Strengthening innovation-driven inclusive and sustainable development

Asia-Pacific Tech Monitor

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UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific
Asian and Pacific Centre for Transfer of Technology (APCTT)

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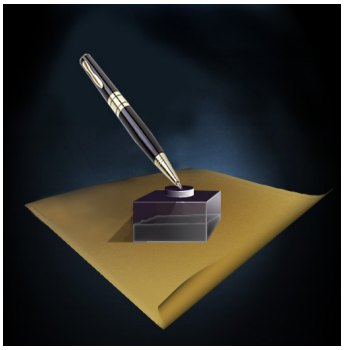

Introductory note

As the year 2021 is folding up, the world is gearing up to meet the challenges of COVID-19 pandemic. Armed with newer and innovative tools of science, technology and innovation (STI), countries are strengthening efforts to provide improved and faster health services to the affected population. Increased number of effective vaccines, drugs, and digital health solutions are helping countries to stem the pandemic. The year 2022 poses optimism for a better and healthy world.

Frontier technologies such as the fourth industrial revolution (4IR) technologies (e.g., Artificial Intelligence, Big Data, Machine Learning and drones) have been successfully used for population screening, tracking the infection, prioritizing the use and allocation of resources, vaccine development and designing targeted responses. Prominent 4IR applications in healthcare include Telehealth or telemedicine to get remote support from health-care professionals; Artificial Intelligence (AI)-based identification of high-risk population and medical diagnostics; and Internet of Medical Things (IoMT)-based tools for remote patient monitoring, tracing and tracking of patients. An important feature of these technologies is that they can be used widely and made affordable for large segments of population.

For example, an AI driven diagnostics platform 'Xray Setu" has been developed in India to serve rural areas by rapid screening and Chest X-ray interpretation of low-quality x-ray images. A wireless sensing system to monitor and analyze cardiac condition has been designed and developed using Internet of Things (IoT) which sends the information to the caregiver as well as a medical practitioner and provides a way of self-managing of heart disease. Smart sensors enabled wearable medical devices which can monitor different health parameters of subject are widely being used.

While the utilization of 4IR technologies is increasing, their wider diffusion and adoption across the Asia-Pacific region is lacking which requires collaborative efforts. The countries can mainstream utilization of 4IR technologies through appropriate policy invectives and institutional support systems to ensure that their healthcare services become truly inclusive and 'leave no one behind'. An example is India's Electronic Vaccine Intelligence Network (eVIN) which leverages IoT trends and provides a real-time track-and-trace system to monitor the movement and storage of vaccines. During the pandemic, eVIN stimulated the development of CoWIN, the COVID Vaccine Intelligence Network, which has been instrumental in ramping up COVID-19 vaccination efforts in a large country like India, in an effective and transparent manner.

This issue of Asia-Pacific Tech Monitor discusses how innovative 4IR technologies can be harnessed to make the healthcare system more robust. The articles provide insights and examples from the Asia-Pacific region into the application of different 4IR technologies such as IoT and machine learning for providing more efficient and effective healthcare.

Wishing you a healthy and happy New Year 2022!

Preeti Soni
Head, APCTT-ESCAP

ASIA-PACIFIC

BANGLADESH

Government moves to ease collateral requirements

The government is set to introduce an innovative financing model under a new law to enable small businesses and start-ups to show their moveable assets as collateral with a view to nurturing entrepreneurs and helping them secure loans. A draft law for the collateral protection for movable assets has already been formulated, according to a finance ministry official. The ministry will submit it to the cabinet by June 30 next year for approval.

The law is expected to provide local technology startups a shot in the arm as they always find it difficult to borrow from local banks and non-bank financial institutions due to a dearth of collaterals considering the nature of their business.

The proposed law is in keeping with the conditions set by the global development partners when they extended budgetary support to the government to help the country recover from the shocks triggered by the coronavirus pandemic. The government is framing the law as it wants to facilitate loans for at least 1,000 cottage, micro, small and medium enterprises (CMSMEs) and startup units by 2024. It will also put in place a more conducive regulatory environment and introduce innovative financing modalities to overcome CMSMEs' collateral issue and enhance financial intermediation. The government will help adopt an alternative credit scoring model by using digital transaction data, mainstreaming cluster and value chain financing, and promoting bank lending based on non-traditional collateral such as trade receivables and warehouse receipts.

Under the proposed law, raw materials, gold and other precious metals, patents, copyrights, work orders, furniture, tree, vehicles, agriculture and processed foods and fishery will be considered as collateral. Policies for cluster and value chain financing, and adoption of alternative credit scoring models to offer digital loans will be introduced. Among the initiatives, the digital credit scheme will commence in December 2022, the cluster financing scheme in September 2022, and the value chain financing in June 2023.

https://www.thedailystar.net

CHINA

Corporate R&D spending

Chinese corporates have boosted R&D expenditure in the past 2 years, as they strive to boost competitiveness and reduce reliance on imports, says Fitch Ratings. We expect spending to keep rising after the country highlighted R&D as a key national strategy in its 14th Five-Year Plan in May 2021. It has also introduced many favorable policies since 2H18, including a R&D super deduction before tax for corporates.

China's corporate R&D notably outpaced GDP in 2019–2020. The corporate R&D/GDP ratio rose to 1.84%, from 1.26% in 2010, increasing at a faster rate than at most developed countries. We believe the higher spending is partly in response to the increasingly intense US–China relationship, after the US imposed import tax on Chinese-made goods in July 2018 and launched a few entity lists against China's high-tech corporates and agencies since October 2019. Companies on the lists face export and other restrictions. This prompted Chinese corporates to reduce reliance on foreign suppliers, especially from the US and its allies.

R&D spending by central state-owned enterprises (SOE) rose by 11.3% yoy, to account for 49% of China's total corporate R&D in 2020, and boosted SOEs' aggregate R&D/revenue ratio to 2.6%, from 1.4% in 2018. This followed the introduction of R&D intensity in the key performance indicators set by the State-owned Assets Supervision and Administration Commission, which said central SOEs should treat scientific research spending as profit in their performance evaluations in early 2021. Growth in central SOEs' aggerate R&D further accelerated to 37.4% yoy in 1H21. Furthermore, Beijing issued Outline of Building a Powerhouse in Intellectual Property (2021–2035) in September 2021, a milestone policy for protecting intellectual property.

https://www.fitchratings.com

R&D spending

China's research and development (R&D) spending accounted for 2.4% of the country's aggregate GDP in 2020, not only recording a near decade high in growth but is quickly catching up with international standards, and in particular, the US, according to a statistical communique released by the National Bureau of Statistics along with two other government departments. Last year, China invested a total of 2.4 trillion yuan ($372 billion) in R&D, up 10.2% compared with the previous year. The ratio between China's R&D and GDP output had risen by 0.16 percentage point compared with the year of 2019, the highest rate of growth in nearly 11 years.

The numbers also show that China is closing the gap with other countries including the US in terms of R&D input. According to data released by the Organisation for Economic Cooperation and Development (OECD), R&D spending in the US was about 3.07% of GDP in 2019. The OECD has not reported US' R&D spending for 2020. The NBS noted that in terms of total R&D input, China's R&D spending accounted for about 54% of US spending in 2020, while it was 2.1 times that of Japan. Currently, China's R&D spending ranks second globally. China's average yearly R&D input growth reached 11.8% between 2016–2019, significantly higher than the US' 7.3% and Japan's 0.7% growth.

The data is also a reflection of China's continued efforts to advanced high-tech growth despite the impact of the coronavirus, as the country has rolled out favorable policies, like improving tax exemptions for domestic research companies, that yield positive results for investment in innovation, the NBS noted.

https://www.globaltimes.cn

Intellectual property rights protection

Zhang Zhicheng, head of the protection department of China's National Intellectual Property Administration, confirmed

that an action plan for IPR protection of the two events has been initiated across the country. The plan aims to enhance the protection of Olympic symbols. It will also allegedly protect design patents and registered trademarks of Olympic symbols in line with the country's patent and trademark laws. Zhang claimed that the plan will help to improve the popularization of IPR protection involving Olympic symbols and raise legal awareness of IPR among the public.

The strategy focuses on IPR protection in areas such as commodity production bases, logistics distribution centers and e-commerce platform headquarters as well as promoting information sharing among related authorities. During the campaign, those who infringe patents or trademarks involving Olympic symbols will be harshly punished, Zhang said, adding that IPR-related inspections in places that produce or sell Olympic products as well as at e-commerce giants need to be intensified.

https://www.insidethegames.biz

Solar subsidy

China has revealed its initial subsidy limits for existing renewables projects in 2022; however, it remains to be seen whether the funding is to be topped up. China's Ministry of Finance set out its first tranche of funding for existing renewable projects for the forthcoming year, making RMB3.87 billion (US$607.3 million) available. Of that total, RMB2.28 billion (US$357.2 million) has been set aside for solar PV projects, with RMB1.55 billion available for wind.

At RMB2.28 billion, the rate available in 2022 is a marked decrease—down 32.6%—on the RMB3.384 billion made available for projects last year. However, it is as yet unclear whether the finance ministry intends for this to be the full sum available in 2022 or whether the pot will be topped up at a later date.

A note issued by the finance ministry establishes the priority for subsidies to be paid by power grid companies in the country according to official fund management measures, as per the usual process. All funds are to be allocated to generators included in China's list of projects, with priority given to national PV projects that are alleviating poverty and so-called 'Top Runner' projects confirmed by China's central government. Half of the total subsidy payable to these projects is to be allocated by the end of this year. Other projects, including distributed systems up to and including 50 kW in size and projects determined by competitive bidding tendered by 2019 will have subsidy allocated proportionally.

https://www.pv-tech.org

INDIA

VC firms betting big on Web 3.0 startups

Indian venture capital firms are betting big on Web 3.0 startups as they view such companies as developers of products for the next stage of the internet, which is characterized by a decentralized online ecosystem based on blockchain technology. Early-stage Indian VC firm Antler India, a unit of Singapore-based venture capital platform Antler, has committed to invest in 25–30 startups in the blockchain and Web 3.0 space in the next 2–3 years. It plans to deploy $100 million to $150 million in over 100 Indian startups over the next 3 years, of which up to $50 million is committed to the Web 3.0 space. The fund will make a minimum investment of $250,000 and will come in at a pre-product market fit stage, Nitin Sharma, partner and global blockchain lead at Antler, told ET.

Sharma is also the founder of another VC fund, Incrypt Blockchain, as part of which he has invested in Mudrex, a social trading and decentralized finance (DeFi) aggregator, OnJuno, a payroll infrastructure bridging banking and crypto, among others. In an unprecedented year for the Web 3.0 space in India, Sequoia India has made about 20 investments in Web 3.0 startups including Betafinance, Clearpool, Coinshift, and Faze, through a combination of equity and token investments.

https://www.google.com

5G technology to be incorporated in global standard

In a major boost for the Department of Telecom, the made-in-India standard 5Gi is all set to be formally incorporated in the global 5G standard (3GPP). This will enable telecom equipment makers, especially the domestic players, to start using this standard to develop network gear for 5G services. According to sources, a formal agreement is expected to be announced in the coming week. The DoT has been coordinating with the global players for the incorporation of 5Gi with the 3GPP standard. 3GPP is an international body that defines the global standard for telecom sector. The new standard was developed under the supervision of Telecom Standard Development Society India and DoT with major contribution from all major IITs and IISc.

Some of the features of the 5Gi standard include enabling higher power for mobile phones. The handset power levels have been doubled under the harmonization of 5Gi with the global standard (increased from 23 dbm to 26 dbm). A modulation scheme, technically called pi/2 BPSK, which was earlier optional under the 3GPP standard, has now become mandatory. However, some other key features developed under 5Gi have not been incorporated by 3GPP, according to sources.

The key selling point of the standard is that it would be especially pertinent for local use, and bolster rural connectivity. It is also supported by Indian technology companies, including TCS, Saankhya Labs, HFCL, Tejas Network. The new standard could make their equipment more relevant for Indian 5G deployment.

A key win for the made in India standard is that the proposed features of 5Gi will now be globally deployed and implemented. Furthermore, any future development of 5Gi will happen under the aegis of 3GPP, which means 5Gi is unlikely to be deployed independently. Thus the concerns of MNCs such as Nokia, Ericsson as well the operators-Bharti, Reliance Jio and Vodafone Idea, that standalone

deployment of 5Gi would fragment the ecosystem, are abated.

Without global standardization, there would have been be an additional burden of testing all elements of the infrastructure and devices for various networks. "In this globalised world standardization and interoperability is the key to driving economies of scale and faster deployment. Otherwise, you have another TDS CDMA or FOMA story, where technologies did not go anywhere due to the lack of standardization," said an industry expert.

https://www.google.com

MALAYSIA

Startup ecosystem roadmap

The Ministry of Science, Technology and Innovation (Mosti) is targeting to build a conducive startup ecosystem with the launch of the Malaysian Startup Ecosystem Roadmap (SUPER) 2021–2030 and the MYStartup platform. In a statement, Mosti said SUPER is a plan to develop a dynamic national startup ecosystem and in line with Vision 2030. MYStartup is a digital information resource portal that provides comprehensive facilitation services for startup ecosystem networks, it said.

Mosti said SUPER is designed to increase the nation's gross domestic product (GDP) and is expected to contribute to high-value job creation as well as expanding deep technology investments by 2030. The development of SUPER has taken into account feedback from over 300 startup ecosystem stakeholders, it said. Mosti said SUPER is for all including government, investors as well as innovators to achieve the ultimate goal of placing Malaysia as one of the Top 20 global startup ecosystems.

Meanwhile, the MYStartup platform is a national digital portal of information resources aimed at helping ecosystem players navigate the startup ecosystem and drive local innovation, Mosti said. It will also assist and guide developing startups that have world class investment value.

https://www.digitalnewsasia.com

PHILIPPINES

Renewable energy roadmap

Philippines' proposed National Renewable Energy Program (NREP) 2020–2040 is setting a target of 35% share of renewable energy (RE) in the power generation mix by 2030 and 50% share by 2040. This was shared by Director Mylene C. Capongcol, OIC of the Department of Energy's (DOE) Renewable Energy Management Bureau, who in a recent online presentation acknowledged that instead of growing, the share of RE in the power generation mix has actually declined. She noted that in 2008, the year the Renewable Energy Act was passed, the share of RE was about 34%. Now it is down to 21%, or 21,609 gigawatt-hours (GWh), out of a total 101,756 GWh of power generated. The government is looking to revert the share of RE to 35% by 2030 and 50% by 2040 under the updated NREP, Capongcol said.

The NREP sets the roadmap for achieving the country's RE goals as required by the Renewable Energy Act of 2008. Republic Act No. 9513, or the Renewable Energy Act, provides the framework for the development, utilization, and commercialization of RE sources, defined as resources that can be replenished regularly and are available indefinitely. These include biomass, solar, wind, geothermal, ocean energy, hydropower, and other emerging RE technologies.

The Act affirms the government's commitment to accelerate the utilization of RE resources in the country to reduce harmful emissions and achieve economic development while protecting the health and environment. The transition to RE from carbon-intensive energies has become even more urgent in light of the massive destruction being wrought by climate change and uncontrolled greenhouse gas emissions not just in the country but on a global scale.

https://www.pna.gov.ph

Funding for research and development

There is a record-breaking increase in human and financial resources supporting research and development (R&D) from 2015 to 2018, a study by the Department of Science and Technology (DoST), the Philippine Statistics Authority and the University of the Philippines Los Baños showed. DoST Assistant Secretary for Finance and Strategic Planning Maridon Sahagun reported that the number of R&D personnel has tripled, from a headcount of 25,000 in 2015 to 75,000 in 2018.

Sahagun said that in 2018, 46% of R&D personnel in the country were working in higher education institutions (HEIs), 72% of which were state-run; 18% were in government, and 2% were part of private non-profit institutions. "Half of the R&D personnel in the Philippines in 2018 are researchers, one-third are auxiliary personnel, and the remaining 16% are classified as technicians," she said.

The National R&D expenditure, also known as the gross expenditure on R&D (GERD) more than doubled, from P21.9 billion in 2015 to P58.9 billion in 2018. Sahagun noted that the ratio of GERD to the gross domestic product jumped from 0.16% to 0.32% within the 3 years. The majority of R&D spending came from the private industry at P31.6 billion, followed by the government (P13.5 billion), HEIs (P11.8 billion), and private non-profit institutions (P1 billion).

The agency also launched its 2019–2020 survey on R&D expenditures and human resources to look into how the pandemic has affected the country's R&D spending and employment of personnel in the field of S&T.

https://www.manilatimes.net

R&D inclusive growth

A strong and purposeful research and development (R&D) programme is a crucial factor in a country's long-term growth. R&D is also essential to the advancement of society. It offers scientific knowledge for the creation of new products, solutions, and services. While it necessitates significant investments and a great deal of patience, the rewards are substantial. Policymakers and researchers are realizing that R&D is a critical component for

increased productivity, competitiveness, and well-being. Moreover, it has the potential to address some global issues such as climate change and public health.

The Republic Act 11293 or the Philippine Innovation Act is said to bolster the government's R&D efforts. The National Economic and Development Authority had developed the implementing rules and regulations in collaboration with the Departments of Science and Technology and Trade and Industry.

The Department of Trade and Industry (DTI) recently announced plans to expand access to research and development (R&D) across the country at a recent event. In his message to the ASEAN Summit on Spin-Off Technologies, the DTI Secretary mentioned that the agency is organizing Regional Inclusive Innovations Centres (RIICs) across the country to democratize the growth of startup communities.

He noted that R&D is the "true heart" and "DNA" of entrepreneurship and that making it more inclusive will enable more startup communities and support young entrepreneurial talents in technology and creative industries. Micro, small, and medium-sized enterprises (MSMEs) can use the RIIC to position their products in the global value chain, giving them a competitive advantage in the global market.

https://opengovasia.com

Energy Option Program

The Independent Electricity Market Operator of the Philippines (IEMOP) launched the Green Energy Option Program or GEOP, December 3, 2021. This is following the Energy Regulatory Commission's issuance of ERC Resolution No. 08, Series of 2021. GEOP is one of the various programs under the Renewable Energy Act of 2008 which aimed to promote the development of renewable energy in the country. The program provides consumers an option to source their electricity supply from renewable energy resources, such as biomass, solar, wind, geothermal, ocean energy, and hydropower. Under the regulation, those with average peak electricity requirements equal to or greater than 100 kW are the first set of consumers that can benefit of the GEOP program. Consumers of electricity are no longer constrained to only source their electricity supply from the distribution utility of their location.

Eligible consumers may now choose from various "Renewable Energy Suppliers" that are authorized by the DOE to procure energy from renewable energy facilities. Through such mechanism, GEOP aims to contribute to energy sustainability and promote further competition in the electricity sector.

https://www.thinkgeoenergy.com

REPUBLIC OF KOREA

Multinational drugmakers' R&D

Global pharmaceutical companies' investment in R&D in the Republic of Korea has continued to rise for the fifth consecutive year in 2020, an industry group report showed. The number of early clinical trials and studies of cancer and rare diseases increased significantly, and employment for R&D also expanded steadily, the report said. Korean Research-based Pharmaceutical Industry Association (KRPIA) released its report on 31 members' expenses for local R&D and researchers. The KRPIA's survey was jointly conducted by a research team led by professor Shin Ju-young of Sungkyunkwan University's School of Pharmacy.

The report showed that 31 multinational drugmakers spent 569.3 billion won ($478.9 million) on clinical research in the Republic of Korea in 2020. The costs excluded R&D expenses commissioned directly by their global headquarters. Despite the ongoing Covid-19 pandemic, multinational pharmaceutical firms continued to contribute to the Republic of Korean economy through increased R&D activities, KRPIA said.

Based on data from 25 KRPIA members that participated in the survey for the past 5 years since 2016, the total R&D spending increased from 360 billion won in 2016 to 590.2 billion won in 2020. Compared to 2019, the R&D jumped by 114.2 billion won (24%) in 2020. The 31 multinationals had 1,846 employees for R&D activities in 2020. They conducted a total of 1,499 clinical trials in 2020. Based on data from 25 KRPIA members between 2016 and 2020, the 25 firms worked on approximately 1,200 studies. In 2020, the number of phase 1 and phase 2 trials increased faster than phase 3 trials.

"Member companies not only invest in R&D through clinical trials but support basic research (three cases), non-clinical trials (four cases), an introduction of locally developed substances, a joint development with domestic pharmaceutical companies and research institutes, and R&D with local hospitals and organizations (12 cases)," an official at KRPIA said. Also, he added that KRPIA ran 15 programs to provide education for local universities and research institutes so that the Republic of Korea could have a better capability for new drug development and harmonize with the international standards.

The total value of investigational drugs, provided for domestic patients for free in clinical trials, was estimated to be 226.6 billion won in 2020, based on data from 31 KRPIA members, KRPIA said. Clinical trials for cancer and rare disease treatment accounted for 64.5% (780 cases) and 10.3% (125 cases). Seventeen studies aimed to develop a Covid-19 treatment or a vaccine.

According to the KRPIA official, the Republic of Korea registered the second-largest clinical trials in East Asia, after China. However, Korea's share in global clinical trials went down from 2017 to 2019 but rose again in 2020 to rank at the world's sixth, up by two notches from 2018, he went on to say. He said this was attributed to the Republic of Korean government's deregulation efforts, including the 5-year national project to advance clinical trials.

https://www.koreabiomed.com

Tax incentives, R&D spending on battery sector

The Republic of Korea said it will increase investment to develop the next-generation battery technology, expand its manufac-

turing base and secure supply chains as it seeks to foster the rechargeable battery industry as the next growth driver. The Ministry of Trade, Industry and Energy unveiled the so-called K-battery blueprint to solidify the nation's battery leadership as major economies are racing to develop their own supply chains to benefit from the fast-growing electric vehicle market.

The Republic of Korea accounted for 44.1% of the global rechargeable battery market last year ahead of China and Japan, led by small batteries for IT devices and medium-sized and large batteries for EVs, according to the ministry. While the nation's battery trio—LG Energy Solution Ltd., Samsung SDI Co. and SK Innovation Co.—accounted for a third of the global EV battery market in 2020, calls for broader support have risen to better compete with Chinese rivals that have expanded their presence on their home turf, the world's top EV market.

"The global competition for rechargeable batteries has just begun in earnest as the U.S., Europe and China are stepping up efforts to secure the manufacturing base, battery technology and supply chains to target the rapidly growing market," the ministry said in a release. "The government has come up with the comprehensive battery policy to make concerted efforts with the private sector as the global battery race will face a critical juncture in the next 5 years."

Under the battery road map, the nation's battery makers and related firms will receive up to a 50% tax discount for R&D spending and 20% of tax cuts on facility investment.

The ministry said it aims to nearly triple battery exports from $7.5 billion in 2020 to $20 billion by 2030, as the nation's three battery makers have vowed to invest a combined 40 trillion won (US$35.3 billion) over the next decade.

While lithium-ion batteries currently dominate the EV battery market, the ministry said it will collaborate with the battery manufacturers and related agencies to develop next-generation batteries with enhanced energy efficiency, longer range and safety. For example, the country will seek the commercialization of the solid-state battery, which is considered a safer and more energy-efficient option for EVs, by 2027.

The Republic of Korea also plans to develop a lithium–sulfur battery, which is more competitive in terms of weight, for drones and aircraft by 2025. The government also vowed to cooperate with the private sector to enhance lithium-ion batteries' capacity and safety via R&D projects aimed at improving the chemistry mix and cell structure.

The ministry said it will build "the next-generation battery park" by 2026 to facilitate local firms' research and test efforts, and create an 80 billion-won fund jointly with the three battery makers to support R&D projects. It also plans to step up efforts to help local companies secure key resources for battery materials and explore ways to reuse materials from spent batteries to cope with possible global shortages of raw materials.

https://m-en.yna.co.kr

Action plans for carbon neutrality

The Republic of Korea will close down 24 aging coal-fired power plants permanently by 2034 as part of efforts to phase out coal consumption for electricity generation by 2050 and boost the country's clean hydrogen self-sufficiency ratio to 34% in 2030, and further to 60% in 2050, the government said December 10. The government unveiled the country's first detailed "action plans" to achieve a carbon neutrality under which the Republic of Korea also plans to use carbon-free sources of ammonia and hydrogen as a key power generation fuel to reduce coal and LNG demand for electricity production.

The action plans, which were announced jointly by 10 related government agencies, such as the industry-energy ministry, the economy-finance ministry, the environmental ministry and the science ministry were focused on an early requirement of coal-fired power plants. "A total of 24 aging coal-fired power plants will be fully retired by 2034 and operation of the other coal power plants will be restricted, which will lead to no coal-based electricity generation by 2050," the joint statement said.

The country is currently running 53 coal-fired power plants as seven have been permanently closed down for the past 2 years as part of President Moon Jae-in's push to reduce the country's heavy reliance on coal in power generation and address worsening air pollution. "The government plans to raise the portion of ammonia to 3.6% in 2030, or 22.1 TWh, in 2030 compared with zero currently," said an official at the Ministry of Trade, Industry and Energy.

In addition, South Korea will provide 27.9 million mt/year of "clean hydrogen" by 2050, green or blue hydrogen, including imports of 22.9 million mt/year of green hydrogen from overseas, the official said. "Under the action plans, the combined portion of renewable and carbon-free sources will rise to 33.8% in the country's power generation mix in 2030, compared with 6.6% in 2020, and will further jump to 93.6% in 2050," the government statement said. "As nuclear reactors will account for 6.1% in 2050, 99.7% of South Korea's power generation will come carbon free," it said.

The country will also secure 900 million mt/year of carbon storage space by 2030 to make sure there are no carbon emissions by 2050, according to the general strategy. The government is also pushing to enact a "basic law on resources security" so as to secure stable supplies of hydrogen, ammonia and renewable sources in addition to oil and gas. With the action plans in place, the shares of coal and LNG in power mix will reduced to 21.8% and 19.5% in 2030, respectively, from 35.6% and 26.4% in 2020, before being phased out in 2050. "With the measures, carbon emissions by the industrial sector will be slashed to 226.6 million mt in 2030, and further to 51.1 million mt in 2050, down 80.4% from 260.5 million mt in 2018," the joint statement said. In an initial stage, the government and businesses will spend Won 90 trillion ($76.3 billion) over the next 4 years until 2025 in carbon reduction projects, the statement said.

https://www.spglobal.com

THAILAND

Incentives for R&D, semiconductors, smart packaging

Thailand has released new incentives for investments in research and development (R&D), semiconductor manufacturing, smart packaging, and other digital technologies, as the government seeks to capitalize on soaring global demand for products in the sector due to supply chain disruptions caused by COVID-19. Thailand's Board of Investment (BOI) approved the incentives at a meeting on June 30, 2021.

Thailand is already a major player in Southeast Asia's semiconductor industry, which analysts expect to grow rapidly in the coming years. The market research firm Fortune Business Insights projects ASEAN's semiconductor market to grow at a compound annual growth rate of 6.1% from 2021 to 2028, rising from US$26.9 billion in 2020 to US$41.9 billion by 2028.

The R&D and human resource (HR) incentives apply to companies making large investments in innovation. Eligible companies will benefit from extended tax holidays lasting up to 13 years without a corporate income tax exemption ceiling. In other words, these companies will be exempt from Thailand's headline corporate income tax rate of 20%.

To qualify, companies must invest a minimum of 200 million baht (US$6.1 million) or 1% of their total sales in their first 3 years on R&D activities. The exact length of the extended tax holiday depends on the amount the company invests in R&D.

Further, companies that adopt apprenticeship programs or invest in advanced technologies will be eligible for similar incentives. For example, semiconductor projects with additional investments in R&D may be eligible for a tax exemption of up to 5 years.

Moreover, companies hiring Thai workers for software development, digital services platforms, or digital content may qualify for a tax holiday of 8 years. The corporate income tax exemption ceiling for this incentive depends on the number of Thai workers hired for these roles, as well as associated expenses for training and acquiring international certifications.

In addition to the R&D and HR development incentives, the BOI approved measures to promote investment in manufacturing, with a focus on semiconductors. Per the BOI's incentives, front-end capital and technology-intensive manufacturing will be given tax holidays for 10 years. This includes front-end semiconductor investments, such as in electronics design, silicon wafers, and wafer FAB.

Back-end semiconductor investments, such as in wafer SORT, die bank, assembly, and integrated circuit testing, qualify for tax holidays of 8 years with machinery investments of at least 1.5 billion baht (US$45.7 million), and 5 years with machinery investments below 1.5 billion baht (US$45.7 million).

Machinery investments worth at least 1.5 billion baht (US$45.7 million) in the advanced printed circuit board (PCB) manufacturing are eligible for tax holidays of 8 years, while investments worth less than 1.5 billion baht (US$45.7 million) qualify for tax holidays of 5 years. Finally, machinery investments in printed circuit board assembly (PCBA) worth at least 500 million baht (US$15.2 million) can enjoy a 5-year tax holiday. Investments worth least than 500 million baht (US$15.2 million) may qualify for a 3-year tax holiday.

The BOI also approved incentives for companies producing smart and environmentally friendly packaging, in line with the government's Bio-Circular-Green (BCG) model. Smart and environmentally friendly packaging includes digitally enabled packaging and packaging made from recycled materials, among others. Companies manufacturing active and intelligent packaging may qualify for tax holidays of 8 years. Active packaging refers to packaging that maintains the quality of the product, while intelligent packaging refers to packaging that can sense the quality of the product.

Further, companies creating smart packaging or parts thereof may be eligible for a tax holiday of 3 years. Smart packaging refers to packaging made from "special substances".

VIET NAM

New regulations on medical device management

On November 8, 2021, the Vietnamese government issued Decree No. 98/2021/ND-CP on the Management of Medical Devices ("Decree 98"). The new decree will take effect from January 1, 2022, replacing Decree No. 36/2016/ND-CP and its amendments on the same subject ("Decree 36"). Below are the main highlights of Decree 98:

1. Classification of medical devices

Under Decree 98, responsibility for the classification of medical devices is given to the organization registering or declaring the medical device. Under Decree 36, this responsibility was reserved for Vietnamese organizations qualified for medical device classification.

2. Clinical trials of medical devices

Decree 98 provides stricter and more detailed requirements on clinical trials. Particularly, medical device trials will include three phases, in which phases 1 and 2 need to be finished before the product registration, while phase 3 will be conducted after the medical devices are approved for circulation, following the specific requirement from the authorities. This requirement aims to continue evaluating the safety and efficacy of medical devices after they are widely used in the community in line with their usage conditions.

3. Medical device registration

Similar to the current regulations, Decree 98 requires that medical devices must be registered with the Vietnamese authority (i.e., must obtain registration numbers) before being imported/manufactured for circulation in the Vietnam market. However, Decree 98 further stipulates new requirements as below.

Validity of registration numbers

Under Decree 98, the registration numbers for all classes of medical devices, not only

Class A medical devices as in the current regulations, are valid indefinitely, except for registration numbers granted under the emergency registration procedure.

Registration procedure for Class A/B medical devices

Instead of having to register with the central level authority with a complex registration dossier as currently required, Decree 98 allows Class B medical devices to be subject to a simpler registration procedure, namely, "Declaration of applied standard" with the provincial level authority, which is the same procedure as for the lowest risk Class A devices.

Registration procedure for Class C/D medical devices

For the first time in Vietnam, Decree 98 sets out three procedures to apply for registration of Class C/D medical devices: the normal registration procedure, a quick registration procedure, and an emergency registration procedure.

The Ministry of Health's evaluation timeline for handling registration dossiers for Class C/D medical devices under the normal procedure will be up to 45 days, while the timeline under the quick and emergency procedures will be only 10 days.

4. Price management

In an effort to control the price of medical devices, Decree 98 includes a new requirement in which registration number holders must declare the prices of their medical devices on the Portal of Medical Device Management before putting the medical devices on the Vietnam market; the actual prices must not be higher than the declared prices. The authorities may question the registration number holder about grounds for the declared prices at any convenient time.

5. Importation of medical devices

Decree 98 sets out situations where medical devices without registration numbers must have import licenses. These include, among others, medical devices for scientific research, tests, trials, quality assessment, or training; medical devices for aid, humanitarian aid, gifts, fairs, exhibitions, displays, or product introduction; and medical devices meeting urgent needs for national defense, security, epidemic prevention and control, and overcoming consequences of natural disasters and catastrophes.

6. Medical device advertisement

Decree 98 completely removes the procedure for approval of medical device advertising contents. Instead, the holders of medical device registration numbers or their authorized entities will be responsible for publicly declaring the intended content and form of the advertising on the Portal of Medical Device Management before conducting the advertising.

7. Transitional regulations

Decree 98 sets out the following transitional mechanisms:

- Medical devices produced/imported into Vietnam before January 1, 2022, may be continuously circulated until they are liquidated as stipulated or until their expiry date.
- For import licenses/registration numbers granted before January 1, 2022:
  - Registration numbers granted under Decree 36 and its amendments will be valid indefinitely.
  - MAs granted to domestic medical devices will be valid until their expiry date.
  - Import licenses for medical devices that were granted from January 1, 2018, will be valid until December 31, 2022. Import licenses for medical devices that are IVD biologicals will have no limit on quantity.
  - For Class C/D medical devices that are not subject to import licenses and whose classification results were published on the Portal of Medical Device Management, they can be continuously imported until December 31, 2022, with no limit on quantity and without an approval letter from the Ministry of Health.
  - MAs for medical devices that are IVD biologicals that were granted from January 1, 2014, will be valid until December 31, 2022, or their expiry date, whichever is later.
- For registration dossiers prepared and submitted in line with Decree 36 but for which registration numbers have not yet been granted as of January 1, 2022:
  - For Class B medical devices, the registrant should conduct the (simpler) procedure for declaration of applied standard with the Department of Health under Decree 98; the governmental fee will be waived.
  - For Class C/D medical devices, if the submitted dossiers comply with Decree 98, they will be reviewed and granted registration numbers in line with Decree 98.
  - Classification certificates issued by local organizations qualified for medical device classification before January 1, 2022, can continue to be used in registration dossiers.
- Registration dossiers for obtaining import licenses submitted before January 1, 2022, will continue to be reviewed and handled in line with current/old regulations. These import licenses will be valid until December 31, 2022.
- From January 1, 2023, it will be required to apply the Common Submission Dossier Template (CSDT). Registration dossiers submitted before December 31, 2022, may submit documents including (i) technical summary, (ii) Instructions for use and (iii) label intended for Vietnam market instead.
- The declaration of advertising content for medical devices will be applied from July 1, 2022.
- Holders of registration numbers or import licenses granted before January 1, 2022, must take responsibility for price declaration under Decree 98 before April 1, 2022, for medical devices that are circulating in the Vietnam market and before putting medical devices on the Vietnam market for the first time.

https://www.tilleke.com

ASIA-PACIFIC

CHINA

AI-powered drug discovery framework

Ping An Insurance (Group) Company of China has reported that its researchers have come up with a deep learning framework for drug discovery. A research team from Ping An Healthcare Technology Research Institute and Beijing's Tsinghua University developed the said framework; its findings were published in the peer-reviewed journal Briefings in Bioinformatics.

The researchers created a new AI-driven framework for drug discovery called MPG that learns molecular representations from large volumes of unlabelled molecules. They also made their own graph neural networks (GNN) model called MolGNet for modeling molecular graphs.

Ping An said drug discovery can take between 10 to 15 years. AI technologies have been employed to speed up the process, particularly in molecule drug design, drug–drug interaction, and drug–target interaction predictions. Yet, molecular designing remained a challenge given the dearth of labeled data for training data sets. To this end, the research team worked with GNN technology, a model that can be pre-trained with unlabelled data instead of relying on labeled data.

In their research, the team crafted a self-supervised pre-training strategy named Pairwise Half-graph Discrimination. It found that after pre-training the MolGNet on 11 million unlabelled molecules, it captured "meaningful" patterns of molecules to produce an interpretable representation.

https://www.mobihealthnews.com

AI-steered platform for COVID-19 prevention and control

Chinese researchers developed a big data and artificial intelligence (AI)-steered model in a bid to reduce economical cost while carrying out accurate COVID-19 prevention and control work. The model, developed by a task force from the Department of Computer Science and Engineering at Southern University of Science and Technology, is able to complete deduction based on the model's simulation. Such model facilitated the establishment of a platform which has provided reference for the government to combat the virus.

The platform started its demonstration experiment in Shenzhen at the beginning of the year and finished the data analysis in May, Song Xuan, leader of the team and also a researcher at the department, told the *China Science and Technology Daily*.

The platform has applied for more than 40 Chinese and international patents, the researcher noted. Working together with Shenzhen disease control and prevention center and Smartcity Tech, the team worked out the platform by integrating, processing, and analyzing a variety of people's mobility and travel data. With AI technology, the platform can provide predictions and simulations of virus transmission based on the model.

https://www.globaltimes.cn

INDIA

Wearable devices with IoT, ML

The Indian Institute of Technology Madras (IIT-M) researchers are enhancing already developed wearable devices with latest technologies that will assist people with hearing impairment and motor disabilities to communicate independently and enhance their quality of life. These wearable sensors will include the latest sensor technologies used in the Internet of Things and Machine Learning (ML). The devices are being developed by the Centre for Rehabilitation Engineering and Assistive Technology (CREATE), a multidisciplinary translational research and educational initiative of IIT Madras. It was conceived as the researchers began interacting with NGOs and inclusive schools.

"Due to the non-availability of affordable and sustainable assistive devices and systems, the hearing-impaired are excluded from the mainstream and inclusive education. Also, the imported devices cannot be afforded by most people," said Prof Anil Prabhakar, Head, CREATE and Faculty, Department of Electrical Engineering, IIT Madras, in a statement. "The cost of the product is kept low and to be less than INR 5000 so that it is an affordable device for its basic functionality. The advance of technology and the advent and availability of low-cost microcontrollers and sensors allows us to come up with this unique low-cost device," Prabhakar said.

The two major projects being developed by CREATE are "Vibe" and "iGest" for the hearing impaired and for persons with motor disabilities, respectively. Both devices will be embedded systems that will bring the latest developments from IoT and ML to wearable assistive devices. Such wearable devices will have rechargeable batteries and communicate with a mobile phone over Bluetooth.

Vibe is a wearable device that vibrates for acoustic sounds around a person with hearing impairment. Vibe features a multitude of sound patterns that are recognized using a microphone and voice recognition modules. The device, compact and wearable as a watch, will alert the hearing impaired about a specific sound such as a doorbell, alarm, or a crying child. It is a simple way of providing vibration input for the pre-identified surrounding sounds, with each such sound corresponding to a specific vibration and blinking LEDs to alert the user.

iGest will function as an alternative and augmentative communication device for persons with cerebral palsy. It will recognize the gestures of those with limited motor skills and convert them into audio output through a smartphone. It aims to address issues of speech impairment and motor impairment faced by persons with cerebral palsy.

iGest, which borrows on commercially available fitness sensors, will be designed using an inertial motion unit. For persons with cerebral palsy, movements can be much slower than normal people and also less repetitive. Hence, iGest will be designed around available Edge ML

microcontrollers that provide ML capabilities to IoT devices.

https://www.english.lokmat.com

Nano robot for rapid cancer diagnosis

Maharashtra Institute of Medical Education and Research (MIMER), Pune has developed a nano robot that is programmed to capture and isolate circulating tumor cells. The tool is expected to lead to a new rapid and accurate diagnostic method for cancer, said Dr Shashwat Banerjee, Scientist at MIMER Medical College at Talegaon Dabhade in Pune.

"In search of better cancer diagnostics, scientists from MIMER, Pune, synthesized multifunctional nanorobot using magnesium-iron oxide Janus nanoparticles. The reported nano robot tested on blood containing a low number of cancer cells exhibited ~100% capture efficiency in less than 5 minutes. The nano robot was further clinically validated by testing it on a cancer patient's blood samples and it exhibited rapid and efficient circulating tumor cells (CTC) capture ability," Dr Banerjee said in a statement.

The findings were published recently in the peer-reviewed journal Communications Chemistry under the title "Water-Powered Self-Propelled Magnetic Nanobot for Rapid and Highly Efficient Capture of Circulating Tumor Cells." This new nano robot-based diagnostic tool may help in improving cancer treatments, allow for better treatment control, enable early interventions and change decision-making from reactive actions towards more predictive early interventions, he added.

According to a recently released report by the Indian Council of Medical Research (ICMR) and the National Centre for Disease Informatics and Research (NCDIR), the number of cancer cases in the country will rise to 15.6 lakh by 2025. This will be an increase of 12% from the current estimated cases. With this rising global burden, prevention and cure of cancer is one of the most important public health challenges of the 21st century.

https://www.indianexpress.com

ISRAEL

AI-based technology to identify patients at risk

A new technology developed at Tel Aviv University will make it possible, using artificial intelligence, to identify patients who are at risk of serious illness as a result of blood infections. The researchers trained the AI program to study the electronic medical records of about 8,000 patients at Tel Aviv's Ichilov Hospital who were found to be positive for blood infections. These records included demographic data, blood test results, medical history, and diagnosis. After studying each patient's data and medical history, the program was able to automatically identify medical files' risk factors with an accuracy of 82%. According to the researchers, in the future this model could even serve as an early warning system for doctors, by enabling them to rank patients based on their risk of serious disease.

Behind this groundbreaking research with the potential to save many lives are students Yazeed Zoabi and Dan Lahav from the laboratory of Prof. Noam Shomron of Tel Aviv University's Sackler Faculty of Medicine, in collaboration with Dr. Ahuva Weiss Meilik, head of the I-Medata AI Center at Ichilov Hospital, Prof. Amos Adler, and Dr. Orli Kehat. The results of the study were published in the journal *Scientific Reports*.

The researchers explain that blood infections are one of the leading causes of morbidity and mortality in the world, so it is very important to identify the risk factors for developing serious illness at the early stage of infection with a bacterium or fungus. Most of the time, the blood system is a sterile one, but infection with a bacterium or fungus can occur during surgery, or as the result of complications from other infections, such as pneumonia or meningitis. The diagnosis of infection is made by taking a blood culture and transferring it to a growth medium for bacteria and fungi. The body's immunological response to the infection can cause sepsis or shock, dangerous conditions that have high mortality rates.

To the researchers' satisfaction, following their training the AI reached an accuracy level of 82% in predicting the course of the disease, even when ignoring obvious factors such as the age of the patients and the number of hospitalizations they had endured. After the researchers entered the patient's data, the algorithm knew how to predict the course of the disease, which suggests that in the future it will be possible to rank patients in terms of the danger posed to their health—ahead of time.

https://www.news-medical.net

MALAYSIA

App to detect Covid-19 through cough patterns

The government is in the midst of introducing a mobile phone application that detects Covid-19 through users' cough sound patterns. The Ministry of Science, Technology and Innovation (MOSTI), through the Sandbox Innovation and National Technology (NTIS) secretariat, is assisting a local company, Serba Dinamik IT Solutions Sdn Bhd, to develop the Covid-19 initial screening product.

"Based on the concept of 'plug-and-play', users only need to download the application and record the sound of 'coughing' three times in a row," Science, Technology and Innovation Minister Dr Adham Baba mentioned in a written Dewan Rakyat reply. "For verification purposes, this application is also equipped with a 'facial recognition' system to identify the user's identity."

According to MOSTI, Covid-19 screening results using this application can be received within 30 seconds. The positively identified users will then be required to undergo RT-PCR or RTK-Ag tests to confirm the presence of the coronavirus. Besides that, MOSTI—through the National Nanotechnology Center (NNC) and the National Institute of Biotechnology Malaysia (NIBM)—has helped a research team from Universiti Teknologi Malaysia (UTM) to identify a simpler, cheaper, and faster Covid-19 screening method.

https://codeblue.galencentre.org

REPUBLIC OF KOREA

Automated system surgical robot

The Ministry of Food and Drug Safety said it designated "Soft Ureteroscopy Automated System Surgical Robot" as the nation's 17th innovative medical device. A surgeon can remove kidney stones using the device by inserting a thin, soft, and flexible ureteroscope and remotely controlling it. The device has an automatic driving function to remember the location of stones and an automatic stone extraction function, making it easy to control and improving surgical accuracy. In addition, the device reduced the risk of ureter damage when removing bulky stones by allowing a surgeon to check the size of the stones during surgery. Also, the device shortened the surgery time and reduced radiation exposure, which helped raise the convenience and safety for both doctors and patients, the ministry said.

The government recognized it as an innovative medical device because it was the first homegrown automated surgical robot for lithotomy. A surgeon had to insert a ureteroscope directly and shoot an X-ray to check and remove stones in the past. This took a much longer surgery time, and the patient was exposed to radiation excessively. As the Soft Ureteroscopy Automated System Surgical Robot is being commercialized, the MFDS will support swift approval for the device, the ministry said.

https://www.koreabiomed.com

SINGAPORE

Smart bandage for chronic wounds

Researchers at the National University of Singapore have developed the world's first smart bandage. The scientists, in collaboration with Singapore Gveneral Hospital, created VeCare, a bandage with a wearable sensor that can conduct real-time, point-of-care assessment of chronic wounds via an app. It uses sensor technology that can detect temperature, pH, bacteria type and inflammatory factors specific to chronic wounds within 15 minutes.

It's estimated that about 1% to 2% of people in developed countries will experience a chronic wound in their lifetime. VeCare could be particularly useful for people with diabetes who have foot ulcers. "The VeCare platform is easily scalable and customizable to accommodate different panels of biomarkers to monitor various types of wounds," said Lim Chwee Teck, director of the Institute for Health Innovation and Technology (iHealthtech) at the National University of Singapore.

The healing process of chronic wounds can be interrupted by infection and repeated trauma, which causes more pain and stress for the patient. In diabetic patients with foot ulcers, this can lead to more severe outcomes like amputation.

VeCare is the first wound assessment platform that can detect bacteria type and probe inflammatory factors within a single 15-minute test. The smart bandage enables rapid assessment of the wound's microenvironment, inflammation, and infection state by detecting multiple chronic wound-specific biomarkers from wound fluid using an electrochemical system. A wound-fluid collector directs the fluid to the sensor. Then, the chip that is connected to the sensor transmits data wirelessly to an app, providing real-time wound assessment and analysis onsite. The chip component, which is powered with a rechargeable battery, can be reused.

https://www.amp.dw.com

EUROPE

DENMARK

AI tool to combat COVID variants

While considerable advances have been achieved in our battle against the coronavirus, new mutations of COVID-19 continue to emerge and could threaten public health. To prevent further severe pandemics, researchers from the University of Copenhagen and the immunotherapy company Evaxion have teamed up to develop a new AI tool that can more quickly and effectively predict how different protein elements can be assembled to increase the likelihood of coronavirus protection. Their tool, BIFROST, is a computer model that uses algorithms to put together virus proteins that are most likely to be included in a vaccine, explains Christian Thygesen, an industrial Ph.D.

Thygesen has developed the model together with Evaxion and Associate Professor Thomas Hamelryck in the Deep Probabilistic Programming group at the University of Copenhagen's Department of Computer Science. "For a vaccine to be effective, the body must be able to produce antibodies against viruses. It does so if it recognizes dangerous proteins—such as coronavirus spike proteins. With BIFROST, we use algorithms to prioritize the parts of viral proteins that we already know can stimulate an immune response, so that we can assemble them in a way that is most likely to work in a vaccine," says Christian Thygesen.

BIFROST uses data on amino acid chains—the building blocks of proteins—to predict how various proteins look and behave. In the future, this knowledge will allow researchers to design "super proteins" that elicit the desired response to viruses in the immune system, with few side effects.

BIFROST has numerous advantages over other models, according to a new study conducted by the three researchers. Until now, researchers have used a computer model called Rosetta to learn about the shape and behavior of proteins. But as Christian Thygesen explains, the Rosetta method has significant shortcomings. "Our new method has the major advantage of running on special hardware that allows us to get answers in seconds rather than waiting hours for results. It saves time and thus money."

BIFROST has another unique attribute that makes it more efficient than Rosetta. "Where, based on a single amino acid chain, Rosetta can only provide one estimate of the protein in question, our tool uses algorithms to calculate the probability of several possible proteins. One piece of an amino acid chain doesn't have to result in exactly the same proteins every time," explains Thygesen

Thus, BIFROST is equipped to provide us with more suggestions about potential protein shapes and behaviors. This is important when trying to develop a vaccine that needs to be able to recognize many new variants of, for example, coronavirus spike proteins.

https://www.medicalxpress.com

GERMANY

AI for early detection and treatment of illnesses

Artificial intelligence (AI) will fundamentally change medicine and healthcare: Diagnostic patient data, e.g., from ECG, EEG, or X-ray images, can be analyzed with the help of machine learning, so that diseases can be detected at a very early stage based on subtle changes. However, implanting AI within the human body is still a major technical challenge. TU Dresden scientists at the Chair of Optoelectronics have now succeeded for the first time in developing a bio-compatible implantable AI platform that classifies in real-time healthy and pathological patterns in biological signals such as heartbeats. It detects pathological changes even without medical supervision. The research results have now been published in the journal *Science Advances*.

In this work, the research team led by Prof. Karl Leo, Dr. Hans Kleemann, and Matteo Cucchi demonstrates an approach for real-time classification of healthy and diseased bio-signals based on a biocompatible AI chip. They used polymer-based fiber networks that structurally resemble the human brain and enable the neuromorphic AI principle of reservoir computing. The random arrangement of polymer fibers forms a so-called "recurrent network," which allows it to process data, analogous to the human brain. The nonlinearity of these networks enables to amplify even the smallest signal changes, which—in the case of the heartbeat, for example—are often difficult for doctors to evaluate. However, the nonlinear transformation using the polymer network makes this possible without any problems.

In trials, the AI was able to differentiate between healthy heartbeats from three common arrhythmias with an 88% accuracy rate. In the process, the polymer network consumed less energy than a pacemaker. The potential applications for implantable AI systems are manifold: For example, they could be used to monitor cardiac arrhythmias or complications after surgery and report them to both doctors and patients via smartphone, allowing for swift medical assistance.

https://www.sciencedaily.com

SPAIN

Autonomous robot designed for Covid-safe communications

A "telepresence" robot has been designed to enable Covid-19 sufferers to talk to their loved ones without putting them at risk. Designed by University of Malaga researchers, the robot has Covid-specific design functions in order to adapt it to the pandemic needs and aims to facilitate the work of professionals in nursing homes and hospitals. "We have enabled people that are isolated in a room to have a video call with relatives and friends without risks and regardless of their ability to use new technologies," said researcher Juan Pedro Bandera.

Patients are able to book an hour for a video call by using a simple web interface, after which the robot boots up autonomously and goes to the counter to be disinfected. It then travels to their room and starts the video call at the scheduled time. When finished, it is disinfected again and goes back to charge. Just over a meter high, with a cylindrical or pedestal-shaped body, this robot also has simple expressive abilities, audio-visual communication capacity and is able to move around autonomously.

The team also envisages it being used in homes for the elderly as an announcer or offering residents the ability to share and view photos. "A social robot that crosses continuously between two people talking, that gets too close to them when moving around, that moves too fast or abruptly or stops in a corridor blocking their way will not be accepted and, therefore, will not be useful," Bandera said.

His team also studied the movement of robots, determining that "smoother" paths tend to decrease energy consumption and increase social acceptability. However, they also show that other critical factors need to be considered, such as keeping an adequate distance from people:

https://eandt.theiet.org/

NORTH AMERICA

CANADA

AI could help predict the necessity of ICU admission

New technology could help doctors make the most of limited resources during the COVID-19 pandemic by identifying patients who require intensive care unit (ICU) treatment. The system, developed by researchers at the University of Waterloo and DarwinAI, an alumni-founded startup company, uses artificial intelligence (AI) to predict the necessity of ICU admission based on more than 200 clinical data points, including vital signs, blood test results, and medical history.

The new AI software was trained using data from almost 400 cases at Hospital Sirio-Libanes in Sao Paulo, Brazil, in which doctors had decided if COVID patients should be admitted for intensive care. Based on lessons learned from that known data, the neural network developed by researchers can predict the need for ICU admission in new COVID cases with greater than 95% accuracy. It also identifies the key factors that drive its predictions to help give clinicians confidence in them.

Rather than replacing doctors, the technology is meant to arm them with a new tool to make faster, more informed decisions and ensure the patients most in need of intensive care receive it. "The goal is to help clinicians make faster, more consistent decisions based on past patient cases and outcomes," said Wong, a director of the Vision and Image Processing (VIP) Lab at Waterloo. "It's all about augmenting their expertise to optimize the use of medical resources and individualize patient care."

Researchers have made the technology freely available so engineers and scientists around the world can work to help improve it. They are now incorporating it into a larger clinical decision support system, developed in their ongoing COVID-Net open-source initiative, that also helps doctors detect COVID and determine its severity using AI analysis of medical images.

https://www.news-medical.net

3D printed medical implant

Health Canada, the government arm that deals with national health, has approved its first Canadian-made 3D printed medical implant. The 3D printed device is a customizable mandibular (lower jaw) plate for use in facial reconstruction surgery, predominantly for patients with oral cancer. It can also be used in conjunction with surgical guides for cutting and drilling operations.

Named the Specifit 3D mandibular plate, the implant was developed by the 3D Anatomical Construction Laboratory (LARA 3D) in Quebec City. LARA 3D is a part of Investissement Québec (CRIQ), an organization providing product development services for new enterprises. The creation of the implant was also supported by the university hospital CHU de Québec-Université Laval, orthopedic screw manufacturer Alkom Digital, and metal powder firm AP&C (a GE Additive company).

For patients that have been diagnosed with oral cancer, the removal of a section of the lower jaw is sometimes a necessary procedure. In these cases, mandibular reconstruction surgery is often used to normalize the lower facial contour, regain architectural support, and improve the relationships between any affected teeth. The procedure can give patients greater functionality when it comes to both speaking and chewing, vastly improving their quality of life.

To enable mandibular reconstruction surgery, a mandibular plate is necessary. The device serves to align and stabilize the several pieces of bone that go into a reconstruction surgery, all while promoting healing and long-term bone fusion.

Bernier adds, "Not only will it improve patients' quality of life; but thanks to optimized, guided, and personalized surgery; it will also enable the development of a 3D medical equipment center of expertise at Centre de recherche du CHU de Québec – Université Laval. We are convinced the approval of this technology marks only the start of innovation, research, and development in 3D medical printing at LARA 3D."

https://3dprintingindustry.com

Robot autonomously performs needle-less vaccinations

It goes without saying that a *lot* of people are receiving the COVID-19 vaccine these days, and will continue to do so for some time. A new robot is designed to help streamline the process, by autonomously—and needle-lessly—vaccinating human patients. Known as Cobi, the device was developed by Canadian startup Cobionix, a University of Waterloo spinoff company. It's claimed to be the first robot to ever successfully perform an intramuscular injection, and it did so without using a hypodermic needle. The idea is that after pre-registering for a vaccination online, patients will show up at a clinic or other location that's utilizing a Cobi robot, then display a piece of identification to a camera on the unit's touchscreen interface. As they arrive, multiple 3D depth sensors detect their presence.

Once their ID has been verified, the Cobi robotic arm retrieves a vial of vaccine from a built-in storage area. A LiDAR sensor on the «hand» of that arm is then used to create a 3D digital map of the patient›s body, which is analyzed via AI-based software to determine the optimal injection site. Utilizing a third-party needle-less technology, the vaccine itself is subsequently injected in the form of a high-pressure jet of fluid that passes through a human-hair-width orifice. The company is unable to provide more details at this time.

https://newatlas.com

USA

AI-based healthcare tools for hospitals

Chipmaker NVIDIA announced the launch of FLARE (Federated Learning Application Runtime Environment), an open-source software platform offering a common computing foundation designed to improve collaboration on AI model development in healthcare. The Flare platform can integrate with existing AI initiatives, including the open-source MONAI framework for medical imaging, using a server-client technique, according to NVIDIA. With this setup, learned model parameters from each participant are sent to a common server and aggregated into a global model.

The Netherlands Cancer Institute (NKI) research and treatment centers currently uses NVIDIA's AI Enterprise software suite to test AI workloads on higher-precision 3D cancer scans than are commonly used today. The higher memory capacity afforded by AI Enterprise, allows researchers to use high-resolution images for training, which in turn helps clinicians better target the size and location of a tumor every time a patient receives treatment.

https://www.healthcarefinancenews.com

AI-powered computer model predicts disease progression

Using artificial intelligence, a team of UB researchers has developed a novel system that models the progression of chronic diseases as patients age. Published in October in the Journal of Pharmacokinetics and Pharmacodynamics, the model assesses metabolic and cardiovascular biomarkers—measurable biological processes such as cholesterol levels, body mass index, glucose, and blood pressure—to calculate health status and disease risks across a patient's lifespan. The findings are critical due to the increased risk of developing metabolic and cardiovascular diseases with aging, a process that has adverse effects on cellular, psychological, and behavioral processes.

"There is an unmet need for scalable approaches that can provide guidance for pharmaceutical care across the lifespan in the presence of aging and chronic comorbidities," says lead author Murali Ramanathan, professor of pharmaceutical sciences, School of Pharmacy and Pharmaceutical Sciences. "This knowledge gap may be potentially bridged by innovative disease-progression modeling." The model could facilitate the assessment of long-term chronic drug therapies, and help clinicians monitor treatment responses for conditions such as diabetes, high cholesterol, and high blood pressure, which become more frequent with age, says Ramanathan.

The research examined data from three case studies within the third National Health and Nutrition Examination Survey (NHANES) that assessed the metabolic and cardiovascular biomarkers of nearly 40,000 people in the United States. Biomarkers, which also include measurements such as temperature, body weight, and height, are used to diagnose, treat, and monitor overall health and numerous diseases. The researchers examined seven metabolic biomarkers: body mass index, waist-to-hip ratio, total cholesterol, high-density lipoprotein cholesterol, triglycerides, glucose, and glycohemoglobin. The cardiovascular biomarkers examined include systolic and diastolic blood pressure, pulse rate, and homocysteine.

By analyzing changes in metabolic and cardiovascular biomarkers, the model "learns" how aging affects these measurements. With machine learning, the system uses a memory of previous biomarker levels to predict future measurements, which ultimately reveal how metabolic and cardiovascular diseases progress over time.

http://www.buffalo.edu

Wireless networks allow brain circuits to be controlled remotely

A new study shows that researchers can remotely control the brain circuits of numerous animals simultaneously and independently through the internet. The scientists believe this newly developed technology can speed up brain research and various neuroscience studies to uncover basic brain functions as well as the underpinnings of various neuropsychiatric and neurological disorders.

A multidisciplinary team of researchers at KAIST, Washington University in St. Louis, and the University of Colorado, Boulder, created a wireless ecosystem with its own wireless implantable devices and Internet of Things (IoT) infrastructure to enable high-throughput neuroscience experiments over the internet. This innovative technology could enable scientists to manipulate the brains of animals from anywhere around the world. The study was published in the journal *Nature Biomedical Engineering* on November 25.

"This novel technology is highly versatile and adaptive. It can remotely control numerous neural implants and laboratory tools in real-time or in a scheduled way without direct human interactions," said Professor Jae-Woong Jeong of the School of Electrical Engineering at KAIST and a senior author of the study. "These wireless neural devices and equipment integrated with IoT technology have enormous potential for science and medicine."

The wireless ecosystem only requires a mini-computer that can be purchased for under $45, which connects to the internet and communicates with wireless multi-functional brain probes or other types of conventional laboratory equipment using IoT control modules. By optimally integrating the versatility and modular construction of both unique IoT hardware and software within a single ecosystem, this wireless technology offers new applications that have not been demonstrated before by a single stand-alone technology. This includes, but is not limited to minimalistic hardware, global remote access, selective and scheduled experiments, customizable automation, and high-throughput scalability.

"As long as researchers have internet access, they are able to trigger, customize, stop, validate, and store the outcomes of large experiments at any time and from anywhere in the world. They can remotely perform large-scale neuroscience experiments in animals deployed in multiple countries," said one of the lead authors, Dr. Raza Qazi, a researcher with KAIST and the University of Colorado, Boulder. "The low cost of this system allows it to be easily adopted and can further fuel innovation across many laboratories," Dr. Qazi added.

One of the significant advantages of this IoT neurotechnology is its ability to be mass deployed across the globe due to its minimalistic hardware, low setup cost, ease of use, and customizable versatility. Scientists across the world can quickly implement this technology within their existing laboratories with minimal budget concerns to achieve globally remote access, scalable experimental automation, or both, thus potentially reducing the time needed to unravel various neuroscientific challenges such as those associated with intractable neurological conditions.

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Harnessing Power of IoT for Healthcare

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Abstract

An increase in world population along with a significant aging portion is forcing rapid rises in healthcare costs. The healthcare system is going through a transformation in which continuous monitoring of inhabitants is possible even without hospitalization. The advancement of smart sensing, embedded systems, wireless communication technologies, nanomaterials, and miniaturization makes it possible to develop intelligent medical systems to monitor activities of human beings continuously. Internet of Things (IoT) enabled wearable and non-wearable sensors monitor physiological parameters and activities continuously along with detect other symptoms such as any abnormal and/or unforeseen situations which need immediate attention. Therefore, necessary help can be provided in times of dire need. The paper will review the latest reported systems, the trends on wearable cum medical devices and smart sensing to monitor activities of humans and issues to be addressed to tackle the challenges. IoT enabled smart devices can collect, analyze and send data across the web using this technology. It can connect both, digital such as heart monitor and non-digital devices like patient beds to the internet. Harnessing the power of IoT will transform the future of the healthcare industry by providing the world with smart digital solutions at the ease of comfort of the consumers. It's a very big market that was reported to had a worth of 22.5 billion USD in 2016 and it's expected to become USD 332.7 billion by 2027.

Introduction

Advancement of high performance materials, smart sensors cum sensing technology, high speed computing, next generation internet connectivity and of course the efforts of mankind to get connected with each other has made a tremendous success on the technological revolution of Internet of Things or IoT. A wide spread of IoT enabled devices and systems have penetrated in our day-to-day life. It is quite confusing and very easy to mix up with web-based information and information from IoT enabled system. IoT enabled system provides us real-time information of any "thing" which is connected to sensor for sensing its parameters of interest to greater community. The IoT market is keep on increasing as is seen in Figure 1 (https://www.statista.com) and this number will only grow as internet connectivity begins to become a standard feature for a great number of electronics devices. Many more devices will be connected to internet in future with proliferation of next generation internets such as 5G and 6G in the rural areas making it at par with urban internet connectivity. Figure 2 shows a few medical devices which are used to keep humans safe and healthy. Many of these devices are not connected to internet yet still the global market for IoT in healthcare sector is expected to reach US$332.7 billion in 2027, growing at a rate of 13.2% from 2020 (https://www.alliedmarketresearch.com). It is important to look into different aspects of IoT in healthcare sector, many issues it faced, challenges, advantages it provides. This paper will discuss on harnessing power of IoT in healthcare sector to make a connected healthcare system for community.

Significant amount of research activities on connected healthcare is currently undergoing and a lot of technical developments has been reported in public domain in the last two decades. A remote 2-D localization (range and angular information) and vital signs, breathing rate and heart rates monitoring of multiple subjects using a single-input and single-output (SISO) frequency modulated continuous wave (FMCW) radar architecture has been demonstrated (Marco et al., 2021).

An IoT-based non-invasive automated patient's discomfort monitoring/detection system has been presented and implemented, using a deep-learning-based algorithm (Imran et al., 2021). The system is based on an IoT enabled camera device; the body movement and posture of the patient are detected without using any wearable sensors. An IoT enabled wrist-worn prototype for ambient monitoring has been reported which measures toxic/hazardous gases, noise, UV, air temperature, humidity, and pressure (Mostafa et al., 2021). In the reported platform, bidirectional communication between the end user and medics has been established in real time via IoT gateway as an intermediate hub between the wearables and the IoT server. In Charn et al. (2020), a capacitive electromyography (CEMG) monitoring system has been reported for remote healthcare applications. A wireless sensing system to monitor and analyze cardiac condition has been designed and developed (Haoran et al., 2018; Elisa

et al., 2016) which sends the information to the caregiver as well as a medical practitioner with an application of the IoT. The reported cardiac auscultation monitoring system provides a way of self-managing of heart disease. Accidental falls are a major concern for the elder people; being the main cause for hospitalization and the second leading cause of unintended injury-related demises among the elder people in the world. A patient-specific fall prediction and detection prototype system utilizing a single tri-axial accelerometer attached to the patient's thigh to distinguish between activities of daily living (ADL) and fall events has been reported (Wala et al., 2019). Fall incidence will trigger an alarming notice to the concern healthcare providers via the Internet. Monitoring activities of human with wearable sensors has been in existence for a long time and is still undergoing. Using one accelerometer, it is possible to recognize daily life activities with higher accuracy based on global and local features and their integrated feature set for classifying countable and uncountable activities (Jianchao et al., 2020). Monitoring physical activities of human as well as early-stage diagnosis of a disease is important for better revival. Kidney function can be qualitatively as well as quantitatively checked by monitoring levels of creatinine in urine or serum samples. A low power IoT enabled microcontroller-associated diagnostic device has been designed and developed for the quantitative measuring of creatinine levels from serum (Sumedha et al., 2019, 2020, 2021; S. Prabhu et al., 2021).

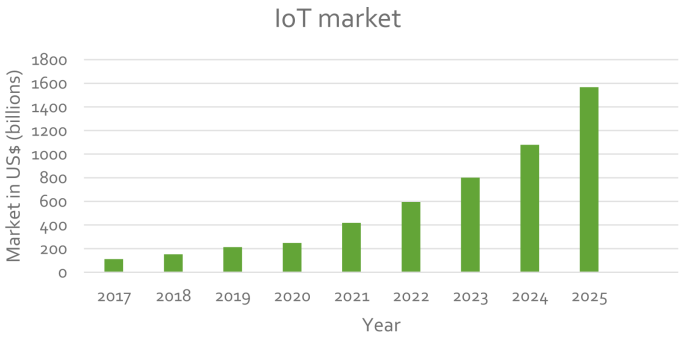


Figure 1: The forecasted market of IoT (https://www.statista.com)

IoT in healthcare—Current situation

In our life whether at home or at hospitals/clinics, we use different types of medical devices, starting from thermometer, blood pressure monitoring devices, diabetic testing kits to surgical instruments, artificial joints, MRI scanners and many more. The medical technology (medtech) industry designs and manufactures a wide range of products to keep us safe and healthy. Technology is allowing these medical devices to generate, collect, analyze and transmit data. With all data collected and appropriately used it is possible to have a connected infrastructure of healthcare systems and services. The IoT and its relationship to medtech is instrumental in helping healthcare organizations to achieve better patient outcomes, lower climbing

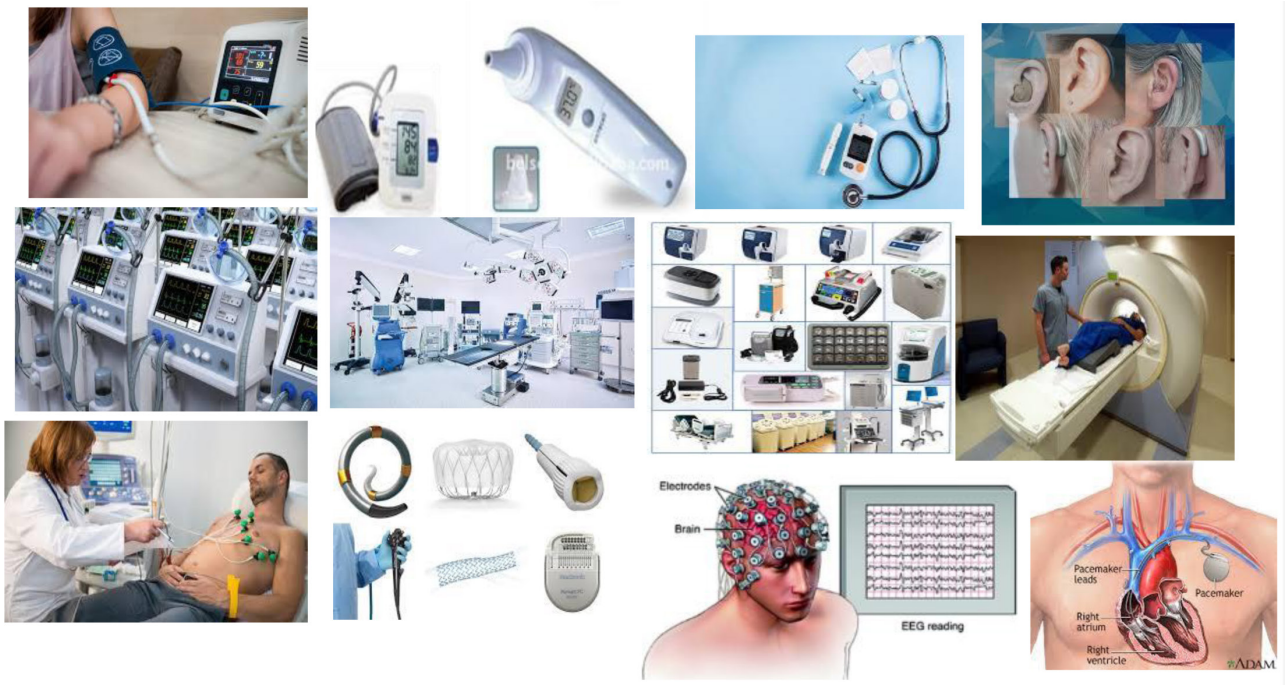


Figure 2: Medical devices keeping us safe and healthy

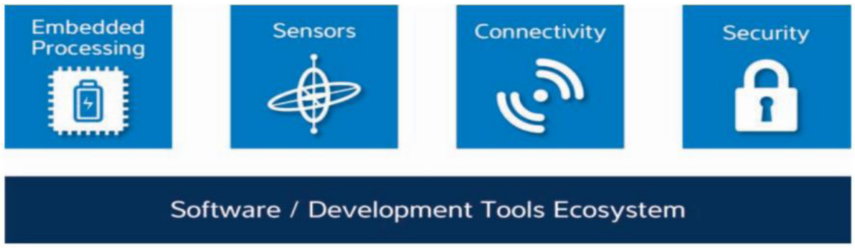


Figure 3: Basic building blocks of IoT enabled system

Figure 4: Wearable watch GARMIN FENIX 6X for monitoring health parameters

healthcare costs, improve efficiency and activate new ways of engaging and empowering patients (https://www.alliedmarketresearch.com). The Figure 3 shows the basic building blocks of any IoT enabled system which can be very well applicable for connected healthcare system. For healthcare applications, the sensors will be medical devices which measure physiological parameters as well point-of-care (POC) devices. Currently internet connectivity is usually not available with many medical devices but with time, the feature of data sharing among different devices as well as data upload in cloud for future use will be slowly included. Security will play a significant role for that to happen. Data need to be securely transmitted without any kind of breach and foul play.

Different products are now available in the market and they come in different forms of ornaments. The most common one is wearable wrist watch, one of them is shown in Figure 4. The product is GARMIN FENIX 6X problack, with current price is AUD1249.00 with a warranty period of 1 year. There are different other models available from many manufacturers. The watch provides heart rate and blood oxygen. It has both Bluetooth and WiFi connectivity. The battery life as specified is 15 to 60 hours. The electronic products consume a significant amount of power if it transmits data wirelessly very frequently. This means the watch needs to be charged almost every day depending on the rate of data transmission. The frequent charging is a major issue as people may forget as well as wearing it continuously on wrist may not be acceptable or comfortable to many people.

There are many companies involved on design and development of healthcare devices. A few of them are Biotronik, General Electric Company (GE Healthcare), Boston Scientific Corporation, Medtronic, Johnson and Johnson Services, Inc., Cisco Systems, Inc., Welch Allyn, IBM Corporation, Siemens Healthcare GmbH, Koninklijke Philips N.V. and others. Most of the current devices are not having full internet connectivity.

In terms of applications of healthcare devices whether IoT enabled or not, hospitals are the largest users of healthcare devices. They are being used for improving healthcare quality while reducing time and cost. Various applications involving healthcare devices in hospitals and clinics involve patient monitoring, X-ray machines, CT scans, and smart apps used to connect patients and doctors. The next large varieties of application of healthcare devices are In-Home Telemedicine, i.e., the devices allowing healthcare services to reach beyond the hospitals and expands their applications. The healthcare devices used On-the-Body will be a significant percentage of the total connected devices now. Smart sensors are now possible to design and build as wearable medical devices which can monitor different health parameters of subject (Muhammad et al., 2021). They can be embedded in apparel, attached to the skin, or can even be implanted under the skin providing full freedom to patients while keeping a watch on their health. The last category of application of healthcare devices are in remote areas. In cases when patients are far away from the physicians, healthcare solutions can be used as a medium to connect them with each other. It not only adds comfort to the healthcare process but also reduces the cost. It will take a significant time to that happen when all medical devices will have internet connectivity and will upload data automatically to cloud. Privacy and security is and will be a strong deterring factor against the high speed proliferation of IoT devices in society in healthcare domain. With time as the society will be more open there will be more complex situations prevail in terms of privacy and security.

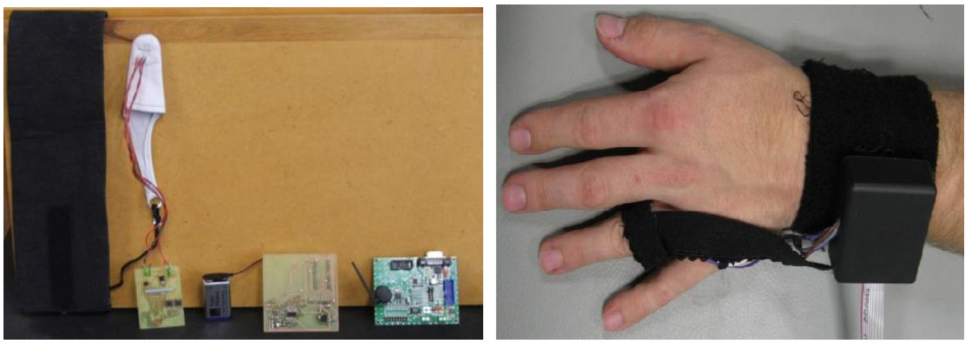
IoT enabled sensors for healthcare

Research on healthcare related activities to design and develop different sensing devices for monitoring physiological parameters as well different human activities started more than a decade ago by our group. The first developed

prototype system was monitoring elderly people living alone at home, especially to detect fall as shown in Figure 5a (G. Sen Gupta et al., 2007; Mukhopadhyay and Sen Gupta, 2007). The developed wearable system need to be worn 24×7 by the monitored person especially by the elderly for detecting any fall of the subject. In the event of any fall, the system will transmit a massage to the caregiver who can be a very close relatives or company representative. The required help will arrive without any significant delay so the person can be taken to hospital or provided necessary treatment. Though many research papers were reported on monitoring the person by remote system, it is not practical. The system has been extended to monitor physiological parameters such as body temperature, heart rate and body conductance to monitor well-beings as shown in Figure 5b of the person (K. Kaur et al., 2012) and end extensive review was done on wearable sensors (S. C. Mukhopadhyay, 2015; A. Nag et al., 2018). The system has been further extended to determine the Fluid Loss Measurement System using a Smart Non-Invasive way (N. K. Suryadevara et al., 2015). Research on wearable devices or simply wearable is a vibrant area of research and the wearables come in different form and sizes with more complexity.

Our early work on wearable device has been extended to monitoring emotion of a person using physiological parameters. With limited training data it was possible to achieve a success rate of 86% with four simple emotions, Angry, Happy, Sad and Neutral using classification technique as shown in Figure 6 (M. T. Quazi et al., 2012; M. T. Quazi and S. C. Mukhopadhyay, 2011). The system is especially useful for elderly under monitoring as the warning message to the caregiver will be decided by the smart system.

It has been realized that wellness of a person can be understood more deeply if the combination of wearable and non-wearable sensors is used at home to monitor the activities of the person. The system will allow to monitor the subject without using any wearable sensors while the person is staying at home but doing all normal day-to-day activities. The concept of smart homes comes into action. A smart home is sensors and technology assisted home for better living which provides a safe, sound and secured living environment for any person especially any individual lives alone at home as shown in Figure 7a. All sensors are wireless sensor, communicating the measured sensor data using wireless transceivers such as Zigbee (A. Gaddam et al., 2011; N. K. Suryadevara and S. C. Mukhopadhyay, 2012). The system may use either WiFi or LoRa or any other wireless communicating protocols.



(a) Worn on finger (b) worn on wrist

Figure 5: Early developed wearable device for physiological monitoring

Figure 6: Human emotion recognition system

Using the concept of IoT and WSN based home monitoring system, smart home can be developed which will convert any old home to a smart home. The number of sensors and their types mostly of similar types for all subjects except a few special sensors will depend on individual's habit of lifestyle. Figure 7b shows the placement of sensors for a typical 2-bed room house. The sensors in the house consists electrical sensors for monitoring usage of any electrical appliances, forces sensors for monitoring bed, sofa, chairs, toilet, environmental sensor, contact sensor and Passive Infra-Red sensors (PIR) for monitoring movement as shown in Figure 7c. All sensors are continuously powered ON and are activated when any event takes place and transmit the data to the gateway which has been configured around a laptop (N. K. Suryadevara et al., 2012a, 2012b).

Data processing is extremely important to extract the real meaning from the measured data by the sensors for any system. An integrated intelligent system relies heavily not only on the accuracy of the measured data but also on the adaptive cum intelligent data processing. For smart home applications, different types of intelligent algorithms have been developed as shown in Figure 8. The big picture is to determine the wellness of the subject under monitoring which represent a quantitative method of healthy condition of the monitored person. The raw sensor data provides the status of the sensors which are connected to different appliances. The first task is to collect and store sensors data at near real time and then annotate them. From the active states of the sensor, the activity of the person is determined. This involves some probabilistic approach as well as matching of pattern of sequence of active status of sensors (N. K. Suryadevara et al., 2013; N. K. Suryadevara and S. C. Mukhopadhyay, 2014). Based on the collected data for previous weeks (8 weeks in our project), the future behavior of the monitored person can be forecasted as shown in Figure 9.

We develop sensors both on MEMS (Micro Electro Mechanical Systems) as well as flexible materials-based technology. Interdigital sensors of novel configura-

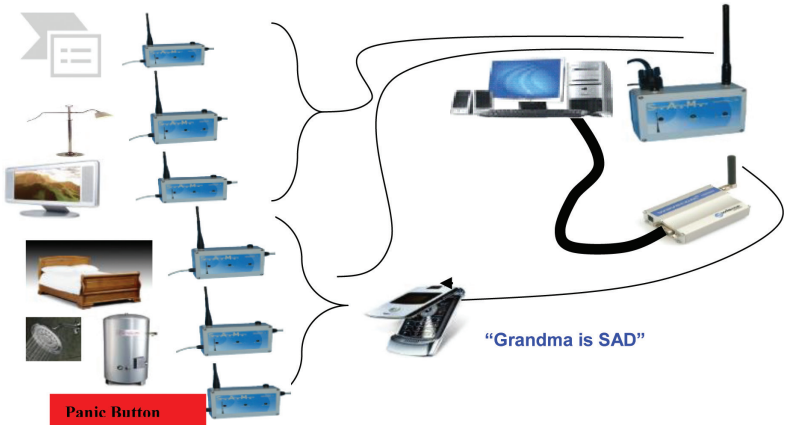


Figure 7a: Concept of smart home: sensors and technology assisted home for better living

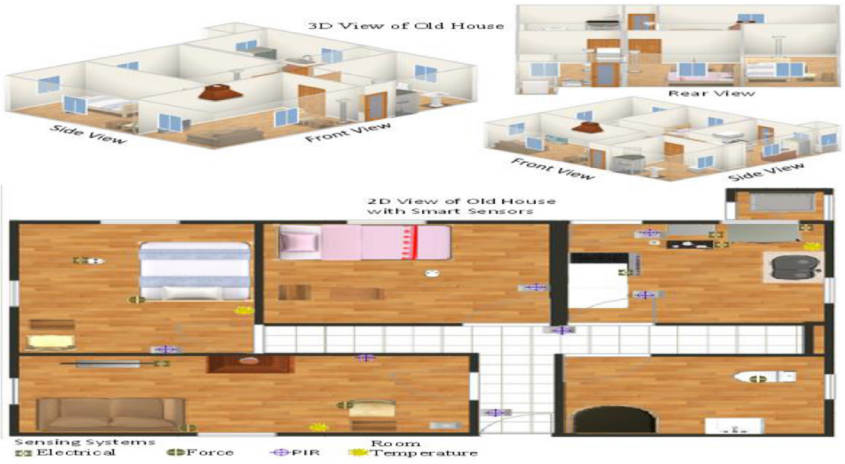


Figure 7b: Placement of sensors in an old home to convert it to a technology assisted home

Figure 7c: Sensors used for monitoring different appliances in a smart home

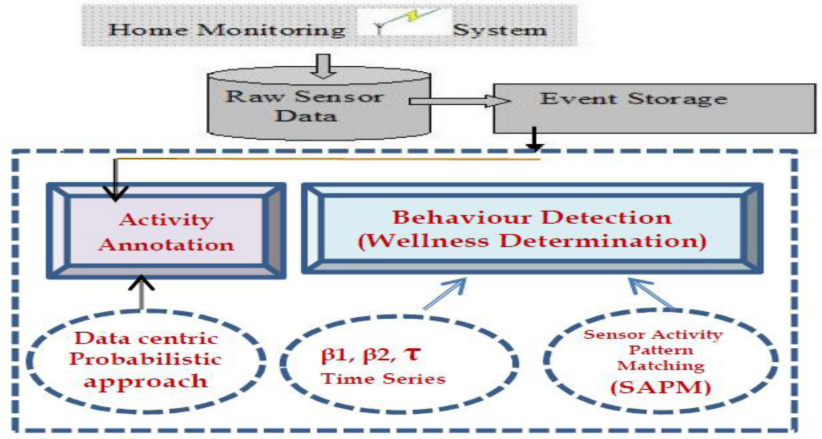


Figure 8: Intelligent data processing for smart home system

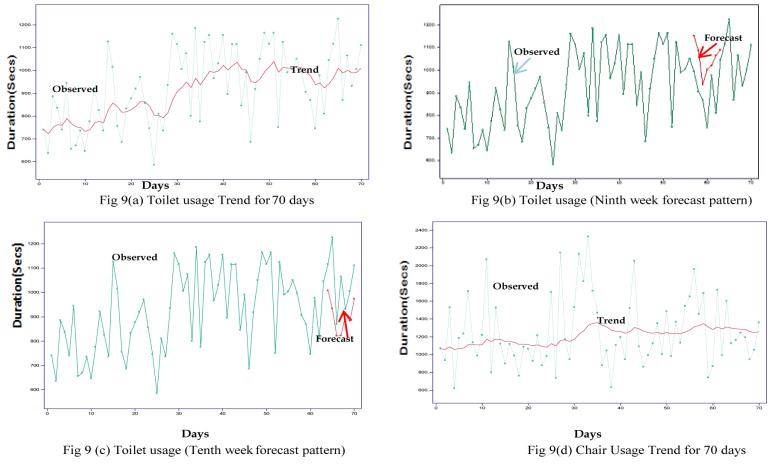


Fig 9(a) Toilet usage Trend for 70 days

Fig 9(b) Toilet usage (Ninth week forecast pattern)

Fig 9 (c) Toilet usage (Tenth week forecast pattern)

Fig 9(d) Chair Usage Trend for 70 days

Figure 9: Data analysis and forecasting of results

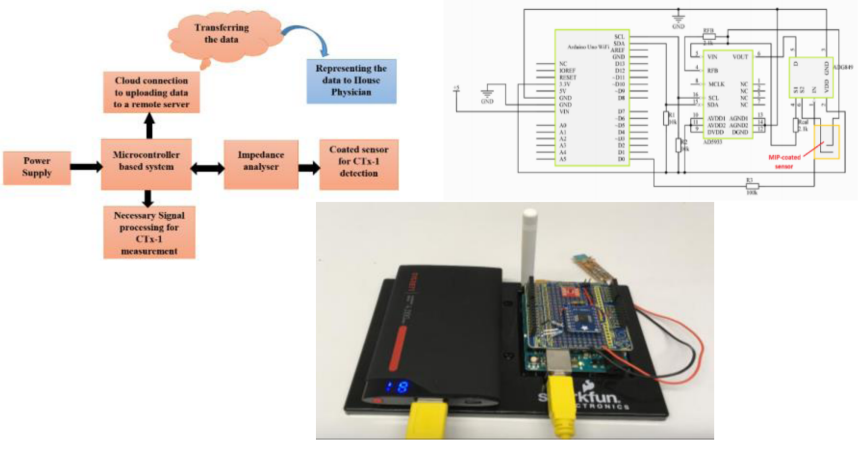


Figure 10: IoT enabled point of care device for early detection of osteoporosis

tions has been designed and fabricated for higher sensitivity. Molecular imprinted techniques based coating materials have been developed to introduce selectivity.

IoT enabled point of care devices have been developed for early detection of osteoporosis as shown in Figure 10 (Nasrin et al., 2018a, 2018b). The current system is based on blood sample with the C-terminal telo-peptide type I collagen (CTX-I). Research is currently undergoing to develop robust sensor which can detect CTX-I from urine and the sensor can be installed at the toilet to covert the toilet to a smart toilet as shown in Figure 11 (Nasrin et al., 2018c, 2018d).

Significant researches have been conducted which indirectly help to keep our health safe and sound. The sensor for evaluation of amount of fat content in meat has been reported (S. C. Mukhopadhyay and C. P. Gooneratne, 2007). The effect of biotoxin in seafood can be dangerous for human health and a sensing system has been designed and developed (A. R. Mohd Syaifudin et al., 2009; Mohd Syaifudin Abdul Rahman et al., 2011), detection of phthalate from plastic bottles (Asif et al., 2013, 2015) and detection of LPG gas to avoid explosion in kitchen (Nag et al., 2016a, 2016b) and detection of nitrate in contaminated water (Md. Eshrat et al., 2017, 2018a, 2018b).

Opportunities and challenges of IoT for healthcare

The IoT enabled healthcare systems provide an enormous opportunity to individual, family and society. It is not only able to monitor the current health condition or future heath situation but also the technology can be used for many other situations. The whole world is now at the hands of coronavirus pandemic (COVID-19) and we are extremely fortunate that the developed vaccine is effective against the COVID-19 virus. Significant researches have been taken place to develop different wearable system to address the challenges posed by COVID-19. An autonomous hand hygiene tracking combining different IoT technologies, which can be applied in healthcare environments to monitor hand hygiene activities and better prevent hospital associated infection has been designed and developed (Fan et al., 2021). The system can record hand-washing activities and provide prompt feedback if the hand-washing is not performed as required using wearable devices and smart dispensers. A smartphone based app has been

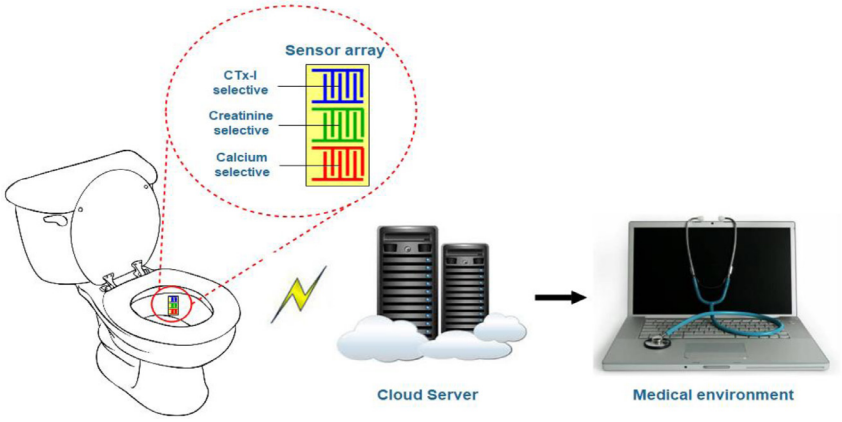


Figure 11: Smart toilet for future

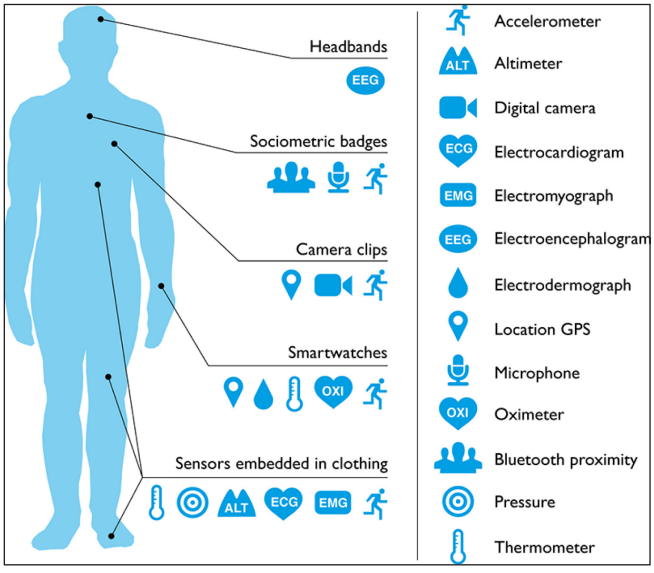


Figure 12: Different wearables on human body

developed which collects smartwatch data and activity tracker data along with self-reported symptoms and diagnostic testing results. Analyzing the personal data collected over time it is possible to identify subtle changes indicating an infection, such as patients with COVID-19 (G. Quer et al., 2020). The paper (Itamir et al., 2021) aims to extend the platform by integrating wearable and unobtrusive sensors to monitor patients with coronavirus disease. Furthermore, the researcher has reported a real deployment in an intensive care unit for COVID-19 patients in Brazil. When a huge amount of data is involved, machine learning will play an important role to analyze the healthcare data as well for prediction any future possibility (Hemantha et al., 2021). In future there will be varieties of wearable used for monitoring human activities as shown in Figure 12 which will provide a great deal of opportunities (Jeong-Hyeon Bae and Hyun-Kyung Lee, 2018).

In terms of the architecture of the connected healthcare system, the most important thing after the collection of data is to store them safely. The proposed architecture is shown in Figure 13. Different sensors will measure different parameters indicating status of human condition and will be collected by doctors, nurses, caregivers and other people. The common point of data collection will be the cloud and all devices need to be IoT enabled to make it happen.

Till the time the cloud for connected healthcare data is made possible, it is heartening to note that individual can upload their activities through various Apps. One of such Apps is Health app available in smart phones. The activities such as walking cum running for the month of September for myself is shown in Figure 14. The apps can accept many parameters though some of them are to be entered manually. If all activities of an individual are noted with time of the day as baseline, it will be possible to know wellness of the subject.

There are many challenges impacting widespread usage of IoT in healthcare applications. There is a need of change of funding, business and operating models. Innovation will require different business models, and progress will depend on both the innovators themselves working in new ways to take on risks and rewards. The next issue is the interoperability to work effectively, the direction of development should be towards open platforms, based on open data standards. This will enable researchers, providers and technology vendors to come together to make data more available to each another. The next item is cyber security—the increasing numbers and capability of connected healthcare devices present additional risks for data security. The scale and cost of breaches is often significant and far reaching. Though not a big challenge but the society and government also need to think of digital talent and building digital capability—there is increasing concern among key stakeholders that a growing skills gap will delay the deployment of IoT enabled healthcare solutions and constrain market growth. We also need to think of maintaining trust in a digital age—as medtech companies develop strategies and services based on the generation and transmission of patient data, they need to ensure they demonstrate clearly to patients, the public and healthcare professionals how their data is being used to reduce the risk of undermining the benefits that access to data can bring. The

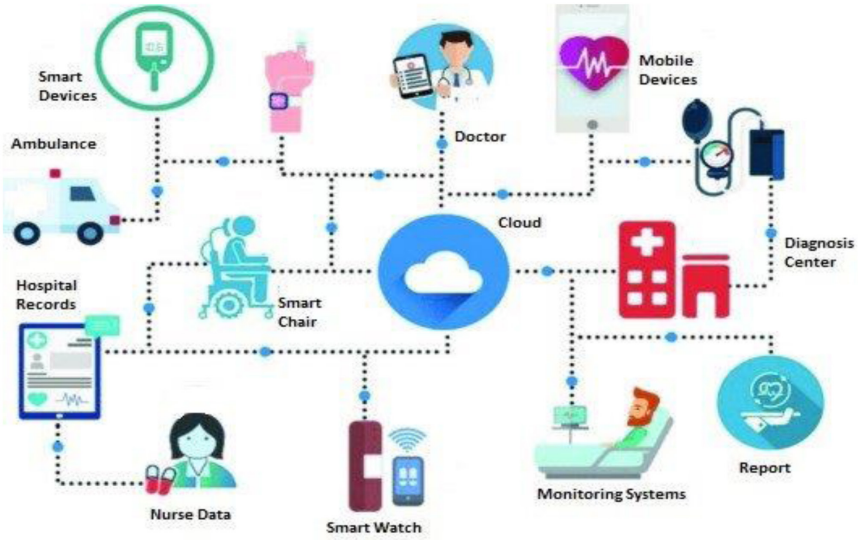


Figure 13: Architecture of connected healthcare system

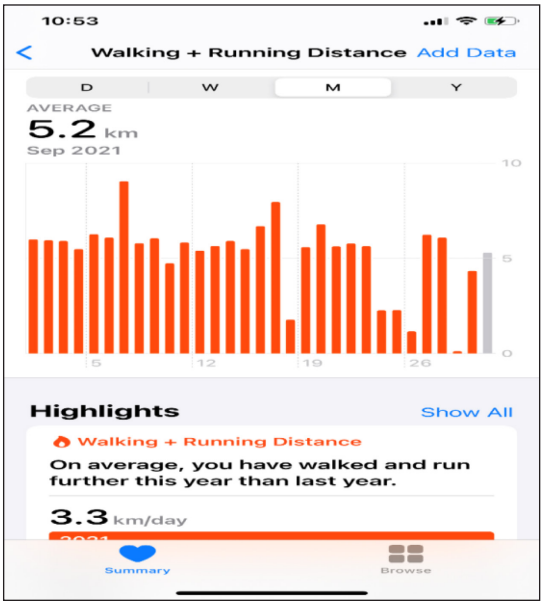


Figure 14: Collection and storage of activity data through health apps

last one is scale—a challenge for medtech companies is to ensure that healthcare organizations, clinicians and patients understand the added-value of connected medical devices and use them at scale to drive better economics and patient outcomes. Affordability of smart phone by everyone may not be financially possible so it will hinder the prospects of using it. The biggest challenge humanity is facing and will continue to face against the harnessing of full power of IoT and its widespread usage in society is the security, trust and privacy issue. Though a significant amount of research activities has taken place and continue to do so to make cyber system, wireless communication fully secured (Guanglou et al., 2018, 2019), there are many incidents happened around us. Many new ways will be developed by dishonest people to cheat common people and the society will pay price for that. The design of security in an IoT system must follow a systematic approach and should be very robust against any intrusion (S. Pal et al., 2020). Along with design and implementation of robust security system, it is more important to make aware of common citizens of the country different ways to the technologies are misused by bad people and consequences it brings. It is extremely important to know for every citizen that private information such as bank account, birth day etc. should not be shared with anyone over phone. If any fake emails or text messages come from someone who is unknown, they must be ignored. Overall, to have the real harness of power of internet connectivity and IoT, there is a need of more community engagement.

Conclusions

A connected healthcare system will offer many advantages for any individual as well as for the whole community and it is only possible to make it happen if the full potential of IoT for health sector is properly harnessed. Researchers throughout the world are developing varieties of medical devices for keeping us safe and healthy but a concerted effort is required to make it happen to extract all advantages and positive power of IoT for the humanity. The effort towards making an open platform for IoT and its availability to everyone will further enhance the pace of development. Though the biggest challenge any individual and society is facing is the issue of privacy and security, there will be some way of avoiding those issues to a certain extent. The on-going research on cyber-security will definitely make the IoT a much stronger and secured for future applications.

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COVID-19 Technology Access Pool

In May 2020, the World Health Organization (WHO) and partners launched the COVID-19 Technology Access Pool (C-TAP) to facilitate timely, equitable and affordable access of COVID-19 health products by boosting their supply. C-TAP was launched in partnership with the Government of Costa Rica, under a global Solidarity Call to Action endorsed by nearly 40 Member States. WHO C-TAP implementing partners include the Medicines Patent Pool, Open COVID Pledge, UN Technology Bank and Unitaid. Developers of COVID-19 health technologies and holders of related knowledge, intellectual property and data are invited to "share their intellectual property, knowledge and data, and join the Solidarity Call to Action."

The C-TAP provides a platform for developers of COVID-19 therapeutics, diagnostics, vaccines and other health products to voluntarily share their intellectual property, knowledge, and data, with multiple quality-assured manufacturers through public health-driven voluntary, non-exclusive and transparent licenses. This enables manufacturers that currently have untapped capacity to produce COVID-19 health products by giving them the legal rights to manufacture and sell the products; the technological know-how required to develop high-quality products effectively and efficiently; and access to clinical data needed to obtain regulatory approval for their products.

By sharing intellectual property and know-how through the pooling and these voluntary agreements, developers of COVID-19 health products can facilitate scale up production through multiple manufacturers that currently have untapped capacity to scale up production.

Developers of COVID-19 health technologies and holders of related knowledge, intellectual property and/or data are invited to voluntarily share with C-TAP by joining the Solidarity Call to Action. C-TAP works through its implementing partners to facilitate timely, equitable and affordable access to COVID-19 health technologies.

For more information, access:

Email: CallToAction@who.int

https://www.who.int/initiatives/covid-19-technology-access-pool

The Equity Agenda in Fourth Industrial Revolution Healthcare Technology

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Abstract

While the COVID-19 pandemic has amplified existing inequities, it has also spurred innovation and use of Fourth Industrial Revolution (4IR) technologies that have the potential to transform our healthcare systems. To ensure that immunization systems can reach those most in need Gavi, the Vaccine Alliance is actively supporting countries in using 4IR technologies, leveraging trends in big data analytics, robotics, the Internet of Things (IoT) and beyond. But unless these technologies are designed with equity and social justice at their core, we risk a healthcare revolution that leaves behind individuals and communities already facing multiple deprivations.

Introduction

The COVID-19 pandemic has amplified existing inequities, putting vulnerable populations, especially women, children, and adolescents, at risk of being left even further behind. However, it has also spurred innovation and use of Fourth Industrial Revolution (4IR) technologies that have the potential to transform our healthcare systems. From artificial intelligence and blockchain, to drones and the Internet of Things (IoT), these technologies have the power to change lives. But unless these technologies, and their use, are designed with equity and social justice at their core, we risk a healthcare revolution that reinforces existing inequities and leaves behind individuals and communities already facing multiple deprivations.

In 2019, nearly half of the world's population remained offline—with the majority living in the Least Developed Countries, where an average of just two out of every ten people are online. In lower-income countries, men are more likely to use the internet, and many fewer women own mobile phones to access the internet. Women in these countries may also lack access to even the most basic services such as antenatal care, skilled birth attendance, and contraception, putting their survival and health at risk. Also, women comprise nearly 70% of the global health and care workforce, although often they do not hold decision-making positions. Therefore, digital healthcare solutions must put equity and gender at their center, otherwise they will not only fail to reach their full potential, but also may exacerbate inequities and squander public trust.

Leveraging 4IR technologies for immunization

Case studies from the work of Gavi, the Vaccine Alliance demonstrate the power of harnessing 4IR technologies to improve the coverage and equity of immunization services. As a public–private partnership, innovation is part of Gavi's DNA. From refrigerators powered by renewable solar energy, to an app that reminds parents of their child's next jab, to drones that deliver vaccines and other medical supplies to remote areas, innovation is the way in which Gavi has adapted over the past two decades to help immunize nearly 900 million children in 73 lower-income countries, saving over 15 million lives. However, more than 12 million children in the 57 Gavi-supported countries are "zero-dose," meaning they do not receive even a single vaccine shot. By simplifying logistics, increasing safety, and facilitating outreach, innovative approaches can help address barriers to immunization, and extend vaccine access to reach zero-dose children, who, despite being only 10% of children born in Gavi-supported countries, account for nearly half of vaccine-preventable deaths.

Gavi has a long history of bringing together the public and private sectors to create solutions that can be scaled up and replicated in other countries and, importantly, tailored to the local context. In 2016, Gavi supported start-up Zipline to establish a groundbreaking drone delivery network in Rwanda—the world's first national drone delivery service. Using cutting-edge 4IR technologies to bridge the rural-urban divide means that communities in remote locations, who may lack transportation, communication, or supply chain infrastructure, now have access to emergency medical supplies. The Zipline network, which was then replicated in Ghana in 2018, delivers vaccines, as well as essential medicines and blood. As COVID-19 infections began to rise, Zipline quickly adapted to also deliver personal protective equipment (PPE) to healthcare workers, as well as COVID-19 test samples. Today, Zipline is delivering COVID-19 vaccines to health facilities in Ghana and, starting next year, in Nigeria—demonstrating the scale and potential of this technology for last-mile delivery.

In 2019, Gavi brought together the financial resources of Tencent and the capabilities of Zenysis Technologies, Inc. to create a digital health platform that uses advanced machine learning to solve data fragmentation challenges and strengthen

governments' existing health information systems to reach more children with life-saving vaccines. This technology was then leveraged to support lower-income countries' COVID-19 response by establishing virtual data control rooms to provide decision-makers with real-time analytics on test results, as well as stocks of diagnostic kits, PPE, and ventilators—to ensure additional support is focused where it is most needed.

4IR technologies provide the tools to address some of the most fundamental challenges to ensuring equitable access to healthcare. It is estimated that 1 in 4 children under the age of 5 do not officially exist because their births have never been officially recorded. If these children don't officially exist, how can we reach them with the life-saving immunization and essential health services they need to survive and thrive?

Gavi is working with technology company Arm and biometrics nonprofit Simprints to develop an affordable, contactless digital identification solution. By creating a unique ID for each individual, health workers can identify patients accurately, and quickly create or access their health records. Biometric data is collected securely using the health worker's smartphone, with timestamps and GPS coordinates to record the treatment time and location. This solution was designed to be inclusive, ensuring it works for diverse populations, and ethical, with solid privacy protocols and patient protection at its core. Through this groundbreaking programme, this fall, Ghana became the first country to deploy contactless biometrics in a nationwide immunization campaign. This is a major milestone—not only in the ability to reach children with immunization, but also in bringing them into contact with the health system to access other essential health services.

Gavi is actively supporting countries in using 4IR technologies to ensure that immunization systems can reach those most in need. Ultimately, these technologies are tools that must be employed within a clear equity framework to ensure they don't further deepen existing inequities. If used responsibly, these technologies could bridge current equity gaps—and safeguard the healthy future every child, everywhere, deserves.

Introduction to the case study: a 4IR technology is changing the way India does healthcare

That India has delivered more than one billion COVID-19 inoculations at such a rapid pace is inspirational, particularly for lower-income countries. It's also a great case study on how to quickly activate health system capacities to vaccinate at scale. One of the most important takeaways from India's experience is the exemplary use of digital innovations, and the ability to continuously adapt in a crisis setting.

Leveraging IoT trends, India's Electronic Vaccine Intelligence Network (eVIN) provides a real-time track-and-trace system to monitor the movement and storage of vaccines. eVIN fields data from thousands of points—including from remote temperature monitoring devices—and enables big data analysis to inform decisions on vaccine stock management, ensuring investments can be maximized and wastage reduced.

When the pandemic hit, eVIN spurred the development of CoWIN, the COVID Vaccine Intelligence Network, which has been highly instrumental in ramping up COVID-19 vaccination efforts in a large country like India, in an effective and transparent manner. CoWIN is a brilliant example of digital innovation that has helped India organize its vaccination efforts in a remarkable way, enabling easy registration of people to be vaccinated, effective vaccine tracking, and vaccine management, otherwise not possible through manual efforts.

The case study presented in the next article of this issue (i.e., Asia-Pacific Tech Monitor, vol. 38, no. 4, Oct-Dec 2021) highlighting the use of CoWIN during the pandemic, excerpted from a report supported by the Bill & Melinda Gates Foundation, Gavi, the Vaccine Alliance and the World Health Organization (WHO), illustrates how 4IR technologies can be leveraged very quickly—at low cost, but to great effect. Gavi is very proud to have funded and supported the development of CoWIN.

Certain solutions like CoWIN have proved so compelling that they will outlast the pandemic. CoWIN can be repurposed for routine immunization services and other healthcare programmes. For instance, in tuberculosis programmes, there has been a persistent challenge of tracking patients who switched to private healthcare services and discontinued their treatment. That can be solved with a shared database on platforms like CoWIN, enabling effective exchange of information between public and private sector providers, and proving extremely helpful in addressing diseases that cause deaths, morbidity, and medical impoverishment.

The success of CoWIN demonstrates how the large-scale use of technology in vaccination programmes can be a game-changer, enabling high reach, a great deal of transparency and real-time data to inform decisions and ensuring effective prioritization of those populations who are highly vulnerable and most in need of life-saving vaccines.

Investigating the Use of Digital Solutions in the COVID-19 Pandemic

An Exploratory Case Study of eIR and eLMIS in India

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This case study is part of a comprehensive evaluation of electronic Immunization Registries (eIR) and electronic Logistics Management Information Systems (eLMIS) in Guinea, Honduras, India, Rwanda, and Tanzania commissioned by the Bill & Melinda Gates Foundation (BMGF), with the support of Gavi, the Vaccine Alliance (Gavi) and the World Health Organization (WHO).

Abstract

Drawing upon primary and secondary sources, this case study showcases the quick adaptation of India's existing eLMIS (eVIN) to accommodate the COVID-19 vaccine roll-out needs, as well as the development of an electronic registration system (CoWIN) to effectively register priority groups, schedule appointments, generate vaccination certificates, and monitor adverse events following immunization (AEFI). While it is premature to draw firm conclusions, the findings in this case study demonstrate that context-specific digital solutions can be flexibly leveraged to support COVID-19 vaccination and maintain routine immunization during a pandemic, provided that investments backed by strong political commitment are made in digital infrastructure and in training the health workforce to overcome equity gaps through the use of the systems.

Background

India was severely hit by the COVID-19 pandemic, with the second wave starting in March 2021 causing record numbers of new infections and deaths, peaking at a rate of approximately 400,000 cases and 4,000 deaths, respectively, every day during May 2021 (WHO, 2021). According to experts, this high COVID-19 toll was attributable to the timing of easing restrictions from the first wave, localized waves in epicenters, such as the cities of Delhi and Maharashtra, mass gatherings for political rallies and religious celebrations, as well as public claims that the pandemic had been beaten (Thiagarajan, 2021a), coupled with the emergence of the delta variant of SARS CoV-2 that was more transmissible than the ancestral virus. The delta variant has since become the predominant variant circulating. The second wave hit India during the initial COVID-19 vaccine roll-out and lead to straining of healthcare resources allocated for the management and treatment of infections as well as for vaccination, resulting in medical supply shortages and slow vaccination rates (Pandey et al., 2021).

With its longstanding experience in running the Universal Immunization Programme (UIP), which targets 26.7 million newborns and 29 million pregnant women every year, India conducts the world's largest routine vaccination programme. Given the size of the target population, the COVID-19 vaccination effort was also one of the largest in the world. Starting on 16 January 2021, 6 million people were vaccinated in the first 24 days with the Covishield™ (AstraZeneca) vaccine (Bagcchi, 2021). In the vaccination response against COVID-19, the responsibility for the delivery of vaccination has been delegated to the respective state governments. The first vaccination phase aimed to reach 300 million beneficiaries by August 2021, starting with healthcare and other frontline workers. It was initially slower than expected, with the country facing vaccine shortages (Pandey et al., 2021). India has since achieved delivery of more than one billion doses as of October 2021 ramping-up vaccinations in more than 61,000 centers, both public and private (BBC, 2021).

Description of digital solutions

Predating the pandemic, India had been using the electronic Vaccine Intelligence Network (eVIN) since 2015, an eLMIS, using a licensed software deployed under overall leadership of the government and with the financial and technical support of Gavi, the Vaccine Alliance and the United Nations Development Programme (UNDP). eVIN was migrated to a locally developed open-source platform in 2020. The system has been scaled nationally in all public health facilities and oversees the logistics of India's Ministry of Health and Family Welfare's (MOHFW) UIP and is now fully managed and funded by the government (Pant, 2021). As a mobile application, it allows for the digitized management of vaccine inventories by cold chain handlers directly from their smartphones, providing real-time information on vaccine stocks and flows, and monitors the storage temperature in those cold chain points where it is implemented. eVIN was leveraged when introducing the COVID-19 vaccines, a decision driven by the system's scale and demonstrated ef-

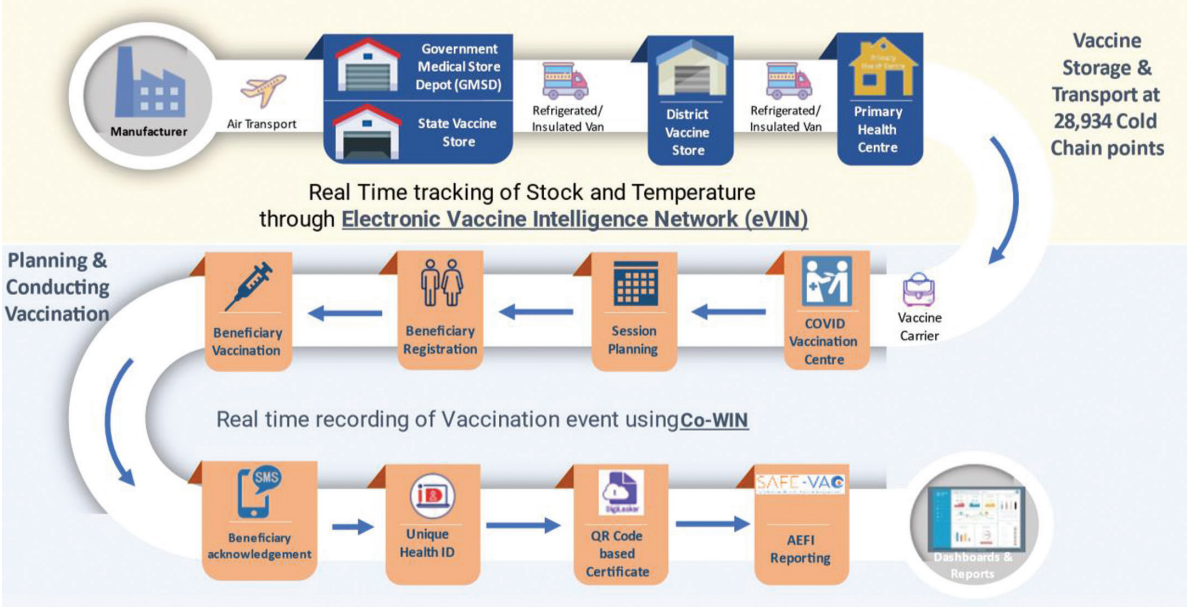

Figure 1: COVID-19 vaccine delivery management system (Pant, 2021)

fectiveness, with eVIN being operational in all of India's 29,500+ cold chain points today. It ensures >99% availability of routine immunization vaccines compared to <85% before its implementation and has lowered stock-out frequency by 80% (UNDP, n.d.). Notably, eVIN did not have to go through an adaptation process to accommodate the management of the COVID-19 vaccines (Pant, 2021).

On the other hand, India had to develop *de novo* the COVID-19 Vaccine Intelligence Network (CoWIN) to complement the eVIN. CoWIN is a cloud-based digitized platform launched in January 2021 as an open-architecture software (Pant, 2021). It facilitates beneficiary registration, scheduling appointments, and session planning. The complementarity of the two systems is depicted below in Figure 1. The primary aim of CoWIN is to enable registration of all beneficiaries while ensuring full transparency in vaccination administration (Court, 2021). In July 2021, the system was made available as open-source to allow for its adoption as a global "digital public good" (Ang, 2021).

CoWIN has several key features besides vaccination appointment scheduling, and registration of vaccination events such as enabling reminders, AEFI reporting, monitoring and analytics and digital certificate generation (Ang, 2021). The latter is a functionality provided by the software Digital Infrastructure for Verifiable Open Credentialing (DIVOC) which has been integrated into CoWIN (DIVOC, 2021). This platform was designed to enable the tracking of over a billion individuals and, to date, is operating across all states in India in over 327,000 public and private vaccination centers. Individuals can register online on the CoWIN website or via the mobile application with their national identification number to select a location and schedule a vaccination appointment. Alternatively, individuals can physically visit one of the vaccination centers where a health worker will assist them with the registration.

India and its development partners have invested significantly in these digital solutions. The roll-out of eVIN platform, including its transition over 6 years from the licensed software to an open-sourced one, cost approximately US$ 65m over a period of 6 years. Of the total cost, the largest component was accounted for by human resources followed by procurement of hardware such as mobile phones and temperature loggers, trainings and communication, with 5.5% accounted for by software development (Pant, 2021). India has received financial assistance for the COVID-19 response and vaccine roll-out, namely from UNDP with US$ 4.6m, UNICEF with US$ 6.6m, and the WHO with US$ 10m (Court, 2021). In addition, Gavi provided a technical assistance grant of US$ 4.6m for CoWIN to support additional functionalities and infrastructure that needed to be embedded in the eVIN system (Court, 2021). The design and implementation process of CoWIN lasted 12 months and incurred US$ 10m in costs for software development, hosting infrastructure (i.e., cloud-based servers) and backend support/helpdesk for citizens. Due to the nature of the services provided, as the client database grew, the hosting infrastructure requirements also grew, primarily due to the storage of data in the cloud driving up costs (Pant, 2021). The assessment of operational costs for related human resources, including trainings and other activities in the field will be part of a forthcoming more comprehensive evaluation of eVIN.

Overall, these digital solutions are providing real-time visibility into vaccine uptake. However, the data required to make informed decisions about vaccine distribution and administration locations are only now yielding insights that can improve programme planning. For example, early

data from CoWIN suggests that most vaccinations were taking place in urban areas and about half of them are walk-ins. This may have resulted in crowding in the COVID-19 vaccination centers with the unintended consequence of potentially rendering some mass campaigns to become super-spreader events (Subramanian, 2021). Current data from CoWIN indicates that most vaccination centers (73%) are in rural areas and that the majority of registrations are through walk-ins (Pant, 2021).

Routine immunization delivery

Against this backdrop, routine immunization services in India have reportedly decreased with at least 100,000 children missing their BCG vaccination and 200,000 children missing one or more Pentavalent vaccine doses. It is estimated that 49,000 additional child deaths and 2,300 additional maternal deaths could have been attributed to the disruption of healthcare services, projecting an overall increase in child mortality of 40% over the next year (Shet et al., 2021). While India currently accounts for 11% of the unvaccinated and under-vaccinated children globally (WUENIC, 2020), it is estimated that 27 million children will miss their doses of pentavalent vaccines during the pandemic (Shet et al., 2021). In order to address this, the Government of India is encouraging State governments to identify the children who missed essential vaccinations and plan catch-up campaigns under the UIP (MOHFW, 2020). While the UIP's integration of the CoWIN platform for routine vaccination is still pending, the latter's repurposing is planned to allow for identification of beneficiaries and for keeping an electronic track record of all vaccines provided under the programme (Madaan, 2021).

Emerging learning and opportunities

The use of the inter-linked CoWIN and eVIN systems for COVID-19 vaccination has increased visibility, accountability, and transparency, facilitated access to vaccination and enabled planning of service delivery. Based upon the observations of key stakeholders, the importance of a digitally trained health workforce that can quickly adapt to new requirements clearly emerged as a key prerequisite for such a platform's success (Pant, 2021). Similarly, the CoWIN story demonstrates the importance of ensuring the end user is also able to effectively manage the technology. The CoWIN app enabled beneficiaries to register online and receive an appointment that provided instructions on when and where to report for vaccination, receive reminders and appointments for the follow-up doses, and download digital vaccination certificates that enabled travel. The linkage with eVIN ensured vaccine availability at the respective vaccination sites.

Despite such successes, India's effort to digitalize its COVID-19 vaccine delivery has been met with some criticism and underscores important lessons to be learned around equitable access, as documented by Mukherji (2021), Sharma (2021), and Gupta et al. (2021). Digital literacy and language barriers surfaced as factors challenging the use of CoWIN initially, however, emphasis placed on training the health workforce ensures the proper use of the system including registering walk-ins.

Going forward, both CoWIN and eVIN are envisioned to be fully integrated into the UIP, thus providing for the functionalities of an eIR/eLMIS with end-to-end visibility of stocks, last-mile delivery, and beneficiary tracking, which is seen as favorable for ensuring the most vulnerable are reached. In particular, CoWIN is planned to be adapted for use as an eIR for routine immunizations, providing easy integration with other systems, including vaccine safety surveillance, given its open platform structure. The use of the integrated systems in routine immunization is intended to reduce the number of zero-dose and partially immunized children and improve immunization coverage through pre-registration of all eligible infants. The MoHFW's plan is to provide the adapted CoWIN as the interface for recording immunization sessions' data at all immunization delivery sites. A flexible database architecture is envisaged to allow the session site data to flow into eVIN from CoWIN, enabling programme managers to have access to data on immunization coverage, vaccine consumption, and wastage in real time, as well as track key performance indicators.

Conclusion

While not a panacea, digital health applications can be essential tools and enablers for immunization systems. This exploratory case study on India demonstrates that digital systems such as eVIN and CoWIN can be successfully leveraged to deliver impact at scale given their **simple and flexible design tailored to context-specific needs**. As a widely used system for routine immunization, eVIN demonstrated its flexibility in accommodating the additional vaccine supply needs as part of the pandemic response. In addition, CoWIN demonstrated how new digital technologies can be appropriately designed and implemented rapidly at scale to serve the emerging needs of an emergency immunization delivery program, as well as the information management needs of a country as large as India. Together both systems have ensured that demand at a specific vaccination site is met with the appropriate supply.

The example of India also demonstrates how **investments in human resources and digital infrastructure** are preconditions for success. Information obtained from the literature and from key-informants has consistently highlighted the importance of sufficient and adequately trained staff for the management of the systems, as well as their diffusion into the community to ensure that end users have the digital knowledge to take advantage of the technology. This is critical to the equity agenda.

Finally, previous strategic investments and **local ownership** of eVIN contributed to an enabling environment that ensured a robust vaccine supply chain during the pandemic and facilitated the development of the CoWIN system *de novo*. This demonstrates how **political commitment and a clear vision** are necessary to support the rapid and agile development and deployment of digital solutions, as

well as their sustained use. India's vision to integrate and streamline the digital solutions for both COVID-19 vaccine delivery and routine immunization was driven by the aim of maximizing system efficiency and effectiveness.

The learnings captured in this case study, while nascent, have the potential to make an important contribution to the larger dialogue on digital health. Investments in this area can positively affect the outcome of health programs and should favor a strategic and coordinated approach to thinking about critical issues around scalability, interoperability, and sustainability of the electronic systems, as evidenced by the experience in India to date.

Acknowledgements

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Tech Events

2022

Mar 4–6, Singapore
2022 The 6th International Conference on Green Energy and Applications
Contact: Ms. Jasmine Zhou
Email: zjh@e.ntu.edu.sg
http://www.icgea.org/

Mar 11–13, Chengdu, China
The 4th International Conference on Robotics and Intelligent Systems (ICRIS 2022)
Contact: Ms. Sharon Liu
Conference Secretary of ICRIS
Tel: +86-28-6302-3585/+86-15902806624
Email: icris@academic.net
http://www.icris.net/

Mar 16–17, Singapore
IoT Asia+
Contact: CONSTELLAR EXHIBITIONS PTE. LTD.
1000 Toa Payoh North, News Centre,
Singapore 318994
Tel: +65 6319 4020
https://www.internetofthingsasia.com/

Mar 18–21, Tianjin, China
2022 8th International Conference on Computing and Artificial Intelligence (ICCAI 2022)
Contact: Ms. Olia Lai
Conference Secretary
Tel: +852-3500-0799
Email: iccai@cbees.net
http://www.iccai.net/

Mar 20–22, Doha, Quatar
2022 3rd International Conference on Smart Grid and Renewable Energy (SGRE)
Contact: Sertac Bayhan
Email: sertac.bayhan@qatar.tamu.edu
http://www.sgre-qa.org/

Mar 23–25, New Delhi, India
7th Smart Cities India Expo
Contact: Pramit Kumar, Vice President
Exhibitions India Group
C-103, Okhla Industrial Estate
Phase III, New Delhi - 110 020, India
Mob: +91 98110 78179
Email: pramitk@eigroup.in
https://www.smartcitiesindia.com/

Mar 27–29, Singapore
2022 3rd Asia Conference on Renewable Energy And Environmental Engineering (AREEE 2022)
Contact: Nancy Liu
Conference Secretary
AREEE Conference Secretariat
Tel: +86-28-86512185
Email: areee@iacsitp.com
http://www.areee.org/

Mar 29–31, Kuala Lumpur, Malaysia
ASIAWATER 2022
Contact: Informa Markets Malaysia Sdn. Bhd.
Suite 5-01, Level 5, Sunway VISIO Tower,
Lingkaran SV, Sunway Velocity,
55100 Kuala Lumpur, Malaysia
Tel: +603 - 9771 2688
Email: asiawater-my@informa.com
https://www.asiawater.org/

Apr 18–20, Singapore
2022 Asia Climate Forum
Contact: Tony Stephenson
Event Director
Tel: +44 (0) 1423 524545
Email: tony@mediageneration.co.uk
https://www.asiaclimateforum.com/

Apr 26–27, Seoul, Republic of Korea
6th Digital Pathology & AI Congress: Asia
Contact: Global Engage Sdn Bhd
Level 33, Ilham Tower
No. 8 Jalan Binjai
50450 Kuala Lumpur
Malaysia
Tel: +60 3 2117 5193
https://www.global-engage.com/event/digital-pathology-congress-asia/

May 20–22, Suzhou, China
2022 6th Workshop on Energy Conservation Technologies (IWECT 2022)
Contact: Ms. Yury Yu
Secretary office of IWECT 2022
Tel: +852-30506939(HK)/+86-19136072802
Email: iwect@apise.org
https://www.iwect.org/

Jul 20–22, Bangkok, Thailand
Future Energy Asia
Contact: Yuyuan Chen
Head of Energy Transition – Asia
dmg events Asia Pacific Pte Ltd
138 Market Street, #05-01, CapitaGreen
Singapore 048946
Tel: +65 6856 5205
Email: YuyuanChen@dmgevents.com
https://www.futureenergyasia.com/

Jul 28–30, Jeju, Republic of Korea
2022 11th International Conference on Environment, Energy and Biotechnology (ICEEB 2022)
Contact: Ms. Liao Vera
Conference secretary
Tel: +852-3500-0137
Email: iceeb@cbees.org
http://www.iceeb.org/

Sep 20–22, Bangkok, Thailand
Sustainable Energy Technology Asia (SETA) 2022
Contact: Ms. Lili Geng
Tel: +66 2 107 1944
Email: lili@gat.co.th
https://www.setaasia.com/

Oct 14–16, Bangkok, Thailand
ASEAN Sustainable Energy Week
Contact: Ms. Darawan Augsornsarasitt
428 Ari Hills Building 18th Floor, Phaholyothin Road, Samsennai, Phayathai, Bangkok, Thailand 10400
Tel: +66 2036 0500 ext. 351 & 235
Fax: +66 2036 0588
Email: darawan.a@informa.com, asew-th@informa.com
https://www.asew-expo.com/

Oct 27–28, HCMC, Viet Nam
ASEAN Wind Energy 2022
Contact: Mabel Gu
Tel: +86 21 6419 9537 - ex 8168
Email: Mabel@leader-associates.com
https://www.aseanwindenergy.com/

2021

Nov 1–3, Tokyo, Japan
11th Asian Conference on Sustainability, Energy & the Environment (ACSEE2021)
Contact: The International Academic Forum (IAFOR)
Sakae 1-16-26 – 201
Naka Ward, Nagoya, Aichi,
Japan 460-0008
Email: acsee@iafor.org
https://acsee.iafor.org/

Tech Ventures & Opportunities

Business Coach

Tech Opportunities

Selected startup support programmes in Malaysia

Malaysian Global Innovation & Creativity Centre, Malaysia
https://www.mymagic.my

Early stage

Idea Lab: Idea Lab is a partnership initiative supporting hackathon/makerthon and Startup Weekend around Malaysia that aims to educate and encourage people on creative entrepreneurial mindset and problem-solving culture through entrepreneurship. Participants must come out with impactful business ideas to pitch in front of panel judges.

Idea Lab enables ecosystem players to collaborate in providing opportunity for aspiring entrepreneurs to develop their idea into actionable solution and sustainable business model.

MaGIC Virtual Bootcamps: MaGIC Bootcamps are intensive output-driven courses for teams to build, test, and refine their ideas to produce Minimum Viable Product (MVP) prototypes with the intentions for commercialization.

These boot camps are designed based on government initiatives according to Sustainable Development Goals (SDGs) and National Technology and Innovation Sandbox (NTIS) focused areas that coincide with addressing national and global issues.

Mid stage

Grill or Chill (GoC): Grill or Chill (GoC) is a platform for startups to showcase their products and get valuable feedback from experts in the startup ecosystem. Each GoC ends with a networking session where you can mingle and connect with other entrepreneurs in a cosy environment.

Virtual Global Accelerator Programme - Cohort 5: An online programme to accelerate local & international startups from all over the world, with an interest to expand their business in the ASEAN region, to be investment-ready in 3 months.

GAP also aims to build a strong ASEAN startup community by cultivating ASEAN relationships.

Late stage

Virtual Global Market-Fit Programme: Virtual Global Market-Fit Programme (GMP) provides a platform for high growth innovative startups to explore cultures, understand ways of business, and gain international market access in countries beyond ASEAN.

This programme aims to provide assistance for startups to accelerate growth with new product/solution market-fit strategies expanding to other countries.

Selected Green Technology Funds

Adaptation Fund (AF)
https://www.adaptation-fund.org

The AF is designed to finance climate change adaptation projects and programs based on the priorities of eligible developing countries.

Climate Investment Funds
https://www.climateinvestmentfunds.org

The CIF accelerates climate action by empowering transformations in clean technology, energy access, climate resilience, and sustainable forests in developing and middle-income countries.

Least Developed Countries Fund (LDCF)
https://www.thegef.org/topics/least-developed-countries-fund-ldcf

The LDCF addresses the needs of least developed countries whose economic and geophysical characteristics make them especially vulnerable to the impact of global warming and climate change.

Special Climate Change Fund (SCCF)
https://www.thegef.org/topics/special-climate-change-fund-sccf

The SCCF finances activities, programs and measures relating to climate change that are complementary to those funded by the resources allocated to the climate change focal area of the Global Environment Facility Trust Fund.

Youth entrepreneurship programme in Philippines

Department of Trade and Industry, Philippines
https://www.dti.gov.ph

Republic Act No. 10679 otherwise known as the Youth Entrepreneurship Act mandates the Micro, Small, and Medium Enterprise Development Council (MSMEDC) through the Department of Trade and Industry (DTI) to implement a national program to promote youth entrepreneurship development. Youth Entrepreneurship Program or YEP is a focused program to address the young demographics of the country to become productive individuals through entrepreneurship. It will help young Filipinos develop their entrepreneurial skills by offering them a comprehensive package of interventions.

YEP targets to help aspiring and existing youth Filipino entrepreneurs aged 18–30 years.

Eligibility of YEP cooperators or partners

Following the definition of "Eligible Entity" specified in Section 4 of the Youth Entrepreneurship Act, eligible cooperators for YEP shall refer to:

- A private or non-profit organization with experience and a proven track record in entrepreneurship and entrepreneurship programs
- A local or national government agency dedicated to uplift the lives of Filipino youth
- A learning organization with experience and a proven track record in entrepreneurship and entrepreneurship programs

Components of YEP

- **Youth Start:** This component focuses on mindset change and models of business of the DTI 7Ms strategy. It aims to stir the entrepreneurial interest and encourage the youth to start their business ventures.
- **Youth Net:** This component focuses on developing mastery of business concepts and strategies as well as providing mentoring support to youth entrepreneurs. It aims to connect youth with the right networks that will support them to overcome startup challenges and exchange innovative ideas.
- **Youth Match:** This component highlights money, provision of machines, and market aspects of the 7Ms framework. It aims to give young entrepreneurs wider access to markets and resources which will bolster their business.

YEP assistance

Interventions to be given per beneficiary shall be following their current level—existing or aspiring young entrepreneurs.

- **Youth Start:** Under this component, entrepreneurial mindsetting seminars or inspirational forums and basic services shall be provided through business registration assistance, business opportunities seminars, and entrepreneurship skills training.
- **Youth Net:** Under this component, mentoring sessions, the establishment of youth entrepreneurship organizations, and/or joining in entrepreneurship associations will be facilitated.
- **Youth Match:** Under this component, young entrepreneurs shall be engaged in various market promotion activities, and their access to investment funding and relevant machines/equipment to increase their productivity will be facilitated.

For more information, you may visit any of the DTI Regional/Provincial Offices or Negosyo Centers near you or contact the Department of Trade and Industry – Bureau of SME Development at (+632) 7791.3310 or via email BSMED@dti.gov.ph.

Connect2Recover Initiative

Connect2Recover is a global initiative that aims to reinforce the digital infrastructure and ecosystems of beneficiary countries. In addition, its objective is also to provide means of utilizing digital technologies such as telework, e-commerce, remote learning and telemedicine to support the COVID-19 recovery efforts and preparedness for the 'new normal' (and potential future pandemics), and, where it is still needed, to prevent the spread of COVID-19 infections while maintaining socio-economic activities.

For more information about participation and contribution to Connect2Recover, please contact: bdtdirector@itu.int

https://www.itu.int/en/ITU-D/Pages/connect-2-recover.aspx

Registration of layout-design of integrated circuit in Thailand

Department of Intellectual Property, Thailand
http://www.ipthailand.go.th

Definition

"Integrated circuit" means a completed or semi-completed product with the electronic function which is composed of components which can generate electronic operation, including a connector which links all components or some parts, by which all components are located on or in the same piece of a semiconductor.

"Layout-design" means layout, diagram or picture made in any form with any method to demonstrate how the integrated circuit is formed up.

"Layout certificate" means an important document issued to protect the layout according to this Act.

"Make commercial benefits" means making benefits through selling, leasing or any other means to obtain remuneration or other benefits. The meaning shall include offering to gain benefits.

"Owner" means a person who receives the layout certificate. It shall include a transferee of the right."

"Official" means personnel appointed by the Minister to operate according to this Act.

"Director-General" means the Director-General of the Department of Intellectual Property.

"Service receiver or applicant" means people who directly receive service or a governmental or private agency which receives service from a governmental agency.

Consideration criteria

1. Accuracy and clearness of the content of the layout-design of integrated circuit. The documentation shall comprise the followings;
   - Fill in all spaces in the form Bor Phor 1, Bor Phor 1 (Por), or Bor Phor 1(Add).
   - Registration application for layout-design of integrated circuit with the signature of the applicant or attorney-in-fact.
   - In case the applicant is the circuit designer, he shall fill in the registration right affirmation form for layout-design of integrated circuit. In case the applicant is a foreigner, the applicant shall use Bor Phor 1(Add) Form.
2. Prepare the documents for right claiming in registration
   - In case the applicant is a transferee, he shall attach the right transferring letter with the signatures of the transferor and transferee.
   - In case the applicant obtains his right through other means, for example inheriting, employment contract, etc., he shall submit the document affirming his right.
3. The Power of Attorney, in case of authorization to an attorney-in-fact registered with the Department of Intellectual Property.
4. Four samples of layout-design of integrated circuit applied for registration.
5. In case the layout-design of integrated circuit is already manufactured for commercial benefits, the manufacturing must be launched not more than 2 years.
6. Details of the electronic function of the layout-design of integrated circuit, such as Data sheet, etc.
7. Drawing or photograph or anything with the same effect used in the manufacturing of the integrated circuits with diagram such as MASK, etc.

Conditions of application submission

1. To apply for protection of the layout-design of integrated circuit, the applicant shall submit the application form as determined by the Director-General.
2. Authorization
   - 2.1 In case the applicant of the patent does not reside in the Kingdom of Thailand, he shall authorize the attorney-in-fact to act on his behalf. In this regard, the power of attorney shall be presented to the Director-General in accordance with the following regulations
     - (1) If the authorization is done outside the Kingdom of Thailand, the signatures in the authorization letter or power of attorney shall be certified by the authorized official of the Thai embassy or consulate or Director of the office of the Ministry of Commerce located in the country where the principal or power grantor resides, or the person authorized to act on behalf of the said officials or the person authorized to certify the signature according to the law in that country, or
     - (2) In case the authorization is done in the Kingdom of Thailand, the applicant shall submit a copy of passport or temporary residence certificate of the principal or power grantor, or any evidence indicating that at the time the authorization was made, the principal or power grantor was in Thailand.

2.2 The Power of Attorney shall be attached with the revenue stamp of 30 Baht/attorney-in-fact/application.

Notes

1. The working process starts after the inspection of the documents is completed, as specified in the manual of the public service.
2. In case the application or documentary evidence is not correct or incomplete, the official shall record the defect of the document or indicate the required additional documentary evidence (Record of conditions on application reception). The applicant shall correct the document and/or submit the additional document within 90 days of the application submission date. If the applicant fails to submit all additional documents within the specific period of time, it shall be deemed that the applicant dismisses the application. The official shall return the application to the applicant and inform the reason of the return and his appeal right.
3. Any fee paid to the Department of Intellectual Property shall not be refunded in all cases, except
   (1) The law stipulates that the fee must be refunded, or
   (2) The applicant double-paid or overpaid the fee, by which the faulty payment resulted from the mistake of the state official, not the payer. In this regard, the Department of Intellectual Property shall consider the refund case by case.
4. In case the applicant is required to submit many additional documentary evidences, the applicant shall submit all additional documentary evidences in the same time.
5. In case the applicant submits the copy of the documentary evidence, the applicant shall certify the copy of the documentary evidence.
6. In case the applicant submits the document in foreign language, the applicant shall submit the document with Thai translation and the correct translation certification of the translator.
7. In case the applicant or the authorized attorney-in-fact does not submit the application by himself, and granted power to the other person to submit the application, the application submitter shall present a sub power of attorney or temporary power of attorney, so that he is eligible to submit the application and sign in the record of conditions on application reception. If it appears that the application and the documentary evidence is not correct or incomplete, and the application submitter is not authorized to sign on the said record, the official shall not receive the application.
8. The working period does not include the time period when the applicant follows the official's instruction or corrects the application, or the period of temporary suspension of registration.

Relevant laws

Protection of Layout-Designs of Integrated Circuits Act B.E.2543

The Ministerial Regulation Re: Determination of fees for layout-designs of integrated circuits B.E. 2545 (dated 26 December 2002).

Notification of the Department of Intellectual Property Re: Time counting according to Protection of Layout-Designs of Integrated Circuits Act B.E.2543 (dated 17 January 2003)

Notification of the Department of Intellectual Property Re: Determination of application forms for layout-designs of integrated circuits, other applications and supporting documents of the said applications (dated 17 January 2003).

Notification of the Department of Intellectual Property Re: Registration of right transferring of layout-designs by inheriting and the evidence of inheriting (dated 17 January 2003)

Global Innovation Index 2021, 14th Edition

Tracking Innovation through the COVID-19 Crisis

The Global Innovation Index 2021 takes the pulse of the most recent global innovation trends and ranks the innovation ecosystem performance of 132 economies, while highlighting innovation strengths and weaknesses and particular gaps in innovation metrics. In its new Global Innovation Tracker section, the report draws on a select set of indicators, including the effects on research and development expenditures or access to innovation finance, to provide a perspective on the impact of COVID-19 on global innovation performance.

For more information, access:

https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2021.pdf

Registration of technology transfer arrangements

Intellectual Property Office of the Philippines, Government of Philippines
https://www.ipophil.gov.ph

Rule 6. Registration Procedure. The Bureau shall act on requests for registration of technology transfer arrangements based on the following procedure:

6.1. Filing. All requests pertaining to technology transfer arrangements shall be filed with the Bureau and duly stamped "Received" with the date, time, and name of the receiving officer upon receipt.

6.2. Notice of Additional Requirements. Should the Bureau find that the applicant has submitted incomplete or insufficient information and requirements, the Bureau shall issue a Notice of Additional Requirements to the applicant within three (3) working days from the filing of the request requiring the applicant to submit the additional requirements. The applicant shall complete the requirements within fifteen (15) working days from receipt of the Notice of Additional Requirements. Should the applicant not be able to comply with the requirements within the aforesaid period, applicant may request for an extension of another fifteen (15) working days and pay the corresponding fee. Otherwise, the file shall be archived and shall only be retrieved upon submission of the complete requirements and payment of the Document Retrieval Fee. (revised Rule 8)

6.3. Filing Date. Upon receipt of all the requirements as contained in the Notice of Additional Requirements, the Bureau shall issue a Notice of Filing Date within three (3) working days from such receipt. The Filing Date shall be the date when the Bureau has satisfactorily received all the requirements. This date is also the date when evaluation of the request shall commence. (revised Rule 7)

6.4. Decision. The Bureau Director shall decide on the request within twenty (20) working days from the Filing Date. (revised Rules 13, 18,22 and 24) A favorable Decision shall cause the corresponding Certificates to be issued. Otherwise, appropriate Notices shall be issued to applicant.

6.4.1. Notice of Findings and Notice to Comply. Should any provision of the agreement violate any of the Prohibited Clauses or Mandatory Provisions of the IP Code, the Bureau shall issue a notice to the parties informing them of the violation and requiring them to comply. (revised Rules 20, 22 and 25)

6.5. Issuance of Certificate. Upon the applicant's satisfactory response to the findings and subsequent compliance with the IP Code provisions, and/or after a favorable Decision by the Bureau Director, the Bureau shall issue the appropriate certificate within seven (7) days from receipt of the duly executed and notarized agreement and payment of the required fees for the following as requested: (revised Rules 14, 19, and 21)

a. Certificate of Registration - A certification that a technology transfer arrangement has been granted certain exemption/s from the requirements of Sections 87 and/or 88 of the IP Code;

b. Certificate of Compliance - A certification that the technology transfer arrangement does not violate any of the Prohibited Clauses and conforms to all the Mandatory Provisions of the IP Code;

c. Certificate of Clearance - A certification that a trademark license agreement covered by Section 150 of the IP Code has been cleared for recordal with the Bureau of Trademarks.

6.6 Entry in the Certificate Registry Book. After the issuance of a certificate, the Bureau shall enter in the Certificate Registry Book the following:

a. Title of the technology transfer arrangement;

b. The parties thereto;

c. Its registration number;

d. The date of registration; and

e. The corresponding type of certificate as enumerated in Rule 6.5 above.

Other information needed by the agency for statistical purposes may likewise be recorded, in accordance with the provisions of the law. (revised Rule 15)

6.7. Publication. The Bureau shall publish in the IPO Gazette all agreements that are granted exemption, registered, or cancelled. The publication shall contain the names of the parties, title and subject of the agreement, the specific exemption/s granted, if any, and the date of cancellation, if such was the case. (revised Rule 33)

Rule 7. General Provisions

7.1. Applicants. Any party to a technology transfer arrangement or his duly authorized representative may file with the Bureau an application for Certificate of Registration, Certificate of Compliance, or Certificate of Clearance (as distinguished under Rule 6.5). Parties may also jointly file such Applications. (revised Rules 5 and 21)

7.2. Requirements. The basic requirements for any request to be filed with the Bureau pertaining to a technology transfer arrangement shall be as follows:

a. Letter request;

b. Copies of the technology transfer arrangement;

c. The duly filled-out sworn application form which shall include a verified statement from the applicant that the agreement is not subject of any judicial, administrative or other proceeding; and

d. Requisite Fees.

Requests for Exemption shall also be accompanied with specifics on the exemption/s being requested and the justification for the exemption/so

In case of Requests for Preliminary Review, the applicant may submit either a draft or a duly executed and notarized agreement.

Other documents may be required by the Bureau to support and establish the merits of a request. (revised Rules 4 and 21)

7.3. Amendments. Minor changes on a technology transfer arrangement, such as addition or deletion of products, increase or decrease in royalty rates and other commercial terms, etc. which do not violate the requirements of Sections 87 and 88 of the IP Code, will not affect the findings of the Bureau and will not necessitate another round of review. Such requests for annotation shall be acted upon by the Bureau within three (3) working days from receipt of all the requirements which may include the surrender of a previously issued certificate covering the technology transfer arrangement. (revised Rule 35(b))

7.4. Issuance and Validity of the Certificates. There will not be issued any perpetual certificates and in no case shall any of these certificates exceed the life of the Technology Transfer Arrangement.

Technology Transfer Arrangements which had expired shall not be issued certifications anew unless aforesaid technology transfer arrangement had been renewed or extended in due course.

Only one (1) original Certificate shall be issued to the applicant and the Bureau will maintain only one (1) original duplicate for file. Requests for additional original copies will not be granted. However, an applicant may request for certified true copies of the original duplicate on file.

a. Maximum Validity of the Certificate of Registration and Certificate of Compliance. The Certificates of Registration and Certificate of Compliance to be issued by the Bureau, as the case may be, may carry a maximum validity of ten (10) years from the date of effectivity of the technology transfer arrangement or from the date of issuance of the certificate, whichever is earlier.

b. Maximum Validity of the Certificate of Clearance. The Certificate of Clearance to be issued by the Bureau on account of Trademark License Agreements for recordal with the Bureau of Trademarks, may carry a maximum validity of ten (10) years but may not exceed the expiration of the Trademark registration itself, as appearing in the Trademark Registration certificate.

7.S. Cancellation of Registration. Automatic cancellation of registration shall be made upon receipt by the Bureau of a duplicate original or certified true copy of the registered technology transfer arrangement containing amendments or modifications that violate the Prohibited Clauses and Mandatory Provisions of the IP Code without approval of the Bureau. (Rule 16)

The Bureau may also cancel the registration of the technology transfer arrangement if, after evaluation, the Bureau has established that the justification for the grant of an exemption submitted by the applicant does not exist or has ceased to exist.

Such action will be made only after the parties in whose names the certificate of registration was issued are given an opportunity to be heard. (Rule 16)

In both cases, the parties shall be required to surrender the certificate provided that the surrender of the certificate shall not be a pre-requisite to the cancellation of the registration. (Rule 16)

(Source: IPOPHL Memorandum Circular No. 2. a 2 0 a 0 2. Series of 2020. Revised Rules & Regulations on voluntary licensing)

World Intellectual Property Indicators Report

The annual WIPI report collects and analyzes IP data to inform policy makers, business leaders, investors, academics and others seeking macro trends in innovation and creativity. The report showed that patent and industrial designs filing activity rebounded in 2020, illustrating the resilience of human innovation even amid the dire global health situation. Trademark filing activity rose by 13.7%, patents by 1.6% and designs by 2% according to the WIPI, which compiles new data from some 150 national and regional authorities and shows how innovators, designers and brands are increasingly relying on intellectual property tools to expand their enterprises and seek new growth.

For more information, access:

https://www.wipo.int/edocs/pubdocs/en/wipo_pub_941_2021.pdf

Stages of startups and source of funding

Startup India Hub, Department for Promotion of Industry and Internal Trade, Government of India

https://www.startupindia.gov.in

There are multiple sources of funding available for startups. However, the source of funding should typically match the stage of operations of the startup. Please note that raising funds from external sources is a time-consuming process and can easily take over 6 months to convert.

Ideation (Pre-Seed Stage)

This is the stage where the entrepreneur has an idea and is working on bringing it to life. At this stage, the amount of funds needed is usually small. Additionally, at the initial stage in the startup lifecycle, there are very limited and mostly informal channels available for raising funds.

Bootstrapping/Self-financing: Bootstrapping a startup means growing the business with little or no venture capital or outside investment. It means relying on your savings and revenue to operate and expand. This is the first recourse for most entrepreneurs as there is no pressure to pay back the funds or dilute control of your startup.

Friends & Family: This is also a commonly utilized channel of funding by entrepreneurs still in the early stages. The major benefit of this source of investment is that there is an inherent level of trust between the entrepreneurs and the investors.

Business Plan/Pitching Events: This is the prize money/grants/financial benefits that are provided by institutes or organizations that conduct business plan competitions and challenges. Even though the quantum of money is not generally large, it is usually enough at the idea stage. What makes the difference at these events is having a good business plan.

Validation (Seed Stage)

At this stage, a startup has a prototype ready and needs to validate the potential demand of the startup's product/service. This is called conducting a "Proof of Concept (POC)," after which comes the big market launch.

A startup will need to conduct field trials, test the product on a few potential customers, onboard mentors, and build a formal team for which it can explore the following funding sources:

Incubators: Incubators are organizations set up with the specific goal of assisting entrepreneurs with building and launching their startups. Not only do incubators offer a lot of value-added services (office space, utilities, admin & legal assistance, etc.), they often also make grants/debt/equity investments.

Government Loan Schemes: The government has initiated a few loan schemes to provide collateral-free debt to aspiring entrepreneurs and help them gain access to low-cost capital such as the Startup India Seed Fund Scheme and SIDBI Fund of Funds.

Angel Investors: Angel investors are individuals who invest their money into high-potential startups in return for equity. Reach out to angel networks such as Indian Angel Network, Mumbai Angels, Lead Angels, Chennai Angels, etc., or relevant industrialists for this.

Crowdfunding: Crowdfunding refers to raising money from a large number of people who each contribute a relatively small amount. This is typically done via online crowdfunding platforms.

Early traction (Series A Stage)

At the Early Traction stage startup's products or services have been launched in the market. Key performance indicators such as customer base, revenue, app downloads, etc. become important at this stage. Funds are raised at this stage to further grow the user base, product offerings, expand to new geographies, etc. Common funding sources utilized by startups in this stage are:

Venture Capital Funds: Venture capital (VC) funds are professionally managed investment funds that invest exclusively in high-growth startups. Each VC fund has its investment thesis—preferred sectors, stage of the startup, and funding amount—which should align with your startup. VCs take startup equity in return for their investments and actively engage in the mentorship of their investee startups.

Banks/Non-Banking Financial Companies (NBFCs): Formal debt can be raised from banks and NBFCs at this stage as the startup can show market traction and revenue to validate its ability to finance interest payment obligations. This is especially applicable for working capital. Some entrepreneurs might prefer debt over equity as debt funding does not dilute equity stake.

Venture Debt Funds: Venture Debt funds are private investment funds that invest money in startups primarily in the form of debt. Debt funds typically invest along with an angel or VC round.

Scaling (Series B, C, D, & E)

At this stage, the startup is experiencing a fast rate of market growth and increasing revenues. Common funding sources utilized by startups in this stage are:

Venture Capital Funds: VC funds with larger ticket sizes in their investment thesis provide funding for late-stage startups. It is recommended to approach these funds only after the startup has generated significant market traction. A pool of VCs may come together and fund a startup as well.

Private Equity/Investment Firms: Private equity/Investment firms generally do not fund startups however, lately some private equity and investment firms have been providing funds for fast-growing late-stage startups who have maintained a consistent growth record.

Exit options

Mergers & Acquisitions: The investor may decide to sell the portfolio company to another company in the market. In essence, it entails one company combining with another, either by acquiring it (or part of it) or by being acquired (in whole or in part).

Initial Public Offering (IPO): IPO refers to the event where a startup lists on the stock market for the first time. Since the public listing process is elaborate and replete with statutory formalities, it is generally undertaken by startups with an impressive track record of profits and who are growing at a steady pace.

Selling Shares: Investors may sell their equity or shares to other venture capital or private equity firms.

Buybacks: Founders of the startup may also buy back their shares from the fund/investors if they have liquid assets to make the purchase and wish to regain control of their company.

Global Innovation Fund

The Global Innovation Fund (GIF) invests in the development, rigorous testing, and scaling of innovations targeted at improving the lives of the world's poorest people. Through grants and risk capital, the Fund helps breakthrough solutions to global development challenges from for-profit firms, non-profit organisations, researchers, and government agencies to maximise their impact and affect meaningful change.

Through grants, loans (including convertible debt) and equity investments ranging from $50,000 to $15 million, we back innovations with the potential for social impact at a large scale, whether they are new technologies, business models, policy practices, technologies or behavioural insights.

The Fund supports innovators at all stages of their life cycle, from start-up and pilot-testing through to larger scale implementation. The innovations funded can be located in any developing country and can focus on any sector relevant to international development, provided they improve the lives of those living on less than $5 a day.

GIF takes a venture capital approach, using a tiered financing model, and offering graduated funding. The goal of staged funding approach is not to fund small organisations that stay small, and medium-sized interventions that stay medium-sized. It is to support organisations to scale up to reach millions of people.

This staged funding approach also allows GIF to manage risk sensibly. The fund is able to take smaller bets on riskier, unproven innovations at the pilot stage, and is able to invest larger amounts in innovations that have demonstrated strong evidence of success, through rigorous impact evaluations where possible. By meeting the financing needs of innovators from the seed stage right through to expansion funding, GIF aims to transform high potential ideas into impact at scale.

For more information, access:
https://www.globalinnovation.fund

Selected business funding in Malaysia

Malaysian Technology Development Corporation (MTDC), Malaysia

https://www.mtdc.com.my

Business Start-up Fund

Business Start-up Fund (BSF) is established to fund early-stage technology-based companies. The Fund incorporates elements of loan and equity, offering companies flexible funding via Convertible Promissory Notes (CPN) and/or Preference Shares.

BSF is designed to provide funding to scalable and viable technology based early stage companies with the objective to remove the financial blockages in achieving the business goals and matching the business standard and high level of competition, particularly in the growth sectors of the economy.

Business Growth Fund

This is a funding program that focuses on growing the company not only on its production output and reach, but also on internal preparedness towards professionalism, corporate governance, and all the necessary tools to escalate the company to the next level.

MTDC-microLEAP Peer-to-Peer (P2P) Financing Programme

MTDC-microLEAP Peer-to-Peer (P2P) Financing Programme is a social lending programme that aimed to facilitate local technology-based companies to obtain financing directly from the mass public; either individual or organization via crowdfunding platform. The programme will enable local technology-based companies to obtain capital through P2P lending from a relatively large number of investors, using an online platform.

Our P2P partner, microLEAP (Microleap PLT), is a Recognized Market Operator by the Securities Commission of Malaysia who operates a P2P financing platform that allows businesses to raise crowd-sourced funds in which the issuers (borrowers) may raise financing from as little as RM1,000 while P2P investors may invest in "Investment Notes" issued by them from as little as RM50.

MTDC-pitchIN Equity Crowdfunding (ECF) Programme

MTDC-pitchIN Equity Crowdfunding (ECF) Programme is an equity crowdfunding programme aimed to facilitate fundraising for local technology-based companies through crowdsourcing. The programme will enable local technology-based companies to obtain capital through equity investment from a relatively large number of public investors, using an online platform.

National Technology & Innovation Sandbox Fund

The NTIS is a national initiative which serves as a "safe place" to allow innovators to test their products, services, business models, and delivery mechanisms in a live environment with relaxations on all or specific processes and/or regulatory requirements. In support of the NTIS programme, MTDC offers the NTIS Fund which will finance relevant activities under the programme.

ASEAN Smart Cities Network

The ASEAN Smart Cities Network (ASCN) is a collaborative platform where cities from the ten ASEAN Member States (AMS) work towards the common goal of smart and sustainable urban development. the primary goal of the ASCN is to improve the lives of ASEAN citizens, using technology as an enabler. By focusing on our people, it adopts an inclusive approach to smart city development that is respectful of human rights and fundamental freedoms as inscribed in the ASEAN Charter. The networking of Smart Cities across ASEAN also contributes to enhancing mutual understanding across cultures.

The 26 ASCN Pilot Cities are: Bandar Seri Begawan, Battambang, Phnom Penh, Siem Reap, Makassar, Banyuwangi, DKI Jakarta, Luang Prabang, Vientiane, Johor Bahru, Kuala Lumpur, Kota Kinabalu, Kuching, Nay Pyi Taw, Mandalay, Yangon, Cebu City, Davao City, Manila, Singapore, Bangkok, Chonburi, Phuket, Da Nang, Hanoi, and Ho Chi Minh City.

The ASCN aims to facilitate cooperation on smart cities development, catalyze bankable projects with the private sector, and secure funding and support from ASEAN's external partners. To this end, 33 partnerships have been established thus far.

For more information, access:
https://asean.org/asean/asean-smart-cities-network/#

Managing Innovation

Managing innovation in Thailand – selected initiatives

National Innovation Agency (NIA), Thailand

https://nia.or.th

Innovation diplomacy

National Innovation Agency (Public Organization) or NIA of Thailand has developed a conceptual framework "Innovation Diplomacy," based on the strategic cooperation with innovative organizations worldwide. The mission is to enhance National Innovation System (NIS) of Thailand to international level, as well as to promote the image of Thailand to become "Innovation Nation."

Innovation and Diplomacy, the two words that could be allied so well for the global affairs in the 21st Century. Innovation Diplomacy will focus more on the commercialization of innovation rather than mainly focus in R&D; therefore, Innovation Diplomacy will be another solution to creating significant economic impacts while strengthening international relations at the same time. NIA, Ministry of Science and Technology (MOST) of Thailand and Department of International Economic Affairs, Ministry of Foreign Affairs (MFA) of Thailand, together will provide the pathway to success for those aims by bringing more and more international partners to work with related Thai public and private sectors as Thailand is now growing extensively and sustainably.

Innovation diplomacy framework

Exploring & informing:

- Explore to understand the innovation systems in foreign countries
- Spot opportunities and barriers for collaboration
- Communicate with the relevant organizations

Influencing & promoting:

- Influence policies/framework to improve the wider conditions for collaboration with innovative companies
- Promote NIA as collaborator and Thailand as a destination for foreign technology-based investment

Cultivating & connecting:

- Build relationships with decision-makers, design targeted events, and workshops to create new international partnerships
- Organize missions to match companies/institutions with appropriate international partners

Activating & scaling:

- Develop, co-develop, or identify external resources to help secure and scale promising collaborations
- Find ways to help accelerate the commercialization or diffusion of innovation
- Build international partnerships that transform global opportunities for innovative firms

Project and activities

Project and activities in each stage of operation are divided into 7 areas.

1. Entrepreneurial Discovery
2. Knowledge Development
3. Knowledge Diffusion
4. Data Driven Innovation
5. Market Innovation
6. Resource Mobilization
7. Transformation of Ideas into Reality

Targeted innovation

Thematic Innovation is the development of projects that focus on innovation. To support the development of the country and enhance innovation capability at the industrial level. leading to the change in the targeted industries of the country through the pursuit of real problems shared by the private sector, the social sector and the academic sector To carry out a prototype innovation project for solving problems and upgrading the country's development to an innovation-based country.

Mind Credit

A mechanism to support innovation capacity building (Managing Innovation Development Credit) or "MIND CREDIT" is a new form of support for the NLA for Thai entrepreneurs to be able to access and use services from consulting firms with expertise in various fields that are important and necessary for the development or expansion of innovative business to elevate Thai entrepreneurs to be ready for competition and stimulate the development of innovative business effectively and lead to the creation of economic value from the country's innovation base. Those wishing to apply for funding under the MIND CREDIT mechanism must submit a project proposal to the Office for approval and the consulting company that the applicant will use the service must pass the qualification examination. Selected and registered by the office according to the criteria for selecting MIND CREDIT consulting firms set by the Office.

The MIND CREDIT support mechanism is intended to allowing Thai entrepreneurs to access and use services from consulting firms with expertise in various fields (4 branches within 2017–2018 and expanding to 10 branches in the long term) that are important and necessary for developing or expanding innovative business results to elevate Thai entrepreneurs to be ready for competition and stimulate the development of innovative business effectively.

Open data innovation in Malaysia

The Malaysian Administrative Modernisation and Management Planning Unit, Government of Malaysia

https://www.malaysia.gov.my

What are Data products?

Data Products are the outputs of innovations developed based on Open Data. Open Data pioneering countries such as Great Britain and the European Union have successfully developed high-quality data products that enhance the efficiency of service delivery as well as generate a data-driven digital economy while enhancing the well-being of the people. In addition, data products are also generated by academics, students, and the business community through the publication of research findings, mobile application development, websites, and Open Data-driven computer applications. In Malaysia, applications such as Dengue Alert that provide information on dengue threats as well as EZ4OKU application that is an application to help people with disabilities are among the data product innovations generated through the Open Data initiative.

Why are Data products developed?

The government in particular Malaysian Administrative Modernisation and Management Planning Unit (MAMPU) has organized various engagement programs, seminars, and exhibitions to provide information and awareness to government agencies, the private sector, academics, communities, and citizens regarding Open Data. The involvement of groups outside government agencies has increased based on observation of increase in the number of data sets accessed, downloads, applications for new data sets, and application to hold interviews with the government on this subject. All of these initiatives were implemented in accordance with the Public Sector ICT Strategic Plan (PSICTSA) 2016–2020 which was developed to support the successful implementation of the National Transformation Program and to enhance the public sector agency delivery system. The National Key Economy Area (NKEA) Communications Content and Infrastructure (CCI) Steering Committee meeting chaired by the YB Minister of Communications and Multimedia held on May 29, 2014 decided that the MAMPU shall lead the Public Sector Open Data Platform Development. In line with this, to realize the Government's aspirations, the Cabinet Meeting on August 20, 2014 agreed that public sector agencies implement open data initiatives. Data Products are outputs that can accelerate the economic, social, and environmental benefits derived from Open Data.

The objectives of Data Product Development are as follows:

i. To promote development of creative, quality and innovative data products

ii. To capitalize on Open Data capabilities in creation of data products

iii. To promote Open Data innovations in the public service delivery system

iv. To improve ranking of the Online Service Index (OSI) through sponsorship of crowdfunding programs in collaboration with strategic partners.

What are the impacts obtained from Data Product development?

The implementation of the Open Data Initiative is outlined in the Eleventh Malaysia Plan (RMK 11) in Chapter 9, Strategy A3: capitalizing on data to improve outcomes and reduce costs. Implementation of Open Data among agencies enables data to be used for more effective analysis, obtaining public feedback interactively and promoting innovative use of government data.

Way forward

Malaysia is moving towards Open Government digital centric technology to enhance people-centered service delivery by eliminating bureaucracy, expand service coverage, and improve accountability. Accordingly, the Government through MAMPU has introduced three (3) Open Data 2019 key performance indicators (KPI) emphasizing on improvement of quality of published data.

Patent Information Tool

The World Intellectual Property Organization (WIPO) has expanded its suite of online services with an online platform providing free access to comprehensive, unbiased, and structured reports on many patent databases. WIPO INSPIRE (Index of Specialized Patent Information Reports) will help a range of stakeholders in searching the myriad of patent databases around the world.

WIPO INSPIRE offers a range of powerful but easy-to-use functionalities for both novice and expert patent information users in mind. They include:

- a comparison of features for up to four patent databases,
- an interactive world database coverage map, allowing users to determine, at a glance, which patent databases offer coverage of a specific jurisdiction.

For more information, access:
https://inspire.wipo.int/

Energy Parks in Sri Lanka

Sri Lanka Sustainable Energy Authority

http://www.energy.gov.lk

A renewable energy park, or "energy park" is an evolving concept, and the definition still varies; but for the most part, it is an area used and planned for the purpose of clean energy development, like wind and solar generation. This renewable infrastructure can serve as smart and sustainable assets for areas with surplus industrial property. Renewable energy parks not only provide a source of reliable, locally produced clean energy, but they have also contributed to eco-tourism and served as an educational resource to local schools, universities, and business groups.

In the past, energy sites have been one-dimensional with a coal or gas plant producing electricity, for example; whereas, energy parks today can incorporate an assortment of technologies and purposes. For instance, generation can come from solar, wind, biomass, geothermal, nuclear, clean fossil, or hydrogen generation.

Energy Park is a concept initially proposed as an alternative strategy to accelerate wind and solar power development in Sri Lanka. Energy Parks function in the form of a public–private partnership. The main purpose of energy parks is to attract investments for renewable energy development at the optimum economic efficiency.

At present, the involvement of the private sector in wind and solar development is in relative slow progression. The main challenge faced by renewable energy developers is that the project capital costs are comparatively higher in terms of specific costs (USD/kW). This disparity is largely due to the:

- Economy-of-scale effect—10 MW projects compared to the current global trend of project capacities of 50–100 MW
- Lack of scale for competitive bidding—leading equipment suppliers are reluctant to bid for small scale projects
- Poor engineering infrastructure involving lift and shift equipment for MW-class projects, especially for wind turbines. This situation compels to call for the hiring of such equipment from overseas at considerable additional costs.
- The need to absorb the cost of dedicated power transmission line.

The main elements of the energy park strategy consist of measures that could, directly or indirectly, contribute to reducing the cost of electricity and enabling renewable energy resources emerge as a financially viable source of energy.

- One measure is to increase the scale of wind and solar power projects from the currently allowable 10 MW capacity per project to a 75–100 MW project. A project of this scale is most likely to result in the reduction in the capital cost due to the following reasons:
  - Economy-of-scale effect
  - Increased competition among equipment suppliers
  - Proportionately lower balance-of-plant costs
- The reduction of operation and maintenance costs due to the low level of specific manpower and spare parts stocks that has to be maintained.
- Large wind projects are often beyond the investment capacity of most local companies and local financial institutes. It is therefore proposed that a Special Purpose Vehicle (SPV) or a joint venture initiative be set up with several local private companies, with us and the CEB as equity partners, centered around an Energy Park located in a particular geographical area, deemed suitable for wind power generation.
- Several countries in Europe, e.g. Denmark, Germany, Norway, offer low-interest or low-interest credit facilities (called Mixed Credit) for projects in developing countries, which are important to the recipient country, but are financially unviable under normal commercial terms. These are however tied aid programs in which goods and services must be financed from the donor country.
- The Government partner of the SPV would act as the Project Team Leader, undertaking the following main activities:
  - Collection of reference data and site-specific data for the particular energy resource
  - Seek soft financing including a long-term renewable energy bond, issued to local investors
  - Land survey, acquisition, and related vesting tasks
  - Local infrastructure development including rail/road building
  - Extension/strengthening of HV transmission
  - Addition/augmentation of Grid Sub Station Capacity
  - Approvals from state agencies and environmental clearance

Advantages of energy parks

The Energy Park is an "energy ecosystem" in which the relationship between producers and consumers is symbiotic. By feeding of each other's waste products the park's occupiers minimize their own energy requirements. The energy they do use is produced locally, eliminating transmission losses, and renewable, eliminating the need for fossil fuels.

Through decentralization and co-location, the Energy Park provides the basis for an economically and environmentally sustainable future.

The main benefits of an energy park are as follows:

- Reduced cost of renewable energy-based power generation
- Better grid integration
- Broad basing of ownership of renewable energy projects
- Renewable energy mainstreamed in the national electricity industry
- Improved public acceptance for the projects
- Favorable investment environment for renewable energy

Energy management in Sri Lanka

National Cleaner Production Centre, Sri Lanka

https://www.ncpcsrilanka.org

The concern on energy consumption and energy cost has been increasing across all energy-intensive industry sectors not only because of its immediate impact on production costs, but also because of environmental impacts. Cost of energy in any organization can potentially bring significantly down to improve business benefits, through proper energy services. NCPC, Sri Lanka is a member of "RECPnet" global network, leading the global Cleaner Production agenda, with a network of over 70 such centers around the globe. As such, there is no organization better equipped to deliver a robust solution that best suits your energy efficiency needs.

Energy consultancy/auditing

Being an Energy Services Company (ESCo) registered under Sri Lanka Sustainable Energy Authority (SLSEA) since the inception of ESCO system in Sri Lanka, NCPC has been expertized to offer customized energy auditing services to any industry sector.

Energy audit attempts to balance the total energy inputs with its use and serves to identify all the energy streams in the systems and quantifies energy usage. Energy audit helps in energy cost optimization, pollution control, safety aspects and suggests the methods to improve the operating & maintenance practices of the system. With a strong dedication to providing commissioning, an energy consulting and sustainability service, NCPC has successfully consulted on over hundreds of detailed energy audits and assessments.

Our energy audits provide you with a clear understanding of energy consumption in your buildings and facilities. Quantitative findings can provide substantial practical guidelines for:

- Continuous improvement in production efficiency
- Identifying cost-saving opportunities in energy efficiency
- Identify fast-payback energy retrofit opportunities
- Make well-informed decisions on capital investments in your industry
- Identify low-cost/no-cost O&M measures that have an immediate impact
- Develop integrated capital improvement programs that coordinate energy programs with other planned improvements

Starting with the development of an energy consumption inventory detailed auditing activities will be conducted to identify buildings and facilities with particular focus on rationalizing their energy profiles. Field measurements will be also taken to quantify critical operating parameters. Following the establishment of an energy consumption profile, the potential energy-saving opportunities can be identified. NCPC-SL equipped with latest energy measuring instruments including power analyzers, flue gas analyzers, Infrared thermometers and etc…

The type of industrial energy audit conducted depends on the function, size, and type of the industry, the depth to which the audit is needed, and the potential and magnitude of energy savings and cost reduction desired. Based on these criteria, an industrial energy audit can be classified into following types:

Preliminary energy audits

Primary energy assessments conducted in short time period based on history data and key instant measurements to identify general energy-saving potentials.

Detailed energy audits

ore comprehensive results and accurate picture of industry energy consumption is given by detailed energy audit since it based on continuous recorded measurements and more history data.

Customized energy services

Apart from standard energy audits, following specific energy services are offered by NCPC

- Demand analysis for tariff changes
- Power factor analysis for corrections
- Equipment efficiency analyze
- Illuminance level analysis for light replacements/daylight utilization
- Heat load calculations for chiller installations, replacements
- Building management systems and energy management systems
- Fuel switching consultancy

Measuring and verification

NCPC offers customized third party measuring and verification services for specially energy-saving implementations to understand the actual energy and monetary savings of particular installation respected to baseline data.

NCPC Sri Lanka, is closely partnered with other RECP members of the RECPnet, who are rich in wealth of experience in respective countries. Hence, we maintain easy access to additional capacity and resources whenever necessary to provide a specific service beyond the capacity of us and the country.

The energy audit services can further provide a range of additional benefits. The findings of an energy audit can be a good reference for your management in supporting commercial decisions. one can acquire a sustainable reputation with your customers. As the law or policy for energy efficiency will be enacted sooner or later; earlier preparation can enhance your competitiveness. A diverse range of industries have already experienced improved energy and production efficiency following our energy audit services.

Technology Offers

GERMANY

Laser waste destruction and co-generation of power

A German consulting firm offers to arrange the technology of laser waste destruction and co-generation of power from its United States (US)-based client company. The US-based technology supplier company is a multi-faceted high-temperature materials processing, energy production, and recycling company. It specializes in system design, manufacturing, management, and operation of the company's proprietary Laser Waste Destruction System (LWD) which are used in processing both liquid and solid waste streams. The company's "Thermal Energy Production Systems" (TEP) incorporate the use of co-generation technology for generating economic electric power on an environmentally friendly basis. Both systems have application designs which will accommodate the energy production and waste stream disposition needs of a small factory or a large municipal user.

Area of Application

Waste treatment, waste utilization: processing of solid wastes and liquid wastes from medium and large factories; hospital wastes, waste from markets/supermarkets; municipal wastes; sludge processing.

Advantages

The system has considerable environmental advantages compared with incinerators: zero NOx & zero dioxine emissions; complete destruction of waste; zero bottom ash; metals are turned into useful by-products; energy from wastes: the electricity produced is used to power the processing plant and excess energy is sold to local power companies at fair market rates. Co-generation reduces operating costs and makes the system a profit-center; heat is recovered to power co-generation plant 5–50 mw; flexible size and configuration; both stationary installation and mobile units are available; automatic control and continuous monitoring; easy maintenance; low manpower required; prefabricated and easily installed everywhere; low capital investment; low operating costs; and turn-key financing/installation/operation.

Environmental Aspects

Waste utilization

Development Status

Fully commercialized

Transfer Terms

- Joint venture
- Technology licensing
- Equipment supply

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HUNGARY

Continuous room-temperature biodiesel production

Our partner, a Hungarian Institute has developed a novel continuous process for the room-temperature production of biodiesel. The main advantage of this technology is the avoidance of soap formation which so far cause many problems during biodiesel production (emulsion formation, washing problems, slow phase splitting, etc.). They are interested in a license agreement or selling of production equipments.

Area of Application

Biofuel production plants, fuel mixing firms

Advantages

- Room temperature process, energy saving
- Avoidance of soap formation, thus many other problems do not occur, like: Problems during emulsion formation; Washing problems; Slow phase splitting
- Continuous production technology in a simple apparatus (tube reactor)
- Cheap catalyst removing (KHSO4 or H2SO4) by recyclization of catalyst-removing KHSO4 (acid) with regenerable ion-exchangers
- The byproducts (K2SO4, glycerol, or methanol) can be used as rapeseed production fertilizer or starting material for biogas production
- No water in glycerol phase
- Low methanol and potassium content in the raw ester phase

Environmental Aspects

- Cleaner production
- Energy efficiency

Development Status

Pilot plant

Legal Protection

Patent

Technical Specifications

Vegetable oil methyl esters are generally produced at 60°C in the presence of 1% KOH/NaOMe catalyst with stirring for 15–60 min.

Transfer Terms

- Technical services
- Technology licensing
- Equipment supply

Target Countries

World-wide

For the above two offers, Contact

Laser Consult Ltd (Hungary)
H-6701 PO Box 1191
Szeged
Hungary

INDIA

Novel transducer matrix for biosensors

The principal objective of the present invention is to provide a process for the synthesis of nanostructured conducting polymer (NSCPs) by using structure directing agents. In addition, this invention also provides a process to develop a nanostructured conducting polymer with high electrical conductivity. Another objective of the present invention is to use the synthesized nanostructured conducting polymers as a transduction matrix for the development of biosensor. Yet another objective of the present invention is to provide a method for the development of optical biosensor by using synthesized nanostructured conducting polymers as a transduction matrix.

Area of Application

An optical glucose biosensor has a potential application in the testing of biological samples.

Environmental Aspects

Environment-friendly

Development Status

Laboratory model

Legal Protection

Patent

Transfer Terms

- Consultancy
- Technical services
- Technology licensing

Plant biomass-based metal sorption column

The present invention provides a process for developing a plant biomass-based biosorption column for the removal of metal ions. The biomaterial comprising of leaves of Jatropha is immobilized on a modified silica gel. The silica gel is modified with cationic polymers for improving the binding of the biomaterial, porosity of the column, and to maintain uniform flow rate. The biosorption column may have possible application in the removal of specific ions from contaminated sites or wastewater. The prepared biosorbent column is very cheap, recyclable, and can be used for selective sorption of Cr (VI) and Cu (II) ions from synthetic multi-elemental water samples

Area of Application

The prepared biosorbent can be used for purification of water in terms of heavy metals.

Advantages

The prepared biosorbent column is very cheap, recyclable, and can be used for selective sorption of Cr (VI) and Cu (II) ions from synthetic multi-elemental water samples.

Environmental Aspects

Environment-friendly

Development Status

Laboratory model

Legal Protection

Patent

Transfer Terms

- Consultancy
- Technical services
- Technology licensing

For the above two offers, Contact

Amity University

Sector-125, Noida

Gautam Buddha Nagar 201303

India

Nanogold-loaded carbon bullets as gene carriers

National Chemical Laboratory (NCL) scientists have developed a process for the preparation of carbon-embedded nanogold particles with sharp edges which can be used as gene carriers. The bullets are sharp enough to penetrate hard material, with less damage (a comparatively lower force of 0.1–0.2 nN required for penetration) and can be delivered with a convenient delivery gun. Intracellular gold particles (biogenic) synthesized by a fungus in situ are embedded on a carbonaceous matrix.

Area of Application

- Gene therapy/improved gene delivery for research and other applications
- DNA-based immunization, to study gene function and its regulation, to establish various disease models, metal ion removal, fuel cells, anti-bacterial applications, catalysis

Advantages

- Preparation process is very simple and easy to implement
- The carbon matrix forms 95% of the carrier reducing the amount of gold needed and the plasmid used per transformation
- Advantages of usage of gold particles- High DNA packing density, better transformation efficiency, low nuclease degradation, being in nano scale, higher surface area is obtained-more gene cargo handled
- Advantages of usage of carbon support- Inert and less damage causing- wound caused due to penetration healed faster, better piercing capacity, for example, can effectively pierce hard plant cell walls, less force required to penetrate the plasma membrane as compared to silver nano needles

Technology Offers

Development Status

Laboratory model

Legal Protection

Patent

Transfer Terms

Technology licensing

Contact

National Chemical Laboratory, CSIR
A208, PAML Building,
National Chemical Laboratory
Dr Homi Bhabha Road,
Pune 411007
India

Dengue tetravalent vaccine

The technology describes a novel recombinant envelop domain-III-based tetravalent protein which elicits protective immune responses against each of the four serotypes of dengue virus, DEN-1, DEN-2, DEN-3, and DEN-4. Hence it is capable of inhibiting the infectivity of each dengue virus serotype which is responsible for different form of dengue fever. The technology further suggests a process for the preparation of this tetravalent protein which involves codon optimizing the sequence, followed by cloning, transforming, and purifying the novel recombinant tetravalent protein. This technology has been tested on mice.

Area of Application

Medical industry

Advantages

- It is a tetravalent vaccine against four different serotypes of dengue virus, i.e., DEN-1, DEN-2, DEN-3, and DEN-4.
- Effective against different types of dengue serotypes.
- It inhibits the infectivity of each dengue virus serotype.
- Cost-effective option in comparison to existing treatments.

Development Status

Laboratory model

Transfer Terms

Technology licensing

Contact

SkyQuest Technology Consulting Pvt. Ltd.
501, Krishna Complex,
Opp. Devashish School,
Bodakdev
Ahmedabad 380054
India

Zero-head hydro turbine

An Indian entrepreneur has developed the zero-head water turbine which generates electric energy from moving water and simultaneously pumps the water for irrigation or other like purposes. He has designed two variants of turbine and pump models. Initially he had developed a water turbine using bamboo for harnessing the flow energy from the river to pump water to his land way back in 1998–1999. And later with the assistance from GIAN-NE, a voluntary organization working in the field of development of grass root innovations, he has developed another version of the same turbine.

Area of Application

Areas where electric power supply is not available

Advantages

- Novelty lies in its portability and the fact that there is no need for a dam. Economically, it is a better as construction and installation cost is minimal as compared to hydro-electric, steam, or any other power plant.
- The maintenance cost is also quite low compared to the conventional hydroelectric power plant.
- Its efficiency is greater than 50%. It can be set up anywhere be it plains or mountains.
- The turbine has a very high potential in rural areas where electric power supply is not available.

Environmental Aspects

Energy efficiency

Development Status

Commercial prototype

Legal Protection

Patent

Transfer Terms

Consultancy

Contact

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PO Box 15051, Vastrapur
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Dehydrated fruits by freeze-drying technique

Thai government organization offers technology for fruit dehydration by freeze-drying technique. Freeze-drying is a process in which water in the sample is frozen at very low temperature

THAILAND

(between −20°C and −40°C) and then sublimed under vacuum and low temperature (below −50°C). This technique was applied to produce various kinds of dehydrated fruits, namely jack fruit, rambutan, lychee, longan, and durian.

To stop the enzymatic reaction, the fruits are initially dripped in the solution of 0.1–0.2% sodium metabisulphite and 0.1% citric acid for 30 minutes. Some types of fruits may also require to go through a blanching process. Then fruits are dried in a freeze dryer under appropriate conditions, i.e., temperature, pressure, and time. Final products produced by this technique are porous and light with reminiscent flavor. They have appearance similar to fresh fruits, especially after reconstitution.

Area of Application

Dehydration of various types of fruits. In addition to the fruits listed above, the technique can be applied to other fruits as well by applying specific conditions to different fruits.

Advantages

The advantage of freeze-drying technique compared to other drying techniques are: good physical appearance; chemical stability; biological activity; and product recovery and reproducibility

Development Status

Commercial prototype

Transfer Terms

Consultancy

Contact

Biological Science Division
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Kitozan biofertilizer

We are 5 years' experience to produce Kitozan which we helped people to save environment and produce organic fruits and vegetable to feed people. which low cost and fast result. We had more than 3 million user in Thailand.

Area of Application

Biotechnology

Advantages

- It can be used with any chemical and fertilizer.
- It can mix with water and feed for animal.
- It can change bad soil to be good soil also.

Environmental Aspects

- Cleaner production
- Waste utilization
- Energy efficiency
- Systems integration

Development Status

Fully commercialized

Legal Protection

- Trade Mark
- Copy right

Transfer Terms

Turnkey

Target Countries

Worldwide

Contact

Aloe Life Co., ltd Thailand
24/548 Vibhawadee Road Donmuang
Bangkok 10210
Thailand

Medicines Patent Pool

The Medicines Patent Pool (MPP) is a United Nations-backed public health organization working to increase access to, and facilitate the development of, life-saving medicines for low- and middle-income countries. Through its innovative business model, MPP partners with civil society, governments, international organizations, industry, patient groups and other stakeholders, to prioritize and license needed medicines and pool intellectual property to encourage generic manufacture and the development of new formulations.

MPP's mandate is to accelerate access to affordable quality treatments for people living with HIV, hepatitis C and tuberculosis, as well as HIV-associated co-morbidities. Since 2018, MPP has expanded its mandate to other patented essential medicines on the World Health Organization (WHO)'s Model List of Essential Medicines (EML) as well as medicines with strong potential for future inclusion on the EML.

For more information, access:

https://medicinespatentpool.org/

Selected Analytical Reports and Technology Platforms & Databases of APCTT

Analytical Reports (available online)

1. National Assessment Framework on Enabling Environment, Technology Innovation Ecosystem for Making Sustainable Energy Options Affordable and Accessible (For Indonesia and Lao People's Democratic Republic), January 2014

   http://apctt.org/nis/sites/all/themes/nis/pdf/National-assessment-framework_-final_ESCAP.pdf

2. Report on the National Assessment Framework of Enabling Environment and Technology Innovation Eco-system for Making Sustainable Energy Options Affordable and Accessible – Indonesia, May 2014

   http://apctt.org/nis/sites/all/themes/nis/pdf/Indonesia_Report-on-National-Assessment-of-Sustainable-Energy_optimized.pdf

3. Indonesia National Sustainable Energy Strategy Report on Enabling Environment and Technology Innovation Ecosystem for Affordable Sustainable Energy Options, May 2014

   http://apctt.org/nis/sites/all/themes/nis/pdf/Indonesia-National-Strategy-Report_final.pdf

4. Report on the National Assessment Framework of Enabling Environment and Technology Innovation Ecosystem for Making Sustainable Energy Options Affordable and Accessible - LAO PDR, May 2014

   http://apctt.org/nis/sites/all/themes/nis/pdf/Lao_Report-on-National-Assessment-of-Sustainable-Energy.pdf

5. Lao People's Democratic Republic National Sustainable Energy Strategy Report on Enabling Environment and Technology Innovation Ecosystem for Affordable Sustainable Energy Options, May 2014

   http://apctt.org/nis/sites/all/themes/nis/pdf/Lao-National-Strategy-Report_final.pdf

6. National Innovation System (NIS) training manual - "NIS Diagnosis and STI Strategy Development to Achieve National Sustainable Development Goals", 2016

   http://apctt.org/nis/sites/all/themes/nis/pdf/NIS%20Training%20Manual.pdf

Technology Platforms and Databases

1. APCTT's Technology4SME Database

   The Technology4SME Database serves as an online platform for information exchange on the availability and sourcing of technologies for small and medium enterprises in countries in the Asia Pacific region.

   http://apctt.org/technology-transfer

2. Renewable Energy Technology Bank

   The primary objective of the Renewable Energy Cooperation-Network for the Asia Pacific (RECAP) established by APCTT is to facilitate technology transfer cooperation among countries in the Asia-Pacific region in the area of renewable energy. RET-Bank provides tested and proven renewable energy technologies (RETs) initially in the areas of solar, biomass, wind, mini-hydro power and geo-thermal energy.

   http://apctt.org/recap/renewable-energy-technology-bank

3. Global Technology Databases

   APCTT has compiled a list of global as well as country-wise technology databases that deal with the technology transfer related services for SMEs and entrepreneurs.

   http://apctt.org/aptitude/