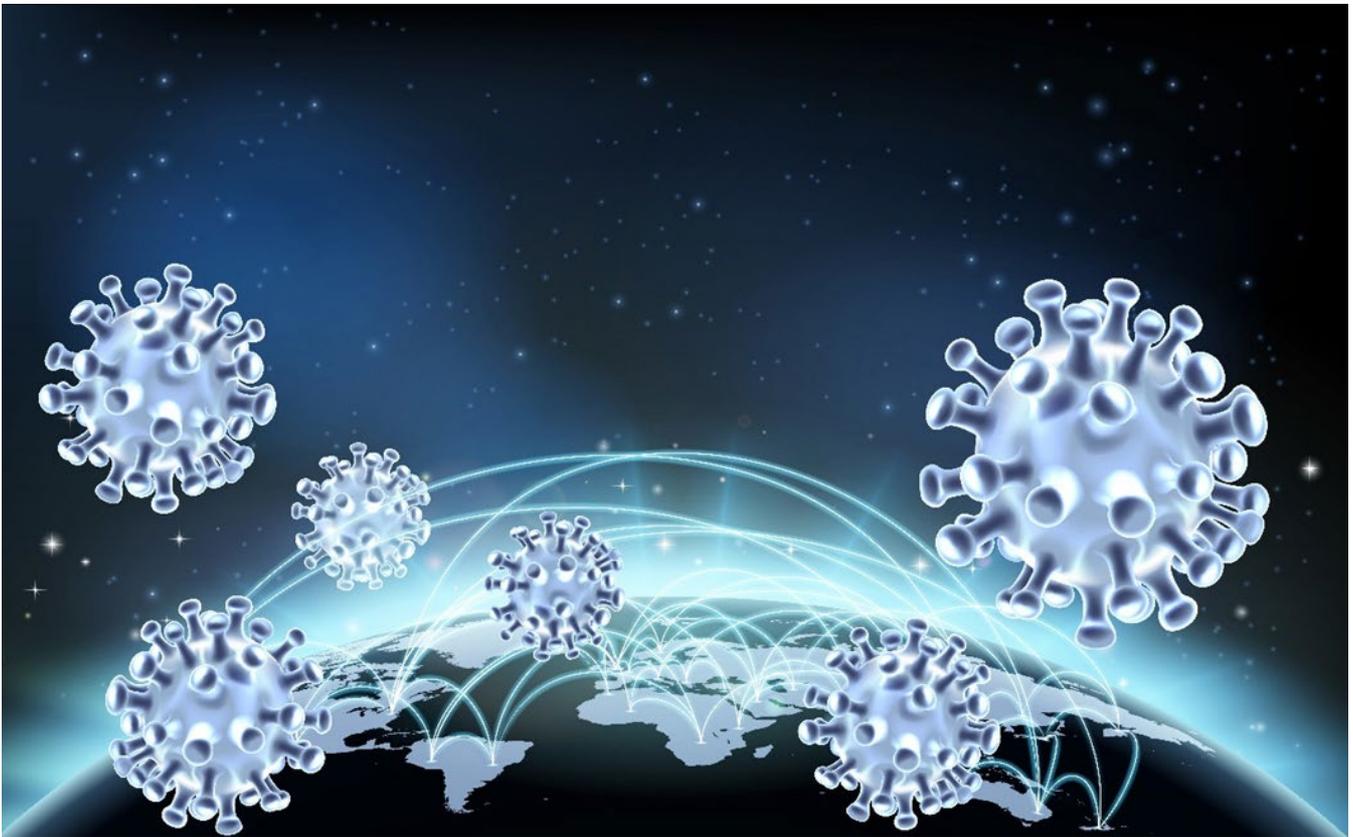


ITRI rolled out the 2030 Technology Strategy & Roadmap to ensure its R&D addresses the latest trends and echoes the needs from industry and society.

Systematic Guidelines for R&D

In our 2030 Technology Strategy & Roadmap, we are fostering technological breakthroughs in the application domains of Smart Living, Quality Health and Sustainable Environment. Meanwhile, we are strengthening the development of ICT enabling technologies to boost multiple applications. The ultimate goal is to utilize our technological prowess to pave the way towards a better future. That is, to shape a future where we can enjoy high quality living, keep healthcare good and affordable, and create a low-carbon, energy-saving and circular community.

As new challenges arise and projects evolve, we adopt rolling management to stay agile and allow progressive elaboration for the 2030 planning. The recent COVID-19 pandemic, for example, is having a significant impact on the world at large and taught us a hard lesson. In the short term, global governments have reviewed their industrial needs especially in medical and healthcare sectors and have become more likely to establish critical technologies on their own. In the long run, social paradigms and business models will be changing. We can analyze the post-pandemic trends from the political, economic, social, and technological (PEST) perspectives as follows.



The COVID-19 pandemic has caused dramatic global changes in PEST aspects.

PEST Analysis of the Post-Pandemic World

Political Factors

Many governments have escalated their awareness on national security and realized that critical fundamental technologies must not be controlled by foreign countries. Although international cooperation remains necessary, self-protection cannot be overlooked. Take Taiwan for example. 90% of its surgical masks were imported, but now it has its own supply of masks in the strategic national stockpile. Moreover, it even has a surplus capacity for export after meeting the domestic demands for mask production.

Economic Factors

The “1.5-meter economy” has accelerated the digitalization of existing business models. New lifestyles such as food delivery services and work-from-home have become more popular than ever. Furthermore, globalization has been redefined. Cost is no longer the sole factor to be considered in international division of labor. Risk diversification becomes even more vital. Following the U.S.-China trade war, the current pandemic has again highlighted the importance of divergent supply chains and diversified market strategies. Taiwanese businesses should embrace digital transformation and emphasize data economy. More specifically, they should keep high-end manufacturing, R&D, and new capital at home and enhance the value of “Smart Taiwan”.

Social Factors

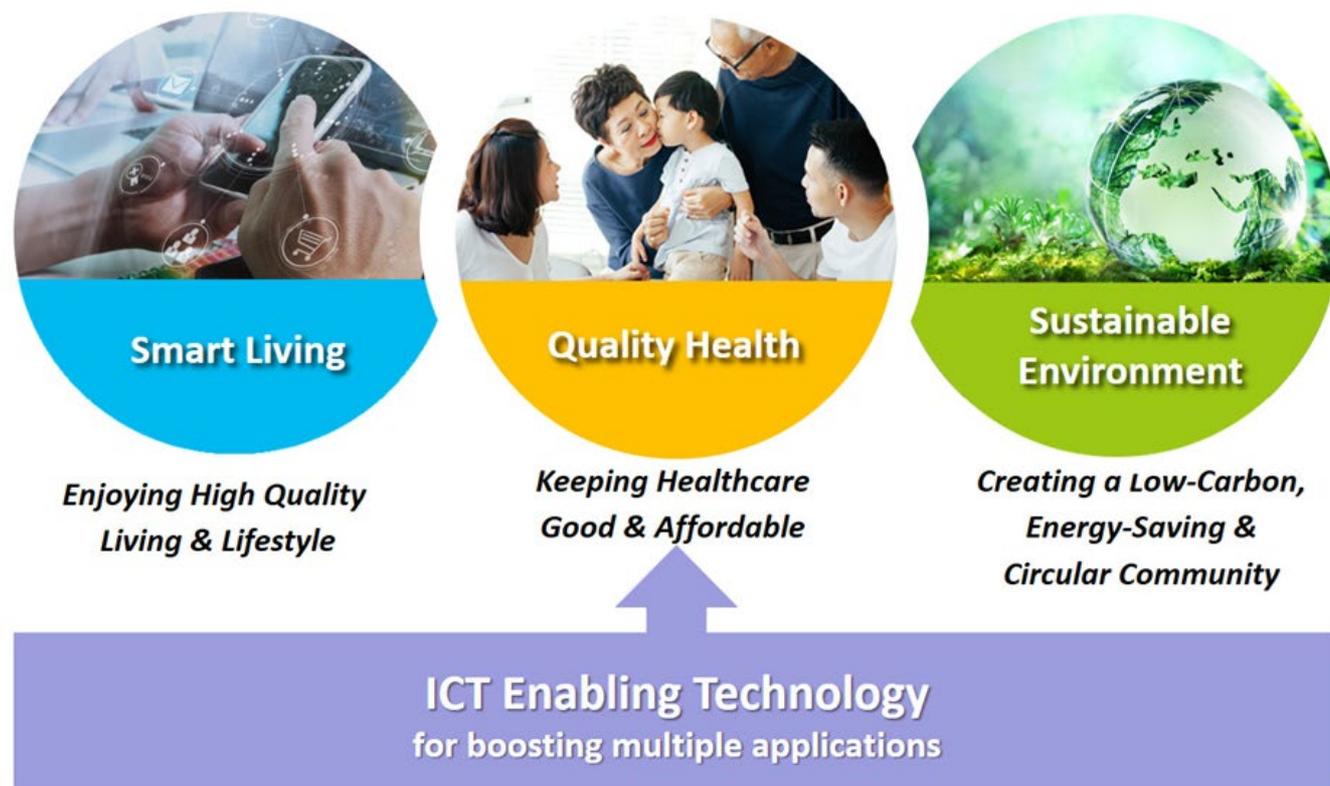
Due to the threat of the devastating pandemic, people have once again acknowledged the power of nature. According to WHO, 75% of all emerging human pathogens during the past decade are zoonotic. That is because humans have invaded animal habitats for economic development. Consequently, viruses that originated in animals are transmitted to the human population. As Dr. Jane Goodall said, the COVID-19 outbreak is a result of humanity's disregard for nature and disrespect for animals. To avoid such disasters, humans should seek ways to coexist with Mother Nature in harmony. Efforts in developing green energy and circular economy solutions must be strengthened to enhance environmental sustainability.

Technological Factors

In terms of technology, the further development of ICT will inevitably bring about new business models. For example, AR and VR technologies will be incorporated more intensively to create more realistic remote conference environments. The pandemic will also drive industries to align their technology R&D with a human-centric view and pay more attention to the biotechnology fields.

ITRI Innovation in 2030 Strategy & Roadmap

Perceiving the changes in the PEST aspects helps us better identify market needs and more clearly anchor our position, potential and direction for our R&D strategies and activities. Below are some examples of how ITRI, through its R&D efforts and under the 2030 guidelines, can help the industry and society stay resilient during the post-pandemic era.



Three application domains and common fundamentals in ITRI's 2030 Technology Strategy & Roadmap.

Smart Living

In the smart living domain, ITRI centers on the development of personalized devices and services, autonomous mobility systems, and smart industries and services. As COVID-19 spurs the growth of unmanned services and zero-contact economy, relevant technological advancement will be stimulated. Online entertainment or remote learning, for instance, may need more interactive immersive renderings. This will drive the tech development in sensor chips, human-machine interaction, camera and imaging, facial recognition and artificial intelligence. In this regard, ITRI can leverage Taiwan's strengths in ICT and the Institute's ability in hardware-software integration to meet industrial demands.

Quality Health

For Quality Health, we are dedicated to the fields of Smart MedTech and Healthcare, where we have developed integrated solutions for smart elder care systems, personalized/precision medicine, and healthcare models. During the COVID-19 crisis, we have developed a series of [anti-pandemic technologies](#), and will further enhance contact-free solutions for health status detection and healthcare systems. Recently we have cooperated with hospitals and developed wireless technologies for vital sign measurement, RFID posture recognition system, smart bed sheets, smart LED lighting, and smart wheelchairs specifically for eldercare. When an elder falls or has abnormal heart rates or breathing patterns, the system will notify caretakers immediately.

Sustainable Environment

While enjoying smart and healthy lives enabled by technologies, we can never ignore our responsibility to look after our planet and foster environmental sustainability. Taiwan, in particular, should be more conscious in resource management and waste disposal on the small island. Therefore, ITRI is accelerating the technology development in circular economy, smart manufacturing, and green energy and environment. Its carbonization technology, for example, can assist farmers in transforming rice hulls and pomelo branches into useful fertilizers, which exemplifies a good circular economic model.

ICT Enabling Technology

To underpin above domain applications, we have been reinforcing the development of AI, semiconductor, communications, cybersecurity and cloud technologies. It is hoped that we can help industries incorporate AI applications, develop low-power, low-latency computing environments, and ensure data privacy and safety. Meanwhile, we would like to create solutions to lower deployment costs for 5G and expand its coverage.

In our belief, technology upgrade and industrial transformation are the major forces to boost economic growth and social welfare. ITRI's 2030 Technology Strategy & Roadmap enables us to focus on technology development that echoes the needs of industry and society accurately. Meanwhile, we value the importance of co-creation and will engage domestic and international partnerships as a crucial support in pursuit of innovation. This is why we have been working so

closely with the academia, industry, and government, and striving to bridge the gaps between home and abroad. ITRI will constantly expand its technology capacity to shape new lifestyles, develop market-oriented solutions, and find uncontested market spaces. Together, we will build a better future.



About the Author

Dr. Edwin Liu received his Ph.D. from University of California, Berkeley in Electrical Engineering and Computer Sciences. Before joining ITRI, he was one of the founders and the Senior Vice President of Smart Grid & Grid Management at Nexant Inc. He is also an IEEE Fellow and the former Chairman of the IEEE Computer & Analytical Methods Subcommittee. To assist industries in multidisciplinary innovation and co-creation for a better future, he is leading ITRI to roll out its 2030 Technology Strategy & Roadmap.





» Spotlight



One-Step Autologous Cartilage Repair System



The One-Step Autologous Cartilage Repair System requires only a single surgery and effectively facilitates autologous knee cartilage repair.

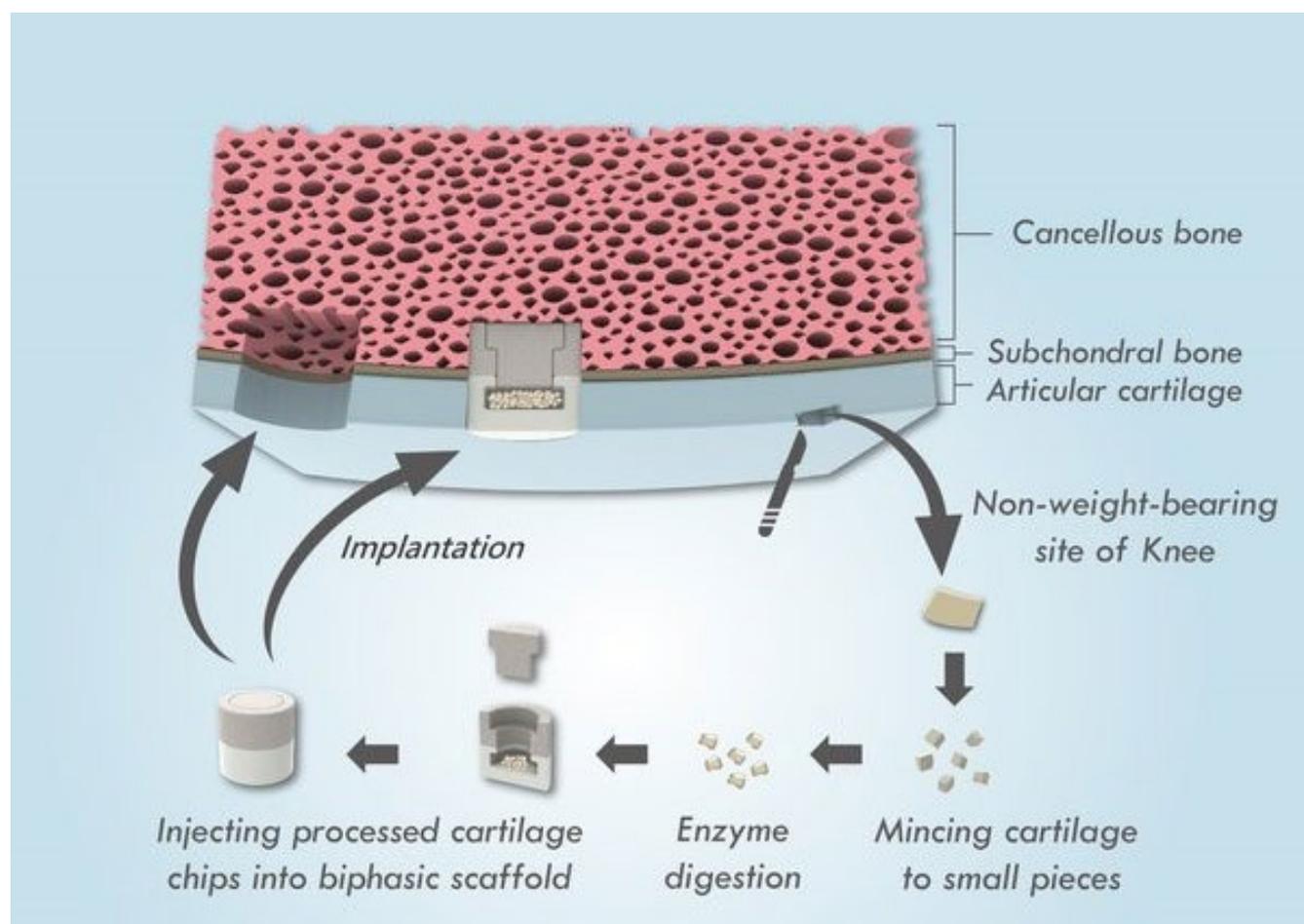
As exercise gains more popularity and the society continues to age, the number of people suffering from degenerative arthritis and sports-related joint injuries has been increasing. The global orthopedic medical devices market has also seen a sustained growth. In light of this, ITRI and BioGend jointly unveiled the One-Step Autologous Cartilage Repair System RevoCart[®]. This is the first regenerative medical product developed domestically in Taiwan, and it obtained TFDA approval in April, 2020. With one-step minimally invasive procedure, this innovative technology has assisted many patients in successful autologous knee cartilage repair.

How was RevoCart® developed?

The One-Step Autologous Cartilage Repair System was developed based on the Biphasic Cartilage Repair Implant (BiCRI) technology, a collaborative result produced by ITRI and National Taiwan University Hospital (NTUH) years ago. The technology was then transferred to Exactech Taiwan, which was later acquired by BioGen. Based on this technology, BioGen created the One-Step Autologous Cartilage Repair System RevoCart®.

How does the system work exactly?

RevoCart® consists of an innovative cartilage repair procedure. First, a small piece is harvested from the patient's own healthy, non-weight bearing cartilage tissue and minced into small particles. Then an enzyme is added to treat the matrix around the cell and the combination is placed inside a degradable biological scaffold to create a biphasic implant that is inserted at the lesion site. The scaffold will degrade and be absorbed once the autograft cartilage grows outward. The procedure is illustrated in the following figure.



The RevoCart® procedure.

Benefits and Applications

RevoCart[®] helps osteochondral tissues to heal and is thus suitable for the repair of chondral or osteochondral defects in the medial and lateral femoral epicondyles of the knee joint and femoral trochlea. The technology can avoid the issues caused by autologous cartilage regeneration repair techniques, such as infection and pain at the harvest site that will lead to longer recovery periods. It can also address the problem of insufficient bone volume. What's better, RevoCart[®] requires only a single minimally invasive surgery that takes about one hour and eliminates the need for in vitro cell cultures. This significantly saves valuable healthcare resources and reduces hospitalization costs while reducing pain for patients.

A Milestone for Knee Cartilage Surgical Technology

The development of new drugs and medical devices requires enormous amounts of resources and lengthy clinical trials. RevoCart[®] has completed clinical trials in Taiwan and obtained TFDA approval, setting a milestone for knee cartilage surgical technologies in Taiwan. It is the perseverance and tenacity of ITRI and BioGend in orthopedic medical devices research that allows the world to witness the culmination of this commercialized multidisciplinary effort.

BioGend Chairman Te-Li Chen indicated that BioGend designs detailed preoperative evaluation and postoperative rehabilitation programs for its patients, collects data with mobile phone apps, and tracks postoperative consultation and care to create a one-stop comprehensive care service. The company is expected to list in the Taipei Exchange at the end of 2020 and looks forward to future collaborations with ITRI to create more regenerative medicine products for the benefit of patients everywhere.



» R&D Focus

Smart Lighting in Hospitals

Apart from homes and offices, smart LED lighting can also be used in healthcare facilities. ITRI has developed a metamerism-based ergonomic lighting technology, a light therapy system, and a visible light positioning system to create a more efficient work environment for hospitals and improve healthcare quality. Field experiments were conducted in Hsinchu Branch of Taipei Veterans General Hospital, using LED lighting to moderate human circadian rhythm and improve sleep quality. Moreover, a positioning system was incorporated to locate the positions of medical equipment and devices throughout the hospital to make inventory taking easier at shift changes. See below for more detailed description.



ITRI worked with Taipei Veterans General Hospital, Hsinchu Branch on using smart LED lighting in healthcare applications.

Ergonomic Lighting Featuring Metamerism

This technology enables the adjustment of metameric lighting to suppress or stimulate melatonin secretion, and, in turn, improve sleep quality. Nursing practitioners in hospitals usually work in shifts, including night and graveyard shifts, which leads to circadian rhythm disruptions and sleep disorders. This ergonomic lighting system, without changing the light

color temperature, is able to adjust light wavelengths accordingly to affect melatonin secretion among health workers. The result showed that the percentage of deep sleep increased from 8% to 25% among those who took on night shifts while the number for those who took on graveyard shifts rose from 12% to 17%.

Light Therapy System

Studies have demonstrated phototherapy's effectiveness in treating depressive disorders, especially in regions of higher latitudes where there is less sunlight. ITRI has identified a range of light spectrum that is effective in improving sleep quality based on normal sleep cycles, customizing optimal metameric wavelengths for individuals. In November 2019, Hsinchu Branch of Taipei Veterans General Hospital introduced this light therapy system in its chronic inpatient psychiatric service. A total of 30 patients received all-day phototherapy for 56 days, with lighting wavelengths and color temperatures adjusted according to subjects' daily routine. The study showed that each treated patient's daily sleep hours increased by one hour and ten minutes in average and there was an average increase of 49.6 pg/ml in melatonin concentration. Moreover, the result indicated that the scores evaluating severity of psychiatric disorders improved by 38%.

Visible Light Positioning System

Seeing that Visible Light Communication (VLC) features high directivity, high security and high bandwidth, ITRI uses VLC to build a positioning system for hospitals. By installing receivers on medical equipment, the location and movement of every item can be tracked wherever LED lighting is accessible and the position information can be displayed on a computer screen. Such a technology is able to conserve energy and ensure high-speed information transmission and network communications safety. The position error can be limited within 30 cm, and signal drifts that are common in indoor positioning can be prevented. Taking inventory at shift changes used to take 30-60 minutes; now it can be completed in 10 minutes with 100% accuracy, significantly shortening the time spent for shift handover.

“Such cooperation is conducive to establishing a supply chain for smart lighting in hospitals and will have a positive impact on inpatient healthcare service as well as the working environment for health workers.”

According to Dr. Chih-I Wu, ITRI's Vice President and General Director of Electronic and Optoelectronic System Research Laboratories, to enhance the value of innovative lighting technologies in healthcare, ITRI has connected industry partners such as Unitech, Tyntek, and Avertronics to advance commercialization efforts and further worked with Taipei Veterans General Hospital, Hsinchu Branch in actual field applications. By improving the mood of medical staff and patients, smart LED lighting helps to elevate their work efficiency and sleep quality. He emphasized that such cooperation is conducive to forming a supply chain for smart hospitals to utilize lighting technologies and these efforts are expected to benefit more patients and health workers.



» R&D Focus

Comprehensive Elder Care Solutions to Promote Fitness & Healthcare for Seniors

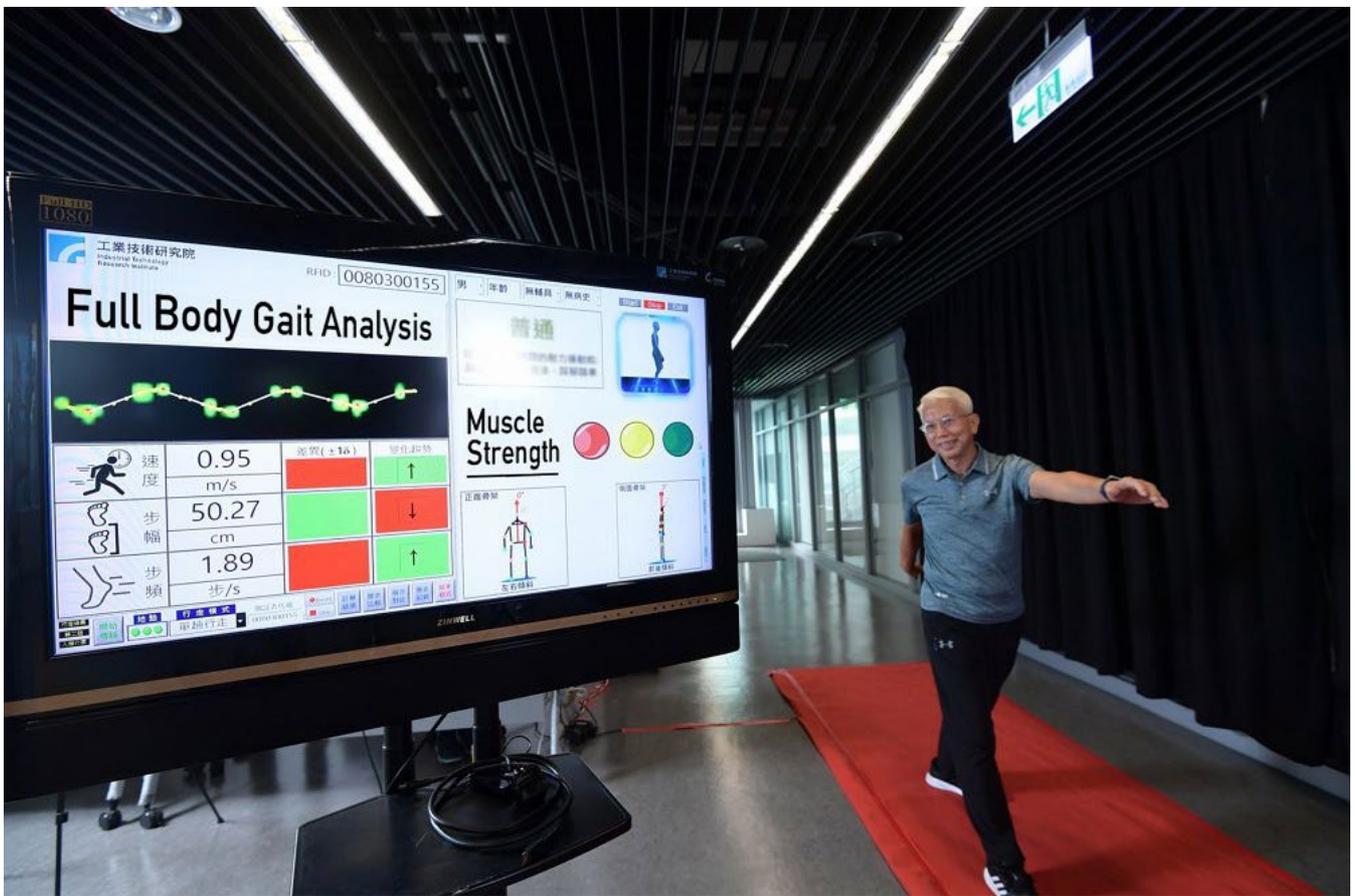
To develop a comprehensive elder care system and increase Taiwan's industrial competitiveness in the global marketplace, ITRI has created a smart elder care verification and testing field at its GuangFu Innovation Campus in Hsinchu, Taiwan. The field is divided into three areas based on the needs of the elderly at different stages, all the way from being able to walk freely to bedridden status. These areas include Physical Ability Tests, Non-Contact Disability Monitoring, and Integrated Solutions for Dementia Care. Companies are welcome here to test their products and collect trial data via the integration with ITRI's fitness or healthcare technologies. Medical or healthcare facilities can also come and see if any technological innovations fit their needs.

The following are some highlights of ITRI's R&D achievements at the smart elder care verification and testing field:

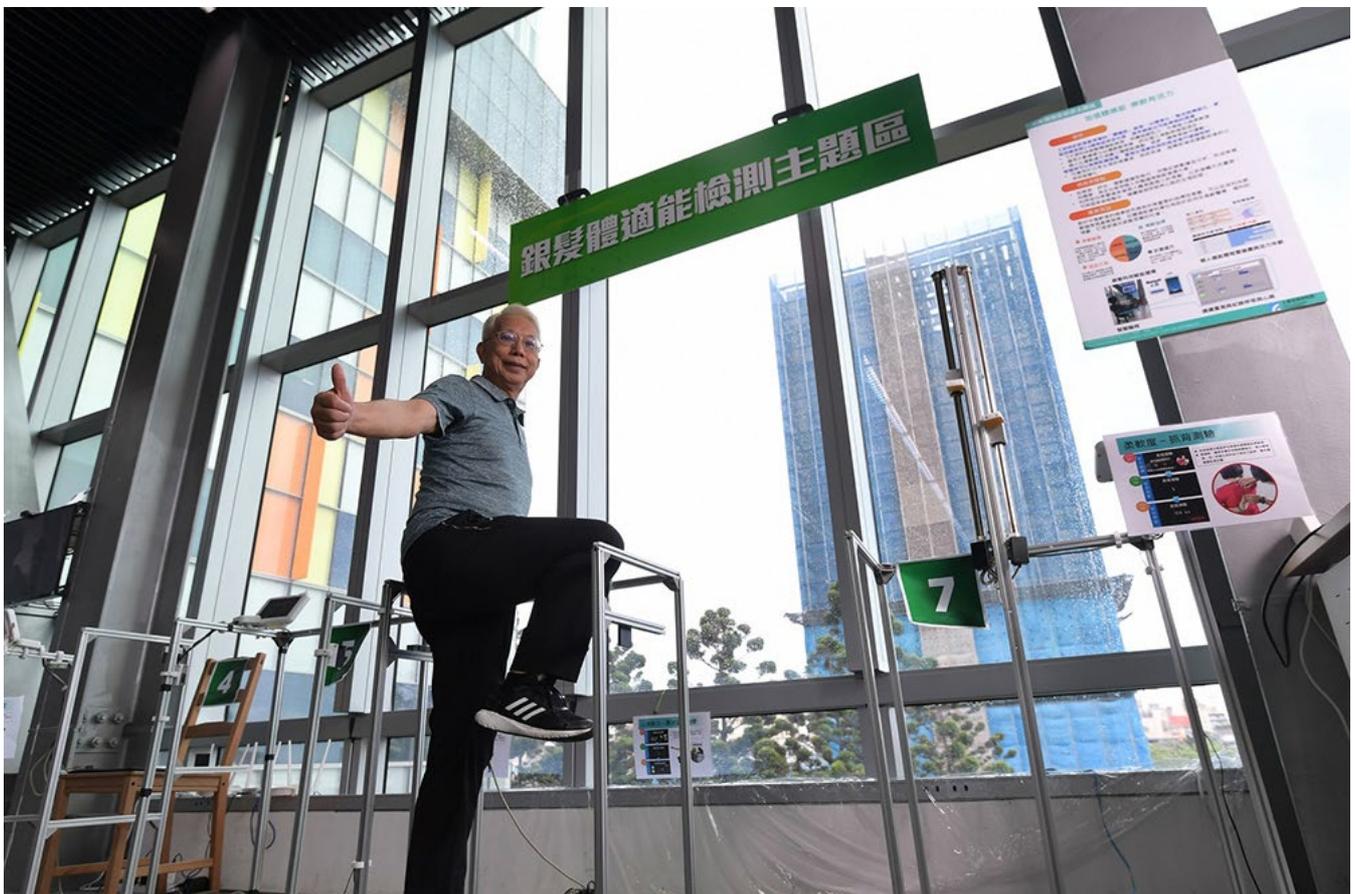
Physical Ability Tests

Full Body Gait Analysis & Fitness Measurement System

The Full Body Gait Analysis System is designed for elders who can walk freely to track their changing gait and posture, and has been adopted by Hsinchu Veterans Home for early detection of walking abnormality or functional decline. The Fitness Measurement System, for its part, can further provide elders with fitness tests including muscle strength, muscle endurance, flexibility and balance. By integrating these data, physiotherapists can recommend personal exercise plans, including frequency, intensity and duration for seniors. The system can be applied to communities to record and analyze individuals' data, creating a reference database which can provide important indicators for future study or government planning in medical care and welfare for the elderly.



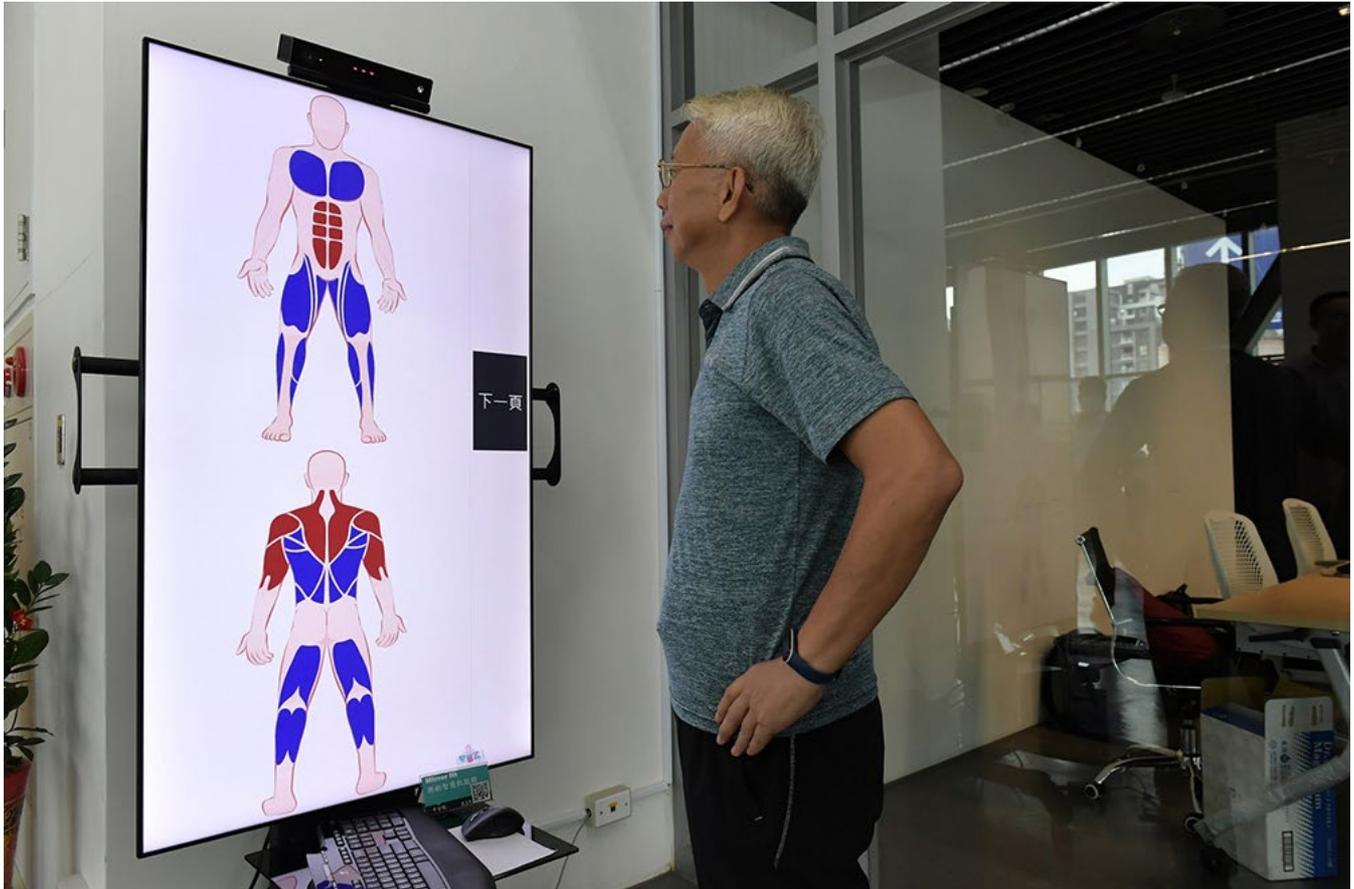
ITRI's Full Body Gait Analysis System can track and analyze the changing gait and posture of elders.



With fitness test results, physiotherapists can recommend personal exercise plans, including frequency, intensity and duration for seniors.

Mirror Fit

ITRI has tapped into AI visual recognition technology to develop a smart muscle assessment system Mirror Fit for the elderly. Without the need for any wearables, the system is able to test seniors on various functional abilities by instructing them to complete specified series of movements under the guidance of a coach or physical therapist. A full-length screen will display the movements in real-time and then provides muscle evaluation and exercise regimens for users to focus on certain body parts or postures during training or regular exercise.



Mirror Fit provides smart muscle assessment for the elderly.

Non-Contact Disability Monitoring

Data Integration Board

The digital board integrates the data collected by remote and non-wearable detection technologies, such as a WiFi physiological measurement system, an infrared posture recognition system, smart bed sheets, and smart lighting, providing a concise summary of the person's breathing, heart rate, temperature, activity, sleep, and nocturia on monitor screens. The integrated system is able to rapidly grasp the status and location of the elderly, thus enhancing efficiency in responding with the appropriate care. For example, when an elder goes to the bathroom at night, the system provides fall or idle detection which can immediately alert medical staff for emergencies.

Physiological Status Monitoring Platform

The Platform integrates data from ITRI's wearable sensing technologies including a smart body temperature patch, a wristwatch oximeter & heart rate monitor and a chest-strap for wireless respiratory rate detection. Its three major characteristics are smart recognition, lightweight wearables and quick deployment. When the monitoring data show irregularity, it will trigger an alert on the platform and generate real-time assessment of the subject for medical staff, therefore improving medical service quality.



ITRI's Physiological Status Monitoring Platform monitors elders' vital signs and can alert medical staff when irregularity occurs.

Integrated Solutions for Dementia Care

PECOLA

ITRI's Personal Companion Robot for Older People Living Alone (PECOLA) employs ambient intelligence technology in caring for its elderly companions. It can record physiological information including emotion, activity, diet and sleep condition. The analysis report has an accuracy of 85% and is equipped with two-way video sessions to enable remote care and bolster the elder's family relationship and social ability.

Citrelax Essential Oil

The essential oil is made from natural ingredients that are non-irritating and proven to ease depression based on animal testing. The oil can, along with exercise, healthy diet and lifestyle, help reduce stress and create relaxation.

To bring more players into the smart elder care platforms, ITRI has joined hands with various partners including nursing homes, medical suppliers, tech developers, furniture retailers, fitness centers, construction businesses, security companies and academic institutions to form a smart elder care consortium. The consortium featuring system integration, field applications, cross-industry innovation and advisory consulting is expected to co-create total solutions and new business operation models while fostering Taiwan's first smart elder care industry chain. All these efforts are made to improve seniors' life quality, which echoes the aim of ITRI's Quality Health application domain.



» Collaboration

Joining Hands with Quanta Computer to Develop Multi-Antenna Laptops



Fine-line and multi-layered circuitry on curved surfaces such as mobile phone cases helps manufacturers produce slim, lightweight consumer electronics.



For 5G communications, mobile devices need to integrate more antennas and components in a compact size while achieving high-efficiency performance and multiple functions. In light of

this, ITRI has introduced its Laser Induced Metallization 3D Circuit (LIM-3D) and worked with world-leading notebook manufacturer Quanta Computer to construct three-dimensional, multi-layered circuits that are only 15 μm in width on various substrate materials. The collaborative result leads to the successful development of a narrow-frame laptop featuring massive MIMO antenna technology. The ultra-slim laptop has a high screen-to-body ratio (90%) and a transmission speed of over 1 Gbps, making it a competitive 5G-enabled product.

The pioneering LIM-3D technology developed by ITRI possesses three distinguishing features: **(1) Fine lines:** the 15 μm line width is a breakthrough from the past limit of 100 μm , which allows a larger number of more detailed circuits on the micro circuit board, meeting the compact requirement of 5G products. **(2) Three-dimensional and multi-layered:** 3D stackable circuitry can be applied on curved surfaces, solving the problem of insufficient circuit design space in the back cover case caused by conventional single-layer design. **(3) Multi-material application:** circuits can be applied on various surfaces including glass, ceramics and metal, offering more alternatives to plastic substrates and hence increasing industrial competitiveness.

Dr. Jwu-Sheng Hu, Vice President and General Director of ITRI's Mechanical and Mechatronics Systems Research Laboratories, stated that ITRI's LIM-3D technology utilizes innovative material formula and manufacturing processes to slim down the circuit lines, thereby enabling diverse substrate applications and minimizing the area occupied by antennas by more than 60%. Compared to existing laptop computers which can only accommodate two antennas, the new laptop co-developed by ITRI and Quanta is able to include 12 antennas in order to fulfill the demand for high-efficiency performance.

Vice President of R&D Center at Quanta Computer Jonny Hsu emphasized that the current challenge faced by the industry is to incorporate multi-antenna in laptops with full metal casing and a high screen-to-body ratio. Through integrating technologies in antenna, material, and processing, Quanta has collaborated with ITRI to develop the world's first metal casing laptop with 5G multi-antenna communication system incorporated. The system can be incorporated in notebooks and tablets, meeting the needs of consumers for visual appeal of metal texture with narrow bezel display while providing high-performance wireless communications. "This technology creates greater product value and increases competitiveness, a true breakthrough and differentiation from the common practice of price competition in Taiwan OEM industry," said Hsu.

According to a report by Yole Development, the global radio frequency front end market for telecom infrastructure is forecasted to reach US\$2.52 billion in 2025, seeing a significant growth thanks to the penetration of active antenna systems. Innovative technologies such as LIM-3D hold the prospect of gaining 5G market share, helping related industries upgrade their capabilities to develop smarter devices and services.



» Collaboration

Collaboration with Excelsius Medical Provides High-Precision Assistance for Eye Surgery

The aging population in combination with the extensive use of electronic devices has led to an increase in eye disorders and diseases such as myopia, cataracts, and glaucoma. To provide more advanced eye surgery solutions, ITRI licensed the OCM (Optical Coherence Microscopy) technology for optical biopsy of eye tissue to high-end ophthalmic surgery devices manufacturer Excelsius Medical, aiming to further the collaboration on the development of the OCM-embedded multi-functional high-precision ophthalmic system.



ITRI and Excelsius Medical signed a technology transfer agreement in late July 2020.

Excelsius Medical has incorporated minimally invasive femtosecond lasers to develop Small Incision Lenticule Extraction technology. In the technology transfer agreement signing ceremony, Dr. Chii-Wann Lin, Vice President and General Director of ITRI’s Biomedical Technology and Device Research Laboratories stated that ITRI’s OCM technology can be

integrated into Excelsius Medical's femtosecond laser system, using non-invasive optical technology with a wavelength of 1300 nm to obtain real-time cross-sectional corneal images. "This novel combination enables the world's first simultaneous viewing of corneal cross-sectional images during surgery," he said.



The tech collaboration between ITRI and Excelsius Medical enables the world's first simultaneous viewing of corneal cross-sectional images during surgery.

Refractive surgery procedures such as LASIK are common in reshaping cornea to improve vision, and refractive surgery equipment involving femtosecond and excimer technologies has a promising market outlook. According to a report by Global Information, the market value of femtosecond laser surgery equipment in 2018 reached 341 million USD, accounting for 54.2% of the overall ophthalmic laser market, and is expected to reach 529 million USD by 2023 with an estimated compound annual growth rate of 9.2%. The collaboration with Excelsius Medical, as Dr. Lin suggests, will assist doctors in making prompt adjustments during surgery and will make Excelsius Medical even more competitive in expanding the market share in cataract surgery, myopia presbyopia surgery and myopia prevention.

Talking about how this tech collaboration can improve surgery, Excelsius Medical President George Huang pointed out that LASIK surgery is performed by using a microkeratome to create a corneal flap and an excimer laser to remove some tissue from the cornea to reshape it;

however, this procedure is prone to uneven corneal cutting and may result in refractive complications. Leveraging ITRI's strengths in hardware-software integration and optical technologies, Excelsius Medical has advanced its refractive excimer laser and ophthalmic femtosecond laser systems to eliminate the need for a microkeratome and allow more precise procedures with shorter operation time, lower surgical risks, fewer side effects and faster recovery time. "This greatly benefits patients with myopia, presbyopia, and cataracts," he said.



About Excelsius Medical

Excelsius Medical is a global major manufacturer of ophthalmic laser surgery instruments and diagnostic equipment. The company is committed to addressing unmet needs in the ophthalmic laser surgery market and providing ophthalmologists worldwide with safe, accurate, and automated technology solutions to treat eye disorders/diseases such as myopia, astigmatism, presbyopia, cataracts and corneal lesions. Located in the Tainan Science Park in Taiwan, Excelsius Medical is active in its marketing in the EU, India, Southeast Asia, South America, and the Middle East. The company has obtained ISO 13485 certification in Germany and Taiwan and is certified with CE marking for its excimer laser myopia surgical instrument. Currently, global multi-center human clinical trials with its femtosecond laser system are ongoing. Its subsidiary in Germany Excelsius Medical GmbH aims to be listed next year.

» Collaboration



ITRI and Bucheon City Sign MoU on Environmental IoT

ITRI and Bucheon City, South Korea signed an MoU via video conferencing on August 10th for the collaboration on the New-Generation Pollution Traceability and Predictive Environmental IoT Technologies. As per the agreement, ITRI will provide environmental IoT testing equipment and analytic technology sharing to Bucheon City. The mutual collaboration is expected to lead relevant industries to seize new opportunities in the Korean market.

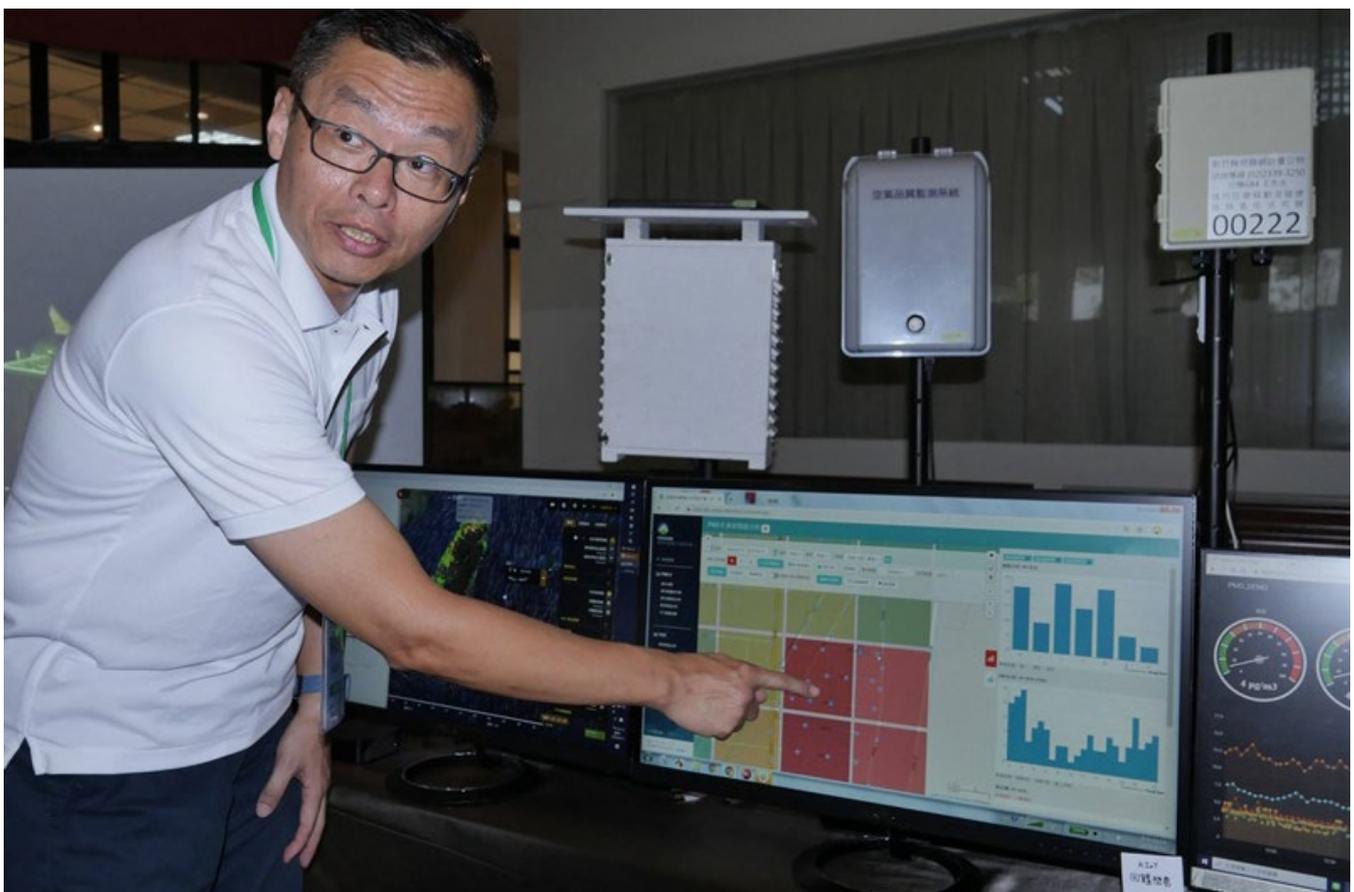


ITRI and Bucheon City signed an MoU on smart city collaboration in August.

Dr. Ren-Chain (Joseph) Wang, ITRI’s Vice President and General Director of Green Energy and Environment Research Laboratories, pointed out that the New-Generation Pollution Traceability and Predictive Environmental IoT Technologies have made unprecedented breakthroughs. First, they have a record-high deployment density—air quality sensors have

been placed in 8,300 locations in Taiwan. Second, with high-resolution data transmission, big data analytics, and artificial intelligence (AI), the miniature air quality sensors are able to collect data for real-time abnormal gas emission warnings, abnormal hotspot tracking, and air quality changes prediction. This creates the world's first platform for smart city environmental governance and traceability that greatly enhances the efficiency of smart environmental management.

The aim of the MoU signing is to establish an environmental IoT smart governance model incorporating ITRI's air quality sensors for technology verification in Bucheon. The sensors can detect particles and gases such as PM 2.5, O₃, NO₂, CO and TVOC. Coupled with central and local government cooperation, AI technology will be used to provide precise hotspot analysis for environmental compliance audits and decision making. This will thereby reduce manual processing while improving the accuracy of law enforcement. ITRI is also looking forward to more academic and research exchanges with South Korea, and hopes to export the service model of this new industrial ecosystem to overseas markets in partnership with domestic vendors of related components and systems.



The New-Generation Pollution Traceability and Predictive Environmental IoT Technologies can provide hotspot analysis to determine air pollution patterns.

Jang Deog-Cheon, Mayor of Bucheon City, pointed out that in the face of rapid economic growth, densely populated cities, various pollution threats and environmental changes, Bucheon is actively moving towards smart city governance and making the city more livable through the cooperation with ITRI. He also expects that relevant big data applications can strengthen the competitiveness of local industries and cultural tourism.

ITRI made Taiwan the testing and verification field for the New-Generation Pollution Traceability and Predictive Environmental IoT Technologies and is cooperating with multiple businesses to drive industrial development and investment. The technologies have been introduced to countries such as Norway, India, and Thailand, and will keep expanding their reach.



» Activity



Celebrating Our 47th Year and Meeting Future Prospects

A Big Thank You to All ITRI Heroes



ITRI celebrated its 47th anniversary on July 3rd, 2020 at its headquarters.

ITRI celebrated its 47th anniversary on July 3rd and invited distinguished guests to attend the ceremony. In the event, Taiwan Vice President Ching-Te Lai and Minister of Economic Affairs Mei-Hua Wang recognized the Institute as an important asset to the nation. They said ITRI has led industry to find new breakthroughs throughout different stages of growth and contributed greatly in improving overall well-being of society. They further expressed their thanks for ITRI's relentless work and quick response in developing a number of anti-pandemic technologies during the COVID-19 outbreak, being a behind-the-scenes hero in helping the nation curb the spread of the virus.

Vice President Lai commented that ITRI underpins Taiwan's industrial competitiveness and creates new horizons for Taiwan's economy. In his expectation, ITRI should complete three missions in the future. First, supporting the government's 5+2 Industrial Innovation and the Six Core Strategic Industries initiatives. Second, using its innovation capability to help society respond to new lifestyles and assist the industry to reposition amid the disrupted supply chain in the post-pandemic era. Third, with the arrival of the global 5G era, ITRI should maximize its strengths in using technology to strengthen industry's competitiveness. Meanwhile, the Vice President expressed thanks for ITRI's support in promoting the industrial development of southern Taiwan, and believes that ITRI can further expand its capacities to link the resources of Liujia Campus, Shalun Smart Green Energy Science City, and the Kaohsiung Material Circular Industrial Park.



Taiwan Vice President Ching-Te Lai (center), Minister of Economic Affairs Mei-Hua Wang (second right), ITRI Chairman Chih-Kung Lee (second left), and ITRI President Edwin Liu (far right) at ITRI's 47th Anniversary Tech Showcase.

Minister Wang indicated that Taiwan is home to many small- and medium-sized enterprises (SMEs), and ITRI is especially needed to help nurture these companies. Currently, she said, Taiwan requires the assistance of technology for epidemic prevention as it desires to open up international exchanges. Consequently, the development of ITRI's Nucleic Acid Detection System becomes crucial. This highly precise detection technology will enable Taiwan to effectively block coronavirus at the border, thereby allowing international interactions to resume, she explained.

ITRI Chairman Chih-Kung Lee stated that for the past year ITRI's outstanding R&D achievements have been recognized by many international accolades. Locally, the Institute has

also been supporting the government's policy of balanced economic development among Taiwan's regions with two main strategies: adding value to industrial technology and fostering the development of innovation-oriented industries. By bridging the industrial, academic and research capacities, ITRI has promoted "smart R&D," "high-end manufacturing clusters," and "high value-added materials" for southern Taiwan. Lee said that ITRI will play a key role in innovation as always, making Taiwan's technological strengths prominent the world over, just like it has achieved in preventing the spread of COVID-19.



Vice President Ching-Te Lai praised ITRI's Positive Pressure COVID-19 Testing Booth for its clever design in improving testing convenience and safety, which perfectly accommodates the needs for medical staff.

ITRI President Edwin Liu remarked that earlier this year during the outbreak of COVID-19, ITRI adopted a three-pronged strategy of preparing protective devices and equipment, establishing virus testing capacities, and strengthening medical care. Efforts in this regard highlighted the use of technology to protect Taiwan. In response to the "new normal" in the post-pandemic era, he said, ITRI is preparing early and exploring the value of smart technologies for Taiwan. The Institute has set forth its 2030 Technology Strategy & Roadmap to develop innovations that meet the lifestyle scenarios of the future, which reflects the government's Six Strategic Industries and its 2030 Science & Technology Vision. To foster technology breakthroughs in application domains of Smart Living, Quality Health, and Sustainable Environment, ITRI will enhance ICT Enabling Technologies including artificial intelligence, semiconductor technology, communications technology, and cybersecurity and cloud technology.



» Activity



ITRI Tech Showcase at BIO Asia-Taiwan 2020



Dr. Chii-Wan Lin (first right), ITRI's Vice President and General Director of Biomedical Technology and Device Research Laboratories, exhibits the iPMx Molecular Rapid Test System to President Tsai Ing-Wen (second right) at ITRI's booth at BIO Asia-Taiwan 2020.

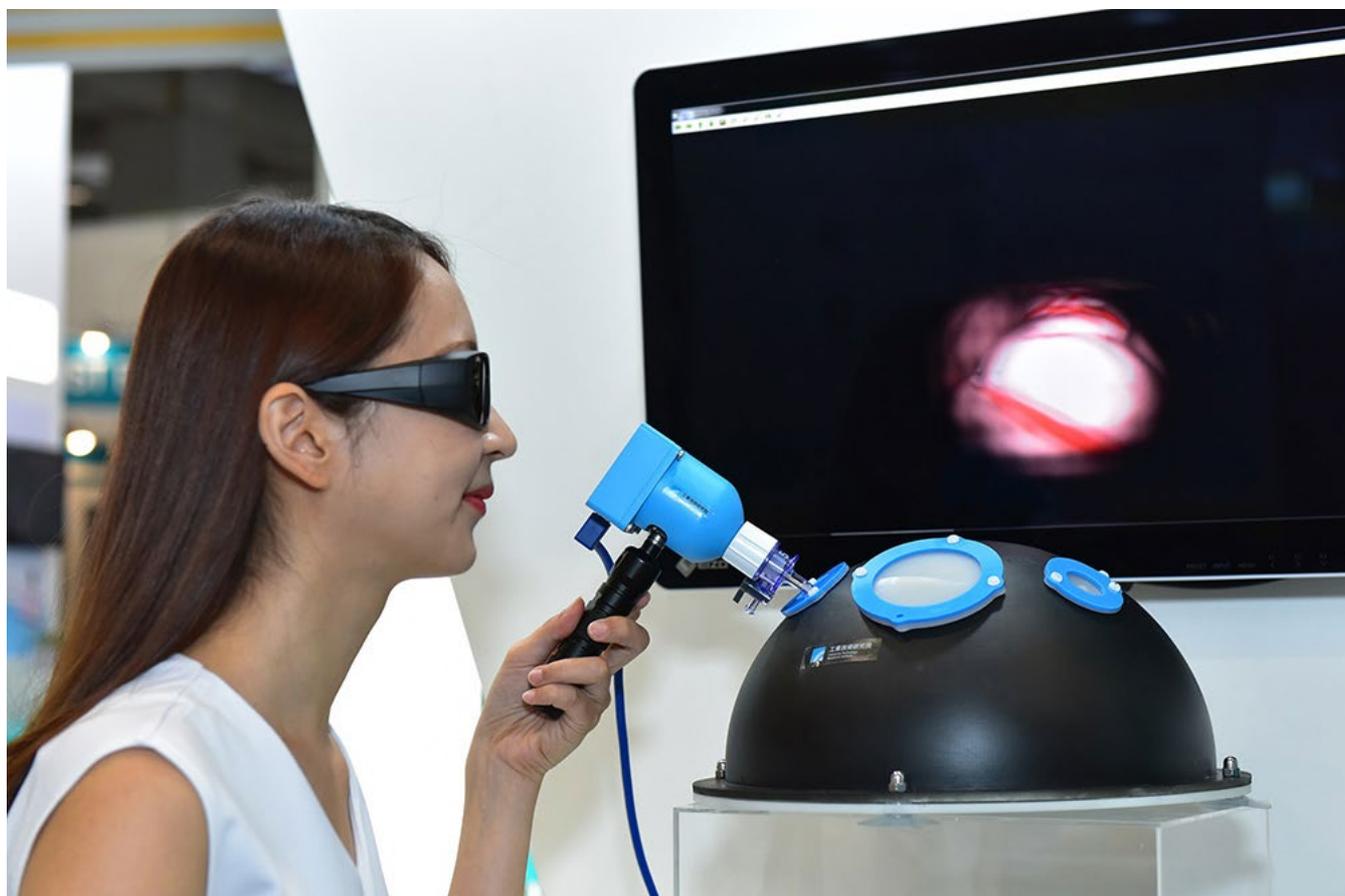
BIO Asia-Taiwan 2020 took place at the end of July in Taipei, with nearly 500 companies showcasing their innovative technologies at over 1,000 booths. For the exhibition, ITRI focused on four core areas: smart medical electronics, regenerative medicine, pharmaceutical R&D, and epidemic prevention while presenting 15 technological innovations. These included the world's first Single-lens 3D Endoscopy Imaging Module, a novel targeted drug for glaucoma, and a molecular rapid test system to detect the SARS-CoV-2 virus.

Dr. Chii-Wann Lin, Vice President and General Director of the Biomedical Technology and Device Research Laboratories at ITRI, said that in the era of smart healthcare, the integration of technology from multiple disciplines is necessary in every application. “Whether it is for medical treatment, diagnostics, healthcare or rehabilitation, we need smarter solutions to provide more precise results and lower the demand for medical manpower,” he said. Dr. Lin added that ITRI has been proactively planning its 2030 Technology Strategy & Roadmap and focusing its efforts on applications in the Quality Health domain. It will continue to facilitate vertical integration in the industry to transform multidisciplinary biotechnology applications into business opportunities that benefit the public.

The highlights ITRI demonstrated during BIO Asia-Taiwan 2020 include:

Single-lens 3D Endoscopy Imaging Module

While traditional endoscopic brain surgery uses 2D imaging and requires an opening one to two centimeters in length, ITRI developed the world’s first Single-lens 3D Endoscopy Imaging Module. The module integrates biomedical engineering with optoelectronics technology and features a 0.4 cm 3D imaging probe to meet clinical needs. It removes the 2D limitations such as flatness and narrow space and thus offers the surgeon a wide field of view and crystal clear images during operation. Moreover, the system can reduce the rate of surgical errors by 40% and the operation duration by 25%, overcoming the hurdles in intracranial surgery.



The Single-lens 3D Endoscopy Imaging Module offers a wide field of view and clear images for surgeons.

Surface Modification of Next-Generation Implantable Conducting Medical Materials

Medical implants may cause potential risks including adhesion formation, immune response, bacterial infection, and device failure. To avoid these problems, ITRI developed a world-leading next-generation conductive coating for implantable medical devices. The technology leverages surface modification technology to introduce electrical conductivity while demonstrating high adherence and low resistance, which can reduce the likelihood of adhesion by over 100 times compared to an uncoated electrode. The coating prevents the interference between the implant and tissue and lengthens the lifetime of the implantable device, avoiding the consequent second operation due to adhesion. The technology also allows for property customization and shortened production time.



ITRI's conductive coating for medical implants can prevent adhesion issues.

Preclinical Ocular Drug R&D & A Novel ROCK Inhibitor for Glaucoma



The novel targeted drug for Glaucoma mitigates conventional treatment side effects.

According to WHO statistics, glaucoma is the second leading cause of blindness. Currently, most glaucoma cases are treated with eye drops and oral medication. However, about 40 to 50 percent of patients develop drug resistance and side effects such as dark circles under the eyes, sunken eyes, and red eyes. ITRI designed a novel ROCK inhibitor that can lower stiffness and outflow resistance of trabecular meshwork and modulate over 80% of aqueous humor excretion through conventional outflow mechanism. ITRI is obtaining related patents and

hopes to transfer the technology by next year.

iPMx Molecular Rapid Test System

The test system adopts the qPCR approach and 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, which is 57 times lighter than traditional testing devices, making it 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 tests. iPMx participated in the COVID-19 Proficiency Test of the Quality Control for Molecular Diagnostics (QCMD) and demonstrated excellent performance by yielding correct results for all samples. The system has been granted the COVID-19 related EUA on Manufacturing of Medical Devices from the Taiwan Food and Drug Administration (TFDA) on July 6, and a trial production of 10 kits and 10,000 reagents was completed in August.



iPMx Molecular Rapid Test System is precise, sensitive, lightweight, and highly efficient.



» Activity



Smart Robotics Technologies Exhibited at TAIROS 2020



ITRI at TAIROS 2020.

The 2020 edition of the Taiwan Automation Intelligence and Robot Show (TAIROS) was launched in Taipei Nangang Exhibition Center during August 19-22. For this event, ITRI has exhibited its latest achievements in intelligent robot technology, specifically displaying its AI Auto Annotation Application in bin picking, the Advanced Robotic Grinding and Polishing System, and a 7-axis modular robot arm. These technologies highlight the sustainable environment concepts being promoted in ITRI's 2030 Technology Strategy & Roadmap, which will assist industry in its digital transformation and seize business opportunities in the post-pandemic era.

Dr. Jwu-Sheng Hu, ITRI's Vice President and General Director of Mechanical and Mechatronics Systems Research Laboratories, commented that after the COVID-19 outbreak, the manufacturing sector is looking to become more automated, more adapted to frequent line changes, and more customized. The 2030 Technology Strategy & Roadmap that ITRI has

drafted responds to the rapidly changing production needs of manufacturers and looks to integrate Taiwan's advantages in machinery, information and communications, and electronics R&D in the development of intelligent robot technology. These robots feature AI, 5G, and cloud communications technologies, offering a path for the digital transformation of factories, and helping manufacturers move towards smart manufacturing. This ultimately enhances their international competitiveness, he said.

Below are some smart robotic technologies that ITRI has showcased at this year's TAIROS.

AI Auto Annotation Application: Robot Random Bin Picking

ITRI has developed the world's first AI auto annotation application, which enables robot random bin picking. The app is able to automatically collect and label data and use a variety of AI recognition imagery to teach robots to access materials. Compared with the bottleneck created by being able to label only 25 images in one hour using traditional methods, this technology enables the labeling of 10,000 images an hour, speeding up labeling by a factor of 400. The configuration time of a bin picking robot, which used to take 30 days, can now be achieved in just one day with this new technology, providing a 30 times faster process. This technology is applicable in warehousing and logistics, shoe manufacturing, and plumbing hardware.



ITRI's AI auto annotation application provides efficient data labeling for robot random bin picking.

RobotSmith: Advanced Robotic Grinding and Polishing System



RobotSmith can simulate the grinding path and improve grinding quality.

ITRI has developed Taiwan's first Advanced Robotic Grinding and Polishing System, which reduces actual grinding errors by simulating the robot's grinding path. The grinding error is less than 1 mm using this system, which can also simulate grinding force to an accuracy of 80%, thus improving grinding quality. When a new workpiece is introduced into the production line, reliable machine vision recognition avoids the need for the factory to halt the production line, as the system can immediately identify the new workpiece and simulate the grinding path, enabling large-variety small-quantity flexible manufacturing. This technology has been applied to metal processing, plumbing hardware, and hand tool industries.

Modular Robot Arm with 7 All-in-One Integrated Smart Joints

ITRI's slim 7-axis robot arm features seven all-in-one

integrated smart joint modules, exhibiting a high payload-weight ratio (1:3) and high positioning accuracy (with a repeatability of ± 0.02 mm). The compact joint module containing a motor, reducer, brake, driver and communication interface features easy maintenance and can easily be adopted to build a custom robot arm. This slender robot arm is lightweight and ideally suited for industrial and service robot applications.



A 7-axis robot arm with ITRI's all-in-one integrated smart joint modules.



» Activity



ITRI and Czech Republic Embark on New Chapter in Technology Diplomacy



ITRI President Edwin Liu (right) and Czech Senate President Miloš Vystrčil (left) posed at a welcome ceremony at ITRI in Hsinchu.

An 89-member Czech delegation led by Senate President Miloš Vystrčil made a visit to ITRI on September 2nd in Hsinchu, where the delegation learned about ITRI's accomplishments in biomedical and pandemic prevention technologies, groundbreaking innovation-oriented R&D, and industrialization of research results. ITRI is the only R&D organization that Senate President Vystrčil visited during his stay, which highlights the significance of ITRI's role in technology diplomacy between Taiwan and the Czech Republic. The visit is expected to engage both sides in more technological cooperation based on their complementary strengths. Moreover, by leveraging the Czech Republic's network in the EU, ITRI hopes to assist Taiwan industry in tapping into Europe's innovation ecosystem and exploring new opportunities there.

ITRI President Edwin Liu welcomed the delegation's visit with a quote from Confucius: "It is a great pleasure to have friends coming from afar". He indicated that ITRI, the largest applied research organization in Taiwan, has played an important role in driving Taiwan's economic growth for the past 47 years. The institute, he stressed, conducts market-oriented research, acts as a bridge between Taiwan and international communities, and works with government research entities to support industry transformation.

According to Dr. Liu, ITRI's dialogue with the Czech Republic started in 2013 with the support of Taiwan's Ministry of Economic Affairs, followed by more than ten visits between both sides. In 2017, ITRI's high-ranking officials visited the Czech Republic and signed an MoU with the Czech Academy of Sciences to establish a research collaboration platform. Moreover, the DELTA program has yielded several R&D cooperation projects. With the Czech Republic's outstanding basic research capabilities and ITRI's expertise in applied research, he believes that the joint collaboration will deliver the best technologies to the market and society.

Czech Senate President Miloš Vystrčil indicated that visiting ITRI was one of the purposes of the delegation's trip to Taiwan—to learn as much as possible about R&D and practical technology implementation. He mentioned that Prague has several prestigious universities and R&D institutes that have built ties with ITRI. The Academy of Sciences, for example, spoke highly of the cooperation with ITRI. Senate President Vystrčil thanked ITRI for its repeated invitations to visit Taiwan and concluded with a reference to the Czech film *Dobří holubi se vracejí* (A Good Pigeon Always Returns Home), indicating that more visits should be expected in the future.



The delegation had a showroom tour to learn about ITRI's tech innovations, especially its anti-pandemic efforts.

After a meeting with ITRI officials, the delegation had a showroom tour in which Mr. Vystrčil was especially impressed by ITRI's tech innovations such as the iPMx Molecular Rapid Test System for COVID-19 virus detection which can generate results in less than an hour. In addition, the Senate President was also amazed at the Institute's excellent performance in making ventilators within 17 days. Since the Czech Republic is also able to produce ventilators, he believes future collaboration in this area can be enhanced.



Czech Senate President Miloš Vystrčil was impressed by ITRI's iPMx Molecular Rapid Test System for its short detection time for COVID-19 virus screening.

ITRI has joined hands with Taiwanese and Czech businesses along with the Czech Academy of Sciences to work on the development of biomedical and green energy technologies. Collaborations include an artificial skin 3D printing project that incorporates ITRI's skin tissue printing equipment, bio-inks and bionic skin technology to develop bionic products that can replace cosmetic testing on animals. Another project involves smart manufacturing and automated assembly for highly durable fuel cells. It is hoped that such joint cooperation will pave the way for entering the EU market.

» About Us



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. It focuses on the fields of Smart Living, Quality Health, and Sustainable Environment. Over the years, ITRI has incubated over 300 innovative companies, including well-known 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 opportunities for international cooperation around the world.

Publisher: Edwin Liu

Editors-in-Chief: June Lin, Jenny Chao

Executive Editor: Irene Shih

Contributing Editors: Dan King, Chloe Chen, Vivian Chen

Video Photographer: Michael Hsu

Graphic Designer: Luc Tsui

Subscription:

<https://www.itri.org/itritoday/subscription>

Inquiries:

E-mail: itritoday@itri.org.tw

ITRI TODAY Website:

<https://www.itri.org/english/itritoday>

Published by:

Industrial Technology Research Institute

No. 195, Sec.4, Chung Hsing Rd. Chutung, Hsinchu, Taiwan 31057, R.O.C.

Tel: +886-3-582-0100

ITRI Website:

<https://www.itri.org/eng>

© 2020 All rights reserved.

ITRI's Overseas Offices

ITRI International Inc.

2880 Zanker Road, Suite 103, San Jose, CA 95134, U.S.A.

Tel: +1-408-428-9988

Fax: +1-408-428-9388

E-mail: seanwang@itri.com

ITRI Japan Office

TTD Bldg., 3F, 1-2-18 Mita, Minato-ku, Tokyo, 108-0073, Japan

Tel: +81-3-54193836

Fax: +81-3-34555079

E-mail: itritokyo@itri.org.tw

ITRI Berlin Office

7 OG.,Hohenzollerndamm 187, 10713 Berlin, Germany

Tel: +49-30-8609-3610

E-mail: contact_germany@itri.org.tw

ITRI Moscow Office

125009, Tverskaya Str., Building 9, Block 7, Office 205, Moscow, Russia

Tel: +7-499-9511952

E-mail: contact_Russia@itri.org.tw

ITRI Eindhoven Office

High Tech Campus 9, 5656 AE Eindhoven, the Netherlands

Tel: +31-408512242

E-mail: contact_nl@itri.org.tw



Related Sites

TAIWAN TODAY

taiwantrade.com